ETHNOBOTANY OF RURAL AND URBAN DOMINICAN REPUBLIC: MEDICINAL PLANTS, WOMEN, AND HEALTH

by

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Abstract

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This dissertation is a contribution to Caribbean ethnobotany and to the understanding of medicinal plant utilization by women and healers in the Dominican Republic. It combines ethnographic and ethnobotanical field work with statistical and laboratory analysis to examine aspects of Dominican women's traditional medicine. The history of the Caribbean region is considered in this discussion as it has shaped the complex interrelationships between plants and people in the Dominican Republic.

This research highlights the richness of plant species and herbal therapies used for Dominican women's health and the diversity of this knowledge across rural and urban communities in the provinces of La Vega and San Cristóbal. The field work was conducted using interviews and surveys with specialists (healers) and generalists (laypersons) in four communities. Several forms of analysis, including diversity indices, an ethnobotanical index, and frequencies, were utilized to examine the data.

The survey yielded a total of 205 plant species reported for ten women's health conditions that varied from menstruation, pregnancy, to menopause. Medicinal plant species and remedies were most frequently reported for postpartum care and vaginal infections. The distribution of responses in the survey indicated a high level of variability, though much variation is associated with socio-demographic factors such as age and location of residence. Rural women proved to hold a greater depth of knowledge about medicinal plants for the women's health conditions than urban women, except for the health condition uterine fibroids. Additional studies are needed to further understand this variation.

Selected plant species reported in this study were also evaluated for estrogenic activity using a literature review and bioassay. The Ishikawa bioassay was applied to methanolic extracts of 11 plant species to determine their estrogenic activity on human carcinoma endometrial cells. None of the botanical extracts showed estrogenic activity.

This study provides a foundation of data upon which further questions can be asked about traditional medicine, women's health, and ethnobotanical methodologies. It is hoped that this study will contribute to the preservation of valuable traditional healing knowledge and practices of communities and individuals in the Dominican Republic.

Dedicated to the people of *Quisqueya,*
to Juan Carlos, and to my family.

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TABLE OF CONTENTS

Chapter 1. Introduction 1

- Introduction 1
- Scope of thesis 6
- Research objectives 9
- Background 11
- Personal introduction to the Dominican Republic 30
- Organization of thesis 32

Chapter 2. The Dominican Republic and Its People: Project Background and Cultural Overview 33

- Introduction 33
- Geography 34
- Peopling of the Caribbean 42
- Dominican ethnobotany: a literature review 50
- Conclusion 64

Chapter 3. Methods: Field Work with Dominican Women and Healers 71

- Initial field work: pounding the pavement with Dominican healers in New York City 71
- Field work in the Dominican Republic 72
- Study sites in the Dominican Republic 73
- Research design and methods of data collection 82
- Data analysis 92
- Ethical issues in field work 92
- Challenges of conducting field work 95

Chapter 4. Women's Medicine in the Dominican Republic I: Interview Results, Conditions, and Treatments 98

- Introduction 98
- Demographic characteristics of the study participants 99
- Demographic characteristics of generalists 99
- Demographic characteristics of specialists 105
- Dominican traditional medicine 126
- Dominican women's traditional medicine 134
- Health conditions and treatments 137
- Salient women's health conditions 178
- Salient treatments: remedies and plants 187
- General botanical trends 200
- Discussion 210
- Conclusion 211

Chapter 5. Women's Medicine in the Dominican Republic II: Intracultural Variation and Ethnobotanical Knowledge 213

Introduction 213
Patterns of plant use and ethnobotanical knowledge 214
Comparing medicinal knowledge in urban and rural communities 217
Comparing medicinal knowledge of generalists and specialists 259
Socio-demographic factors and ethnobotanical knowledge 276
Discussion 284
Conclusion 293

Chapter 6. Women's Medicine and Phytoestrogens 311

Introduction 311
Literature review of phytoestrogens 311
Phytoestrogens 313
Human health and phytoestrogens 335
Botanical sources studied for phytoestrogens 348
Adverse effects of phytoestrogens 370
Evaluating Dominican plants for estrogenic activity 373
Literature review 374
Ishikawa bioassay 375
Conclusions 386

Chapter 7. Conclusions 399

Summary of findings 399
Applications and considerations 407
Future research directions 411

Appendix 414

Bibliography 429

TABLES

Table 2.1. Women's conditions and symptoms reported in Dominican ethnobotanical literature. 66

Table 2.2. Plants most frequently reported in Dominican ethnobotanical literature for women's health conditions. 70

Table 3.1. Project study sites. 73

Table 4.1. Age distribution of generalists in study sites. 100

Table 4.2. Educational level of generalists in study sites. 101

Table 4.3. Civil status of generalists in study sites. 102

Table 4.4. Primary residence of generalists in study sites. 103

Table 4.5. Socio-economic status of generalists in study sites. 104

Table 4.6. Demographic characteristics of specialists in the study. 110

Table 4.7. Women's health conditions selected for the study. 135

Table 4.8. Cultural significance of 10 women's health conditions in the provinces of La Vega and San Cristóbal, Dominican Republic (participants, n = 237). 180

Table 4.9. Frequency variables (number of field reports, number of plant species, percentage of knowledgeable participants, Informant Agreement Ratio) compared for 10 women's health conditions. 183

Table 4.10. Number of total field reports for 10 women's health conditions (participants, n = 237). 186

Table 4.11. Plant species frequently reported by healers (n = 11) for *botellas*. 193

Table 4.12. Most frequently reported plants for Dominican women's medicine. 195

Table 4.13. Plants reported in all four study sites to treat the same health condition(s) (participants, n = 237). 198

Table 4.14. Plant families reported for Dominican women's traditional medicine. 202

Table 5.1. Medicinal plant species reported by specialists (n = 11) and generalists in Los Calabazos R1 (n = 33), La Colonia R2 (n = 34), La Vega U1 (n = 87), and San Cristóbal U2 (n = 72) for 10 women's health conditions. 296

Table 5.2. Distribution of field reports and plant species in Los Calabazos R1 (n = 33), La Colonia R2 (n = 34), La Vega U1 (n = 87), and San Cristóbal U2 (n = 72) for 10 women's health conditions. 234

Table 5.3. Diversity indices calculated from the number of plant field reports in Los Calabazos R1 (*n* = 33), La Colonia R2 (*n* = 34), La Vega U1 (*n* = 87), and San Cristóbal U2 (*n* = 72) for 10 women's health conditions. 240

Table 5.4. Descriptive statistics of variables used to define ethnomedical knowledge index for Los Calabazos R1 (*n* = 33), La Colonia R2 (*n* = 34), La Vega U1 (*n* = 87), and San Cristóbal U2 (*n* = 72). 247

Table 5.5. Number of medicinal plant species reported for hot flashes, menorrhagia, and uterine fibroids in Dominican ethnomedical literature (*n* = 30) and by Dominican healers in New York City (*n* = 6) and the Dominican Republic (*n* = 11). 251

Table 5.6. Medicinal plant species (*n* = 46) reported by Dominican healers in New York City (*n* = 6), species (*n* = 34) reported by Dominican healers in the Dominican Republic (*n* = 11) and those species (*n* = 22) reported by both groups (*n* = 17) for uterine fibroids. 306

Table 5.7. Medicinal plant species reported exclusively by Dominican healers in New York City (*n* = 6). 256

Table 5.8. Plant species used by Dominican healers in New York City and the Dominican Republic that share the same vernacular name. 257

Table 5.9. Medicinal plants frequently reported by specialists (*n* = 11) and generalists (*n* = 226). 261

Table 5.10. Distribution of field reports and plant species of generalists (*n* = 226) and specialists (*n* = 11) for 10 women's health conditions. 268

Table 5.11. Diversity indices calculated from the number of plant field reports of generalists (*n* = 226) and specialists (*n* = 11) for 10 women's health conditions. 271

Table 5.12. Descriptive statistics of variables used to define ethnomedical knowledge index for generalists (*n* = 226) and specialists (*n* = 11). 272

Table 5.13. Pearson's correlations for age, education, and socio-economic status (SES) for all study participants (*n* = 237). 277

Table 5.14. Multiple regressions with ethnobotanical knowledge index (EKI) as the dependent variable for all study participants (*n* = 237). 279

Table 5.15. Regression coefficients with ethnobotanical knowledge index (EKI) as the dependent variable for all study participants (*n* = 237). 280

Table 5.16. Multiple regressions with ethnobotanical knowledge index (EKI) as the dependent variable for rural study participants (*n* = 76). 280

Table 5.17. Regression coefficients with ethnobotanical knowledge index (EKI) as the dependent variable for rural study participants (*n* = 76). 280

Table 5.18. Multiple regressions with ethnobotanical knowledge index (EKI) as the dependent variable for urban study participants (n = 161).....281

Table 5.19. Regression coefficients with ethnobotanical knowledge index (EKI) as the dependent variable for urban study participants (n = 161). 281

Table 6.1. Plants with estrogen receptor binding activity and activity in estrogen dependent breast cancer cell lines. 387

Table 6.2. Dominican plants used for women's health with *in vitro* and *in vivo* estrogenic activity. 393

Table 6.3. Plants tested in Ishikawa bioassay. 378

FIGURES

Figure 2.1. Map of Caribbean....36
Figure 2.2. Map of Hispaniola....37
Figure 2.3. Map of migration patterns to the Caribbean....44
Figure 3.1. Map of the Dominican Republic showing the four study sites: Los Calabazos, La Vega city (San Miguel), La Colonia, and San Cristóbal city (Hacienda Fundación)....74
Figure 3.2. The rural community of Los Calabazos....76
Figure 3.3. A *fogón*, a wood-burning stove, painted with a mixture of clay and water....77
Figure 3.4. The main residential street in Proyecto Hacienda Fundación in San Cristóbal....80
Figure 4.1. Plant species reported frequently for menstrual cramps (participants, n = 237)....139
Figure 4.2. Plant species reported frequently for excessive menstruation (participants, n = 237)....144
Figure 4.3. Plant species reported frequently for suspended menstruation (participants, n = 237)....148
Figure 4.4. Plant species reported frequently for pregnancy prevention (participants, n = 237)....151
Figure 4.5. Plant species reported frequently for morning sickness (participants, n = 237)....154
Figure 4.6. Plant species reported frequently for postpartum care (participants, n = 237)....159
Figure 4.7. Plant species reported frequently for infertility (participants, n = 237)....164
Figure 4.8. Plant species reported frequently for menopausal hot flashes (participants, n = 237)....167
Figure 4.9. Plant species reported frequently for uterine fibroids (participants, n = 237)....171
Figure 4.10. Plant species reported frequently for vaginal infections (participants, n = 237)....175
Figure 4.11. Remedy categories used for Dominican women's traditional medicine....190

Figure 4.12. Habits of medicinal plants used for Dominican women's traditional medicine. 203

Figure 4.13. Plant parts used for Dominican women's traditional medicine. ...205

Figure 4.14. Habitats of medicinal plants used for Dominican women's traditional medicine 206

Figure 4.15. Distribution of plant collection locations of generalists and specialists in rural and urban study sites in the Dominican Republic (participants, n = 237). 208

Figure 5.1. Number of distinct plant species reported versus number of women interviewed in each community, Los Calabazos R1 (n = 33), La Colonia R2 (n = 34), La Vega U1 (n = 87), and San Cristóbal U2 (n = 72). 219

Figure 5.2. Venn diagrams illustrating the number of medicinal plant species (A) and botanical families (B) reported by generalists in rural (n = 67) and urban study sites (n = 159) in the Dominican Republic for 10 women's health conditions. 225

Figure 5.3. Percentage of Dominican women in Los Calabazos R1 (n = 33), La Colonia R2 (n = 34), La Vega U1 (n = 87), and San Cristóbal U2 (n = 72) who reported a remedy for the 10 women's health conditions. 227

Figure 5.4. Mean ethnobotanical knowledge index with 95% confidence intervals for Los Calabazos R1 (n = 33), La Colonia R2 (n = 34), La Vega U1 (n = 87), and San Cristóbal U2 (n = 72) (ANOVA, F-test = 8.35, $p < 0.0001$). 248

Figure 5.5. Venn diagram illustrating the number of medicinal plant species reported in Dominican ethnobotanical literature (references, n = 30) and by Dominican healers in the Dominican Republic (n = 8) and New York City (n = 6) for uterine fibroids. 253

Figure 5.6. Number of distinct plant species reported versus number of generalists (n = 226) and specialists (n = 11) interviewed. 263

Figure 5.7. Percentage of generalists (n = 226) and specialists (n = 11) who reported a remedy for the 10 women's health conditions (G-test, significance ***$p < 0.0001$, **< 0.001, *< 0.05). 265

Figure 5.8. Mean ethnobotanical knowledge index with 95% confidence intervals for generalists (n = 226) and specialists (n = 11) (ANOVA, F-test = 72.20, $p < 0.0001$). 273

Figure 5.9. Age of study participants versus mean number of plant species reported in each study site (n = 237). 284

Figure 6.1. Structures of mammalian endogenous estrogens: 17β-estradiol, estriol, and estrone. 314

Figure 6.2. Structures of isoflavones: biochanin A, daidzein, formononetin, and genistein. 324

Figure 6.3. Structures of metabolized isoflavones 325

Figure 6.4. Structures of coumestans: coumestrol and 4'-methoxycoumestrol. 328

Figure 6.5. Structures of some plant lignans: secoisolariciresinol, matairesinol, lariciresinol, and pinoresinol. 330

Figure 6.6. Structures of mammalian lignans: enterodiol and enterolactone..331

Figure 6.7. Structures of other estrogenic compounds: diethylstilbestrol, resveratrol, and zearalenol. 333

Chapter 1. Introduction

Introduction

Ethnobotany, the study of the relationship between plants, people, and culture, draws from both the natural and social sciences, thus providing an integrated, multidisciplinary framework for examining the complex interactions between humans and plants. The use of plants is vital for human survival around the world. Plants have long been utilized for medicines, food, building materials, hunting, fibers, musical instruments, rituals, and a multitude of other uses. Harshberger (1896) first published the term "ethnobotany" to describe studies of "plants used by primitive and aboriginal people." However, ethnobotany has changed considerably since 1896. Today, the term defines multi-layered studies that recognize the dynamic relationship between plants and people and evaluate this relationship in the context of historical, political, and social processes (Davis 1995).

Although Harshberger coined the term "ethnobotany," others were recording peoples' uses of plants much earlier in history. In the first century BC in Europe the Greek physician, Pedanius Dioscorides, wrote the "De Materia Medica" that described over 500 plants and their uses. The "Ebers Papyrus," an Egyptian scroll from about 1550 BC, is another early historical record of herbal therapies. In the 1500s, missionaries sent to Meso-America noted local uses of plants. In addition, botanists such as von Humboldt and Spruce recorded plant use information while making botanical collections (Davis 1995).

Earlier definitions that described studies limited to "primitive and aboriginal" people reflect colonial and racial attitudes at the time, which classified indigenous groups as being sub-human and in need of civilizing. In today's context, the use of "primitive" and "aboriginal" to describe people is considered most inappropriate and disrespectful. In the last several decades, ethnobotanical studies have evolved to include a broader spectrum of people that use plants, for example, individuals with common or general knowledge as well as those with specialized knowledge. In addition, ethnobotanical studies are now being conducted in a wide range of settings including both rural and urban environments. Urban ethnobotany applies ethnobotanical methodologies of plant collection, documentation, and interviews to an urban setting (Balick *et al.* 2000). Often ethnobotany is conducted with indigenous groups in remote regions of the world such as the Amazon; however, there is much to be learned from people living in complex urban centers.

The multidisciplinary nature of ethnobotany

As a multidisciplinary science, ethnobotany can be approached using methodologies from such diverse fields as anthropology, botany, clinical medicine, ecology, ethnopharmacology, folklore, linguistics, and phytochemistry. Each discipline has a distinct approach and methodology to research ethnobotany. Ethnobotanical studies may be done independently in these disciplines or by a multidisciplinary team of researchers. Integrative ethnobotanical projects that involve researchers from diverse disciplines can provide more complete and accurate descriptions and understandings of plant use by people (Prance 1995).

Ethnobotanists face several challenges when reviewing ethnobotanical literature because of the diverse range of data collected and documented about plants, people, and culture. Anthropological accounts may focus on cultural concepts and disease systems, detailing aspects of the people and community, with less focus on plant use, ecology, or plant documentation (e.g., Laguerre 1987; Trotter 1981). Classical ethnobotany conducted by a botanist may focus exclusively on lists of plants and their uses, accurately documenting scientific names and collecting vouchers, but provide limited information about the cultural context of the plants and practices (e.g., Hodge and Taylor 1957). Phytochemical and ethnopharmacological studies often concentrate on understanding the effectiveness and activity of useful plants and their chemical constituents (e.g., Claeson *et al.* 2000; Frei *et al.* 1998).

Considering the diversity of ethnobotanical studies, it can be expected that methodologies, voucher information, and references may be inconsistent across the field. Studies may report uses based on observations or uses that are remembered but no longer in practice. Details about how the use information was collected may be omitted or voucher information may not be included in published results.

Ethnobotanical studies range from extensive projects that capture multiple facets of human-plant interactions to narrow, concentrated studies that investigate one aspect of human-plant interactions, such as medicinal plants or uses of a distinct plant species. Studies have described the ethnobotany of one cultural group or region (e.g., Alcorn 1982; Alexiades 1999; Baleé 1994; Bauml 1994; Boom 1987; Duke 1975; Figueiredo *et al.* 1993; Forero Pinto 1980; Hodge and Taylor 1957; Milliken *et al.* 1992; Smith 1928). Researchers have investigated plants used for a specific purpose, for example wound healing (Gomez-Beloz 2001), natural pesticides (Orozco 2003), or incense copals (Case *et al.* 2003). Uses of individual plant families, genera, or species have also been studied, for example palms (e.g., Balick 1988; Read 1988), pteridophytes (Nwosu 2002), *Erythroxylum* species (Plowman 1984), and *Citrus aurantium* L. (Rutaceae) (Paul and Cox 1995).

A large number of ethnobotanical studies have focused on medicinal plants and traditional medicine (Austin and Bourne 1992; Davis and Yost 1983; Eldridge 1975; Laguerre 1987; Quinlan 2000; Tiwari 2000). Traditional medicine varies largely from culture to culture and region to region and can include a wide range of therapies, health beliefs, and practitioners. The World Health Organization (WHO) (2002) describes traditional medicine as, "including diverse health practices, approaches, knowledge and beliefs incorporating plant, animal, and/or mineral based medicines, spiritual therapies, manual techniques and exercises applied singularly or in combination to maintain well-being, as well as to treat, diagnose or prevent illness." The WHO (2002) estimates that 60% of the world's population relies on traditional medicine for primary health care and calls for research into its safe and effective use, stressing the importance of considering the cultural context of traditional medical systems.

The evolution of ethnobotany

More recently, ethnobotanists have aimed to develop a more rigorous discipline that uses the scientific method to test hypotheses about plant use and human-plant interactions. To this end, quantitative studies used to measure plant use, importance of plant species, and the value of forest plants have influenced the evolution of the field and helped to develop a stronger theoretical and methodological framework for ethnobotany. One of the pioneers in quantitative ethnobotanical analysis is Daniel Moerman, who used multiple linear regressions to demonstrate that medicinal plants were not selected at random (Moerman 1979). Brian Boom (1987) also contributed to this emerging field by evaluating a one-hectare plot to determine the percentage of useful species known by the Chácabo in Brazil. Others who have also contributed to this growing body of ethnobotanical literature include Trotter and Logan (1986), who developed a formula to select effective medicinal plant species; Prance and coauthors (1987) further compared plant use values of one hectare forest plots among four indigenous groups; and Phillips and Gentry (1993a, b) tested hypotheses about forest value and intracultural variation. Additional studies focused on rigorous, hypothesis-driven research include work by Gomez-Beloz (2001, 2002), who developed a quantitative approach to assess the selection and efficacy of a wound healing plant, *ohoru (Symphonia globulifera* L.f., Clusiaceae) used by the Winikina Warao of the Orinoco River Delta, Venezuela and Campos and Ehringhaus (2003) who tested several hypotheses about palm uses among indigenous and folk communities of southwestern Amazonia.

While traditional ethnobotanical studies that include descriptive lists of plants and their uses are valuable and provide a foundation upon which more complex questions can be formulated, studies designed with clear qualitative or quantitative methodologies can provide higher analytical resolution that can be more broadly applied to conservation efforts, health initiatives, and policy decisions (Davis 1995). Quantitative and qualitative studies demand that the researcher make decisions about sample size, systematic data collection, and methods of analysis. Such parameters are necessary for hypothesis-driven studies, which can further enhance the methodology and theoretical foundation of a discipline.

Scope of thesis

There are several gaps in ethnobotanical literature. First, traditional ethnobotanical studies tend to classify groups as having a homogeneous culture. However, most societies are complex and hierarchical, and there are multiple factors that affect plant knowledge transmission that must be considered in any ethnobotanical study. As noted by Alexiades (1996a: 75), "The question of intracultural variation has been ignored in most ethnobotanical and ethnographic studies…" It is important to include different sections of a community or society to capture the breadth of knowledge. To further illustrate this point, ethnobotanical studies tend to focus on healers' or specialists' rather than generalists' or laypersons' knowledge. Healers may be more frequently interviewed about plant use; however, local women or men that are not healers may have different knowledge sets (Alexiades 1996a: 76). Studies that do not include a spectrum of people do not adequately reflect the distribution and variation of knowledge within a community or group.

Second, in the past ethnobotanical research results were presented without including specific details about the gender of study participants (Howard 2003b: 20). Gender differences of investigators and study participants may have also affected research results (Kothari 2003). Such factors add to the difficulty of examining the extent of women's knowledge of plants or their knowledge of traditional medicine.

Thirdly, ethnobotanical studies tend to focus on indigenous people and as observed by Prance (1995: 64), "one of the most neglected aspects of ethnobotany today is the study of the *campesinos*, *caboclos*, *mestizos*, peasants, or whatever they are called locally." These groups maintain close contact with their environment and are also knowledgeable about their natural resources.

To address these inconsistencies, I investigated the role of medicinal plants in women's health care in urban and rural (*campesino*) populations in the Dominican Republic. I selected study sites in the Dominican Republic to examine questions of cultural variation and heterogeneity because Caribbean cultures are "inescapably heterogeneous" because of the diverse cultural groups in the region, many of whom have long histories in the Caribbean (Trouillot 1992). I also selected this region because historically, limited ethnographic research has been conducted in the Caribbean due in part to the cultural complexity (Trouillot 1992). Historically, anthropological and ethnobotanical studies tended to focus on indigenous groups, which are almost non-existent in the Caribbean. However, this is changing and more studies examining cultural diversity are being conducted in this region (Fernandez Olmos and Paravisini-Gebert 2001).

I also conducted interviews with healing specialists (men and women) and generalists (laywomen) of various ages from rural and urban communities to further address questions of ethnobotanical knowledge variation, to shed light on women's medicinal plant knowledge, and to study Dominican traditional women's medicine from more than one perspective. Increased interest in women's health has encouraged further research to understand how women in different cultures address their health from early menstruation to menopause (Brems and Griffiths 1993; Browner and Sargent 1990). This study highlights the richness of plant species and herbal therapies used for women's health in the Dominican Republic and the diversity of this knowledge across the rural and urban Dominican landscape. In addition, this study attempts to describe several broad themes recurrent in Dominican traditional medicine.

Research objectives

In this study, I focused on three main objectives. The first is to provide qualitative and descriptive information on traditional women's medicine in the Dominican Republic. Specifically, I studied and documented the medicinal plants used for 10 women's health conditions varying from menstruation to pregnancy to menopause. The second objective is to test hypotheses concerning intracultural variation including age, educational level, healing experience, socio-economic status, and location of residence. For this objective, I compared rural and urban populations using several criteria: 1) the number of plants cited for health conditions; 2) the composition of plant species reported for health conditions; 3) the percentage of study participants who reported a remedy for a women's health condition; 4) the diversity of plants reported; and 5) overall ethnobotanical knowledge. In addition, I compared specialists' (healers') knowledge and generalists' (laypersons') knowledge using the same criteria as mentioned above. The terms healer and specialist will be used interchangeably in this thesis as will the terms generalist and layperson. I also examined demographic factors such as age, educational level, and socio-economic status as predictors of ethnobotanical knowledge. I compared these different data sets to evaluate how medicinal plant knowledge is distributed within a community and to understand how healing knowledge is transmitted. The last objective is to evaluate traditional uses of plants using a literature review and laboratory analysis. Specifically, I selected plants used for women's health conditions and tested them for estrogenic activity to further understand the mechanisms underlying their traditional uses.

This study is a contribution to the preservation of traditional healing practices used in the Dominican Republic, which are rapidly declining with urbanization and Western influences. This study also provides a foundation of data upon which further questions can be asked about traditional medicine, women's health, and ethnobotanical methodologies. The objectives were developed to study the importance, role, and cultural context of medicinal plants for women's health care and to illustrate the knowledge and use of plant medicine. This study provides information about medicinal plants utilized by women that can be incorporated into health care programs in the Dominican Republic and in regions with growing Dominican populations, such as New York City.

Prior to discussing the specifics of this thesis, I review ethnobotanical studies that have investigated intracultural variation and those studies that have examined women's traditional medicine. Next, I briefly introduce phytoestrogens and their role in women's health to provide a scientific context for the laboratory work conducted in this study. Phytoestrogens are plant compounds that show estrogenic activity and that are structurally similar to mammalian hormones. I then present several prominent ethnobotanical studies from the Caribbean. This background literature provides a framework upon which to place the present study. To close, I discuss my personal introduction to the Dominican Republic and the process and development of this project. At the end of this chapter I discuss the organization of this thesis and summarize the main points of each section.

Background

Ethnobotany and intracultural variation

Traditional plant knowledge is important for health care initiatives (Bodeker 1995; Bodeker and Kronenberg 2002) and conservation efforts (Balick *et al.* 2002; King 1996), yet our understanding of the distribution of plant knowledge within a community or across multiple communities is in its infancy (Campos and Ehringhaus 2003). As stated above, ethnobotanical studies tend to minimize the variation of plant knowledge in a community by reporting plant use information as homogeneous across a cultural group. Pelto and Pelto (1975) discussed historical factors and methodological challenges that explain the reduction of intracultural variation in ethnographic studies. An explanation for this pattern is that many investigations tend to focus on one "informant" who is knowledgeable about useful plants, while the reality is that several informants may have different knowledge about the same plant species (Alexiades 1996a). Ethnobotanical models that describe the distribution and diversity of plant knowledge in a community can more fully examine the complexity of human-plant interactions (Berlin 1992: 200). These studies can provide heterogeneous and homogeneous data that help demonstrate the nuances and complexities of traditional plant knowledge. This information could be beneficial in the planning of health care programs, natural resource management projects, and development policies.

Several ethnobotanical studies have examined intracultural variation of plant knowledge with respect to age (Phillips and Gentry 1993b), gender (Alexiades 1999; Boster 1986), education (Aquino Morillo *et al.* 1986), socio-economic status (Quinlan 2000), and occupation or kinship affiliation (Boster 1985; Garro 1986). Results from these studies suggest that cultural knowledge is not random but patterned by individual experience, kinship, and gender.

In Peru, Phillips and Gentry (1993b) interviewed mestizo people and found that older people had a greater knowledge of medicinal plants than young people. Boster (1986) interviewed men and women of the Aguaruna Jívaro about varieties of manioc (*Manihot esculenta* Crantz, Euphorbiaceae) and reported that women could more consistently name varieties of manioc than men, and that women who were close kin more frequently agreed with each other than those who were not close kin. Boster also noted that men agreed to a greater degree about forest plants than women. In the Dominican Republic, Aquino Morillo and coworkers (1986) found that medicinal plant knowledge and educational level were inversely related. In Dominica, Quinlan (2000) reported that individuals in Bwa Mawego with higher socio-economic status tended to know more plant cures and that as age increased so did traditional plant knowledge. These studies suggest the complexity of plant knowledge and report specific plant knowledge known by individuals with greater age, specific gender, and increased socio-economic status.

Studies have also examined similarities and differences in plant knowledge among multiple study sites (Aquino Morillo *et al.* 1986; Robineau 1986; Yates and Ramírez-Sosa 2004) and between indigenous and folk communities (Campos and Ehringhaus 2003). For example, researchers have studied the diversity of plant identification and classification systems in communities (Berlin 1992; Hays 1976). Adu-Tutu and coworkers (1979) compared plant species used in Africa for dental hygiene among four ethnic groups including socio-demographic characteristics. They found variation in species selection based on age, gender, and ethnic group. Shackleton and collaborators (2002) compared patterns of use of savanna resources among three villages of differing socio-economic status in South Africa. The village classified as most rural in their study had the largest number of users and utilized the greatest diversity of resources. Yates and Ramírez-Sosa (2004) used the tree, *Brosimum alicastrum* Sw. (Moraceae) to examine intracultural variation and found that urbanization had a negative effect on the knowledge held by El Salvadorean adolescents. In their comparison of palm use among indigenous and folk communities in Brazil, Campos and Ehringhaus (2003) suggested that plant resources often fit into distinct cultural niches among communities. As highlighted by these studies, plant knowledge and use may be affected by tradition, transmission, environment, and plant availability. As Howard (2003b: 23) mentioned, "Knowledge transmission is increasingly the subject of research because the mechanisms are poorly understood, and because plant- and environment-related knowledge transmission is eroding rapidly within many indigenous and peasant societies."

Studies that compare plant knowledge from generation to generation can help to explain the transmission of botanical knowledge. Based on their survey in Micronesia, Lee and coauthors (2001) showed significant changes in cultural knowledge over generations, suggesting that the loss of tradition is as critical as the loss of plant species biodiversity. Research that includes time as a variable provides a method to study changing patterns of plant knowledge.

The transmission of cultural plant knowledge, including remedies, healing modalities, and useful plants, has been correlated with kinship, social level, gender, and age (Alexiades 1999: 349). Plant knowledge may also be transmitted via dreams, trial and error, reading books, observation, songs, games, and stories (Balick 1996; Turner 2003). In addition, other factors, such as access to forests, markets, and gardens, may affect an individual's plant knowledge. People living in rural communities may have better access to plant resources than their urban counterparts, and, therefore, may have more opportunities to experiment with different plants. The opposite may also be found. Individuals living in urban communities may have better access to diverse plant resources in markets than rural people who may live in ecologically degraded environments and have limited ethnopharmacopoeias. Other pressures that may affect the transmission of plant knowledge may be at a national level, such as economic and political factors beyond the control of an individual that force individuals to be dependent on plant resources for medicine or governmental regulations that prohibit traditional healing practices (Pelto and Pelto 1975).

Studies addressing intracultural variation can also provide inventory data about a particular resource such as forest plants, medicinal plants, or food plants. For example, plot surveys have been used as a technique to measure an individual's ethnobotanical knowledge of forests (Bernstein *et al.* 1997; Phillips and Gentry 1993a). This technique contributes to understanding categorization of forest plants and their uses and at the same time measures the ecological diversity and plants used in a known area of forest.

In addition to understanding the range of knowledge about plants, other studies have evaluated patterns in health seeking behavior (Pescosolido *et al.* 1998; Robineau 1986), illness perception (Chavez *et al.* 1995), and illness classification (Foster 1979; Garro 1988; Trotter 1991; Weller 1984). Health seeking behavior, either searching out medicinal plants, a healer, or physician have provided further understanding of traditional medical systems and conceptualizations of health in different cultures (Bhatti and Fikree 2002; Cocks and Moller 2002; Pescosolido *et al.* 1998). Pescosolido and coworkers (1998) showed that the preference of a health care provider and a treatment approach were associated with age, education, gender, and severity of illness among the poor in Puerto Rico. Robineau (1986) described differences in illness definitions, plant resources, and health provider preferences between rural and urban communities in the Dominican Republic. He found that the first attempt by both rural and urban individuals to cure an ailment was with medicinal plants and home remedies. Results provided in these studies are particularly important for integrative and holistic health care programs and suggest that further research could be beneficial to understand the role of traditional healing in public health care.

Studies of intracultural variation focus on shared, restricted, and unique patterns of plant use or knowledge. It has been theorized that a domain that is commonly known by many, for example, food plants, will have a lower degree of heterogeneity due to its importance to the community (Boster 1986). According to Boster (1985), "...cognitive diversity is organized in a way that reflects the dynamics of the cultural system, that deviations from a consensus are patterned according to the sexual division of labor, individual expertise, and membership in kin and residential groups." Variation in knowledge of plant use or health seeking behaviors largely depend on an individual's contact with others, access to resources, and individual experience (Berlin 1992).

A researcher faces several challenges when studying intracultural variation. For example, knowledge may be idiosyncratic, due to participants not remembering correctly, an artifact of research methods or sampling error due to investigator errors in data collection, or misinterpretations (Foster 1979). The variable selected for study may also be problematic if there are several different pronunciations of a word or different words to describe the same category or object. In such a situation, a false variation may be detected in several objects that really are all the same (Berlin 1992). For example, if common plant names are recorded without making voucher collections, it might appear that several individuals reported different plants when in fact; they all reported the same plant using a different common name. Faulty stimuli posed by the investigator such as ill-formed questions or photos or illustrations of objects rather than live or three-dimensional objects may also lead to ambiguous data results (Diamond 1989).

All the studies described above provide valuable evidence to support the need for more ethnobotanical studies that address intracultural variation. In addition, studies are needed to further elucidate the transmission of plant knowledge and to highlight factors that affect the acquisition of plant knowledge. A deeper grasp of how plant knowledge is distributed in a community may be beneficial in aiding community-based service programs.

Generalists and specialists

Ethnomedical studies tend to ignore laypersons because specialists such as healers, shamans, and midwives are considered to be more knowledgeable (Kothari 2003). However, laypersons can have subsets of knowledge or even different plant knowledge than specialists (Alexiades 1996a). Laywomen often have a prominent role in providing health care in their families and communities and may have knowledge different from or overlapping with that of healers or healing specialists (McClain 1989). In addition, laypersons and healers may differ in their etiologies of symptoms, descriptions of illnesses, and treatments within the same community (Etkin 1993).

According to Kleinman (1980: 72-3), explanatory models of medical practitioners are commonly focused on disease—the malfunction of biological or psychological process—while those of laypersons are focused on illness—the psychosocial experience and meaning of perceived disease that is created by personal, social, and cultural reactions to disease. Work by Kleinman (1980) and Kleinman *et al.* (1978) suggests explanatory models to compare cognitive systems or perceptions in cross-cultural studies of health care. According to Kleinman, explanatory models offer an explanation from the patient and the practitioner of the sickness and treatment. They may include the cause of the sickness, the nature of the sickness physiologically, the symptoms, the severity of the condition, and the treatment. Social class, ethnicity, education, gender, past experiences with health care, and medical training can influence explanatory models.

Fabrega and Silver (1973) conducted one of the first studies to address differences between generalists and specialists. They used two interview formats to compare illness classification between shaman and non-shaman in Zinacantan, Mexico, and found that the two groups did not differ in their evaluation of symptoms as indicators of illness. However, shaman had specialized ceremonial knowledge and spiritual abilities that non-shaman did not possess. Other studies have continued to address these differences. Garro (1986) noted there was a single system of beliefs that was common to both curers and non-curers in Mexico, but that there was higher agreement about this system within the curer group than the non-curer group. Nolan (2000) found the opposite to be true between healing novices and experts in Missouri. He found that both groups shared a common "core" plant classification system, but that novices tended to agree more with each other than experts.

Historically, ethnomedical studies have primarily involved specialists. The literature on generalist knowledge and use of medicinal plants is scant in comparison. To provide a more complete understanding of a healing system, both generalists and specialists need to be included in a study. In addition, by querying both generalists and specialists about their knowledge of medicinal plants, studies can cover a larger spectrum of traditional knowledge and provide data to fill these research gaps.

Healer diversity

In addition to differences between healers and laypersons, healers themselves often have specialities. For example, in Belize there are doctor-priests/priestesses, village healers, grannie healers, midwives, massage therapists, bone setters, and snake doctors, each possessing a unique, specialized healing knowledge (Arvigo and Balick 1998). Other researchers have also noted a stratification of healer skills such as use of medicinal plants, massage, bone manipulation, and prayers, in Mexico (Brett 1994: 94-96; Leonti *et al.* 2001), in Dominican populations in New York City (Balick *et al.* 2000; Reiff *et al.* 2003), and in the Ozark Mountains (Nolan and Robbins 1999). Specialists can differ in their healing modalities, choice of plants, and treatment of ailments. The origins or acquisition of a healer's plant and curing knowledge can include individual experimentation, kinship, dreams, and hallucinogenic substances

(Alexiades 1999). Specialization of healers may be in response to more complex illnesses or complex societies (Winkelman 1986).

In some cases, healing knowledge is restricted to a select individual or group of individuals (Brett 1994; Garro 1986). For example, in the Dominican Republic, *ensalmos* (healing prayers) are often kept as a secret and shared only with close kin (Deive 1979). In some societies a woman is not qualified to be a shaman (Kothari 2003). Such gender restrictions may suggest forms of power. Several scholars have suggested that knowledge needs to be considered within a framework of social relations of power (Browner and Perdue 1988; Howard 2003a).

Ethnobotany and women's medicine

Invisible barriers tend to exist between genders in indigenous and peasant communities (Alexiades 1999). Historically, the majority of ethnobotanists have been male; and therefore, gender differences may have caused communication barriers between a researcher and women participants depending on cultural structures (Howard 2003a). This is exemplified by Plotkin (1993: 105), who observes that, "Although I have little knowledge of the plants involved, I am convinced that there exists a wealth of ethnobotanical treatments for menstrual problems, birth control, difficult childbirth, and so on, which is simply unavailable to the male ethnobotanist." Also taboos, for example, those surrounding the menstrual cycle, may have further resulted in confusion about plants used for women. These obstacles may have contributed to incomplete descriptions of women's health conditions.

Martin's (1987) study conducted with women of different social and economic classes in the United States presented insight into the combination of ways that scientific ideas, as well as socio-economic background influenced women's views of their bodies. She discussed science as a cultural system and explained the medical metaphors surrounding the menstrual cycle and the birthing process. In her analysis, she described nuances of individual experiences about menstruation, childbearing, and menopause to further understand women's health. Although her research was not ethnobotanically directed, it offers a model to study women's perception of their bodies and of the processes that are unique to women.

Past ethnobotanical studies of women's traditional medicine have concentrated on plants for reproductive health such as regulating fertility, including emmenagogues and abortifacients (Arenas and Moreno Azorero 1972; Conway and Slocumb 1979; Lal and Lata 1980; Laszlo and Henshaw 1954; Newman 1979, 1985; Weniger *et al.* 1982). Emmenagogue refers to an agent that renews or stimulates menstruation (Gruenwald *et al.* 1998). According to Conway and Slocumb (1979), the distinction in indigenous communities is somewhat gray between an emmenagogue (stimulate delayed menses) and abortifacient (terminate pregnancy). Farnsworth and coworkers (1975a, b) published a comprehensive review of anti-fertility plants and their pharmacology. Their studies were part of an initiative to search for new forms of contraception and fertility regulation. A small number of authors have examined other aspects of women's health and traditional medicine, including traditional beliefs and conceptualizations of women's reproductive physiology (Bonilla-Vega 1998; Browner 1985b; Browner and Ortiz de Montellano 1986; Browner and Perdue 1988; Giraldo-Tafur 1996).

Browner (1985a, b) reported medicinal plants used in Oaxaca, Mexico, for women's health conditions such as childbirth, fertility regulation, menstrual cramps, and suspended menstruation. Giraldo-Tafur (1996) discussed plants used by Siona women in Colombia for birth control, stimulating child delivery, use as a galactogen, irregular menstruation, and illnesses of the reproductive system. These studies examined plant use in the context of local medical concepts and health categories (Browner 1985a, b; Giraldo-Tafur 1996).

Giraldo-Tafur (1996) reported that a Siona woman during menstruation has a "hot" body and therefore cannot be exposed to extreme temperature differences, which might result in hemorrhaging or cause problems with the uterus. She also mentioned that young Siona girls near menarche were prohibited from bathing in cold water. For Siona women, cold entering the body could cause hemorrhaging or uterus problems; and therefore, plants categorized as "hot," such as *ruda* (rue, *Ruta graveolens* L., Rutaceae), *manzanilla* (chamomile, *Matricaria* sp., Asteraceae), *anís de Peru* (Peru anise, *Piper* sp., Piperaceae), and *altamisa* (*Ambrosia* sp., Asteraceae) were used for these illnesses (Giraldo-Tafur 1996). Browner (1985a, b) also noted that women in Oaxaca had a similar conceptualization of maintaining balance in the body and used hot and cold treatments. The women used plants because they warmed the body or the blood, while others were selected because they irritated, burned, or dried out the uterus.

Other research that has addressed women's health and plant use include studies about peyote (*Lophophora williamsii* (Lem. ex Salm-Dyck) J. M. Coult., Cactaceae) ingestion, pregnancy, and parturition among the Huichol in Mexico (Schaefer 1997), plants used in South Africa for dysmenorrhea (Lindsey *et al.* 1999), and women's health in Kenya (Nyaoro 1997). Schaefer (1997) presented preliminary data about the cultural practices of peyote consumption by pregnant Huichol women. She found the pregnant women consumed peyote during the peyote pilgrimage. In her study, Huichol women also reported that peyote consumption could facilitate a faster, less painful delivery.

An example of an ethnopharmacological approach to women's medicine is a study that screened medicinal plants used by healers in South Africa for the treatment of dysmenorrhea (Lindsey *et al.* 1999). The authors tested the plants for prostaglandin-synthesis inhibitors and uterine relaxing activity using cyclooxygenase and *in vitro* uterine bioassays, respectively. Cyclooxygenase is an enzyme that converts arachidonic acid into prostaglandins, hormones that affect inflammation. Three plants, *Siphonochilus aethiopicus* (Schweinf.) B. L. Burtt (Zingiberaceae), *Cenchrus ciliaris* L. (Poaceae), and *Solanum mauritianum* Scop. (Solanaceae), showed high cyclooxygenase inhibition activity. However, none of the plants relaxed contractions in the other uterine bioassay.

Nyaoro (1997) discussed the importance of herbal medicine in primary health care and presented a few plants that are used for promoting women's health in Kenya. Her paper offered a broad overview of women's traditional medicine in Kenya rather than a detailed investigation and called for more research in this area.

Another study (Scott 1974, 1975) that contributed to understanding women's health examined beliefs about the menstrual cycle and fertility regulation among five ethnic groups in Florida. Scott (1975) found that beliefs regarding the menstrual cycle were ethnically patterned. She also reported that women rejected fertility-regulating methods because they modify the menstrual cycle, which was viewed by all ethnic groups as harmful.

Other studies have contributed descriptive information about women and traditional medicine (Finerman 1989; McClain 1989; Sanchez Mayers 1989). For example, Sanchez Mayers (1989) described the use of traditional medicine by Mexican-American women. Studies that address women's role as informal healers have demonstrated the breadth of knowledge that they contribute to family health (Finerman 1989). Women play an integral role in providing health care to their children, families, and other communities yet in reviewing ethnobotanical literature it is apparent that women's knowledge is under-represented. As suggested by other researchers (Bonilla-Vega 1998; Kothari 2003) it is critical to include women, who are pivotal players in family and community health care, in studies that address traditional healing and medicinal plants.

Phytoestrogens and women's health

Phytoestrogens are plant-derived compounds that structurally or functionally mimic mammalian estrogens and therefore are considered to play an important role in women's health for menopausal symptoms and osteoporosis, as well as for the prevention of cancers and heart disease (Adlercreutz 2002; Kronenberg and Fugh-Berman 2002; Setchell 1998). Estrogens influence the growth and function of female and male reproductive tissues, maintain the skeletal and central nervous system, provide cardioprotective effects in the cardiovascular system, and protect against colon cancer and aging skin (Gruber *et al.* 2002; Ruggiero and Likis 2002). Considering the numerous effects estrogens have on the human body, it is not surprising to consider the potential of phytoestrogens for human health.

Increasing numbers of people are seeking complementary and alternative health care practices and treatments that are seen as more "natural" as a way to complement biomedical health care (Eisenberg *et al.* 1993, 1998). Many women turn to phytoestrogens as an alternative to hormone replacement therapy (HRT) and estrogen replacement therapy (ERT) because of their undesirable side effects, such as increased risk of breast and endometrial cancer and irregular bleeding (Brzezinski and Debi 1999; Wade *et al.* 1999; Wagner *et al.* 2001). Concerns about ERT and HRT are being further confirmed by the recent suspension of the Women's Health Initiative (WHI) study testing the risks and benefits of HRT on healthy postmenopausal women (Rossouw *et al.* 2002). This study was the first randomized double-blind clinical trial to test the health benefits and risks of combined estrogen and progestin (Prempro™, composed of conjugated estrogens plus medroxyprogesterone acetate) on healthy postmenopausal women. The study was halted because the health risks exceeded the health benefits. Although phytoestrogens are being considered as an alternative HRT, the present literature (Glazier and Bowman 2001; Kang *et al.* 2002) shows conflicting evidence for their use.

Some of the more common phytoestrogens are compounds known as isoflavones, which are found primarily in the family Fabaceae (Dewick 1993). In this botanical family, soy (*Glycine max* (L.) Merr.) is one of the most well studied plants for phytoestrogens (Burke *et al.* 2000; Fitzpatrick 2003; Wagner *et al.* 2001). Other plants have also been investigated as a source of phytoestrogens and will be discussed in detail in Chapter 6.

Plants in traditional medicine are often used for a myriad of ailments and health conditions. Yet, many of the uses are anecdotal and have not been tested for efficacy and safety using the biomedical approach (Williamson *et al.* 1996). This present study contributes chemical-based data about medicinal plants used in the Dominican Republic for women's health conditions by testing a small number of plant species for estrogenic activity. The results may suggest biological components that could contribute to the therapeutic effects of the plant. In addition, this data suggest plants that deserve further research for women's health, for example hormone replacement therapy, prevention of osteoporosis, and relief of menopausal symptoms such as hot flashes, breast pain, and vaginal dryness.

Caribbean ethnobotany

The Caribbean offers a wealth of diversity for ethnobotanical and ethnomedical inquiry. The long history of pre-colonial, colonial, and post-colonial contact in the region has given rise to a complex spectrum of societies. Trouillet (1992) provides an eloquent description of this region from an anthropological standpoint:

> This region where boundaries are notoriously fuzzy has long been the open frontier of cultural anthropology: neither center nor periphery, but a sort of no man's land where pioneers get lost, where some stop overnight on their way to greater opportunities, and where yet others manage to create their own 'new' world amidst First-World indifference.

Islands in the Indian and Pacific Oceans have comparable histories as the Caribbean, yet the flora in the Caribbean on the large islands has evolved via distinct borders (Adams 1997). There are approximately 100 inhabited islands in the region with an additional 50 or more cays or islets (Adams 1997). The islands were derived from fragmented continents, volcanic land, and living coral reefs.

Here I review several ethnobotanical and ethnomedical studies of the Caribbean, however this discussion is not considered exhaustive. Multiple authors have provided data about healing practices in the Caribbean (Fernandez Olmos and Paravisini-Gebert 2001; Laguerre 1987; Quinlan 2000). The use of medicinal plants and herbal therapies is a prominent theme in these investigations (Ayensu 1981; Eldridge 1975; Girón *et al.* 1991; Gupta 1995; Halberstein 1997; Hernández Colón 1976-1977; Honychurch 1986; Liogier 1990; Morton 1981; Robineau 1996; Seaforth 1998; Wong 1976). An international organization known as the Environment and Development in the Caribbean (Enda-Caribe) began an important initiative in 1982 to record and investigate medicinal plants of the Caribbean with the goal of producing a Caribbean pharmacopoeia. This project is known as Traditional Medicine in the Islands (TRAMIL) and provides monographs of medicinal plants used in the region.

A recent collection of papers provides a descriptive analysis of diverse forms of healing practices in the Caribbean, including a general discussion of Caribbean ethnomedicine, African healing in Cuba, Afro-Caribbean healing in Haiti, Santería in diaspora communities, and Espiritismo among Puerto Ricans (Fernandez Olmos and Paravisini-Gebert 2001). Santería is an Afro-Caribbean religion and healing system that evolved from Africa and is well-known by Cubans (Brandon 1989-1990). African slaves syncretized African deities with Christian saints and developed new healing practices and beliefs. Espiritismo is a healing system that involves communication with the spirit world via mediums and is considered a blending of Christianity with the teachings of a French educator and philosopher who used the pseudonym Allan Kardec (Paulino 1995). As part of this collection of papers, one of the authors, du Toit (2001) highlighted the importance of medicinal plants in Caribbean healing beliefs and practices.

Several studies have examined African influences on healing practices and plant use (Esquivel *et al.* 1992; Fuentes 1992; Grimé 1979; Laguerre 1987).

It is almost inescapable to study Caribbean traditional medicine without comparing it or relating it to African healing and belief systems. Laguerre's (1987) work is a valuable contribution to further the study of Afro-Caribbean medical traditions. In addition, Grimé (1979) described plants that were introduced by slaves and those that continued to be used by blacks in the Americas and the Caribbean. Esquivel and coauthors (1992) further complemented Laguerre's work through their analysis of plants that have been introduced to Cuba from Africa. Fuentes (1992) also reported on plants from Africa, specifically sacred plants used in Afro-Cuban religions.

Researchers have also conducted ethnobotanical studies that focus on general plant use in the Caribbean. For example, Horst (1997) and Read (1988) presented the multiple uses of native and introduced palm species. Paul and Cox (1995) surveyed the utilization of *Citrus aurantium* in Haiti. This species had a range of uses including medicine, religion, construction, agriculture, and food preparation.

This dissertation is a contribution to Caribbean ethnobotany and to the understanding of medicinal plant utilization by women and healers. It combines ethnographic and ethnobotanical field work with statistical and laboratory analysis to examine aspects of Dominican women's traditional medicine. The history of the Caribbean region is considered in this discussion as it has shaped the complex interrelationships between plants and people in the Dominican Republic.

Personal introduction to the Dominican Republic

My interest in studying Dominican traditional medicine began in 1998 when I started working with Dominican healers in New York City. I participated as a research assistant in the Urban Ethnobotany project (P.I.s Dr. Michael Balick and Dr. Fredi Kronenberg), which focused on Latino healers, a majority of whom were Dominican, in New York City and their recommendations of traditional treatments for women's health conditions. I was involved with all phases of the research including healer screening, patient-healer consultations, healer interviews, plant collection, data processing and analyzing, and publication of some of the results (Balick *et al.* 2000; Ososki *et al.* 2002).

As I continued to work on the Urban Ethnobotany project, I developed a close relationship with two Dominican healers who invited me to visit them in the Dominican Republic. Both of them spent one to two months each year visiting family and friends there and suggested that I should visit them during that time. In 1999 I traveled to the Dominican Republic for a ten-day reconnaissance trip. During my trip I visited the two healers with whom I worked in New York City, who both invited me into their homes and gave me a tour of the medicinal plants in their gardens and neighborhoods. At the local markets I saw some of the same plants I had seen in New York City as well as new ones.

During my trip in the Dominican Republic, I also met with Lic. Milcíades Mejía, the Director of the Jardín Botánico Nacional (National Botanical Garden) of Santo Domingo (JBSD), Lic. Ricardo García, the Co-director of JBSD, and Lic.

Daisy Castillo, the Director of the Botany Department at JBSD, to discuss my project, study sites, and potential ways to work together. Prior to my trip, I had met them at the Latin American Botanical Congress in Mexico City in 1998. It was in Mexico that we began to discuss the possibilities of collaborating together. During my summer trip Lic. Mejía and Lic. Castillo offered institutional support for my project (letters, Appendices A - C). The botanists at JBSD were influential in the success of this project as they provided assistance in various facets of the field work such as technical assistance, botanical identification, study site recommendations, and contacts.

In addition to support from JBSD, Librada Dionicio, the Director of a respected women's organization, the Confederación Nacional de Mujeres del Campo (CONAMUCA, National Confederation of Rural Women), met with me several times to discuss my project and potential study sites. She also provided me with a letter of support (Appendix D). In addition, I discussed my project with Dr. Lionel Robineau of the Environment and Development in the Caribbean (Enda-Caribe) via e-mail to ensure that my study would contribute to the efforts of the TRAMIL project, which was already doing extensive work with traditional medicine in the Dominican Republic.

These initial experiences further confirmed my desire to pursue ethnobotany as a vehicle to study traditional plant medicine and to work with a diverse array of collaborators including scientists, local people, and non-governmental organizations. In addition, my conversations with Dominican collaborators reconfirmed the practical aspects of ethnobotanical research that can easily be disseminated and applied to areas of health care, conservation, development, and policy planning.

Organization of thesis

This thesis is divided into seven chapters; the initial chapters are introductory in nature and set a background for the study. Chapter 2 provides detailed information about the Dominican Republic and offers a framework for the project. Chapter 3 presents the study sites and research methodology. Chapter 4 provides a discussion of Dominican ethnomedicine including women's health conditions and plants used for those conditions. In Chapter 5, I test hypotheses about similarities and differences in plant use among the four study sites and between generalists (laypeople) and specialists (healers). Chapter 6 provides a detailed discussion of phytoestrogens and includes a literature review and laboratory analysis. In the last chapter, Chapter 7, I present the major findings and theoretical considerations from this project and discuss future research directions for the study of women's traditional medicine.

Chapter 2. The Dominican Republic and Its People: Project Background and Cultural Overview

Introduction

The Dominican Republic represents the diversity, variation, and change that characterize traditional plant use in the Caribbean. The waves of migration to this Caribbean country have shaped the complex, multi-layers of culture that have developed there over the past 500 years. The mix of African, Amerindian, and European traditions in the Dominican Republic has influenced the use patterns, names, and beliefs surrounding medicinal plants. In addition, the numerous plants and the diverse vegetation of the Dominican Republic, ranging from mangrove forests to subtropical dry forest to montane wet forest, have helped to shape the present-day pharmacopoeia.

Environmental factors unique to the Caribbean also affect the way people use plants for food, medicine, and construction. For example, hurricanes can dramatically impact the Caribbean landscape, uprooting plant and human populations and changing ecosystems. A cyclone may destroy populations of useful plants and may force people to rely on substitute plants.

Multiple factors contribute to the knowledge of and decisions involved in medicinal plant use in the Dominican Republic. Differences in plant availability, use, and access exist across provincial borders as well as within small communities. Social factors change and influence access to plants. The health of individual family members, personal health care preferences, and overall family composition are also in constant flux and affect medicinal plant use.

To help provide a framework for this project, I offer background information about the Dominican Republic including a brief history of the country, a discussion of the people that have shaped the culture and plant use in the country, and a review of the ethnobotanical literature from the Dominican Republic.

Geography

The Dominican Republic is located on the island of Hispaniola, which is located in the Greater Antilles in northwestern Caribbean, with Puerto Rico to the east, Cuba to the northwest, and Jamaica to the southwest (Figures 2.1 and 2.2). The Atlantic Ocean borders on the north, the Mona Passage borders on the east, and the Caribbean Sea is to the south of the Dominican Republic. The Dominican Republic is situated between 17°40' N and 19°56' N latitude and 68°20' W and 72°01' W longitude and occupies the eastern two-thirds (48,225 km^2) of the Caribbean island of Hispaniola, with Haiti occupying the western one-third (Tolentino and Peña 1998). Prior to the Spanish conquest, the Taino Indians inhabited the island, which they referred to as *Quisqueya* (Mother of All Lands) or *Haiti* (Land of Mountains) (Cambeira 1997). The country is divided into 29 provinces and one national district. It has the tallest mountain in the

Caribbean islands, Pico Duarte, which rises to an elevation of 3,087 m (Adams 1997).

Figure 2.1. Map of Caribbean.

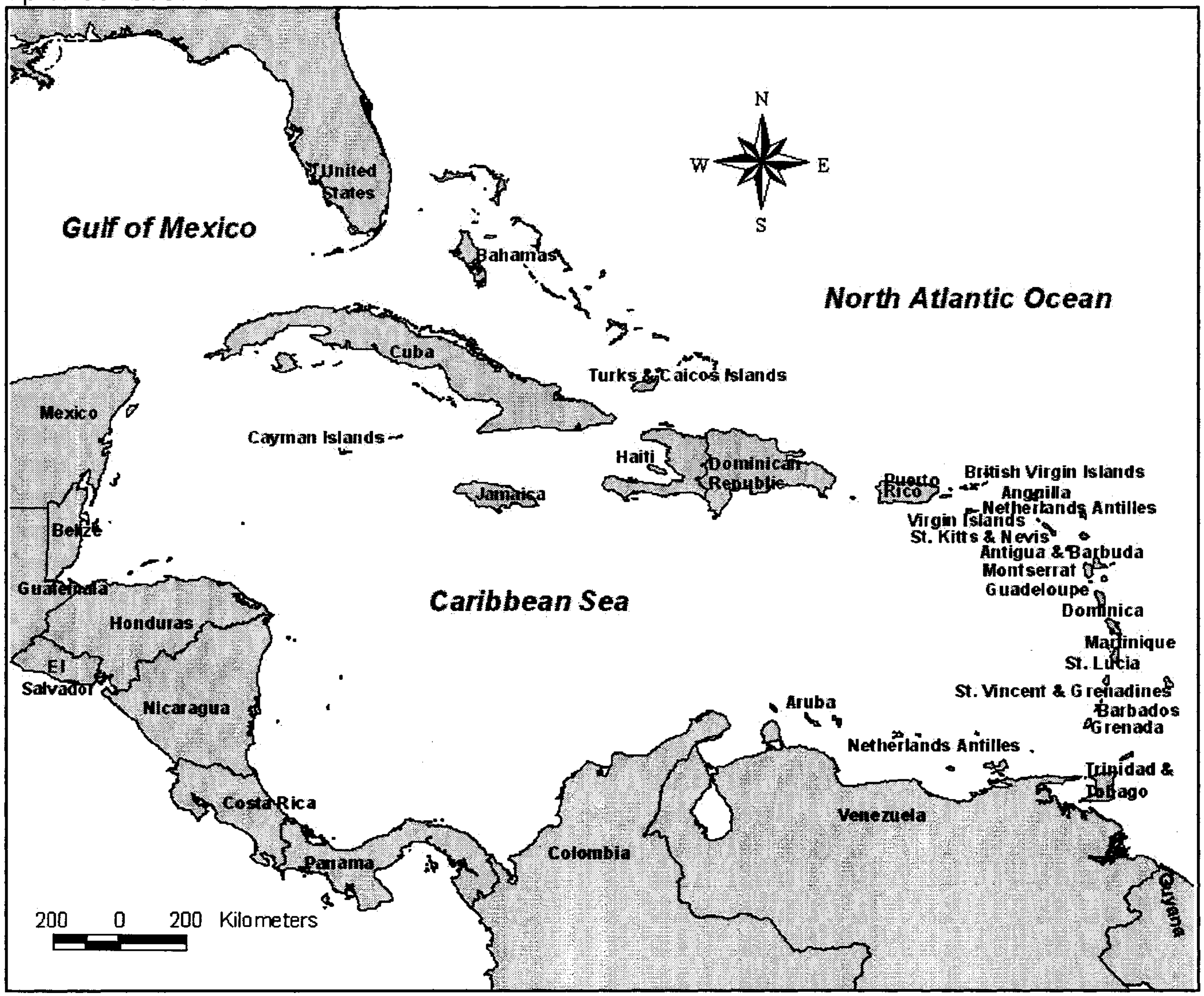
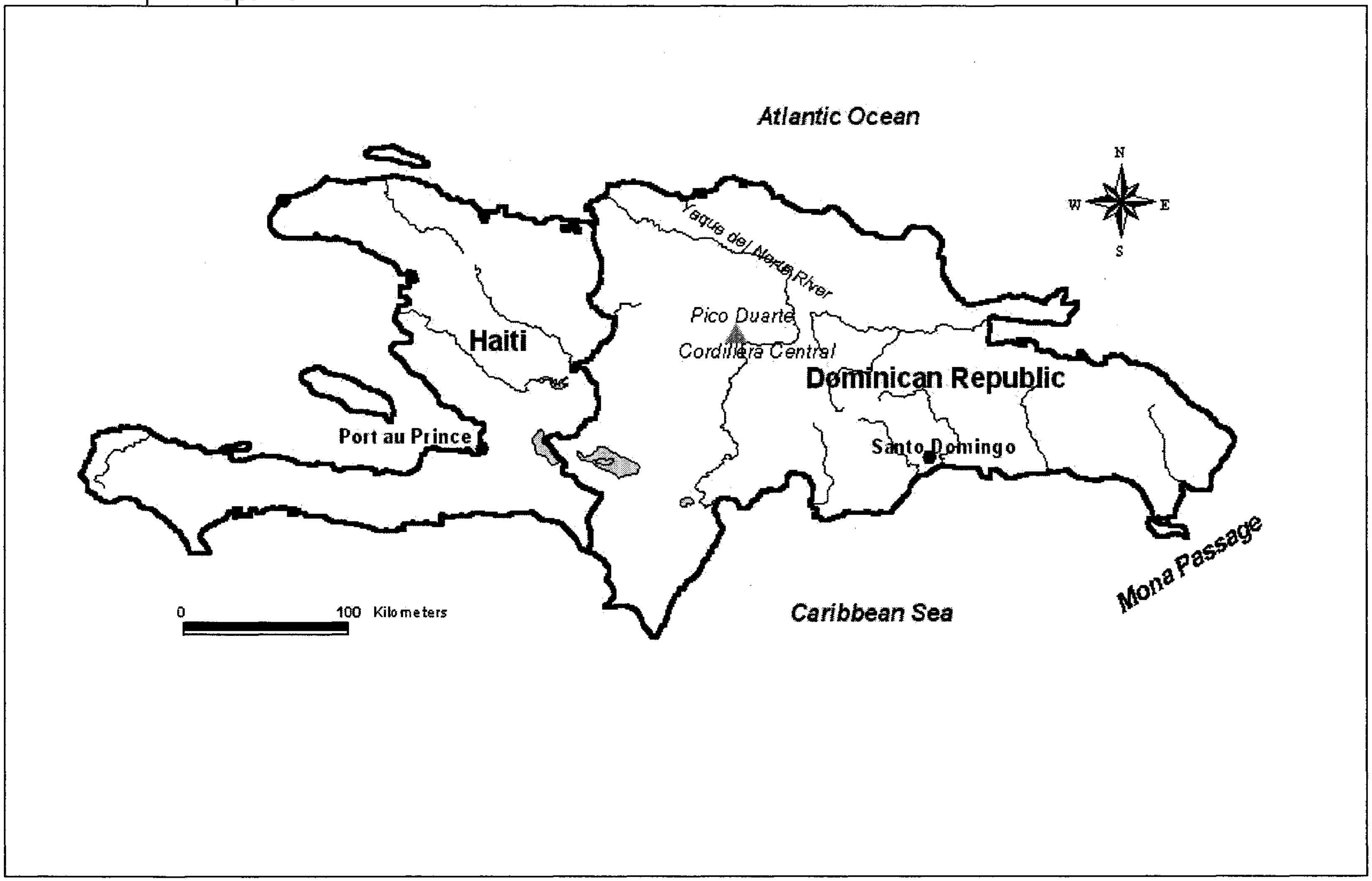


Figure 2.2. Map of Hispaniola.



Climate

Rainfall patterns vary across the country. The annual rainfall in the arid regions located in the southwest ranges from 600 - 700 mm, and from 2,000 - 2,800 mm in the more humid mountainous areas of the northeast (Zanoni 1989). The mean temperature in the Dominican Republic tends to oscillate between 24 °C and 27 °C. However, Pico Duarte in January can approach temperatures as low as 0 °C. The hurricane season lasts from June to October and is characterized by hot, humid weather and daily rainfall (Bolay 1997). Seasons are defined by rainfall rather than temperature on the island.

Flora and vegetation

The number of vascular plant species in the Caribbean is approximately 13,000; of these 6,550 are single island endemics (Adams 1997). The flora of the Dominican Republic has approximately 4,685 species of vascular plants. In Hispaniola, 30% of the species are considered endemic, which is the third highest rate in the Caribbean for endemic species, after Cuba (53%) and Jamaica (31%) (Adams 1997). As would be expected based on area, the smaller islands of the eastern Caribbean known as the Lesser Antilles have smaller floras. Some islands in the Lesser Antilles are less than 2,000 km^2 in area and less than 3% of the plant species are considered endemic (Adams 1997). The major published floras or checklists of the Dominican Republic include those of Urban (1920-1921), Moscoso (1943), and Liogier (1981-2000).

The most diverse regions in the Dominican Republic are those located at high altitudes (May 2001). For example, Pico Duarte has the highest endemism (46.6%) in the Dominican Republic (Zanoni 1993). The vegetation ranges from coastal beach communities to mangrove, lagoon, and riverine formations, to savannas, forests, and woodlands, each contributing to the richness of the country's flora (Adams 1997).

Tolentino and Peña (1998) reviewed past literature reporting vegetation classification in the Dominicana Republic, including Durland (1922), Ciferri (1936), and Hager and Zanoni (1993). They included an oversized color-coded vegetation and land use map designed from LANDSAT^{TM} images, aerial photos, topographic maps, and field work. They estimate that since the 1960's, 80% of the original forest cover has been disrupted. To help preserve the country's biodiversity, 13.3% of the land is protected in national parks, wildlife refuges, scientific reserves, and sanctuaries (García and Roesch 1996).

Population and culture

The population of the Dominican Republic in 2001 was estimated to be ca. 8.6 million (http://www.cia.gov). About 70% of the population lives in urban centers. The capital, Santo Domingo, is the largest city with an estimated population of two million. Although the central northern Cibao region, including Santiago and La Vega, has the highest regional population, the Distrito Nacional (Santo Domingo and surrounding areas) is the most densely populated area of the country. The arid southwestern region is the least populated area. The Dominican population is 73% mulatto (a person of mixed European and African ancestry), 16% European descent, and 11% African descent (Bolay 1997).

Language

The native language is Spanish incorporating indigenous and African elements specific to the Dominican Republic (Cambeira 1997: 239-242). Province La Vega, part of the Cibao region, is known for its distinctive dialect in which the Spanish letters "r" and "l" are often replaced by the pronunciation of the Spanish "i". For example, *puerco* (pig) and *capital* (capital) are pronounced as *pueico* and *capitai.* This has been suggested as a vestige of Taino pronunciation (Ferbel 2002). Dominicans use Taino names for their children such as Anacaona and Hatuey. A popular expression is "*un chin*" or "*chin-chin*" which is a Taino phrase that means a small amount (Ferbel 2002). In other Spanish speaking countries it is more common to hear the phrase "*un poquito.*" Examples of words of African origin used in the Dominican Republic are *ñame* (yam, *Dioscorea* sp., Dioscoreaceae), *guineo* (banana, *Musa* sp., Musaceae), and *bemba* (full lips) (Museo del Hombre Dominicano exhibit, Santo Domingo, 2000).

Public health

There are three separate and overlapping official public health care delivery systems in the Dominican Republic: the Secretaria de Estado de Salud

Pública y Asistencia Social (SESPAS) for the general population; the Instituto Dominicano de Seguros Sociales (IDSS) for social security coverage of individuals and their dependents; and the Instituto de Seguridad Social de las Fuerzas Armadas (ISSFAPOL), coverage for members of the armed forces (Whiteford 1992). In addition to these national governmental systems, there are international agencies and private voluntary organizations that contribute to the public health care delivery system.

Several external factors influence the quality of public health care in the Dominican Republic. In rural areas, where it is difficult to access health care facilities, people often rely on *clínicas rurales* (rural clinics). The rural clinics are open limited hours, sometimes only two days a week. They are staffed with *pasantes*, medical doctors and students doing an obligatory year of public service; therefore, there is little continuity for patients to see the same health care practitioner for more than a few years, at most, over their lifetimes. Another factor that has impacted public health care in the country is the lack of guaranteed medical coverage, so patients must pay for medicines and materials (i.e., surgical dressings, syringes) (Ortiz 1994: 341). Low salaries for medical professionals in the public sector have also contributed to inferior health care (Ortiz 1994: 224).

In 1992, the Secretaries of Public Health in the Dominican Republic, Dr. Marta Brown and General Miguel Angel Estepan, enforced an “unprecedented crackdown on traditional healers and ‘centers of witchcraft,’ as well as a policy to discourage traditional herbal home remedies” (Ortiz 1994: 14). This campaign was an attempt to modernize the Dominican health care system by discrediting traditional health care practices—*medicina popular*—including the use of herbal remedies for ailments. The national health campaigns that encouraged Dominicans to use government health services and discouraged the use of herbal remedies impacted the transmission of knowledge of home-based remedies across generations and from neighbor to neighbor (Ortiz 1994: 3). Although that period is over and there are no new efforts to reduce the usage of medicinal plants, there continues to be an undertone that *medicina popular* is for uneducated or poor people.

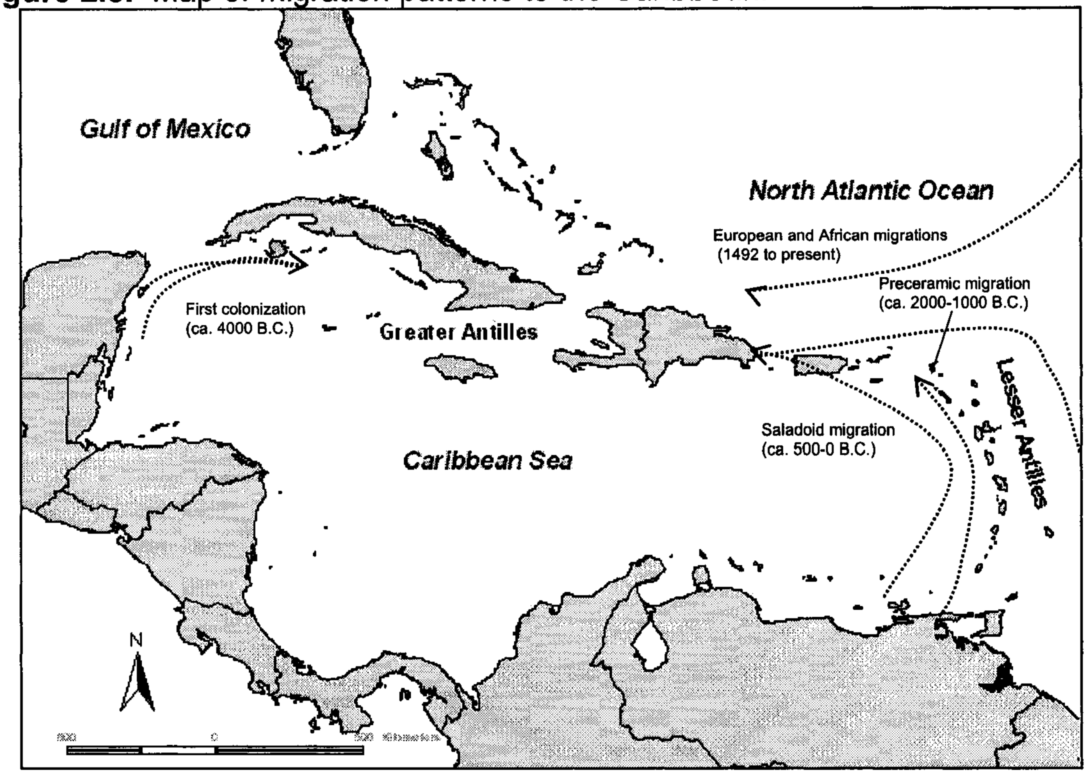
Despite such obstacles in recent years, healers have persisted and traditional medicine continues to be practiced in the Dominican Republic. Local community workshops have been conducted by non-governmental organizations such as the Confederación Nacional de Mujeres del Campo to educate communities about medicinal plants and their preparation as herbal tinctures, salves, and teas (Librada Dionicio, pers. comm., 1999).

Peopling of the Caribbean

Migrations of Indigenous groups

Early evidence suggests that the Caribbean islands were colonized approximately 6,000 years ago (Wilson 1997). Researchers believe the earliest inhabitants of the Caribbean were from the Yucatán Peninsula of Mexico because of the similarity of stone tools used by the people in both the Yucatán and some of the original inhabitants of Cuba and Hispaniola (Wilson 1997). These original inhabitants, described as Casimiroid people, were hunter-gatherers who migrated from Mexico around 3,500 to 4,000 B.C. and had to adapt to the limited number of mammals found on the Caribbean islands (Figure 2.3, adapted from Wilson 1997: 2) (Rouse 1999: 51-57). Around 2,000 - 1,000 B.C., another pre-ceramic group(s) from South America migrated through the Lesser Antilles into Puerto Rico and Hispaniola and eventually to Jamaica and Cuba. Evidence of their presence in the region is shown by paleoethnobotanical findings of their consumption of roots from the *guáyiga* cycad (*Zamia debilis* L.f., Cycadaceae) and fruits from the royal palm (*Roystonea hispaniolana* L. H. Bailey, Arecaceae) and false-mamey (*Clusia rosea* Jacq., Clusiaceae) (Petersen 1997). The favorable winds and ocean currents helped facilitate their migration.

Figure 2.3. Map of migration patterns to the Caribbean.



Following these two migrations, the Saladoid people from the Orinoco Delta in South America started to settle in the Caribbean islands around 500 B.C. (Wilson 1997: 5). They introduced cassava, also known as *casabe* or *yuca* (*Manihot esculenta*), which is still a common staple for many people in the Caribbean. Caribbean archeologists postulate that the origin of the Taino, the group Columbus encountered in 1492 on Hispaniola, came from the blending of these early pre-Columbian Amerindian groups (Rouse 1999).

By the middle of the sixteenth century nearly all the Taino had been decimated on Hispaniola, yet their cultural influences are still seen on the island. On Puerto Rico, remanents survived in the hills much later, but maybe not as much as the present-day descendants of the Taino say. Father Bartolomé de Las Casas (1971), a Spanish chronicler, documented some of the ancient traditions of the Tainos. Tainos were agriculturalists who maintained a communal society. The Tainos planted root crops and other food plants on *conucos,* cultivated mounds of land approximately three feet high (Rouse 1999: 12). Dominicans continue to depend on their small farms, referred to as *conucos,* where they grow plants such as *casabe*, *batata* (sweet potato, *Ipomoea batatas* (L.) Lam., Convolvulaceae) and *yautía* (taro, *Colocasia esculenta* (L.) Schott, Araceae).

The Tainos had sophisticated religious beliefs structured around several gods. Their healers were called *bohuti* or *behique*, and they were also priests able to communicate with the dead and the *zemi* or *cemi*, anthropomorphic figurines formed from wood, stone, or ceramic that served as mediums between the people and the spirit world (Mañon Rossi 1983; Rouse 1999: 14). In the Taino society, the *bohuti* were highly respected and were ranked just below the *caciques* (regional chiefs), who were also able to communicate with the spirit world via the *zemis*. The *bohuti* used ground *cohoba* seeds (*Anadenanthera peregrina* (L.) Speg., Fabaceae), a cultivated plant, mixed with an alkaline substance (lime from burned seashells) to make a hallucinogenic snuff to aid in their diagnosis and healing (Museo del Hombre Dominicano exhibit, Santo Domingo, 2000). *Cohoba* is also traditionally used by tribes in the Orinoco basin of Colombia and Venezuela and referred to as *yopo* (Schultes and Hofmann 1979; Von Reis Altschul 1972) and was most likely introduced to the Caribbean by migrants from South America. The use of *cohoba* appears to be an extinct tradition of the Tainos; it was not reported by anyone in the present study.

The Taino language contributed many vocabulary words to the present-day Dominican Spanish. For example, *barbacoa,* a Taino word, is still used to refer to storage bins built from wood to store *víveres* (edible starchy roots) in rural communities in the Dominican Republic and also to refer to the way of cooking meat over an open fire. *Batey* was used by the Tainos to name the open area or plaza where festivals were celebrated and goods were exchanged. Today *batey* refers to the shanty communities, where sugarcane plantation workers reside, many of them Haitian immigrants (Cambeira 1997: 43). *Bohío* is another Taino term applied to homes with palm-thatched roofs occasionally seen in the Dominican countryside (Vega 1997). Many other Taino words persist including names of marine life such as the *lambí* (conch), *tiburón* (shark), and *carey* (sea turtle); names of rivers, *Yaque*, *Sosúa*, and *Nagua*; and names of mountains and sierras, *Baoruco*, *Neiba*, and *Jaragua* (Vega 1997).

Taino influences are also seen in the present-day Dominican diet. *Casabe*, an important part of Dominican cultural heritage, is often prepared and eaten, as it was hundreds of years ago (Ferbel 2002). The roots are grated and prepared into large, thin disks, which are cooked on a flat surface or griddle. While other Taino influences may exist, they are not known with certainty.

Migrations of European groups

Following the indigenous people, various European groups migrated to the Caribbean (Figure 2.3). Their presence had a considerable cultural and ecological impact on the Caribbean islands as they, too, introduced their forms of government, religion, and plants for food and medicine. *Caña (*sugarcane, *Saccharum officinarum* L., Poaceae), *romero* (rosemary, *Rosmarinus officinalis* L., Lamiaceae), and *ruda* (rue, *Ruta chalepensis* L., Rutaceae) are examples of some of the plants introduced from Europe. The concurrent introduction of European medicinal plants, concepts of therapy, and medicine influenced the healing practices on the Caribbean islands.

Hispaniola, Cuba, Jamaica, and Puerto Rico were the initial islands to be colonized (Wilson 1997). The Spanish were the first Europeans to settle and establish colonies, starting in the Dominican Republic and radiating outward toward the other islands in the Caribbean (Rouse 1999: 147). The Spanish imposed their language, customs, architecture, religious beliefs and practices, and politics. When the Spanish settled in the Dominican Republic, they rationalized that, due to religious differences, the Taino were an inferior people and in need of civilizing. The Spanish also enforced the *encomienda* system to exploit the land for gold. This system enslaved the indigenous people into forced manual labor in which they were treated as property.

Beginning in the 1500s, French, Dutch, and English privateers and buccaneers attempted to gain riches in Hispaniola and other parts of the Spanish Main, the mainland surrounding the Caribbean. During that time, piracy was considered an acceptable occupation among the rivals of Spain. Buccaneers and pirates maligned and rejected all forms of authority including the Spanish governance. These various groups began to settle in the northwestern coast of Hispaniola, particularly on the island of Tortuga (8 km north of Port-de Paix, Haiti), which had been abandoned by the Spanish. The French strongly encouraged attacks on the Spanish settlements and began to form the colony, called Saint Domingue, at the western end of Hispaniola, which later became Haiti.

After the Treaty of Ryswick in 1697, Hispaniola was divided with France ruling the western portion of the island, essentially what was to become Haiti, for a little over a hundred years. During that time, Haiti, known as Saint Domingue, became one of the wealthiest colonies in the New World because of its successful exploitation of African slave labor and trading. The wars in Europe in the late 1700s greatly affected the Spanish colonies in the Caribbean, and Spain was forced to cede the Spanish part of Hispaniola (present-day Dominican Republic) to France in 1797. Before France could reap the benefits of its new occupied territory, the slaves of the western part rebelled against France and won independence in 1804 as Haiti.

For a period of 22 years, Haitians occupied the eastern part of Hispaniola. During this time there was a decline in the economy and an increasing bitterness toward Haiti by Dominicans. The Haitian occupation lasted until February 27, 1844. The *Trinitarios*, a rebel group founded by Juan Pablo Duarte, took over the Ozama Fortress in Santo Domingo and forced the Haitian officials to leave. In 1861 Spain annexed eastern Hispaniola although this did not last long, and in 1863 the War of Restoration led to the repeal of the annexation in 1865.

Migrations of African groups

The Spanish depended on African slaves sent to the Caribbean to work on the plantations (Figure 2.3). Their importation to the Caribbean began early in the 1500s. In 1511, Spain gave permission for African captives to be imported into Hispaniola. As the groups before them had done, they too influenced the Caribbean with their cultural practices and beliefs. In addition, many Africans from diverse tribes in West Africa brought plants from their homeland and introduced them to the Caribbean islands. *Molodrón* (okra, *Abelmoschus esculentus* (L.) Moench, Malvaceae), *ñame* (yams, *Dioscorea* spp., Dioscoreaceae), *café* (coffee, *Coffea arabica* L., Rubiaceae), *guandules* (pigeon peas, *Cajanus cajan* (L.) Millsp., Fabaceae), and *ajonjoli* (sesame, *Sesamum indicum* L., Pedaliaceae) are some examples of plants introduced from Africa (Esquivel *et al.* 1992; Grimé 1979). In addition to plants, African slaves brought their healing traditions and religious beliefs, which were often maintained in secret (Cambeira 1997; Laguerre 1987).

The Spanish colonists forced their religion of Catholicism on the Africans. However, the Africans continued their religious beliefs by disguising their religious practices. When appearing to pray to Catholic saints they secretly were praying to their own deities. This practice is often referred to as Santería. This complex layering is known as syncretism and is a common theme throughout Caribbean culture.

Over time, traditions from various groups in the Caribbean have slowly blended and evolved into present-day healing practices of Espiritismo, Santería, Brujería, and Vodú (also known as Vudú, Vodun, Vodou, and Voodoo) (Paulino 1995). Deive (1979) and Davis (1987) document various religious practices and healing beliefs of Dominican Vodú. An example of the complex layering of religious practices is seen in Dominican Vodú, in which the Virgin Mercedes (*la Virgen de las Mercedes*) represents the Vodú deity *loa Ofeliá Balenyó* (Jiménez Lambertus 1980).

A group of African slaves known as the *cimarrons* (maroons), escaped runaway slaves, were similar to the buccaneers in their resistance to Spanish governance. They aligned with the Taino to rebel against the Spanish. In Hispaniola they established *manieles*, communities where they recreated their African villages and maintained their traditions (Cambeira 1997: 74-75). These communities provided a symbol of resistance to the Spanish. They also influenced the cultural history of the Dominican Republic by maintaining the vestiges of African language and traditions.

Dominican ethnobotany: a literature review

This review of Dominican ethnobotanical literature combines results from a previous survey of 30 literature sources (Ososki *et al.* 2002) with eight additional references collected during my field work to provide an understanding of medicinal plant use in the Dominican Republic. These references provide a baseline of information on plant use in the Dominican Republic, which offer a context for this ethnobotanical study.

The majority of Dominican ethnobotanical literature has been written in the last two decades (García and Roesch 1996) and is descriptive, providing lists of plants and their uses (Cordero 1978; Estévez and Báez 1998; Rodríguez Martínez 1992, 1999). Although these studies contribute to the documentation of plant use in the Dominican Republic, many of the papers and books do not include methodology (i.e., how the data were collected or from whom), cite vouchers, or in some cases, provide scientific names. There are several notable exceptions that include this information (Hernández Colón 1976-1977; Robineau 1986, 1991, 1995; Weniger and Robineau 1988a, b).

A valuable source of information about medicinal plant use in the Caribbean is the TRAMIL series (Robineau 1991, 1995, 1996; Weniger and Robineau 1988a, b) published by Enda-Caribe (Robineau and Soejarto 1996). The TRAMIL program originated in Hispaniola in 1982 and expanded to other parts of the Caribbean (Weniger 1991). The project aim is to document the use of local plants by the general public and to provide safety and efficacy information for people who choose to use local remedies for economic, cultural, or personal reasons, while also preserving cultural traditions (Robineau and Soejarto 1996). A standard methodology is used across the publication series. A committee evaluates each plant and either approves or disapproves it for popular use through literature searches of chemical composition, potential toxicity, and therapeutic value and efficacy, as well as original laboratory analysis.

Each species is evaluated based on sets of minimum criteria for safety, quality, and efficacy, and is assigned a place on a scale (Robineau 1996). The scale is divided into three categories: recommended for use, not recommended for use, or in need of further research if there is a scarcity of data. The safety criteria include toxicity levels based on oral, inhaled, and topical dosages and administration. The toxicity level for groups at high risk, such as children and pregnant women, is included in the evaluation. Peri- and postnatal toxicity, mutagenicity, teratogenicity, and embryo-toxicity studies are also critical for assigning a safety score to a plant. The quality criteria include proper plant identification, correct plant part, and hygienic preparation and application of a remedy. The criteria for efficacy include identified active constituents and pharmacological action related to traditional use.

The TRAMIL series provides a valuable source of ethnopharmacological information for those who choose to use medicinal plants; however, the methodology affords limited understanding of the Dominican ethnomedical system. The TRAMIL project objective has its foundations in public health care and focuses on medicinal plants frequently used by laypeople (or generalists) for common health conditions. The project does not include healers (or specialists) nor does it include all health conditions treated with herbal medicine.

Ethnobotanical studies focusing on medicinal plants sold in local markets in the capital city Santo Domingo have also contributed to understanding plant use in the Dominican Republic. González Canalda (1972) published transcriptions of interviews with medicinal plant vendors in Santo Domingo. She also included a list of plants sold by vendors and their uses, both medicinal and magico-religious, a category that includes plant uses of a supernatural quality, such as obtaining luck or love. While she provided scientific names and common names, a drawback is that specific voucher specimens were not included.

Lantigua García and Cruz Hernández (1998) identified 83 medicinal plant species sold in four local markets in Santo Domingo and tested 12 of them using anti-microbial tests (*Staphylococcus aureus, Escherichia coli, Pseudomona aeruginosa, Salmonela typhimurian*). The researchers included data on the cost of individual plant material per pound, a list of the most popular plants purchased, a list of the plant parts sold, their condition (i.e., fresh, dry), and the area where the plant was collected. This study suggested marketing potential for medicinal plants in the Dominican Republic and has provided information for local communities interested in commercializing medicinal plants.

Liogier and coworkers' (2000) *Diccionario Botánico de Nombres Vulgares de la Española* (Dictionary of the Common Names of the Plants of Hispaniola), first published in 1974, provides a comprehensive list of common names of plants, their scientific names, and short botanical descriptions. This reference also included uses from other Caribbean literature sources. It is a useful guide for researchers working with local communities.

Other ethnobotanical studies conducted in the Dominican Republic are more general and have described plants for medicine, food, construction, religion, aphrodisiacs, and other uses. For example, ethnobotanical inventories have been done in rural communities in the municipality of Bayaguana, Province Monte Plata (Polanco *et al.* 1998), with *campesinos* (peasant) in Valle Nuevo National Park and Armando Bermúdez National Park (Peguero 1998, 1999), and on the peninsula of Samaná (Peguero *et al.* 1995). These studies shed light on the diversity of plants used in the Dominican Republic.

Other studies about the Dominican Republic have discussed plant use in relation to ethnomedical systems (Hernández Colón 1976-1977; Rodríguez and Colectivo Mujer y Salud 1994); cultural value (Avila Suero 1988; Deive 1979); social identity (Brendbekken 1998); and educational level (Aquino Morillo *et al.* 1986). Hernández Colón (1976-1977) published an ethnomedical study about the useful plants of Pedernales, a Dominican province bordering Haiti. Her study was the first in the Dominican Republic to investigate medicinal plants as therapeutic agents from the local healers' viewpoint as opposed to the biomedical standpoint. The dichotomy of these two systems can be referred to as etic and emic. Emic categories refer to the perception, cultural categories, and classifications as defined by the local community members, while etic categories of a surrounding environment or behaviors of a local community are defined by a researcher or outside person, and often based on scientific classifications (Zent 1996).

Hernández Colón (1976-1977) described the rationale of how the medicinal plants work using the healers' conceptualization of this process. For example, "cold" illnesses were treated with "hot" remedies and "hot" illnesses with "cold" remedies. She also reported an additional category for plants known as "*fresco*" meaning fresh or cool. The classification of hot and cold health conditions and remedies can be referred to as the hot-cold theory (Foster 1987).

The hot-cold theory falls under the more general medical theory based on humoral medical traditions (Foster 1994). According to medical historians, the three major humoral medical traditions are Hippocratic-Galenic of Western Europe, Ayurvedic of India, and the Chinese system (Foster 1994). The humoral medical system has been widely described for many other Spanish-American countries as well as Brazil and Haiti, and for Puerto Ricans in New York City (Browner 1985a; Foster 1987, 1994; Harwood 1971; Laguerre 1987). Humoral medicine is based on the balance of the body's four humors (blood, phlegm, yellow bile, and black bile) (Foster 1987). The humors are considered fluids that move freely in the body around the organs. The hot-cold theory takes into account the equilibrium of temperatures in the body and proposes that a body that is evenly warm is healthy. Temperature in this system can have a thermal quality as well as a metaphoric quality. For example, blood is considered hot and moist, phlegm cold and moist, yellow bile hot and dry, and black bile cold and dry (Foster 1994).

In addition to the hot-cold theory, Hernández Colón (1976-1977) also discussed the continued lack of success of poorly designed medical programs that do not consider the layperson's understanding of illness or their medical beliefs and healing practices. Medical programs in the Dominican Republic continually depend on a biomedical approach that ignores traditional healing practices. Hernández Colón proposed that further studies were needed to improve future health plan programs in the Dominican Republic by incorporating local health care categories and ethnopharmacopoeias.

Another study described the ethnomedical system used by midwives in the province of San Cristóbal (Rodríguez and Colectivo Mujer y Salud 1994). Based on extensive interviews with midwives, Rodríguez and Colectivo Mujer y Salud (Woman and Health Collective) (1994) included a detailed account of plant remedies used for a variety of women's health conditions. She also included common terminology used for health conditions and medicinal plants. A drawback of her study is that scientific names of the plants and voucher specimens were not reported; therefore, the botanical information is uncertain.

Avila Suero (1988) devoted an entire chapter of his book to health and traditional healing in the community of Barreras, in southwestern Dominican Republic. Much of his discussion focused on the traditions of one person who was considered to be a well-respected healer in the community. Although he reported on plant use data from observed patient-healer consultations, a drawback of the study is, again, the lack of botanical scientific names and voucher specimens and the small sample size of one healer.

In addition, Deive (1979) discussed healing and the various kinds of healers known in Dominican culture. Included in the study was a detailed list of *ensalmos*, types of prayers used specifically for illnesses. Often an *ensalmo* is passed down from generation to generation or shared between healer and apprentice. In Deive's study, the section on medicinal plants included a general discussion of their cultural value as medicine and listed some specific common plants and their uses. Deive's work provided a rich, cultural context of Dominican healing; however, his study offered limited botanical details such as voucher specimens and scientific names.

The study by Brendbekken (1998) offered a look at the interrelationships between plants and people and included an analytical perspective of the social life of Dominicans, the construction of the Dominican *campesino* (peasant) identity, and their beliefs of the spiritual world. She conducted her study in the Province Elías Piña near the Haitian border and discussed many outside factors that influence plant use in the Dominican Republic, such as historical, social, and psychological factors. Her study area was essentially very rural and had a high influence of Haitian culture woven throughout its folk customs and spirituality (Brendbekken 2003). Her analysis included a comprehensive list of plants used in those communities, reporting common and scientific names, plant descriptions, plant qualities (i.e., bitter, hot), uses, and recipes. She made field collections for her study that were identified by taxonomists at the Jardín Botánico Nacional (JBSD) in Santo Domingo. Brendbekken's (1998) research provides a detailed analysis of healing beliefs and practices using a clear study methodology and valuable botanical information.

In addition to ethnomedical studies, other studies have evaluated plant use in relation to educational influences. Daisy Castillo of the JBSD conducted her master's thesis research on the relationship between medicinal plant use and educational level of members of three communities (urban, semi-urban, rural) located in the Province San Cristóbal (Aquino Morillo *et al.* 1986). The results of her work showed that medicinal plant use was inversely related to education. In addition to evaluating educational influences, she also described the plant uses in the three communities.

Other literature about Dominican medicinal plants has been written by an agronomist (Rodríguez Martínez 1987, 1990, 1991a, b, 1992, 1999), physicians (Cordero 1978; Estévez and Báez 1998), and others, such as folklorists (Lebrón Saviñon 1987; Liriano María 1988; Mañon Rossi 1983; Pimentel Arias 1989). In several of these sources it is unclear whether the uses were reported from field work, documented from other literature sources, or based on experiences outside of the country (Rodríguez Martínez 1987, 1990, 1991a, b, 1992, 1999). In one of his books, Rodríguez Martínez (1999) included both exotic plants, such as dong quai (*Angelica sinensis* (Oliv.) Diels, Apiaceae) and native Dominican plants; although the book included over 50 references, the use information is not referenced individually for each plant; therefore, it is difficult to confirm if Dominicans used these plants or if Rodríguez Martínez suggested these plants for use.

The books by Cordero (1978) and Estévez and Báez (1998) are medicinal plant guides that included botanical descriptions, medicinal uses, and scientific analyses that have been collected from field work and other sources. These texts offer detailed information about each medicinal plant; however, they did not differentiate between primary and secondary sources nor did they mention voucher specimens.

Several other references reviewed may be considered guidebooks for the use of medicinal plants or folkloric accounts of medicinal plant use in the Dominican Republic (Lebrón Saviñon 1987; Liriano María 1988; Mañon Rossi 1983; Pimentel Arias 1989). They provide information about medicinal plants intended for the general public. Dominican medicinal plant use information can also be found in references that are general to the Caribbean islands (Ayensu 1981; Grimé 1979; Gupta 1995; Honychurch 1986; Liogier 1990; Morton 1981; Seaforth 1998).

Another source of Dominican medicinal plant use information is community health manuals that are published by non-governmental organizations in the Dominican Republic. The Instituto de Medicina Dominicana (Institute of Dominican Medicine) (1997, 1999) and Enda-Caribe are examples of organizations that have produced such manuals. Information reported in these health care guidebooks was compiled from community meetings focused on medicinal plant use and the terminology used for health conditions, causes, and symptoms came from people in the local communities. These books were written for laypeople and include illustrations of preparations of remedies and symptoms associated with the illnesses. These manuals provide a useful source of medical information for common, simple ailments and are valuable in preserving traditional healing knowledge. For initial background research, they provide preliminary details to acquaint a researcher about common illnesses and medicinal plants.

Dominicans and traditional medicine in New York City

Dominicans continue to practice their traditional medicine and healing traditions even when they immigrate to urban centers such as New York City (Reiff *et al.* 2003). A study that involved collaboration with eight Latino healers in New York City resulted in the identification of 67 plant species that were used for women's health conditions (Balick *et al.* 2000). Six of the eight Latino healers were from the Dominican Republic. To further evaluate Dominican medicinal plant use in New York City, the authors of these studies conducted a literature review to compare the plants reported in their field study with plants reported in the Dominican ethnomedical literature (Ososki *et al.* 2002). From these two sets of plants, 19 species overlapped, representing 29% (n = 65) of the species prescribed by Dominican healers in New York City.

Additional studies have reported on traditional healing practices and health care beliefs of Dominicans living in New York City (Allen *et al.* 2000; Bearison *et al.* 2002; Ruiz 1990). In Ruiz's (1990) study, the author discussed common health care beliefs and practices of Dominican patients at an inner-city hospital, interviewing them about perinatal and infancy care as well as perceived outcomes from the patient's perspective. More recent studies have shown the use of traditional medicine or complementary and alternative medicine (CAM) by Dominican patients at the Columbia Presbyterian Hospital Emergency Department (Allen *et al.* 2000). In this study, 28% of the participants reported using CAM often in the form of herbal remedies in the last year. Of those participants, 80% rated CAM as effective in treating their health complaint. Another investigation examined herbal remedies used by Dominican mothers to treat their asthmatic children (Bearison *et al.* 2002). In this study, researchers interviewed Dominican mothers of asthmatic children regarding their beliefs about asthma and its causes and found that home remedies used for prevention lead to high rates of noncompliance with medically prescribed treatments.

Dominican medicinal plants and women's health

Based on the original review of 30 Dominican ethnomedical references discussed above, which ranged from botanical to anthropological to folkloric, I compiled a list of health conditions specific to women (Table 2.1 at end of Chapter 2). These terms include a combination of folk terms and medical terms depending on how they were reported in the literature. I grouped these uses by the following categories: menstruation, pregnancy, menopause, infection, and other conditions. The terms are presented in Spanish and English. An assumption is made that the information published is based on primary sources; however, in several instances this is not certain.

As part of this review, over 300 reports of plants associated with women's health conditions in the Dominican Republic were noted and entered into a database. The most common terms in the literature were emmenagogue, followed by galactogens and abortifacients. One explanation for this may be that the researchers were interested in simply recording emmenagogues or that it is a condition that is commonly treated and known by many in the Dominican

Republic. It is difficult to draw conclusions about these terms because the methodology was often not reported for the majority of these sources.

From the literature review, over 160 plant species were recorded for women's health conditions in the Dominican Republic. I selected three plants that were reported in at least 30% of the references (*n* = 30) suggesting their importance to women's health. These plants are *bija* (annatto, *Bixa orellana* L., Bixaceae), *sorosí* or *cundeamor* (*Momordica charantia* L., Cucurbitaceae), and *aguacate* (avocado, *Persea americana* Mill., Lauraceae). Table 2.2 (at end of Chapter 2) lists these plants and their uses and preparations. The leaves of *Bixa orellana* were often prepared as a bath and used for vaginal infections (Bonnelly de Calventi *et al.* 1985; Deive 1979; Lebrón Saviñon 1987; Mañon Rossi 1983; Pimentel Arias 1989), while the leaves were taken orally in a tea as an emmenagogue (Bonnelly de Calventi *et al.* 1985; Robineau 1991, 1995; Weniger and Robineau 1988a).

Momordica charantia was primarily used to regulate menses, to treat uterine problems, and as an emmenagogue. The roots and leaves were boiled, sweetened, and taken orally (Cordero 1978), or sometimes a simple decoction of the leaves was taken orally (Robineau 1986). The fruit was also used in combination with the leaves but the preparation and administration were not specified (Deive 1979; Hernández Colón 1976-1977; Lebrón Saviñon 1987).

Persea americana was used for amenorrhea, dysmenorrhea, stimulating and regulating menses, and as an abortifacient. To stimulate or regulate menses, a decoction of leaves, flowers, new shoots, or fruit was prepared and taken orally (Bonnelly de Calventi *et al.* 1985; Deive 1979; Estévez and Báez 1998; Robineau 1986; Rodríguez Martínez 1987, 1991a). The fruit of avocado, boiled in a decoction and mixed with salt, was taken orally as an abortifacient. The leaves, prepared and administered in the same fashion, were used for amenorrhea (Robineau 1991, 1995; Weniger and Robineau 1988a, b). Leaves, flowers, and new shoots were prepared as an infusion or decoction and used as an abortifacient (Lebrón Saviñon 1987; Rodríguez Martínez 1987, 1991a). *Persea americana* was also used to combat tumors; the seed was grated, honey was added, and the mixture was applied externally (Cordero 1978; Lebrón Saviñon 1987).

This literature provides a baseline of data upon which to compare the present study. Many references from diverse disciplines noted plants for women's health in the Dominican Republic, but only a few have presented this topic as the main focus of the study (Balick *et al.* 2000; Ososki *et al.* 2002; Reiff *et al.* 2003; Rodríguez and Colectivo Mujer y Salud 1994). More studies are needed that ask complex questions about traditional health care and human-plant interrelations. Using a combination of ethnobotanical, ethnomedical, phytochemical, and statistical approaches to analyze the data, this present study offers specific information about traditional women's medicine in the Dominican Republic. I attempt to construct an understanding of Dominican ethnomedicine based on the review of literature and my own field work, with a realization that this system is continually evolving and new plants and uses are acquired as old ones are abandoned.

Conclusion

An understanding of historical and cultural background in the Dominican Republic provides a useful context for this study. Historical forces have contributed greatly to the present-day use of medicinal plants in the Dominican Republic where rural and urban people continue to use herbs as do people of various socio-economic backgrounds. This blending of cultures is seen in the diverse healing practices of Dominican healers who incorporate healing beliefs and medicinal plants of African, European, and Taino origins. In addition to historical influences, the current age of globalization has left its mark. Contemporary factors—such as international travel, television, and the Internet—are now helping to shape the constantly evolving uses of plants by people in the Dominican Republic.

In this chapter, I reviewed Dominican ethnomedical and ethnobotanical literature and described commonly reported plants and terminology used for women's health. I also discussed the challenges faced by ethnobotanists when evaluating studies from diverse disciplines, particularly those with differing methodologies. The references in the literature review provide valuable descriptions of healing traditions and report on medicinal plant use, yet they lack an integrative, multidisciplinary approach to further understand Dominican traditional medicine. Some references included laboratory analysis of medicinal plants (Bonnelly de Calventi *et al.* 1985; Robineau 1991, 1995; Weniger and Robineau 1988a, b), however more research is needed to test the traditional uses through phytochemical studies. Based on this review, the need for more thorough and rigorous studies of Dominican traditional medicine is increasingly apparent. For example, studies are needed that record ethnomedical details (e.g., descriptions of health conditions from specialists' (healers') and generalists' (laypersons') perspectives) and use ethnobotanical methodologies (e.g., cite the sources of plant use information, include voucher specimens, report scientific names).

To thoroughly investigate traditional Dominican medicine, an interdisciplinary approach is essential. Due to the range of methods used to collect and present information, it is difficult to judge the quality and accuracy of these references which can lead to faulty assumptions and conclusions. Therefore, systematic studies that use similar standards and criteria to record and present information are needed to advance our understanding of traditional medical systems. In order to study a medical system, all aspects of the system need to be incorporated. For example, studies need to query about a range of health conditions, interview healers and laypeople, and include a discussion of innocuous and toxic medicinal plants. Such an approach is necessary for understanding the intricacies and multiple facets of any medical system.

Table 2.1. Women's conditions and symptoms reported in Dominican ethnobotanical literature.

Health Condition, Symptom, Use	Spanish Translation	Literature
MENSTRUATION	*Menstruación*	
Abundant menses	*Menstruación abundante*	(Estévez and Báez 1998; Rodríguez Martínez 1999)
Amenorrhea	*Amenorrea*	(Robineau 1995)
Anti-inflammation for menses	*Antiinflamatorios en la menstruación de poco flujo*	(Rodríguez Martínez 1990, 1999)
Calm menses	*Calmante en la menstruación*	(Pimentel Arias 1989)
Cramps	*Calambres menstruales, dolores de la menstruación*	(Estévez and Báez 1998; Rodríguez Martínez 1999)
Dysmenorrhea	*Dismenorrea*	(Estévez and Báez 1998; Mañon Rossi 1983; Rodríguez Martínez 1999)
Emmenagogue	*Emenagogo*	(Bonnelly de Calventi *et al.* 1985; Cordero 1978; Lebrón Saviñon 1987)
Menorrhagia	*Menorragias*	(Mañon Rossi 1983)
Menstrual deficiencies	*Deficiencias menstruales*	(Rodríguez Martínez 1990, 1991)
Menstrual disorders	*Trastornos menstruales*	(Estévez and Báez 1998)
Menstrual irregularities	*Menstruación irregular*	(Estévez and Báez 1998)
Painful periods	*Períodos dolorosos*	(Estévez and Báez 1998; Rodríguez Martínez 1999)
Regulates menses	*Regula la menstruación*	(Bonnelly de Calventi *et al.* 1985; Polanco 1991)
Spasmodic action in painful menses	*Acción espasmolítica en períodos menstruales dolorosos*	(Rodríguez Martínez 1990, 1999)
Stimulates menses	*Bajar las reglas*	(Deive 1979; Lebrón Saviñon 1987; Robineau 1995)
Stops menses	*Para la menstruación*	(Honychurch 1986)
Uterine hemorrhaging	*Hemorragias uterinas*	(Rodríguez Martínez 1999)

Table 2.1. Continued

Health Condition, Symptom, Use	Spanish Translation	Literature
PREGNANCY	*Embarazo*	
Abortifacient	*Abortivo*	(Bonnelly de Calventi *et al.* 1985; Robineau 1995)
Aids childbirth	*Facilita el parto*	(Deive 1979)
Alleviates postpartum spasms	*Aliviar los entuertos*	(Rodríguez and Colectivo Mujer y Salud 1994)
Aids in placenta removal	*Precipitar la salida de la placenta, bajar la placenta*	(Rodríguez and Colectivo Mujer y Salud 1994)
Cramps, pain of child delivery	*Dolores del parto*	(Rodríguez and Colectivo Mujer y Salud 1994)
Detain mother's milk, stop lactation	*Detener el flujo de leche, antigalactógena*	(Honychurch 1986)
Galactogen, increase mother's milk production	*Aumentar la producción de leche en madres que lactan*	(Estévez and Báez 1998)
Infertility	*Infertilidad, impotencia sexual, frigidez*	(Estévez and Báez 1998)
Morning sickness	*Malestares*	(Estévez and Báez 1998)
Uterine hemorrhages after birthing	*Suspendiéndose las hemorragias de origin uterino*	(Lebrón Saviñon 1987)
MENOPAUSE	*Menopausia*	
Hot flashes	*Calores de la menopausia*	(Estévez and Báez 1998)
Hysteria	*Histerismo*	(Mañon Rossi 1983)
Nerves	*Nervios*	(Liriano María 1988)
Vaginal spotting due to menopause	*Derrame de sangre vaginal debido a la menopausia*	(Avila Suero 1988)
INFECTION	*Infección*	
Genital-urinary region	*Región genitor-urinaria*	(Robineau 1995)

Table 2.1. Continued

Health Condition, Symptom, Use	Spanish Translation	Literature
Leucorrhea, vaginal secretions	*Leucorrea*	(Cordero 1978; Mañon Rossi 1983)
Uterine discharge	*Flujos uterinos*	(Estévez and Báez 1998)
Uterine problems	*Afecciones uterinas*	(Cordero 1978)
Vaginal discharge	*Flujos vaginales*	(Polanco 1991)
Vaginal infection	*Infecciones vaginales*	(Avila Suero 1988; Deive 1979; Mañon Rossi 1983)
Vaginal membrane inflammation	*Inflamaciones de mucosa vaginal*	(Rodríguez Martínez 1990, 1999)
White discharge	*Flujo blanco*	(Bonnelly de Calventi *et al.* 1985)
Yellow discharge	*Flujo amarillo*	(Polanco 1991)
OTHER CONDITIONS/USES		
Dirty uterus	*Matriz sucia*	(Avila Suero 1988)
Hemostatic, astringent	*Hemostático, astringente*	(Bonnelly de Calventi *et al.* 1985)
Hormonal balancer	*Desequilibrio hormonal*	(Rodríguez Martínez 1999)
Hot blood	*Caliente en la sangre*	(Liriano María 1988)
Inflamed ovaries	*Ovarios inflamados*	(Avila Suero 1988)
Pain in ovaries	*Dolor en los ovarios, dolores de los ovarios*	(Avila Suero 1988)
Raise uterus	*Subimiento de la matriz*	(Estévez and Báez 1998)
Stimulate hormones	*Estimula las secreciones hormonales*	(Rodríguez Martínez 1991)
Stimulate ovaries	*Activando los ovarios*	(Rodríguez Martínez 1999)
Strengthen fallen uterus	*Fortalecer el útero caido, fortalecer el útero fuero de sitio*	(Rodríguez Martínez 1992)
Threatened abortion	*Riesgos de aborto, las amenazas de aborto*	(Estévez and Báez 1998; Rodríguez Martínez 1999)

Table 2.1. Continued

Health Condition, Symptom, Use	Spanish Translation	Literature
Tumor	*Tumores benignos*	(Lebrón Saviñon 1987; Mañon Rossi 1983; Rodríguez Martínez 1999)
Ulceration of cervix	*Ulceración de la cerviz del útero*	(Rodríguez Martínez 1999)
Uro-genital cancer	*Cancer del sistema urogenital*	(Rodríguez Martínez 1999)
Uterine colic	*Cólico uterino*	(Bonnelly de Calventi *et al.* 1985)
Venereal disease	*Enfermedades de la calle, enfermedades venéreas*	(Mañon Rossi 1983)

Table 2.2. Plants most frequently reported in Dominican ethnobotanical literature for women's health conditions.

Scientific Name [Family] (Cm. Name)	Traditional Use	Plant Part and Preparation	Literature
Bixa orellana L. [Bixaceae] (*bija*)	Vaginal wash, douche	Leaves, cooked	(Bonnelly de Calventi *et al.* 1985; Deive 1979; Lebrón Saviñon 1987; Pimentel Arias 1989;)
	Vaginal secretions, leucorrhea	Part not specified, infusion, external wash	(Mañon Rossi 1983)
	Emmenagogue	Leaves, decoction, taken orally	(Bonnelly de Calventi *et al.* 1985; Robineau 1991, 1995; Weniger and Robineau 1988b)
Momordica charantia L. [Cucurbitaceae] (*cundeamor*, *sorosí*)	Emmenagogue	Fruit, leaves	(Deive 1979; Hernández Colón 1976-77; Lebrón Saviñon 1987)
	Emmenagogue, treat uterine problems	Roots, leaves, boiled, sweetened, taken orally	(Cordero 1978)
	Stimulate menses	Leaves, decoction, taken orally	(Robineau 1986)
	Amenorrhea	Leaves, decoction, taken orally	(Robineau 1991, 1995; Weniger and Robineau 1988a, b)
	Regulate menses	Leaves, tea, taken orally	(Rodríguez Martínez 1999)
Persea americana Mill. [Lauraceae] (*aguacate*)	Stimulate menses	Leaves or fruit in decoction, taken orally; flowers, leaves, tea, taken orally	(Deive 1979; Estévez and Báez 1998; Robineau 1986;)
	Abortifacient, emmenagogue, regulate menses	Leaves, flowers, new shoots, tea, taken orally; flowers, leaves, infusion, taken orally	(Lebrón Saviñon 1987; Rodríguez Martínez 1987, 1991b)
	Painful menses	Leaves, tea, taken orally	(Estévez and Báez 1998)
	Emmenagogue	Leaves, preparation and administration not specified	(Bonnelly de Calventi *et al.* 1985; Cordero 1978)
	Abortifacient, amenorrhea	Leaves, decoction with salt, taken orally; fruit, decoction, taken orally	(Robineau 1991, 1995; Weniger and Robineau 1988a, b)
	Regulate menses	New growth, preparation and administration not specified	(Bonnelly de Calventi *et al.* 1985)

Chapter 3. Methods: Field Work with Dominican Women and Healers

Initial field work: pounding the pavement with Dominican healers in New York City

From January 1998 to August 2000 I worked with Dominican healers in New York City as part of the Urban Ethnobotany project. As discussed previously, this study focused on Latino healers in New York City and their recommendations of traditional treatments for women's health conditions. The women's conditions investigated were endometriosis (growth of endometrial tissue outside of the uterus), hot flashes (sudden brief sensations of heat often experienced during menopause), menorrhagia (excessive uterine bleeding), and uterine fibroids (benign connective tissue tumors).

Accompanied by Dominican healers, I collected fresh and dried plant samples at local *botánicas* in New York City to verify their scientific names. *Botánicas* are shops that sell traditional remedies and function as herbal pharmacies providing fresh and dried herbs, mixtures and tinctures, as well as religious and ritual items such as candles, oils, figurines of saints, and holy water (*agua bendita*) (Borello and Mathias 1977; Delgado and Santiago 1998; Fisch 1968). In addition to traditional healers, I also interviewed shopkeepers and assistants, who handled the medicinal plants at *botánicas,* about Dominican plants used for women's illnesses. Based on these interviews and plant collecting trips in New York City, I became familiar with common medicinal plants used and sold by Dominicans.

An additional component of the Urban Ethnobotany project was the comparative literature review discussed in detail in Chapter 2. This literature review and contacts with healers (mentioned before) provided a baseline of data about Dominican plants used for some women's health conditions and provided me with a working knowledge of Dominican plants, their uses, and their common names. However, the women's health categories in the literature review were not described in detail suggesting the need for further investigation in this area.

Field work in the Dominican Republic

The field work for this project was conducted in the provinces of La Vega and San Cristóbal. La Vega is a province located in the central region of the country, the Cibao, and San Cristóbal is located southwest of the capital, Santo Domingo. Within each province a rural and an urban study site were selected for a total of four study sites. The sites were selected based on the presence of a women's organization and suggestions from Dominican collaborators. The rural and urban sites were at comparable distances from each other in both provinces. Adult women (over 18 years of age) were included in the study. I also included men who were considered healers. I conducted the study from September 2000 to August 2001. I divided my time between the four study sites and Santo Domingo, where the Jardín Botánico Nacional is located.

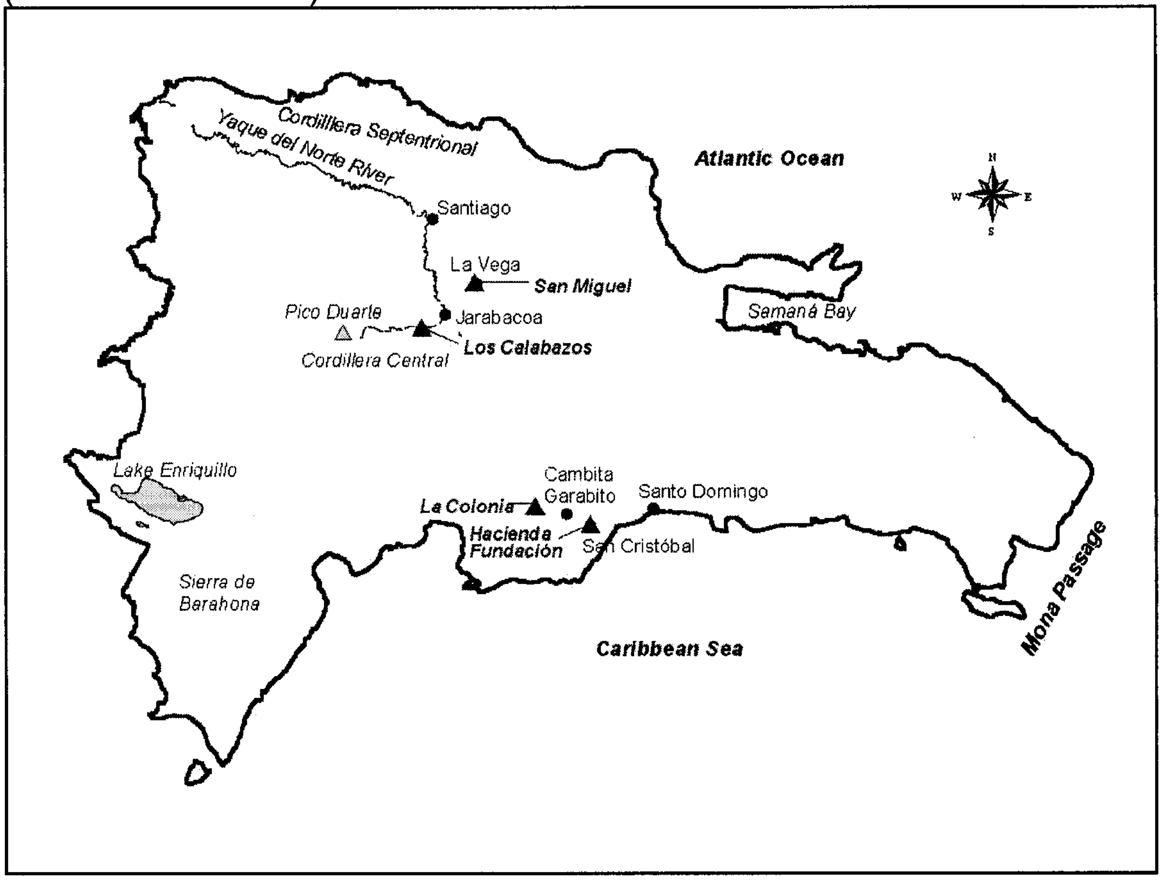
Study sites in the Dominican Republic

Two sites were located in the province of La Vega: Los Calabazos, a rural community, and the city of La Vega. Within the city of La Vega, I worked in a section named Proyecto Habitacional de San Miguel. The other two sites were in the province of San Cristóbal: La Colonia, a rural community and the city of San Cristóbal. In the city of San Cristóbal, I worked in a section named Proyecto Hacienda Fundación (Table 3.1, Figure 3.1). Throughout this study, I refer to the urban sites as San Cristóbal and La Vega.

Table 3.1. Project study sites.

Province	Name of Study Site	Urban/Rural
La Vega	Los Calabazos	Rural
	La Vega city: Proyecto Habitacional de San Miguel	Urban
San Cristóbal	La Colonia	Rural
	San Cristóbal city: Proyecto Hacienda Fundación	Urban

Figure 3.1. Map of the Dominican Republic showing the four study sites: Los Calabazos, La Vega city (San Miguel), La Colonia, and San Cristóbal city (Hacienda Fundación).



Los Calabazos

Los Calabazos is located 35 km from the city of La Vega at an elevation of 750 m (Figure 3.2). The other large populated town close by is Jarabacoa, located 13 km from Los Calabazos. The road from Jarabacoa to Los Calabazos is carved into the hillside and one of the major Dominican rivers, Yaque del Norte, lies roughly 100 m below the road. People from Los Calabazos frequently travel to Jarabacoa either by hitchhiking or by public transportation, which is typically in the form of a pick-up truck. The trip takes approximately forty minutes. People from Los Calabazos rarely travel to the city of La Vega. It is a longer and more costly trip, including the pick-up truck fare plus a bus fare. The bus service between Jarabacoa and the city of La Vega is frequent and usually takes approximately one hour.

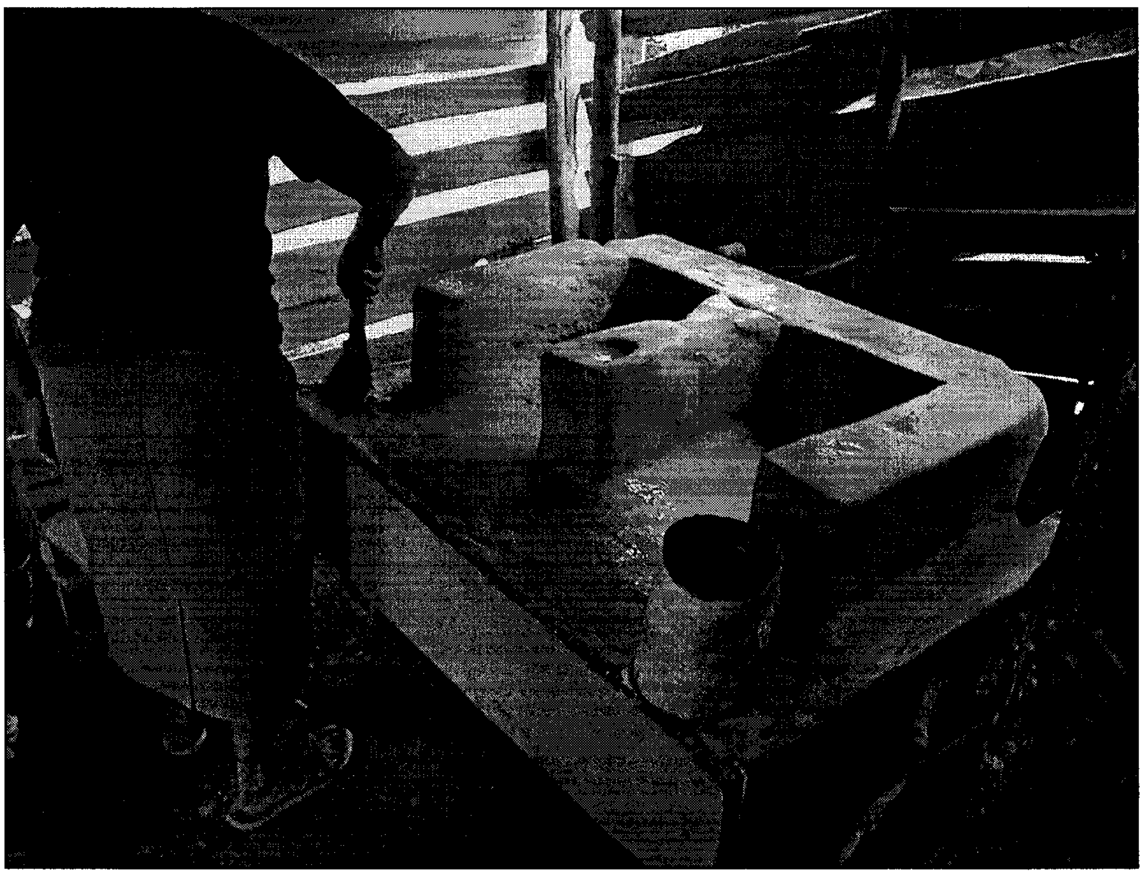
In Los Calabazos, the homes are built on a steep hill leading down to the river; a few homes are located on a flat section of land near the river. The other side of the river is called La Majaguita and is connected to Los Calabazos by two bridges passable only by foot. By political boundaries it is considered to be part of another district. Road access does not exist to this community from the other side of the river, but those few families living in La Majaguita attend all the meetings in Los Calabazos and children attend the schools in Los Calabazos. Therefore, in this study, families in La Majaguita were considered part of the Los Calabazos study site.

Figure 3.2. The rural community of Los Calabazos.

Many of the inhabitants of Los Calabazos are agriculturalists; some are involved in animal husbandry. Much of the land has been cleared for agriculture and wood extraction except in forested canyons along the river. Coffee (*Coffea arabica*) various varieties of beans (*Phaseolus* spp., Fabaceae), and *tayota* (chayote, *Sechium edule* (Jacq.) Sw., Cucurbitaceae) are grown and sold in the local markets. Over the past few years the coffee crops have suffered due to weather conditions and insect infestations. Many *campesinos* in the area were turning to other crops, such as *Sechium edule*, as sources of income.

The homes are either made from wood planks or cement block with tin roofs. Cooking is done with wood on a *fogón* (a wood-burning stove) (Figure 3.3.) or gas stove. The *fogón* is made with mud from the river and cement blocks and painted with a gray mixture of water and clay found upstream. There is no electricity in the community, although one family uses a car battery to power a television and another family has a gas generator that provides them with electricity for lights. A stream at close proximity to the community provides Los Calabazos with running water, which is piped into almost all the homes by gravity. Most of the homes have a latrine. The closest phone is located in Jarabacoa.

Figure 3.3. A *fogón*, a wood-burning stove, painted with a mixture of clay and water.



La Vega

The city of La Vega is located in the subregion of the Cibao Central. It is the largest city and is the capital of the province of La Vega. To facilitate the study one neighborhood was selected as a study site. This community was Proyecto Habitacional de San Miguel, a multi-family housing development. I consulted with Sr. Suvier the Director of the Instituto de la Educación Para el Campesino (IDELPA), an organization involved with community outreach in La Vega. He suggested I speak with Marcelino Capellan, one of the community leaders of the Junta de Vecinos (Neighborhood Association) in Proyecto Habitacional de San Miguel, who was influential in helping me establish myself in the community.

Proyecto Habitacional de San Miguel is located next to the neighborhood of Villa Francisca Segunda and 2 km from the municipal market. The housing development was built around 1996 and is composed of apartment buildings made of cement block. A lottery was used to select families for San Miguel and included individuals from various professions, such as doctors, agronomists, and factory laborers. The development houses approximately 195 families. Some buildings have three floors with two apartments on each floor, others are two stories high with two apartments per floor; and one is a duplex. Many of the first floor apartments have a small front and back yard. They all have running water, electricity, and indoor plumbing. Blackouts are common, sometimes lasting more than eight hours per day, as I experienced in the rest of the country. Often the blackouts result in water pressure loss for those individuals living in apartments on the upper floors, so that they have to fetch water from the lower apartments.

San Cristóbal

In the city of San Cristóbal I worked in a section of the city called Proyecto Hacienda Fundación. Padre Julio Césero of the Instituto Politécnico Loyola in San Cristóbal helped me find this community. He put me in contact with Professor Ana Roig who lives in the community. She facilitated my acceptance into the community and let me use her home as a base of operation.

Proyecto Hacienda Fundación is similar to Proyecto Habitacional de San Miguel in that it is a housing development with cement block apartment buildings, Figure 3.4. There are seven buildings with six apartments each and eight buildings with 12 apartments each. Families on the first floors often had gardens in the front or back of their homes. Proyecto Hacienda Fundación was built around 1990 and houses approximately 140 families. A lottery was also used as in Proyecto Habitacional de San Miguel to select families and included individuals from a range of professions such as doctors, agronomists, and factory laborers. The development is located 2 km from the municipal market. Each home has electricity, running water, and indoor plumbing. As is the case in Proyecto Habitacional de San Miguel, often the electricity does not function causing some of the tenants to experience lack of running water due to the pressure loss.

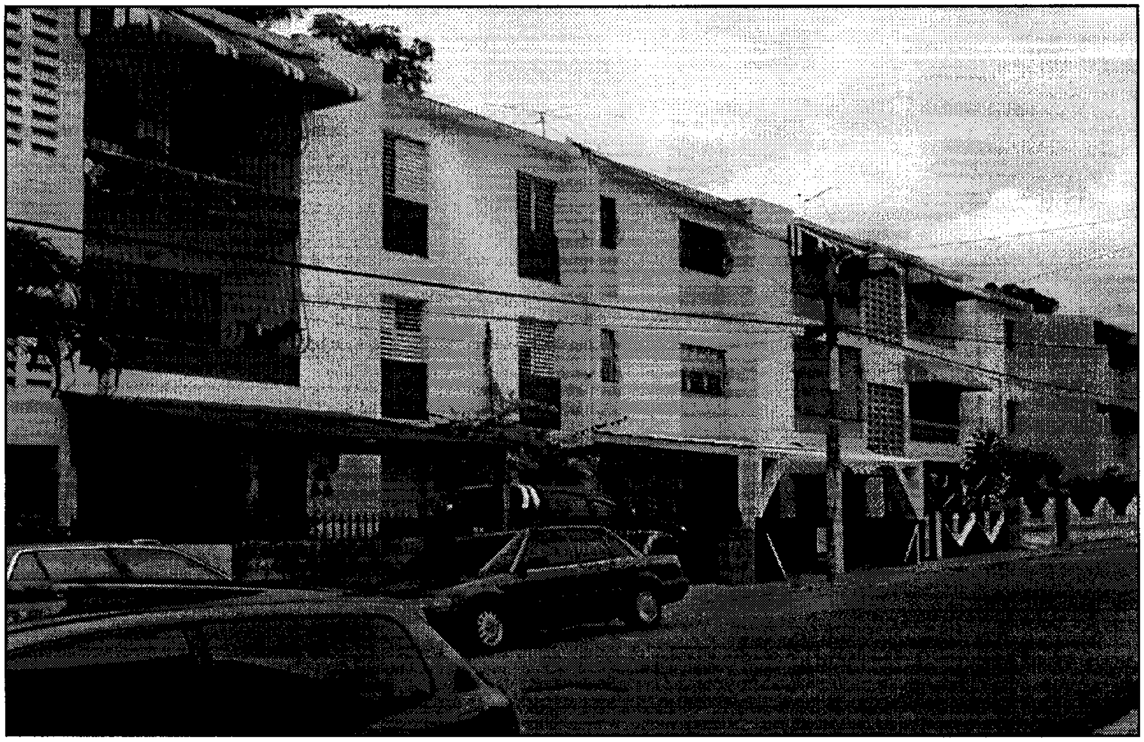


Figure 3.4. The main residential street in Proyecto Hacienda Fundación in San Cristóbal.

La Colonia

La Colonia is located 26 km north from the city of San Cristóbal and 11 km from the largest town, Cambita Garabita. La Colonia is located at 700 m elevation. The road from Cambita Garabita to La Colonia is long, windy, and hilly; the majority of the homes are located along this road. I refer to the study site as La Colonia; however, it is actually composed of three agricultural communities: La Colonia, La Cabirma, and El Cajón. There are roughly 70 homes and a combined population of 320 based on a census done by the mayor in 1998. I combined these communities because of the small size of each community. Also, men and women from these communities share the same women's association and agriculturalists' association.

The homes are either made of wood planks or cement block with tin roofs. The homes of cement block are more desirable because of their status and better protection during hurricanes. This also holds true in Los Calabazos in the province of La Vega. The majority of the homes have electricity except for those located far from the main road, however it usually only functions half of the day. This community does not have running water; all water is bought or collected from a well or from rainwater. Some homes have indoor toilets, some have latrines, and others have neither. The closest phone is located in La Colonia proper.

Study sites and hurricanes

Although over 20 years have passed since Hurricane David, one of the most destructive hurricanes in the century, which struck the island in 1979, it is prominent in the memories of many Dominicans. In all of my study sites people mentioned the impact of Hurricane David on their lives. Particularly, in the rural communities, many of the middle-aged men and women shared stories of the devastation. In Los Calabazos, located near Pico Duarte, the Yaque del Norte River carved out a new path during the hurricane and took with it much of the local vegetation and fish. Before David, fish such as the *dajao* (Taino word for *Agonostomus monticola* (Bancroft, 1836)) were part of the local diet. According to many, today no one fishes because "*los peces se fueron con el huracán David*" (the fishes disappeared with Hurricane David).

In October of 1998 the island's inhabitants were again faced with more destruction, this time from Hurricane Georges. My study sites were near the path that Hurricane Georges took to cross Hispaniola. In the San Cristóbal province, both in La Colonia and the city of San Cristóbal, people described how the hurricane winds ripped out trees and left mountaintops completely bald. The damage of the hurricane was still visible, especially in the cracked and fallen roads located in the high elevation areas of the Cordillera Central. The drive between Los Calabazos and Jarabacoa was still treacherous and numerous landslides along the way were reminders of Hurricane Georges. The government employed local community members to rebuild and reinforce this road. Huge metal box cages about 4 meters long, 3 meters wide, and 1.5 meters tall were filled with rounded granite stone and stepped up below the cliffside of the road to prevent future landslides and erosion. The two swinging foot-bridges that dangled over the Yaque del Norte river connecting Los Calabazos with the neighboring community, Majaguita, were destroyed during Hurricane Georges and left 10 families on that side of the river isolated for several weeks.

Research design and methods of data collection

I used a multi-method approach for data collection to enhance understanding by adding layers of information and by using one method to validate or refine another. I will discuss each one separately, although they were used throughout the study and sometimes at the same time. The methods I used include the following: participant observation, open interviews, a survey, a semi-structured interview, voucher collection, and a literature investigation (Alexiades 1996b; Martin 1995). I collected medicinal plants to document data from interviews and surveys with generalists (laywomen) and specialists (healers). Primary data were gathered in five settings: 1) during administration of the survey with generalists and specialists; 2) during interviews with specialists; 3) during plant collection field trips with both generalists and specialists; 4) while participating in the preparation of herbal remedies with specialists; and 5) during informal conversations. To assist me in conducting the surveys, I trained three students from the Universidad Autónoma de Santo Domingo who also worked at the Jardín Botánico Nacional, Santo Domingo.

Throughout this study, the focus of investigation was on reported uses of plants rather than on observed uses of plants. Observing uses requires extended time in the field and also such observation can be invasive to individuals. Because of the limited study period and the fact that the project involved more than one site, I focused on reported uses. I did ask each respondent to report whether they had used their reported remedy; however, answers did not always seem reliable. Therefore, all reported uses were included in the analysis, not just those that were used by the respondent.

Other studies have evaluated lists of plants (Campos and Ehringhaus 2003; Gomez-Beloz 2001), a hectare of forest (Boom 1987; Prance *et al.* 1987), and tree plots (Phillips and Gentry 1993a, b) which puts limits on the sampling universe based on the plants available in different environments or vegetations. The focus of this study was to understand the role of plants and home remedies in Dominican health care, hence, defining a set of meaningful conditions to be used for elicitation was more appropriate for this study rather than using a list of plants or a defined plot. The methodology used differed from other studies in that a health condition was employed to elicit plant names and remedies as opposed to utilizing a specific list of species or group of species to elicit uses (Campos and Ehringhaus 2003; Phillips and Gentry 1993a, b). Using this free-listing approach (Alexiades 1996a; Bernard 1994: 239-242), encouraged participants to report plants that they truly remembered or perhaps had recently used and is evaluating the depth of plant knowledge of each individual and community rather than their select knowledge of a specific list of plants as in a checklist interview (Martin 1995).

Participant observation

Participant observation is not a specific method for collecting data, but it provides an opportunity for researchers to establish themselves in a community, gain an understanding of the workings of the community, and develop more specific research questions (Bernard 1994). Participant observation helped me to build a foundation for further understanding of medicinal plant use in these communities and to refine my interview and survey questions.

On several occasions while living in the Dominican Republic, I would assist women with household chores or meal preparation. However, I usually felt quite clumsy in the kitchen and found I was better observing the food preparation than actually preparing it. As I became more comfortable with the Dominican healers I would ask to participate in the preparation of their herbal remedies. This would often involve accompanying them as they went to collect medicinal plants either near their homes or around the community, near the river or forest, or at a pharmacy or medicinal plant market.

Open interviews

At the beginning of research, it was through informal conversations or open interviews (Alexiades 1996a) that I became familiar with the study areas and began to establish rapport with community members, including generalists and some specialists. Initial conversations and interviews were also helpful for me to understand nuances in language and idiomatic expressions. Each night I would write down everything that I could remember from conversations, giving particular attention and detail to topics related to health and plant use. As time went on, I became more comfortable carrying around my notebook and began to jot things down during conversations. As my relationships developed in the communities, it became easier to ask questions that were important for this study. I also felt more at ease in conducting the interviews and surveys.

Survey

Surveys provide a standard, systematic format for collecting information (Aday 1989; Bernard 1994). For this study, I created a survey to elicit both qualitative and quantitative information about the diversity of herbal remedies and medicinal plant species known and used for women's health conditions in the four study communities. The initial questions generated socio-demographic data such as age, birthplace, length of residence, civil status, number of children, educational level, religious affiliation, affiliation in community organizations, and occupation. There was also a short household inventory used to estimate socio-economic background. The bulk of the survey was concerned with medicinal plant knowledge. The survey was conducted with generalists and specialists. Each participant was asked to 'free-list' as many medicinal plants that they knew and used. Then I asked each participant to 'free-list' all the plants or remedies they knew for each of the 10 health conditions. I recorded information about the preparation and administration of the remedies, how they worked, whether they had been used, how they were learned, any precautions that should be taken when using the remedy, and if they had other uses.

Several questions on the survey were used as name generators. I had a question that solicited names of individuals who were recognized as knowledgeable about medicinal plants. I also asked each participant interviewed to report healers and/or midwives they knew or had visited. These questions helped me to find specialists. Additional questions concerned health care and plant collection data. Questions for this survey were developed from previous ethnobotanical studies (Balick *et al.* 2000; Brett 1994), health surveys (Aday 1989), and suggestions from my dissertation committee members and my Dominican collaborators. Observations, informal conversations, previous field work with the Dominican community in New York City, and additional ethnomedical studies were used to improve the design of the survey so that it included culturally specific terminology and relevant women's health conditions.

To ensure valid data, all surveys were administered with the interviewee and myself. This was done to reduce interference from others in the household (Bernard 1994; Romney 1999). In some instances this was not possible, and on a few occasions children were present. If a visitor came by, we would stop the survey and then resume after they had left.

In some cases I was accompanied during the survey. For example, when I was training the students from the Universidad Autónoma de Santo Domingo, they would first observe me conduct the survey and then I would observe them. Juan Carlos Saborío Mora, my colleague and husband, accompanied me and assisted in conducting surveys and interviews with four male healers. In this setting, the presence of another male eased the discussion of women's health and as a married woman I felt it was more socially appropriate.

Semi-structured interview

I used a semi-structured interview with the healers to collect data about the 10 women's health conditions such as descriptions, symptoms, causes, and treatments. Data was also collected about why medicinal plants were effective. In addition, specific data was collected on the plants used for the 10 conditions, including their mode of collection, preparation, and administration. Interviews took place in healers' homes. Afterwards we would take a walk, usually in the home gardens, to see and collect the plants discussed. An advantage of doing structured interviews is that the researcher asks the same questions in the same order to each participant. To ensure culturally appropriate interview questions I depended on my field experience with Dominican healers in New York City and my notes from the informal interviews in the communities in the Dominican Republic.

All the interviews were recorded on audiotape except in one instance with a healer who did not want to be taped. Informed consent was obtained prior to beginning the interview.

Sample selection of generalists and specialists

For the survey I selected adult women age 18 and older. I used cluster sampling to select generalists (laywomen) for the surveys (Bernard 1994). In the rural communities, all women who participated in the local women's association were included in the survey. In Los Calabazos all women in the community were members of the women's association and in La Colonia a selection of women in the community were members of the association. In the urban communities, I chose a cluster of multi-family housing developments to ease the cost-effectiveness of sampling in a large urban area. Women were randomly chosen from the housing developments that were composed of apartment buildings between one and four stories tall. One woman from each floor (or story) of each apartment building was interviewed to ensure that 50% of the woman in each apartment building were interviewed.

The sample of specialists (healers) was not selected randomly; women, who participated in the survey, reported names of healers, both adult men and women, who I later approached about participating in the study. The rationale for this method was that local community members were better able to judge a person's healing ability and/or plant knowledge than I was. All individuals were approached and asked to participate and any decision not to participate was respected. Prior to conducting the survey or interview, informed consent was obtained from all participants.

Mobile herbarium

The mobile herbarium concept was originally suggested to me by Dr. Montserrat Rios in which she used herbarium specimens. Based on discussions with Dr. Douglas Daly, I modified the mobile herbarium concept to include digital photos. The mobile herbarium was used during the surveys and interviews to verify plant identification. It was made of 44 digital photographs (7 cm x 5 cm) of medicinal plants from the four study sites. During the early phases of the study, I collected these photographs using a digital camera. A preliminary test was done with three Dominicans who were not participating in the study to verify the quality of the photos.

In addition to the photographs of plants, some pressed and dried plants were used to ensure consistency of information from interviewees and to elicit further information about the plants. The disadvantage of this technique is that the plants are pressed and dried; and therefore, they lack the smell, taste, and ecological context, which may be necessary for identification or provoking association (Diamond 1989; Martin 1995). For the present study, digital photos and pressed and dried plants were an easy way to show participants many plants at one time and proved to be reasonable techniques for verifying plant names.

Voucher collection and identification

Medicinal plant specimens were collected on plant gathering excursions with local healers and others shortly after the interview or survey. During these trips, we discussed the common names of plants, their various uses, the modes of collection, preparation, and administration. Unanswered questions from the interviews were often clarified during the plant collecting trips. In some cases, a well-known or common plant that had already been collected with another study participant in that community was not collected again.

Voucher specimens were prepared using standard botanical techniques (e.g., Alexiades 1996c; Balick 1999) and deposited at the herbarium of the Jardín Botánico Nacional, Santo Domingo (JBSD) and of The New York Botanical Garden (NY) to provide a permanent record of plants from the study. Accurate plant identification was possible because the flora of the Dominican Republic is well documented, and both JBSD and NY have extensive herbarium collections from the region and taxonomic specialists who could assist in the identification. Lic. Brígido Peguero, JBSD, generously assisted me with the botanical identification.

Individual plants that were found in a person's home garden were photographed to make digital image vouchers so as not to harm the plant. These images were identified with the help of specialists at JBSD and NY and were given a separate series of collection numbers starting with PV, meaing photograph voucher.

Plant fragments, such as roots, crushed leaves, or seeds, that were not of herbarium quality, along with other ingredients from pharmacies that were of either botanical, mineral, or unknown origin were placed into a reference collection with a separate number series starting with R, meaning reference. Most of these were identified with specialists of JBSD or by contacting the manufacturer. This collection was deposited at JBSD and photographed. A small number of well-known, cultivated plants were shown to me; however, it was not possible to collect these plants or to take photographs of them. These plants I noted as sight references (SR).

Other methods

During my field work, I also attended local community meetings to understand what issues were important to the residents, how they governed themselves, and how they interacted with non-governmental agencies that assisted them with community-based projects. In addition, I had meetings with representatives from non-governmental agencies that provided additional perspectives on health care, conservation, and development priorities.

Other individuals that provided me with further information were Dr. Dionisio Bueno and Lic. Brígido Peguero. Dr. Bueno, a medical doctor from the city of La Vega, combines the use of local medicinal plants and allopathic medicine in his practice and clarified some of my questions related to women's health conditions and Dominican traditional medicine. In helping me to identify plant specimens, Lic. Brígido Peguero shared additional information about uses of the plants from other parts of the country, other common names, and related stories he had heard from his own field work. All these perspectives provided me with valuable information that further enhanced my investigation of the role of medicinal plants in Dominican women's health care.

Data analysis

The following statistical software programs were used for data analysis: JMP® software (SAS Institute Inc.), Resampling Stats© software, and SPSS© Student Version software. Interview and survey data were entered into and stored in an ACCESS® database and then exported into JMP® and SPSS© via Excel®. Taped interviews were reviewed to verify field notes.

Ethical issues in field work

An area of concern in the field of ethnobotany revolves around ethical issues, such as sensitivity to and respect for others' knowledge. Often there is incompatibility between worldviews: indigenous communities tend to view knowledge as public, and in some cases, as sacred, while western societies often view knowledge as a commodity, see detailed discussions by Cunningham (1996) and Posey (2002). These differing viewpoints have raised several ethical questions in conducting ethnobotanical field work.

In the past decade, there has been a blurring of distinctions between industry and academia in part because private industries and commercial businesses often fund academic projects (Alexiades 1999: 53-55). Once results are published they become public and researchers have little control over how this knowledge is used. The disclosure of novel plants or novel uses of plants may hinder a local community from negotiating some form of monetary compensation in the future with a pharmaceutical company (Alexiades 1999). In many cases, governmental policies are not in place to protect this kind of knowledge; therefore, researchers must make personal decisions to safeguard any novel information they collect. To address these concerns, plants specific to a community or healer that they did not want shared were not reported in this study.

Permission to conduct field work was solicited from each study community. I addressed cultural sensitivity and ethical concerns by openly discussing the research design with community members and incorporating the needs and concerns of the community into the research design as discussed by Alexiades (1996a). As done in other studies (e.g., Alexiades 1999; Gomez-Beloz 2001), compensation was discussed at a community meeting and each group decided how they wanted to be compensated for time spent on the project.

Study participants in La Colonia decided they wanted to have a series of English classes for those 12 years and older. They also decided on a workshop to learn how to prepare soaps and salves that could be made with local plants and potentially sold in the community. In Los Calabazos, participants wanted assistance with non-governmental agencies, in the form of letters and faxes. They also had a community trail with useful plants that they wanted labeled with scientific name, common name, and general uses. The two urban communities decided on a written booklet that would present the information gathered from the interviews and surveys. In addition, transportation and food were also shared with individual communities. The healers were given monetary compensation due to the extended time commitment of their interviews.

Compensation was also discussed in terms of exchange of information. Community members taught me about medicinal plants and in exchange I promised to provide the information that they shared with me in the form of a booklet/manual and a scientific publication written in Spanish as well as copies of this study (Article 17, "Exchange of Information," Convention on Biological Diversity, http://www.biodiv.org/convention/articles.asp).

Since 1999, The City University of New York Graduate Center (CUNYGC) has required that all students working with human subjects obtain permission of The CUNYGC Institutional Review Board (IRB) prior to conducting research. Therefore, all my study protocols were evaluated and approved by The CUNYGC-IRB (Appendices E and F). Such institutional mechanisms assist in protecting study participants and encourage ethically sound studies. For both the survey and interview, a standard protocol was used that included a consent form that was approved by The CUNYGC-IRB on Human Subjects (Appendix G). Rather than using a written consent I used an oral consent to ensure that the participants understood their involvement. I wrote the oral consent form in English and translated it into Spanish. Once approved by The CUNYGC-IRB, this form was explained to each potential study respondent. If the respondent consented to participate in the study, I gave them a copy of the written oral consent form and proceeded with the survey or interview.

Challenges of conducting field work

I would like to share one story to illustrate the pitfalls of working in the field of ethnobotany. A healer's name was repeatedly mentioned in Los Calabazos during the interviews. Her name was Doña Rosa (a pseudonym used for confidentiality) and she lived approximately 15 km from the community. An entire day was needed to visit this healer, involving two vehicle rides and a 3 km walk to arrive at her home. It is difficult in a rural community for a woman to leave her home for an entire day because she is responsible for preparing meals, taking care of her children and often livestock, and tending a home garden or *conuco*. To make a trip to Doña Rosa's home a woman must find another woman, often the eldest daughter, a sister, or relative to take care of her family and chores for the day.

I decided to visit Doña Rosa and talk to her about participating in my project. Her work hours began at noon so I arrived early and waited in line with five other prospective patients. Before identifying myself as a student researcher, I decided to have a *consulta* (consultation) with her. My first observations were that she seemed affluent for Dominican standards because she had a cordless phone and her home was large, made of cement block, and had electricity. She wore gold earrings, necklaces, and bracelets. My consultation involved several prayers and her viewing a candle that enabled her to see my illnesses.

I thought the fee would be nominal based on my experience in New York City with Latino healers (approx. US$10-25 for consultation) and was shocked when it was equivalent to US$115. I then identified myself as a student, although this did not lower the price. The fee included an herbal remedy known as a *botella* (discussed in Chapter 4), two over-the-counter pharmacy drugs, and bathing in her sacred water well. I paid what I could and proceeded to the sacred well.

Following my visit, I causally asked more about her in the community. I discovered that she generally charges high fees. One man had seen her 12 years ago for kidney problems and been charged an amount equal to three months of his income at that time. One young woman was particularly frank about her and said, "*alguien que sabe tanto debería saber quien tiene dinero y quien no*" (somebody that knows so much, should know who has money and who doesn't). This healer was not included in the study.

During my fieldwork, I faced several other challenges. The Spanish spoken in the Cibao region initially sounded foreign to me. In addition, to adjusting to the different dialects of the country, I also learned many new Spanish words used in the Dominican Republic. For example, a banana was called *guineo* and papaya was referred to as *lechosa*.

As a woman, I had other difficulties. For example, one of the healers said that women know how to prepare medicinal remedies such as *botellas* but that they do not know where to find some of the plants, which are in the forest. He said finding these plants, especially the roots, "*no es trabajo de mujer*" (is not women's work). I had to convince the men that I could handle hiking in the forest and Juan Carlos further assisted me in convincing them. After my first trek into the forest, it was acknowledged that I was capable of hiking long distances along steep, treacherous hillsides. However, one benefit of being a woman was that I was not asked to assist in slaughtering a pig.

Being a woman in my late twenties and being from another country may have also affected the kind of information women chose to share with me. For example, older women may have chosen not to discuss certain herbal remedies with me because of my age. One experience I had with the midwife of La Colonia contradicts this speculation. She said that she was talking with me openly as if she were talking with one of her daughters. As a researcher from the United States, my presence may have also influenced people's choice of words in discussing herbal medicine because of pressure to perhaps appear "modern" when talking to an outsider.

Chapter 4. Women's Medicine in the Dominican Republic I: Interview Results, Conditions, and Treatments

Introduction

The purpose of this chapter is to contribute to the body of information on women's health in the Caribbean and Latin America and to show the valuable role of women in the preservation of traditional knowledge and primary health care in these communities. Other researchers have discussed the need for more studies that elucidate women's knowledge of natural resources as well as the relationships between women and their surroundings (Howard 2003a; Kainer and Duryea 1992). This chapter focuses on traditional women's medicine used in four communities in the Dominican Republic and demonstrates the vital role of women as stewards of plant knowledge for health care.

First, I present general socio-demographic characteristics of the study sample including biographical information on each of the healers who participated in this study. Then, I discuss common themes in Dominican traditional medicine. I conclude this chapter with a discussion of Dominican women's health conditions and their traditional treatments.

Demographic characteristics of the study participants

During 11 months in the field, 237 individuals were interviewed from four study sites, 226 were laywomen or generalists and 11 were healers or specialists, both men and women. I was able to work with the largest sample sizes in the urban sites, 72 individuals in San Cristóbal and 89 in La Vega. In the rural communities, I worked with a sample size of 39 in Los Calabazos and 37 in La Colonia. Sixty-eight percent of the participants were from urban sites (n = 161) and 32% (n = 76) were from rural communities.

The following sections present socio-demographic characteristics including age composition, educational level, civil status, length of residence, and socio-economic status. The sample was divided into two data sets, generalists (n = 226) and specialists (n = 11). Generalists were laypeople and do not consider themselves to be healers or healing experts. Specialists were healers or individuals with exceptional medicinal plant knowledge and healing abilities. I first describe generalists who were all women.

Demographic characteristics of generalists

Age

As seen in Table 4.1, the mean age for generalists interviewed was 40.5. The mean age for each group of women was not considerably different from the mean age of all women. La Colonia had the highest mean age (45.1) of interviewees and La Vega had the lowest mean age (37.7) of interviewees. The bulk of interviews came from women ages 25 - 55. The distribution in each study site varied slightly. Los Calabazos had the largest range in ages. The oldest woman interviewed was 76, from Los Calabazos.

Table 4.1. Age distribution of generalists in study sites.

	Total sites	La Colonia	Los Calabazos	La Vega	San Cristóbal
		Rural	Rural	Urban	Urban
n =	226	34	33	87	72
Mean	40.5	45.1	40.3	37.8	41.7
Mode	50	46	25	35	21
SD	13.5	13.2	17.4	11.2	13.8
Range	58	51	58	53	52
Min.-Max.	18-76	19-70	18-76	18-71	18-70

Educational status

The highest level of education attained by the majority of women (42%) in the study was elementary school (*primaria*) (Table 4.2). The percentage of women who attended high school (*colegio, bachiller*) and university (*universidad*) was comparable, 25.7 and 24.8, respectively. A small number of women (7.5%) in the communities had not attended school. The level of education differed for individual study sites. The bulk of women in both rural sites attended elementary school and few went to high school or university. Los Calabazos shows the highest percentage with no schooling (27.3%). In the two urban communities, women were more evenly distributed as being elementary school-, high school-, and university-educated.

External constraints, such as access to resources and economic status, greatly influence educational opportunities in the Dominican Republic. For example, several elder women in the rural communities did not have a school nearby and therefore their parents did not let them attend a school far away—it was not considered safe for a young girl to travel far from home. One woman's father did not believe education was important for young girls; they needed to stay at home to help their mothers and learn to cook for men. The young to middle-aged women in rural areas had other challenges in pursuing their education. Many attended elementary school but to continue with high school located in town might involve daily transportation costs or moving in with a relative if that were an option.

Table 4.2. Educational level of generalists in study sites.

	Percentage of Generalists				
Education Level	Totals	La Colonia	Los Calabazos	La Vega	San Cristóbal
		Rural	Rural	Urban	Urban
n =	226	34	33	87	72
No schooling	7.5	8.8	27.3	4.6	1.4
Elementary School	42.0	79.4	60.6	29.9	30.6
High School	25.7	11.8	9.1	31.0	33.3
University	24.8	0	3.0	34.5	34.7

Civil status

The majority of women interviewed were married (50.9%) as shown in Table 4.3, except in Los Calabazos. In this community, 57.6% of the women were in common-law unions, which is notably different from the other communities. During surveys, women explained to me that common-law unions are widespread in rural sectors in the Dominican Republic due to economic costs of weddings and marriage licenses. None of the women interviewed in the rural communities were separated or divorced. In La Colonia, none of the women interviewed were single and two women (6.1%) in Los Calabazos were single. A higher percentage of women were single in the urban communities (10.3%, Los Vega; 13.9%, San Cristóbal). The majority of single women were under 26 years of age.

Table 4.3. Civil status of generalists in study sites.

	Percentage of Generalists				
Civil Status	Total	La Colonia	Los Calabazos	La Vega	San Cristóbal
		Rural	Rural	Urban	Urban
n =	226	34	33	87	72
Single	9.3	0	6.1	10.3	13.9
Married	50.9	61.8	30.3	57.5	47.2
Union*	21.2	29.4	57.6	17.2	5.6
Divorced	7.5	0	0	9.2	12.5
Separated	6.2	0	0	3.4	15.3
Widow	4.9	8.8	6.1	2.3	5.6

*Common-law union

Length of residence

The sample was evenly distributed between women who have primarily resided in urban communities and those who have primarily resided in rural communities (Table 4.4). The women in rural communities have lived the majority of their lives in rural towns and many have lived their entire lives in the same community. In La Vega, 37.9% of women interviewed primarily resided in rural areas before moving to the city, whereas in San Cristóbal a smaller number of women lived in rural communities (15.3%) prior to living in the city. A small percentage of women in San Cristóbal (2.8%) had resided half their lives in urban and rural settings. Women in rural communities tended to live in their same communities for longer periods of time than women in urban communities. In Los Calabazos, the longest residence was 64 years and the shortest residency was two years. The longest residence in La Colonia was 55 years and the shortest was two years. In La Vega the longest residence was five years and the shortest was one month. Thirteen years was the longest residence in San Cristóbal and the shortest was three months. The duration in the urban communities is reflective of the age of the housing developments, which were recently built. The majority of the inhabitants of La Vega and San Cristóbal had lived in urban settings prior to moving to the housing developments.

Table 4.4. Primary residence of generalists in study sites.

	Percentage of Generalists				
Primary Residence	Total	La Colonia	Los Calabazos	La Vega	San Cristóbal
		Rural	Rural	Urban	Urban
n =	226	34	33	87	72
Rural	46.9	88.2	97	37.9	15.3
Urban	52.2	11.8	3	62.1	81.9
Rural and Urban	0.9	0	0	0	2.8

Socio-economic status

Using a general index (Bernard 1994: 289-309), socio-economic status (SES) was calculated for each individual. The survey included a household inventory consisting of the following variables: house ownership, additional property ownership, running water, radio, car, gas stove, indoor toilet, television, motorcycle, scooter, and refrigerator. Each variable was given one point if it was present in the household. Eleven was the maximum number of SES points for the survey. The results for each community are presented in Table 4.5. As would be expected, women in urban communities cluster around points 7 to 9 indicating a higher SES versus women in rural communities, who cluster between 4 and 7.

Table 4.5. Socio-economic status of generalists in study sites.

	Percentage of Generalists				
SES points[a]	Total	La Colonia	Los Calabazos	La Vega	San Cristóbal
		Rural	Rural	Urban	Urban
n =	226	34	33	87	72
mode		5,7	4,5	8	7
11	2				1
10	10			4	
9	22			22	9
8	60	1	1	33	27
7	63	9	1	24	30
6	36	8	4	4	5
5	15	9	11		
4	13	3	11		
3	4	3	4		
2	1		1		
1		1			

[a]SES points refer to the number of items from a household inventory. A point was given for each of the following items: house ownership, additional property ownership, indoor water, radio, car, gas stove, indoor toilet, television, motorcycle, scooter, and refrigerator.

Demographic characteristics of specialists

Healer diversity

Healers are individuals recognized by others as specialists who have an extensive empirical knowledge of herbal remedies and prayers and often have an innate ability to heal spiritually. Community members often seek out their services. As one gains trust and acceptance with local healers, the more intimate one becomes with the depth and breadth of knowledge of these people who are well respected and influential in their communities. I observed that many Dominicans continue to use healers for their health care needs, both physical and spiritual.

Healers are generally referred to as *curanderos* in Spanish, yet there are other Spanish words used for specific kinds of healers. In the Dominican Republic healers are described as "*medicos de las plantas de la tierra*" (plant doctors of the land) or as *curiosos*. *Curiosos* are those individuals who know medicinal plants and prayers, heal, and have clairvoyant abilities. The term *curioso* has also been heard in Peru to refer to a healer (pers. comm., Dr. Olga Orozco, 2003). In the interviews, several women claimed that *curanderos* cure and know more about illnesses than *curiosos*. One specialist was called a *santiguadora* because she blessed babies as a form of protection. Other kinds of healers in San Cristóbal and La Vega were *botelleros*, *brujos*, and *comadronas*. *Botelleros* are able to prepare an herbal preparation known as a *botella*. *Brujo* literally translates as witch and is also used by some Dominicans to refer to a healer. *Comadronas* are midwives. These terms are fluid and their description depends on the individual asked. The descriptions presented here provide a general sense of the distinctions for each healer classification.

Botelleros are experts at preparing a *botella*, a traditional brew made with plants and used for a variety of ailments, such as infertility, kidney problems, and postpartum healing, which will be discussed in more detail later in this chapter. The *botelleros* spend many days, sometimes weeks, collecting the necessary plants and non-herbal products to prepare their special brew. *Botelleros* know many plants and are able to distinguish plants that a layperson may confuse as being the same plant. *Botelleros* seem comparable to pharmacists. They do not necessarily diagnose but they know the remedies and the plants for specific illnesses.

Brujos are experts at curing spiritual ailments and often help people with relationship problems, luck, and bad magic. To some Dominican women in this study, *brujos* were considered "witches" that have no direction of God, have evil thoughts and perform evil acts, while to others they are considered a kind of healer. They often use e*nsalmos,* which are types of prayers or psalms used specifically for healing illnesses (Deive 1979), as well as baths, plants, amulets, and animal blood to treat their patients.

Brujos become entranced and act as channels or mediums for *misterios* (spiritual guides or divine beings) who guide them in healing their patients (Davis 1987). In addition, *misterios* can guide *curiosos* and *curanderos* in healing. Jiménez Lambertus (1980) described this form of healing as part of Dominican

Vodú in which it is common for selected individuals to loose their memory as they *montan el misterio* or allow their body to be possessed by *misterios*. The *misterios* do not have physical bodies so they borrow bodies of humans to eat their favorite meals, drink rum, dance, and to voice communications such as diagnoses of illnesses and their treatments (Ortiz 1994: 241). As a form of exchange for borrowing the bodies, the *misterios* reveal winning lottery numbers and relevant medical information (Ortiz 1994: 241). *Misterios* are also referred to as *luáses* ("loas") (Jiménez Lambertus 1980). Davis (1987) and Deive (1979) provide detailed discussions of Dominican Vodú. The expression *montar caballo* can also be used to describe the possession of an individual by a *misterio*. The individual is referred to as the *caballo* (horse) who is mounted or possessed (*montar*).

Partera and *comadrona* are both essentially midwives; technically a *partera* has a certificate of training at a hospital and a *comadrona* does not, although many Dominicans use these words interchangeably. As midwives they aid in child delivery, prenatal care, and postpartum care. They are also sought when pre-pubescent girls are slow to develop into young women. Medicinal plants, massage, saints, prayers, washes, and *ensalmos* are all techniques used by *parteras* to aid women in childbirth. There are herbal remedies to ease labor, to remove the placenta, to increase and stop lactation, and to quell morning sickness. *Comadronas* prepare a remedy similar to the *botella* but it is used for postpartum cleansing and healing. It is referred to as a *bebedizo,* although some also call it a *botella*. Today there are few practicing *comadronas* in the Dominican Republic and those that are practicing often do not have apprentices.

Seventy three percent (n = 37) of rural mothers over 40 years of age had delivered their babies with a *comadrona* compared with 14% (n = 84) of urban mothers over 40 years of age. Mothers under 40 years of age, both rural (64%, n = 33) and urban (97%, n = 76) primarily delivered their babies in a hospital or clinic. One *partera* explained that the shift from *comadronas* to hospitals and clinics is largely due to better transportation from rural areas to city health centers and to an increase in the number of clinics and hospitals. Another *partera* mentioned that the government has imposed stricter regulations and penalties for midwives; consequently, many are cautious about practicing.

In addition to the healer categories presented, many communities have men and women, often elders of the community, with extensive knowledge of healing remedies and *ensalmos*. Although they usually do not consider themselves to be "healers," community members repeatedly turn to them for help.

Although the range of healing practices and remedies is diverse among different healers and often distinct to different regions of the country, there are commonalities, such as the use of medicinal plants, prayers, faith, and *ensalmos*. Some healers may fall under more than one specialist category, for example, both *curiosa* and *partera*.

Specialists from the provinces of La Vega and San Cristóbal

For this study, the term healer is broadly defined as a person who was considered by other community members to be a healing specialist and had extensive knowledge about medicinal plants. I include *curiosos*, *curanderos*, *brujos*, *comadronas*, and *botelleros* as healers or specialists. Several of these specialists did not refer to themselves by these names. Two of the healers were *promotoras de salud* (health promoters) and were trained by their mothers to be *comadronas*. The Ministry of Health and the health outreach program of the Catholic Church selected them to be health promoters in their communities.

A total of 11 healers participated in this study: four (36%) were men and seven (64%) were women (Table 4.6). Eight were from the province of La Vega and three were from the province of San Cristóbal. Two of the eleven healers lived in an urban community, while the others lived in rural communities. This difference in distribution of healers in the two provinces and in rural and urban sites does not reflect the actual distribution of healers in these provinces or communities; rather, it is an artifact of sampling and research design. In the urban areas, I focused on healers that lived within or close to the study sites as a result some healers mentioned by urban women were not interviewed.

Table 4.6. Demographic characteristics of specialists in the study.

Healer[a]	Gender	Age[b]	Education	Civil Status	Study Site
R2F0035	F	30	Elementary	Married	Rural
R1F0002	F	50	Elementary	Married	Rural
R1F0003	F	53	Elementary	Married	Rural
R1F0009	F	53	Elementary	Widow	Rural
R1M0006	M	65	Elementary	Married	Rural
R1F0035	F	74	No schooling	Married	Rural
R2M0036	M	74	Elementary	Married	Rural
R2F0034	F	77	No schooling	Widow	Rural
R1M0031	M	78	No schooling	Single	Rural
U1F0075	F	88	Elementary	Widow	Urban
U1M0051	M	101	Elementary	Single	Urban

[a]Codes are used to protect the identity of the healers as agreed with the CUNYGC Institutional Review Board.
[b]Ordered by age

The mean age for the healers was 67.5 (± SD 19.92). The youngest healer was a woman age 30 and the eldest was a 101 years old man. Seventy-three percent of them attended some form of elementary school while the others did not attend school. Fifty-five percent of the healers were married; the others were single or widows.

Healer profiles

Here I present a summary of background, training, and healing practices of each specialist:

Healer R2F0035

Healer R2F0035 was 30 years old at the time of the interview. She was the youngest healer in the study and had been healing for 16 years. She referred to herself as a *curiosa*, but mentioned that others call her *curandera* or *bruja*. She did not like being called a *bruja* because she felt it was associated with evil magic. At times she does not like her work because people ask her to do harm to others which she refuses to do as part of her practice.

R2F0035 shared her story of being clairvoyant at a young age. She later experienced an illness that was untreatable in the hospitals and clinics. Finally she was cured when she visited a *curioso*. The healer told her that she had the gift to be a *curiosa* and that by practicing as a healer she would cure her own illness. She was also told by this healer that she *tenía luz* (had light) and could *estar iluminada* (be illuminated) and serve *misterios* (spiritual guides or divine beings). R2F0035 described *una luz que llega* (a light that comes) when she is seeing a patient and she loses her memory for that period of time.

Los misterios taught her the plants. When she is possessed, another person records the remedies that the *misterios* verbalize through her. As a young girl she did not know how to identify plants used for remedies, so she accompanied her father to collect them and learned through him. She believes that her ability to heal others may have also come from *herencia* (inheritance) because her grandmother was a *comadrona*.

R2F0035 sees patients in her home; she makes house calls only for emergencies. She sees approximately five people a day, the majority women, and works four days a week. Most of her patients are local; others come from the city of San Cristóbal and as far as Santo Domingo. She charges a nominal fee for her consultation but is conscious that if someone cannot pay she will still treat that individual. For serious conditions, she advises her patients to see a doctor.

Her main method of diagnosis is spiritual guidance of *los misterios*. By communicating with them, she is able to see the illness of the patient and prescribe a treatment. As part of her diagnosis she sometimes requests that the patient bring a sample of urine (*orines*) from the morning. By looking at the urine sample and focusing her attention, *el misterio* is able to see through her and detect if a patient is pregnant or has an infection, inflammation, or illness. The *misterio* speaks through her and it is the patient who then retells R2F0035 what was said so that the treatment can be carried out. She does not know how she is able to see the illnesses and described it as a *milagros de Dios* (miracle of God.) Davis (1987: 244) previously reported the use of urine by Dominican healers and said that this practice has been incorporated into Dominican healing because of its use and importance as an indicator of illnesses in biomedicine.

Healer R2F0035 uses *bebedizos*, teas, *ensalmos*, massage, and salves as part of her treatment and openly shares her knowledge of plants. She prepared her first *botella* for her mother. She allows her patients or family members to prepare teas on their own using her recipe. However, she prefers to prepare the *botellas* for her patients because they include many different plants and there is a greater risk of making a mistake by adding the wrong plant. She tests all her remedies on herself before she prescribes them to her patients. An *ensalmo* is different because it is sacred and therefore cannot be taught to everyone; it must remain secret and may eventually be passed on to her daughter or son.

She is Catholic and strongly believes in faith for healing. She has faith in God and believes that through him people are healed. The *Virgen de Altagracia* (Virgin Altagracia), the patron saint of the Dominican Republic, and the *Gran Poder de Dios* (Great Power of God) are also important in her healing practice and provide her protection and guidance as a healer. She stated that "*si no hay fe no hay nada*" (if there is no faith, there is nothing).

Healer R1F0002

Healer R1F0002 is well-known in her community for her encyclopedic knowledge of medicinal plants and her healing hands. For many years she also worked as a *promotora de salud* and gave first aid to children, helped expecting mothers, and taught community members about nutrition and hygiene. She does not call herself a *partera* or *curandera* but others refer to her in those ways. Her mother was a *partera* and taught her about traditional medicine. She also learned about medicinal plants through courses she took as a *promotora*. She has had the opportunity to take many classes with naturopathic doctors through her health training. She does not read nor write yet she has an incredible ability to remember medicinal plants and their uses. To treat others, she relies on her training from her mother, courses as a *promotora*, and her own experiences with healing.

When she was younger, she assisted women during the childbirth process as her mother had done, but now there are few women that give birth in their homes. R1F0002 explained that hospitals and clinics are more accessible due to better transportation services; consequently, there is less need for midwives. She said that young women today prefer going to hospitals for pre- and postnatal care as well as to deliver their babies, but if there were an emergency, she would help deliver the baby.

She described having clairvoyant abilities when she was younger and people would visit her to ask about such things as distant family members, their destiny, and lucky numbers. Her family was uncomfortable with this practice and considered her a *bruja.* She chose not to continue this line of work. Instead she focused her time on healing the community through medicinal plants and prayer.

People from the community often ask her about remedies or to help them heal a family member. Women primarily consult her about treatments for vaginal infections (*infecciones vaginales*) and excessive menstruation (*derrame*), while men tend to ask her about treatments for headaches (*dolores de cabeza*) and body aches (*dolores del cuerpo*). She also treats children, primarily for fevers (*fiebres*), headaches, and stomachaches (*dolores de barriga*) associated with parasites.

She uses teas, baths, prayer, and *botellas* for treatment and encourages the use of daily teas as a form of health prevention. In difficult cases she recommends a doctor. She is Catholic and discussed the importance of faith in God, saints, and the person providing care to heal a patient.

Healer R1F0003

R1F0003 refers to herself as a *promotora de salud* (health promoter) or *enfermera del campo* (rural nurse). She has been a *promotora* for 15 years and knows about nutrition, diet, and medicinal plants, as well as how to vaccinate. Prior to being a *promotora* she helped deliver babies and many in her community referred to her as a *comadrona*. Her mother was also a *comadrona* and taught her everything about delivering babies. R1F0003 delivered her first baby at the age of 20. As a *promotora* she continues to help mothers by teaching them how to eat right, the importance of visiting the doctor, and prenatal care. In emergency situations, she will deliver a baby when a woman is unable to reach a hospital.

Healer R1F0003 learned about medicinal plants from her mother and through experience. Her mother taught her how to prepare a *bebedizo*, a common remedy given to mothers after delivery. In her treatment of others she uses medicinal plants, *ensalmos*, massage, baths, and medicines from the pharmacy and those given to her by the *Programa de Salud Pública* (Public Health Program). All her work is voluntary; she does not charge for her services or for the plants she prepares as remedies. When she buys ingredients from the pharmacy, she only charges the cost to buy them.

R1F0003 is Catholic and often calls on God and the Virgin Mary to assist her in healing and delivering babies. Santa Rosa and San Ramón are saints that protect her and guide her in treating illnesses. She considers faith in God to be important because, *"si no tenemos fe, no hay nada valido"* (if we do not have faith, nothing is valid). She also believes that having faith and trust in the healer is necessary to assist in the healing process. Her mother gave her an *ensalmo* that helps position a baby for delivery. This *ensalmo* she cannot share with anyone; it can only be passed on to one of her daughters who will continue the tradition.

Healer R1F0009

At the time of this study, R1F0009 was 53 years old and had lived in her community for 30 years. She is a widow and has nine grown children. Her sons live with her and farm their land. They have a number of *tayota* plants (*Sechium edule*) and sell the fruits at markets.

She does not refer to herself as a healer but others in the community recognize her ability to heal and prepare *botellas*. Women consult her more frequently than men for postpartum care, vaginal infections, and infertility. Men often consult her for kidney (*riñones*) problems. Lack of appetite (*no apetito*) and weakness (*débil*) are common ailments of children that she treats.

Healer R1F009 began assisting her mother to prepare *botellas* when she was 12 years old and over the years learned the plants and their preparations. Her mother was a *comadrona*. Local community members, individuals in Santiago, and others in New York purchase her *botellas*. Her *botellas* cost 50-60 pesos (approx. US$3-3.50, exchange rate in 2000-2001: $1 = 17 pesos).

Individuals in her community consult her when they are ill. She uses teas, *botellas*, and prayer to heal. She has faith in God, which she believes is important for healing as well as having faith in the person who is healing. R1F0009 said, "*todo mueve de Dios*" (all moves with God).

Healer R1M0006

At the time of the interview, healer R1M0006 was 65 years old and the mayor of his community where he has lived for 63 years. He is married, has nine children, and earns his living by farming. Some people call him a *curioso*, *curandero*, or *botellero*, although he does not call himself by a specific name. He explained to me that because he does not earn his primary income by making *botellas*, he is not called a *botellero*.

He realized he could heal people when his first daughter was born. He described himself as having *inteligencia* (intelligence), meaning he easily remembers plant names, what they look like, and how they are used. He thanks God for this ability to heal. He does not know how to diagnose or examine people, but he is able to prepare natural medicines if they tell him what they have. His mother was a *partera* and taught him about medicinal plants.

The *botella* is his specialty, which is so popular that it is sometimes taken to New York City. R1M0006 charges 100 pesos (approx. US$6, exchange rate 2000-2001: $1 = 17 pesos) per *botella*. He charges for his *botella* because they are time intensive to prepare and involve collecting plants many kilometers away from his home, purchasing ingredients at the pharmacy in town, and preparing and cooking the plants can take a half a day.

He said all his recipes can be shared and taught, but it is important that the person learns how to identify the plants. He mentioned that he has told his sons some of the plant names but they are unable to recognize these plants in the field. He said many plants are toxic and can be dangerous if a person does not know them well.

For R1M0006, faith is extremely necessary for healing. He said, "*no hay fe, no hay nada*" (without faith, there is nothing). He has faith in God and saints. Santa Carmen is the saint that provides protection for him when he heals.

Healer R1F0035

R1F0035 was 74 years old and has lived in the same community all her life. Unfortunately, due to her health condition we were not able to complete the interview, but what is described can provide some details of her practice as a healer. Everyone in the nearby community and surrounding areas knew of healer R1F0035 and many had visited her for treatment. Women I interviewed said that she was older and not working as much as before. She still had hours for consultations, usually in the mornings before noon.

R1F0035 knew that she was different at an early age. As a little girl she would hear angels and voices calling her in the morning and telling her that she had to go to church to pray. Both her mother and sister thought she was crazy. She explained that many of the plants and remedies she learned through *una luz de Dios* (a light from God) that guides her in diagnoses and in treatments. She said, "*Tengo esta inteligencia…desde joven empezé a tener esta luz*" (I have this intelligence…since I was young I began to have this light).

Her husband used to collect the plants that were far away from the house and she collected those close by. Now, her husband has heart problems so she hires someone to collect the plants or has her grandson purchase them in Santo Domingo at one of the medicinal plant markets.

In her living room she has an altar with a statue of the Virgin Altagracia and a candle burning. Each time I visited, the candle was always burning. Healer R1F0035 is Catholic and, like the others, is very religious and has a strong faith in God. She openly shares her remedies and treatments because "*es una bendición compartir con otros*" (it is a blessing to share with others).

Healer R2M0036

At the time of the interview R2M0036 was 74 years old and mayor of his district. At first I was going to work with his son, who gives consultations, but he did not want to be interviewed and said his father was more knowledgeable about medicinal plants used in his healing practice. As father and son they work as a team to heal patients. This description includes details about the son's healing practice as described by his father.

R2M0036 was 15 years old when his father, a *curandero,* died. R2M0036 explained that his father's healing abilities were passed on to his son. In a dream, his father told him that his ability to heal was placed in the unborn child his wife was carrying. His son has been healing for 20 years and calls himself a *curandero*. Through dreams and revelations R2M0036 learns about plants that heal.

R2M0036's son sees his patients on Tuesdays and Fridays. Davis (1987: 235) noted that these two days are the most recommended for spiritual healing in the Dominican Republic. The father and son team see approximately five to 10 people per day, both men and women. The patients come from nearby communities and as far away as Santo Domingo and even New York. A separate building made of wood planks and painted pink is used as a consultation room. Sixty percent of the patients are women who suffer from vaginal infections (*infecciones vaginales*), vaginal pain (*dolores vaginales*), pain in the womb (*dolores en la matriz*), and problems with their husbands (*problemas con sus esposos*). The consultations are 50 pesos (approx. US$3, exchange rate in 2000-2001: $1 = 17 pesos) and a *botella* costs 200 pesos (approx. US$12).

His son's principal methods of diagnoses involve checking the pulse, looking at urine, and looking into the patient's eyes. He also asks the patient to explain their ailment. R2M0036's son is guided in diagnosing the patient by *los misterios*. His father explained that, "*El monta misterios y ve el quebranto que tiene la persona*" (The *misterios* possess him and he sees the illness that a person has). R2M0036 explained that the *misterios* come from *herencia* and *nacimiento* (birth); not everyone is born with them. When his son is in this state he does not remember anything; therefore, his father records the plant names that his son tells the patient.

A variety of treatments are used in his son's healing practice, including wine, pills, *botellas*, *ensalmos*, prayer, massage, *despojo del cuerpo* or *limpieza* (spiritual cleansing), and baths. If the treatment needed is a tea, the patient is given a list of plants with instructions, but if the treatment is a *botella*, R2M0036 prepares it.

Spiritual beliefs are important in the healing practice of R2M0036's son. He has 21 *misterios* that he calls on; if one does not work he calls on another. R2M0036 reported six names of *misterios* that his son calls on that have been previously documented (Jiménez Lambertus 1980). According to the father, who is Catholic, faith is essential for healing: "*si no tiene fe no cura, la fe lo conecta con Dios*" (if you do not have faith, you don't heal; the faith connects one with God). In addition to working together to heal, both father and son maintain their *conucos* with local crops, such as coffee and corn, and raise pigs.

Healer R2F0034

R2F0034 has lived in her community for 30 years. At the age of 21 she began delivering babies, healing, and using medicinal plants. She explained that her ability to heal and deliver babies came from *herencia* because her paternal grandmother was a *comadrona*. R2F0034 called herself a *comadrona* until 1971 when she began referring to herself as a *partera*. R2F0034 took an 8-month course at the San Cristóbal hospital, where she worked with physicians to deliver babies, and was granted a certificate as a *partera*. She uses medicinal plants in treating patients, she also provides prenatal care, prepares women for delivery, and uses manual manipulation to aid the birthing process.

Healer R2F0034 delivers babies in her community and occasionally in cases where the mother does not reach a hospital in time. She has assisted with more than 100 births; in the past, she use to help with three to four a week. She has even delivered triplets. If a delivery is particularly difficult she advises the mother to see a physician and will go to the hospital with her. People pay her what they can afford for her services.

I interviewed her in May 2001; her most recent delivery was the 12th of February 2001. Healer R2F0034 has noticed a decrease in the number of babies she has delivered over the years. This decrease, she explained, was due to women preferring to deliver their babies in hospitals, better transportation to clinics, and *planificación* (family planning). Members of her community affectionately refer to her as *Mamá* (mother) because she has delivered many who live there.

Prayer, massage, and medicinal plants in teas, baths, and *bebedizos* are used in her healing practice. Her recipes are not secrets and she shares them with those who want to learn although, sadly, no one has studied under her. A granddaughter had conducted a couple of interviews with her but then decided to become a lawyer. Unfortunately, not one of the healers in this study has had an apprentice.

God and prayers are an integral part of her healing. She says faith in God is important for healing and for everything one does in life. She considers herself a Christian and is part of the Seventh Day Adventist Church. In addition to healing, she works as a seamstress, gives injections, and sells basic medicines such as aspirin.

Healer R1M0031

At the time of the interview, R1M0031 was 78 years old and had never been married. He has lived in the same community for 40 years. He enjoys his tobacco and lives a simple life. In addition to healing, he also works as a farmer.

Healer R1M0031 is known by some in his community as a *curioso* and for his *botellas*. In addition to plants, R1M0031 also uses *ensalmos* to heal ailments or problems. He said *ensalmos* are his own and cannot be taught to anyone. He does not examine or diagnose patients like a healer, rather each person explains their problem and then he recites an *ensalmo* or prepares a treatment, often a *botella*. For serious conditions he recommends seeing a doctor.

He charges 50 pesos (approx. US$3, exchange rate in 2000-2001: $1 = 17 pesos) for his *botellas* but will take less if people cannot afford it. He noted that if he would charge too much or take money from people who have little, God would observe these actions and they will affect him later. Patients come to him from neighboring communities, Santo Domingo, and even some come from New York City.

He is Catholic and very religious, with a strong faith in God. The Virgin Altagracia provides him with protection and helps him heal. He asks the Virgin to help him heal specific illnesses and through his dreams remedies and solutions often come to him. He began preparing *botellas* when he was 20 years old and learned about medicinal plants through his dreams. He explained that he has *inteligencia* (intelligence) and "*aprendió de cabeza, que algunas personas están iluminadas en esta forma*" (he learned by himself, that some people are illuminated in this way).

Healer U1F0075

U1F0075 was approximately 88 years old at the time of the interview. She was raised and lived half of her life in a rural community. She moved to the city when she was around 50 years old. Women in her community refer to her as a *curiosa* or *comadrona*. She said that because doctors are now more accessible to people she does not work as a *comadrona*. One woman called U1F0075 a *santiguadora*, because she blesses (*ensalma*) babies to protect them by sprinkling them with *agua bendita* (holy water), brushing the air around them with a sprig of rue (*Ruta chalepensis*), and saying *ensalmos*.

U1F0075 began healing and using medicinal plants when she was about 24 years old. Her grandmother was a *comadrona* and taught her many remedies. Healer U1F0075 constantly asked her grandmother about plants for healing and easily remembered their names and uses. She explained that she was born with the knowledge to heal and through prayer and dreams she began to learn more. U1F0075 described herself as having a *mente abierta* or *mente suave* (open mind), which facilitated her ability to heal. After she married, she also learned more about traditional healing by apprenticing with a healer.

In addition to medicinal plants, she also uses prayer and *ensalmos* in her healing practice. She said individuals in her community, especially women, consult her for their health problems. She is less open to sharing her recipes with others because they may want to use the remedies for their own businesses. Because I was a foreigner, she felt she could share them with me. She collects her plants from her home or purchases them at the local municipal market or in Santo Domingo for hard to find plants.

U1F0075 explained that one must have faith in God and in the plants to heal. The Virgin Altagracia and Jesus Christ are also important for her healing and she prays to them to guide her. She used to have an altar to many saints, such as the *Gran Poder de Dios* and San Miguel, but the priest of her church asked her to remove it because it was not part of Catholicism.

Healer U1M0051

U1M0051 was the oldest healer in the study; he was 101 years old and showed me his identity card to prove it. He had never been married. He had moved to the city four years ago; prior to that he had lived in a rural community. Some community members referred to him as a *curioso* or *curandero*. When asked what he referred to himself as, he responded with simply his name and stated that he does not believe in *brujos*.

When he was a child, his caretaker taught him about medicinal plants. He said he learned to heal using plants when he was in his mid-twenties and learned quickly by listening to others. In addition, he learned from *curanderos*, who treated him when he was ill.

People come from all over the province to see U1M0051, including many from the city of Santiago. Primarily, women come to see him for his *lavados* (vaginal washes) and *botellas*. He does not diagnose; people tell him what they have and he knows what they need. His recipes can be openly shared. As did the other healers, U1M0051 noted that faith in God and in the plants is necessary for the healing process to work.

Dominican traditional medicine

Dominican traditional medicine is complex and has evolved from the blending of several cultures, particularly groups of Amerindians, Europeans, and Africans as discussed in Chapter 2. Traditional medicine among Dominicans includes the use of medicinal plants, prayers, and faith and involves traditional healers, midwives, and herbalists. Several authors (Brendbekken 1998; Cordero 1978; Davis 1987; Deive 1979; Hernández Colón 1976-1977) as discussed in Chapter 2 have been influential in documenting medicinal plant use and traditional knowledge within the Dominican Republic. This present study aims to further understand and document Dominican traditional medicine.

Prior to examining women's health, I briefly discuss several prominent themes and concepts in Dominican traditional medicine that surfaced during the interviews and surveys with healers and women. These themes are cleansing, taboos, and cultural-bound medical illnesses and syndromes.

Cleansing

A common theme in Dominican ethnomedicine is *limpieza* or cleansing. Cleansing the body is important for good health because it rids the body of infection and illness. It often refers to the removal of something from the body, for example through coughing, diarrhea, urine, sweating, or menstruation. It can also refer to a spiritual cleansing of a person or house, which may be called a *despojo*.

A medicine is considered good if it causes one to expel urine, feces, blood, or mucus from the body. Preventing infection or illness from leaving the body is considered harmful and will cause damage later. As one healer said, "*Los medicos paran la infección y las botellas botan (para botar) la infección*" (The doctors stop the infection and the *botellas* get rid of the infection). An herbal remedy is described as effective because it "*bota la infección*" (gets rid of the infection); "*limpia la sangre*" (cleanses the blood); and "*corre la menstruación y limpia la matriz*" (promotes menstruation flow and cleanses the womb).

Desareglos, taboos, and illness

Inappropriate behavior, such as breaking taboos or social deviation, is often referred to as a *desareglo* or *desasurdo*, depending on the region, and this behavior may cause illness. Other researchers working in the Dominican Republic have also discussed these terms (Brendbekken 1998; Hernández Colón 1976-1977). Often *desareglos* are associated with individuals at risk of becoming ill, for example, menstruating women, pregnant women, and youngsters at puberty. *Desareglos* are also associated with environmental changes such as phases of the moon and extreme temperature changes. In La Colonia, *desasurdo* can also mean a late menstruation that is caused by a *desareglo*. During the surveys, *desareglo* was often stated as an explanation for why some women have irregular menstruations. Because this study focused on women's health, the majority of *desareglos* discussed here are related to women's behaviors, although I will mention others.

If a woman does a *desareglo* during and around the time of her period it can lead to excessive menstruation (*derrame*), suspended menstruation (*menstruación suspendida*), or menstrual cramps (*dolores menstruales*). It can also displace blood in the body and lead to headaches and infections. Women interviewed stated that they need to be careful about what they put in their hands and mouths because their pores are open during that time of month; and therefore, they are more affected by changes in temperature and by chemicals such as laundry soap and bleach. Such exposures can lead to health problems in the future.

Desareglos reported in the interviews varied slightly depending on the study sites. Some common *desareglos* from Los Calabazos and La Colonia were putting one's hands in soil, painting a *fogón* (stove), washing one's hair, going barefoot, washing with bleach or detergent, cooking with *naranja agria* (*Citrus aurantium*), lifting heavy objects, or using a lot of force. In addition to these taboos, women from the urban study sites also mentioned straightening hair or painting nails. These actions all involve exposure to extreme temperatures, toxic chemicals, or minerals that can change the equilibrium in the body. Dominicans interviewed explained that illnesses and menstrual problems could occur if any of these behaviors are done during and around menstruation, when a woman's body is most vulnerable to abrupt changes.

A well-known story among women in all four study sites tells of a woman who tried to stop her menstruation by putting sliced limes (*Citrus aurantifolia* (Christm.) Swingle, Rutaceae) on the soles of her feet. The story varies, in some versions the woman was going to a party and others mentioned the woman was a prostitute. The outcome of the story is always the same: the woman never menstruates again, becomes very ill, and dies. According to the women interviewed, the message of the story is that women must not muddle with the timing of their periods because a woman's body is delicate and must be taken care of. Women provided the same explanation for *desareglos*—that these taboos are to protect women. However, this belief was more strongly held by elders than young women.

Traditionally, pregnant women were told not to eat *guanábana* (soursop, *Annona muricata* L., Annonaceae) or *piña* (pineapple, *Ananas comosus* (L.) Merr.) during their pregnancy because it could cause the blood to congeal and lead to death or grave illness. After women deliver a baby they are *en riesgo*, which literally means "at risk" and refers to the postpartum period, which may last for 39 to 42 days depending on the individual asked. During this time, a woman is expected to take extra care of herself and to follow strict rules that are culturally enforced, as discussed above. For example, a new mother cannot leave the house for several days after delivering her baby or go out in the rain.

Many taboos are linked to menstruation and hinder women's behavior. These kinds of prohibitions or restraints in behavior may also illustrate a form of power control or oppression over women or those less dominant in a society (Kothari 2003). Women who are menstruating are not allowed in *conucos* or to touch flowers because their presence will harm plants. In addition, they are not allowed to collect or touch plants because it may cause the plants to wither and to have spots or blemishes. Women who are menstruating are neither allowed to touch babies or carry them, nor can they cut a person's hair. Although many still believe these taboos, there are many who no longer do.

Traditionally, the same restrictions held true for teenagers, especially for girls. Teenagers were not allowed to eat pineapple as well as other fruits because they were considered too acidic. Eating *guanábana* (*Annona muricata)*, *caña* (*Saccharum officinarum*), *mamón* (*Annona reticulata* L., Annonaceae), *anón* (*Annona squamosa* L., Annonaceae), and *candongo* (*Rollinia mucosa* (Jacq.) Baill., Annonaceae) would make the blood stagnate and disrupt menstrual flow, leading to illnesses or problems with a child's development. Teenagers were also not allowed to wet their heads or put their hands in white soil. Girls were told not to wash their faces or hair in a river or wet their hair in the rain because then they would not reach menarche. For many, these traditions are no longer adhered to because they are now considered unhealthy.

Elders believe health problems are more prevalent today because young people, especially women, do not follow traditions. Many young women I interviewed do not believe in *desareglos* and live their life the same with or without their menstruation. The elders believe this behavior explains why young women suffer from fibroids, vaginal infections, and menstrual problems more than they did in the past.

Other *desareglos* are regulated by a new moon or related to hot and cold temperatures. Hair should not be washed nor should hair or fingernails be cut during a new moon because it will cause unhealthy hair or nails. Women interviewed mentioned that exposure to extreme temperature changes can also cause illness. For example, bathing in a cold river after working in a *conuco* may cause an infection because pores are open and coldness can more easily enter the body. Another example is a pregnant woman who puts her feet in cold water may suffer from *resfriado* that may involve congestion, chills, pain, and cramping. In both these examples, the individual is initially hot and then exposed to cold temperatures. Exposure to cold may also cause a bad headache because the blood coagulates which causes it to flow slowly to the brain.

In the Dominican Republic, some illnesses are recognized as hot while others are considered cold. To regain a healthy body, hot or cold illnesses tend to be treated with remedies that have the opposite quality. For example, a hot illness would be treated with a cold remedy or a cold illness would be treated with a hot remedy. Hot and cold are not necessarily associated with temperature.

Espasmo (pronounced *epaumo* or *paumo*) is paralysis or muscle spasm caused by exposure to an extreme change in temperature. For example, if a person has been exercising and is hot and then opens a refrigerator, he or she may become paralyzed in part of their face. Dominicans are warned not to iron clothes and then go into cold air or not to open a refrigerator or wet their hands after working outside because it will cause a *dolor de cabeza* (headache) or *espasmo*. One day after returning from a hike to a *conuco* in Los Calabazos, I received a warning to not wash my hands in cold water because my blood would congeal and the cold would cause my hands to tremble.

Cultural-bound medical illnesses and syndromes

In the study sites, there were several conditions that women considered untreatable by doctors. These ailments were *mal de ojo*, *empacho*, *espasmo*, *subimiento de la matriz,* and *subimiento del padrejón.* Healers are consulted for these conditions.

Mal de ojo (sickness caused by evil eye) usually affects infants. The symptoms of *mal de ojo* may be loss of appetite, excessive crying, or lethargy. The illness is often caused by an individual who looks at a baby or another person with envy, or by an individual who has *mal ojo* (evil eye). However, *mal de ojo* can also be done unintentionally by looking at a child. Those with *mal ojo* cause harm to living things when they touch or look at them; for example, if they touch a plant it could dry out and die. To prevent *mal de ojo*, some mothers purchase *azabaches*, amulets made of black coral that have been blessed, for their child or have their child blessed by a *santiguadora*. This condition has been well documented in Latin America groups (Arvigo and Balick 1998; Paulino 1995; Trotter 1981).

Empacho is caused by eating "damaged" food or by food that sticks to the stomach lining. Often the individual does not want to eat or drink anything. Children tend to be affected by *empacho* more than adults. A mother interviewed in Los Calabazos said that she would have to take her daughter to a healer because doctors do not know how to treat *empacho*. *Empacho* has also been described as a culturally defined illness of Mexican-American populations (Trotter 1981; Trotter 1991) and populations in Belize (Arvigo and Balick 1998).

Espasmo as discussed in the previous section is a form of muscle paralysis that is often treated by healers. Some women interviewed mentioned that medical doctors do not understand *espasmo* nor know how to treat the condition. An exception was Dr. Dionisio Bueno, a medical doctor whom I interviewed, who knew how to treat *espasmo*. He combined both medical training with traditional medicine. He mentioned that *espasmo* was a common condition that affects adults in the Dominican Republic. He had treated Dominican patients with *espasmo* in the Dominican Republic and in New York City.

Women suffer from *subimiento de la matriz* and men suffer from *subimiento del padrejón,* also referred to as *suba el padrejón*. It was explained as feeling pain and discomfort in the upper abdomen and associated with a lack of appetite, anxiousness, and possibly diarrhea. *Padrejón* was described as the masculine equivalent of the *matriz* (womb). *Subimiento del padrejón* is usually cured by receiving an *ensalmo* and by taking an herbal tea made from the leaves of *cilantro ancho* (*Eryngium foetidum* L., Apiaceae), *berenjena baja* (*Solanum capsicoides* All., Solanaceae), and *berenjena grande* (*Solanum torvum* Sw., Solanaceae), or a tea made from the bark of *roble* (*Catalpa longissima* (Jacq.) Dum. Cours., Bignoniaceae). The leaves of *naranja agría* (*Citrus aurantium*) may also be prepared as a curative tea for *subimiento de la matriz* or *del padrejón*. Brendbekken (1998: 102) previously documented these same health conditions in her work with Dominicans living near the Haitian border.

Dominican women's traditional medicine

To narrow the focus of women's medicine, 10 health conditions were selected that varied from menstruation to pregnancy to menopause (Table 4.7). The conditions were selected at the initial stages of the field research prior to conducting the surveys and interviews. The conditions were chosen based on initial conversations with women in Dominican communities to learn about common health ailments (vaginal infections, menstrual cramps, postpartum care), research conducted in New York City with Dominican healers (Balick *et al.* 2000), and a literature review of Dominican ethnomedical studies (infertility, suspended menstruation, morning sickness) (Ososki *et al.* 2002). Hot flashes, menorrhagia (excessive menstruation), and uterine fibroids were included for comparison with the study in New York City. The conditions from the literature were selected because they allowed for a more complete investigation of women's health. Pregnancy prevention was also selected to explore preventative family planning measures in Dominican traditional medicine. From a biomedical viewpoint, postpartum care and morning sickness can be classified as obstetric care and menstruation (excessive, suspended, and cramps), infertility, vaginal infections, hot flashes, uterine fibroids, and pregnancy prevention fall under gynecological care (Venes and Thomas 2001). These conditions represent a broad range of health conditions and therefore may be useful in future comparative studies of women's health.

Table 4.7. Women's health conditions selected for the study.

English	Spanish
Menstrual cramps	*Dolores menstruales, calambres*
Excessive menstruation	*Derrame de la mujer*
Suspended menstruation	*No llega la menstruación*
Pregnancy prevention	*Prevenir el embarazo*
Morning sickness	*Mal estar de la barriga durante el embarazo*
Postpartum care	*En riesgo después de dar luz*
Infertility	*Infertilidad*
Menopausal hot flashes	*Calores del cambio or menopausia*
Uterine fibroids	*Fibroma*
Vaginal infections	*Infecciones vaginales, infecciones de la mujer*

The term condition is used rather than illness because in many cases these conditions are part of a woman's life cycle and therefore are not considered illnesses. The survey was limited by the 10 conditions selected for study, but it allowed those interviewed to discuss a broad range of different plant species and other home remedies. During the interview, other health conditions were discussed informally and recorded; however, they are not included in this analysis. This methodology allowed me to investigate plant species that were reported frequently for particular health conditions and those species reported commonly in each community.

The data presented in this chapter includes information collected through the survey with generalists and specialists (n = 237) from the four study sites and information from the healer interviews (n = 11). The sample is somewhat skewed toward the urban study sites because more people were interviewed there than the rural sites. The sample also has a generalist and gender bias. Only 5% of the sample is composed of healers or specialists and only 2% are men because the study focus was geared toward women's knowledge about women's health. Despite these biases, the sample is reflective of the community and generalizable because a representative number of individuals from the four communities was interviewed. Out of approximately 455 households in the four communities, I spoke with 237 individuals, which is approximately 52% of the study area. In each community, the number of individuals surveyed represents roughly at least 45% of the community. The large sample size in this study contributes to the reliability of the data about traditional medicine for Dominican women's health.

I present a description of each condition as described by generalists and specialists, followed by a discussion of medicinal plants and remedies frequently reported for each condition. I selected the plants listed in Figures 4.1 through 4.10 because they were reported at least seven times for a health condition. For two health conditions, excessive menstruation (Figure 4.2) and pregnancy prevention (Figure 4.4), few plants had that many reports so to include at least five plants in each figure I selected plants that were reported less than seven times. Postpartum care was the other exception. Due to the numerous plants reported for this condition, 30 plants were reported at least seven times, only plants that were reported 10 or more times were included in Figure 4.6. Following this discussion, I explore different methods for analyzing culturally significant health conditions and treatments based on several forms of consensus. I end by presenting general botanical trends found in this study.

Prior to this discussion, I would like to introduce a few Spanish terms commonly used in the study communities to describe female anatomy. Ovaries can be referred to as *ovarios* as well as *senos*. *Senos* are also breasts. Uterus or womb in Spanish is *útero, matriz*, or *vientre*. *Cuello de la matriz* or *cuello del vientre* refer to the vaginal canal.

Health conditions and treatments

Menstrual cramps (Dolores menstruales, calambres)

Menstrual cramps were described as part of the *naturaleza de una mujer* (nature of being a woman). Symptoms related to menstrual cramps were sore breasts, vomiting, gassiness, headaches, dizziness, flu, lack of appetite and energy, leg soreness, diarrhea, nervousness, and vaginal discomfort.

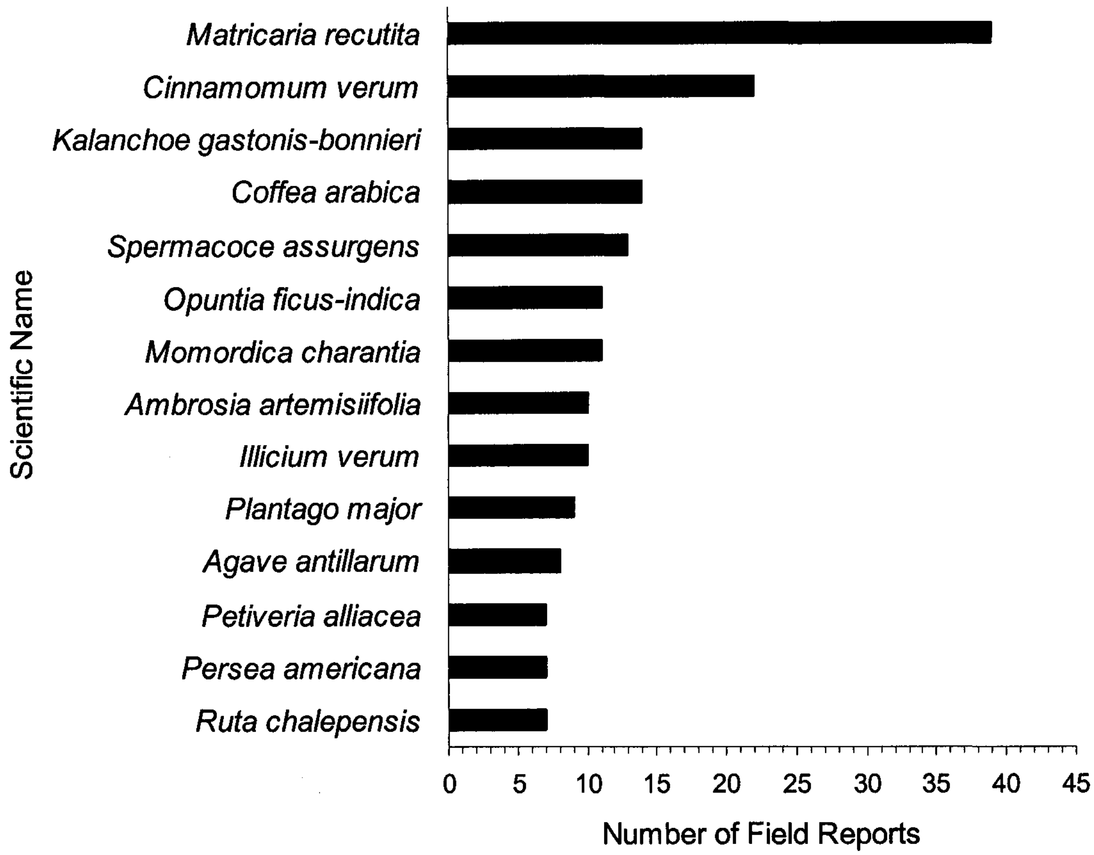
According to healers and many women interviewed, infections in the uterus or ovaries cause menstrual cramps. Other causes mentioned were *coagulos de sangre* (clots of blood) in the uterus, *desareglo*, and *ovarios* *inflamados* (inflamed ovaries). *Ovarios inflamados* was not a condition selected for this study. However, other researchers have reported this condition in the Dominican Republic (Avila Suero 1988) and Mexico (Leonti *et al.* 2001). In the Dominican Republic, a common belief about menstrual cramps is that after a woman marries she will not suffer from cramps. This is illustrated in the following expression which was well-known among the women interviewed, "*hasta que no se casa no se quitan*" (as long as you are not married, you won't get rid of them).

Another consultant that I interviewed during my field work in the Dominican Republic offered a different perspective on causes of menstrual cramps. During an interview with Dr. Dionisio Bueno, he discussed the problem of excessive hormones in chicken that affect women's health in the Dominican Republic. Based on his own medical experience, he said that many young women (13 - 18 years old) now have painful periods because they have ovarian cysts that are caused by eating large amounts of chicken loaded with hormones. He also said that 7 and 8 year old girls in the Dominican Republic are physically more developed for the same reason.

Plants utilized to treat menstrual cramps

Figure 4.1 shows the most frequently reported plants for menstrual cramps. Ninety-four plant species were identified for this condition. There were a total of 360 field reports of a remedy or plant of which 339 were plant-specific field reports. A total of 123 individuals (52%, n = 237) reported a plant-specific field report for menstrual cramps.

Figure 4.1. Plant species reported frequently for menstrual cramps (participants, *n* = 237).



Matricaria recutita

Manzanilla or chamomile (*Matricaria recutita* L., Asteraceae) was the most salient plant for treating menstrual cramps (Figure 4.1). Thirty-nine individuals reported it for this condition (32%, *n* = 123). Some women grew *manzanilla* in their home gardens, while others purchased it at a pharmacy or market.

Women reported a tea that was prepared by boiling *un puñito* or *un chin* (approx. two tablespoons) of flowers in water for approximately 10 minutes. One cup could be taken up to three times a day until the cramps lessen. It was reported that *manzanilla* helped “bring down the menstruation” (*baja la menstruación*) and cleansed the uterus. In addition, women said the plant removed blood clots, alleviated pain, refreshed, and calmed the body.

Chamomile has been reported in numerous other studies as an emmenagogue (Cordero 1978), for menstrual cramps (Rodríguez Martínez 1999), and for childbirth (Leonti *et al.* 2001).

Cinnamomum verum

Canela or cinnamon (*Cinnamomum verum* J. Presl, Lauraceae) was the second most salient plant for treating cramps and was used by 17% (n = 123) of the study participants. A common mixture reported was a tea of *Cinnamomum verum* and *ají dulce* (sweet pepper, *Capsicum annuum* L., Solanaceae). Women prepared the fruit of *ají dulce* by removing the seeds and boiling it with a stick of cinnamon. It was reported that one cup a day would help to calm menstrual pain and “bring down the menstruation.” The other common mixture reported was a tea with cinnamon and *aguacate* or avocado (*Persea americana*). Two to three leaves of avocado were boiled with a stick of *canela* for approximately 10 minutes and one cup of tea was taken once or twice daily. This remedy was also used to alleviate pain, bring down a menstruation, remove blood clots, and increase menstrual flow. A few remedies that were cited by individual women were *C. verum* with either *maíz* (corn, *Zea mays* L., Poaceae), *coco* (coconut, *Cocos nucifera* L., Arecaceae), *alhucema* or *algucema* (lavender, *Lavandula angustifolia* Mill., Lamiaceae), or *ajo* (garlic, *Allium sativum* L., Liliaceae). Both cinnamon and avocado leaves have been reported previously as emmenagogues (Farnsworth *et al.* 1975a; Morton 1981).

Kalanchoe gastonis-bonnieri

Mala madre (*Kalanchoe gastonis-bonnieri* Raym.-Hamet & H. Perrier, Crassulaceae) has this name because it reproduces asexually by producing plantlets on the margin of the leaf that then fall off; it appears that the plant is ridding itself of its offspring. I observed this plant cultivated in home gardens. Thirteen individuals, representing 11% of those reporting a plant (n = 123) reported *Kalanchoe gastonis-bonnieri* for menstrual cramps. Typically, *K. gastonis-bonnieri* was used in a mixture of three or more plants and often in combination with *juana la blanca* (*Spermacoce assurgens* Ruiz & Pav., Rubiaceae), *tuna* (*Opuntia ficus-indica* (L.) Mill., Cactaceae), *llantén* (*Plantago major* L., Plantaginaceae), or *cundeamor* (*Momordica charantia*). In some cases, the same mixtures were reported for vaginal infections and menstrual cramps. In part, this is because Dominican women consider that infections cause menstrual cramps.

Coffea arabica

Café (coffee, *Coffea arabica*) was also reported for menstrual cramps. It was reported by 13 study participants (11%, n = 123). Coffee was cultivated in La Colonia and Los Calabazos and therefore there was a plentiful source and it was widely sold throughout the study areas. For Dominican women, menstrual cramps and excessive menstruation were considered symptoms of an infection in the uterus, so plants that increased menstrual flow were used to rid the body of infection. For example, a cup of coffee was taken with either a grated seed of *nuez moscada* (nutmeg, *Myristica fragrans* Houtt., Myristicaceae), a sprig of *ruda* (rue, *Ruta chalepensis*), toasted and powdered *malagueta* seeds (all-spice, *Pimenta dioica* (L.) Merr., Myrtaceae), or toasted and grated *güeymate* or *mate colorado* (*Canavalia nitida* (Cav.) Piper, Fabaceae) seeds. Other preparations included, crushed bulbs of *cebollín* (*Allium cepa* L., Liliaceae), a leaf or two of *artemisa* or *altamisa* (*Ambrosia artemisiifolia* L., Asteraceae), or the exudate of *sábila* (*Aloe vera* (L.) Burm.f., Asphodelaceae) added to a cup of coffee. Both *altamisa* and *sábila* were considered *amarga* (bitter). Others have reported coffee to regulate menses (Rodríguez Martínez 1987, 1991a).

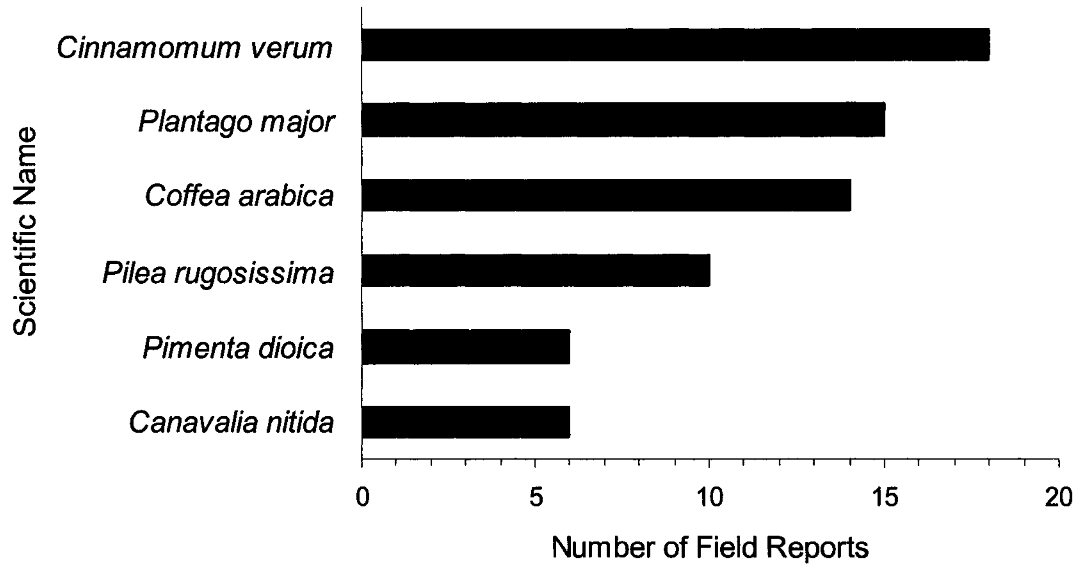
Excessive menstruation (Derrame de la mujer)

During the surveys, women described *derrame* or excessive menstrual bleeding in terms of quantity and duration. Excessive menstrual bleeding refered to a large amount of blood flow and to a time period longer than the average three to four days of menstrual flow. Dizziness, headaches, vomiting, nervousness, weakness, *tontera* (stupidity), and lack of appetite may also be associated with excessive menstruation. According to healers, this condition was often caused by a fall, lifting something heavy, or moving with a lot of force, which could open the hips and lead to excessive bleeding. *Cadera abierta* (open hips), *descenso* (dropped uterus), *útero abierto* (open uterus), or the loss of a baby may also cause excessive menstruation. Fibroids, *desareglo*, and infection were also mentioned as potential causes of excessive menstruation. Women that were not healers mentioned the following as causes of *derrame*: heredity, having lots of blood in the body, *cadera abierta*, and *matriz débil* (weak womb). According to those interviewed, to treat excessive menstruation, a woman needed to take plants that would cause her to bleed more so that she could rid her body of any infection. The treatment was considered effective if the next menstruation had a normal flow.

Plants utilized to treat excessive menstruation

Figure 4.2 shows the most frequently reported plants utilized to treat excessive menstruation. Seventy-one plant species were identified for this condition. There were a total of 201 field reports of a remedy or plant of which 186 were plant-specific field reports. A total of 87 individuals (37%, n = 237) reported a plant-specific field report for excessive menstruation.

Figure 4.2. Plant species reported frequently for excessive menstruation (participants, n = 237).



Cinnamomum verum

Canela (cinnamon, *Cinnamomum verum*) was the most frequently reported plant used to treat excessive menstruation (Figure 4.2). *Cinnamomum verum* was reported by 17 individuals for excessive menstrual flow (20%, n = 87). For excessive menstruation, cinnamon was typically reported as a mixture rather than by itself. A common remedy reported in Los Calabazos was a stick of *canela* with several leaves of *cejúa* (*Pilea rugosissima* Killip, Urticaceae). The mixture was prepared by boiling one liter of water, adding the plants, turning off the fire, and letting the mixture steep for 15 - 30 minutes. A small cup of this tea was taken twice a day for three days.

The tea turns a slight reddish color, which may explain its use. Red plants or plants that produce a red exudate are often used for blood related illnesses in traditional medicine. The doctrine of signatures has been used to explain this phenomenon, which states that observable plant characteristics such as leaf shape, color of exudates, or form of roots bear some resemblance to the illnesses that they heal (Balick and Cox 1996). Women claimed that the tea worked by controlling the blood flow and that a noticeable change would be observed in the following menstruation. Cinnamon has also been reported in Mexico and Colombia to stimulate blood flow (Browner and Ortiz de Montellano 1986).

Plantago major

Llantén (common plantain, *Plantago major*) was the next most frequently reported plant for excessive menstruation. Fifteen individuals reported the use of *Plantago major* (17%, n = 87). *Llantén* is a common plant that is easy to find in urban and rural communities where it often grows along trails and roadsides.

Plantago major was prepared in a variety of different remedies. One remedy was a tea made by boiling the whole plant in water. *Plantago major* was also prepared in tea mixtures with any of the following plants: the bark of *canela* (*Cinnamomum verum*), aerial parts of *cundeamor* or *sorosí* (*Momordica charantia*), seeds of *malagueta* (*Pimenta dioica*), a leaf of *maguey* (*Agave antillarum* Descourt., Agavaceae), aerial parts of *copada* (*Tagetes erecta* L., Asteraceae), or flowers of *manzanilla* (*Matricaria recutita*). These mixtures tended to be preferred over teas of single ingredients.

In western Dominican Republic, *Plantago major* was used in *bebedizos*, for the eyes, to help the womb, and to help girls develop (Brendbekken 1998). It has also been reported before for excessive menstruation (Estévez and Báez 1998).

Coffea arabica

The third most frequently reported plant for *derrame* was coffee (*Coffea arabica*). It was reported by 12 individuals (14%, n = 87). A common remedy for excessive menstruation was a cup of strong coffee with grated nutmeg (*Myristica fragrans*). Women reported taking one cup daily or two small cups twice a day. It was claimed to help normalize, regulate, and stop some of the menstrual flow.

Another remedy was prepared by adding a spring of *ruda* or rue (*Ruta chalepensis*) to coffee. The mixture was covered and left to steep. In place of *Myristica fragrans* and *Ruta chalepensis*, seeds of allspice (*Pimenta dioica*) and *güeymate* or *mate colorado* (*Canavalia nitida*) were powdered and added to strong coffee. Women prepared the allspice by toasting the seed and then crushing it into a powder. *Canavalia nitida* was also toasted until the red seed exploded and the endocarp was grated and added to coffee. Women interviewed explained that these remedies work to regulate menstrual flow by initially increasing the flow and removing any infection.

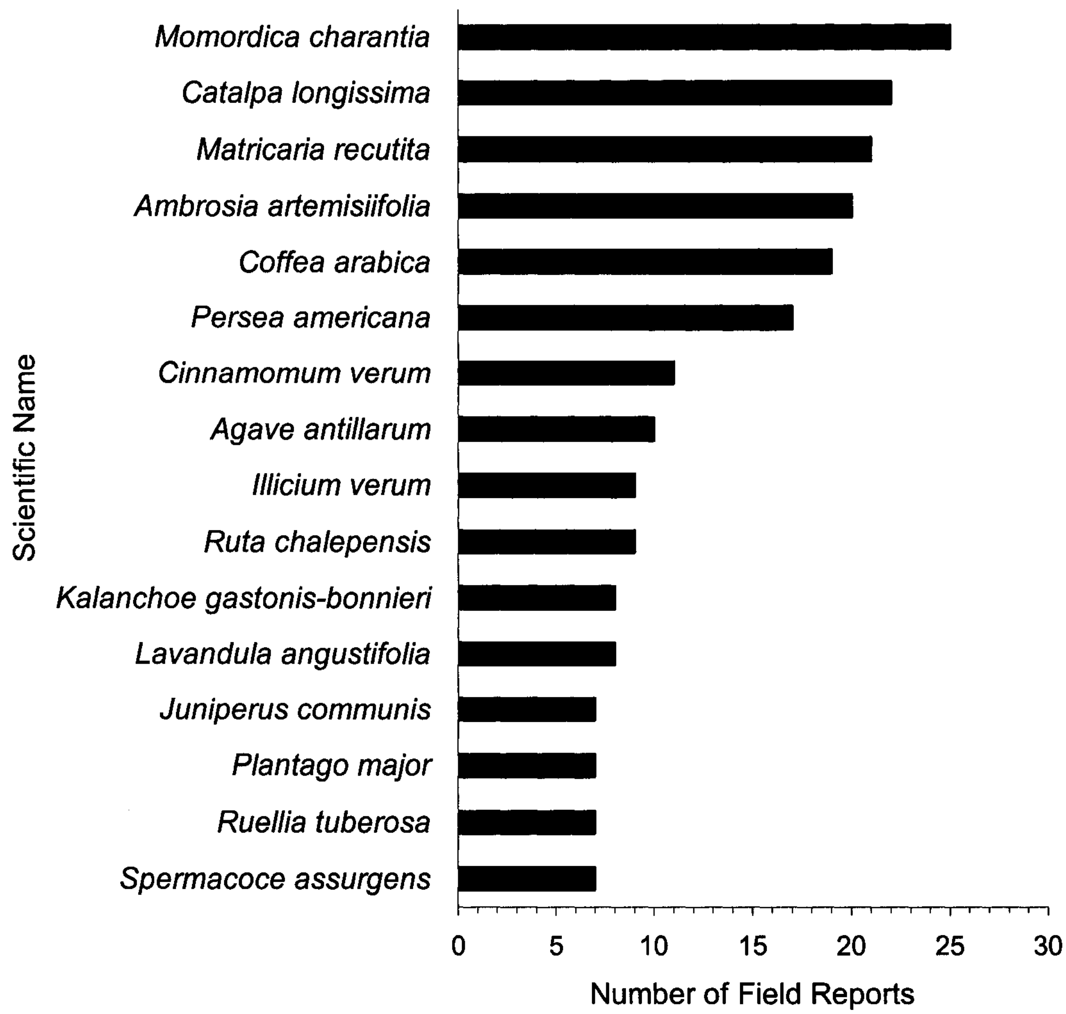
Suspended menstruation (No llega la menstruación, menstruación suspendida)

During the interviews, women mentioned that a suspended menstruation might be associated with headaches or a compromised immune system. They also said that a woman might not menstruate because she could be pregnant, anemic, or pre-pubescent. Also *desareglos* can cause a delayed or absence of menstruation. For example, washing with bleach, washing one's head, and painting a *fogón* can all lead to a suspended period. An infection in a young girl may also lead to a suspended menses. Dominican women consider this condition particularly serious as illustrated above (section: *Desareglos*, taboos, and illness) in the story of the woman who used sliced limes in her shoes. Both healers and women described menstruation as a form of cleansing and if it was suspended other health problems could result. Mothers closely monitored the development of their daughters. Young girls who do not develop by a certain age were given *botellas* to induce their menses.

Plants utilized to treat suspended menstruation

The most frequently reported plants for suspended menstruation are shown in Figure 4.3. A total of 111 plant species were identified for this condition. There were a total of 479 field reports of a remedy or plant of which 402 were plant-specific field reports. A total of 109 individuals (46%, n = 237) reported a plant-specific field report for suspended menstruation.

Figure 4.3. Plant species reported frequently for suspended menstruation (participants, n = 237).



Momordica charantia

Cundeamor or *sorosí* (*Momordica charantia*) was reported by 23 individuals (21%, n = 109) in this study for the treatment of suspended menstruation (Figure 4.3). This delicate vine was common in both rural communities. Children enjoyed eating the bright, red arils of the fruit. The plant was reported to be *amarga* (bitter).

Both the leaves and stem were reported in remedies for treating suspended menstruation. *Momordica charantia* was prepared as a tea with several other plants such as *artemisa* or *altamisa* (*Ambrosia artemisiifolia*) and *Agave antillarum*. In addition, *botella* mixtures were reported to "bring down menstruation" and included *Momordica charantia* as an ingredient. In the Dominican Republic, this plant was also used for *rasquiña* (rash).

Brendbekken (1998) reported that people from Río Limpio used *Momordica charantia* for infections, *botellas*, ovary problems, and suspended menstruation. *Momordica charantia* has been well documented in Dominican ethnobotanical literature as a plant for amenorrhea and as an emmenagogue (Cordero 1978; Deive 1979; Hernández Colón 1976-1977; Robineau 1991, 1995; Weniger and Robineau 1988b).

Catalpa longissima

Roble (*Catalpa longissima*) was the second most frequently reported plant species for treating suspended menstruation. Twenty-two individuals cited this plant (20%, n = 109). *Catalpa longissima* was widely cultivated in the Dominican Republic and has been planted in recent years along major city streets as well as in the countryside. It was also reported to prevent pregnancy and was considered *amargo* (bitter). A few women mentioned using *C. longissima* in mixtures with other plants, but the most common remedy was *roble* tea. Women prepared the tea by boiling a piece of bark, approximately 3 cm by 7 cm, in water for 10 to 15 minutes. Some women added salt to the tea. According to those interviewed, *roble* was bitter and therefore worked to "bring down the menstruation." Others have also reported *roble* for treating amenorrhea in the Dominican Republic (Gupta 1995; Robineau 1996).

Matricaria recutita

Manzanilla (*Matricaria recutita*) was a popular plant in women's medicine in the Dominican Republic and was discussed for menstrual cramps. Twenty individuals cited this plant for treating suspended menstruation (18%, n = 109). It was most frequently used as a tea and six *botella* mixtures included *M. recutita*. Women prepared the tea by adding approximately two tablespoons of chamomile to a cup of water and boiling it for five or 10 minutes. It was also prepared in teas with other plants, such as *alhucema* or *algucema* (*Lavandula angustifolia*) and *anís de estrella* (*Illicium verum* Hook.f., Illiciaceae).

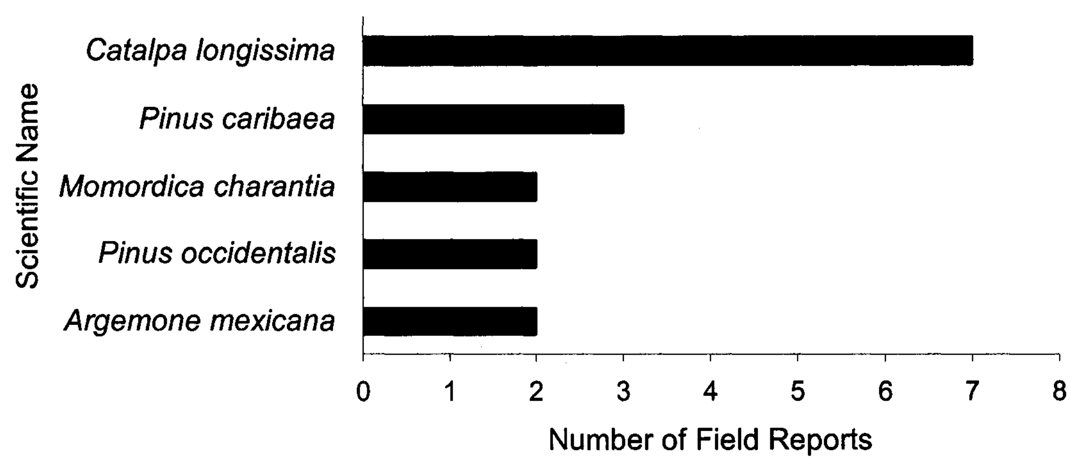
Pregnancy prevention (Prevenir el embarazo)

Women tended to report the usage of biomedical forms of contraception for pregnancy prevention. The birth control pill and patch, injections, and condoms were reported, as well as becoming *preparada* (having a hysterectomy). A few women who reported hysterectomies as a form of pregnancy prevention stated that their husbands refused to use condoms or to consider vasectomies (*amarrandose los tubos*). A woman from Los Calabazos said that she did not want to take birth control pills because they lead to menstrual problems, weight gain, and weight loss. Several healers also expressed concern about contraceptives. R2F0035 said, "*si toma algo para evitar, la mujer puede llegar a tener una enfermedad porque podría cerrar la matriz o pegar algo a la matriz*" (if a woman takes something to avoid pregnancy, she can become ill because it could close her womb or make something stick to the womb).

Plants utilized for pregnancy prevention

Medicinal plants for pregnancy prevention were reported by only 18 individuals, representing 8% (n = 237) of the total number of interviews. The most frequently reported plants for pregnancy prevention are shown in Figure 4.4. A total of 38 plant species were identified for this condition. There were 57 field reports of a remedy or plant of which 51 were plant-specific field reports.

Figure 4.4. Plant species reported frequently for pregnancy prevention (participants, n = 237).



Catalpa longissima

Roble (*Catalpa longissima*) was the most frequently reported plant for pregnancy prevention (Figure 4.4). Seven of the 18 individuals (39%) who reported a remedy for preventing pregnancies reported using this plant.

Catalpa longissima is a tree that is considered *amarga* (bitter). Women prepared *roble* as a concentrated tea. The bark or a cut of the wood was boiled in water, sometimes with salt, until half the liquid was boiled off. According to those interviewed, the tea worked by making a woman less fertile and could sterilize her if too much tea was consumed. Dominicans interviewed in other studies have reported *roble* for stimulating menstruation (Robineau 1986).

Pinus caribaea

Cuaba (pine, *Pinus caribaea* Morelet, Pinaceae) is also known as *pino* when referring to the living tree. *Cuaba* is the resinous wood of *Pinus caribaea* that is used in medicine. Three individuals (17%, n = 18) reported this plant. *Pinus caribaea* grows in the Central Cordillera near Pico Duarte in the central part of the island; individuals located far from this area typically purchase *cuaba* at municipal markets.

The medicinal wood, usually 3 cm by 7 cm in size, was either boiled in water as a tea or left in rum and prepared as a tincture for pregnancy prevention. According to women and healers I interviewed, *cuaba* dries the uterus and can potentially sterilize a woman if used for too long. Another use of *cuaba* was as a soap, that was purchased at pharmacies or markets. A healer reported that washing the vaginal area with this soap following sexual relations could help to prevent a pregnancy. In rural communities without electricity, people light splints of *Pinus caribaea* to make a natural torch (*bombillo*) and to start wood fires for cooking.

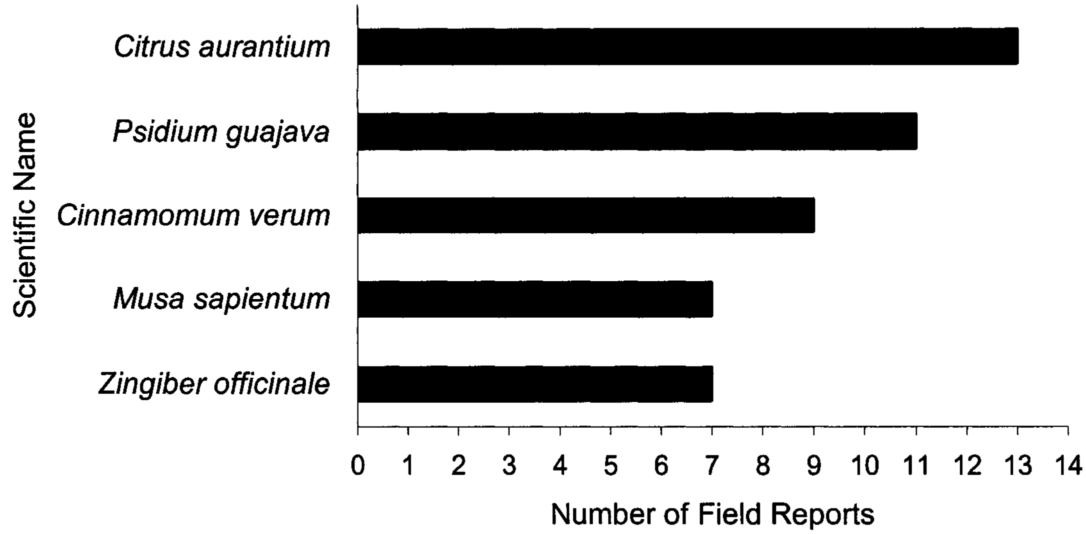
Morning sickness (Mal estar de la barriga durante el embarazo)

For morning sickness, women reported the following symptoms which were associated with the first several months of pregnancy: nausea, discomfort, lack of appetite, anxiousness, dehydration, and low immune system. *Tontera* (stupidity) and dizziness were also mentioned as symptoms of morning sickness.

Plants utilized to treat morning sickness

The most frequently reported plants for morning sickness are shown in Figure 4.5. Seventy-nine plant species were identified for this condition. There were a total of 202 field reports of a remedy or plant of which 160 were plant-specific field reports. A plant-specific field report was reported by 78 individuals (33%, n = 237) for morning sickness.

Figure 4.5. Plant species reported frequently for morning sickness (participants, *n* = 237).



Citrus aurantium

Naranja agria (sour orange, *Citrus aurantium*) was the most frequently-mentioned plant treatment for morning sickness (Figure 4.5). It was reported by 13 individuals (17%, *n* = 78). *Citrus aurantium* is a common plant in rural landscapes. Dominicans used it frequently in cooking; the juice from one fruit was often added to *chicharrones* (fried pork), *sancocho* (a traditional stew), or fish.

Naranja agria was most commonly prepared as a tea. The leaves were boiled in water for approximately 10 minutes. The acidity of the leaves was considered effective in reducing nausea associated with morning sickness. Another remedy was a tea of *naranja agria* leaves boiled with *jengibre* (ginger, *Zingiber officinale* Roscoe, Zingiberaceae). Some women reported using a tea of

Citrus aurantium with a tablet of chocolate. One woman grated the pulp of one fruit and boiled it with a pinch of salt as a tea. These preparations were used to relieve nausea, prevent dehydration, and boost the immune system. In the Dominican Republic in the town of Río Limpio, *C. aurantium* was reported for dizziness, diarrhea, and colds (Brendbekken 1998).

Psidium guajava

The next most frequently reported plant for treating morning sickness was *guayaba* (guava, *Psidium guajava* L., Myrtaceae). It was reported by 10 individuals, representing 13% (n = 78) of the individuals who reported a plant-specific field report. I observed this shrub growing throughout the rural communities of Los Calabazos and La Colonia and I also saw it in home gardens in La Vega and San Cristóbal. It is well-known for its fruit and as a treatment for diarrhea (Ross 1999).

The acidic properties of *Psidium guajava* were reported as effective for alleviating nausea associated with pregnancy. For morning sickness, there were several different preparations of guava. Women reported chewing the leaves, eating the fruit (particularly tart, unripe ones), preparing a juice from the fruit, or making a tea with the leaves, salt, and sugar. Individuals reported that eating one fruit alleviated nausea. Others reported taking a cup of tea either daily or as needed. *Guayaba* was reported to reduce nausea, vomiting, and acidity, as well as prevent dehydration. One woman claimed that the tea would help a baby become physically stronger. Other uses of *P. guajava* were diarrhea, vomiting, colds, and insomnia.

Brendbekken (1998) also reported *Psidium guajava* for diarrhea and stomachache. This plant is well-known in Central and South America as a treatment for diarrhea (Gupta 1995; Robineau 1995).

Cinnamomum verum

Canela (cinnamon, *Cinnamomum verum*) was not only reported frequently for treating morning sickness, but also for other health conditions. For morning sickness, *Cinnamomum verum* was reported by 12% of the respondents (9, n = 78). A cinnamon stick or two were often added to teas for its medicinal properties and for flavor. A common preparation included boiled sticks of *C. verum* with a few leaves of *Citrus aurantium* until the leaves were soft and wilted.

Musa sapientum

Another plant reported for treating morning sickness was *guineo* (banana, *Musa sapientum* L., Musaceae), reported by six individuals (8%, n = 78). This plant was widely cultivated in the Dominican Republic and many rural families had several plants in their home gardens or *conucos*. It was a main staple in the Dominican diet. The unripe fruit was typically boiled in salted water and served with salami, similar to American bologna.

For morning sickness, women prepared *guineo* by roasting the green fruit and preparing a beverage. The charred material produced from roasting the *guineo* was either used like coffee beans to prepare a hot drink or left in water for a couple hours, strained, and the liquid was drunk. The blackened *guineo* may also be eaten as is. Two women also reported eating boiled green bananas to alleviate nausea.

Non-herbal remedy

Eight individuals from three of the four communities reported a remedy that did not include fresh plant material. This remedy was prepared with urine from the father of the baby and *cerveza negra* or *cerveza Morena* (a malted barley beverage). A small amount of urine was added to *cerveza negra* and given to a pregnant woman to drink. Women claimed that the remedy successfully treated nausea just after one treatment. However, in order for the treatment to be effective, a pregnant woman could not be told that the beverage contained urine.

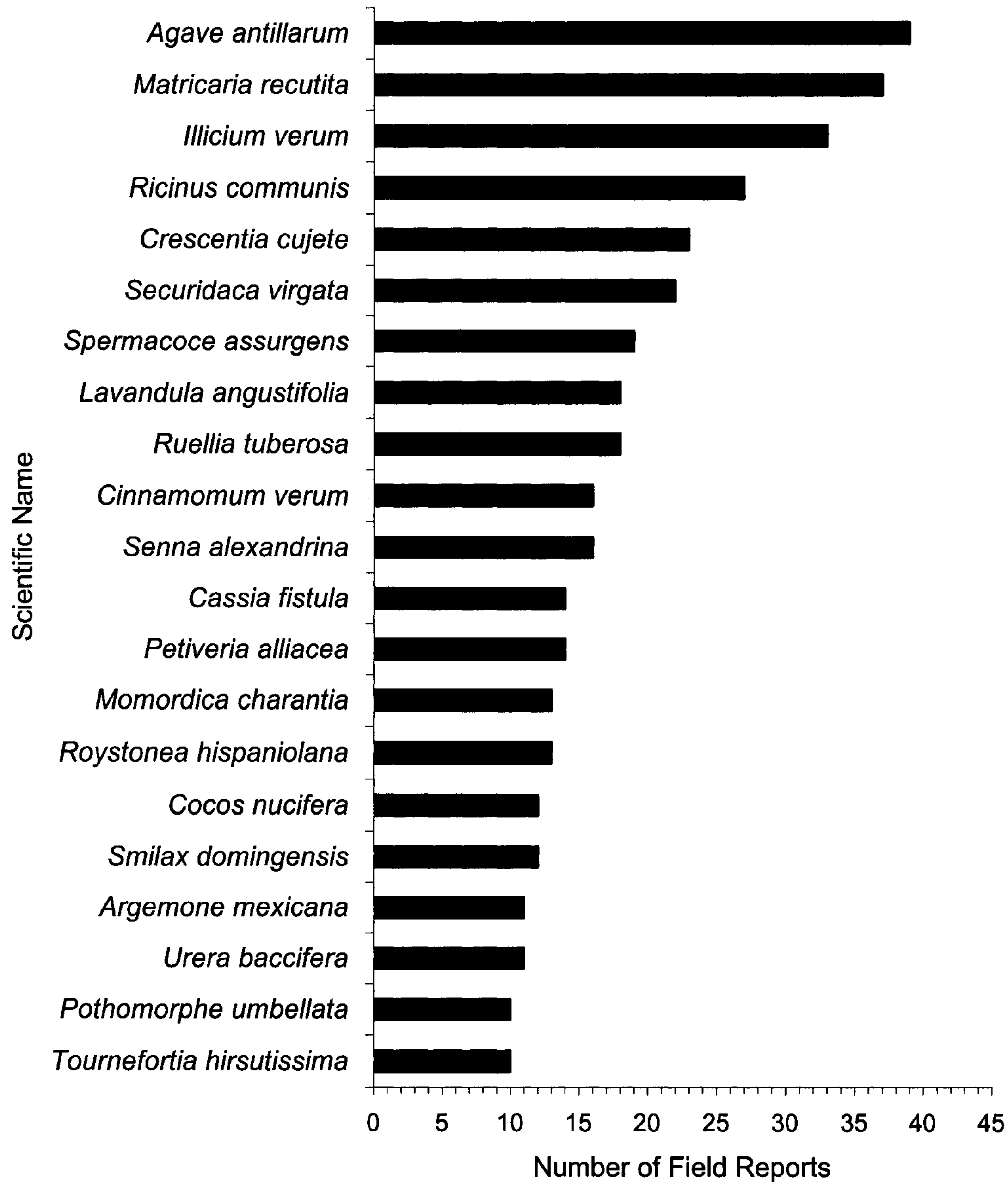
Postpartum care (En riesgo después de dar luz)

After childbirth, a woman is *en riesgo* (at risk) and has to take extra care of her health so as not to have health problems later. Healers and women mentioned open pores in the skin, anemia, headache, weakness, dizziness, and gassiness as part of what a woman experiences during the postpartum period. The duration of the postpartum period differed slightly depending on the person interviewed, but usually lasted as long as 39 to 42 days. Some of the restrictions associated with this vulnerable period after childbirth were mentioned above in the discussion of *desareglos*.

Plants utilized for postpartum care

Medicinal plant species were reported by 108 of the study participants (46%, n = 237) for postpartum care. The most frequently reported plants for this condition are shown in Figure 4.6. A total of 139 plant species were identified for this condition. There were 795 field reports of a remedy or plant of which 704 were plant-specific field reports.

Figure 4.6. Plant species reported frequently for postpartum care (participants, *n* = 237).



Agave antillarum

Maguey (agave, *Agave antillarum*) was the most frequently reported plant for postpartum treatment (Figure 4.6). It was reported by 39 individuals (36%, *n*

= 108). It was sometimes cultivated in home gardens, could be purchased at markets, or collected wild in rural areas. Both the *penca* (leaf) and the *cepa* (trunk with roots) were reported for medicine in the Dominican Republic.

Agave antillarum was almost always reported to be in a mixture, usually as a *botella*. Fifty-eight individuals reported using a *botella* as a postpartum remedy. *Agave antillarum* was a common ingredient in *botellas* and was reported in 30 of the mixtures (52%, n = 58). In some cases, an individual only named a few plants in a mixture or only referred to the name of a remedy, for example *botella*, and not the ingredients. The preparation of a *botella* will be explained in more detail later in this chapter.

One healer mentioned that she would not prepare a *botella* without *maguey*. As much as half to a whole leaf was used to prepare a *botella*. Too much of the plant could make the remedy overly bitter. Women mentioned that a *botella* worked by cleansing the uterus and vaginal canal, by removing the placenta and any water that remained inside, and by eliminating any blood clots in the uterus.

In the town of Río Limpio in the Dominican Republic, the *cepa* of agave was used in *botellas* to treat kidney problems and to treat infections (Brendbekken 1998). Cordero (1978) reported the use of *Agave americana* (possibly referring to *A. antillarum*) for dysmenorrhea, amenorrhea, and as an emmenagogue.

Matricaria recutita

Manzanilla (chamomile, *Matricaria recutita*) was the second most frequently reported plant for postpartum care. It was reported by 32% of the participants who reported a plant for this condition (*n* = 108). *Matricaria recutita* was most commonly reported as an ingredient in a *botella* for postpartum healing and was reported in 17 of the *botella* preparations (29%, *n* = 58). The flowers were also used in a postpartum tea with the seeds of *anís de estrella* (star anise, *Illicium verum*). One to two spoonfuls of each plant was boiled for approximately three minutes and the tea was taken twice a day. Another variation of this mixture included *Illicium verum* and *M. recutita* with the leaves of *canelilla* (*Pimenta haitiensis* (Urb.) Landrum, Myrtaceae).

Illicium verum

Anís de estrella (star anise, *Illicium verum*) was discussed above for making a postpartum tea and was the third most frequently reported plant (32 field reports) utilized for this condition. In addition to being used in a tea, it was also added to *botella* mixtures. Twenty-three *botella* preparations (40%, *n* = 58) included *Illicium verum.* The common name *anís de estrella* describes the anise smell of the seeds and the star-shaped fruit. This plant originates from southeast China and northeast Vietnam (Mabberley 1997) and is an exotic in the Dominican Republic that is imported dried. It was purchased at pharmacies or markets.

Brendbekken (1998) also reported that community members in Río Limpio used *anís de estrella* in *botellas* and considered the plant to be "hot" and to have a sweet taste and odor.

Ricinus communis

Higuereta or *castor* (castor bean, *Ricinus communis* L., Euphorbiaceae) is a common short-lived shrub found throughout the Dominican Republic, often growing along roadsides and in pastures. This plant was reported by 23 of the individuals interviewed. The seeds were processed to extract oil. Some women reported preparing the oil in their homes, while others would purchase it at their local pharmacy or market.

The oil of *Ricinus communis* was used as a *purgante* (purgative) to clean the uterus. It was reported to clean everything inside and to sometimes cause slight diarrhea. It was prepared by adding a ½ to 2 spoonfuls of the oil to a *cerveza negra* (a malted barley beverage) and was administered once, three days after giving birth. Eight different individuals in the province of San Cristóbal mentioned this remedy and two women from the city of La Vega reported it. There were no reports from Los Calabazos. *Ricinus communis* was also reported in the literature as a purgative in communities located near the border of Haiti in the Dominican Republic (Brendbekken 1998).

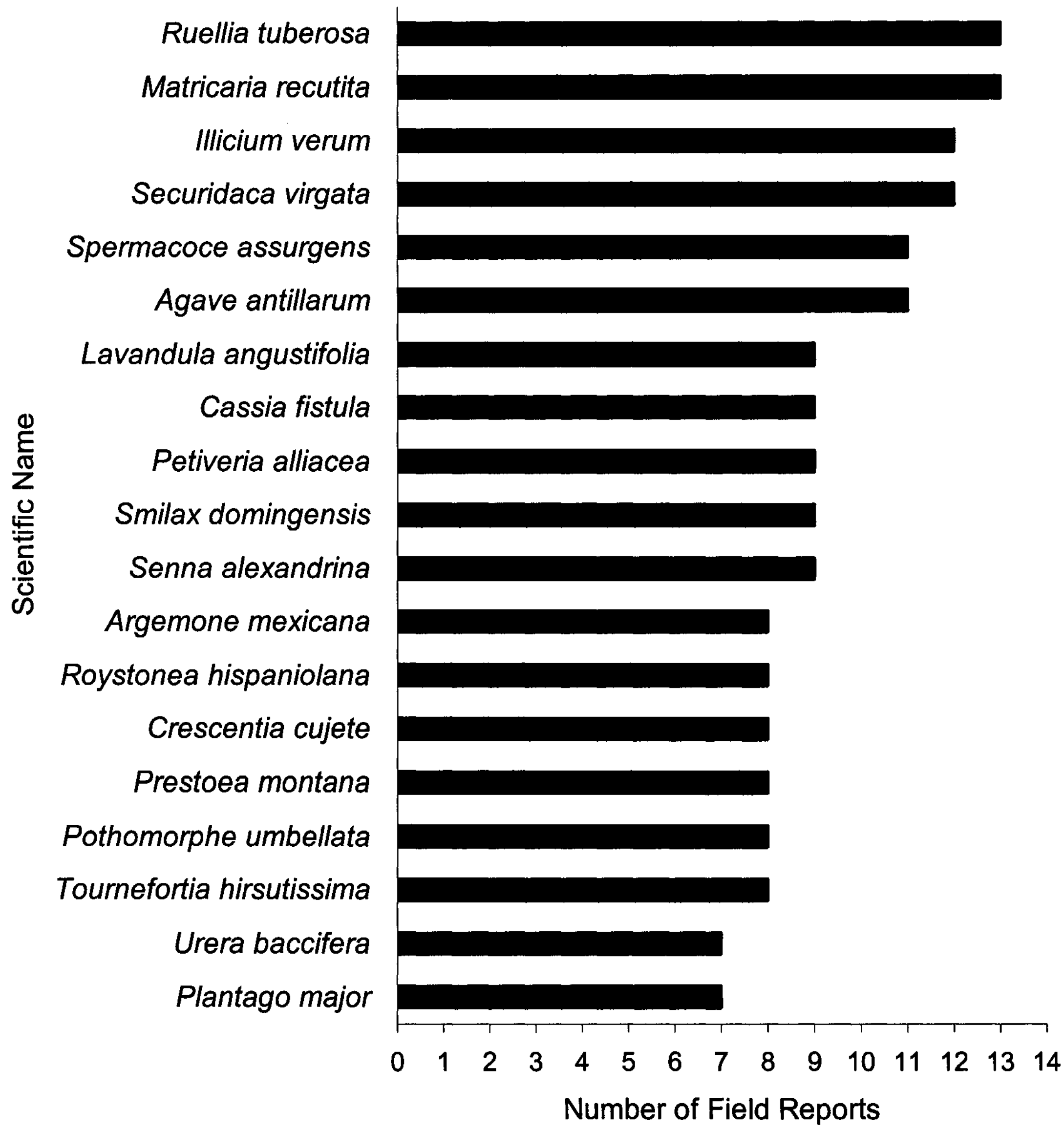
Infertility (Infertilidad)

During my field work, study participants mentioned that either a male or female partner may be infertile, but for this discussion I will focus only on women's infertility. Women reported that infertility was often the result of an infection in the womb, or as one healer frankly stated, *una matriz sucia* (a dirty womb). A uterus full of water or *ovarios inflamados* (inflamed ovaries) may also cause infertility. In addition, women mentioned that infertility might be the result of a *matriz cerrada* (closed uterus) or a *matriz infantil* (small uterus).

Plants utilized to treat infertility

The most frequently reported plants for treating infertility are shown in Figure 4.7. A total of 127 plant species were identified for this condition. There were 440 field reports of a remedy or plant of which 398 were plant-specific field reports. Thirty-nine individuals (16%, n = 237) reported a plant-specific field report for infertility.

Figure 4.7. Plant species reported frequently for infertility (participants, n = 237).



Ruellia tuberosa

Periquito or *guaucí* (*Ruellia tuberosa* L., Acanthaceae) was the most salient plant for infertility (Figure 4.7). Thirteen people reported this plant (33%, n = 39) and all used it in a *botella* preparation. In the Dominican Republic, *Ruellia* *tuberosa* is also called *yuquita* because the root, used for medicine, looks like a miniature *yuca* (*Manihot esculenta*), hence the name. In the Dominican Republic, *R. tuberosa* has been reported as an abortifacient (Bonnelly de Calventi *et al.* 1985) and used in *botellas* (Mañon Rossi 1983).

Matricaria recutita

Manzanilla (chamomile, *Matricaria recutita*) was the second most frequently used plant for the treatment of infertility, being reported by 33% (13, $n = 39$) of the individuals who reported a plant for infertility. Each individual reported using *manzanilla* as an ingredient in a *botella* mixture.

Illicium verum

Twelve individuals (31%, $n = 39$) reported using *anís de estrella* (*Illicium verum*) for treating infertility. It was used as an ingredient in a *botella*. *Illicium verum* was also mentioned for postpartum healing. It is not surprising that *I. verum* is used in postpartum and infertility treatments because it is a key ingredient in a *botella* preparation. According to the women and healers interviewed, infections or unclean wombs cause infertility; and therefore, a remedy that purges and cleanses the uterus is considered effective for this condition. The *botella* as a postpartum treatment has a similar purpose: to cleanse the women's reproductive system, to prevent infection, and to maintain health. Therefore, it is understandable that similar remedies are used for postpartum and infertility treatments.

Securidaca virgata

Maravelí (*Securidaca virgata* Sw., Polygalaceae) was also reported as frequently as *Illicium verum* for infertility. In treating fertility, this plant was always reported as part of a *botella* mixture. This vine grows near rivers and moist areas and is uncommon. The root, the medicinal part of the plant, was sold in Dominican markets. Eight of the eleven specialists (73%) reported the use of *maravelí* for infertility. Although this plant was also known among generalists, they reported its use for infertility less frequently (2%, n = 226). Plants known in common between specialists and generalists will be discussed in more detail in Chapter 5.

Brendbekken (1998) also reported *Securidaca virgata* as an ingredient in *botellas* in the Dominican Republic. *Securidaca virgata* has also been reported as an emmenagogue by Cordero (1978).

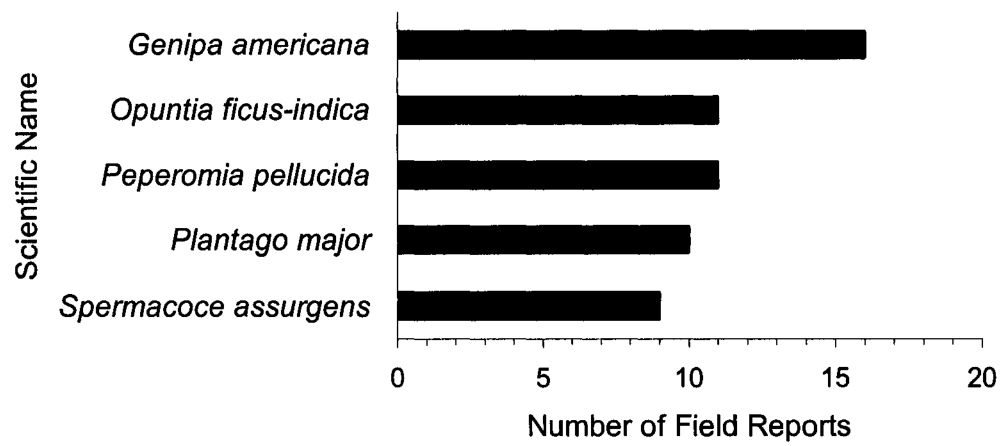
Menopausal hot flashes (Calores del cambio or de la menopausia)

According to the healers in the study, women may experience hot flashes, surges of heat, when they are 45 years or older. Irregular menstruation, weakness, body aches, discomfort, and high blood pressure were also associated with menopause. Emotional distress of waiting for a menstruation that may never come were also associated with menopause. One of the women in San Cristóbal mentioned that hot flashes occured because *el cambio de sangre* (change of blood), which she said was part of menopause.

Plants used for menopausal hot flashes

The most frequently reported plants for menopausal hot flashes are shown in Figure 4.8. A total of 92 plant species were identified for this condition. There were 227 field reports of a remedy or plant of which 205 were plant-specific field reports. Fifty-five individuals (23%, *n* = 237) reported a plant-specific field report for hot flashes.

Figure 4.8. Plant species reported frequently for menopausal hot flashes (participants, *n* = 237).



Genipa americana

Jagua (*Genipa americana* L., Rubiaceae) was the most frequently reported plant for menopausal hot flashes (Figure 4.8). It was reported by 25% of the individuals (14, *n* = 55). The tree was common in the province of San Cristóbal. Fruit stands along the main road near the city sold *jagua*. I did not observe a tree of *Genipa americana* in the two La Vega communities; however, it may grow in areas where I did not visit. The fruit was sold in the municipal market in La Vega.

In San Cristóbal, 13 study participants reported the use of this plant, whereas only one person from La Vega mentioned it. The most common preparation reported for *Genipa americana* was as a fresh fruit juice. The fruit was sliced and left in water for a day or more and then blended into a juice. Women reported drinking it as frequently as needed. They mentioned that it refreshed, helped with blood circulation, lowered blood pressure, removed body heat, and helped with weakness. Thirteen of the field reports cited this particular remedy. It has also been reported in other parts of the Dominican Republic as an ingredient in *botellas* and as a remedy to treat high blood pressure and uterine problems (Brendbekken 1998).

Opuntia ficus-indica

Tuna or *alquitira* (*Opuntia ficus-indica*) was reported to treat vaginal infections and was also commonly used to treat hot flashes. *Tuna* was reported by 11 individuals (20%, n = 55) for this condition. The plant was known to refresh the body, which explains why women and healers reported it for this condition. *Genipa americana* was used by women in San Cristóbal, while women in La Vega more frequently reported the use of *Opuntia ficus-indica* for hot flashes. The most common preparation of *Opuntia* was as a juice. Women prepared a single cactus pad (a cladophyll) by removing the spines and peeling it, and then they chopped it and boiled it in two liters of water until the volume was reduced to one liter. *Opuntia ficus-indica* was also reported in mixtures with *Spermacoce assurgens* and *Kalanchoe gastonis-bonnieri.*

Peperomia pellucida

Siempre fresca (*Peperomia pellucida* (L.) Kunth, Piperaceae) was reported 11 times (20%, n = 55) for treatment of hot flashes. This plant grows in moist habitats. Some women had it growing in their home gardens. *Peperomia pellucida* was also sold in the municipal markets in San Cristóbal and La Vega.

Women prepared *Peperomia pellucida* usually as a tea with other plants such as *Spermacoce assurgens, Opuntia ficus-indica,* and *Kalanchoe gastonis-bonnieri.* The leaves, preferably tender leaves (*cogollitos* or *cojollitos*), were used in a tea. In some cases the entire plant was prepared as a tea that was sipped throughout the day. This plant was reported to be *fresca* (fresh) and to have the same refreshing, cooling properties as *Genipa americana* and *Opuntia ficus-indica*.

Uterine fibroids (Fibroma)

Women reported that a fibroid consisted of a round mass with roots that becomes attached to the uterus. It was thought to be more common in women that were 30 years or older and already had children. Suspended, excessive, and painful menstruation, weakness of the hips, full abdomen, and a leg falling asleep were reported as indicators that a woman has fibroids.

As part of the discussion of uterine fibroids, we also talked about *quistes* (cysts). Women described cysts as fibroids just beginning to form. They also considered cysts softer than fibroids and to form from blood. Women reported that cysts did not make roots unless there were many of them in which case they could form roots and become a fibroid. One healer said that, they were made of fat. According to the interviews, cysts could be found in different parts of the body such as the breasts and hands. Young girls were considered more susceptible to cysts because they have not developed into women and because they have not yet given birth.

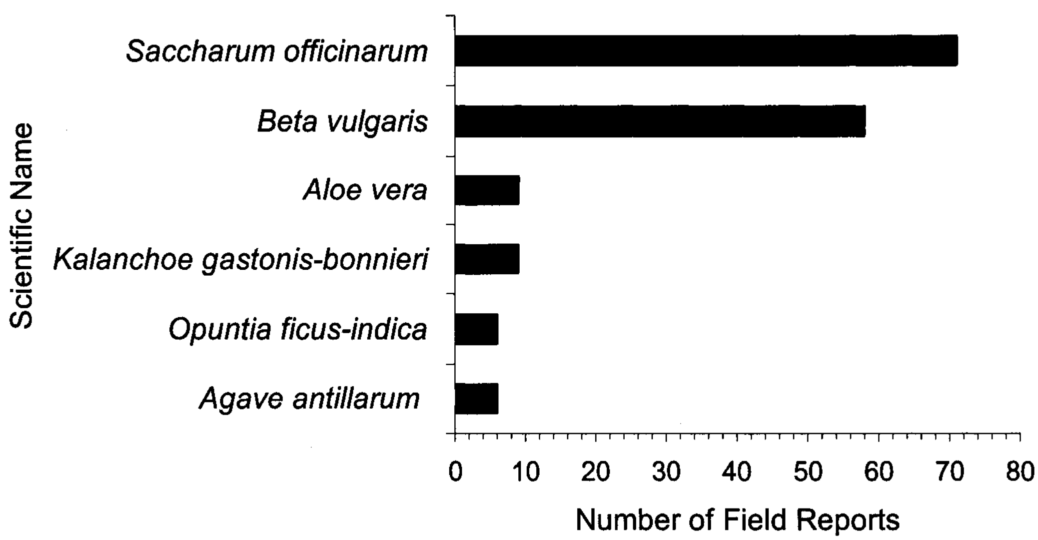
Women and healers described fibroids as balls of fat that formed like a baby grows in the womb. Fibroids were considered to be fibrous like meat and cysts were considered more gelatinous. Respondents reported that uterine fibroids and cysts took blood and may cause a woman to loose blood. Other symptoms reported for fibroids were excessive and/or suspended menstruation.

The most frequently reported cause of uterine fibroids was blood clots that were not properly removed during menstruation or after pregnancy. Other causes reported were inflammation, not cleaning well after childbirth, and cysts developing into a fibroid. Women reported that ovarian cysts were caused by *ovarios inflamados* (inflamed ovaries). One healer considered fibroids to be *una infección de grasa* (an infection of fat), while another said that fibroids were caused from a vaginal infection. Another healer emphasized the importance of treating fibroids because their "roots" could enter the womb and become cancerous. One elderly woman in Los Calabazos said that fibroids have only recently begun to affect women in the Dominican Republic.

Plants utilized to treat uterine fibroids

Medicinal plant species were reported by 99 individuals (42%, *n* = 237) to treat uterine fibroids. The most frequently reported plants for this condition are shown in Figure 4.9. Seventy-eight plant species were identified for this condition. There were 294 field reports of a remedy or plant of which 269 were plant-specific field reports.

Figure 4.9. Plant species reported frequently for uterine fibroids (participants, *n* = 237).



Saccharum officinarum and *Beta vulgaris*

Melaza or molasses made from sugarcane or *caña* (*Saccharum officinarum*) was the most popular ingredient reported for the treatment of uterine fibroids (Figure 4.9). There were 71 field reports for this plant from 69% of the participants (68, n = 99). Molasses may also be made from sorghum (*Sorghum bicolor* (L.) Moench, Poaceae), but in the Caribbean it is almost always made from *Saccharum officinarum* because of the plentiful supply of sugarcane in the region.

Sugarcane has a long history in the Dominican Republic because the island was the first New World major producer of sugar made from sugarcane. Interestingly in the Dominican Republic, the two plants, *remolacha* (red beet, *Beta vulgaris* L., Chenopodiaceae) and molasses, are used in a widely known mixture for fibroids. There are two varieties of *Beta vulgaris*; one is the red beet and the other is the sugar beet, used to make sugar. The sugar beet is neither cultivated nor sold in the Dominican Republic. *Remolacha* was reported by 58 individuals (59%, n = 99) for fibroids. To prepare the mixture, the bulbous root of the red beet is either grated or blended to extract the juice and then molasses is added to the juice. The amount of beets varies from one bulb to three pounds and the amount of molasses varies from one spoonful to half a bottle (approx. 8 ounces), depending on the quantity desired or individual taste.

The dosage ranges from approximately one small espresso cup to a glass of the mixture taken one to three times daily. The women explained that the beet-molasses mixture worked by *desbaratando la fibroma* (destroying the fibroid), *quitando la fibroma* (removing the fibroid), and *limpiando la matriz* (cleansing the uterus). The mixture was also reported to increase the amount of blood in the body and the number of red blood cells, which helps explain its other use for anemia.

In the community of Río Limpio in the Dominican Republic, *Beta vulgaris* was used for anemia, as a *construyente de sangre* (blood builder), to help women with amenorrhea, and to increase red blood cells (Brendbekken 1998). A detailed discussion of the properties of this mixture has been discussed by Fugh-Berman and co-authors (n.d.). These authors also discussed the doctrine of signatures as an explanation for the use of beets to treat fibroids because red beets and fibroids have a similar appearance. Dominican healers in New York City also reported the use of beets and molasses for uterine fibroids (Balick *et al.* 2000).

Vaginal infections (Infecciones vaginales, infecciones de la mujer)

According to the women and healers interviewed, vaginal infections were associated with a discharge and sometimes a bad odor. A white discharge could indicate the beginning of an infection and was referred to as *frialdad*. More severe infections may have either a yellow discharge or a discharge containing blood. Vaginal pain, itching, and painful urination may also be associated with an infection. Discomfort in the knees, in the hips, and while standing might also be caused by an infection. A woman often lacked motivation to take part in daily tasks.

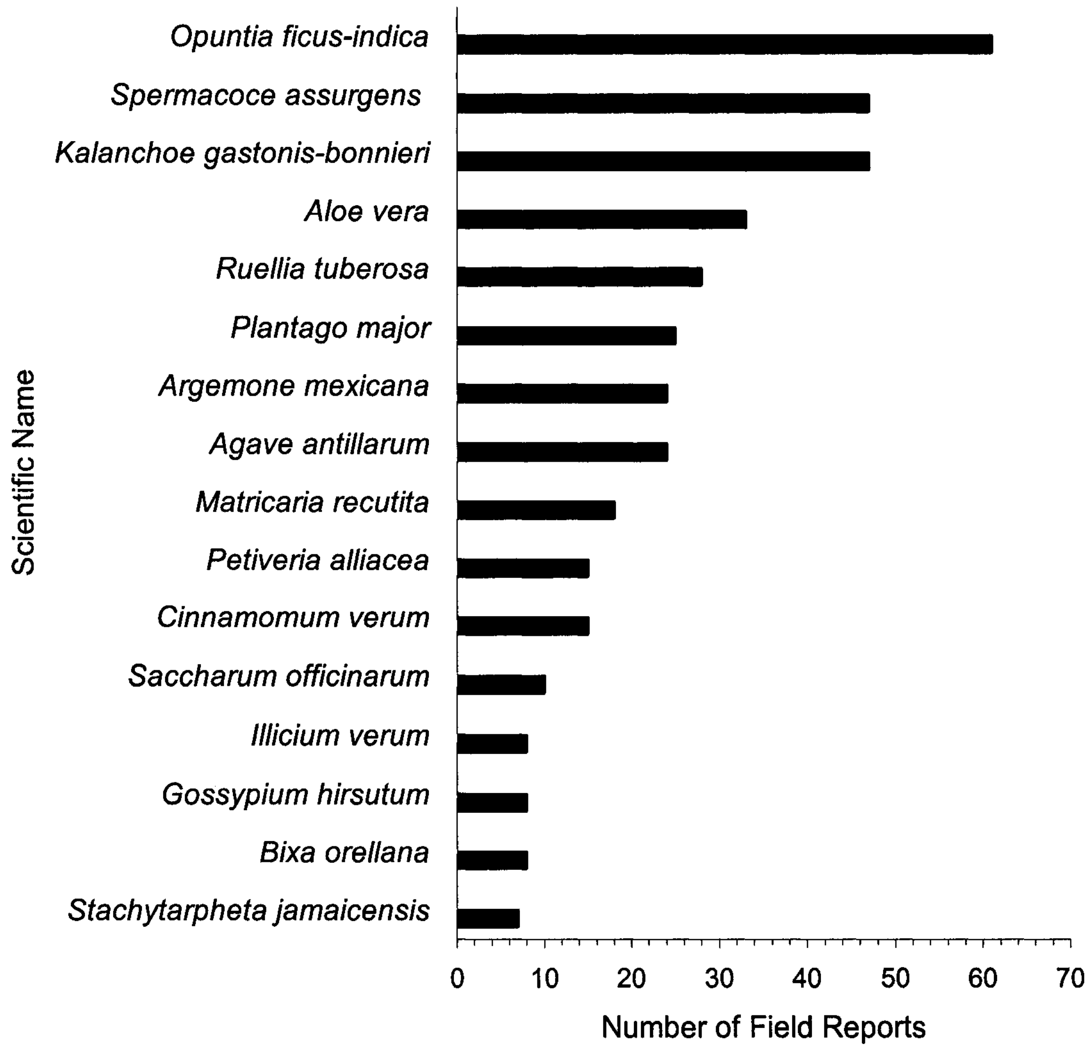
The causes of vaginal infections included external and internal factors such as water contaminated with microbes or parasites, wet clothing left on for an extended time, dirty bathing towels, cold caught inside the vagina from bathing in rivers, and sexually transmitted diseases exchanged between partners, which were referred to as *enfermedades de la calle* or *enfermedades del mundo*. Some of the healers mentioned that vaginal infections were caused by other infections or illnesses in the body, such as kidney problems and ovarian infections. Another reported cause of infection was residual tissue or water not thoroughly cleansed from the womb following childbirth that may become infected. Vaginal infections may also result from *desareglos.*

Some respondents felt that women in general did not take care of themselves by adhering to taboos as in the past; therefore, they were now more susceptible to infections. Study participants mentioned that if a vaginal infection was not treated it could lead to vaginal or uterine cancer. The use of *ovulos* (vaginal suppositories) was considered by one healer to make an infection worse.

Plants reported to treat vaginal infections

The most frequently reported plants for treating vaginal infections are shown in Figure 4.10. A total of 117 plant species were identified for this condition. There were 617 field reports of a remedy or plant of which 583 were plant-specific field reports. There were 156 individuals (66%, n = 237) who reported a plant-specific field report for vaginal infections.

Figure 4.10. Plant species reported frequently for vaginal infections (participants, n = 237).



Opuntia ficus-indica

The most frequently reported plant to treat vaginal infections was *tuna* or *alquitira* (*Opuntia ficus-indica*) (Figure 4.10). It was reported by 54 of the individuals who reported a plant for this condition (35%, n = 156). This plant was often found cultivated in home gardens.

The *penca* (cactus pad or cladophyll) was used fresh and prepared carefully by removing the spines and peeling it. Different amounts were used ranging from a half to an entire cladophyll. A common form of measurement was *tres dedos* of the *penca*, which is the width of the three middle fingers held together. It was boiled in approximately one liter of water for 10 minutes and then strained. One cup of tea was administered daily or could also be used as a vaginal wash after bathing. Another popular preparation was to remove the *cristal* (viscous pulp) from the cladophyll and place a coating on the bottom panel of underwear. *Opuntia ficus-indica* was considered to refresh and remove infections. It was explained that this plant was often prepared alone because of its *babosa* (mucous) quality; however, it was also prepared in mixtures, often with *Spermacoce assurgens*. Women also reported that it was used as an anti-inflammatory. Other studies (Estévez and Báez 1998; Rodríguez Martínez 1999) have reported the use of *O. ficus-indica* for vaginal infections.

Spermacoce assurgens

The second most frequently reported plant to treat vaginal infections was *juana la blanca* (*Spermacoce assurgens*). It was reported by 44 respondents (28%, n = 156). *Spermacoce assurgens* was widespread, often growing along trails and roadsides.

The entire plant was used for teas though some individuals use only the leaves. It was often prepared as a mixture with either *Opuntia ficus-indica*, *Plantago major*, or *Ruellia tuberosa*; all three plants were reported to remove infections. Women in the study sites reported that *juana la blanca* cleansed and removed infections. In addition, it was used for kidney problems (*problemas con los riñones*) because it caused frequent urination. Brendbekken (1998) also reported the use of this plant for kidney problems and as an ingredient in *botellas.*

Kalanchoe gastonis-bonnieri

The use of *mala madre* (*Kalanchoe gastonis-bonnieri*) was reported by 43 individuals for vaginal infections (28%, n = 156). A common remedy reported was a tea and vaginal wash for this health condition. One to three leaves were used fresh with other plants, such as *Plantago major* and *Spermacoce assurgens*. The plants were placed in two liters of water and boiled down to one liter. Some women also added salt to the mixture. This plant was described as *fresca* (fresh). One woman considered *mala madre* to be an antibiotic.

In Río Limpios, *mala madre* was used in treating the *ovarios* (ovaries), the *madre* (uterus), and the *padrejón* (the male equivalent of a uterus) (Brendbekken 1998). *Kalanchoe gastonis-bonnieri* has been reported in Dominican ethnobotanical literature as a wash for vaginal infections (Polanco 1991; Robineau 1991, 1995).

Aloe vera

Sábila (aloe, *Aloe vera*) is a well-known medicinal plant in the Dominican Republic. The smaller plants with white spots were thought to bring good luck and were often hung near the front door of a home because they can survive for a long time without water. Nineteen percent of the study participants who mentioned a plant-specific field report suggested *sábila* (30, *n* = 156).

For vaginal infections, the *cristal* (gelatinous plant material inside the leaf) was formed in the shape of an *ovulo* (vaginal suppository) and used as a vaginal suppository. It was administered at night. The *cristal* was also placed in underwear as indicated above for *Opuntia ficus-indica*. Another remedy reported was a tea mixture prepared by boiling the *penca* of *tuna* and the *cristal* of *sábila* in approximately one liter of water until the water boiled down to half a liter. The tea was taken one to three times daily for vaginal infections. Women claimed that it cleansed and refreshed the vagina, alleviated pain, and removed the infection as well as prevented further infections. This remedy was used from one to three weeks or until the infection was healed. Thirty individuals reported the use of *sábila* to treat vaginal infections (19%, *n* = 156).

In the Dominican literature, *Aloe vera* has also been reported for colds and high fevers (Brendbekken 1998) and as an emmenagogue (Estévez and Báez 1998; Rodríguez Martínez 1999).

Salient women's health conditions

In this study, consensus or agreement among participants is interpreted "as a measure of cognitive salience, and hence cultural significance" (Alexiades 1999: 303). I explore the cultural importance or salience of each health condition using four different variables to compare consensus. The results are summarized in Table 4.8.

Table 4.8. Cultural significance of 10 women's health conditions in the provinces of La Vega and San Cristóbal, Dominican Republic (participants, *n* = 237).

Women's Health Conditions	Total Field Reports[a]	Plant-specific Field Reports	Plant Species (No.)	Percentage of Participants	IAR[b]	Most Frequently Reported Medicinal Plant
Postpartum care	795	704	139	48	0.83	*Agave antillarum* Descourt *Matricaria recutita* L. *Illicium verum* Hook.f.
Vaginal infections	617	583	117	68	0.81	*Opuntia ficus-indica* (L.) Mill. *Kalanchoe gastonis-bonnieri* Raym.-Hamet & H. Perrier *Spermacoce assurgens* Ruiz & Pav.
Suspended menses	479	402	111	48	0.77	*Momordica charantia* L. *Catalpa longissima* (Jacq.) Dum. Cours. *Matricaria recutita* L.
Infertility	440	398	127	16	0.71	*Matricaria recutita* L. *Ruellia tuberosa* L. *Illicium verum* Hook.f. *Securidaca virgata* Sw.
Menstrual cramps	360	339	94	52	0.74	*Matricaria recutita* L. *Cinnamomum verum* J. Presl *Coffea arabica* L. *Kalanchoe gastonis-bonnieri* Raym.-Hamet & H. Perrier
Fibroids	294	269	78	42	0.74	*Saccharum officinarum* L. *Beta vulgaris* L.
Hot flashes	227	205	92	24	0.60	*Genipa americana* L. *Opuntia ficus-indica* (L.) Mill. *Peperomia pellucida* (L.) Kunth
Morning sickness	202	160	79	38	0.61	*Citrus aurantium* L. *Psidium guajava* L.
Excessive menses	201	186	71	38	0.65	*Cinnamomum verum* J. Presl *Plantago major* L. *Coffea arabica* L.
Pregnancy prevention	57	51	38	8	0.34	*Catalpa longissima* (Jacq.) Dum. Cours. *Pinus caribaea* Morelet

[a]Ordered by number of total field reports
[b]IAR=Informant Agreement Ratio

The number of total field reports cited for a health condition refers to the number of plants and remedies mentioned to treat a health condition. In some cases, only the name of a remedy was mentioned such as a *botella* but the individual interviewed did not know the plant ingredients used to prepare this mixture. The number of plant-specific field reports refers only to the field reports of plants. The number of plant species reported to treat a condition is defined as the total number of species cited to treat a health condition. The percentage of participants who reported an herbal remedy for a health condition is the number of individuals that were able to mention at least one plant or remedy for a health condition.

The Informant Agreement Ratio (IAR) is an index devised by Trotter and Logan (1986) that shows the degree of consensus among informants about favored remedies or plants for the treatment of specific conditions or ailments. The maximum IAR is equal to one, which means complete agreement of a remedy or plant for a specific condition; in other words, individuals use the same species for the same condition. The more times a plant is reported for a specific condition, the more likely that it is a favored remedy for that health condition. Trotter and Logan (1986) used this index to identify effective traditional medicines for specific health ailments among Mexican Americans. The ratio is calculated using the following formula:

$$IAR = \frac{Na - Nra}{Na - 1}$$

Na = total number of field reports for a condition
Nra = total number of distinct plant species cited for that condition

An IAR value of zero occurs when there are as many different reported plants as there are responses to a health condition. This means there is high variation of species reported for a condition and may suggest that few plants are effective, plant selection is random, or traditional treatments for a condition are not freely exchanged among informants.

Table 4.8 shows that postpartum care had the greatest number of field reports (795) of all 10 health conditions, however vaginal infections had the greatest percentage of participants (68%) who reported a plant or remedy. Both these health conditions had IAR values close to 1.0 suggesting a high degree of agreement on the plants used for these two conditions among individuals studied in the four communities.

Table 4.9 shows how the health conditions rank using each separate variable and shows a combined overall rank. Comparing the number of total field reports for each health condition produces the following ranking: postpartum care (795) > vaginal infections (617) > suspended menstruation (479) > infertility (440) > menstrual cramps (360) > fibroids (294) > hot flashes (227) > morning sickness (202) > excessive menstruation (201) > pregnancy prevention (57). The health conditions with the highest number of field reports were postpartum care followed by vaginal infections. Pregnancy prevention showed the lowest number of field reports. These numbers may be misleading because some conditions may be well-known by many people and therefore there will be a higher number of field reports associated with them. To give a more complete representation of the data it is useful to compare the other variables.

Table 4.9. Frequency variables (number of field reports, number of plant species, percentage of knowledgeable participants, Informant Agreement Ratio) compared for 10 women's health conditions.

	Rank by Frequency Variables					
Health Condition	Total Field Reports	Plant Species	Percentage of Participants	IAR[a]	Total (sum)	Overall Rank[b]
Postpartum care	1	1	3	1	6	1
Vaginal infections	2	3	1	2	8	2
Suspended menses	3	4	3	3	13	3
Menstrual cramps	5	5	2	4	16	4
Infertility	4	2	7	5	18	5
Fibroids	6	8	4	4	22	6
Hot flashes	7	6	6	8	27	7
Morning sickness	8	7	5	7	27	7
Excessive menses	9	9	5	6	29	8
Pregnancy prevention	10	10	8	9	37	9

[a]IAR=Informant Agreement Ratio
[b]1=highest salience.

The number of plant species provides another way to compare health conditions (Table 4.9). Using this parameter, conditions are ranked as follows: postpartum care (139) > infertility (127) > vaginal infections (117) > suspended menstruation (111) > menstrual cramps (94) > hot flashes (92) > morning sickness (79) > fibroids (78) > excessive menses (71) > pregnancy prevention (38). The most salient condition with this consensus parameter is postpartum care followed by infertility. Both these conditions are frequently treated with *botellas*, which contain large numbers of plant species and may explain the high values for these conditions.

Table 4.9 also shows the percentage of participants who reported an herbal remedy, which produced a slightly different ranking of the health conditions (percentage based on total participants, *n* = 237): vaginal infections (68%) > menstrual cramps (52%) > suspended menstruation (48%) = postpartum care (48%) > fibroids (42%) > excessive menstruation (38%) = morning sickness (38%) > hot flashes (24%) > infertility (16%) > pregnancy prevention (8%). The condition with the highest percentage of participants who reported a remedy is now vaginal infections followed by menstrual cramps. These conditions are considered well-known because there is a greater number of study participants who reported a remedy or plant to treat the condition. Postpartum healing is now fourth in the ranking and pregnancy prevention is again last. A low percentage (16%, *n* = 237) of participants was able to report an herbal remedy for infertility. The few participants, usually healers, who reported treatments for this condition were able to report high numbers of plants. As stated above, this condition is often treated with a *botella*. The percentage of participants who were able to report an herbal remedy was below 50% for all health conditions, except vaginal infections and menstrual cramps. This may be explained by the diversity of individuals in the sample, including all ages of women with diverse levels of medicinal plant knowledge. In Chapter 5, I will examine these variations by comparing study sites and individual differences.

Prioritizing conditions by IAR values results in the following order (Table 4.9): postpartum care (0.83) > vaginal infections (0.81) > suspended menstruation (0.77) > menstrual cramps (0.74) = fibroids (0.74) > infertility (0.71) > excessive menstruation (0.65) > morning sickness (0.61) > hot flashes (0.60) > pregnancy prevention (0.34). Using IAR values, postpartum care ranks as the most salient condition followed closely by vaginal infections. Pregnancy prevention remains the least salient health condition. High IAR values suggest that there is high agreement (or low variance) about treatments used for a particular health condition.

According to the analysis in Table 4.9, the most salient and therefore culturally significant health conditions are postpartum care followed by vaginal infections. Suspended menstruation is ranked in third place followed by menstrual cramps, then infertility and fibroids. Pregnancy prevention has the lowest ranking in all four categories. Pregnancy prevention had a low consensus for traditional remedies, although women did mention contraceptive pills or condoms as preventative treatments. There are a several reasons that may explain why pregnancy prevention was the least salient health condition. It may be a condition that is not commonly treated by traditional medicine and therefore is not well known. Perhaps women did not want to share this kind of information with me because of concern that I might use a treatment incorrectly. If I had inquired about plants used as abortifacients I might have been able to better understand and explain the low percentage of women who reported an herbal remedy for pregnancy prevention.

Broader women's health categories

I divided the health conditions into two broad categories based on the biomedical viewpoint of obstetric and gynecologic conditions to show the distribution of field reports for each condition in the study (Table 4.10). The conditions in this study that fall under the category of obstetric conditions include postpartum care and morning sickness. Gynecologic conditions include menstruation (excessive, suspended, cramps), hot flashes, infertility, fibroids, vaginal infections, and pregnancy prevention.

Table 4.10. Number of total field reports for 10 women's health conditions (participants, *n* = 237).

Health Condition	Number of Field Reports			Percentage
	Plant	Other	Total	
Gynecologic conditons				
Excessive menses	186	15	201	5
Menstrual cramps	339	21	360	10
Suspended menses	402	77	479	13
Vaginal infections	583	34	617	17
Fibroids	269	25	294	8
Hot flashes	205	22	227	6
Infertility	398	42	440	12
Pregnancy prevention	51	6	57	2
TOTAL	2433	242	2675	73
Obstetric conditions				
Morning sickness	160	42	202	6
Postpartum care	704	91	795	22
TOTAL	864	133	997	27
TOTAL	3297	375	3672	100

Field reports of herbal remedies for gynecologic conditions represented the largest category in this study (73%, field reports n = 3672) and included eight of the health conditions. Field reports of herbal remedies for obstetric conditions represented 27% of all the field reports (n = 3672). The largest percentage of field reports (22%) was mentioned for postpartum treatment. Vaginal infections had 617 field reports representing 17% of the total number of reports. As discussed earlier, both postpartum and infertility treatments are composed of complex mixtures of plants, which helps to increase the number of field reports for those conditions.

Salient treatments: remedies and plants

As discussed above consensus is explored as a measure of cultural significance. Frequently reported traditional therapies used for Dominican women's medicine in the provinces of La Vega and San Cristóbal will be discussed in this section, including complex mixtures compared with individual plant preparations, frequently reported mixtures, frequently reported plants, and plants reported in all four study sites.

Frequently reported remedies

Dominican traditional medicines include plants and processed plant products, as well as other ingredients. Processed plant products such as molasses, rum, gin, or *malta* (a malted barley beverage) were part of herbal mixtures, particularly *botellas* or *bebedizos,* which will be discussed in more detail below. Other ingredients included in traditional remedies were calcium, iron, milk of magnesium, salt, human urine, eggs, as well as other items listed in Appendix H. In this study I classify processed plant products and other ingredients as non-herbal ingredients.

Individual plants versus mixtures

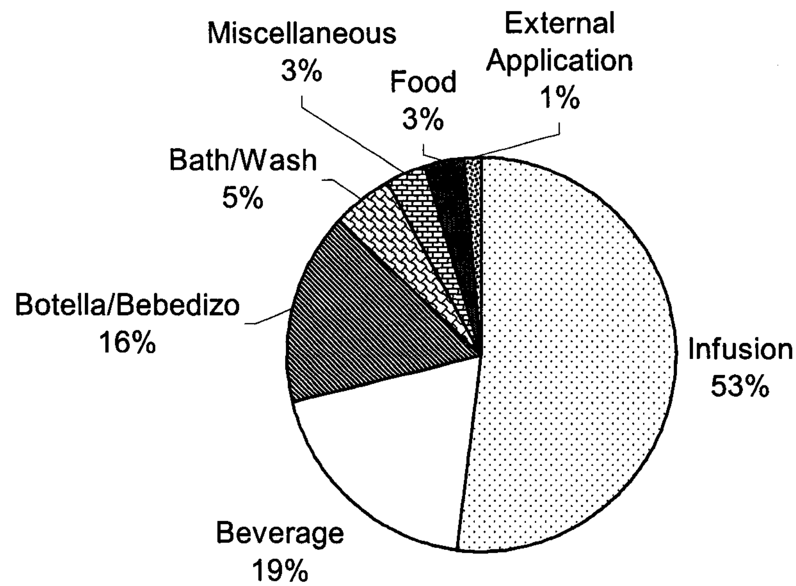
Traditional ethnobotanical studies tend to list individual plants and their uses. Usually one plant has a list of many uses and ailments. This provides a false representation that all plants are used individually. Although this may be the case for some remedies, medicinal plants are commonly used in mixtures or formulas. Little attention has been given to formulas and mixtures reported in ethnobotanical literature perhaps because it is difficult to code and analyze such data.

In the survey, a health condition was used to elicit plants and herbal formulas. This framework helped to understand patterns of plant use for specific health conditions. For example, coding mixtures may demonstrate synergies or complexes of plants that are commonly used together. In addition, two different plants may always be prescribed together or there may be plants that are only used individually.

A total of 1093 remedies were documented, of which 112 had ingredients that I was not able to collect and identify, resulting in a total of 981 remedies with identified ingredients. Of the 981 remedies, 57 did not include any plants. Plants were defined as the actual plant itself and did not include processed plant products such as sugar, rum, and gin in this analysis. The only exception to this classification was molasses (*Saccharum officinarum*), which is a processed plant product that was categorized as a plant because it was treated the same way in the study of Dominican women's medicine by Balick and coauthors (2000). Of the 924 remedies with plants, 482 were mixtures of two or more plants and 442 were single plant remedies. The remedy with the highest number of plants was a *botella* reported in Los Calabazos that included 55 plants. The most frequently reported mixture was also a *botella*. Forty percent of the women who reported a *botella* were not able to describe the plants used or the preparation. They often knew about the *botella* from a family member.

I classified remedy preparations into the following groups: infusion, beverage, bath/wash, *botella/bebedizo*, food, external applications, and miscellaneous. Figure 4.11 shows the distribution of remedies reported for all 10 health conditions. Remedies consisted primarily of medicinal plants prepared as infusions (53%), *botellas/bebidizos* (16%), and beverages (19%). Infusions, including teas and coffees, were the most common remedy preparation reported in the interviews. To make infusions, plants were either steeped in water or coffee. Some women referred to plants steeped in water as a *tisana*. The *botella* or *bebedizo* represented the second most frequently reported remedy.

Figure 4.11. Remedy categories used for Dominican women's traditional medicine.



Infusion (té, café, tisana): preparation of herbs as tea, coffee, or *tisana*; ***Beverage (bebida, agua de coco, jugo, vino, trago, zumo, purgante)***: fruit juice, coconut water, wine, herbal tincture, expressed plant liquids, and herbal purgative; ***Botella/Bebedizo***: herbal mixture prepared as a decoction that includes non-herbal ingredients such as honey and gin and stored in a bottle; ***Bath/Wash (baño, lavado, vapor)***: infusion of herbs used as a wash or bath or sat over to absorb vapors; ***Food (comida)***: medicinal plants eaten or cooked as a food such as a fruit or soup; ***Miscellaneous (jarabe, mastica, olor/vapor, ovulo, vitamina)***: medicated syrup, herbal chew, inhalant, vaginal suppository, and vitamins; and ***External application (jabón, collar)***: soaps and necklace.

Botellas and bebedizos: a common traditional Dominican remedy

The *botella* or *bebedizo* is a well-known Dominican remedy; it is a traditional brew used to treat a variety of ailments, such as infertility, kidney problems, postpartum healing, and *enfermedades de la calle* (venereal diseases). Several different kinds of *botellas* exist for different ailments. Other studies have also reported the use of this remedy by Dominicans (Brendbekken 1998; Davis 1987; González Canalda 1972; Rodríguez and Colectivo Mujer y Salud 1994). Both in urban and rural areas it is recognized as a powerful treatment for many different health conditions.

The mixture is prepared from numerous plants as well as ingredients from pharmacies and food markets. *Mamajuana* is a particular kind of *botella* that is a tincture rather than a cooked brew. It was commonly sold in city markets as a general tonic and for male virility. Leaves, roots, branches, and stems are chopped and inserted into a glass bottle, often a recycled wine or rum bottle, and then alcohol, usually rum, is added. The tincture, depending on the desired strength, is usually left to sit for a few hours, days, or weeks before it is drunk. Each person who makes *botellas* has a slightly different style and method of preparation. During my field work I tasted different *botellas*. Some tasted sweet, others bitter, some were viscous, and others less viscous.

The brew usually contains a minimum of seven plants and can contain more than 30 different plant species in addition to non-botanical ingredients. The mixtures depend on the ailment being treated, availability and accessibility of medicinal plants, and the recipe of the healer. As would be expected, each healer has a slightly different way of preparing a *botella*.

One incident from my field work illustrates the individual variations of preparing a *botella*. As I recorded R1M0006 making his *botella* R1F0009 came by to watch. She told me that R1M0006 added too much *cañafístula* (*Cassia* *fistula* L., Fabaceae) and *sen* (*Senna alexandrina* Mill., Fabaceae) and it causes one to "*corre demasiado*" (have too much diarrhea). Her *botellas* included smaller amounts of those two plants.

Despite such differences, there are key plants used consistently in *botella* preparation. I define key plants as those reported by five or more specialists for *botella* preparation. Table 4.11 lists these key plants. Healer R2F0035 stressed the importance of two plants by saying that she would not prepare a *botella* if she could not collect *maravelí* (*Securidaca virgata*) and *maguey* (*Agave antillarum*). She said these plants were essential for a *botella*. As discussed above these plants are uncommon and must be purchased or collected from far distances; such factors contribute to the price of the *botella*.

Table 4.11. Plant species frequently reported by healers (n = 11) for *botellas.*

Plant Family	Scientific Name {Voucher}[a]	Number of Field Reports[b]	Number of Healers
Polygalaceae	*Securidaca virgata* Sw. {140, 208, 432, 504, PV46}	34	11
Asteraceae	*Matricaria recutita* L. {R72, R76, R163}	32	8
Illiciaceae	*Illicium verum* Hook.f. {R74}	31	8
Acanthaceae	*Ruellia tuberosa* L. {160, 356}	30	8
Lamiaceae	*Lavandula angustifolia* Mill. {R75}	30	7
Smilaceae	*Smilax domingensis* Willd. {171, 534}	26	6
Arecaceae	*Roystonea hispaniolana* L. H. Bailey {PV154}	25	6
Rubiaceae	*Spermacoce assurgens* Ruiz & Pav. {128, 142, 178, 390, 509}	25	6
Piperaceae	*Pothomorphe umbellata* (L.) Miq. {138, 182, 393}	24	5
Arecaceae	*Prestoea montana* (Graham) G. Nicholson {PV101}	22	6
Urticaceae	*Urera baccifera* (L.) Gaudich. ex Wedd. {293}	21	5
Boraginaceae	*Tournefortia hirsutissima* L. {290}	18	5
Agavaceae	*Agave antillarum* Descourt. {241, 378, PV138}	17	6
Fabaceae	*Cassia fistula* L. {R3, R78}	15	6
Fabaceae	*Senna alexandrina* Mill. {R153, R71}	15	6
Myristicaceae	*Myristica fragrans* Houtt. {R138}	14	5

[a]All numbers are A. Ososki collections
[b]Ordered by number of field reports

Collecting plants for a *botella* can take several days because some plants are collected in remote regions and other ingredients such as gin and honey must be purchased. After the plants have been collected, the basic process of making a *bebedizo* takes roughly three to five hours. The roots and large plant parts are coarsely chopped and then carefully washed. A large *pilón* (cauldron) is filled with water and heated as the plants are added. After approximately two to three hours of boiling, the mixture turns a dark coffee color and is ready to be strained.

The liquid is strained and placed in a separate pot; the plant parts are discarded. At this point, one healer uses a slightly different preparation. She crushes the herbs from the pharmacy (e.g., seeds of *Illicium verum* and *Pimenta dioica*) and adds them to the strained liquid. The empty cauldron is put back on the heating source and either honey or sugar are added and heated until the honey boils or the sugar caramelizes. In La Colonia, the *botellas* tend to be made with honey and in Los Calabazos they are usually made with raw sugar as opposed to white, refined sugar. The dark, strained liquid is then poured back into the *pilón* with the heated honey or sugar. One or two bottles of *malta* (malted barley beverage) are then added to the mixture. There are several kinds of *maltas*: *Malta Morena*, *Malta India*, and *Malta Alemana*. I saw some *botellas* prepared with only *Malta Morena* and others only with *Malta Alemana*. In addition, grated nutmeg might be added. Once the mixture has cooled, alcohol, either gin or rum, is added directly to the mixture, or sometimes the mixture is bottled and alcohol is then added to each bottle. Healers mentioned that the alcohol acts as a preservative and adds flavor.

The *botella* is administered for one to two weeks. A *tazita* or small cup, such as an espresso coffee cup, is taken three times a day. This amount may also be expressed as *tres dedos de una taza* (three fingers of a cup); the three middle fingers held together to indicate the depth of liquid in a cup.

Due to the extensive preparation, a *botella* can range in price from 50 pesos to 200 pesos (approx. US$3 to $12, exchange rate in 2000-2001: $1 = 17 pesos). The price depends on who prepares it and where they live. The *botellas* are more costly in urban areas than rural areas because it is more difficult to collect plants and many need to be purchased. Most healers are considerate and will also suggest that a person pay what they can afford.

Frequently reported plants for women's health

Most frequently reported plants

Table 4.12 shows the most frequently reported plants from the surveys with generalists and specialists in the four study sites. These plants were reported 100 times or more. Four of these plants were reported for all 10 health conditions and two plants were reported for all health conditions but pregnancy prevention.

Table 4.12. Most frequently reported plants for Dominican women's medicine.

Scientific Name [Family] {Voucher}[a]	Number of Health Conditions	Total Field Reports
Matricaria recutita L. [Asteraceae] {R163, R72, R76}	10	142
Spermacoce assurgens Ruiz & Pav. [Rubiaceae] {128, 142, 178, 390, 509}	10	116
Opuntia ficus-indica (L.) Mill. [Cactaceae] {257, 274, PV53, PV72}	10	105
Kalanchoe gastonis-bonnieri Raym.-Hamet & H. Perrier [Crassulaceae] {363, 376, PV148, PV57}	10	102
Agave antillarum Descourt. [Agavaceae] {241, 378, PV138}	9	104
Cinnamomum verum J. Presl [Lauraceae] {R133}	9	100

[a]All numbers are A. Ososki collections

Manzanilla (chamomile, *Matricaria recutita*) was the most frequently reported plant with 142 field reports and was predominately used for menstrual cramps, postpartum care, and suspended menstruation. It is a well-known medicinal plant that is used by women around the world (Blumenthal *et al.* 2003). While *Matricaria recutita* has a wide spread use in the Dominican Republic and abroad, *Spermacoce assurgens* appears to be specific to the Dominican Republic (Aquino Morillo *et al.* 1986). The study participants primarily used *S. assurgen* for vaginal infections. This plant species is less well-known as a medicinal plant. Other species of *Spermacoce* have been reported in use elsewhere in the literature. For example, in Nicaragua *S. confusa* Rendle is boiled as a tea with *Chamaesyce thymifolia* (L.) Millsp. (Euphorbiaceae) for uterine pain (Barrett 1994) and the root of *S. laevis* Lam. is prepared in a tea for mental depression (Chhabra *et al.* 1991) in eastern Tanzania.

Opuntia ficus-indica and *Kalanchoe gastonis-bonnieri* were reported frequently in remedies for treating vaginal infections. They tended to be cultivated in women's home gardens. *Maguey* (*Agave antillarum*) was reported often for postpartum care and could be collected in the wild, cultivated, or purchased from medicinal plant vendors. The other plant that was reported frequently is *canela* (cinnamon, *Cinnamomum verum*), which was purchased at pharmacies or food markets. *Canela* was typically used with other plants as a tea to treat menstrual cramps.

Plants reported in all four communities

Evaluating cultural significance or importance can also be done by comparing plants that are independently reported in all four study sites for the same health condition. Table 4.13 shows a list of these plants. Table 4.13 contains many of the plants that have been discussed in earlier sections of this chapter.

Table 4.13. Plants reported in all four study sites to treat the same health condition(s) (participants, *n* = 237).

Scientific Name [Family] {Voucher}[a]	Field Reports	Health Condition[b]
Agave antillarum Descourt. [Agavaceae] {241, 378, PV138}	104	1, 6, 7
Allium sativum L. [Liliaceae] {PV157}	18	1
Aloe vera (L.) Burm.f. [Asphodelaceae] {PV10, PV124, PV139, PV87, R105}	58	1
Ambrosia artemisiifolia L. [Asteraceae] {338, 371, 419}	48	5
Argemone mexicana L. [Papaveraceae] {247, PV141, PV153, PV73}	65	1, 8
Beta vulgaris L. [Chenopodiaceae] {PV168}	69	8
Bixa orellana L. [Bixaceae] {260, 320, PV151, PV50}	31	1
Canavalia nitida (Cav.) Piper [Fabaceae] {R83}	8	4
Cinnamomum verum J. Presl [Lauraceae] {R133}	100	2, 4, 5, 6, 10
Coffea arabica L. [Rubiaceae] {PV160}	64	4, 5
Crescentia cujete L. [Bignoniaceae] {267, R42}	34	6, 7
Illicium verum Hook.f. [Illiciaceae] {R74}	83	5, 6
Kalanchoe gastonis-bonnieri Raym.-Hamet & H. Perrier [Crassulaceae] {363, 376, PV148, PV57}	102	1, 6
Lavandula angustifolia Mill. [Lamiaceae] {R75}	54	6
Matricaria recutita L. [Asteraceae] {R72, R76, R163}	142	5, 6, 10
Opuntia ficus-indica (L.) Mill. [Cactaceae] {257, 274, PV53, PV72}	105	1
Persea americana Mill. [Lauraceae] {322, 324, PV13}	29	10
Petiveria alliacea L. [Phytolaccaceae] {136, 252}	56	1
Pimenta dioica (L.) Merr. [Myrtaceae] {R132}	17	4
Plantago major L. [Plantaginaceae] {273, 436, PV59, PV81, PV147}	87	1
Ruellia tuberosa L. [Acanthaceae] {160, 356}	83	1, 9
Ruta chalepensis L. [Rutaceae] {339, 407, PV56}	30	10
Saccharum officinarum L. [Poaceae] {321, 450, PV175}	97	8
Securidaca virgata Sw. [Polygalaceae] {140, 208, 432, 504, PV46}	57	6
Senna alexandrina Mill. [Fabaceae] {R153, R71}	34	6
Spermacoce assurgens Ruiz & Pav. [Rubiaceae] {128, 142, 178, 390, 509, PV62}	116	1, 5, 6

[a]All numbers are A. Ososki collections

[b]1 = vaginal infections; 2 = morning sickness; 4 = excessive menstruation; 5 = menstrual cramps; 6 = postpartum care; 7 = infertility; 8 = fibroids; 10 = suspended menstruation

Allium sativum and *Bixa orellana* were reported in each community to treat vaginal infections because these plant species were considered effective against infections. The leaves of *Ambrosia artemisiifolia* were steeped in a cup of strong coffee for menstrual cramps. For suspended menstruation, the leaves of *ruda* (garden rue, *Ruta chalepensis*) were also steeped in coffee. *Canavalia nitida* was reported in all four communities for excessive menstruation because it *cierra la cadera* (closes the hips). *Pimenta dioica* was also used to slow a heavy menstrual flow. The preparation of both these plants was discussed above for excessive menstruation and menstrual cramps. *Lavandula angustifolia* and *Senna alexandrina* were common plants used in the preparation of *botellas* taken during the postpartum period.

Cinnamomum verum was reported for the same five health conditions in all four communities, while *Matricaria recutita*, *Spermacoce assurgens*, and *Agave antillarum* were reported in common for three conditions. Individuals interviewed in all four communities demonstrated agreement on plants for all 10 women's health conditions, except pregnancy prevention and menopause. This analysis provides an additional approach to evaluating the role and function of plants in women's medicine in the Dominican Republic. In addition, it demonstrates the breadth and variety of uses of individual plants.

General botanical trends

A total of 205 plant species were documented for the 10 women's health conditions, including 70 plant families. I made a collection of over 400 herbarium specimens, 193 digital photographs of plants that were not made into herbarium specimens as there was only a single plant in a participant's home garden, and 173 reference collections consisting of ingredients purchased from supermarkets and pharmacies to voucher this research. Table 4.14 lists the number of genera and species for botanical families reported for women's medicine. Forty-four percent of the plant families are represented by one species and are not included in Table 4.14.

Plant families

The salient families for women's traditional medicine based on the number of genera and species are the following: Fabaceae, Lamiaceae, Apiaceae, Rubiaceae, Verbenaceae, Malvaceae, Poaceae, Asteraceae, and Myrtaceae. A high number of reported medicinal plants in this study belong to the Fabaceae family (20 reported genera and 13 reported species), which is interesting to note because this family is recognized in women's health for its concentration of phytoestrogens that have been found in soy (*Glycine max*) and red clover (*Trifolium pratense* L., Fabaceae). Some of the plant families are expected, due to their abundance and economic importance, such as Apiaceae and Rubiaceae. Others, such as Malvaceae, Verbenaceae, and Myrtaceae may suggest selection due to efficacy for women's health conditions. Other families and genera not detected in the four study sites due to geographical constraints may also be valuable for women's health in the Dominican Republic.

Table 4.14. Plant families reported for Dominican women's traditional medicine.

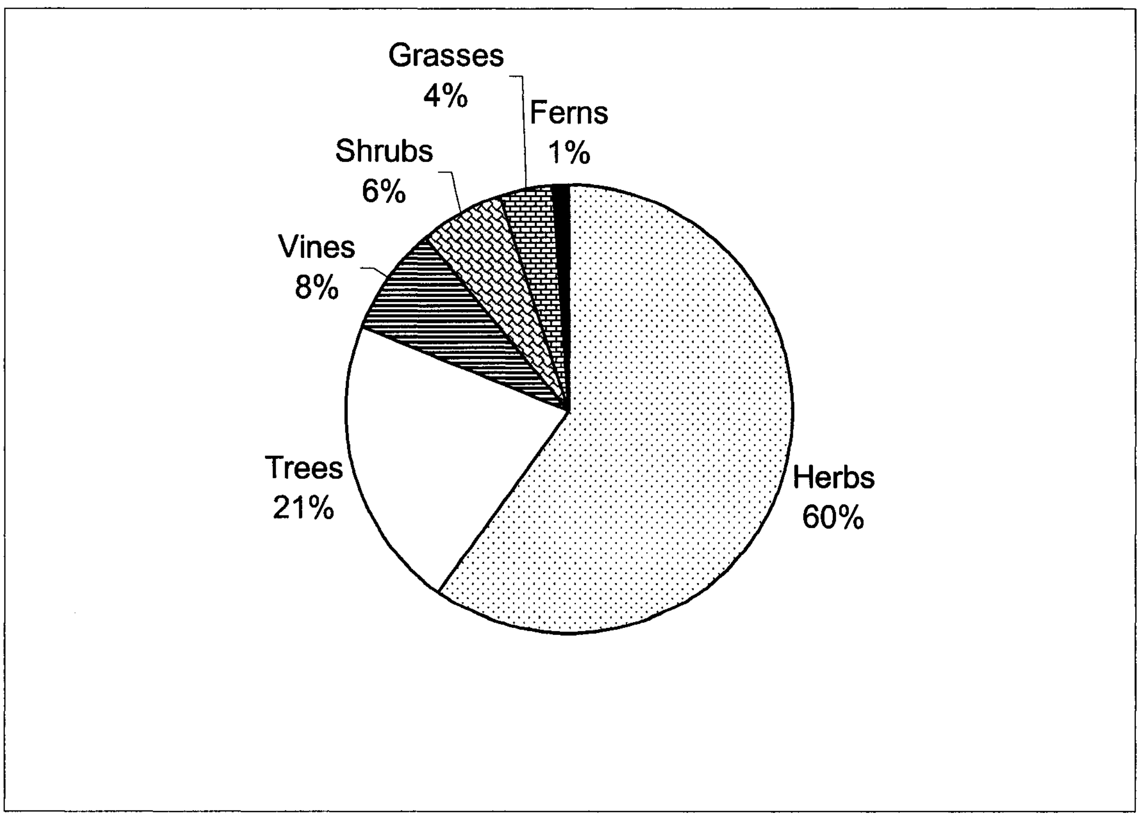
Family	Genus Total	Species Total
Fabaceae	16	20
Lamiaceae	7	9
Apiaceae	8	8
Rubiaceae	7	8
Verbenaceae	5	8
Malvaceae	7	7
Poaceae	7	7
Asteraceae	6	7
Myrtaceae	5	7
Euphorbiaceae	4	5
Piperaceae	3	5
Rutaceae	3	5
Solanaceae	2	4
Amaranthaceae	3	3
Arecaceae	3	3
Bignoniaceae	3	3
Chenopodiaceae	3	3
Cucurbitaceae	3	3
Meliaceae	3	3
Anacardiaceae	2	3
Clusiaceae	2	3
Zingiberaceae	2	3
Agavaceae	2	2
Brassicaceae	2	2
Commelinaceae	2	2
Lauraceae	2	2
Oxalidaceae	2	2
Polygalaceae	2	2
Pteridaceae	2	2
Rosaceae	2	2
Scrophulariaceae	2	2
Smilacaceae	2	2
Sterculiaceae	2	2
Tiliaceae	2	2
Urticaceae	2	2
Acanthaceae	1	2
Annonaceae	1	2
Crassulaceae	1	2
Liliaceae	1	2
Malpighiaceae	1	2
Musaceae	1	2

Passifloraceae	1	2
Pinaceae	1	2

Medicinal plant habits

Figure 4.12 shows the habits of medicinal plants used for women's health in the Dominican Republic. The classification is based on personal observation. The percentages in Figure 4.12 are based on 3297 plant-specific field reports. Herbs (60%) were the most frequently reported form of medicinal plant followed by trees (21%). Some vines (8%), shrubs (6%), grasses (4%), and ferns (1%) were also reported but with less frequency.

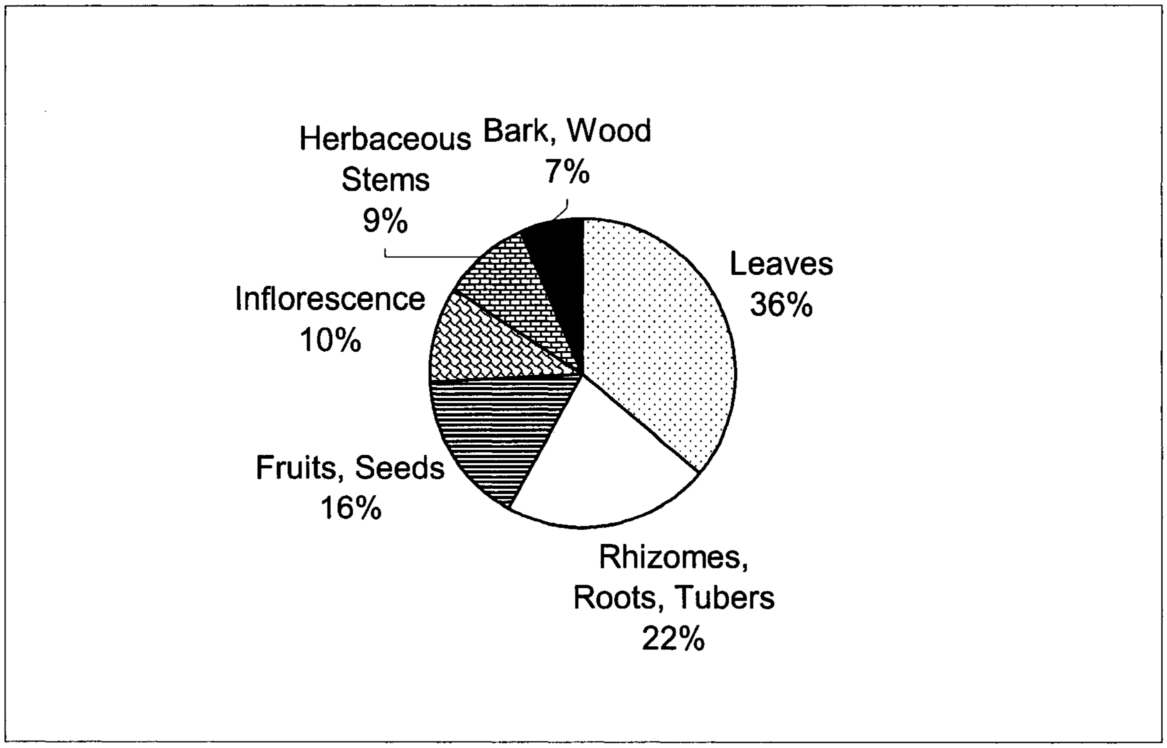
Figure 4.12. Habits of medicinal plants used for Dominican women's traditional medicine.



Medicinal plant parts

Figure 4.13 shows the distribution of medicinal plant parts reported for women's health. The percentages in Figure 4.13 are based on 2657 plant-specific field reports in which a plant part was reported. Leaves (*hojas*) are the most commonly used plant part (36%). Many medicinal preparations use new shoots or leaves, which are called *cogollos* also pronounced as *cojollos.* They are fresh, less damaged than older leaves, and richer in plant compounds (McKey 1974). Roots (*raíces*) and underground plant parts (e.g., *batata*) are also used frequently for women's medicine (22%). Dominican women mentioned that the root is the most powerful part of a plant because the root stores the plant's nutrients; for this reason it is used for strong remedies. Fruits/seeds (16%), inflorescences (10%), and herbaceous stems (9%) were also used in medicinal remedies. Stems included the stems of *Opuntia ficus-indica* known botanically as cladophylls. Wood and bark were also reported in treatments for women's medicine (7%).

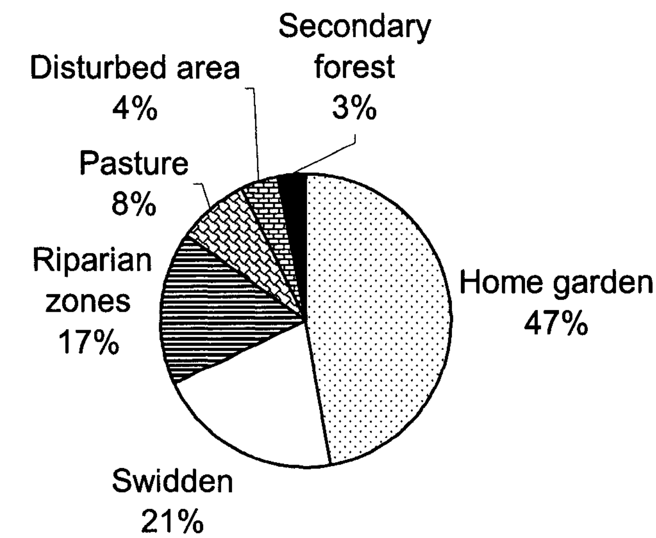
Figure 4.13. Plant parts used for Dominican women's traditional medicine.



Medicinal plant habitats

The distribution of medicinal plant habitats is presented in Figure 4.14. The data is based on the plants reported in remedies and that were collected as vouchers (n = 2084). The habitat categories are based on observations while collecting the plants and field reports from study participants.

Figure 4.14. Habitats of medicinal plants used for Dominican women's traditional medicine.



Home garden: the area surrounding the home, referred to as *patio*, usually had a combination of propagated plants and trees as well as volunteer plants; ***Swidden***: cultivated fields, referred to as *conuco*; ***Riparian zones***: area along a river, including riverbanks and marshes; ***Pasture***: open, grassland where animals were left to graze, sometimes referred to as *monte*; ***Disturbed area***: empty lots, land alongside roads, and common pathways in communities, also could be referred to as *monte*; ***Secondary forest***: secondary vegetation.

The majority of plants inhabited home gardens (47%). Swiddens (21%) and riparian zones (17%) were other habitats where plants were collected. Plants were also collected in pastures (8%), disturbed areas (4%), and in secondary forest (3%). Plants of disturbed areas were found growing spontaneously around apartment buildings, in rural communities, in empty lots, and along roadsides.

The large number of plants collected from home gardens coincides with the fact that individuals are not using rare or endangered species. This is further illustrated by the low percentage of plants collected from wild populations such as secondary forests or riparian zones. The reliance on medicinal plants from home gardens suggests the sustainable use of plant resources employed in the Dominican traditional medical system.

In urban communities, plants tended to be purchased or brought from the countryside after a visit with family. However, urban women living in first floor homes in San Cristóbal or La Vega had small gardens and sometimes cultivated their plants. Figure 4.14 does not include plants that were purchased at supermarkets, pharmacies, and medicinal plant markets because I did not observe where these plants were grown.

Plant collection

As part of the survey, I asked where people collected plants. There were five pre-selected categories: *patio* (home garden), *conuco* (cultivated plot), *loma/monte* (uncultivated areas), *farmacia* (pharmacy), and *mercado* (market). Including all the responses from urban and rural generalists and specialists (n = 237), plants were collected predominately in home gardens (74%) followed by markets (41%). Figure 4.15 shows the distribution of three collection locations for rural and urban communities.

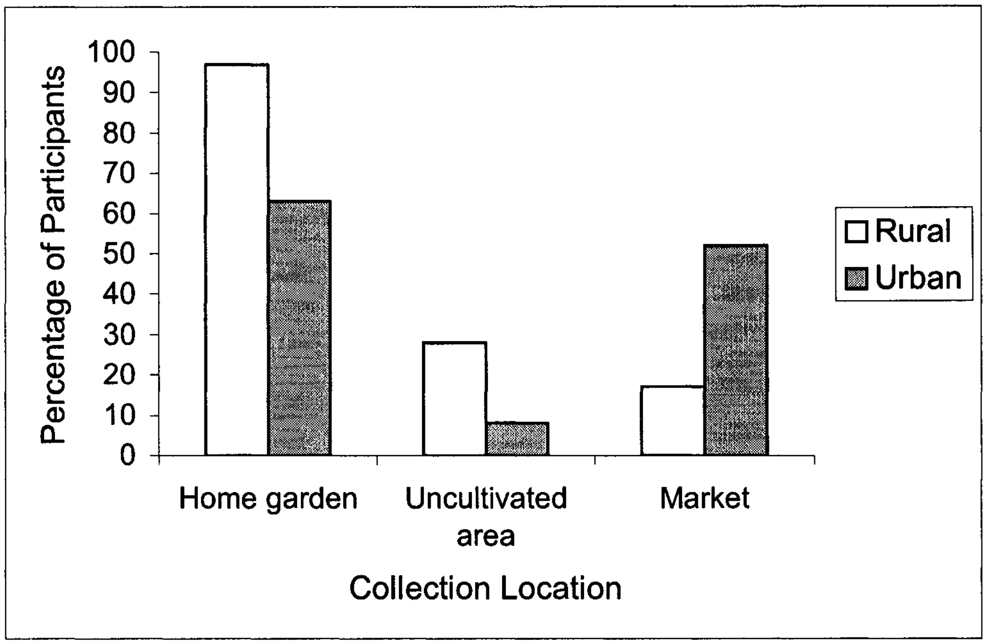


Figure 4.15. Distribution of plant collection locations of generalists and specialists in rural and urban study sites in the Dominican Republic (participants, *n* = 237).

Plants were collected in home gardens by 97% of the rural participants and 63% of the urban participants. A home garden is the predominant collection location for rural and urban Dominicans in this study. A total of 28% of the rural participants collected plants in uncultivated areas versus 8% of the urban participants. In urban communities, 52% of the participants obtained medicinal plants at markets and only 17% of rural women purchased plants at markets. The large percentage of study participants in urban communities that obtained medicinal plants in markets is not surprising because urban individuals have better access to markets than rural individuals.

Another question I asked of each study participant (*n* = 237) was about the time of day to collect medicinal plants. The majority of participants did not have a preference and 43% stated that it is better to collect medicinal plants in the morning. The percentage of urban (42%) and rural (46%) participants that reported collecting plants in the morning was comparable. Several reasons for morning collection were that the plants are *más frescas* (fresher) and the time of day is also *más fresca* (cooler). Collecting plants during the middle of the day is considered to damage a plant and cause it to dry out. They stated that many plants wilt during the strong sun and should not be collected at that time because they are less effective. These explanations of collection time are both out of respect for the plant and for the healing properties of the plant.

The opposite was observed for plant collection with respect to moon phases. Eighteen study participants stated that medicinal plants should not be collected during the *luna nueva* (new moon) because *no tiene fuerza, tiene mucha agua, y se daña la medicina* (they aren't strong, have a lot water, and damage the medicine). Three individuals mentioned that cutting a tree or large plant during the new moon may also damage the plant causing it to dry out and suffer from termite infestations. Two individuals mentioned that seeds should not be sown during the new moon because worms will eat the plants, otherwise. These traditions were reported by a significantly greater number of rural participants (41%) than by urban participants (7%). Some participants mentioned that not collecting medicinal plants during the new moon is a tradition that was practiced in the past and presently Dominicans tend not to adhere to these beliefs.

Discussion

A broad range of plant species and herbal preparations were reported for the 10 health conditions. The number of species reported for each condition varied considerably. Postpartum care had 139 plant species versus 38 plant species reported for pregnancy prevention. This difference may be explained because of the number of plants used in remedies for these conditions and because of the number of participants who were familiar with a remedy for a particular condition. Few participants were able to report a plant or remedy to prevent pregnancy, whereas many knew therapies for postpartum healing. In addition, a *botella* was used as a postpartum treatment, which includes numerous plants while participants tended to prevent pregnancy with a tea made of a single plant.

Botella preparation varied and depended on the preparer, ailment, and region. During interviews, I asked specialists about the origins of the *botella* and how Dominicans learned about it. Many explained that it was a tradition that has been practiced for generations. They usually learned about it from their parents or grandparents who were healers. It would be interesting in future studies to investigate the differences and similarities in *botella* preparations and to further investigate the origin of this treatment.

Culturally significant women's health conditions and plant remedies were discussed in this chapter. I used several forms of consensus to evaluate the health conditions and their traditional treatments. In the provinces of La Vega and San Cristóbal, vaginal infections and postpartum care were the most common women's health conditions. It is not surprising that vaginal infections was one of the more salient women's health condition because it is a health condition that can affect women of all ages. A high number of plant species and herbal remedies were used to treat these conditions in all four communities. *Opuntia ficus-indica* and *Kalanchoe gastonis-bonnieri* were frequently reported for vaginal infections and *Agave antillarum* was used for postpartum healing. Pregnancy prevention was the least well-known condition among study participants, although biomedical forms of contraception were reported.

Conclusion

The results presented in this chapter illustrate women's wealth of knowledge about medicinal plants, as all participants were women except for four male healers. The health conditions represent different times of a woman's life cycle and are not exclusive to reproductive health. This approach offers a broader understanding of the role of traditional medicine and medicinal plants in Dominican women's health. In addition, I present several common themes in Dominican traditional medicine that aid in further defining this medical system. The results presented about Dominican women's medicine provide a basis upon which more in-depth studies can investigate specific women's health conditions and herbal therapies. Studies could evaluate plants that were frequently reported, such as *Kalanchoe gastonis-bonnieri* and *Agave antillarum* for their possible therapeutic effectiveness.

The diversity of healers in this study may be a reflection of the long healing traditions held in the country that were shaped by indigenous, European, and African influences. Further studies with Dominican healers are needed to understand the variation in healing practices. Such investigations could be coordinated to complement health care initiatives in the Dominican Republic.

Women play a vital role in the health care of their families and communities in the Dominican Republic and elsewhere; and therefore, it is essential that they are participants in the planning of health care programs. Understanding the depth and breadth of ethnobotanical knowledge that exists about women's medicine is important for effective health care programs that include traditional knowledge. Documenting the conditions that are treated with medicinal plants and recording common treatments can help to improve health care outreach in rural and urban communities by informing physicians of conditions treated with traditional remedies and of local health care beliefs or illness conceptualizations.

Chapter 5. Women's Medicine in the Dominican Republic II: Intracultural Variation and Ethnobotanical Knowledge

Introduction

In many ethnobotanical studies, reports on plant utilization are presented as homogeneous knowledge, therefore an assumption is made that there is little variation. Ethnobotanical knowledge is diverse and can differ from one individual to another, as well as from one community to another, making it difficult to analyze because of its inherent variable nature. Studying variation gives insight into the distribution and transmission of plant knowledge in a community. A description of these patterns provides a benchmark that future studies can use to evaluate erosion or acquisition of knowledge over time. Research that recognizes local knowledge and studies differences and similarities in traditional knowledge across a community can provide useful information for development projects that work closely with community members to improve conservation, health care, and overall living conditions.

In this chapter, I examine the differences and similarities of plant use and knowledge about women's health in the Dominican Republic using three hypotheses. Comparisons are made at the community level and individual level. To test these hypotheses, I examine the data using different forms of analysis. I also build on previous studies that have used ecological techniques, such as diversity indices and the 'species-area curve,' to evaluate ethnobotanical knowledge (Begossi 1996; Campbell *et al.* 1986; Krebs 1998).

Patterns of plant use and ethnobotanical knowledge

I tested three hypotheses about ethnobotanical knowledge.

> **Hypothesis 1:** The first hypothesis states that the medicinal plant species reported for women's medicine are the same in rural and urban communities, and that any variation is random.
> ***Hypothesis 1a:*** An alternative hypothesis is that rural and urban communities have distinct pharmacopoeias that are specific to each community.
> ***Hypothesis 1b:*** Another alternative hypothesis states that plant species reported for particular treatments in rural communities will be a subset of those species reported in urban communities. The opposite may also be observed.

Hypothesis *1b* that rural women's knowledge will be a subset of urban women's knowledge is based on several assumptions. The intial assumption is that rural women will be more geographically isolated and dependent on their local flora, while women living in urban environments will have better access to medicinal plant markets containing an array of plants from different regions in the Dominican Republic. In addition, women in urban communities will tend to have neighbors from diverse communities and better access to television and other media sources, allowing them more access to new and different plant species and their uses. The opposite may also be true. More plant species may be reported in rural communities because rural women have more access to wilderness and land to grow plants and less access to allopathic medicine than urban women.

Hypothesis 2: The second hypothesis holds that generalists and specialists share the same ethnobotanical knowledge and any variation is random.
Hypothesis 2a: One alternative hypothesis is that generalists and specialists will have different sets of healing knowledge.
Hypothesis 2b: Another alternative hypothesis is that ethnobotanical knowledge of generalists will be a subset of that known by specialists.

Hypothesis *2b* is based on the intuitive assertion that specialists (healers) will treat a broader range of health conditions and use a greater number of plants than generalists (laypersons). They also may tend to know toxic and rare plants that are less well-known and more difficult to collect.

Hypothesis 3: The third hypothesis states that socio-demographic characteristics (age, education, and socio-economic status) are not associated with ethnobotanical knowledge.
Hypothesis 3a: An alternative hypothesis is that socio-demographic characteristics (age, education, and socio-economic status) are associated with ethnobotanical knowledge.
Hypothesis 3ai: As age increases so will Dominican ethnobotanical knowledge.
Hypothesis 3aii: The more years of formal education a Dominican has, the less ethnobotanical knowledge he/she will know.
Hypothesis 3aiii: As socio-economic status increases Dominican ethnobotanical knowledge will decrease.

The alternative Hypothesis *3a* is based on past research (Boster 1986; Phillips and Gentry 1993b) that suggests that demographics may shape an individual's ethnobotanical knowledge. I examine age, education, and socio-economic status (SES) as variables that may predict the extent of a person's ethnobotanical knowledge. SES refers to the general wealth of an individual as discussed in Chapter 4. Hypothesis *3ai* is based on past research (Phillips and Gentry 1993b; Yates and Ramírez-Sosa 2004) that suggests that elders in a community are the keepers of traditional knowledge. They have had additional life experiences and more time to learn about traditional medicine. They also may have lived during a time when biomedicine or allopathic medicine was less available and therefore had to rely on other forms of health care. Hypothesis *3aii* suggests that Dominicans that have more education will be more acculturated and will tend to seek allopathic treatment more so than Dominican's with less education. Hypothesis *3aiii* suggests that socio-economic status will also influence ethnobotanical knowledge. Dominicans with more financial resources can more likely afford medicine from a pharmacy, doctor's consultations, and transportation costs. Increased use of biomedicine may result in Dominicans abandoning traditional healing practices. However, studies (O'Connor 1995; Reiff *et al.* 2003) have shown that the increased use of biomedicine has not caused individuals to abandon traditional healing practices; rather the two are used in parallel.

As discussed in Chapter 3, data were collected from local women (generalists) and healers (specialists) using a survey. The same questions were asked in each of the four study communities of Los Calabazos, La Colonia, La Vega, and San Cristóbal. To test these hypotheses, I used a multi-analytical approach by adding layers of analysis and using one type of data to validate or refine another.

I used several measures of ethnobotanical knowledge: the number and composition of plant species reported, the percentage of individuals who reported a remedy for a health condition, the number of field reports of medicinal plants and remedies, and diversity indices. In addition, an ethnobotanical knowledge index (EKI) was developed using additional variables from the survey, explained later in the chapter. The statistical software used for these analyses were JMP® software (SAS Institute Inc.), Resampling Stats© software, and SPSS© Student Version software.

An additional analysis compared the ethnobotanical knowledge of Dominican healers in New York City (Balick *et al.* 2000) with the data from the present study. This analysis provides preliminary data about the distribution of traditional knowledge across national borders and also tests the degree to which Dominican healers retain traditional knowledge in a new urban and distant setting.

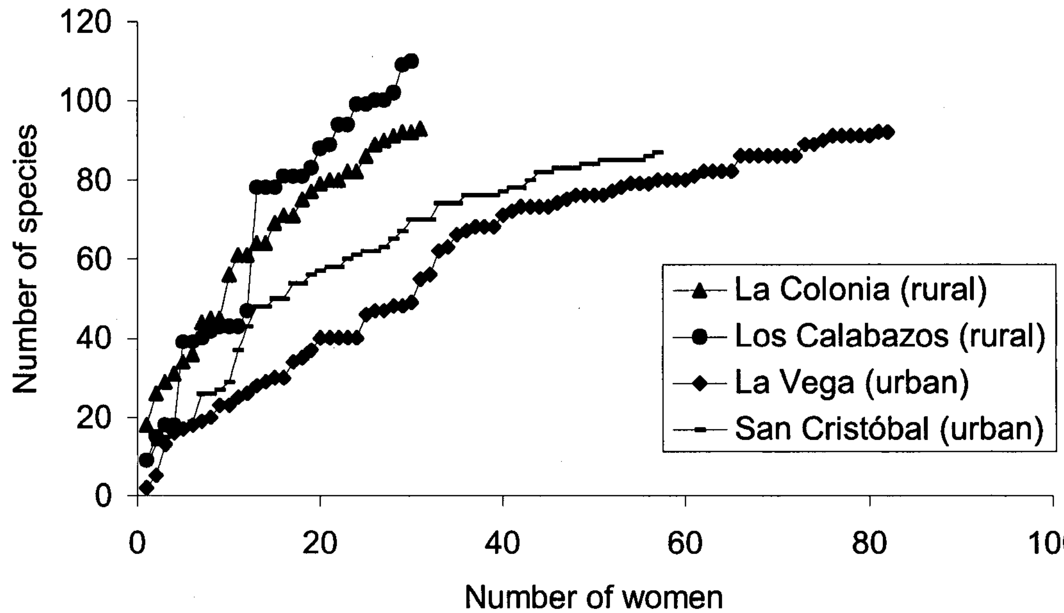
Comparing medicinal knowledge in urban and rural communities

Plant species reported in rural and urban communities

The four communities in this study were analyzed individually and then compared to address the first hypothesis. A total of 226 surveys were administered to Dominican laywomen or generalists (Los Calabazos (n = 33), La Colonia (n = 34), La Vega (n = 87), San Cristóbal (n = 72)). Healers or specialists were not included in these analyses of urban and rural communities because the number of healers per study site was significantly different (G-test, $p < 0.0005$). Significance was tested using the log-likelihood ratio test, also known as the G-test (Sokal and Rohlf 1995).

In ecology, the concept of the 'species-area curve' has been used to approximate sample size. Since the 1800s the relation of species and area has been a fundamental concept of ecology. Two researchers, H. C. Watson and de Candolle, have been credited as orginators of the 'species-area curve' concept (Rosenzweig 1995). The 'species-area curve' is essentially a collector's curve. In ecology, the 'species-area curve' has been used to approximate the area of forest needed to inventory the species present in an ecosystem (Campbell *et al.* 1986). Balick (1994) adapted this curve to ethnobotanical data and renamed it the 'multiple use curve.' This curve gauges the completeness of a medicinal plant inventory, for example, approximately how many interviews are needed to capture complete information about the uses of a plant being studied (Balick *et al.* 2002). As the 'multiple use curve' reaches a straight line (asymptote), it is interpreted that little information remains to be collected and thus an adequate sample size has been achieved. To roughly estimate an appropriate sample size, I modified the 'multiple use curve' concept to evaluate how complete the ethnobotanical information collected was regarding the number of species known for women's health as opposed to the number of uses reported for a single plant. I will refer to this analysis as the 'multiple species curve.' Figure 5.1 illustrates the relationship between the number of medicinal plant species reported by the number of women interviewed in all four communities.

Figure 5.1. Number of distinct plant species reported versus number of women interviewed in each community, Los Calabazos R1 (n = 33), La Colonia R2 (n = 34), La Vega U1 (n = 87), and San Cristóbal U2 (n = 72).



While sample sizes differ, the curves in Figure 5.1 highlight the breadth of species known for women's health conditions in the four sites and suggest that further species may still be reported with additional interviews. The slope of the line for La Colonia and for Los Calabazos is steeper than the slope of the line for La Vega and San Cristóbal, suggesting that each individual rural woman tended to report more new species than each individual urban woman. The graph also roughly indicates the number of interviews needed to obtain reports of a certain number of medicinal plant species. For example, Figure 5.1 shows that 20 rural women reported 80 plant species whereas over 40 urban women were needed to obtain that same number of species. These results need to be interpreted with caution as the slope is affected by the order of the persons interviewed and therefore is not fixed and may fluctuate. The end point is a fixed value and can provide an approximate indication of the number of interviews necessary to report a number of distinct plant species. In Los Calabazos 33 women reported 107 plant species and in La Colonia 34 women reported 93 plant species versus the urban communities where 72 women in San Cristóbal reported 87 plant species and 87 women in La Vega reported 92 plant species. The end point values confirm that fewer interviews were needed in the rural areas than in the urban areas to report a number of distinct plant species.

Of the 226 laywomen interviewed, 200 (88%) named a plant or remedy for one of the 10 health conditions. A total of 2148 field reports of plants were cited from these women including 187 plant species from 70 different plant families. Undetermined plants reported in the surveys that were not collected or verified with a photo were not included in these calculations. Table 5.1 (at end of Chapter 5) shows all the plant species reported in all study sites. The total number of field reports for plant species reported by generalists in Los Calabazos and La Colonia was 589 and 459, respectively. The total field reports for La Vega was 673, and for San Cristóbal the total was 427. The combined value for rural communities was 1048 and for urban communities was 1100.

Several plant species were reported in common between rural and urban communities and other species were only reported in one community. A total of 33 plant species were reported in common in all four communities (18%, n = 187). Thirty-nine plant species (21%) were reported only in Los Calabazos, 22 species (12%) were cited only in La Colonia, 19 species (10%) were specific to La Vega, and 14 (7%) species were cited only in San Cristóbal. The most frequently reported plant species by generalists were *Matricaria recutita* and *Kalanchoe gastonis-bonnieri*, with 103 and 95 field reports, respectively.

The top six plant species cited by laywomen in the rural communities were *Agave antillarum*, *Momordica charantia*, *Spermacoce assurgens*, *Coffea arabica*, *Ambrosia artemisiifolia*, and *Opuntia ficus-indica*. Of these plants, *Agave antillarum*, *Momordica charantia*, and *Ambrosia artemisiifolia* were reported more frequently in La Colonia, while *Coffea arabica* and *Opuntia ficus-indica* were reported more frequently in Los Calabazos. A similar number of reports of *Spermacoce assurgens* were mentioned in both rural communities.

In the urban communities, the top six species reported by laywomen were *Matricaria recutita*, *Kalanchoe gastonis-bonnieri*, *Saccharum officinarum*, *Beta vulgaris*, *Cinnamomum verum*, and *Opuntia ficus-indica*. Of these species, *M. recutita*, *S. officinarum*, *B. vulgaris*, and *C. verum* are usually purchased at supermarkets, pharmacies, or markets, while *K. gastonis-bonnieri* and *O. ficus-indica* are grown in home gardens. This is quite different from the plants reported in rural communities, which are either common in disturbed habitats (*Momordica charantia* and *Spermacoce assurgens*) or cultivated in home gardens or *conucos* (*Ambrosia artemisiifolia*, *Coffea arabica*, and *Opuntia ficus-indica*). *O. ficus-indica* is reported as a top ranking plant in both rural and urban communities. The top plants reported in rural and urban sites are different species, except for *O. ficus-indica*; however, all 10 plants were reported in all four communities except for *Momordica charantia*, which was not reported in Los Calabazos. Yet, I did observe it growing in this community.

Although some women in urban communities had front or backyard gardens, they tended to report more cultivated species that were found in supermarkets such as *Apium graveolens* L. (Apiaceae), *Capsicum annuum*, and *Linum usitatissimum* L. (Linaceae). They also reported *Tradescantia spathacea* Sw. (Commelinaceae), a common ornamental, and *Pimenta haitiensis*, an allspice endemic to Hispaniola and sold in municipal markets. This is not surprising considering an urban environment has less access to wild plant resources. Although some urban women visited relatives in the countryside to collect medicinal plants, many resorted to plants found in their community or at markets. Rural women were able to collect their plants locally, except for exotic plants, such as *Illicium verum* and *Lavandula angustifolia*, which are not in cultivation in the Dominican Republic and need to be purchased at pharmacies. A flip side of this observation is that rural women have less access to plants sold in supermarkets and municipal markets because of the distance of these markets from rural communities. Common market plants such as *Capsicum annuum* and *Averrhoa carambola* L. (Oxalidaceae) were not reported for any of the women's conditions in the rural communities. Surprisingly, I did not observe these plants in rural home gardens.

Adiantum tenerum Sw. (Pteridaceae) and *Hamelia patens* Jacq. (Rubiaceae) were only reported in La Colonia and were found commonly along trails or roadsides. *Hamelia patens* was observed growing in Los Calabazos but it was not reported for women's health. The same was true of *Centrosema* *pubescens* Benth. (Fabaceae) which was observed in both rural communities, however, it was only reported for women's medicine in Los Calabazos.

There are a few plants that were reported in the urban sites that merit further discussion. These are *ñame* (yam, *Dioscorea alata* L., Dioscoreaceae), *soya* (soy, *Glycine max*), and *lino* (flax, *Linum usitatissimum*). Reports of these plants are interesting because of their popularity for women's health in the United States and other countries. Soy and flax in particular have been purported as sources of phytoestrogens (Adlercreutz and Mazur 1997; Setchell 1998). Chapter 6 provides a detailed discussion of phytoestrogens and women's health.

In this study, two women reported the use of flax in a plant mixture for vaginal infections. One of them also reported the same flax mixture for infertility. This is not surprising because the majority of Dominican women interviewed mentioned that infertility is caused by an infection. Two other women mentioned soy for hot flashes; both of them had learned about this remedy from reading magazines. Of these women, one also reported yams for hot flashes. She had also learned about this remedy from a magazine article. Neither healers nor rural women reported using these plants. This illustrates a relatively unheralded way in which new knowledge about medicinal plants is acquired. In the future, more women in these communities might report soy and flax as important plants for women's health.

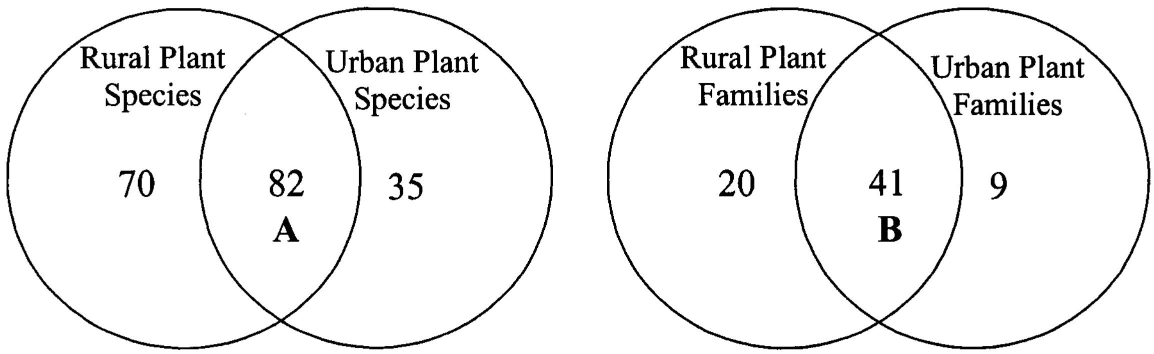
Data presented in Table 5.1 (at end of Chapter 5) suggest that rural and urban women use some similar medicinal plants (18%, n = 187); however, each community also uses plants that were not reported in the other communities

(21% in Los Calabazos, 12% in La Colonia, 10% in La Vega, and 7% in San Cristóbal). Proximity and availability appear to be contributing factors in plant choice, as well as preferences of a person's family. As mentioned above, I observed the same plant species (*Centrosema pubescens* and *Hamelia patens*) growing in both rural communities; however, they were not reported as medicinal plants in both communities. This example illustrates that a person's family or relatives may be a stronger predictor of medicinal plant preference and use than availability and access.

Number of plant species reported in rural and urban communities

For further comparison, the four study sites were collapsed into two categories of rural and urban. Based on 187 plant species from 70 botanical families, there were 82 plant species (44%) that were reported by both groups (Figure 5.2.A). Women in rural sites reported an additional 70 plant species (37%) that were not reported in the urban sites. And the women living in the urban communities reported an additional 35 plant species (19%) that were not reported in the rural sites. Eighty one percent of the total plants or 152 species were reported in the rural communities and 63% or 117 species were reported in the urban communities. There is a significant difference between the total number of plant species reported by rural and urban women (G-test, $p = 0.0124$). Figure 5.2.B shows the number of plant families that were specific to the rural and urban sites and those families that overlapped.

Figure 5.2. Venn diagrams illustrating the number of medicinal plant species (A) and botanical families (B) reported by generalists in rural (n = 67) and urban study sites (n = 159) in the Dominican Republic for 10 women's health conditions.

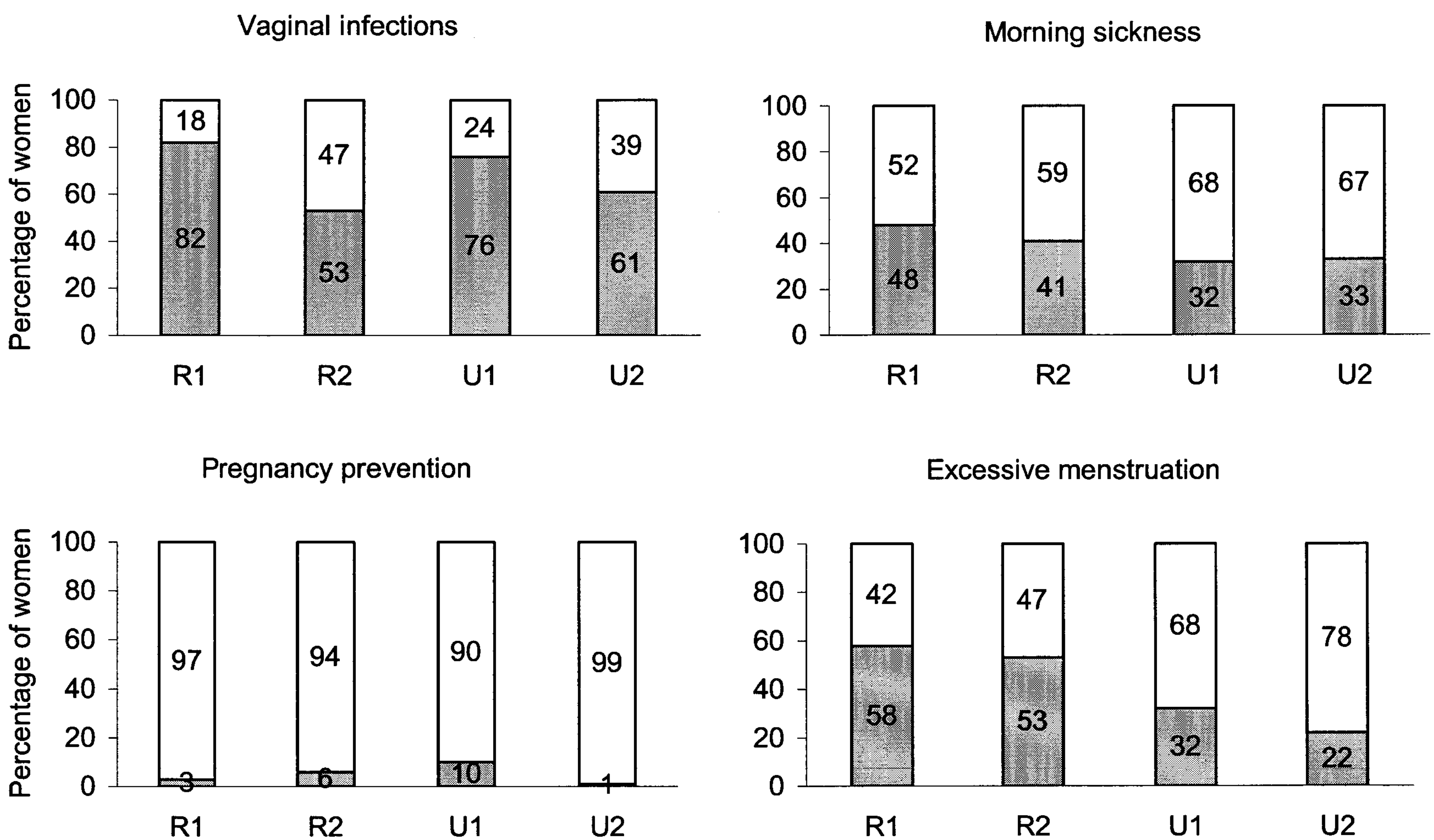


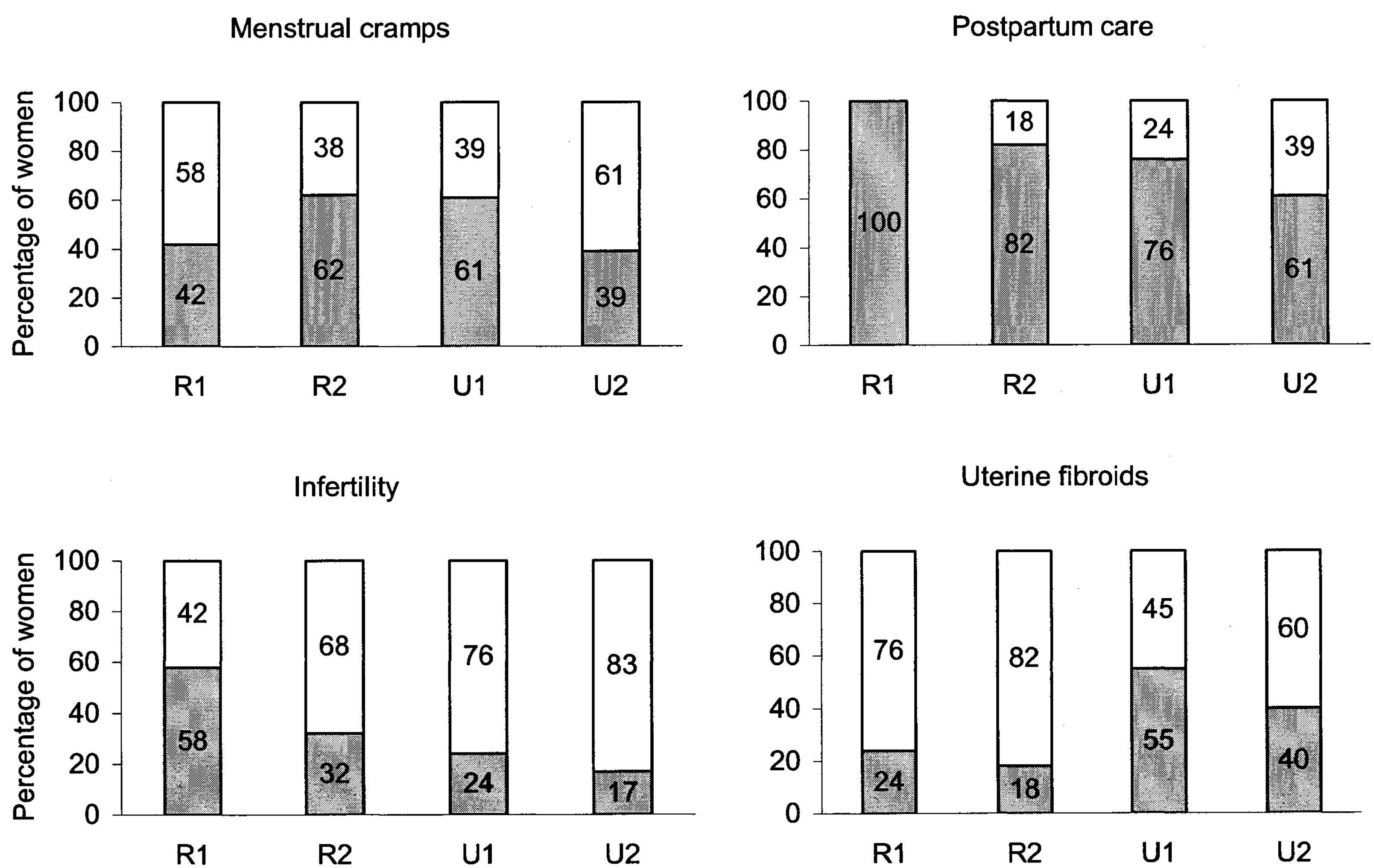
For further analysis, the mean number of plant species reported per study participant was compared for urban and rural sites. The women in the rural sites reported a higher number of plant species (9.97 $\pm$ SE 1.08) than in the urban sites (5.38 $\pm$ SE 0.34). An analysis of variance test confirmed a significant difference in the means of the two groups (F-test = 27.73; $p < 0.0001$). Both urban and rural women reported a number of the same plants yet evidence from this analysis suggests that a greater number of plant species are known in rural communities than in urban communities.

Percentage of rural and urban women who reported a remedy for a health condition

Figure 5.3 illustrates the percentage of women who reported a remedy for the 10 women's health conditions. A remedy is defined as either naming a single plant or a traditional remedy for a condition. In some cases a remedy was known by name, for example a *botella*, but the respondent did not know the plants used to prepare the remedy. I used the G-test to compare the percentage of women who reported a remedy in each community for each health condition.

Figure 5.3. Percentage of Dominican women in Los Calabazos R1 (n = 33), La Colonia R2 (n = 34), La Vega U1 (n = 87), and San Cristóbal U2 (n = 72) who reported a remedy for the 10 women's health conditions. Reports No reports




Menstrual cramps
Postpartum care
Infertility
Uterine fibroids
Percentage of women
100
80
60
40
20
0
R1
R2
U1
U2
58
42
38
62
39
61
61
39
100
18
82
24
76
39
61
42
58
68
32
76
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76
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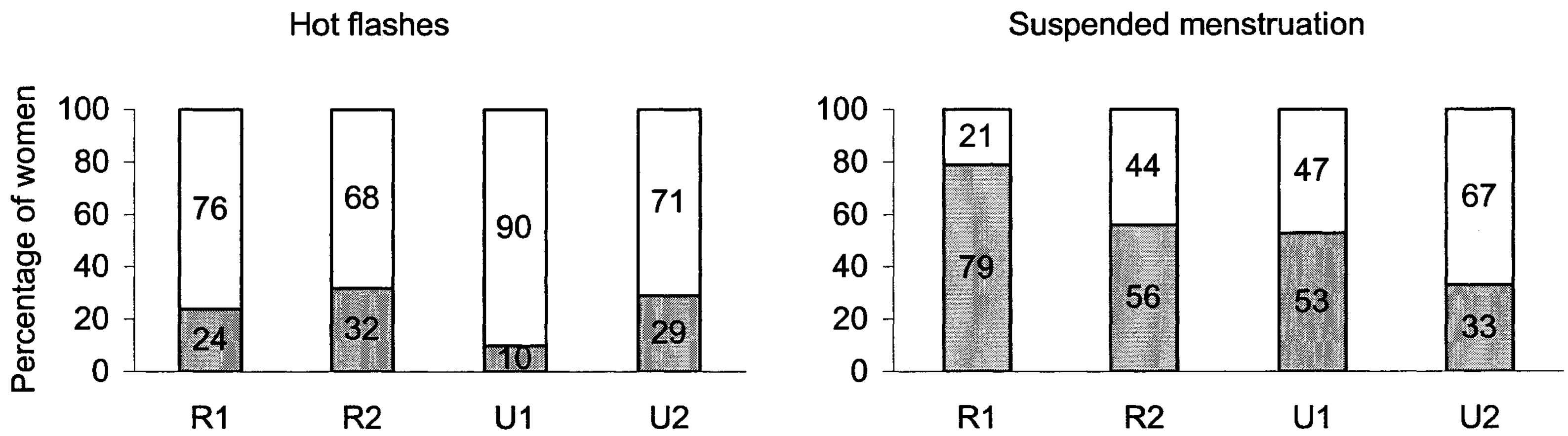
82
18
45
55
60
40


Hot flashes
Suspended menstruation
Percentage of women
100
80
60
40
20
0
76
24
68
32
90
10
71
29
21
79
44
56
47
53
67
33
R1
R2
U1
U2

The highest percentage (50% or more) of women in all four communities reported remedies for postpartum care and vaginal infections. These conditions were also discussed in Chapter 4 as being salient women's health conditions. Every woman interviewed in Los Calabazos knew a remedy for postpartum care, while only 82% of the women in La Colonia reported a remedy. A higher percentage of women in Los Calabazos knew a remedy for postpartum care than the other three communities (G-test, $p < 0.0001$). San Cristóbal had the lowest percentage of women name a remedy for postpartum care (61%).

The percentage of women who reported a remedy for vaginal infections varied. Los Calabazos (82%) and La Vega (76%), both in the same province, had a higher percentage of women report a remedy for this condition (G-test, $p = 0.0065$) than the communities in the province of San Cristóbal (La Colonia = 53%; San Cristóbal = 61%). In all communities, a small percentage of women ($\leq$ 10%) reported a remedy for pregnancy prevention. A significantly higher percentage of women in rural communities (G-test, $p < 0.0001$) reported a remedy for excessive menstruation than in urban communities. For this condition, both rural communities had 53% or more women who reported a remedy, while the urban communities showed a maximum of 32% of the women.

A higher percentage of women reported traditional remedies for infertility and suspended menstruation in the two rural communities as compared with the urban communities. A significantly higher percentage of women in Los Calabazos reported a remedy for infertility (G-test, $p < 0.0002$) and suspended menstruation (G-test, $p < 0.0005$) than La Colonia, La Vega, and San Cristóbal.

For those same conditions, La Colonia had a significantly greater percentage of women who reported traditional medicine than San Cristóbal (G-test, $p = 0.01$), but La Colonia and La Vega were not significantly different.

The exception was uterine fibroids, which had a significantly higher percentage of women report herbal medicines for this condition in urban communities as compared with the rural communities. At least 40% of the women interviewed in each urban community reported a remedy for this condition. A maximum of 24% of women in the rural communities reported a remedy for treating fibroids. Both La Vega and San Cristóbal showed significantly different percentages of women when compared with La Colonia (G-test, $p < 0.0001$) for uterine fibroids. Los Calabazos and La Vega also had significantly different percentages of women who reported a remedy (G-test, $p = 0.0003$) for this condition; however, the percentages in Los Calabazos and San Cristóbal were not significantly different (G-test, $p = 0.06$).

Uterine fibroids was the only condition that had a higher percentage of women in urban communities report a remedy than rural communities. There are several plausible reasons for these findings. It is possible that uterine fibroids affects urban women more than rural women, they may also occur more frequently in urban women than rural women, or uterine fibroids may be considered a recently recognized women's condition which has not been incorporated into traditional plant knowledge in the rural communities. Because uterine fibroids are usually diagnosed with an ultrasound, another explanation may be that fibroids are less likely to be detected in women who live in rural communities where there is less access to modern medical technology; therefore, the condition is diagnosed with less frequency. As a result, urban women might know more about uterine fibroids than rural women. Further studies are needed to understand these differences.

Of the women interviewed, three in the rural sites (4%, n = 67) mentioned having fibroids and 11 (7%, n = 159) reported having fibroids in the urban sites. Remedies reported to treat fibroids further support the trend observed in the data above. A popular remedy for this condition was a mixture of *Beta vulgaris* and *Saccharum officinarum* (beets and molasses), which was reported by a greater percentage of women (19%, n = 159) in the urban sites than the rural sites (7%, n = 67).

Results from this data suggest that a greater percentage of rural women know medicinal plants and remedies for the 10 health conditions. Uterine fibroids was an exception because a higher percentage of urban women reported traditional remedies than rural women. Pregnancy prevention showed a low percentage of women for all communities. It should also be noted that at least one woman in every community was able to report a plant or remedy for each condition.

The issue of differences in health concerns between urban and rural could in some cases be a function of cultural differences; one might expect rural women to be more concerned with postpartum care, for instance. Surprisingly, I expected more women to report traditional treatments for pregnancy prevention. One explanation for the low percentage of women who reported a remedy for this condition may be that women did not feel it was appropriate to share this kind of information with me. Perhaps there was concern by women interviewed that I might try a recipe that could have negative results.

Distribution of medicinal knowledge in rural and urban communities

To further evaluate the differences and similarities of medicinal knowledge in urban and rural communities, Table 5.2 compares the 10 health conditions from the four study sites using percentages of field reports and number of plant species. In Los Calabazos women cited a total of 656 field reports of plants and non-herbal ingredients and women in La Colonia mentioned 536 reports. In La Vega there were 717 field reports and in San Cristóbal there were 517 field reports. To compensate for the variation in sample sizes, the field reports were calculated as percentages. The percentage of field reports was calculated by dividing the number of total field reports for each health condition by the total field reports from a study site. For example, from a total of 656 field reports in Los Calabazos (R1) 131 field reports were cited for vaginal infections, which is 20% of the total field reports from Los Calabazos.

Table 5.2. Distribution of field reports and plant species in Los Calabazos R1 (*n* = 33), La Colonia R2 (*n* = 34), La Vega U1 (*n* = 87), and San Cristóbal U2 (*n* = 72) for 10 women's health conditions.

	Percentage of Field Reports				Number of Plant Species			
Health Condition	R1	R2	U1	U2	R1	R2	U1	U2
Vaginal infections	20	15	24	18	52	32	36	30
Morning sickness	6	4	5	9	15	9	24	23
Pregnancy prevention	1	1	2	1	3	2	7	2
Excessive menstruation	8	8	7	5	21	21	25	19
Menstrual cramps	5	11	16	10	23	32	30	30
Postpartum care	24	27	13	21	74	45	33	27
Infertility	16	8	4	4	65	27	19	11
Uterine fibroids	4	3	15	12	4	12	14	18
Hot flashes	3	6	2	9	9	19	10	19
Suspended menstruation	13	17	12	11	40	34	31	24

Postpartum care had the highest percentage of field reports and number of plant species in Los Calabazos (24%, 74 plant species) and in La Colonia (27%, 45 plant species). Postpartum care also had the highest percentage of reports (21%) in San Cristóbal, while vaginal infections had the highest percentage of reports in La Vega (24%). The rural communities tended to report a greater number of plant species for infertility than the urban communities. Los Calabazos reported the highest number of species (65) for infertility. La Colonia cited 27 species. La Vega and San Cristóbal reported 19 and 11, respectively. Sixteen percent of the field reports in Los Calabazos were for infertility and 8% of the reports in La Colonia were for infertility, while La Vega and San Cristóbal both had 4% for this condition.

For uterine fibroids, the urban groups cited relatively a higher percentage of field reports (La Vega 15%; San Cristóbal 12%) than the rural groups (Los Calabazos 4%; and La Colonia 3%). This is a similar pattern as was observed above for the percentage of women who reported a remedy for this condition. In correspondence with the percentages of women who reported a remedy, there were few field reports and plant species cited for pregnancy prevention.

The variation that exists among the different communities in Table 5.2 appears to be random except for a few conditions that show marked differences. The results suggest conditions that are frequently treated with traditional medicine in both rural and urban communities including postpartum care and vaginal infections. In addition, the data illustrate how communities differ in their knowledge of treating health conditions with home remedies. Different access to plant resources and socio-demographic characteristics of each population may explain some variation in the knowledge of plants reported among the communities.

Diversity of medicinal plant knowledge in rural and urban communities

The number and composition of plant species reported, the percentage of women who reported a remedy, and the distribution of field reports each give an indication of the levels of ethnobotanical knowledge within the communities, but this data does not provide information on the diversity of species used in the study sites. Diversity indices were employed to compare the richness and diversity of plant species reported per group by condition. Ecological models can provide quantitative tools that complement ethnobotanical data analysis (Begossi 1996). Diversity indices are commonly used in ecology and applied at the community level to provide a measurement to compare different populations, to determine the well being of an ecosystem, and as an environmental indicator of species rich and species poor communities. Diversity indices can provide answers to questions posed in comparative studies. For example, plant diversity can be compared among health conditions, between generalists and specialists, or among various study sites.

Interpreting diversity and the well being of an ecosystem or in this case the well being of traditional knowledge is complicated and can be viewed from different angles. One interpretation of high diversity may classify traditional knowledge as rich and diverse suggesting that community members have maintained their traditions. Low diversity may be interpreted as communities that are experiencing cultural erosion and individuals are losing their knowledge of natural resources. This assumes that high diversity is equivalent to pristine or ancestral knowledge and low diversity is the loss of that knowledge.

Another model that has been suggested by Alexiades (1999) is that herbal practices reflect historical processes including contact of groups with other groups that has led to the exchange and sharing of plants and information. He proposes that human-plant interactions are constantly changing as people continually interact with surrounding resources, both native and introduced, and that impact is complex and may result in loss of knowledge and/or acquisition of new knowledge. A community with high medicinal plant diversity may be classified as a heterogeneous population and a community with low diversity may be considered homogeneous. A heterogeneous population may suggest that community members come from diverse backgrounds and tend not to talk and share traditional knowledge among each other. Applied to an urban setting, perhaps individuals come from different regions and maintain their distinct traditions as well as incorporate new practices that they learn from their neighbors. A homogeneous population may be interpreted that traditional knowledge is openly shared and perhaps knowledge is specialized or refined to a few efficacious species. Another interpretation of diversity may suggest the floristic diversity available to a community. A low diversity may mean that the study site is located in a region that has low floristic diversity so fewer traditional plants are reported.

Common diversity indices utilized in ecology are species richness, the Shannon-Wiener index (H'), Evenness (E), and the Simpson index (D). Species richness is the number of species in a defined sample. The Shannon-Wiener index is used to indicate diversity based on species richness and relative species abundance. The calculation of the Shannon-Wiener index is made using the following formula, $H' = -\sum p_i \ln p_i$, where p_i is the number of individual field reports in the ith species. The greater the value of H' means that the probability is greater that the next individual randomly selected from a sample will not belong to the same species as the previous one.

Evenness (E) is another indicator of diversity and measures the relative abundance of individuals among a species. E is calculated as a ratio of observed diversity (*H'*) to maximum diversity (*H*max). Maximum diversity would occur if all species were equally abundant. The values for E range from 0 to 1. The maximum value of E occurs when there is an equal number of individuals for each species (Magurran 1988). In ethnobotany, a maximum E would be the same number of field reports or informants for each species (Begossi 1996). A low evenness ratio means a high dominance of a few species.

The Simpson index (*D*) is a slightly different measurement of diversity because it is weighted towards the abundance of the dominant species and is less sensitive to species richness (Krebs 1998). Simpson's index was calculated using the original formula (Simpson 1949), $D = \sum p_i (p_i - 1)/N(N-1)$ and is expressed as 1-*D* so that greater diversity is associated with increased values.

The number of times a plant species was reported in the field was used to calculate the different indices. Non-herbal ingredients were not included in this analysis. The diversity indices for each sample are based on bootstrap 95% confidence intervals. Bootstrap is a useful technique for calculating standard errors and confidence limits of different statistics, which allows reduced bias in sample calculations (Sokal and Rohlf 1995). As part of the bootstrap method, random resampling is used to repeatedly sample from an unknown population without replacement (Sokal and Rohlf 1995). The Species Diversity program by

Dr. Dwight Kincaid, Professor of Biology at Lehman College of The City University of New York, was used in Resampling Stats© software to run the diversity indices with bootstrap analysis (see Appendix I). This program calculates Simpson and Shannon-Wiener indices with Evenness and bootstraps the species lists to provide 95% confidence intervals for both the Simpson and Shannon indices. Table 5.3 shows the diversity indices for the 10 women's conditions by study site.

Overall, the importance of medicinal plants for women's health in the Dominican Republic is apparent, with a richness of 205 species, which includes plants reported by all study participants. The Shannon-Wiener value including all data was 4.57 (95% CI 4.47 - 4.68) and the Evenness value was 0.86. Results from this study can be compared with other ethnobotanical studies. Begossi (1996) calculated diversity indices (Richness and Shannon-Wiener) for 10 different ethnobotanical studies. According to her results, the data from the Dominican Republic could be classified as having low diversity as the values are similar to those of Tonga (Shannon-Wiener = 4.49, Eveness = 0.97, Richness = 105), which was classified as having low diversity. Tonga had a sample size of 50 informants (gender not specified) and 2037 field citations specifically for medicinal plants. However, the diversity values might have been higher for the Dominican Republic had this study included a greater sample size that included men and questions about general medicinal plant use.

Table 5.3. Diversity indices calculated from the number of plant field reports in Los Calabazos R1 (*n* = 33), La Colonia R2 (*n* = 34), La Vega U1 (*n* = 87), and San Cristóbal U2 (*n* = 72) for 10 women's health conditions.

Study Sites[a]	Richness of Species	Field Reports	Simpson Index (95% Confidence Intervals)	Shannon-Wiener Index (95% Confidence Intervals)	Evenness
All	205	2148	0.98 (0.98-0.99)	4.57 (4.47-4.68)	0.86
R1	107	589	0.98 (0.98-0.98)	4.29 (4.21-4.39)	0.92
R2	93	459	0.97 (0.96-0.98)	3.91 (3.77-4.12)	0.86
U1	92	673	0.96 (0.95-0.97)	3.68 (3.53-3.89)	0.81
U2	88	427	0.97 (0.96-0.98)	3.89 (3.77-4.04)	0.87
Rural	152	1048	0.98(0.98-0.99)	4.49 (4.41-4.59)	0.89
Urban	117	1100	0.97 (0.96-0.97)	3.93 (3.80-4.01)	0.82
Vaginal infections					
R1	52	122	0.95 (0.94-0.97)	3.47 (3.34-3.74)	0.88
R2	32	74	0.93 (0.92-0.94)	3.01 (2.92-3.22)	0.87
U1	36	169	0.91 (0.88-0.95)	2.88 (2.67-3.19)	0.80
U2	30	85	0.92 (0.91-0.94)	2.93 (2.82-3.15)	0.86
Rural	68	196	0.96 (0.95-0.97)	3.66 (3.52-3.87)	0.87
Urban	51	254	0.93 (0.91-0.95)	3.13 (2.97-3.42)	0.80
Morning sickness					
R1	15	34	0.89 (0.87-0.92)	2.46 (2.36-2.58)	0.91
R2	9	15	0.83 (0.80-0.89)	1.99 (1.89-2.20)	0.90
U1	24	36	0.94 (0.92-0.95)	3.00 (2.88-3.13)	0.94
U2	23	30	0.95 (0.95-0.95)	3.08 (3.08-3.10)	0.98
Rural	21	49	0.92 (0.91-0.94)	2.76 (2.67-2.87)	0.91
Urban	37	67	0.96 (0.95-0.97)	3.39 (3.32-3.50)	0.94
Pregnancy prevention					
R1	3	3	0.67 (0.67-0.67)	1.10 (1.10-1.10)	1.00
R2	2	2	0.50 (0.50-0.50)	0.69 (0.69-0.69)	1.00
U1	7	12	0.76 (0.74-0.86)	1.70 (1.64-1.95)	0.87
U2	2	2	0.50 (0.50-0.50)	0.69 (0.69-0.69)	1.00
Rural	5	5	0.80 (0.80-0.80)	1.61 (1.61-1.61)	1.00
Urban	9	14	0.82 (0.80-0.89)	1.97 (1.89-2.20)	0.89
Excessive menstruation					
R1	21	46	0.92 (0.90-0.94)	2.77 (2.67-2.94)	0.91
R2	21	38	0.93 (0.92-0.94)	2.86 (2.76-2.96)	0.94
U1	25	44	0.93 (0.91-0.95)	2.92 (2.80-3.12)	0.91
U2	19	25	0.93 (0.92-0.95)	2.83 (2.75-2.93)	0.96
Rural	36	84	0.95 (0.94-0.96)	3.30 (3.20-3.46)	0.92
Urban	38	69	0.94 (0.93-0.96)	3.27 (3.15-3.51)	0.90

Study Sites[a]	Richness of Species	Field Reports	Simpson Index (95% Confidence Intervals)	Shannon-Wiener Index (95% Confidence Intervals)	Evenness
Menstrual cramps					
R1	23	36	0.93 (0.92-0.95)	2.97 (2.85-3.10)	0.95
R2	32	57	0.95 (0.94-0.96)	3.22 (3.10-3.37)	0.93
U1	30	108	0.89 (0.85-0.95)	2.75 (2.51-3.18)	0.81
U2	30	50	0.96 (0.96-0.96)	3.43 (3.28-3.33)	1.01
Rural	48	92	0.96 (0.96-0.97)	3.60 (3.53-3.72)	0.93
Urban	44	156	0.93 (0.91-0.97)	3.19 (2.97-3.56)	0.84
Postpartum care					
R1	74	144	0.98 (0.98-0.98)	4.06 (4.02-4.13)	0.94
R2	45	121	0.95 (0.93-0.96)	3.34 (3.20-3.53)	0.88
U1	33	91	0.92 (0.90-0.96)	3.04 (2.84-3.34)	0.87
U2	27	82	0.92 (0.91-0.95)	2.90 (2.79-3.17)	0.88
Rural	102	265	0.98 (0.98-0.98)	4.22 (4.13-4.33)	0.91
Urban	42	173	0.94 (0.93-0.96)	3.24 (3.13-3.41)	0.87
Infertility					
R1	65	100	0.98 (0.98-0.98)	4.07 (4.06-4.09)	0.98
R2	27	35	0.95 (0.95-0.96)	3.20 (3.13-3.27)	0.97
U1	19	27	0.94 (0.93-0.94)	2.90 (2.81-2.91)	0.98
U2	11	17	0.89 (0.88-0.90)	2.28 (2.25-2.37)	0.95
Rural	82	135	0.98 (0.98-0.98)	4.25 (4.22-4.29)	0.96
Urban	26	43	0.95 (0.95-0.96)	3.12 (3.08-3.19)	0.96
Uterine fibroids					
R1	4	18	0.64 (0.48-0.75)	1.13 (0.94-1.38)	0.82
R2	12	18	0.89 (0.88-0.91)	2.35 (2.28-2.46)	0.95
U1	14	94	0.73 (0.60-0.90)	1.72 (1.53-2.47)	0.65
U2	18	59	0.81 (0.75-0.92)	2.17 (2.01-2.75)	0.75
Rural	13	36	0.81 (0.76-0.91)	2.04 (1.92-2.51)	0.79
Urban	26	153	0.77 (0.66-0.93)	2.04 (1.85-3.00)	0.63
Hot flashes					
R1	9	15	0.83 (0.80-0.89)	1.99 (1.89-2.20)	0.90
R2	19	29	0.93 (0.92-0.94)	2.81 (2.76-2.89)	0.95
U1	10	12	0.89 (0.89-0.90)	2.25 (2.24-2.30)	0.98
U2	19	43	0.88 (0.84-0.94)	2.52 (2.35-2.86)	0.85
Rural	27	44	0.95 (0.94-0.96)	3.14 (3.08-3.22)	0.95
Urban	26	55	0.91 (0.89-0.95)	2.83 (2.67-3.15)	0.87

Study Sites[a]	Richness of Species	Field Reports	Simpson Index (95% Confidence Intervals)	Shannon-Wiener Index (95% Confidence Intervals)	Evenness
Suspended menstruation					
R1	40	72	0.94 (0.92-0.97)	3.34 (3.13-3.59)	0.91
R2	34	71	0.92 (0.89-0.96)	3.02 (2.82-3.45)	0.86
U1	31	78	0.91 (0.89-0.96)	2.93 (2.78-3.34)	0.85
U2	24	39	0.95 (0.94-0.95)	3.07 (3.02-3.12)	0.97
Rural	62	142	0.96 (0.95-0.98)	3.66 (3.52-3.95)	0.89
Urban	42	118	0.94 (0.93-0.97)	3.28 (3.11-3.58)	0.88

[a]R1 = Los Calabazos, R2 = La Colonia, U1 = La Vega, and U2 = San Cristóbal

In Los Calabazos, postpartum care and infertility show the highest values for the Shannon-Wiener index, 4.06 (95% CI 4.02 - 4.13) and 4.07 (95% CI 4.06 - 4.09), respectively. Postpartum care and infertility are also the highest values for La Colonia, 3.34 (95% CI 3.20 - 3.53) and 3.20 (95% CI 3.13 - 3.27) respectively. This is not surprising, as these conditions had high Informant Agreement Ratio values in Chapter 4. In addition, the *botella* mixtures prepared for these conditions can contain large numbers of plants. For San Cristóbal, the highest diversity value was for menstrual cramps (3.43, 95% CI 3.28-3.33) and for La Vega the highest value was for postpartum care (3.04, 95% CI 2.84-3.34).

A greater diversity of plants was reported for morning sickness in the urban communities than the rural communities. An explanation for this trend may be that rural communities are composed of women who are related through marriage or family and they may openly discuss treatments for morning sickness. In the urban communities women may also discuss treatments for this condition primarily with kin; however, their kin may live in different regions of the country. Therefore, it would be expected that urban communities represent a more heterogeneous group than rural communities, which may partially explain the difference in medicinal plant diversity.

The medicinal plants reported for pregnancy prevention, menstrual cramps, and hot flashes showed patterns of diversity between provinces rather than between rural and urban communities. A greater diversity of medicinal plants was reported for menstrual cramps and hot flashes in San Cristóbal province than La Vega province. This suggests that women in San Cristóbal know different treatments for these conditions and women in La Vega province tend to use similar treatments. The opposite was true for pregnancy prevention, in which La Vega province showed a greater diversity of medicinal plants reported than San Cristóbal province. The plants reported for suspended menstruation did not show prominent diversity patterns among the study sites. This pattern may suggest a loss of plant knowledge for this condition or perhaps women have specialized and rely on a few valuable species.

Overall, the Simpson index for diversity of medicinal plant species used was relatively high for the rural and urban study sites. The majority of health conditions and study sites were above 0.92 except for pregnancy prevention (0.64) and uterine fibroids (0.89). The diversity of plant species for pregnancy prevention was the lowest value of all the conditions. It was also the lowest value for each community. On the other hand, evenness was high (1.00), but this was due to the equal number of plant species and field reports, which were low in all sites. The diversity of plant species and evenness reported for uterine fibroids was low, especially in the urban groups. Low evenness suggests the dependence on a few dominant plant species for this condition, which corroborates the results from Chapter 4 that showed a high number of field reports for beets and molasses.

The overall diversity of plant use in rural areas (H' = 4.49, 95% CI 4.41 - 4.59; richness = 152; 1-D = 0.98, 95% CI 0.98 - 0.99; E = 0.89) was significantly higher than urban areas (H' = 3.93, 95% CI 3.80 - 4.10; richness = 120; 1-D = 0.97, 95% CI 0.96 - 0.97; E = 0.82) based on comparing the 95% confidence intervals that do not overlap. The difference in diversity indices between rural and urban communities may be due to the greater diversity of plants available in rural communities. When individual study sites are compared for overall diversity, Los Calabazos is significantly different from the other three communities and La Colonia, La Vega, and San Cristóbal are not significantly different from each other. This may be explained because Los Calabazos is the most remote community in this study and due to the geographical distance from cities perhaps community members are less influenced by external factors and may maintain their cultural traditions or perhaps they rely on traditional medicine more than other communities due to their limited access to biomedical health services.

An ethnobotanical knowledge index to compare communities

To further analyze plant knowledge in different communities, an ethnobotanical knowledge index (EKI) was developed and used to compare rural and urban study sites. This concept evolved from my reading of Quinlan's study (2000: 274-275). The EKI measures the ethnobotanical knowledge of an individual. The EKI was composed of the following variables drawn from the survey data: (1) number of medicinal plants reported from a free-list; (2) number of plants reported for all 10 conditions; (3) number of distinct plant species reported for all 10 conditions; (4) number of remedies reported for all 10 conditions; (5) number of distinct remedies; and (6) number of conditions known.

The value for 'medicinal plants reported from a free-list' indicates the breadth of general medicinal plant knowledge reported by an individual not just that associated with women's health conditions. For this value each medicinal plant name mentioned by a participant in the initial free-list of medicinal plants received one point. The value for 'plants for all 10 conditions' is similar but includes only the plants mentioned for the 10 targeted health conditions in this study. A point was assigned each time a plant was reported by an individual for a condition even if it was mentioned for multiple remedies or conditions. The value for 'distinct plants for all 10 conditions' indicates depth of an individual's knowledge. For this value, each distinct plant species mentioned received only one point, regardless of it being reported multiple times for different remedies or health conditions by the same person. The 'remedies for all 10 conditions' is a broader measure of ethnobotanical knowledge and includes home remedies that are non-herbal such as honey or rum. A point is assigned for each remedy. The value for 'distinct remedies for all 10 conditions' demonstrates depth of knowledge, as did 'distinct plant species for all 10 conditions.' Each distinct remedy reported by an individual was given one point, even if it was reported for more than one condition. The value for 'conditions known' is a measure of ethnomedical knowledge and shows the range of knowledge an individual has about the 10 women's health conditions. One point was given for each condition that had a remedy or plant treatment.

The EKI was calculated by combining the six variables described above. Table 5.4 presents descriptive statistics of the six variables. Some of the variables are characterized by greater oscillations, or heteroscedasticity, due to the magnitude of the values (Sokal and Rohlf 1995). For example, the values for 'medicinal plants reported from a free-list' ranged from 3 to 59 while the values for 'conditions known' ranged from 0 to 10. If these values were used without modification, the first variable would be weighted more heavily than the second.

To minimize heteroscedasticity, the six variables were recoded into relative values from 0 to 1 by dividing a single value by the maximum value for that variable. For example, an individual who reported 60 medicinal plants in a free list, where the maximum plants reported was 78, would have a recoded value of 0.77. Although log transformation is commonly used to solve this discrepancy in a series, this data did not fit the requirements for log transformation because some values were zero. The six variables were recoded in the same manner and then summed to give the EKI. The maximum EKI value possible was 6.00.

Table 5.4. Descriptive statistics of variables used to define ethnomedical knowledge index for Los Calabazos R1 (*n* = 33), La Colonia R2 (*n* = 34), La Vega U1 (*n* = 87), and San Cristóbal U2 (*n* = 72).

Variables	Study Site	Mean	Standard Deviation	Standard Error	Minimum, Maximum
Plant Free List	Combined	19.08	11.42	0.76	3,59
	R1	28.61	13.69	2.38	9,59
	R2	24.71	10.99	1.88	3,58
	U1	14.61	7.14	0.77	3,38
	U2	17.44	2.27	0.24	0,10
Plants for Women's Conditions	Combined	7.80	7.65	0.51	0,67
	R1	13.00	13.29	2.31	0,67
	R2	10.09	6.42	1.10	0,28
	U1	6.66	5.38	0.58	0,29
	U2	5.71	5.53	0.65	0,22
Distinct Plants for Women's Conditions	Combined	6.74	6.33	0.42	0,57
	R1	10.94	11.21	1.95	0,57
	R2	9.03	5.63	0.97	0,26
	U1	5.74	4.16	0.45	0,18
	U2	4.94	4.43	0.52	0,17
Remedies	Combined	5.17	3.58	0.24	0,19
	R1	7.12	3.43	0.60	2,14
	R2	5.50	3.48	0.60	0,19
	U1	4.98	3.21	0.34	0,15
	U2	4.36	3.84	0.45	0,16
Distinct Remedies	Combined	4.38	2.96	0.20	0,16
	R1	5.67	3.10	0.54	1,13
	R2	4.65	2.95	0.51	0,16
	U1	4.24	2.43	0.26	0,13
	U2	3.85	3.35	0.39	0,13
Conditions Known	Combined	4.16	2.37	0.16	0,10
	R1	5.24	1.85	0.32	2,9
	R2	4.35	2.24	0.38	0,10
	U1	4.31	2.27	0.24	0,10
	U2	3.40	2.54	0.30	0,9

As would be expected, a strong association exists between the six variables chosen for the EKI; bivariate correlations were significant at the 0.01 level (2-tailed, Pearson's correlation). The significant association suggests that the individual variables could have been used independently to produce similar results. Nonetheless, all variables were included as an effort to provide a robust measure of ethnobotanical knowledge.

Figure 5.4 displays the mean EKI with 95% confidence intervals for each community. Los Calabazos does not overlap with either of the urban communities; however, it does overlap with La Colonia.

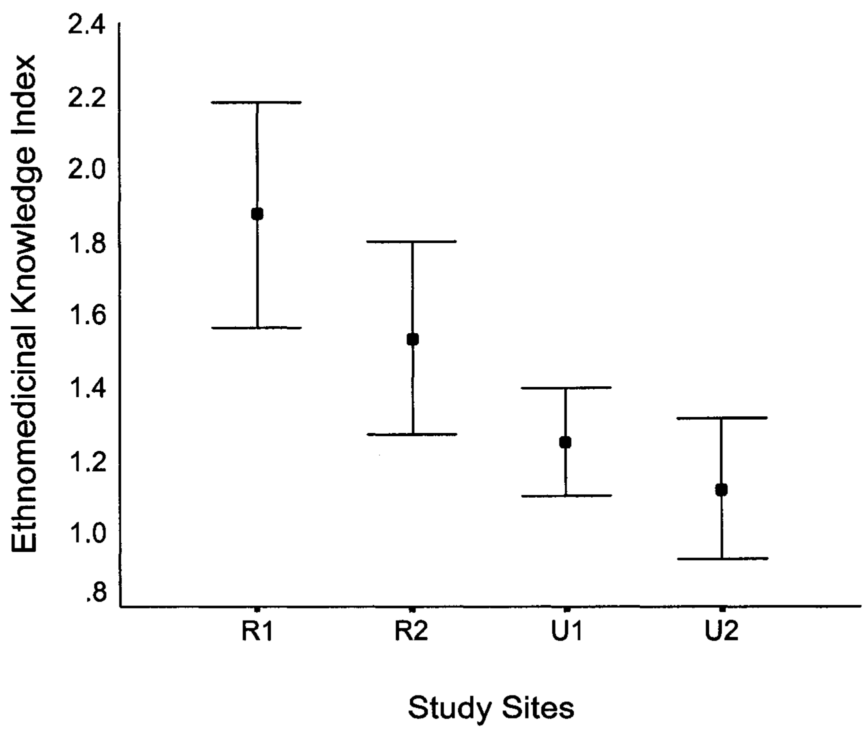


Figure 5.4. Mean ethnobotanical knowledge index with 95% confidence intervals for Los Calabazos R1 (*n* = 33), La Colonia R2 (*n* = 34), La Vega U1 (*n* = 87), and San Cristóbal U2 (*n* = 72) (ANOVA, F-test = 8.35, $p < 0.0001$).

The mean EKI for rural and urban communities was compared using one-way analysis of variance (ANOVA) to determine if there were significant differences among the communities. An ANOVA showed significant differences among the four study sites (F-test = 8.35, $p < 0.0001$), but based on further calculations the relative magnitude of variance between the communities was 11%, and the variance within groups was 89% meaning that more variation occurs throughout a community than between communities.

In an additional analysis, I collapsed the four communities into two groups of rural and urban and performed an ANOVA test, which showed significance (F-test = 20.464, $p < 0.0001$). The mean EKI for the rural group was 1.70 $\pm$ SE 0.100 and for the urban group was 1.19 $\pm$ SE 0.060. However, the relative magnitude of variance between groups was 15% and the variance within groups was 85%, reaffirming that more variation occurs within study sites among individuals than between urban and rural groups. The ANOVA results suggest that each study site has heterogeneous knowledge, so it is difficult to compare the sites to each other. The population of women living in the city of San Cristóbal appeared to be from a more heterogeneous origin than the population in the city of La Vega, which may explain some of the variation in medicinal plant use in that area. In addition, a greater number of women (37.9%) living in La Vega had lived in rural settings prior to living in the city than women (15.3%) in San Cristóbal. A latter section of this chapter will demonstrate socio-demographic factors such as age, education, and socio-economic status as other variables that may explain some of the differences in medicinal plant knowledge within communities.

Transnational patterns in medicinal plant knowledge: comparing plant use in New York City and the Dominican Republic

Dominican traditional medicine is not limited to the borders of Hispaniola. New York City has a growing Dominican community (estimated at ca. 424,850 people by United States Census Bureau 2000) that continues to maintain traditional healing practices (Balick *et al.* 2000; Ososki *et al.* 2002; Reiff *et al.* 2003). To provide an additional perspective to inter-community variation within a culture, data about plant use from Dominican healers living in New York City (Balick *et al.* 2000) was compared with plant use of Dominican healers living in the Dominican Republic from this present study. Three conditions—hot flashes, excessive menstruation (menorrhagia), and uterine fibroids—surveyed in the Dominican Republic were the same as conditions studied by Balick and coworkers (2000) with Dominican healers in New York City. The data collected from Dominican healers in New York City was based on multiple consultations with different patients diagnosed with the above-mentioned health conditions. The data collected with Dominican healers in the Dominican Republic involved querying healers once about treatments they use for the same three conditions mentioned above and did not involve patients. In New York City, two Dominican healers diagnosed patients with hot flashes and six healers diagnosed patients with uterine fibroids. In the Dominican Repubic, 11 healers participated in the present study, of which nine healers reported plants for hot flashes and eight healers reported plants for menorrhagia and uterine fibroids. Because the sample sizes and data collection methods are different, the comparisons can only provide a rough estimate. However, this comparison can give a basis upon which to build further studies to address questions of transmission and acquisition of plant knowledge in different environments.

An additional literature data set was also used for comparison. This data set was discussed in detail in Chapter 2 and consists of plant species reported in 30 ethnobotanical references specific to the Dominican Republic for the above women's conditions and associated symptoms (Ososki *et al.* 2002). Table 5.5 shows the number of plant species reported in each data set for a health condition and shows the number of species that were listed in all three data sets for a single health condition (Overlap).

Table 5.5. Number of medicinal plant species reported for hot flashes, menorrhagia, and uterine fibroids in Dominican ethnomedical literature (*n* = 30) and by Dominican healers in New York City (*n* = 6) and the Dominican Republic (*n* = 11).

Health condition	Number of plant species: Dominican Republic Healers	New York City Healers	Dominican Literature	Overlap
Hot flashes	63	7	17	1
Menorrhagia	24	7	13	2
Uterine fibroids	56	68	57	8

For hot flashes, *Genipa americana*, *Kalanchoe gastonis-bonnieri*, and *Tilia mandshurica* Rupr. & Maxim. (Tiliaceae) were reported by healers in New York City and the Dominican Republic but not in the literature. *Citrus* species (Rutaceae) were reported in all three data sets for hot flashes. *Citrus aurantifolia* (*limón agrio*) was reported in the Dominican Republic and *C. aurantium* and *C. sinensis* Osbeck (*naranja*) were reported in the literature. *Naranja* and *limón agrio* were reported in New York City and the specimens were identified to genus. Because the species collected in New York City were only identified to genus, all *Citrus* species were collapsed and reported as one species that overlapped as seen in Table 5.5. Two plant species, *Plantago major* and *Ruta chalepensis,* were reported in all data sets for menorrhagia, and *Petiveria alliacea* was reported by both the Dominican healers and New York City healers for this condition.

Eight plant species overlapped among the three data sets for uterine fibroids and include *Beta vulgaris*, *Momordica charantia*, *Opuntia ficus-indica*, *Petiveria alliacea*, *Petroselinum crispum* (Mill.) Nyman ex A. W. Hill (Apiaceae), *Rosmarinus officinalis*, *Ruta chalepensis*, and *Saccharum officinarum*.

Of the three conditions, uterine fibroids provides the most accurate comparison of plant use between the two study areas because of the comparable sample sizes of healers from New York City (n = 6) and the Dominican Republic (n = 8) that reported a medicinal plant species. A Venn diagram (Figure 5.5) displays the number of plant species that overlapped for uterine fibroids among the three data sets and the number of plant species distinct to each. The total number of distinct plant species reported by Dominican healers in New York City and the Dominican Republic for uterine fibroids was 102 and an additional 29 species were reported in the literature review. Of a total of 131, eight species (6%) overlapped in all three data sets.

Figure 5.5. Venn diagram illustrating the number of medicinal plant species reported in Dominican ethnobotanical literature (references, *n* = 30) and by Dominican healers in the Dominican Republic (*n* = 8) and New York City (*n* = 6) for uterine fibroids.

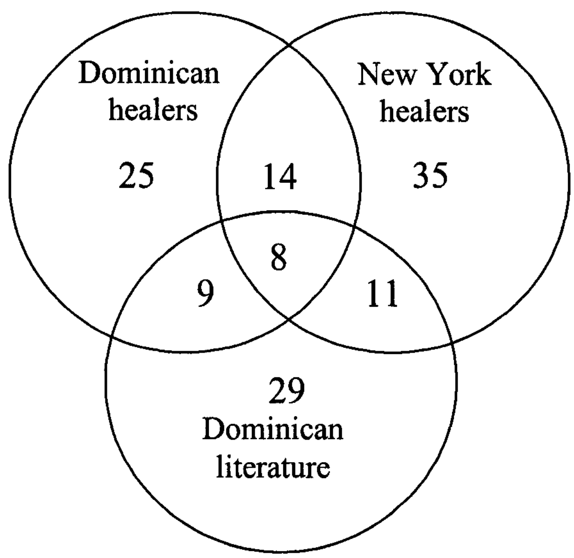


Table 5.6 (at end of Chapter 5) shows the plant species reported by Dominican healers in New York City and the Dominican Republic for uterine fibroids and the number of healers that reported each plant. Table 5.6 lists 22 plant species (22%, *n* = 102) that were reported in common between Dominican and New York City healers for uterine fibroids. New York City healers reported a greater number of distinct plant species for fibroids (*n* = 46) than Dominican

healers (n = 34), similar to the pattern observed among rural and urban women in the present study (see Figure 5.3 and Table 5.2).

Two plants that were popularly reported for uterine fibroids by New York City healers were *Agave* sp. and *Kalanchoe gastonis-bonnieri* (Balick *et al.* 2000). These plants were reported in the Dominican Republic for other women's health conditions, but healers did not report these plants for uterine fibroids. The plant species frequently reported for uterine fibroids among healers in the Dominican Republic that was not reported by New York City healers was *Spermacoce assurgens* (Balick *et al.* 2000). It is important to remember that these plants are often used in mixtures rather than in individual preparations.

Beet juice with molasses was a remedy reported by both New York City and Dominican healers for uterine fibroids. *Botellas* were also reported for uterine fibroids in New York City and the Dominican Republic, although they were not always referred to by this name in the New York City study, rather only the plants and preparation were reported. As discussed in Chapter 4, a *botella* for postpartum care is used to cleanse the uterus and to remove any impurities after pregnancy. Perhaps the use of a *botella* for postpartum care has been adapted for fibroids as a way of cleansing and removing fibroids from the uterus. Differences in treatment approaches may be explained by individual preferences; perhaps each healer uses his/her own remedy for a health condition.

The greater number of plants reported for fibroids in New York City than in the Dominican Republic and the greater number of plants reported in urban communities in the Dominican Republic than in rural communities suggests that women tend to be more familiar with fibroids in urban environments. Fibroids may be a more common health condition for women in urban settings because of environmental influences or due to better access to modern medical technology in urban settings that diagnoses more women with this condition.

In Table 5.6, there are 13 plant species specifically reported in New York City for uterine fibroids (Balick *et al.* 2000) that were not reported in the Dominican Republic by specialists or generalists for any women's health condition. These 13 medicinal plant species are listed in Table 5.7. Several of the plants listed in Table 5.7 are not easily found in the Dominican Republic such as *Ficus religiosa* L. (Moraceae), *Phoenix dactylifera* L. (Arecaceae), *Tabebuia impetiginosa* (DC.) Standl. (Bignoniaceae), *Uncaria tomentosa* (Willd. ex Roem. & Schult.) DC. (Rubiaceae), and *Vaccinium macrocarpon* Aiton (Ericaceae).

Table 5.7. Medicinal plant species reported exclusively by Dominican healers in New York City (*n* = 6).

Species [Family] {Voucher}[a]	Vernacular Name
Chamaemelum nobile (L.) All. [Asteraceae] {5, 30, 32, 65}	*manzanilla*
Coccothrinax argentea (Lodd. ex Shult. & Schult.f.) Sarg. ex Becc. [Arecaceae] {106}	*cana*
Fevillea cordifolia L. [Cucurbitaceae] {72, 75}	*ayamo, jayamo, jallamo*
Ficus religiosa L. [Moraceae] {78}	*alamo*
Helichrysum italicum (Roth) G. Don f. [Asteraceae] {85}	*siempre fresca*
Myrsine sp. [Myrsinaceae] {104}	*palo santo*
Phoenix dactylifera L. [Arecaceae] {113}	*palma*
Solanum tuberosum L. [Solanaceae] {118}	*papa*
Tabebuia impetiginosa (DC.) Standl. [Bignoniaceae] {35}	*palo de arco*
cf. *Taraxacum officinale* Weber [Asteraceae] {61}	*diente de león*
Uncaria tomentosa (Willd. ex Roem. & Schult.) DC. [Rubiaceae] {81}	*uña de gato*
Vaccinium macrocarpon Aiton [Ericaceae] {100}	*cranberry*
Zingiber zerumbet (L.) Sm. [Zingiberaceae] {56}	*jengibre amargo*

[a]All numbers are A. Ososki collections

Of these13 taxa reported exclusively in New York City for uterine fibroids, five have the same common name as plants reported in the Dominican Republic (Table 5.8). In the Dominican Republic, *manzanilla* (*Matricaria recutita)* and *palma* (*Roystonea hispaniolana*) were used for uterine fibroids by healers. In addition, these plants were used by generalists and for the nine other women's health conditions except *palma* was not reported to treat excessive menstruation. On the other hand, *siempre fresca* (*Peperomia pellucida*) was reported only by generalists for hot flashes and *jengibre amargo* (*Zingiber cassumunar* Roxb., Zingiberaceae) was only used by generalists for menstrual cramps and vaginal infections. *Uña de gato* (*Pisonia aculeata* L., Nyctaginaceae) was used by generalists and specialists for all health conditions except excessive menstruation, pregnancy prevention, and uterine fibroids.

Table 5.8. Plant species used by Dominican healers in New York City and the Dominican Republic that share the same vernacular name.

New York Plant Species Species [Family] {Voucher}[a]	Dominican Plant Species Species [Family] {Voucher}[a]	Vernacular Name
Chamaemelum nobile (L.) All. [Asteraceae] {5, 30, 32, 65}	*Matricaria recutita* L. [Asteraceae] {R76}	*manzanilla*
Helichrysum italicum (Roth) G. Don f. [Asteraceae] {85}	*Peperomia pellucida* (L.) Kunth [Piperaceae] {336}	*siempre fresca*
Phoenix dactylifera L. [Arecaceae] {113}	*Roystonea hispaniolana* L. H. Bailey [Arecaceae] {540}	*palma*
Uncaria tomentosa (Willd. ex Roem. & Schult.) DC. [Rubiaceae] {81}	*Pisonia aculeata* L. [Nyctaginaceae] {434, 500}	*uña de gato*
Zingiber zerumbet (L.) Sm. [Zingiberaceae] {56}	*Zingiber cassumunar* Roxb. [Zingiberaceae] {R143}	*jengibre amargo*

[a]All numbers are A. Ososki collections

Of the taxa listed in Table 5.8 three of the plants reported in New York City and the Dominican Republic share common botanical families. *Palma* used in New York City is *Phoenix dactylifera* and *palma* used in the Dominican Republic is *Roystonea hispaniolana*. Both are different species but they are in the Arecaceae family. Both species of *jengibre amargo* are in the genus *Zingiber*. In the Dominican Republic the chamomile used was *Matricaria recutita*, while in New York City Dominican healers used *Chamaemelum nobile*. *Uña de gato* used in New York City was *Uncaria tomentosa*, which is usually imported from Peru and is a different species and family than *Pisonia aculeata* used in the Dominican Republic. Table 5.8 illustrates the importance of collecting voucher specimens for ethnobotanical studies because common names can vary.

The results in Tables 5.7 and 5.8 signify that people seeking medicinal plants in new settings substitute species commonly used in their place of origin with different plant species accessible in their new environment. The United States government strictly regulates plant species allowed into the country, especially fresh fruit; and therefore, some species that are commonly used in the Dominican Republic may not qualify for importation, such as the fresh fruit of *Genipa americana* which is used medicinally but may carry pathogens that could harm agriculture in the United States. As a result, New York City healers may be forced to rely on other species. Different species that are substituted may be selected because of their efficacy or use for similar conditions in other pharmacopoeias in New York City. In some cases, plants with similar physical characteristics and morphology may be substituted. For example, the flowers of *Chamaemelum nobile* and *Matricaria recutita* or the rhizomes of *Zingiber zerumbet* (L.) Sm. (Zingiberaceae) and *Zingiber cassumunar* appear to be similar. Other plants may be selected because they share a common name even though their morphology is quite different, such as *Peperomia pellucida* which is a succulent plant as opposed to the non-succulent *Helichrysum italicum* (Roth) G. Don f. (Asteraceae).

Comparing medicinal knowledge of generalists and specialists

Plant species reported by generalists and specialists

This study documented 205 plant species for women's medicine in the Dominican Republic. Fifty-four percent of the plants were reported by both generalists and specialists. Eight percent (8 plants) were reported only by specialists and 38% (79 species) were reported by generalists (Table 5.1 at end of Chapter 5). At first glance these numbers appear misleading because they suggest that generalists know more plant species than specialists. However, if sample size is considered, a more accurate picture emerges. There were 11 specialists and 226 generalists in the study. The mean number of distinct plant species known by specialists (mean = 29.27 $\pm$ SE 2.71) is significantly higher than the mean for generalists (mean = 6.74 $\pm$ SE 0.42).

Of the 16 species reported exclusively by specialists, 81% were reported once. Three species were reported by two different specialists, *Chiococca alba* (L.) Hitchc. (Rubiaceae), *Senna sophera* (L.) Roxb. (Fabaceae), and *Yucca aloifolia* L. (Agavaceae). Of the 79 plants reported exclusively by generalists, 47% were reported once. The most commonly reported plants (reported in general by 12 or more individuals) for generalists were *Citrus sinensis* Osbeck (Rutaceae), *Peperomia pellucida*, and *Zea mays*. These plants, particularly *C. sinensis* and *Z. mays,* are common and easily found in supermarkets, home gardens, and *conucos*. Interestingly, specialists did not report these plants, perhaps because they know of other more effective plants.

Table 5.9 shows eleven of the most frequently reported plants by both generalists and specialists. The number of field reports and the number of individuals that independently reported each species are illustrated to show the importance of each species to the two groups. *Matricaria recutita* had the highest number of field reports for both generalists (103) and specialists (39). Chamomile has been reported for centuries for its beneficial effects for health, therefore it is not surprising that this would be the most frequently reported species for both groups.

Table 5.9. Medicinal plants frequently reported by specialists (*n* = 11) and generalists (*n* = 226).

Species [Family] {Voucher}[a]	Number of Field Reports[b]		Number of Individuals	
	Specialists	Generalists	Specialists	Generalists
Agave antillarum Descourt. [Agavaceae] {241,378, PV138}	18	86	6	45
Beta vulgaris L. [Chenopodiaceae] {PV168}	3	66	3	61
Cinnamomum verum J. Presl [Lauraceae] {R133}	13	87	6	62
Illicium verum Hook.f. [Illiciaceae] {R74}	32	51	8	32
Kalanchoe gastonis-bonnieri Raym.-Hamet & H. Perrier [Crassulaceae] {363,376,PV148, PV57}	7	95	1	62
Matricaria recutita L. [Asteraceae] {R163,R72,R76}	39	103	9	60
Opuntia ficus-indica (L.) Mill [Cactaceae] {257,274,PV53,PV72}	19	86	4	55
Ruellia tuberosa L. [Acanthaceae] {160,356}	37	46	8	27
Saccharum officinarum L. [Poaceae] {321, 450,PV175}	3	94	3	74
Securidaca virgata Sw. [Polygalaceae] {140,208,432,504,PV46}	37	20	10	13
Spermacoce assurgens Ruiz & Pav. [Rubiaceae] {128,142,178,390,509}	34	82	8	51

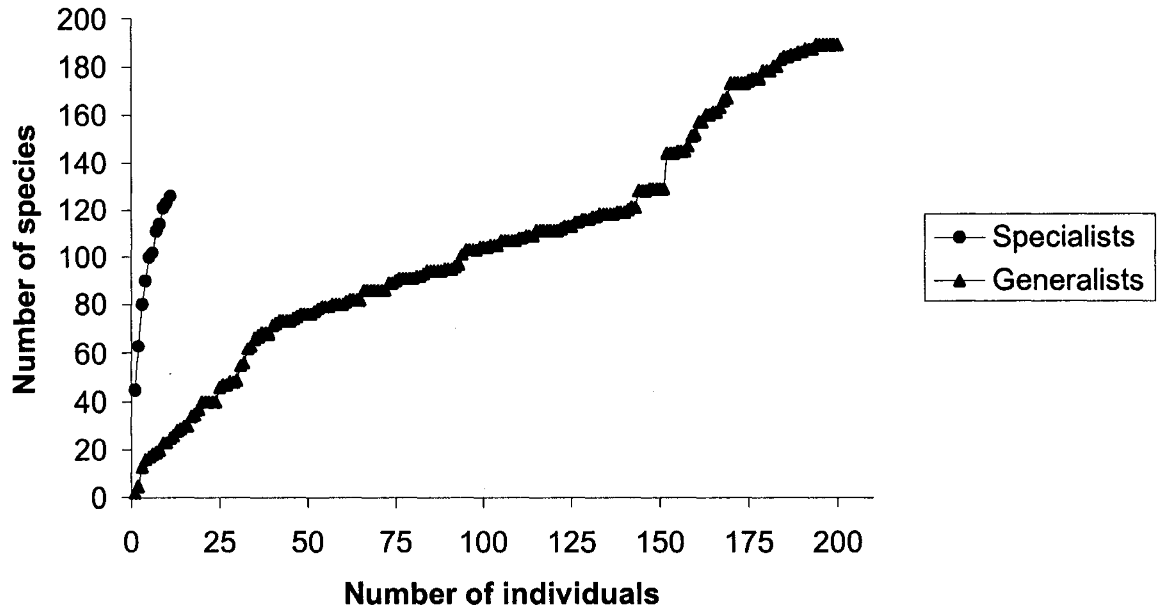
[a]All numbers are A. Ososki collections
[b]specialists: 1113 total field reports, 126 total plant species; generalists: 2148 total field reports, 187 total plant species

For generalists, *Kalanchoe gastonis-bonnieri* (95), *Saccharum officinarum* (94), *Cinnamomum verum* (87), *Agave antillarum* (86), and *Opuntia ficus-indica* (86) have the highest number of field reports. While *Beta vulgaris* does not have as many field reports (66) as these top ranked plants it was reported by 61 generalists. Using field reports, the top ranked plant species for specialists were *Matricaria recutita* (39), *Ruellia tuberosa* (37), *Securidaca virgata* (37), *Spermacoce assurgens* (34), and *Illicium verum* (32). The plants reported by specialists tend to be included in the preparation of *botellas,* while the plants reported by generalists tend to be used in teas.

The number of individuals who cited a plant suggests plants that are widely known. *Securidaca virgata* was the most widely known plant among specialists: 91% of the eleven healers reported this plant while it was rarely reported by the 226 generalists (6%). *Securidaca virgata* was reported by specialists for all 10 conditions except excessive menstruation. *Saccharum officinarum* was the most widely reported plant by generalists and was cited for all 10 conditions except for pregnancy prevention.

In Figure 5.6, 'multiple species curves' are graphed for generalists and specialists and the number of species reported.

Figure 5.6. Number of distinct plant species reported versus number of generalists (n = 226) and specialists (n = 11) interviewed.



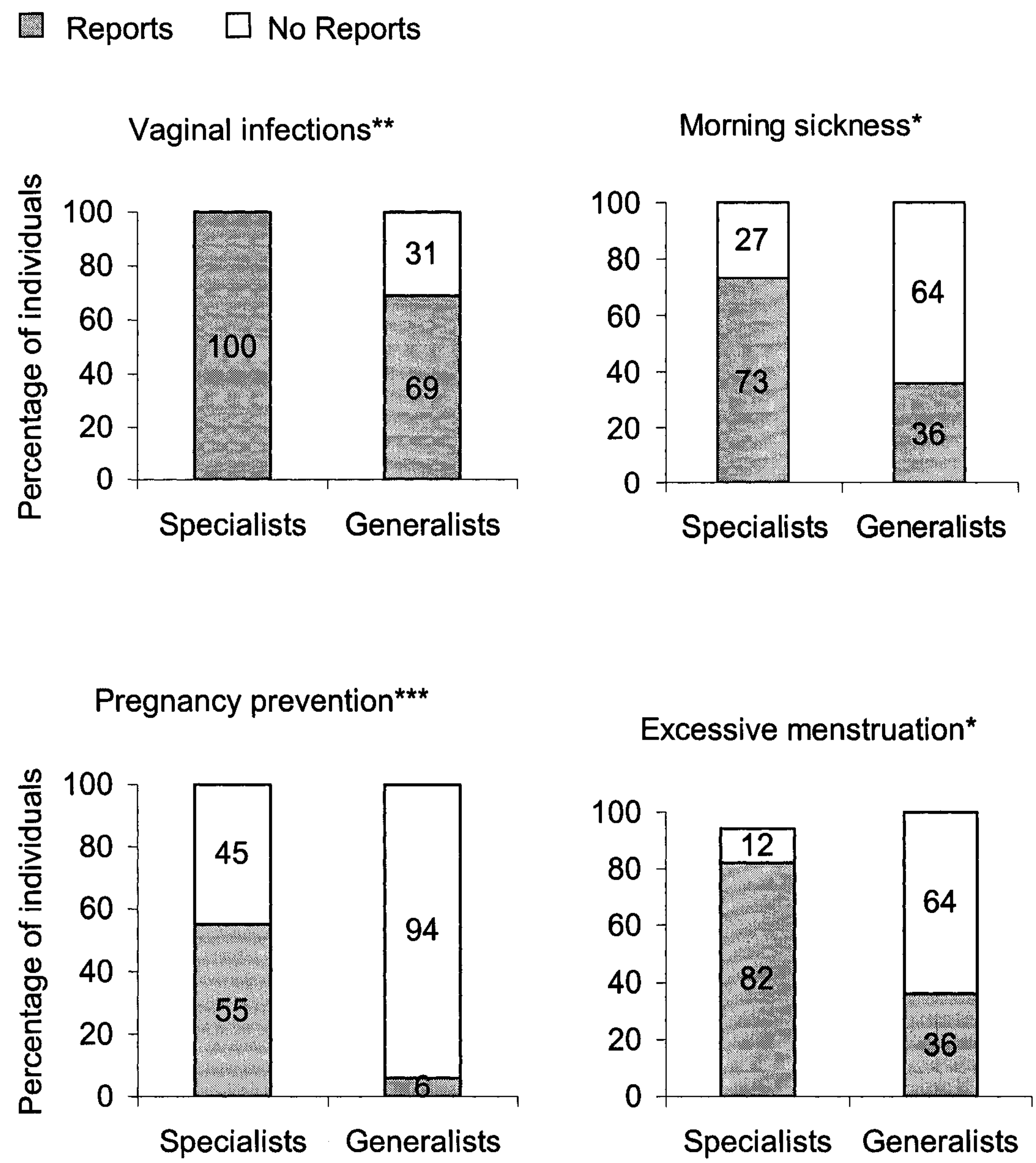
While sample sizes differ, the graph highlights the large number of species reported for 10 women's health conditions by specialists as compared to generalists. More interviews with specialists may lead to additional species being reported because the curve does not appear to reach a plateau. The curve for generalists shows a couple different asymptotes, which may be a reflection of the sample that is composed of generalists from four different communities. The graph also estimates the number of generalists or specialists that may be needed to approximately obtain a certain number of medicinal plant species. For example, Figure 5.6 shows that 11 specialists reported 126 species and over 140 generalists were interviewed in order to obtain that same number of species. These results should be interpreted with caution, as mentioned earlier the curve is not fixed and may fluctuate depending on the sequence of individuals interviewed.

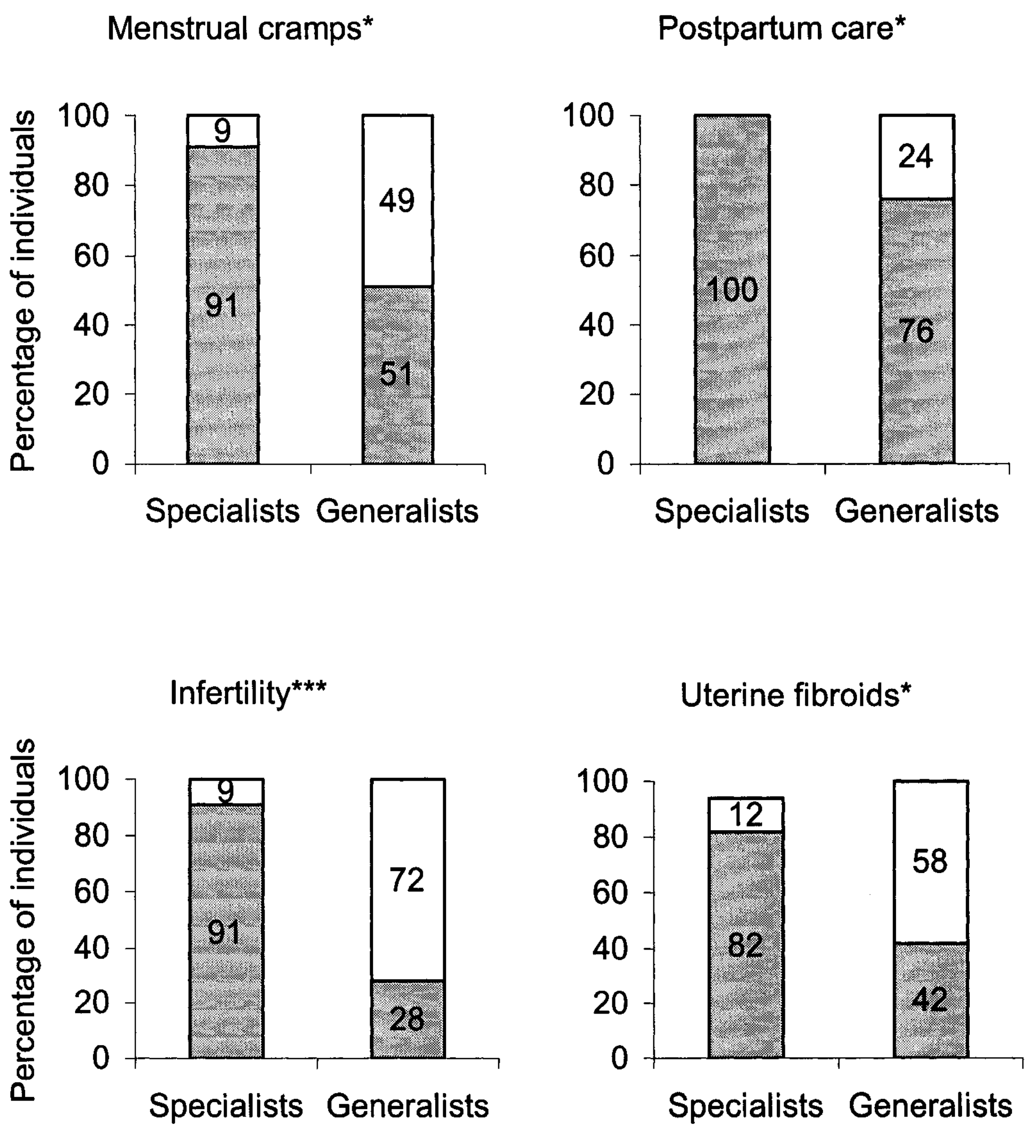
Percentage of generalists and specialists who reported a remedy for the women's health conditions

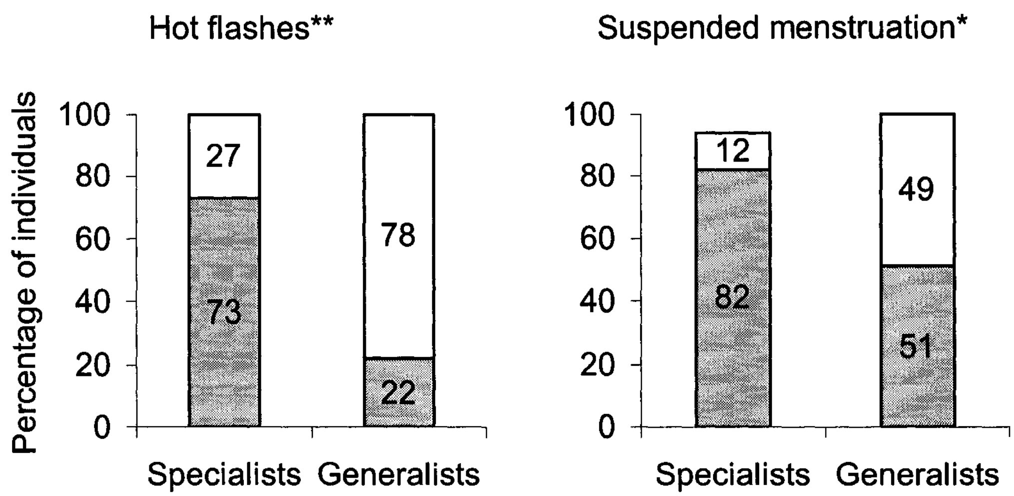
For all 10 conditions, a greater percentage of specialists reported a remedy than the generalists (Figure 5.7). A significantly greater percentage of specialists reported a remedy for infertility and pregnancy prevention (G-test, $p < 0.0001$) than generalists, which suggests that these conditions are treated with specialized knowledge. Infertility and pregnancy prevention may also be considered more serious health conditions, therefore healers are consulted for these conditions. As in earlier analyses, pregnancy prevention was considered the least well-known condition in Dominican traditional medicine because of the low percentage of specialists (55%) and generalists (5%) who reported a remedy for this condition. For this condition, individuals in both groups recommended condoms, the birth control pill, and other non-botanical methods during surveys.

Some specialists did not mention a remedy for every condition because they thought that a physician should treat the condition, or, in some cases, they were not familiar with a traditional remedy. Healers differed in their treatments and healing specialties that may, in part, explain the low response to some of the health conditions.

Figure 5.7. Percentage of generalists (n = 226) and specialists (n = 11) who reported a remedy for the 10 women's health conditions (G-test, significance ***p < 0.0001, **< 0.001, *< 0.05).




Menstrual cramps*
Postpartum care*
Infertility***
Uterine fibroids*
Percentage of individuals
100
80
60
40
20
0
9
91
49
51
100
24
76
72
28
12
82
58
42
Specialists
Generalists



These results show that medicinal plant knowledge for the 10 women's health conditions was not specific to generalists or specialists. Figure 5.7 shows that overall a greater percentage of specialists reported treatments for the conditions than generalists and that some conditions were well-known by both groups. For example, all healers reported an herbal treatment for vaginal infections and postpartum care. A high number of generalists were also able to report herbal therapies for vaginal infections (69%) and postpartum care (76%). This suggests that these are common conditions treated with traditional medicine as has been suggested in Chapter 4. There were two conditions that were not well-known by either group, morning sickness and hot flashes. Fewer specialists reported therapies for morning sickness (73%) and hot flashes (73%). This may be explained because the male healers tended not to report treatments for these conditions perhaps because they are not asked to treat these conditions.

Another explanation may be that these conditions are not typically treated with plants because they are natural and part of a woman's life cycle.

Distribution of medicinal knowledge of generalists and specialists

The number of field reports and the number of plant species cited for each health condition was compared for generalists and specialists to further understand differences between these groups (Table 5.10). The total number of field reports including plant species and non-herbal ingredients for specialists was 1246 versus 2426 for generalists. Percentages were used for an easier comparison between the groups.

Table 5.10. Distribution of field reports and plant species of generalists (*n* = 226) and specialists (*n* = 11) for 10 women's health conditions.

	Percentage of field reports		Number of plant species	
Health Condition	Specialists	Generalists	Specialists	Generalists
Vaginal infections	11	20	68	95
Morning sickness	4	6	40	49
Pregnancy prevention	3	1	30	12
Excessive menstruation	3	7	24	61
Menstrual cramps	8	11	54	66
Postpartum care	23	21	93	109
Infertility	19	8	85	89
Fibroids	7	9	56	31
Hot flashes	9	4	63	43
Suspended menstruation	13	13	72	82

The highest percentage of field reports for both groups was for postpartum care. This condition was also associated with the greatest number of plant species. After postpartum care, infertility had the greatest percentage of field reports for specialists, and vaginal infections had the second highest for generalists. Infertility showed a significant difference in the percentage of field reports, whereas the number of species for each group is not considerably different. This may be an artifact of research design in that the sample sizes are different. Based on conversations during the interviews, infertility tends to be a condition treated by a specialist, either a physician or healer. However, women either knew from personal experience or via a neighbor that a healer would prescribe a *botella* for infertility and in some cases women knew some of the plants used to prepare this remedy.

Based on these data, vaginal infections are a common women's health concern. Therefore, it is not surprising that this condition is ranked second among generalists. An anthropological study (Bonilla-Vega 1998) investigating women's health in the Dominican Republic also reported vaginal infections as a common ailment for Dominican women.

Diversity of medicinal plant use between generalists and specialists

Diversity of medicinal plants reported by generalists and specialists per condition is presented in Table 5.11 and includes the Shannon, Simpson, and Evenness indices. The overall Shannon-Wiener index for specialists was 4.40 (95% CI 4.33 - 4.48); for generalists it was 4.39 (95% CI 4.29 - 4.53). These values are similar and suggest that both groups use a diverse range of plants. The Simpson index is 0.98 (95% CI 0.98 - 0.99) for specialists and 0.98 (95% CI 0.98 - 0.98) for generalists. Evenness for specialists was 0.91 and 0.84 for generalists.

For specialists, postpartum care showed the highest diversity index (4.28, 95% CI 4.23 - 4.33), which may reflect the use of *botellas* that are composed of high numbers of plants. Specialists showed the lowest diversity of plant species for excessive menstruation (3.09, 95% CI 3.06 - 3.13), a trend that corroborates the low number of reports mentioned for this health condition as compared with the other conditions (see Table 5.10). For generalists, infertility showed the highest diversity (4.27, 95% CI 4.23 - 4.33). The lowest diversity for generalists was observed for pregnancy prevention (2.21, 95% CI 2.11 - 2.48) and uterine fibroids (2.14, 95% CI 1.94 - 3.12).

Low diversity suggests that these conditions are treated with a small number of dominant species, which is further confirmed by the low evenness index of 0.62 for fibroids and 0.89 for pregnancy prevention among generalists. Low diversity may also be interpreted as low salience or knowledge about a particular condition. Diversity indices may provide additional data about the kinds of remedies and mixtures used for a condition.

Table 5.11. Diversity indices calculated from the number of plant field reports of generalists (n = 226) and specialists (n = 11) for 10 women's health conditions.

Healing Ability	Richness of species	Field Reports	Simpson Index with 95% Confidence Intervals	Shannon-Wiener Index with 95% Confidence Intervals	Evenness
All women's health conditions					
Specialist	126	1113	0.98 (0.98-0.99)	4.40 (4.33-4.48)	0.91
Generalist	189	2148	0.98 (0.98-0.98)	4.39 (4.29-4.53)	0.84
Vaginal infections					
Specialist	68	128	0.98 (0.97-0.98)	3.99 (3.92-4.06)	0.94
Generalist	95	450	0.95 (0.93-0.96)	3.55 (3.39-3.84)	0.78
Morning sickness					
Specialist	40	43	0.97 (0.96-0.98)	3.63 (3.55-3.69)	0.98
Generalist	49	116	0.96 (0.95-0.97)	3.54 (3.45-3.68)	0.91
Pregnancy prevention					
Specialist	30	32	0.96 (0.96-0.97)	3.38 (3.36-3.40)	0.99
Generalist	12	19	0.85 (0.83-0.92)	2.21 (2.11-2.48)	0.89
Excessive menstruation					
Specialist	24	33	0.95 (0.95-0.95)	3.09 (3.06-3.13)	0.97
Generalist	61	153	0.96 (0.95-0.97)	3.68 (3.56-3.89)	0.89
Menstrual cramps					
Specialist	54	85	0.98 (0.98-0.98)	3.88 (3.85-3.92)	0.97
Generalist	66	248	0.95 (0.94-0.97)	3.60 (3.41-3.86)	0.86
Postpartum care					
Specialist	93	261	0.98 (0.98-0.98)	4.28 (4.23-4.33)	0.94
Generalist	109	438	0.97 (0.97-0.98)	4.08 (3.95-4.25)	0.87
Infertility					
Specialist	85	217	0.98 (0.98-0.98)	4.21 (4.17-4.26)	0.95
Generalist	89	178	0.98 (0.98-0.98)	4.27 (4.23-4.33)	0.95
Uterine fibroids					
Specialist	56	76	0.98 (0.98-0.98)	3.88 (3.92-3.96)	0.96
Generalist	31	189	0.78 (0.69-0.94)	2.14 (1.94-3.12)	0.62
Menopausal hot flashes					
Specialist	63	102	0.98 (0.98-0.98)	4.01 (3.98-4.05)	0.97
Generalist	43	99	0.95 (0.93-0.97)	3.34 (3.20-3.59)	0.89
Suspended menstruation					
Specialist	72	135	0.98 (0.98-0.98)	4.11 (4.07-4.16)	0.96
Generalist	82	260	0.96 (0.96-0.97)	3.83 (3.70-4.00)	0.87

Ethnobotanical knowledge index to compare generalists and specialists

I used the ethnobotanical knowledge index to further measure and compare generalist and specialist knowledge. Table 5.12 provides descriptive statistics for each variable used to define the EKI of generalists and specialists.

Table 5.12. Descriptive statistics of variables used to define ethnomedical knowledge index for generalists (*n* = 226) and specialists (*n* = 11).

Variables	Respondent	Mean	Standard Deviation	Standard Error	Minimum, Maximum
Plant Free List	Combined	20.35	13.45	0.87	3,75
	Specialists	51.55	15.21	4.59	34,78
	Generalists	19.08	11.42	0.76	3,59
Plants for Women's Conditions	Combined	9.15	10.13	0.66	0,70
	Specialists	37.00	14.48	4.37	15,70
	Generalists	7.80	7.65	0.51	0,67
Distinct Plant for Women's Conditions	Combined	7.78	8.02	0.52	0,57
	Specialists	29.27	9.00	2.71	15,46
	Generalists	6.74	6.33	0.42	0,57
Remedies	Combined	5.48	3.91	0.25	0,22
	Specialists	11.73	5.22	1.57	4,22
	Generalists	5.17	3.58	0.24	0,19
Distinct Remedies	Combined	4.58	3.30	0.21	0,20
	Specialists	8.55	6.44	1.94	1,20
	Generalists	4.38	2.96	0.20	0,16
Conditions Known	Combined	4.35	2.50	0.16	0,10
	Specialists	8.18	2.14	0.64	3,10
	Generalists	4.16	2.37	0.16	0,10

A one-way ANOVA was used to compare the mean EKI of specialists to the mean EKI of generalists. Figure 5.8 presents the results of this analysis that revealed a significant difference (F-test = 72.20, $p < 0.0001$) between the EKI mean of specialists (3.48 $\pm$ SE 0.292) and generalists (1.34 $\pm$ SE 0.054). In addition, for each individual variable there is a statistically significant difference between generalists and specialists. For example, the variable 'distinct plant species for women's health conditions' examined alone shows a significant difference between generalists and specialists (F-test = 127.26, $p < 0.01$).

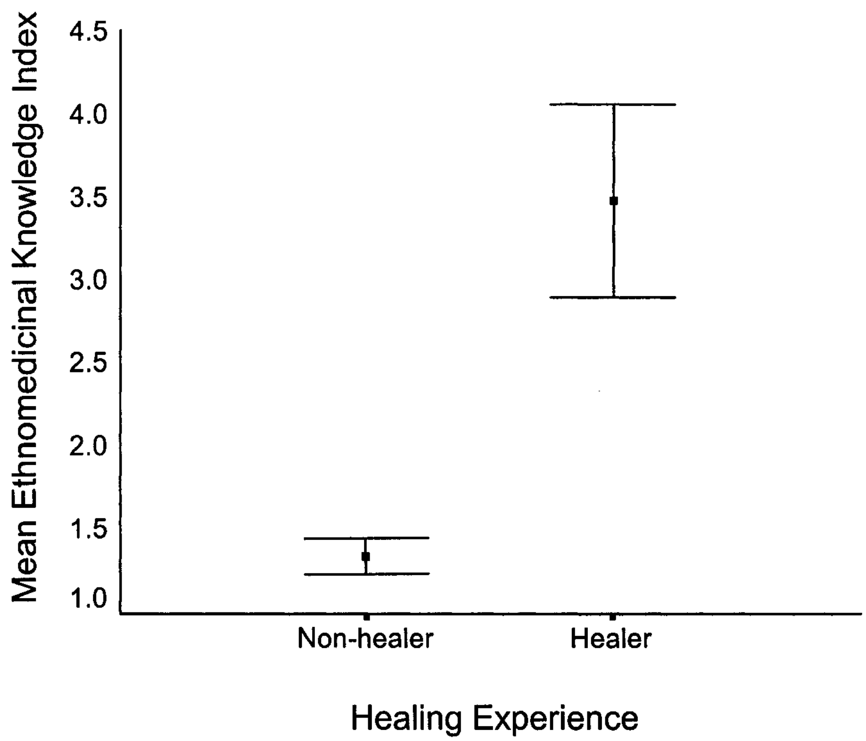


Figure 5.8. Mean ethnobotanical knowledge index with 95% confidence intervals for generalists (n = 226) and specialists (n = 11) (ANOVA, F-test = 72.20, $p < 0.0001$).

The relative magnitude of variance between groups was 77.5% and the variance within groups was 22.5% meaning that more variation occurs between the two categories than within the groups. This analysis suggests that there are different levels of knowledge and high agreement within each group.

It should be noted that some women who were categorized as generalists showed equal or more knowledge than some of the specialists, although this was not presented in Figure 5.8. These women tended to have relatives that were healing specialists and live in rural communities. Few individuals in their respective communities reported these individuals as knowledgeable about plants and therefore they were not classified as specialists.

These results are not surprising; it is expected that specialists have greater ethnobotanical knowledge than generalists. However, this analysis provides an objective, quantitative technique to measure knowledge differences among individuals. Using EKI as an indicator of healing expertise can also help identify individuals who have extensive ethnobotanical knowledge even if they are not identified in the community as specialists.

Similarities and differences between male and female specialists

As discussed earlier, healers in this study vary according to their specialization, but several patterns exist in their choices of treatment. For example, 100% of the healers prescribed a *botella* or *bebedizo* as a postpartum treatment and 91% prescribed the same preparation for infertility. The preparation of a *botella* or *bebedizo* can vary slightly depending on the specialist and the condition.

Although sample sizes differ, when comparing male and female specialists, there is an apparent pattern in the selection of remedies. Male healers tended to prescribe a *botella* for all the women's health conditions, except for one specialist who prescribed a *lavado* (vaginal wash) for the majority of conditions. The preparation of his *lavado* was similar to a *botella*, but it was administered differently. Excessive menstruation was an exception in that three of the male healers reported teas that included one or two plants. Another exception was pregnancy prevention because one male healer prescribed a single plant mixture for this condition.

Strikingly, rather than prescribing a *botella* for all health conditions, female specialists more often prescribed diverse preparations ranging from teas with single plants to purgatives to baths and juices. All the female specialists interviewed reported the *botella* preparation for postpartum care and infertility. A female specialist also reported a *botella* for vaginal infections, and two others reported using this remedy for uterine fibroids and suspended menstruation.

This variation between genders suggests that female specialists know a greater diversity of treatment approaches for women's health conditions than their male counterparts. Although male specialists were knowledgeable about treating women's conditions, they tended to use the same remedy for multiple conditions. This difference is further confirmed by comparing the mean number of distinct plant species reported by male specialists (25) versus female specialists (32) for the 10 health conditions, as well as comparing the EKI values for male specialists (2.77) and female specialists (3.89). Quinlan's (2000: 284) study in the Caribbean island of Dominica found that men treated illnesses with fewer plants than women and suggested that men may use plants that have broader medicinal properties. While her subjects were not healers, her results support gender differences observed in this study and suggest that more studies evaluating medicinal knowledge and gender are warranted.

Socio-demographic factors and ethnobotanical knowledge

Age, education, and socio-economic status

In this section, I will address individual factors that may predict a person's ethnobotanical knowledge. All 237 individuals, both specialists and generalists, were included in this analysis. The independent variables considered were age, education, and socio-economic status (SES), and the dependent variable was the ethnobotanical knowledge index (EKI).

Education and SES data were recoded. During the surveys, education data were recorded as highest level of education attained (elementary, high school, or university) and the number of years completed at that level. In the Dominican system of education, elementary school (*primaria*) consists of eight years, high school (*bachiller*) consists of four years, and university (*universidad*) consists formally of four years. A new variable was created that included the total number of years of education and ranged from 0 to 16. The SES index variable measures an individual's general personal wealth based on a household inventory. The SES index was created using a household inventory as described in Chapter 4.

The three variables, age, education, and SES, were first evaluated to determine their independence from each other. The variables contain either interval or continuous data and therefore can be tested for independence using bivariate correlations (Sokal and Rohlf 1995). As would be expected, these three variables are highly correlated (Table 5.13). Age is negatively correlated with education and SES, which suggests that increased age among adults is associated with decreased levels of education and SES. This relationship may also reflect generational differences in that elders in the Dominican Republic had limited access to education when they were young in comparison to present-day young people. As would be expected, education and SES are positively correlated which means that high levels of education are associated with high levels of SES.

Table 5.13. Pearson's correlations for age, education, and socio-economic status (SES) for all study participants (n = 237).

Variables	Pearson Correlation	Significance (2-tailed)**
Age-Education	-0.464**	0.000
Age-SES	-0.198**	0.002
Education-SES	0.526**	0.000

** Correlation is significant at the 0.01 level (2-tailed).

Age, education, and SES were also analyzed with the location variable, rural or urban. Results showed that age was independent of region. As reported in other studies, both education and SES levels were confounded by region (Bernard 1994: 474). Individuals with high levels of education and SES were associated primarily with urban communities while low levels of education and SES were associated with rural communities.

Separate analyses limited to rural individuals showed evidence that EKI covaried negatively with education (r = -0.373, p = 0.001) meaning that increased levels of education were associated with low levels of EKI. EKI and SES in rural areas did not show a significant association. Analyses with urban individuals failed to show any relation with education or SES and EKI. In both rural and urban analyses, age was positively correlated with EKI ($p < 0.005$) meaning increased age was associated with high values of EKI.

Individuals were divided into two age groups based on the mean. Within the young age group (≤ 40 years old), there was a negative association between EKI and SES ($r = -0.254$, $p = 0.005$), meaning as SES increased EKI decreased. The same negative association between SES and EKI was found within the age group > 40 years old ($r = -0.378$, $p < 0.0001$). EKI and education also showed a negative association ($r = -0.361$, $p < 0.0001$) for the older age group, but no association between these variables was found for the young age group.

Another analysis evaluated EKI within two groups scored as more educated or less educated. Less educated included eight years or less of schooling and more educated included nine years or more of schooling. Within the group coded as more educated, there was no significant difference between EKI and SES or age, but within the less educated group both values were associated with EKI. SES showed a negative interdependence with EKI ($r = -0.294$, $p = 0.001$) meaning increased SES was associated with low EKI. Age showed a positive association ($r = 0.329$, $p < 0.0001$) meaning that greater age was associated with a high EKI value.

Two groups of lower (≤ 7) and higher (> 7) SES were also created. A pattern similar to the other analysis was observed: the lower SES group displayed a negative association between EKI and education ($r = -0.368$, $p < 0.0001$). Age showed a positive association with EKI ($r = 0.352$, $p < 0.0001$). The higher SES group showed no resolution between EKI, education, and age.

In summary, statements can be made about EKI levels within age groups and within rural communities. Age was positively associated with EKI regardless of study site. In rural areas alone, which tended to have less education and SES levels, education was negatively correlated with ethnobotanical knowledge. No resolution of the variables was found, however, within urban communities, that had higher SES and higher educational levels. The data about education level confirms previous evidence based on a study (Aquino Morillo *et al.* 1986) conducted in the mid-1980s in three communities (urban, semi-urban, rural) in the province of San Cristóbal that found that a greater percentage of individuals with lower educational levels tended to use medicinal plants as compared to those with higher educational levels.

Multiple regressions were used to determine what percentage of variance could be explained using the three variables—age, SES, and education. These variables explain 18.9% of the variance of EKI for individuals in the study (Table 5.14 and 5.15).

Table 5.14. Multiple regressions with ethnobotanical knowledge index (EKI) as the dependent variable for all study participants ($n = 237$).

Predictors	R squared	F value	Significance
Age Education SES	0.189	18.062	0.000

Table 5.15. Regression coefficients with ethnobotanical knowledge index (EKI) as the dependent variable for all study participants (*n* = 237).

Independent variable	Beta	t	Significance
Age	0.259	3.884	0.000
Education	-0.088	-1.146	0.253
SES	-0.222	-3.193	0.002

To further evaluate these three variables as predictors of EKI in rural and urban settings, multiple regressions were done individually for rural and urban groups (Tables 5.16 to 5.19). Tables 5.16 and 5.17 show multiple regressions for rural communities and Tables 5.18 and 5.19 show regressions for urban communities. For this analysis, the combined variables account for 22.4% of the variance of EKI for rural individuals (Table 5.16) but only 4.9% of the variance of EKI for urban individuals (Table 5.18). These values further illustrate age and locality as predictors of EKI.

Table 5.16. Multiple regressions with ethnobotanical knowledge index (EKI) as the dependent variable for rural study participants (*n* = 76).

Predictors	R squared	F value	Significance
Age Education SES	0.224	6.917	0.000

Table 5.17. Regression coefficients with ethnobotanical knowledge index (EKI) as the dependent variable for rural study participants (*n* = 76).

Independent variable	Beta	t	Significance
Age	0.361	2.800	0.007
Education	-0.155	-1.193	0.237
SES	-0.082	-0.769	0.445

Table 5.18. Multiple regressions with ethnobotanical knowledge index (EKI) as the dependent variable for urban study participants (*n* = 161).

Predictors	R squared	F value	Significance
Age Education SES	0.049	2.674	0.049

Table 5.19. Regression coefficients with ethnobotanical knowledge index (EKI) as the dependent variable for urban study participants (*n* = 161).

Independent variable	Beta	t	Significance
Age	0.225	2.515	0.013
Education	0.030	0.347	0.729
SES	0.021	-0.252	0.802

As would be expected, ethnobotanical knowledge differs among individuals and between communities. For the entire sample, EKI ranged from 0.04 to 5.71 with a mean of 1.44 $\pm$ SE 0.060. Some individuals did not know any traditional remedies for the 10 women's conditions studied, while others knew remedies but did not know the medicinal plants in the mixtures. Yet others knew a remedy and plant for every condition; and some reported the same plants and remedies for every woman's health condition.

The evidence did not show clearly that SES or education predicts ethnobotanical knowledge of women's medicine across the board because of the high correlation that these variables show with region. Based on the above analysis, age and location of residence are strong predictors of ethnobotanical knowledge of women's health care.

Age and ethnobotanical knowledge

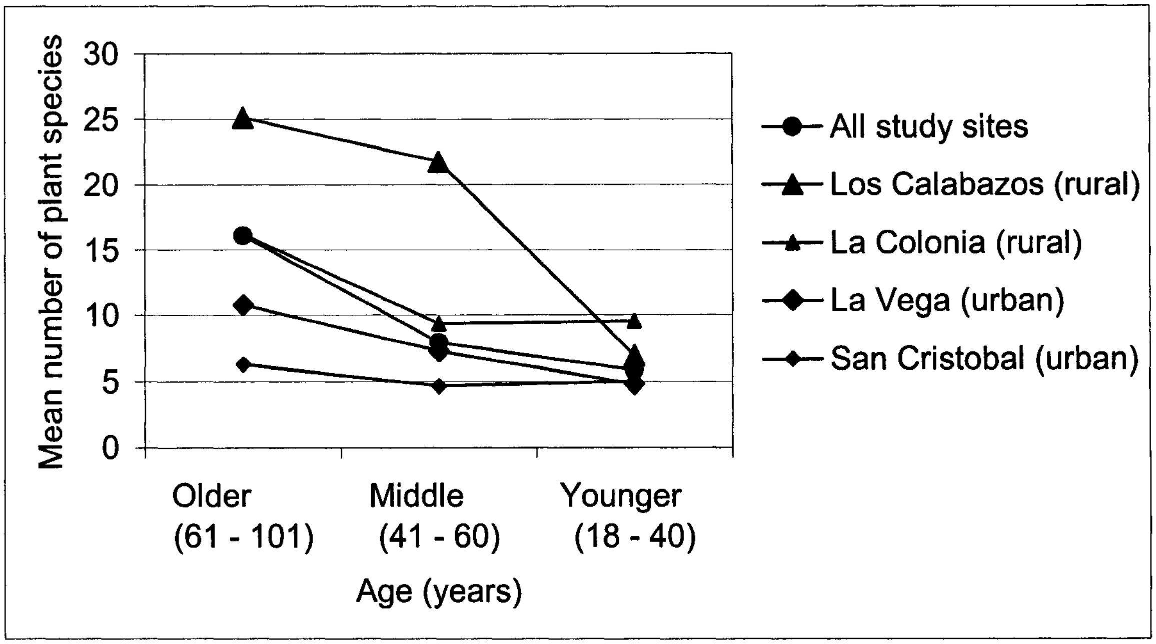
It seems plausible that age would be correlated with the number of plants known for particular health conditions. For example, older women should know more plants to treat hot flashes than younger women because this is a condition that affects only them. This assumes that life experiences influence plant knowledge. To further investigate this question, all respondents in the study, including male healers, were categorized into two age groups, ≤ 40 and > 40. A one-way ANOVA was run for each condition using these two age groups and the number of plants reported by individual.

The three conditions that showed a significant difference between age groups were hot flashes (F-test = 4.614, $p = 0.036$), menstrual cramps (F-test = 4.470, $p = 0.037$), and postpartum care (F-test = 6.791, $p < 0.01$). For all three conditions, respondents older than 40 years old tended to know more plants.

Life experiences, raising children, and more time to learn different remedies are surely reasons for why older individuals were able to mention more plant species than younger individuals for these conditions. For example, one woman I interviewed said that her mother would prepare a tea for her when she had cramps, but she did not know how to make it. Other factors that may explain the differences in knowledge are that younger women tend to want to appear 'modern' by using biomedicine and also that younger women may have had better access to a variety of medical treatment than older generations. While the use of *botellas* is still common in much of the Dominican Republic, more women are using modern medicine. This is particularly true in the urban environments, but is also true in the rural communities.

To further explore this question, Figure 5.9 shows the degree of ethnobotanical knowledge for three age groups: younger (18 to 40), middle (41 to 60), and older (61 to 101). For this analysis, ethnobotanical knowledge was defined as the mean number of plant species reported by each group. All study sites show a decline in the mean number of plant species for the younger age group (18 to 40). The rural community of Los Calabazos shows a steeper decline than the other communities. The combined curve of all study sites shows that the steepest decline in knowledge has occurred between the older age group (61 - 101) and the middle age group (41 - 60). This analysis illustrates that perhaps other factors such as decreased dependence on medicinal plants or lack of sharing medicinal plant knowledge may be influencing the different levels of knowledge because by the age of 40 many Dominicans have considerable family experience and therefore time and life experiences may not be the only factors influencing such traditional knowledge.

Figure 5.9. Age of study participants versus mean number of plant species reported in each study site (n = 237).



Discussion

Cultural similarities and differences

The first hypothesis, Hypothesis 1, which states that rural and urban communities use the same medicinal plants, was rejected based on the results of the plant lists, the percentage of individuals who reported a remedy, and diversity indices of the four communities. The first alternative hypothesis, Hypothesis *1a*, that rural and urban communities have distinct ethnobotanical knowledge and pharmacopoeias, cannot be completely rejected, because although rural and urban communities shared species and knowledge there were also specific plants reported in each community. Both rural and urban women were able to report home remedies and plants for all 10 health conditions. While the communities shared many plant species in common, it was demonstrated that some plants were preferred over others in each community.

In some cases a plant species was found growing in more than one community but was only reported in one site. This is illustrated by a couple of plant walks I went on with women during which I would occasionally point out a plant that was reported in another study site to see if they had a use for it. For these few cases the women responded that the plant was considered a "weed" and not used. In future studies it would be interesting to combine the lists of reported plants from several communities and use the checklist or plant interview technique as described by Boom (1987) to query people.

The second alternative hypothesis, Hypothesis *1b*, was that plants reported in rural communities would be a subset of plants reported in urban study sites. The basis for this hypothesis was that urban centers would receive heavy trade and exchange of plants from various parts of the country and potentially from abroad as opposed to rural areas that I believed would be more isolated and likely to be dependent on their local flora. This was not the case, however: rural women reported more plant species than women living in urban communities. These results suggest an erosion of plant knowledge as people migrate to urban centers. These results, perhaps in part, are due to the limited access and exposure in urban environments to natural resources including plants and increased preference for other forms of treatment such as pharmaceuticals. Other studies (Alexiades 1999: 353; Milliken and Albert 1996) have reported a similar pattern of increased use of pharmaceuticals and a decreased use of plant medicine among indigenous groups as they become acculturated.

Future longitudinal studies in these same communities could compare plant knowledge over time to see how their pharmacopoeias evolve and to better understand the acquisition of cultural plant knowledge. For example, it would be interesting to see if flax and soy become more widely reported by women in these communities as these herbs increase in popularity in urban centers.

Hypothesis 2, that stated there is no difference between generalists and specialists, was also rejected. Specialists and generalists show different levels of knowledge, and specialists have a greater ethnobotanical knowledge than generalists. Also, there was less variance among specialists and among generalists than there was between these two groups. In addition, the first alternative hypothesis, Hypothesis *2a*, that specialists have distinct ethnobotanical knowledge and a unique pharmacopoeia, cannot be completely rejected. The majority of plant species were reported by both specialists and generalists. Although some plant species were specific to specialists and other species were specific to generalists, the knowledge and pharmacopoeias were not exclusive for the two groups. Comparing EKI levels using ANOVA showed a significant difference between generalists and specialists that suggests that the two groups are distinctly different in their levels of traditional knowledge.

The other alternative hypothesis, Hypothesis *2b*, proposed that generalists would use a subset of plants reported by specialists, suggesting both common and distinct sets of knowledge. The basis for this hypothesis was that specialists would have an extensive knowledge of medicinal plants for women's medicine, and they would tend to know toxic and rare plants with which generalists would not be familiar. However, this trend was not observed. This may be due in part to artifacts of the research design, in particular the large difference in sample size. I compared all specialists and generalists rather than comparing an equal number of specialists and generalists within the same community.

The results from the present study demonstrate that generalists and specialists share common ethnobotanical knowledge and use similar medicinal plants, and at the same time each group has a distinct set of plants and healing knowledge. Garro (1986), in her work comparing the system of folk medical knowledge for curers and non-curers in a rural community in Mexico noted a similar trend of shared and distinct knowledge between the two groups. Future studies could use a pre-selected list of plants as in the checklist interview, or a plant-transect as in the plant interview to further evaluate differences and similarities between generalists and specialists.

Plants for women's medicine

The variety of plants used for the 10 women's health conditions is extensive and includes cultivated, wild-collected, and purchased plants. Individuals in urban environments tended to purchase their plants or grow them in home gardens. A few species, such as *Plantago major* and *Spermacoce assurgens* are wild-collected because they are readily available in empty lots, along roadsides, and in disturbed habitats. Rural women tend to rely on plants that they have access to in their home gardens and *conucos* or plants that can be wild-collected. Rural women reported few plants that needed to be purchased.

Many plants are known in all four study sites and by both specialists and generalists. Plants specific to a community were also noted. For example, *Adiantum tenerum* was specific to La Colonia and *Pilea rugosissima* to Los Calabazos. *Adiantum tenerum* was reported by nine different women in La Colonia and was used primarily for postpartum care. It was also reported for suspended menstruation, infertility, and vaginal infections. Eight different women in Los Calabazos reported *P. rugosissima* for excessive menstruation. Medicinal plants used for uterine fibroids in New York City and in the Dominican Republic also showed similarity and variation. Species were reported in New York City that were not reported in the Dominican Republic and other species were mentioned in the Dominican Republic that were not cited in New York City. Transnational comparisons of Dominican traditional medicine provide an additional perspective on the evolution of healing practices as people migrate to new environments.

Traditional knowledge of women's health conditions

The higher percentage of women who reported a remedy for the health conditions in rural communities was perhaps due to the surrounding vegetation and the common practice of cultivating useful plants in home gardens and *conucos*. Also, there may be a greater reliance on natural resources in rural settings as compared to urban environments. Distance from health centers, costs of transportation, and high costs of medications may also contribute to the reliance on traditional medicine manifested as an increased level of medicinal plant knowledge in rural areas. Women in the urban communities may rely on allopathic medicine perhaps because it is more readily available and accessible to them than medicinal plants. Education and social pressures may also encourage urban women to use biomedical resources more than medicinal plants. However, this may change with the popularity of herbal use in the United States and other countries. In the future, perhaps Dominican women living in urban areas will report more traditional medicines incorporating those from their families as well as new uses acquired from the media or neighbors from other regions or even perhaps, from abroad.

Interpreting diversity of plant knowledge

As mentioned above, diversity of plant knowledge can be interpreted in different ways to compare individuals or communities. For example, low diversity of plant knowledge could be explained by several factors such as loss of knowledge, decrease dependence on plant knowledge, specialization and use of efficacious species, or recently introduced health conditions.

The low diversity of medicinal plant species reported for a specific condition may indicate a loss of knowledge for that condition, which may suggest that study participants are only able to remember species they frequently use (Begossi 1996). Low diversity may also be interpreted as a decreased dependence on medicinal plants perhaps because other treatment options, such as pharmaceuticals, are more available, which is related to loss of knowledge (Figueiredo *et al.* 1993). As people become less dependent on medicinal plants they tend to forget their names and uses. Low diversity may also be an indicator of specialization and efficacious plant species. For example, over time a community may refine their ethnopharmacopoeia by discovering that only a small number of plants are efficacious for a particular health condition. An additional factor that may explain low diversity is that a health condition may be recently introduced and therefore does not have an established list of herbal treatments (Davis and Yost 1983). This factor assumes that previously-known health conditions will have higher diversity values, which contradicts the previous factor that suggests that over time people will specialize and select only a few efficacious plant species.

High diversity of plant knowledge may also be explained using similar factors as discussed above for low diversity. Further analysis may help to tease out prominent factors that influence the diversity of plant knowledge for a health condition. Additional studies are needed in this area to evaluate these questions.

Measures of ethnobotanical knowledge

The EKI provided a useful method to quantify ethnobotanical knowledge that permitted comparisons among the groups. It can also be used to ensure that individuals with greater ethnobotanical knowledge are included in studies or development programs; as discussed above, several individuals that were categorized as generalists could have been recoded as specialists based on their EKI values.

Ethnobotanical knowledge is complex and diverse and the EKI has proven to be a useful concept to examine such knowledge. However, the six variables selected to define EKI are specific to this study. In addition, this study has further restricted the parameters of ethnobotanical knowledge by focusing on women's medicine and a specific set of health conditions. These limits, as well as the confines of the study design such as sample size and study sites, should be kept in mind when interpreting the data. Despite these limitations, the components of the EKI help to define several levels and types of knowledge that otherwise may not be factored in to an analysis. In addition, the EKI concept provides a form of measurement that can be used to compare medicinal plant knowledge among individuals and communities.

Socio-demographic factors and ethnobotanical knowledge

The third hypothesis, Hypothesis 3, that states that socio-demographic characteristics (age, education, and socio-economic status) are not associated with ethnobotanical knowledge can be rejected. Correlations between EKI and the independent variables of age, education, and SES did show significance in several cases. The results of analyzing socio-demographic factors as predictors of ethnobotanical knowledge show two trends. One is that age is correlated with EKI, i.e., people of an older generation tend to have greater ethnobotanical knowledge. This trend supports Hypothesis *3ai* that stated ethnobotanical knowledge would increase with age. This result would be expected because as individuals age they gain life experiences and have more time to learn new remedies, health conditions, and plant species. Around age 60, the EKI tends to reach a plateau. Age as a predictor of ethnobotanical knowledge is further supported by the three women's health conditions—hot flashes, menstrual cramps, and postpartum care—that were associated with individuals greater than 40 years old. These data are not surprising, as elders are often sought for wisdom and advice and are considered stewards of traditional knowledge. Also, age brings more experience and perhaps in older generations people may have relied more heavily on traditional medicine because they had less access to modern medicine than younger generations.

The other trend is that EKI is associated with setting. Rural communities had higher levels of ethnobotanical knowledge for women's health than urban communities. Individuals living in urban settings continue to use and remember traditional knowledge, but in many cases their knowledge is limited when compared with individuals living in rural communities. The other two variables, SES and education, were confounded by region. Low SES and education were associated with rural sites, and high SES and education were associated with urban sites. Both Hypothesis *3aii* and *3aiii* about education and SES cannot be rejected and further investigation is needed to accurately test these hypotheses.

Gender was not included in the analysis for this study except for a discussion of treatments reported by male and female specialists. Differences in plant species reported and remedies selected by male and female specialists suggest that further studies in this area are needed to further understand the distribution of traditional knowledge for women's medicine.

Conclusion

Plant knowledge for women's medicine both differs and concurs in rural and urban communities and between generalists and specialists. The groups are not exclusive and much of their knowledge overlaps. In addition, patterns of similarity and variation were observed between healers living in New York City and those living in the Dominican Republic. For example, plant species reported for hot flashes, menorrhagia, and uterine fibroids were the same for the two groups. Hot flashes and menorrhagia had a greater number and richer composition of plants reported by healers living in the Dominican Republic than New York City healers, while the opposite was true for uterine fibroids. Some plant species and healing knowledge may be group-specific because of cultural preferences, access to plant resources, and influences of media and technology, while other species and healing knowledge are shared between groups.

The results presented in this chapter reject the initial hypotheses that rural and urban communities share the same medicinal plants. Many of the same plants were reported in both communities, but each community also uses distinct plants. The rural communities tended to hold an overall greater knowledge base about women's traditional medicine than the urban communities. This holds true for the number of plant species reported, the percentage of women who reported a remedy for different health conditions, diversity, and the ethnobotanical knowledge index. In conclusion, the greater knowledge demonstrated in rural environments probably stems from close contact with natural resources and reliance on these resources for health care. People in urban communities, in contrast, have access to a diverse array of treatment approaches and less contact with natural resources and diverse plant populations.

As would be expected, specialists also showed greater knowledge about traditional medicine for women's health as compared to generalists. Plant species reported by specialists and generalists were both shared and showed variation. In addition, female healers reported a wider variety of treatments than male healers. Factors such as age and region were also correlated with ethnobotanical knowledge, while education and socio-economic status were confounded by region.

Ethnobotanical knowledge is fluid and constantly adapting to changing conditions such as urbanization, people-plant migrations, and fluctuating ecosystems. Fixed borders do not exist between rural and urban groups, nor do they exist between generalists and specialists, as information is shared through various channels. Plants may be selected for a variety of reasons, for example, their efficacy, accessibility, or strongly rooted cultural traditions passed down from generations. The accumulation of knowledge develops over generations, with age, and through contact with other individuals and groups. Understanding the changing body of medicinal knowledge that exists is important for effective planning of health care programs that respect traditional medicine and encourage the participation of local communities. Additional studies in other regions and/or countries are needed to examine the range of knowledge among individuals in a community to more rigorously understand the heterogeneity of plant use within groups; this knowledge can inform and support development projects in health, natural resource management, conservation, and other needed services to communities.

Table 5.1. Medicinal plant species reported by specialists (*n* = 11) and generalists in Los Calabazos R1 (*n* = 33), La Colonia R2 (*n* = 34), La Vega U1 (*n* = 87), and San Cristóbal U2 (*n* = 72) for 10 women's health conditions.

Scientific Name [Family] {Voucher}[a]	Vernacular Name	No. Field Reports[b] R1	R2	U1	U2	HL[c]
Abelmoschus esculentus (L.) Moench [Malvaceae] {SR1}	*molondrón*		1			
Acacia macracantha Humb. & Bonpl. ex Willd. [Fabaceae] {315}	*aroma*	2				3
Adiantum tenerum Sw. [Pteridaceae] {452}	*cilantrico de pozo*		14			
Agave antillarum Descourt. [Agavaceae] {241, 378, PV138}	*maguey, maguey verde, maguey blanco*	1	40	11	34	18
Allium cepa L. [Liliaceae] {R169, SR3}	*cebollín, cebolla*		1	1	1	
Allium sativum L. [Liliaceae] {PV157}	*ajo*	4	1	6	5	2
Aloe vera (L.) Burm.f. [Asphodelaceae] {PV10, PV124, PV139, PV87, R105}	*sábila, acibar*	12	4	21	19	2
Alpinia zerumbet (Pers.) B. L. Burtt & R. M. Sm. [Zingiberaceae] {265}	*dragón*	2				8
Alternanthera tenella Colla [Amaranthaceae] {351, 399}	*lleve sangre, periquito*	1	2			
Ambrosia artemisiifolia L. [Asteraceae] {338, 371, 419}	*altamisa, artemisa*	5	30	2	4	7
Ananas comosus (L.) Merr. [Bromeliaceae] {PV7}	*piña*	1		3	2	
Annona muricata L. [Annonaceae] {317}	*guánabana*	4				12
Annona reticulata L. [Annonaceae] {316}	*mamón*	6				14
Apium graveolens L. [Apiaceae] {SR9}	*apio*				2	
Arachis hypogaea L. [Fabaceae] {SR7}	*maní*				1	
Argemone mexicana L. [Papaveraceae] {247, PV141, PV153, PV73}	*cardo santo*	5	11	9	15	25
Arracacia xanthorrhiza Bancr. [Apiaceae] {PV155}	*rábano*				1	
Artemisia cf. *absinthium* L. [Asteraceae] {269}	*ajencio, ajenjo*	3	9	1		
Averrhoa carambola L. [Oxalidaceae] {SR12}	*carambola*				1	
Bambusa vulgaris Schrad. ex J. C. Wendl. [Poaceae] {523}	*bambú*					7

Table 5.1. Continued

Scientific Name [Family] {Voucher}[a]	Vernacular Name	No. Field Reports[b] R1	R2	U1	U2	HL[c]
Begonia domingensis A. DC. [Begoniaceae] {239}	*cocaria*	1				
Beta vulgaris L. [Chenopodiaceae] {PV168}	*remolacha*	8	2	34	22	3
Bixa orellana L. [Bixaceae] {260, 320, PV151, PV50}	*bija, bija morada*	8	2		9	12
Brassica integrifolia (H. West) Rupr. [Brassicaceae] {303}	*mostaza*	2				
Caesalpinia brasiliensis L. [Fabaceae] {R29}	*palo de brasil*					7
Caesalpinia coriaria (Jacq.) Willd. [Fabaceae] {478}	*guatapanal*			1		6
Cajanus cajan (L.) Millsp. [Fabaceae] {231}	*guandul*		3	1		1
Calophyllum calaba L. [Clusiaceae] {332}	*mara*	1				
Canavalia nitida (Cav.) Piper [Fabaceae] {R83}	*güeymate, mate colorado*	3			1	4
Capraria biflora L. [Scrophulariaceae] {159, 203}	*feregoza*	6				
Capsicum annuum L. [Solanaceae] {PV164}	*ají, ají dulce*			4	2	
Carica papaya L. [Caricaceae] {SR2}	*lechosa*				1	7
Casimiroa edulis La Llave & Lex. [Rutaceae] {307}	*pera*			2		
Cassia fistula L. [Fabaceae] {R3, R78}	*cañafístula*	11		3	2	15
Catalpa longissima (Jacq.) Dum. Cours. [Bignoniaceae] {357, 499}	*roble*	3		24	6	13
Catharanthus roseus (L.) G. Don [Apocynaceae] {420}	*todo el año, rosa catalana*		1			10
Cecropia schreberiana Miq. [Cecropiaceae] {R90}	*guayumbo, yagrumo*			2		4
Cenchrus echinatus L. [Poaceae] {185, 492, 234}	*cadillo de gato, cadillo de conuco, cadillo almacita*					3
Centrosema pubescens Benth. [Fabaceae] {236}	*diverta caminante*	2				1
Chamaesyce hirta (L.) Millsp. [Euphorbiaceae] {165, 222}	*maicasa, malcasá*	2				3
Chenopodium ambrosioides L. [Chenopodiaceae] {183, 342, 364}	*apasote*	5			1	
Chiococca alba (L.) Hitchc. [Rubiaceae] {R86, R162}	*timacle*					11

Table 5.1. Continued

Scientific Name [Family] {Voucher}[a]	Vernacular Name	No. Field Reports[b] R1	R2	U1	U2	HL[c]
Cinnamomum verum J. Presl [Lauraceae] {R133}	*canela*	20	11	44	12	13
Cissus verticillata (L.) Nicolson & C. E. Jarvis [Vitaceae] {328}	*bejuco caro*	4				21
Citharexylum fruticosum L. [Verbenaceae] {158}	*penda*	3				1
Citrus aurantifolia (Christm.) Swingle [Rutaceae] {440, 471}	*limón, limón agrio*	3		7	3	4
Citrus aurantium L. [Rutaceae] {503}	*naranja agria*	10	3	4	1	4
Citrus sinensis Osbeck [Rutaceae] {213}	*china, naranja*	6	1	3	4	
Cocos nucifera L. [Arecaceae] {PV182, R99}	*aceite de coco, coco, coco indio*		5	7	8	13
Coffea arabica L. [Rubiaceae] {PV160}	*café*	29	8	7	5	15
Corchorus siliquosus L. [Tiliaceae] {460}	*escobita dulce*		2			
Crescentia cujete L. [Bignoniaceae] {267, R42}	*higüero*		6	5	15	8
Cucurbita pepo L. [Cucurbitaceae] {PV11}	*auyama*			1		
Cuminum cyminum L. [Apiaceae] {R135, R95}	*anís de comino, comino*		3		2	6
Cupania americana L. [Sapindaceae] {232}	*guárana*	3				
Cymbopogon citratus (DC.) Stapf [Poaceae] {174, 330, 377}	*limoncillo*	2		1	2	2
Daucus carota L. [Apiaceae] {PV176}	*zanahoria*		1	7		
Desmodium affine Schltdl. [Fabaceae] {189, 191, 395}	*amor seco*	3	1	1		15
Dioscorea alata L. [Dioscoreaceae] {SR8}	*ñame*			1		
Doyerea emetocathartica Grosourdy [Cucurbitaceae] {R144}	*batata de burro*				2	1
Eleusine indica (L.) Gaertn. [Poaceae] {309}	*pata cotorra*	2				
Eleutherine bulbosa (Mill.) Urb. [Iridaceae] {433}	*cebolla de sangre*		6			
Equisetum giganteum L. [Equisetaceae] {169, R165}	*cola de caballo*	2		1	1	12
Eryngium foetidum L. [Apiaceae] {382, 408}	*cilantro ancho*			1	1	
Eucalpytus rostrata F. Muell. [Myrtaceae} {508}	*eucalipto*				1	
Eupatorium aromatisans DC. [Asteraceae] {405}	*anica*		2			4

Table 5.1. Continued

Scientific Name [Family] {Voucher}[a]	Vernacular Name	No. Field Reports[b] R1	R2	U1	U2	HL[c]
Eupatorium odoratum L. [Asteraceae] {437}	*rompezaragüey*		3			
Exostema caribaeum (Jacq.) Roem. & Schult. [Rubiaceae] {R91}	*quina*			2		3
cf. *Exostema* sp. [Rubiaceae] {R81}	*quina*			2		
Foeniculum vulgare Mill. [Apiaceae] {326, 454, R5}	*hinojo*		2	2		3
Garcinia cf. *barkeriana* (Urb. & Ekman) Alain [Clusiaceae] {R93}	*palo de cruz, palo escruz*	1	1			1
Garcinia cf. *glaucescens* Alain & M. Mejía [Clusiaceae] {R166}	*palo de cruz, palo escruz*			2		
Genipa americana L. [Rubiaceae] {464, R142}	*jagua*		3		13	2
Glycine max (L.) Merr. [Fabaceae] {SR4}	*soya*			2		
Gomphrena globosa L. [Amaranthaceae] {365]	*habanita*		6			3
Gossypium hirsutum L. [Malvaceae] {409, PV113, PV69}	*algodón morado*		1	8		12
Gouania polygama (Jacq.) Urb. [Rhamnaceae] {R141}	*bejuco indio*				2	2
Guarea guidonia (L.) Sleumer [Meliaceae] {145}	*cabirma*	2				
Guazuma ulmifolia Lam. [Sterculiaceae] {459, 502}	*guácima*	2	4			
Hamelia patens Jacq. [Rubiaceae] {417}	*buzunuco*		10			1
Hibiscus rosa-sinensis L. [Malvaceae] {451}	*cayena*		1			
Hordeum vulgare L. [Poaceae] {R155}	*cebada*		4			
Hymenaea courbaril L. [Fabaceae] {537}	*algarroba*		2			
Illicium verum Hook.f. [Illiciaceae] {R74}	*anís de estrella*	12	12	22	5	32
Inga vera Willd. [Fabaceae] {144}	*guama, jina*	2				2
Iresine herbstii Hook. [Amaranthaceae] {447, PV30}	*molleja de gallina*	2	3			1
Jatropha curcas L. [Euphorbiaceae] {435}	*piñón, piñón de leche*					6
Jatropha gossypiifolia L. [Euphorbiaceae] {379, 483}	*túa-túa*			1	1	6

Table 5.1. Continued

Scientific Name [Family] {Voucher}[a]	Vernacular Name	No. Field Reports[b] R1	R2	U1	U2	HL[c]
Kalanchoe gastonis-bonnieri Raym.-Hamet & H. Perrier [Crassulaceae] {363, 376, PV148, PV57}	*mala madre*	2	20	49	24	7
Kalanchoe pinnata (Lam.) Pers. [Crassulaceae] {168, PV89}	*brujo, bruja, tope*	4	2	1	1	
Lantana camara var. *aculeata* (L.) Moldenke [Verbenaceae] {401}	*Doña Ana*		1			
Lavandula angustifolia Mill. [Lamiaceae] {R75}	*algucema, alhucema*	8	9	5	2	30
Leucaena leucocephala (Lam.) de Wit [Fabaceae] {R149}	*lino*		4			
Linum usitatissimum L. [Linaceae] {R164}	*lino*			3		
Lippia alba (Mill.) N. E. Br. [Verbenaceae] {358, 367}	*limoncillo*					2
Lippia micromera Schauer [Verbenaceae] {194, 423}	*orégano, orégano de chiquito, orégano de comer*	5		3	3	2
Lippia scaberrima Sond. [Verbenaceae] {190, 263}	*orozul*	4				
Macfadyena unguis-cati (L.) A. H. Gentry [Bignoniaceae] {291, 539}	*pega palo*	1	1			11
Majorana hortensis Moench [Lamiaceae] {272}	*mejorana*	4				7
Malachra alceifolia Jacq. [Malvaceae] {388}	*malva*		1			10
Malpighia cnide Spreng. [Malpighiaceae] {301}	*cereza*					3
Malpighia emarginata Sessé & Moc. ex DC. [Malpighiaceae] {PV178}	*cereza*			2		
Mangifera indica L. [Anacardiaceae] {305}	*mango*			1		
Manihot esculenta Crantz [Euphorbiaceae] {PV95}	*yuca*			1		1
Matricaria recutita L. [Asteraceae] {R163, R72, R76}	*manzanilla*	11	10	74	8	39
Mentha cf. *spicata* L. (rugose form=*M. cordifolia* auth., non Opiz) [Lamiaceae] {259, 375, PV35}	*yerba buena*	8	3	1	4	10
Mentha cf. x *piperita* L. var. *officinalis* Sole [Lamiaceae] {137}	*toronjil*	2				1

Table 5.1. Continued

Scientific Name [Family] {Voucher}[a]	Vernacular Name	No. Field Reports[b] R1	R2	U1	U2	HL[c]
Mentha sp. [Lamiaceae] {SR13}	*menta*				2	
Merremia quinquefolia (L.) Hallier f. [Convolvulaceae] {482}	*viní-viní*			1		
Momordica charantia L. [Cucurbitaceae] {250, 448, PV189}	*cundeamor, sorosí*		38	2	9	15
Mora abbottii Rose & Leonard [Fabaceae] {458}	*almacey*		1			
Morinda citrifolia L. [Rubiaceae] {PV63}	*noni, piña de puerco*				1	
Musa sapientum L. [Musaceae] {PV103, PV186}	*guineo, guineo morocho, rulo*		5	2	1	3
Musa x *paradisiaca* L. [Musaceae] {PV102}	*plátano*		1		1	
Myristica fragrans Houtt. [Myristicaceae] {R138}	*nuez moscada*	6	5	1	1	15
Nasturtium officinale R. Br. [Brassicaceae] {341}	*berro*		1			
Not determined [Nyctaginaceae] {R79}	*jalapago*	2				
Ocimum basilicum L. [Lamiaceae] {325, 510}	*albahaquita, albahaca*	2			2	
Ocimum tenuiflorum L. [Lamiaceae] {362, 410}	*albahaca morada, albahaquita morada*		4		2	
Olea europaea L. [Oleaceae] {SR14}	*aceituna*					1
Opuntia ficus-indica (L.) Mill. [Cactaceae] {257, 274, PV53, PV72}	*alquitira, tuna, tuna de España*	30	5	44	7	19
Oxalis corniculata L. [Oxalidaceae] {228}	*tremolina*	5				1
Panax sp. [Araliaceae] {SR5}	*ginseng*			1		
Passiflora edulis Sims [Passifloraceae] {308, 455}	*chinola*		1	7		
Passiflora quadrangularis L. [Passifloraceae] {348, 467, PV70}	*granadillo*	4	3	5		
Pavonia spinifex (L.) Cav. [Malvaceae] {141}	*cadillo de tres pies, cadillo tres pie, hierba tres pies*	2			3	17
Pelargonium cf. *graveolens* L' Hér. [Geraniaceae] {PV120}	*geranio*	5				
Peperomia pellucida (L.) Kunth [Piperaceae] {336}	*siempre fresca*		3	3	6	

Table 5.1. Continued

Scientific Name [Family] {Voucher}[a]	Vernacular Name	No. Field Reports[b] R1	R2	U1	U2	HL[c]
Persea americana Mill. [Lauraceae] {322, 324, PV13}	*aguacate morado, aguacate*	7	1	17	3	1
Petiveria alliacea L. [Phytolaccaceae] {136, 252}	*anamú*	15	1	10	4	26
Petroselinum crispum (Mill.) Nyman ex A. W. Hill [Apiaceae] {PV165}	*perejíl*	3			1	1
Phaseolus vulgaris L. [Fabaceae] {R139}	*habichuela*		2	2	1	
Pilea rugosissima Killip [Urticaceae] {211}	*cejúa*	8				2
Pimenta dioica (L.) Merr. [Myrtaceae] {R132}	*malagueta*	3	2	2	1	9
Pimenta haitiensis (Urb.) Landrum [Myrtaceae] {R89}	*canelilla*			8		7
Pimenta racemosa var. *grisea* (Kiaersk.) Fosberg [Myrtaceae] {505}	*ozua*				1	
Pimenta racemosa var. *racemosa* Fosberg [Myrtaceae] {R50}	*malagueta*					1
Pimpinella anisum L. [Apiaceae] {R137, R77]	*anís dulce, anís, anís de chiquita, anís de comer*	2	1	4	2	14
Pinus caribaea Morelet [Pinaceae] {R140}	*cuaba*		1	3	5	
Pinus occidentalis Sw. [Pinaceae] {PV23}	*cuaba*	1				6
Piper aduncum L. [Piperaceae] {152, 461}	*guayuyo, guayuyu*	3	1			1
Piper marginatum Jacq. [Piperaceae] {186}	*anisete, aniseto*	4		2		3
Pisonia aculeata L. [Nyctaginaceae] {500}	*uña de gato*	5				7
Plantago major L. [Plantaginaceae] {273, 436, PV147, PV59, PV81}	*llantén*	7	22	22	14	22
Plectranthus amboinicus (Lour.) Spreng. [Lamiaceae] {253, 422, PV58}	*orégano poleo, orégano*	4		2	3	
Pleopeltis astrolepis (Liebm.) E. Fourn. [Pteridaceae] {327A}	*con de café*	1				
Pluchea carolinensis (Jacq.) G. Don [Asteraceae] {215, 416, 449}	*salvia*		4	1	1	7

Table 5.1. Continued

Scientific Name [Family] {Voucher}[a]	Vernacular Name	No. Field Reports[b] R1	R2	U1	U2	HL[c]
Polygala paniculata L. [Polygalaceae] {233, 289, 466}	*mentol, maravelí*					1
Pothomorphe umbellata (L.) Miq. [Piperaceae] {138, 182, 393}	*broquelejo, broquelejos*	7	2	1		28
Pouteria sapota (Jacq.) H. E. Moore & Stearn [Sapotaceae] {R120}	*zapote*				1	
Prestoea montana (Graham) G. Nicholson [Arecaceae] {PV101}	*manacla*	5				22
Prunus occidentalis W. S. Lyon [Rosaceae] {135}	*almendra*			1	1	
Psidium guajava L. [Myrtaceae] {310, 443, PV132, PV145}	*guayaba*	4	1	6	3	2
Ricinus communis L. [Euphorbiaceae] {153, 201, R171, R172, R173}	*higuereta, aceite de higuereta, aceite de resina, aceite castor*		11	2	14	11
Rosa sp. [Rosaceae] {PV44}	*rosa*		1			
Rosmarinus officinalis L. [Lamiaceae] {287, R134}	*romero*	2	1	1	4	1
Roystonea hispaniolana L. H. Bailey [Arecaceae] {PV154}	*palma*	10		1		25
Ruellia tuberosa L. [Acanthaceae] {160, 356}	*guaucí, periquito, yuquita*	24		18	4	37
cf. *Rumex* sp. [Polygonaceae] {R82}	*ribalbo*		4		4	13
Ruta chalepensis L. [Rutaceae] {339, 407, PV56}	*ruda*	13	4	6	2	5
Saccharum officinarum L. [Poaceae] {321, 450, PV175, SR10}	*caña, melaza*	19	4	39	32	3
Salvia micrantha Vahl [Lamiaceae] {444}	*cizaña*		7			
Sambucus mexicana C. Presl ex DC. [Caprifoliaceae] {161}	*saúco*	2				1
Securidaca virgata Sw. [Polygalaceae] {140, 208, 432, 504, PV46}	*maravelí*	11	6	1	2	37
Senna alata (L.) Roxb. [Fabaceae] {162}	*guajavo*	3				15
Senna alexandrina Mill. [Fabaceae] {R153, R71}	*sen*	11	4	1	3	15
Senna occidentalis (L.) Link [Fabaceae] {400}	*brusca prieta, bruca prieta*		2		1	7

Table 5.1. Continued

Scientific Name [Family] {Voucher}[a]	Vernacular Name	No. Field Reports[b] R1	R2	U1	U2	HL[c]
Senna sophera (L.) Roxb. [Fabaceae] {495}	*brusca hembra, bruca hembra*					9
Sida acuta Burm.f. [Malvaceae] {175}	*escoba de puerco*	4				1
Simarouba glauca DC. [Simaroubaceae] {R92}	*juan primero*	1	1			
Smilax domingensis Willd. [Smilacaceae] {171, 534}	*bejuco chino, bejuco de para*	11	1			26
Solanum americanum Mill. [Solanaceae] {277}	*morita*	2				
Solanum capsicoides All. [Solanaceae] {210}	*berenjena baja*	2				3
Solanum melongena L. [Solanaceae] {285, 304}	*berenjena de comer*					2
Solanum torvum Sw. [Solanaceae] {314, PV64}	*berenjena alta, berenjena cimarrona, berenjenita*	2		2		3
Spermacoce assurgens Ruiz & Pav. [Rubiaceae] {128, 142, 178, 390, 509, PV62}	*juana la blanca*	20	18	30	14	34
Spermacoce verticillata L. [Rubiaceae] {497}	*clavelillo*	1				
Spinacia oleracea L. [Chenopodiaceae] {SR11}	*espinaca*				1	
Spondias cytherea Sonn. [Anacardiaceae] {R98}	*manzana de oro*			1		
Spondias mombin L. [Anacardiaceae] {468}	*jobo, jobobán*		1		2	
Stachytarpheta cayennensis (Rich.) Vahl [Verbenaceae] {462}	*brusca dulce, bruca dulce*		1			3
Stachytarpheta jamaicensis (L.) Vahl [Verbenaceae] {235, PV60}	*verbena morada, verbena, verbena cimarrona*	5		5		16
Swietenia mahagoni (L.) Jacq. [Meliaceae] {456}	*caoba*		2			1
Syzygium aromaticum (L.) Merr. & L. M. Perry [Myrtaceae] {R136}	*clavo, clavo dulce*	3		4	2	9
Tagetes erecta L. [Asteraceae] {279, 411, 412}	*clavel de muerte, copada*	4	3	2	1	7
Tamarindus indica L. [Fabaceae] {SR6}	*tamarindo*			1		8
Ternstroemia peduncularis DC. [Theaceae] {525}	*botoncillo*					2

Table 5.1. Continued

Scientific Name [Family] {Voucher}[a]	Vernacular Name	No. Field Reports[b] R1	R2	U1	U2	HL[c]
Tetragastris balsamifera (Swartz) Oken [Burseraceae] {246}	*almácigo*	1				
Theobroma cacao L. [Sterculiaceae] {PV169}	*chocolate, cacao*	4	2		2	3
Tilia mandshurica Rupr. & Maxim. [Tiliaceae] {R108}	*flor de tilo*		1	3	1	10
Tournefortia hirsutissima L. [Boraginaceae] {290}	*nigua*	9		2		18
Tradescantia spathacea Sw. [Commelinaceae] {380, PV52}	*maguey morado*			3	4	
Trichilia pallida Sw. [Meliaceae] {155}	*palo amargo*	1				3
Trophis racemosa (L.) Urb. [Moraceae] {446}	*ramón de vaca*				1	
Urena lobata L. [Malvaceae] {240}	*cadillo de gato*	1				
Urera baccifera (L.) Gaudich. ex Wedd. [Urticaceae] {293}	*pringamosa*	11				22
Valeriana scandens L. [Valerianaceae] {R73}	*valeriana*	7				7
Vanilla planifolia Andrews [Orchidaceae] {PV162}	*vainilla*					2
Verbascum thapsus L. [Scrophulariaceae] {R161}	*borraja*		3			
Vitex agnus-castus L. [Verbenaceae] {130, PV121}	*Reina Luisa, yerba Luisa*	3	2	1		
Wallenia laurifolia Sw. [Myrsinaceae] {501}	*caimoní, carmoní*	1				3
Yucca aloifolia L. [Liliaceae] {421}	*para rayo*					5
Zea mays L. [Poaceae] {PV166}	*maíz*	4	1	5	4	
Zingiber cassumunar Roxb. [Zingiberaceae] {R143}	*jengibre amargo*				2	
Zingiber officinale Roscoe [Zingiberaceae] {Pv167}	*jengibre*	7	1	2	2	1
Total		589	459	673	427	1113

[a]All numbers are A. Ososki collections
[b]Reports from generalists in R1 = Los Calabazos, R2 = La Colonia, U1 = La Vega, and U2 = San Cristóbal
[c]Number of field reports from healers (specialists)

Table 5.6. Medicinal plant species (*n* = 46) reported by Dominican healers in New York City (*n* = 6), species (*n* = 34) reported by Dominican healers in the Dominican Republic (*n* = 11) and those species (*n* = 22) reported by both groups (*n* = 17) for uterine fibroids.

Scientific Name [Family] {Voucher number}[a]	Vernacular Name	Number of Healers[L] New York City	Dominican Republic
Argemone mexicana L. [Papaveraceae] {26, 52, 59, 111, 247}	*cardo santo*	3	2
Beta vulgaris L. [Chenopodiaceae] {95, PV168}	*beet, remolacha*	3[L]	3
Cassia fistula L. [Fabaceae] {50, R78}	*cañafístula*	1	1
Cecropia schreberiana Miq. [Cecropiaceae] {282}	*yarumo, yagrumo*	1	1
Chiococca alba (L.) Hitchc. [Rubiaceae] {105, R162}	*timacle*	1	1
Equisetum giganteum L. [Equisetaceae] {114, 169}	*cola de caballo*	1	1
Illicium verum Hook.f. [Illiciaceae] {64, R74}	*anís de estrella*	1	2
Lavandula angustifolia Mill. [Lamiaceae] {41, 66, R75}	*algucema, alhucema*	2	2
Momordica charantia L. [Cucurbitaceae] {54, 250}	*cundeamor*	1[L]	1
Opuntia ficus-indica (L.) Mill. [Cactaceae] {40, 46, 257}	*tuna, alquitira*	1[L]	1
Petiveria alliacea L. [Phytolaccaceae] {1, 10, 11, 15, 53, 89, 90, 252}	*anamú*	4[L]	2
Petroselinum crispum (Mill.) Nyman ex A. W. Hill [Apiaceae] {92, PV165}	*perejíl*	1[L]	1
Pimpinella anisum L. [Apiaceae] {88, R77}	*anís*	1	1
Pluchea carolinensis (Jacq.) G. Don [Asteraceae] {80, PV34}	*salvia*	1	1
Psidium guajava L. [Myrtaceae] {107, 310}	*hoja guayaba*	1	1
Rosmarinus officinalis L. [Lamiaceae] {19, 86, 287}	*romero*	1[L]	1
Ruellia tuberosa L. [Acanthaceae] {51, 69, 160}	*periquito, guaucí*	2	2
Ruta chalepensis L. [Rutaceae] {17, 21, 37, 339}	*ruda*	1[L]	1
Saccharum officinarum L. [Poaceae] {42, PV175}	*molasses, melaza, miel de pulga*	3[L]	3
Securidaca virgata Sw. [Polygalaceae] {38, 70, 208}	*maravelí*	2	2
Senna alexandrina Mill. [Fabaceae] {74, R71}	*hoja madre*	1	1

Table 5.6. Continued

Scientific Name [Family] {Voucher}[a]	Vernacular Name	Number of Healers[L] New York City	Dominican Republic
Tilia mandshurica Rupr. & Maxim. [Tiliaceae] {6, 29, 34, R108}	*tilo*	1	1
Agave sp. [Agavaceae] {12, 14, 47, 48, 49, 57, 62}	*maguey de bestia*	4[L]	
Aloe vera (L.) Burm.f. [Asphodelaceae] {77}	*sábila*	2[L]	
Ambrosia peruviana Willd. [Asteraceae] {24}	*altamiza, artemisa*	1[L]	
Ananas comosus (L.) Merr. [Bromeliaceae] {102}	*piña*	1[L]	
Anisum vulgare Gaertn. [Apiaceae] {63}	*anís*	1	
Apium graveolens L. [Apiaceae] {93}	*apio*	2	
Bixa orellana L. [Bixaceae] {39, 43}	*bija*	1	
Caesalpinia brasiliensis L. [Fabaceae] {103}	*palo de brasil*	1	
Caesalpinia coriaria (Jacq.) Willd. [Fabaceae] {60}	*guatapanal*	1	
Chamaemelum nobile (L.) All. [Asteraceae] {5, 30, 32, 65}	*manzanilla, chamomile*	3	
Chenopodium ambrosioides L. [Chenopodiaceae] {3, 23, 27}	*apasote, epasote*	1[L]	
Citrus sp. [Rutaceae] {79, 99, 116}	*orange, limón*	2[L]	
Coccothrinax argentea (Lodd. ex Shult. & Schult.f.) Sarg. ex Becc. [Arecaceae] {106}	*cana*	1	
Daucus carota L. [Apiaceae] {97}	*carrot, zanahoria*	2[L]	
Doyerea emetocathartica Grosourdy [Cucurbitaceae] {82, 109}	*batata zandumbia, batata de burro*	2	
Eucalyptus sp. [Myrtaceae] {4, 18, 20}	*eucalipto*	1	
Fevillea cordifolia L. [Cucurbitaceae] {72, 75}	*ayamo, jayamo, jallamo*	2	
Ficus religiosa L. [Moraceae] {78}	*alamo*	1	
Gouania lupuloides (L.) Urb. [Rhamnaceae] {84}	*bejuco indio*	1	
Guazuma ulmifolia Lam. [Sterculiaceae] {73}	*guácima*	1	
Helichrysum italicum (Roth) G. Don f. [Asteraceae] {85}	*siempre fresca*	1	

Table 5.6. Continued

Scientific Name [Family] {Voucher number}[a]	Vernacular Name	Number of Healers[L] New York City	Dominican Republic
Hamelia patens Jacq. [Rubiaceae] {417}	*buzunuco*	1[L]	
Kalanchoe gastonis-bonnieri Raym.-Hamet & H. Perrier [Crassulaceae] {45}	*mala madre*	4[L]	
Manihot esculenta Crantz [Euphorbiaceae] {318}	*cogollo de yuca*	1	
Mentha sp. [Lamiaceae] {22}	*yerba buena*	2	
Musa x *paradisiaca* L. [Musaceae] {101}	*plátano*	1	
Myrsine sp. [Myrsinaceae] {104}	*palo santo*	1	
Panax pseudoginseng Wall. [Araliaceae] {112}	*ginseng*	1	
Phoenix dactylifera L. [Arecaceae] {113}	*palma*	1	
Pinus caribaea Morelet [Pinaceae] {71, 76}	*cuaba*	1	
Piper marginatum Jacq. [Piperaceae] {2, 33, 91}	*anís*	2	
Plantago major L. [Plantaginaceae] {8, 25}	*llantén, yantén*	1[L]	
Rosa sp. [Rosaceae] {83}	*rosa, rose*	1	
Senna ligustrina (L.) H. S. Irwin & Barneby [Fabaceae] {44}	*sen*	2	
Solanum melongena L. [Solanaceae] {96}	*berejena*	1	
Solanum tuberosum L. [Solanaceae] {118}	*papa*	1	
Spermacoce verticillata L. [Rubiaceae] {16, 55, 67, 110}	*juana la blanca*	3	
Spinacia oleracea L. [Chenopodiaceae] {115}	*espinaca*	1	
Tabebuia impetiginosa (DC.) Standl. [Bignoniaceae] {35}	*palo de arco*	1	
cf. *Taraxacum officinale* Weber [Asteraceae] {61}	*diente de león*	1	
Tournefortia gnaphalodes (L.) Roem. & Schult. [Boraginaceae] {9}	*planta marina*	1	
Uncaria tomentosa (Willd. ex Roem. & Schult.) DC. [Rubiaceae] {81}	*uña de gato*	2	
Vaccinium macrocarpon Aiton [Ericaceae] {100}	*cranberry*	1	
Zea mays L. [Poaceae] {94, 108}	*barba de maíz*	1[L]	

Table 5.6. Continued

Scientific Name [Family] {Voucher number}[a]	Vernacular Name	Number of Healers[L] New York City	Number of Healers[L] Dominican Republic
Zingiber officinale Roscoe [Zingiberaceae] {58}	*ginger, jengibre*	1[L]	
Zingiber zerumbet (L.) Sm. [Zingiberaceae] {56}	*jengibre amargo*	1	
Allium sativum L. [Liliaceae] {PV157}	*ajo*		1
Alpinia zerumbet (Pers.) B. L. Burtt. & R. M. Sm. [Zingiberaceae] {265}	*dragón*		1
Carica papaya L. [Caricaceae] {SR2}	*lechosa*		1
Catalpa longissima (Jacq.) Dum. Cours. [Bignoniaceae] {499}	*roble*		2[L]
Catharanthus roseus (L.) G. Don [Apocynaceae] {278}	*rosa catalana*		1[L]
Cissus verticillata (L.) Nicolson & C. E. Jarvis [Vitaceae] {R60, 328}	*bejuco caro*		1
Cocos nucifera L. [Arecaceae] {PV182}	*coco*		1[L]
Coffea arabica L. [Rubiaceae] {PV160}	*café*		1[L]
Desmodium affine Schltdl. [Fabaceae] {189}	*amor seco*		2
Eupatorium odoratum L. [Asteraceae] {187}	*zaragüey*		1[L]
Inga vera Willd. [Fabaceae] {526}	*jina*		1
Macfadyena unguis-cati (L.) A. H. Gentry [Bignoniaceae] {291}	*pega palo*		1
Majorana hortensis Moench [Lamiaceae] {272}	*mejorana*		1[L]
Malachra alceifolia Jacq. [Malvaceae] {276}	*malva*		1
Matricaria recutita L. [Asteraceae] {R76}	*manzanilla*		2[L]
Mentha cf. *spicata* L. (rugose form=*M. cordifolia* auth., non Opiz) [Lamiaceae] {259}	*yerba buena*		1
Myristica fragrans Houtt. [Myrtaceae] {R138}	*nuez moscada*		1
Pavonia spinifex (L.) Cav. [Malvaceae] {141}	*cadillo tres pies*		2
Pimenta haitiensis (Urb.) Landrum [Myrtaceae] {R89}	*canelilla*		1
Pinus occidentalis Sw. [Pinaceae] {312}	*cuaba, pino*		1

Table 5.6. Continued

Scientific Name [Family] {Voucher number}[a]	Vernacular Name	Number of Healers[L] New York City	Dominican Republic
Pothomorphe umbellata (L.) Miq. [Piperaceae] {182}	*broquelejo, broquelejos*		2
Prestoea montana (Graham) G. Nicholson [Arecaceae] {PV101}	*manacle*		2
Roystonea hispaniolana L. H. Bailey [Arecaceae] {PV154}	*palma*		1
Senna alata (L.) Roxb. [Fabaceae] {162}	*guajavo*		2
Smilax domingensis Willd. [Smilacaceae] {171, 298}	*bejuco chino*		2
Solanum capsicoides All. [Solanaceae] {210}	*berenjena baja*		1
Solanum torvum Sw. [Solanaceae] {314}	*berenjena cimarrona*		1
Spermacoce assurgens Ruiz & Pav. [Rubiaceae] {142, 178}	*juana la blanca*		3
Stachytarpheta jamaicensis (L.) Vahl [Verbenaceae] {235}	*verbena morada*		1[L]
Tamarindus indica L. [Fabaceae] {SR6}	*tamarindo*		1[L]
Ternstroemia peduncularis DC. [Theaceae] {525}	*botoncillo*		1
Tournefortia hirsutissima L. [Boraginaceae] {290}	*nigua*		2
Urera baccifera (L.) Gaudich ex Wedd. [Urticaceae] {293}	*pringamosa*		1
Valeriana scandens L. [Valerianaceae] {R73}	*valeriana*		1

[a]All numbers are A. Ososki collections

[L]plant species reported in Dominican ethnobotanical literature for symptoms related to uterine fibroids (Ososki *et al.* 2002)

Chapter 6. Women's Medicine and Phytoestrogens

Introduction

The first part of this chapter is a literature review on recent advances in the state of knowledge of phytoestrogens from a botanical perspective. The identification and classification of phytoestrogens, botanical sources of phytoestrogens, and their proposed mechanisms of action are discussed. The effects of phytoestrogens on breast and prostate cancers, cardiovascular disease, menopausal symptoms, and osteoporosis are also examined including research on benefits and risks. In the second part of this chapter I present the results of a literature review of the medicinal plants reported during my interviews and surveys in the Dominican Republic and the results of a bioassay used to test these plants for estrogenic activity.

Literature review of phytoestrogens

There is a rapidly growing body of literature on phytoestrogens. In evaluating the literature on phytoestrogens two of the more frequently cited reviews include those by Price and Fenwick (1985) and Kurzer and Xu (1997). Other more recent reviews are by Adlercreutz (2002, 2003), Ibarreta and coauthors (2001), and Fitzpatrick (2003). Some reviews are general (Adlercreutz 1998a; Anderson *et al.* 1999; Bingham *et al.* 1998; Knight and Eden 1996; Messina 1999; Potter and Steinmetz 1996; Setchell 1998; Tham *et al.* 1998;

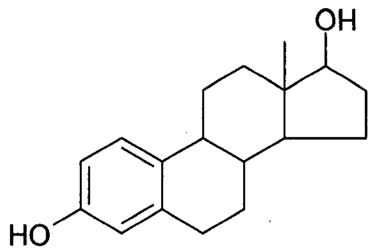
Whitten and Naftolin 1998); others are specific to health conditions, such as phytoestrogens as an alternative for hormone replacement therapy (Glazier and Bowman 2001; Kronenberg and Fugh-Berman 2002; Scheiber and Rebar 1999; Wuttke *et al.* 2003a, b); phytoestrogens and breast cancer (Adlercreutz 2002, 2003; Adlercreutz *et al.* 2000b; Barnes 1998; Cline and Hughes 1998; De Lemos 2001; Glazier and Bowman 2001; Messina and Loprinzi 2001; Peeters *et al.* 2003; This *et al.* 2001; Wagner *et al.* 2001); phytoestrogens and cardiovascular disease (Clarkson and Anthony 1998; Kris-Etherton *et al.* 2002; Van der Schouw *et al.* 2000; Wroblewski Lissin and Cooke 2000); phytoestrogens and chronic renal disease (Ranich *et al.* 2001); phytoestrogens and prostate cancer (Adlercreutz 2002; Morrissey and Watson 2003; Moyad 1999); phytoestrogens and colon cancer (Adlercreutz 2002; Messina and Bennink 1998); phytoestrogens and obesity and diabetes (Bhathena and Velasquez 2002); and phytoestrogens and pediatric conditions (Zung *et al.* 2001). Additional reviews present phytoestrogen content and activity of foods, herbs and spices (Mazur 1998; Reinli and Block 1996; Zava *et al.* 1998). Other reviews have focused on phytoestrogens and their effect on domestic animals (Adams 1995; Lundh 1995).

Soy (*Glycine max*) has received considerable attention as a source for phytoestrogens as shown by numerous review articles (Anderson *et al.* 1995; Fitzpatrick 2003; Messina *et al.* 1994; Setchell 1998; Sirtori 2001; Vincent and Fitzpatrick 2000; Wagner *et al.* 2001), yet other botanical sources, such as red clover (*Trifolium pratense* L., Fabaceae) (Fugh-Berman and Kronenberg 2001; Saloniemi *et al.* 1995) and black cohosh (*Actaea racemosa* L., syn. *Cimicifuga* *racemosa* (L.) Nutt., Ranunculaceae) are also being studied (Foster 1999; Liu *et al.* 2001a; Wuttke *et al.* 2003c).

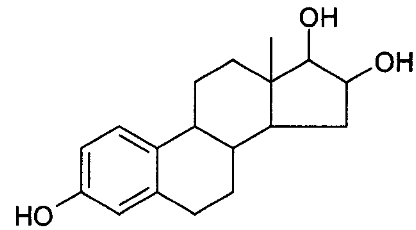
In addition to reviews in English, there are reviews in French (Drapier-Faure 2001), German (Huber 2000), Japanese (Kinjo 2000), and Polish (Badowski and Urbanek-Karlowska 2001). Of historical interest are the early reviews of phytoestrogens by Bradbury and White (1954) and Farnsworth and coworkers (1975a, b).

Phytoestrogens

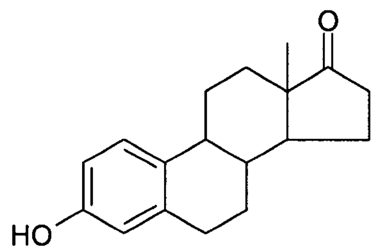
Phytoestrogens defined functionally are substances that promote estrogenic actions in mammals and structurally are similar to mammalian estrogen 17β-estradiol (E_2) (Knight and Eden 1996; Price and Fenwick 1985). Other mammalian endogenous estrogens are estriol and estrone, which are weakly estrogenic as compared to their mammalian counterpart, E_2 (Gruber *et al.* 2002) (Figure 6.1). Diverse biological activity of phytoestrogens is due in part to their ability to act estrogenically as estrogen agonists and anti-estrogenically as antagonists. As estrogen agonists, phytoestrogens mimic endogenous estrogens and cause estrogenic effects. As estrogen antagonists, they may block or alter estrogen receptors (ER) and prevent estrogenic activity, causing antiestrogenic effects (Brzezinski and Debi 1999).



17β-Estradiol



Estriol



Estrone

Figure 6.1. Structures of mammalian endogenous estrogens: 17β-estradiol, estriol, and estrone.

As estrogen agonists and antagonists, phytoestrogens can also be classified as selective estrogen receptor modulators (SERMs) (Brzezinski and Debi 1999). SERMs are non-steroidal chemicals with a structure similar to E_2 and an affinity toward estrogen receptors (Riggs and Hartmann 2003). SERMs are unique in that they can function as agonists or antagonists depending on the tissue, ER, and concentration of circulating endogenous estrogens (Gruber *et al.* 2002). Tamoxifen and raloxifene are well-known SERMs. Tamoxifen has been used in clinical practice to treat breast cancer patients because it acts as an estrogen antagonist in breast tissue, slowing cancer cell proliferation and as an estrogen agonist in bone tissue and in the cardiovascular system to prevent osteoporosis and heart disease. However, tamoxifen has shown estrogenic activity in the uterus and, therefore, may increase the risk of endometrial cancer (Poulet *et al.* 1997; Pukkala *et al.* 2002).

Mechanistically, phytoestrogens have been shown to bind to two types of estrogen receptors: estrogen receptor α (ERα), which was cloned in 1986, and estrogen receptor β (ERβ) cloned in rats (Kuiper *et al.* 1996) and in humans (Mosselman *et al.* 1996). The two receptors differ in their tissue distribution and affinity to ligands, yet there is some overlap. In rats, ERα and ERβ both are clearly expressed in ovary and uterus tissue (Kuiper *et al.* 1997). ERβ has been shown to have ligand-specificity toward phytoestrogens and is distributed in humans in ovary, spleen, testis, and thymus tissue (Mosselman *et al.* 1996) and in rats in bladder, brain, lung, ovary, prostate, testis, and uterine tissue (Kuiper *et al.* 1997). Phytoestrogens show a lower binding affinity than E_2 and some show a higher binding affinity for ERβ than for ERα, which may suggest different pathways for their actions and explain tissue-specific variability of phytoestrogenic action (Anderson *et al.* 1999; Kuiper *et al.* 1998). The complexity of phytoestrogens and ERs appears to be further compounded because different transcriptional activities *in vitro* are activated depending on the ligands as well as the environment of the promoter region of specific genes for translated ERα and ERβ receptors (Paech *et al.* 1997). Recent research in teleost fish (Atlantic croaker, *Micropogonias undulatus* (Linnaeus, 1766)) identified a third estrogen receptor, ERγ, which is found in various tissues (Hawkins *et al.* 2000).

Mechanisms of action

Both genomic and nongenomic mechanisms have been proposed to explain phytoestrogenic effects on human health (Anderson *et al.* 1999). Phytoestrogens are able to interact with enzymes and receptors, and because of their stable structure and low molecular weight they can pass through cell membranes (Adlercreutz 1998b). These interactions allow them to bind to ERs, induce specific estrogen-responsive gene products, stimulate ER-positive breast cancer cell growth (Kurzer and Xu 1997), interfere with steroid hormone metabolism or action (Adlercreutz 1998b), and alter ER structure and affect transcription (Santti *et al.* 1998). Some genomic mechanisms of action include estrogenic and antiestrogenic effects on ERs, while other effects may not involve direct interaction with ERs (Messina and Loprinzi 2001). Nongenomic effects that do not involve ERs include: induction of cancer cell differentiation, inhibition of tyrosine kinase and DNA topoisomerase activities, suppression of angiogenesis, and antioxidant effects of phytoestrogens (Kurzer and Xu 1997). Other effects can take place at the cellular and molecular level and potentially influence the biosynthesis and metabolism of steroids and fatty acids, the serum steroid carrier proteins (sex steroid binding proteins and α-fetoprotein), and the intracellular and transmembrane transfer of hormones to a membrane and to nuclear receptors (Benassayag *et al.* 2002). Phytoestrogens inhibit enzymes needed for hormone conversions, which may reduce cancers by lowering biological activity of sex hormones in target organs (Adlercreutz 1998b). As estrogen-like compounds, some phytoestrogens are able to induce estrus in mammals (Mineta *et al.* 2001).

The different activities and the bioavailability of phytoestrogens vary depending on such factors as the form of administration, dosage, individual metabolism, and the ingestion of other pharmacological substances (Kelly *et al.* 1995; Wiseman 1999; Xu *et al.* 1995). Target tissue, concentration dependency, number and type of ER, and presence or absence of endogenous estrogens also influence the effects of phytoestrogens (Glazier and Bowman 2001).

Not only do phytoestrogens differ in their biological activity, but they also differ structurally because they come from diverse chemical classes, which may affect their influence on tissues and receptors (Lieberman 1996). Due to the diversity of chemicals that show estrogenic effects, it appears that estrogenic activity is often emphasized over chemical structure in defining phytoestrogens.

Identification of phytoestrogens

The ability of plant substances to cause estrus in animals was documented in the mid-1920s (Bradbury and White 1954; Costello and Lynn 1950). The Allen-Doisy technique was one of the first bioassays to detect estrogenic activity in ovariectomized rats and mice (Allen and Doisy 1923). In this bioassay, the uterine weight of the test animal was used to measure estrogenic activity. Plants from different botanical families tested with this technique include beets (*Beta vulgaris*), parsley (*Petroselinum crispum*), plum and cherry (*Prunus* spp., Rosaceae), potato (*Solanum tuberosum* L., Solanaceae), and rice (*Oryza sativa* L., Poaceae) (Bradbury and White 1954). Later, steroidal estrogens were detected in plants, such as estrone found in pomegranate seeds (*Punica granatum* L., Punicaceae) and the date palm seeds (*Phoenix dactylifera*), although the presence of these compounds has been questioned (Heftmann 1967). Although phytoestrogens were originally noticed because they induced estrus in animals, not all plants that show estrogenic activity induce estrus. In addition, there are plant substances that induce estrus that are not phytoestrogens.

Since the early 1920s additional *in vivo* and *in vitro* methods have been developed to test estrogenic and antiestrogenic activity of plants. *In vivo* tests used to evaluate estrogenic activity include the degree of cornification of vaginal epithelium in rats and mice, uterotrophic assays that measure uterine wet weight in immature or ovariectomized rats or mice, and proliferative effects in the female genital tract (Diel *et al.* 2002; Galey *et al.* 1993). Estrogenic activity based on bioassay methods should be viewed with caution when extrapolating to humans because phytoestrogens have been shown to metabolize differently in different animal species (Reinli and Block 1996). In addition, many variables can affect results in animal studies such as the model species, dosage, length of study, and routes of administration (Yang and Bittner 2002). In clinical and epidemiological studies, the same principle applies as studies vary by type of intervention (extracts, purified compounds), dosage, age of subject, and length of study, among other variables.

Some *in vitro* assays utilized to investigate estrogenic activity include: the receptor binding assay in which the binding affinity to the ERs is measured, E-screen assay which tests the ability of a substance to stimulate growth of estrogen sensitive cells such as human breast cancer cells, the reporter gene assay which measures the ability of a substance to activate transcription via an estrogen sensitive promoter, and the analysis of gene expression which evaluates the regulation of estrogen sensitive genes in cell culture (Diel *et al.* 1999; Mueller 2002). Some assays are more sensitive to phytoestrogens than others (Dixon-Shanies and Shaikh 1999). Other examples of *in vitro* assays are the transient gene expression or co-transfection assay (Miksicek 1993, 1994) and the Ishikawa cell line, an organ specific model that uses estrogen responsive human endometrial adenocarcinoma cells (Pisha and Pezzuto 1997; Wober *et al.* 2003). Measuring quantitative structure-activity relationships (QSAR) has been recommended as an initial screening technique for estrogen receptor binding affinity prior to *in vitro* and *in vivo* assays (Hu and Aizawa 2003).

In the mid-1980s, the primary method for phytoestrogen analysis was gas chromatography coupled with a mass spectrometer (GC-MS), which involved extensive purification procedures for either plants or physiological samples before analysis (Wang *et al.* 2002). It is still a valuable method for physiological samples, such as urine and blood, containing low concentrations of phytoestrogens; although, GC-MS is labor intensive and new techniques have been developed (Wang *et al.* 2002).

High pressure liquid chromatography (HPLC) was first used to detect flavonoids in 1976 by Fisher and Wheaton (1976). It is one of the most common analytical methods used for phytoestrogen identification because limited sample preparation is involved and both glycosides and aglycones can be analyzed directly (Wang *et al.* 2002). HPLC coupled with a mass spectrometer (LC-MS) is especially useful for this type of analysis. Franke and coworkers (1995) have developed reversed-phase HPLC methods that are tailored for phytoestrogen analysis. Acid hydrolysis, a part of sample preparation, converts glycosides into their respective aglycones. The solvent system they used was a linear gradient of acetonitrile and acetic acid and water with a photodiode array (PDA) detector. This group recently reported a new technique for determining phytoestrogens (Franke *et al.* 2002).

One drawback of using LC-MS is the ineffective isomer differentiation and the inability to produce molecular ions for some flavonoids (Wang *et al.* 2002). Additional reports discuss methods used to detect polyphenolic phytoestrogens in foods and biological fluids (Joannou *et al.* 1995; Wilkinson *et al.* 2002). Other non-chromatographic methods have also been used for phytoestrogen analysis, such as immunoassay techniques, deconvolution spectroscopy, and matrix-assisted laser desorption ionization time-of-flight mass spectrometry (MALDI-TOF-MS) (Wang *et al.* 2002).

Comparing phytoestrogen levels and content in foodstuffs and plants is not always possible because various methods are used to extract and quantify phytoestrogens. Different varieties of plants and brands of food as well as diverse forms of processing need to be considered when evaluating phytoestrogen levels (Mazur 1998). In addition, individual plants may show different levels of phytoestrogens due to seasonal variation and microbial or insect damage prior to analysis (Price and Fenwick 1985). Instability and easy degradation of some phytoestrogens during processing and analysis may also explain varying analytical results (Ibarreta *et al.* 2001).

Classification of phytoestrogens

There are several classes of phytoestrogens: steroidal estrogens, found in few plants and the more ubiquitous phenolic estrogens, isoflavones, coumestans, and lignans, which will be the focus of this review. Other classes of phytoestrogens that have been reported include: anthraquinones (Matsuda *et al.* 2001), chalcones (Rafi *et al.* 2000), flavones (Milligan *et al.* 1999), prenylflavonoids (Kitaoka *et al.* 1998), and saponins (Chan *et al.* 2002). Examples of plant steroids are estrone found in palms (*Elaeis guineensis* Jacq., Arecaceae) and β-sitosterol that is found in almost all plants (Duke 1992; Farnsworth *et al.* 1975a, b). Studies have reported conflicting evidence about estrone found in the seeds of pomegranate (Miksicek 1994) and the presence of estrone in palm kernel residue could not be confirmed by further investigations (Jacobsohn *et al.* 1965). Steroidal plant compounds reported in earlier investigations have been questioned due to the limited technology available at the time to isolate and identify compounds (Price and Fenwick 1985).

Phytoestrogens have been categorized based on their chemical structures, which resemble E_2. Estrogen receptors bind with steroidal as well as numerous non-steroidal compounds. An aromatic ring and a hydroxyl group is important for binding effectiveness and the remainder of the ER will accept hydrophobic groups (Anstead *et al.* 1997). Important features that enable chemicals to bind to an ER are the steric and hydrophobic properties of a compound, as well as the hydrogen bonding between the phenolic hydroxyl group and the ER binding site (Hu and Aizawa 2003). Estrogenic flavonoids are similar in structure to E_2. They are composed of a planar ring system that includes a *p*-hydroxy-substituted aromatic ring that is approximately 12 Å away from a second in-plane hydroxyl group (Hu and Aizawa 2003). Two ring structures separated with two carbon atoms as well as spacing between hydrophobic and hydrogen bond interactions are also important in binding affinity to ERs (Brzozowski *et al.* 1997). Other characteristics for ER-binding affinity of a chemical are the degree and size of branching of the alkyl group and its location on the phenolic ring and the distribution range of electron density on the A ring (Hu and Aizawa 2003).

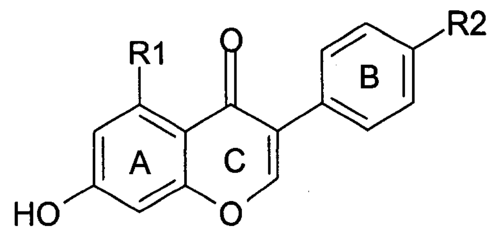
Biological activity of individual phytoestrogens varies and is often reported as less active than mammal or synthetic estrogens (Knight and Eden 1996; Tham *et al.* 1998). Differences in estrogenic activity of similarly classified chemicals may be due to structural features or deviations in those structures. Some phytoestrogenic compounds may show different estrogenicity due to the bioassay employed (Messina and Loprinzi 2001) and others may not show estrogenic activity in bioassays because only their metabolized derivatives are hormonally active (Miksicek 1994). These metabolized derivatives may be active aglycons produced by the removal of the sugar moiety during metabolism or xenobiotics produced through metabolic processes (Adlercreutz *et al.* 1987; Xu *et al.* 1995). More research is needed to elucidate the structural activity relationship that is required for a natural product to be active as a phytoestrogen.

Isoflavones

Isoflavones are the most well-known of the phytoestrogens. The recognition of "clover disease" in Australian sheep in the 1940s led to the investigation of estrogenic activity of isoflavones (Kingsbury 1964). The sheep whose diet was predominately subterranean clover (*Trifolium subterraneum* L., Fabaceae) suffered from a reproductive disorder that reduced the lambing rates and involved abnormal lactation, changes in the sex organs, permanent infertility, prolapsed uterus, and maternal dystocia (Bennetts *et al.* 1946).

Naturally occurring isoflavones that have shown estrogenic activity are: the aglycones, daidzein (4′,7-dihydroxyisoflavone) and genistein (4′,5,7-trihydroxyisoflavone); the glycosides, daidzin and genistin; and biochanin A and formononetin, 4′-methyl ethers of daidzein and genistein (Kurzer and Xu 1997; Price and Fenwick 1985) (Figure 6.2). In plants, they can often be found as glycosides (Ibarreta *et al.* 2001). In processing, isolation, and analysis, these compounds are readily degraded chemically or enzymically to the aglycone

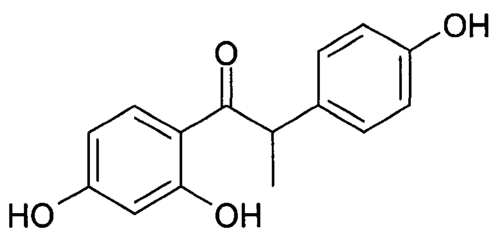
(Price and Fenwick 1985). Glycitein is another isoflavone reported in soy that has also shown estrogenic activity (Song *et al.* 1999).



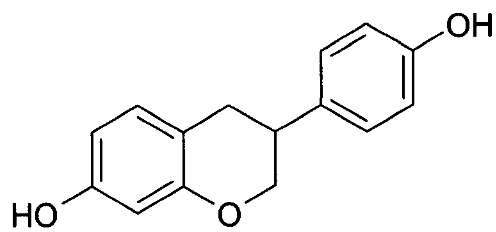
Isoflavone	R1	R2
Biochanin A	OH	OCH_3
Daidzein	H	OH
Formononetin	H	OCH_3
Genistein	OH	OH

Figure 6.2. Structures of isoflavones: biochanin A, daidzein, formononetin, and genistein.

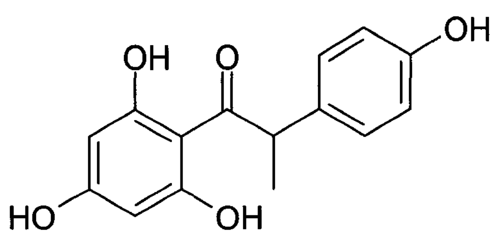
After mammals consume isoflavones, daidzein and genistein are metabolized in the gastrointestinal tract. Biochanin A and formononetin can metabolize to genistein and daidzein, respectively. Daidzein may be further metabolized to dihydrodaidzein and then to *O*-desmethylangolensin (*O*-DMA) and equol (Figure 6.3) (Kurzer and Xu 1997). Equol is not metabolized equally in all humans (Kelly *et al.* 1995) and an individual's ability to transform soy isoflavones into equol may offer an explanation for the varied results of present phytoestrogen studies (Setchell *et al.* 2002). Genistein metabolizes to dihydrogenistein and then to 6′-hydroxy-*O*-DMA (Kurzer and Xu 1997) and hormonally inert *p*-ethylphenol in sheep and humans (Ibarreta *et al.* 2001; Price and Fenwick 1985) (Figure 6.3). These new compounds produced from metabolism may have different biological effects than the original isoflavones digested (Naftolin and Stanbury 2002).



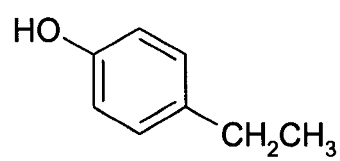
O-Desmethylangolensin (*O*-DMA)



Equol



6′-Hydroxy-*O*-DMA



p-Ethylphenol

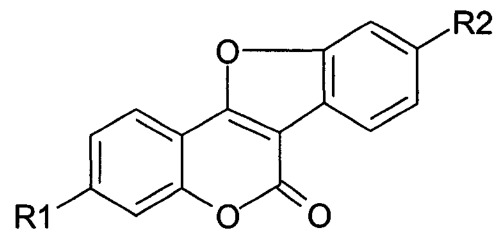
Figure 6.3. Structures of metabolized isoflavones.
Formononetin is metabolized to daidzein that metabolizes into dihydrodaidzein and then to *O*-desmethylangolensin (*O*-DMA) and equol. Biochanin A is metabolized to genistein, which metabolizes into dihydrogenistein and then into 6′-hydroxy-*O*-DMA and *p*-ethylphenol.

Isoflavones are primarily found in the Fabaceae family, which has food legumes such as soy, peanut (*Arachis hypogaea* L.), and clover (*Trifolium* spp.). Soy seeds show high levels of formononetin and biochanin A (both 729 µg/g dry weight) (Ibarreta *et al.* 2001). Other food sources of isoflavones are oilseeds and nuts, such as the sunflower seed (*Helianthus* spp., Asteraceae) and walnut (*Juglans nigra* L., Juglandaceae), from different botanical families (Mazur 1998; Sirtori 2001). Isoflavones have also been found in the Iridaceae and the Euphorbiaceae family (Dewick 1993). They are primarily extracted from soy and red clover (Messina 1999). Raw soybeans contain 1.2 to 4.2 mg/g dry weight of isoflavones, while high protein soy products like soy flour contain 1.1 to 1.4 mg/g dry weight (Kurzer and Xu 1997).

Of all the isoflavones, genistein has received the most attention. Estrogenic and antiestrogenic effects of geinstein, including effects independent of ERs, have been discussed in relation to breast cancer (Bouker and Hilakivi-Clarke 2000; Brownson *et al.* 2002) and other conditions (Dixon and Ferreira 2002). Several studies have tested genistein with breast cancer cell lines and the results tend to show cell proliferation at low doses and inhibition at high concentrations (Anderson *et al.* 1999). Genistein has been shown as a powerful antioxidant (Ruiz-Larrea *et al.* 1997). However, other researchers have shown that genistein and other phytoestrogens have low antioxidant ability, suggesting that phytoestrogens may not have a significant effect as antioxidants (Mitchell *et al.* 1998).

Coumestans

Coumestans are another group of plant phenols that show estrogenic activity. Coumestrol was first reported in 1957 by Bickoff and coworkers as a new phytoestrogen that was isolated from ladino clover (*Trifolium repens* L., Fabaceae), strawberry clover (*Trifolium fragiferum* L., Fabaceae), and alfalfa or lucerne (*Medicago sativa* L., Fabaceae) (Bickoff *et al.* 1957). Their presence in fodder crops has been associated with disrupting reproductive performances of livestock (Adams 1995; Price and Fenwick 1985). For example, feeding cattle haylage containing 37 ppm (mg/kg) or more of coumestrol resulted in negative estrogenic effects such as udder development, bulling of steers, and prolapsed vagina, cervix, and rectum (Lookhart 1980). However few coumestans isolated from plants have shown uterotropic activity (Kurzer and Xu 1997; Price and Fenwick 1985). The main coumestans with phytoestrogenic effects are coumestrol and 4′-methoxycoumestrol (Figure 6.4). Coumestrol and genistein have higher binding affinities to ERβ than the other phytoestrogen compounds (Whitten and Naftolin 1998). *In vitro* coumestrol has been reported to inhibit bone resorption and stimulate bone mineralization (Tsutsumi 1995).



Coumestan	R1	R2
Coumestrol	OH	OH
4'-Methoxycoumestrol	OH	OCH_3

Figure 6.4. Structures of coumestans: coumestrol and 4'-methoxycoumestrol.

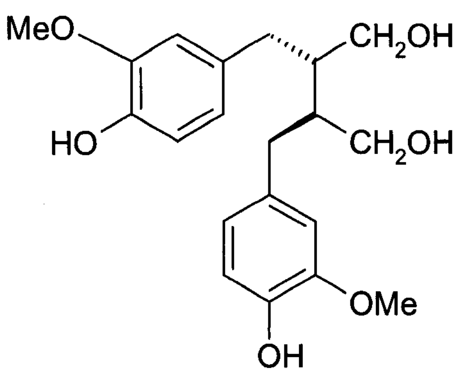
Coumestans are less common in the human diet than isoflavones (Ibarreta *et al.* 2001), yet similar to isoflavones in that they are also found in legumes, particularly food plants such as sprouts of alfalfa and mung bean (*Vigna radiata* (L.) R. Wilczek, Fabaceae) (Adams 1995; Lookhart 1980; Mazur 1998). They are especially high in clover (Franke *et al.* 1995). Soy sprouts also show high levels of coumestrol (71.1 µg/g wet weight) (Ibarreta *et al.* 2001).

Coumestrol content in plant material has been reported to vary according to plant variety, stage of growth, cutting, presence of disease, location, and insect/fungal attacks (Price and Fenwick 1985). Attacks by insects and fungus may cause plants, for example alfalfa, to produce coumestrol or 4'-methoxycoumestrol as phytoalexins (Adams 1995). Phytoalexins are a diverse class of compounds that are often secondary metabolites formed as a result of injury or disruption, which aid plants by protecting them from insects, bacteria, and viruses (Ibarreta *et al.* 2001).

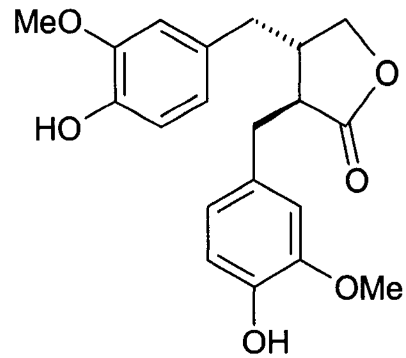
Lignans

Lignans were first identified in plants and later in biological fluids of mammals. As a class of compounds they contain a dibenzylbutane skeleton and in plants they aid in the formation of lignin that is used to construct the plant cell wall (Setchell and Adlercreutz 1988). A cyclic pattern observed in the urinary excretion of these phenolic compounds by humans and animals during the menstrual cycle initiated interest in their physiological role (Adlercreutz *et al.* 1987). They were thought to be a new class of endogenous hormones. These compounds were elucidated simultaneously by different researchers and identified as unique mammalian lignans (Setchell *et al.* 1980; Stitch *et al.* 1980).

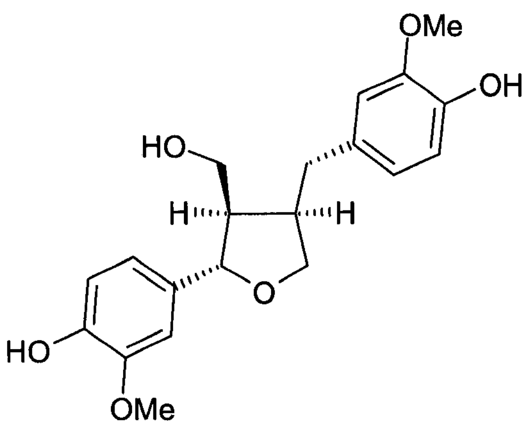
The most well-known phytoestrogenic lignans are secoisolariciresinol and matairesinol (Figure 6.5) that are converted by bacterial action in the gut into enterodiol and enterolactone (Figure 6.6), mammalian lignans not found in plants (Setchell and Adlercreutz 1988). Enterodiol can be further metabolized to enterolactone (Borriello *et al.* 1985). Removal of the sugar moiety through metabolism by intestinal bacteria is common in isoflavones and lignans (Adlercreutz *et al.* 1987). Mammalian lignans, like isoflavones, have a low molecular weight and are considered chemically, biochemically, and biologically unique and stable molecules because they have phenolic groups in the *meta* position of their aromatic rings (Adlercreutz 1998a). Recently, other enterolactone precursors have been identified: arctigenin, 7-hydroxymatairesinol, lariciresinol, pinoresinol, and syringaresinol (Figure 6.5) (Heinonen *et al.* 2001; Meagher *et al.* 1999). The last three are found in cereals, specifically whole-grain rye products. However, more studies are needed to evaluate the estrogenic activity of these compounds.



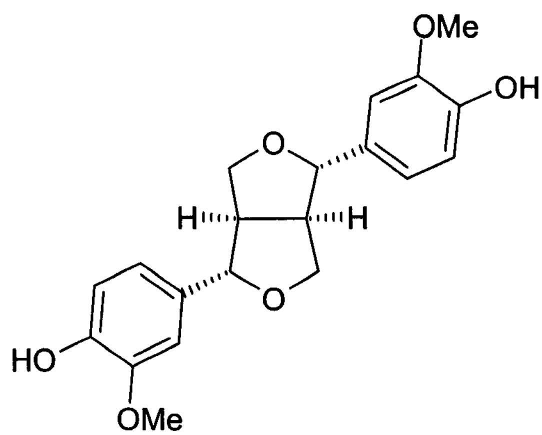
Secoisolariciresinol



Matairesinol



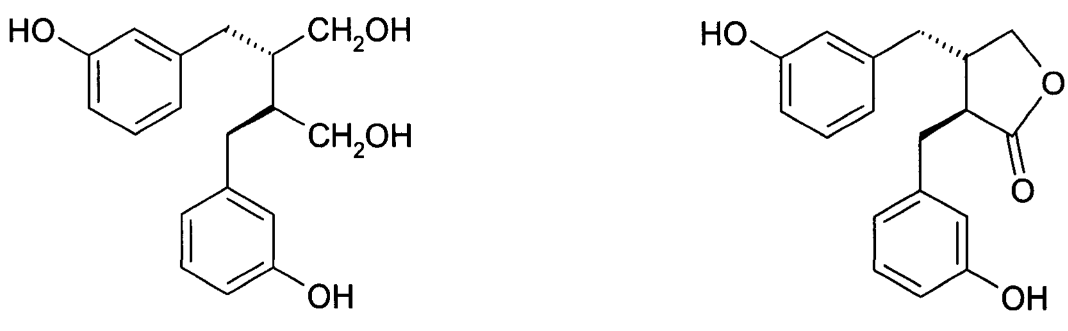
Lariciresinol



Pinoresinol

Figure 6.5. Structures of some plant lignans: secoisolariciresinol, matairesinol, lariciresinol, and pinoresinol.

Lignans are widespread in foodstuff such as cereals, fruits, and vegetables and have not been studied as thoroughly as isoflavones and coumestans (Ibarreta *et al.* 2001). Lignans are commonly found in rye bread (*Secale cereale* L., Poaceae) and oilseeds such as flaxseed (*Linum usitatissimum*) (Thompson *et al.* 1991). Flaxseed contains the most abundant amount of lignans with about 0.8 mg of secoisolariciresinol/g dry weight (Kurzer and Xu 1997) and when crushed and defatted the phytoestrogen content rises (Mazur 1998). Lignans are also found in brewed green and black tea and coffee (Mazur *et al.* 1998). Grains and cereals show high levels of lignans in the aleurone and pericarp/testa layers (Mazur 1998). Pumpkin seeds (*Cucurbita pepo* L., Cucurbitaceae) contain secoisolariciresinol and trace amounts of lariciresinol (Sicilia *et al.* 2003). Secoisolariciresinol is found in many food and beverage categories, while matairesinol is found in smaller amounts and only trace amounts in food legumes (Mazur 1998).



Enterodiol	Enterolactone

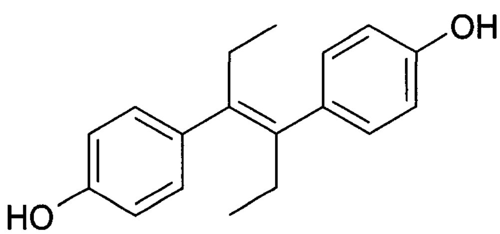
Figure 6.6. Structures of mammalian lignans: enterodiol and enterolactone. Plant lignans secoisolariciresinol and matairesinol are converted by human gut bacteria to enterodiol and enterolactone, respectively.

Large amounts of lignans have also been reported in coniferous trees, such as the heartwood of Norway spruce (*Picea abies* (L.) H. Karst, Pinaceae), which has shown greater concentrations of lignans than flax (Saarinen *et al.* 2000). Hydroxymatairesinol (HMR) was first identified in spruce and was reported as a novel precursor to enterolactone. Additional testing with this compound showed potent antioxidant activity and decreased breast tumors in the rat dimethylben[*a*]anthracene-induced mammary tumor model; however, HMR did not show estrogenic activity in the uterine growth assay or through transcriptional responses via ERα or ERβ (Saarinen *et al.* 2000). These results suggest that the antitumor activity of HMR may involve nongenomic mechanisms of activity.

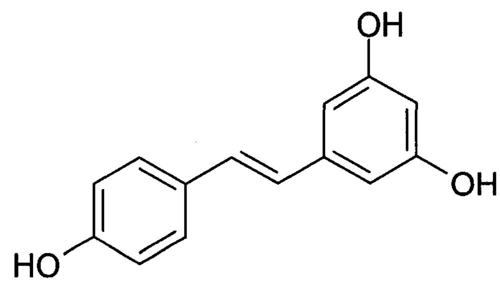
A case-controlled study on metabolized lignan conducted with Finnish men showed a reduced risk of myocardial infarction associated with higher concentrations of serum enterolactone (Vanharanta *et al.* 1999). Adlercreutz (2003) points out that purified lignans consumed neonatally or prepubertally may have a protective effect on breast tissue by increasing the differentiation of proliferative terminal end bud structures also observed during pregnancy and lactation.

Other estrogenic compounds

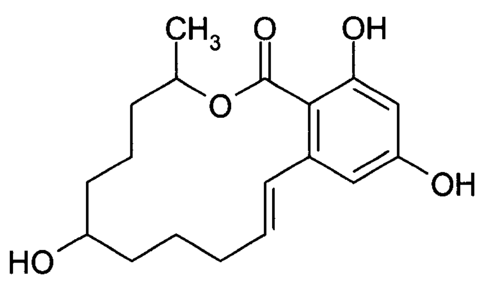
Other compounds that have shown estrogenic activity are resveratrol (*trans*-3,4′,5-trihydroxystilbene), diethylstilbestrol (DES) (4,4′-dihydroxy-*trans*-α, β-diethylstilbene), and mycotoxins such as zearalenol (Figure 6.7). Resveratrol, a stilbene, is found in a variety of plants and functions as a phytoalexin to protect against fungal infections. Other sources of resveratrol are the skin of grapes (*Vitis vinifera* L., Vitaceae), wine, as well as other botanicals such as hu-chang or Japanese knotweed (*Polygonum cuspidatum* Siebold & Zucc., Polygonaceae) (Bagchi *et al.* 2001). Resveratrol has been reported to bind to ERs and stimulate the growth of human breast cancer cells (Ghem *et al.* 1997) and to increase ovarian weight and disrupt estrous cycles in gonadally intact Sprague-Dawley rats (Henry and Witt 2002).



Diethylstilbestrol



Resveratrol



Zearalenol

Figure 6.7. Structures of other estrogenic compounds: diethylstilbestrol, resveratrol, and zearalenol.

In addition to plant estrogens, xenoestrogens and mycotoxins when ingested have a similar estrogenic response as endogenous estrogens.

Pesticides and industrial chemicals (i.e., polychlorinated biphenyls), sometimes referred to as endocrine disrupters, are examples of xenoestrogens found in the environment (Belcher and Zsarnovszky 2001; Ibarreta *et al.* 2001). Diethylstilbestrol is a synthetic stilbene that has also shown strong estrogenic effects in humans (Setchell 1998). Mycotoxins are secondary metabolites produced by molds such as *Fusarium* often found on stored crops (Ibarreta *et al.* 2001; Kurzer and Xu 1997). Resorcyclic acid lactone compounds, such as zearalenone and zearalenol and their derivatives, have been referred to as mycoestrogens, a type of mycotoxin, because they show estrogenic activity but they are not inherent to food plants (Figure 6.7).

Zearalenone is a widely distributed mycoestrogen that has strong estrogenic effects. It is primarily produced by *Fusarium graminearum*, *F. culmorum*, and *F. crookwellense* and is usually associated with corn but can also be found in other cereals such as barley and wheat (IARC 1993). Reproductive problems such as vulvovaginitis (vaginal swelling), prolonged estrus, reduced sex drive, infertility, and abortions have been shown in animals consuming contaminated feed as well as testicular atrophy and enlarged mammary glands in male swine (Schoental 1985; Visconti and Pascale 1998). In some cases farmers have exploited the potential of mycotoxins and used it to promote fattening of sheep and cattle (Yang and Bittner 2002). Methods are being developed to detect mycotoxins in foodstuffs and feedstuffs to safeguard both animal and human health (Rosenberg *et al.* 1998). The United States Food and Drug Administration (FDA) has not established advisory limits nor action levels for zearalenone, although if this mycotoxin is present usually other mycotoxins which the FDA has set advisory levels for are also present, such as deoxynivalenol produced by *Fusarium* species.

New sources of estrogenic compounds are attractive for human health because of the numerous effects that endogenous estrogens have on the human body. Yet some synthetic estrogenic compounds have raised concern for human health because of the negative effects they can have on the body. Although phytoestrogens come from plants and are therefore considered 'natural,' they may also have negative effects on health that have not been clearly identified. At present much of the research on phytoestrogens is evaluating the beneficial and adverse effects of these compounds on different health conditions.

Human health and phytoestrogens

Investigators have proposed the hypothesis that lowered cardiovascular disease, osteoporotic fractures, rates of breast cancer, and hot flushes in Asian populations are related to a diet rich in soy, in other words phytoestrogens (Adlercreutz 1998a; Adlercreutz *et al.* 2000b; Clarkson and Anthony 1998; Wagner *et al.* 2001). Therefore, diet has been evaluated specifically in relation to phytoestrogen content. However when evaluating this relationship, confounding factors such as lifestyle, diet, socio-cultural, and morphological differences that distinguish Asian and Western populations must be considered in the analysis (This *et al.* 2001). Several studies have discussed the potential effects of phytoestrogens in treating breast cancer, endometrial cancer, liver disease, and prostate cancer (Adlercreutz *et al.* 2000b; Fotsis *et al.* 1993; Lei *et al.* 2002; Messina and Loprinzi 2001; Strom *et al.* 1999). Additional research has shown that intestinal bacteria are seen as important in the metabolism of phytoestrogens and have the ability to refine phytoestrogens into compounds similar in structure to E_2 that can protect against cancer (Xu *et al.* 1995). Some of the proposed mechanisms by which phytoestrogens may inhibit cancer cells are: inhibition of DNA topoisomerase, suppression of angiogenesis, induction of differentiation in cancer cell lines, and induction of apoptosis (Glazier and Bowman 2001).

As studies continue to evaluate the biological effects of phytoestrogens on human health, the complexity of these compounds becomes more evident as both estrogenic and antiestrogenic effects and a variety of mechanisms of action are observed (Kronenberg and Hughes 1999). More well designed clinical trials are needed to assess the beneficial effects of phytoestrogens on health (Naftolin and Stanbury 2002).

Breast cancer

In western countries, breast cancer is the most common form of cancer affecting women (Parkin 2001). Historically, the risk of breast cancer was much higher in American women than Asian women prior to the influence of the western diet in Asian cultures (Bouker and Hilakivi-Clarke 2000). Epidemiological studies of breast cancer and dietary intake of soy and lignan have recently been reviewed (Peeters *et al.* 2003), as well as mechanisms of phytoestrogenic action in breast tissue (Adlercreutz 2003). One goal has been to find an estrogen replacement therapy for women at risk for breast cancer or who have survived breast cancer. A diet rich in phytoestrogens has been suggested as a preventative agent against breast cancer although there is conflicting evidence (Adlercreutz *et al.* 2000b; Wagner *et al.* 2001). Phytoestrogens act as weak estrogens and exhibit estrogenic activity in a low-estrogen environment; therefore, it has been postulated that they show antiestrogenic activity in a high-estrogen environment (Messina and Loprinzi 2001). This explanation suggests that prior to menopause when there is a high-estrogen environment, phytoestrogens may protect against breast cancer and after menopause when there is a low-estrogen environment they may stimulate breast cancer (Anderson *et al.* 1999). This theory is highly debated and many studies show conflicting evidence about the action of phytoestrogens in relation to breast cancer.

Five *in vitro* studies of phytoestrogens on mammary cells have been reviewed and summarized by This and coauthors (2001). Biphasic effects of genistein in varying concentrations of culture medium were demonstrated on mammary cells (MCF-7 cancer cells). At physiological doses of 100 nM/l to 1 μM/l, genistein stimulates cellular proliferation. In the presence of physiological doses of E_2, genistein competes for the binding site of E_2 and slightly inhibits cellular proliferation. At doses greater than 10 μM/l genistein inhibits cellular proliferation most likely because of the inhibition of tyrosine kinase activity of growth factor receptors. Therefore the activity of genistein is highly dependent on concentration and the concentration of estradiol in the culture medium (This *et* *al.* 2001). Black cohosh, dong quai (*Angelica sinensis*), ginseng (*Panax* spp., Araliaceae), and licorice root (*Glycyrrhiza glabra* L., Fabaceae) were tested on cell proliferation of MCF-7 human breast cancer cells and dong quai and ginseng were observed to stimulate the growth of MCF-7 cells (Amato *et al.* 2002).

An *in vivo* study reported that newborn female rats treated with genistein and then exposed to a carcinogen showed an increased latency and lowered incidence and number of induced mammary tumors (Lamartiniere *et al.* 1995). This antitumor activity was further confirmed by studies reviewed by Barnes (1997) that showed a reduction in the number of tumors observed in animals treated with genistein during neonatal and prepubertal periods as opposed to a later period (Barnes 1997).

However, other studies have shown contradictory evidence and suggest that breast cancer patients should avoid soy. A commonly reported study found that dietary genistein might stimulate the growth of estrogen-dependent tumors in humans with low estrogen levels (Hsieh *et al.* 1998). Ovariectomized athymic nude mice were implanted with MCF-7 cells and then either given a control diet, a diet with genistein, or a diet supplemented with estradiol (Hsieh *et al.* 1998). The tumors were measured and diets with genistein were observed to stimulate tumor growth. Another study with women in need of surgery for benign and malignant breast tumors, who were treated with 45 mg of isoflavones for two weeks, showed higher rates of breast cancer cell proliferation (McMichael Philips *et al.* 1998).

A variety of different mechanisms have been suggested for the action of phytoestrogens on breast tissue. There are several isoforms of ER that may play a role in ERβ heterodimerization with ERα resulting in decreased estrogenic effects (Adlercreutz 2002). Additional mechanisms proposed are: inhibition of tyrosine as well as other protein kinases, inhibition of angiogenesis, alteration of growth-factor activity, and binding proteins (Adlercreutz 2002).

In a case-controlled study, women (n = 144) who excreted high concentrations of phytoestrogens, equol and enterolactone, showed a significant lowered risk of breast cancer (Ingram *et al.* 1997). Evidence from an epidemiological study suggests that a diet low in fat and high in soy proteins, vegetable oils, and vegetables rich in carotene is associated with lowered risk of breast cancer in premenopausal women (Lee and Gourley 1991). Some studies did not determine exact quantities of phytoestrogens ingested making them problematic for comparisons. Plasma estrogens and breast cancer have been studied more than urinary estrogens because plasma estrogens are easier to identify (Kurzer 2002). In evaluating various studies, methodologies must be considered when extrapolating conclusions. Studies often differ by subject age, timing and dose of administration, length of study, and form of analysis. More research is needed to evaluate the different binding effects of phytoestrogens to ERα and ERβ for breast cancer.

Cardiovascular disease

The leading cause of death in women in industrialized nations is coronary heart disease (CHD). During menopause the risk of CHD greatly increases and it is proposed that this is due to the loss of estrogen (Wroblewski Lissin and Cooke 2000). Lipid profiles, vascular reactivity, cellular proliferation, and thrombosis are factors that affect CHD and on which phytoestogens have shown beneficial effects (Anderson *et al.* 1999).

Mechanisms suggested to explain the possible role of phytoestrogens in the prevention of cardiovascular disease and the reduction of atherosclerosis are as follows: improvement of plasma lipid concentrations, reduction of thrombus formation such as inhibition of platelet action, improvement of systemic arterial compliance, and antioxidant activity (Van der Schouw *et al.* 2000). Phytoestrogens also bind to ERs and activate them, which allows homodimerization and interaction with estrogen response elements (ERE) that are regulatory sites on DNA molecules situated within target gene promoters (Van der Schouw *et al.* 2000). Target gene transcription may be positively or negatively regulated by the DNA-bound receptor depending on the cellular and promoter context. Several mechanisms of action reported to explain the hypocholesterolemic effects of phytoestrogens include: increased bile acid secretion, which aids removal of low density lipoprotein (LDL); affected hepatic metabolism coupled with increased removal of LDL by hepatocytes; and enhanced thyroid function (Wroblewski Lissin and Cooke 2000). LDL shows increased oxidative resistance when isoflavones are incorporated into LDL cholesterol (Vincent and Fitzpatrick 2000). Additional mechanisms of action have been suggested to explain the effects on plasma lipid concentrations including: action on ERs, reduction of endogenous cholesterol synthesis, and increased activity of cholesterol receptors (Glazier and Bowman 2001). The isoflavone genistein has been shown to act as a protein tyrosine kinase inhibitor, which may explain decreased platelet action (Tham *et al.* 1998).

Studies suggest that isoflavones as antioxidants may affect atherogenesis by reducing the oxidation of LDL (Ruiz-Larrea *et al.* 1997; Wagner *et al.* 1997). Kurzer and Xu (1997) reviewed antioxidant effects of isoflavones from *in vitro* and *in vivo* studies and reported that soy isoflavones act as antioxidants by directly or indirectly enhancing the activities of catalase, superoxide dismutase, glutathione peroxidase, and glutathione reductase enzymes. Hwang and coworkers (2001) report that extracts of soy, alfalfa, and acerola cherry (*Malpighia glabra* L., Malpighiaceae) may synergistically interact to prevent LDL oxidation. Most of the research has been conducted with soy isoflavones and limited research has been conducted to evaluate the effects of lignans and coumestans on cardiovascular disease.

Prostate cancer

Prostate cancer is one of most common cancers for men in the United States however little is known about its etiology. *In vitro* studies using human prostate cancer cells have demonstrated inhibition of cell growth with high concentrations of phytoestrogens (Adlercreutz *et al.* 2000a). Rats consuming soy and rye bran delayed the growth of implanted prostate tumors (Landstöm *et al.* 1998). Further testing with the same phytoestrogens increased apoptosis of the tumors and reduced tumor growth in nude mice implanted with human prostate tumors. However, estrogen has shown controversial effects, such as growth of prostate cancer and benign prostatic hyperplasia suggesting that phytoestrogens may have similar effects (Adlercreutz *et al.* 2000a). Adlercreutz (2002) reviewed some of the more recent studies on prostate cancer and stated that findings support the hypothesis that soy consumption prevents prostate cancer, yet more studies are needed.

The interaction of phytoestrogens with ERs and ER isoforms, such as ERβ2 or ERβcx in the prostate, as well as other receptors can lead to a variety of biological actions (Morrissey and Watson 2003). The relative binding affinity for different ERs and the formation of the ER complex, which can bind to EREs may explain the actions observed in the prostate. Other factors that affect whether phytoestrogens have a positive or negative effect on the prostate may be ER co-factors and phosphorylation status (Morrissey and Watson 2003). In addition, the effects on growth factor receptors have been suggested because of the inhibition of growth-factor-mediated stimulation of cell proliferation (Adlercreutz 2002). Other mechanisms may be due to regulation of steroid receptor pathways, anti-androgenic effects, inhibition of 5α-reductase, 17β-hydroxysteroid dehydrogenase and aromatase activity, inhibition of tryrosine specific protein kinases and DNA topoisomerase II, and antioxidant activity (Morrissey and Watson 2003).

Several epidemiological studies suggest the beneficial use of phytoestrogens in reducing prostate cancer (Jacobsen *et al.* 1998; Severson *et al.* 1989; Strom *et al.* 1999). A human study of 83 cases and 107 controls used a dietary questionnaire to evaluate phytoestrogen consumption for prostate cancer risk (Strom *et al.* 1999). The results showed slightly protective effects on prostate cancer risk with greater consumption of phytoestrogens. Severson and coworkers (1989) showed increased tofu consumption associated with a decreased risk of prostate cancer in men of Japanese ancestry living in Hawaii. Another study reported that Adventist men who consumed soy milk daily were at lower risk for prostate cancer (Jacobsen *et al.* 1998). However, this study had a small number of cases and the confidence interval was wide. An herbal mixture including licorice and ginseng as well as six other herbs has shown estrogenic activity and was effective in two human cases of hormone-refractory prostate cancer (De la Taille *et al.* 2000). Other studies have evaluated alternative therapies, such as soy, black cohosh, vitamin E, and red clover, for their potential use in alleviating hot flashes for prostate cancer patients (Moyad 2002). A recently published randomized cross-over study on soy food consumption and serum prostate specific antigen (PSA) in men with hyperlipidemia showed lowered LDL, no significant effects on serum PSA, and reduced calculated risk for CHD (Jenkins *et al.* 2003).

There is a paucity of research on the effects of phytoestrogens and prostate cancer. Although the present studies show a positive association between phytoestrogens and prostate cancer risk, more clinical studies are needed to confirm this hypothesis.

Menopausal symptoms

Symptoms associated with menopause, such as hot flashes and vaginal dryness, motivate many women to seek medical solutions. Hormone replacement therapy has proven effective in the reduction of hot flushes, yet it is still controversial if HRT may be associated with increased risks of breast and endometrial cancer. Initial findings from a Women's Health Initiative randomized controlled trial in which women received a daily dose of conjugated equine estrogen (0.625 mg) and medroxyprogesterone acetate (2.5 mg) have shown an increased risks to benefits ratio (Rossouw *et al.* 2002). The investigators detected increased risks of invasive breast cancer and CHD with the consumption of the combined hormone preparation after 5.2 years of average follow-up. Due to controversial evidence on HRTs, alternative therapies have been sought such as phytoestrogens and SERMs.

The mechanisms of action are still poorly understood because of the complex biological actions observed in phytoestrogens. As discussed before, target tissue, kinds of ERs, and the concentration of endogenous estrogens are all factors that affect phytoestrogen activity at the cellular level. Other non-receptor mechanisms may also explain the biological effects of phytoestrogens on menopausal symptoms, such as antioxidation, blocking of enzymes involved in the biosynthesis of estrogen, inhibition of protein kinase which is part of intracellular signaling, and inhibition of 5α-reductase and aromatase (Vincent and Fitzpatrick 2000). The reduction of bioavailability levels of free sex steroids such as estrogen may also be the result of phytoestrogens stimulating sex hormone-binding globulin (SHBG) synthesis (Vincent and Fitzpatrick 2000).

Some botanicals used in Western countries for menopausal symptoms are black cohosh, dong quai, ginseng, red clover, hops (*Humulus lupulus* L., Cannabaceae), evening primrose oil (*Oenothera biennis* L., Onagraceae), and chasteberry or chaste tree berry (*Vitex agnus-castus* L., Verbenaceae) (Kronenberg and Fugh-Berman 2002; Liu *et al.* 2001b). Several reviews have discussed studies conducted on phytoestrogens and menopausal symptoms and still much contradictory evidence exists as to the benefits of phytoestrogens (Glazier and Bowman 2001; Kang *et al.* 2002; Kronenberg and Fugh-Berman 2002; Merritt 2001; Wuttke *et al.* 2003b). More research is needed in this area, especially studies examining long term effects of phytoestrogens on endometrial tissue and bone loss.

Osteoporosis/bone health

Osteoporosis is often associated with women in menopause. Evidence supports ERT in the prevention of osteoporosis in postmenopausal women that has resulted in more research to evaluate the effects of phytoestrogens on bone mineral density. Researchers hypothesize that a diet rich in isoflavones has a protective effect on bone (Tham *et al.* 1998). Ipriflavone, a synthetic isoflavone derivative (7-isopropoxy-isoflavone), has been used extensively in animal and human studies to evaluate bone health and phytoestrogens with beneficial results (Scheiber and Rebar 1999). Vincent and Fitzpatrick (2000) reviewed three animal studies and concluded that genistein has a biphasic effect on bone mineral density in ovariectomized rats, meaning that lower doses improved bone mineral as opposed to high doses. Van der Shouw and coworkers (2000) reviewed three studies on bone mineral density with phytoestrogen consumption that were conducted with postmenopausal women. Two of the studies showed an increase in bone mineral density and the third study, a 10 year follow-up study conducted in the Netherlands, reported a loss of bone associated with higher urinary equol and enterolactone excretion.

Kurzer and Xu (1997) reviewed several other studies that include possible mechanisms of action to explain phytoestrogens' beneficial effect on bone loss. These mechanisms include preventing urinary calcium loss, beneficial effects on osteoblasts, and influences on the secretion of calcitonin, which suppresses bone resorption. In addition, soy foods are considered a good source of calcium. Estrogen receptors have been found in osteoblasts, which may cause alteration in some protein production. The phytoestrogen-ER complex (formed by the binding of phytoestrogens and the ER) may bind to EREs and inhibit or suppress specific gene expression (Anderson *et al.* 1999). More long-term studies are needed on bone density and fracture rates to determine safety, efficacy, and appropriate dosage.

Cognition

Cognition and memory functioning have been reported to decrease around menopause (File *et al.* 2002), and therefore studies have investigated the association of ERT and cognition, as well as phytoestrogens and cognition (Vincent and Fitzpatrick 2000). However, limited studies are available about the effects of phytoestrogens on cognitive function. A study conducted with female rats suggested that soy phytoestrogens function as estrogen agonists because they increase choline acetyltransferase and nerve growth factor messenger RNA in the frontal cortex and hippocampus (Pan *et al.* 1999). Other human studies have also suggested improved memory with dietary phytoestrogens (File *et al.* 2001, 2002).

Contradictory evidence has also been reported. One review paper summarized two studies about tofu consumption in Hawaii that suggest increased cognitive dysfunction (Sirtori 2001). The mechanisms are not understood, but it has been suggested that phytoestrogens act as estrogen agonists and may increase spine density and synapse formation in the hippocampus of adults (File *et al.* 2003). In addition, phytoestrogens may interact with the transcription of neurotrophin genes (File *et al.* 2003). More research is needed to understand the effect phytoestrogens might have on cognitive functioning.

Botanical sources studied for phytoestrogens

Plant compounds can be limited to specific botanical families that may assist researchers in identifying other species that contain the same compounds. This concept is referred to as chemotaxonomy. For example, there is a higher concentration of phytoestrogens in legume plants even though they are also found in other grains, vegetables, and fruits distributed across the plant kingdom. The most common phytoestrogens found in legumes are isoflavones. Isoflavones are part of a group of chemicals known as the isoflavonoids, which are almost exclusively limited in distribution to the Fabaceae family and more specifically to the Fabaceae-Papilionoideae (Dewick 1993). Fabaceae-Mimosoideae and Fabaceae-Caesalpinoideae have shown very few plants with isoflavonoids. A few isolated cases of isoflavonoid derivatives have been reported in other plant families in the dicotyledons. Of the Monocotyledons, species of *Iris* (Iridaceae) are a major source of isoflavonoids. Of the Gymnosperms, the genera *Juniperus* and *Podocarpus* have been reported to produce isoflavonoids (Dewick 1993).

Phylogenetic analysis uses chemical, molecular, and traditional systematic data (such as plant anatomy) to suggest evolutionary relationships of plant taxa (Daly *et al.* 2001). This type of analysis provides a useful tool that can guide researchers in more effectively locating specific plant compounds because it elucidates chemotaxonomies (Daly *et al.* 2001).

Based on the phylogenetic tree of Daly and coworkers (2001), plants that have phytoestrogens tend to be concentrated in an upper evolutionary group that consists of the botanical orders, Fagales, Cucurbitales, Rosales, Fabales, and Malpighiales. Cucurbitales contains Cucurbitaceae (pumpkin), Rosales contains Cannabaceae (hops), Fabales contains Fabaceae (soy, licorice, red clover), and Malpighiales contains Linaceae (flax). Other plant species that have shown estrogenic activity are found in different orders located at basal positions from the initial group mentioned: Myrtales (evening primrose), Apiales (dong quai, ginseng), and Lamiales (chasteberry). Although estrogenic activity has been reported for these plant species, specific phytoestrogens have not been identified. Chemotaxonomy offers an innovative way to select potential plant sources for further testing. For example, the phylogenetic relationships suggest that research should be conducted in plant families found within the initial botanical group discussed above. Although the majority of studies on phytoestrogens have been conducted on soy, other botanical species have also been included in this discussion.

Soy

Soy or soybean (*Glycine max*) belongs to the Fabaceae family and has long been used as a food plant. Of the bean plants it has one of the highest levels of protein and oil (Duke 1981). Medicinally it has been reported in ancient

Chinese herbals for the healthy functioning of the heart, kidneys, liver, and stomach (Duke and Ayensu 1985). It was domesticated in China around the eleventh century BC and there are many varieties. The Chinese distinguish the different varieties by color. Black seeds are associated with medicine and have been used for strength and vigor as well as in mixtures for postpartum treatment and sexual disorders (Li 1973). Black bean sprouts have been used as a laxative, for rheumatism, and to stimulate hair growth. A "bean relish" made of salted fermented beans has been highly valued in Chinese medicine and has multiple uses including colds, headaches, hemorrhaging in abortion, threatened abortion, difficult labor, irritability, and fever (Li 1973). In the 1940s, genistin, the genistein glycoside, was first reported in soybean oil meal and was later shown to have estrogenic activity in mice (Cheng *et al.* 1953). Soy has been well studied for phytoestrogens and numerous articles have been published on the benefits and risks of soy over the last few years. In this overview, some of the more recent research will be presented.

It is unclear whether soy protein with trace amounts of isoflavones (phytoestrogen-extracted soy protein), phytoestrogen-intact soy protein, or a combination of both causes the beneficial cholesterol effects seen in animal studies (Van der Schouw *et al.* 2000). Consumption of soy protein has shown a decrease in lipid peroxidation as compared to casein consumption in postmenopausal cynomolgus monkeys and lowered atherosclerosis in rabbits (Van der Schouw *et al.* 2000; Wagner *et al.* 1997). Isoflavone-intact soy protein has lowered LDL and raised high density lipoprotein (HDL) cholesterol suggesting that the active components are found in the extractable protein portion (Clarkson and Anthony 1998). When acetylcholine was administered to rhesus monkeys fed intact isoflavones, their arteries dilated whereas the group fed isoflavones extracted from soy constricted (Honoré *et al.* 1997). These results are supported by another study with rhesus female monkeys that observed that a diet of soy with intact isoflavones sustained normal coronary blood flow after an intracoronary infusion of collagen possibly due to platelet aggregation being inhibited or because platelets release vasoconstrictors (Williams and Clarkson 1998). Two studies showed that a diet of soy protein inhibited atherosclerotic plaque formation as opposed to animal protein, yet more research is needed to determine if benefits are mediated by soy protein or by phytoestrogens (Van der Schouw *et al.* 2000). Further investigations are needed to elucidate the effects of phytoestrogen dietary supplements, which are often isolated from soy and then encapsulated and sold in tablets or capsules.

A meta-analysis of 38 studies reported that a diet containing an average of 47 g soy protein decreased total cholesterol by roughly 9.3%, LDL cholesterol by 12.9%, and triglycerides by 10.5% and increased HDL cholesterol by 2% (Anderson *et al.* 1995). Another review reported that several human studies found evidence that a diet of soy protein reduces LDL (Wroblewski Lissin and Cooke 2000). In a randomized clinical trial conducted for nine weeks with hypercholesterolemic men and women, increased isoflavone doses (25 mg, 42 mg, or 58 mg) in soy protein showed a lower LDL and total cholesterol concentration suggesting a dose-response relationship (Crouse *et al.* 1998). A placebo-controlled crossover trial with menopausal and perimenopausal women showed improved systemic arterial compliance with the daily consumption of soy isoflavone supplements (Nestel *et al.* 1997). However, four small studies showed no statistically significant association between a soy isoflavone diet and an increase in HDL cholesterol for pre-menopausal women and the effects on LDL cholesterol were conflicting (Cassidy *et al.* 1995). Further findings showed that isoflavone pills improved arterial compliance but did not show effects on plasma lipids (Clarkson and Anthony 1998).

A reduction of the relative risk of breast cancer in premenopausal women who consume a soy rich diet has been reported (Ingram *et al.* 1997) while others indicate a moderate and non-significant reduction of this risk (Hargreaves *et al.* 1999; Petrakis *et al.* 1996). Kurzer (2002) reviewed hormonal effects, including concentrations of reproductive hormones in the blood, menstrual cycle lengths, and menstrual phase lengths, of soy in premenopausal women and reported that lowered risk of breast cancer is often associated with a longer menstrual cycle, reduced estrogens, increased sex-hormone binding globulin, and increased excretion of 2 to 16 α-hydroxy estrogens. Time exposure has also been proposed to explain benefits of soy. Limited evidence exists to suggest that soy consumption in adult life is protective against breast cancer; however, very high levels of consumption (Peeters *et al.* 2003) or consumption throughout life starting at adolescence (Adlercreutz 2002) could potentially reduce the risk of breast cancer.

A detailed discussion of soy for women who have survived breast cancer has been presented (Messina and Loprinzi 2001). The avoidance of soy for breast cancer patients has been reported in one study that showed increased breast nipple aspirate fluid (NAF) secretion and breast cell hyperplasia in postmenopausal women on ERT who consumed daily 80 mg of soy isoflavones over five months (Petrakis *et al.* 1996). A drawback of this study is the lack of a control group, and fluid secretion continued to increase in the patients even after they ceased soy consumption. Presently soy isoflavones have not been reported to show significant effects on endometrial tissue (Balk *et al.* 2002; Vincent and Fitzpatrick 2000).

Several studies have reviewed the use of soy for HRT (Burke *et al.* 2000; Kronenberg and Fugh-Berman 2002). A double-blind parallel multi-center randomized placebo-controlled trial of 104 postmenopausal women who took 60 g of isolated soy protein daily (76 mg of isoflavones) versus placebo reported that the mean number of daily hot flushes were significantly reduced in the group consuming soy ($p < 0.01$) (Albertazzi *et al.* 1998). Other studies have also shown positive effects with soy extracts (Faure *et al.* 2002; Han *et al.* 2002; Scambia *et al.* 2000). However, negative and mixed results of soy for menopausal symptoms have also been reported (Quella *et al.* 2000; St. Germain *et al.* 2001). These studies often differ by soy product, dose, length of study, and subjects making it difficult to compare the results. More studies are needed to elucidate the effects and safety of soy on women with a history of breast cancer and osteoporosis.

Black Cohosh

Black cohosh (*Actaea racemosa*, *Cimicifuga racemosa*, Ranunculaceae) grows in eastern North America, from southern Maine to Georgia (Ramsey 1997). Black cohosh, also known as baneberry, black snakeroot, bugbane, and rattleweed, is used for various women's health conditions. Native Americans used the roots and rhizomes for a variety of indications such as stimulation of menstrual flow, dysmenorrhea, suppression of cough, treatment of diarrhea, childbirth, and rheumatism (Foster 1999). The 19th century American Eclectic physicians recognized black cohosh to be "very efficacious in maladies of the female reproductive organs" (King and Newton 1852).

Knowledge of this useful herb soon reached Europe, where it has been a popular herbal medicine for menopausal symptoms for a number of years. A standardized black cohosh extract (Remifemin™) was developed in Germany, and this product has been studied both in animals and short-term clinical trials of menopausal women. According to these studies the extract appears to provide relief for hot flashes (Jarry *et al.* 1985; Stoll 1987).

A historical study using the Allen-Doisy bioassay did not detect estrogenic activity in black cohosh, which was part of the Lydia E. Pinkham mixture, a popular tincture used by women (Costello and Lynn 1950). More recent studies reported that formononetin was detected in a methanol extract of a black cohosh sample that previously bound to an ER *in vitro* (Jarry and Harnischfeger 1985; Jarry *et al.* 1985), although this is surprising based on chemotaxonomy. Others have reported detecting additional flavonoids, such as kaempferol (Schmitz 1993) and biochanin A, genistein 4'-methyl ether (McCoy and Kelly 1996). Authors have speculated that black cohosh may work through estrogen-like compounds (Jarry *et al.* 1985), but to date this has not been established. Others have failed to find formononetin in black cohosh extracts (Kennelly *et al.* 2002; Struck *et al.* 1997).

In vitro data on black cohosh in breast cancer cell lines is limited. The case is being made in both the scientific and popular press that the biological activity of black cohosh is not estrogenic but rather accomplished through some SERM or non-steroidal compound that has clinical effects similar to some of the activities of estrogen. Inconsistent results are reported for *in vitro* studies using black cohosh extracts and estrogen receptor binding activity and stimulation of breast cancer cells (Dixon-Shanies and Shaikh 1999; Düker *et al.* 1991; Harnischfeger and Cillien 1996; Jarry and Harnischfeger 1985; Jarry *et al.* 1985; Nesselhut *et al.* 1993; Zava *et al.* 1998). Fukinolic acid, a black cohosh constituent, showed increased cell proliferation of an estrogen dependent MCF-7 cell system with reference to estradiol (Kruse *et al.* 1999). Another study tested estrogenic and antiestrogenic effects of black cohosh extracts on proliferation of MCF-7 cells and on gene expression using ethanolic and isopropanolic extracts and concluded that black cohosh contains antiestrogenic compounds because the extract antagonized estradiol induced activities in the different experiments (Zierau *et al.* 2002). Another recent investigation found that black cohosh extract did not display significant competitive binding to ERα nor ERβ (Liu *et al.*

2001a). Furthermore, in this same study black cohosh did not show estrogen activity, as indicated by alkaline phosphatase (AP) activity with cultured Ishikawa (endometrial) cells. In addition, black cohosh extracts do not have any estrogenic activity in a number of assays where ER-positive breast cancer cells were used (personal communication, Dr. Ruth Lupu).

Kronenberg and Fugh-Berman (2002) reviewed randomized, controlled trials of Remifemin™ for menopausal symptoms conducted in Germany and the United States. Three of the four trials report black cohosh helpful for hot flashes. More research is still needed to examine the long-term effects of black cohosh for treating menopausal symptoms. A recent study reported beneficial effects of combined administration of tamoxifen and black cohosh extract (CR BNO 1055) for hot flushes in women surviving breast cancer (Hernández Muñoz and Pluchino 2003). A double-blind, placebo-controlled study with postmenopausal women demonstrated that CR BNO 1055 was comparable to conjugated estrogens in treating climacteric complaints and maintaining bone metabolism, and did not increase endometrial thickness (Wuttke *et al.* 2003c).

Investigators proposed that black cohosh contains unidentified compounds that produce estrogenic effects (Kronenberg and Fugh-Berman 2002; Wuttke *et al.* 2003c). An additional hypothesis is that the compounds in black cohosh interact with a third estrogen receptor, ERγ, yet to be identified in humans but recently reported in teleost fish (Jarry *et al.* 2003). Metabolic conversion of precursor molecules, serotonin receptor blocking activity, and dopaminergic compounds have also been suggested as potential mechanisms of action for black cohosh (Jarry *et al.* 2003). Currently, black cohosh is in a clinical trial at Columbia University and the University of Illinois at Chicago for the treatment of menopausal hot flashes, as well as assessment of cognitive function and bone metabolism.

Most studies have reported that black cohosh extract is free of significant side effects. However, the length of these studies is not sufficiently long to insure safety with respect to uterine tissue and function. Further studies are needed to elucidate the mechanism of action of black cohosh. In addition, studies are needed to determine whether users of black cohosh may benefit from decreased risk of fractures and cardioprotective effects, as purported of traditional ERT, as well as to clarify whether black cohosh extract stimulates breast cancer cells *in vivo*, *in vitro,* and in women.

Red Clover

Red clover (*Trifolium pratense*, Fabaceae) is an herb that is indigenous to Europe and parts of the Middle East and has naturalized in North America (Mabberley 1997). It is well-known as an animal fodder. Humans have rarely consumed red clover, although it has been used medicinally. In the beginning of the twentieth century a "Trifolium Compound" that included red clover blossoms along with other botanicals was marketed by pharmaceutical companies for venereal disease, although there was little evidence to support this use (Foster and Tyler 1999). The Celtics and Romans employed red clover as a sedative. Traditionally it has been reported by Native American Iroquois as a gynecological aid for "the change of life" (Herrick 1995). More recently it has been used to purify blood, treat skin conditions, and for bronchial asthma because it reduces muscle spasm and is a decongestant (Keville 1999).

Estrogenic activity of red clover was initially recorded in 1950 (Legg 1950). With further research estrogenic compounds were identified as formononetin, biochanin A, daidzein, and genistein (Mazur 1998). Coumestrol has been reported in an unspecified species of clover (Franke *et al.* 1995). Although *in vitro* data on red clover is limited, studies do support the plant's estrogenic activity. Red clover extracts tested in four *in vitro* assays showed consistent estrogenic effects with the highest binding potency for both ERs as compared to other plant extracts tested (Liu *et al.* 2001b). Genistein appeared as the most active component in AP induction ability and up-regulation of progesterone receptor (*PR*) expression in Ishikawa cells and there was no evidence of antiestrogenic activity. This study supports the results of earlier work using the radioreceptor assay which showed red clover extracts bound to the ER of MCF-7 cells and to the *PR* of T47-D cell lines (Zava *et al.* 1998). Two preparations of Menoflavon®, a red clover extract, showed a higher binding affinity to ERβ than ERα in a transactivation assay (Dornstauder *et al.* 2001).

In vivo estrogenic and antiestrogenic effects of red clover extract have been studied in the uterus, vaginal cells, and mammary glands of ovariectomized Sprague-Dawley rats (Burdette *et al.* 2002). Uterine weight and thickness was increased with the extract, although to a lesser extent than increases observed with E_2 and there was no evidence of antagonizing effects on E_2. Red clover extract did induce partial cornification of vaginal cells at high doses after two weeks. Lastly, no estrogenic or antiestrogenic effects of red clover extract were observed on the mammary gland (Burdette *et al.* 2002).

Several human studies have evaluated red clover for a variety of health conditions such as breast cancer, cardiovascular disease, and menopausal symptoms. Rimostil^{TM}, a red clover extract, has significantly increased HDL cholesterol in serum at different doses (28.5, 57, and 85.5 mg/day) and lowered levels of HDL cholesterol in serum after stopping the treatment; however, there was no control group in this study (Clifton-Bligh *et al.* 2001). A double-blind, placebo-controlled trial with postmenopausal women that involved daily consumption of isoflavones derived from red clover reported improved arterial compliance, although the study design and high dropout rate have been questioned (Nestel *et al.* 1999). On the other hand, a randomized double-blind study using purified isoflavones, predominately formononetin and biochanin A from red clover, did not significantly change the total plasma cholesterol, LDL cholesterol, HDL cholesterol, or plasma triglyceride levels in postmenopausal women with slightly elevated plasma cholesterol levels (Howes *et al.* 2000).

The effects of red clover on endometrial cancer have also been studied. A double-blind randomized, controlled study using purified isoflavones (50 mg daily) from red clover did not show reduced cell proliferation in the endometrium of 30 women ranging in age from 45 to 50 based on the detection of a Ki-67 antigen in endometrial biopsy specimens (Hale *et al.* 2001). Small sample size, the type of isoflavone treatment, and the limited timing of examination in the menstrual cycle may have affected the results.

Red clover has been reviewed for menopausal symptoms (Fugh-Berman and Kronenberg 2001; Kronenberg and Fugh-Berman 2002). A red clover extract, Promensil^{TM}, contains isoflavones in the aglycone form and was used in a randomized, double-blind, placebo-controlled trial with 30 menopausal women. Significant differences between the control and placebo group were observed at week 8 and 12 with the control group showing reduced hot flush count (Van de Weijer and Barentsen 2002).

One note of caution about red clover is the potential presence of coumarins that have been reported in some other clover species, often in damaged plant tissue. These compounds act as anticoagulants and therefore should be detected in red clover extracts prior to consumption (Fugh-Berman and Kronenberg 2001). Additional studies are needed to further elucidate the benefits or adverse effects of red clover as a source of phytoestrogens.

Flax

Flax (*Linum usitatissimum*, Linaceae) is an herb that is considered one of the oldest continuously cultivated plants. The Latin name of the species means “most useful” (Haggerty 1999). Because of its fiber, it is well-known in both tropical and temperate regions and was found in ancient Egyptian tombs. Several European pharmacopoeias have included it as a medicinal plant (Grieve 1985). The seeds, also known as linseed, are medicinal and have been used to make flour; they produce mucilage when infused or boiled in water. Flax has been used for colds, coughs, and fevers, to reduce inflammation, and as a demulcent. Native American Cherokee used flaxseed for fevers and "violent colds, coughs and diseases of lungs" (Hamel and Chiltoskey 1975) and the oil has been used as a laxative (Haggerty 1999). In the Middle Ages the flowers were used for protection against sorcery (Grieve 1985). Flax has been attractive as an oil seed because it contains polyunsaturated fatty acids such as α-linolenic acid, which may lower cholesterol and have antioxidant effects for health.

Flaxseed is considered one of the richest sources of lignan phytoestrogens (Thompson *et al.* 1991), although a recent study has reported Norway spruce as another rich source (Saarinen *et al.* 2000). Several studies have developed techniques to identify and quantify phytoestrogens in flaxseed (Charlet *et al.* 2002; Muir and Westcott 2000; Obermeyer *et al.* 1995), yet limited clinical studies have been conducted on the phytoestrogens in flax and their role in human health.

In rats flaxseed consumption has resulted in developmental reproductive changes (Tou *et al.* 1998), changes in estrus cycle (Orcheson *et al.* 1998), and menstrual cycle (Phipps *et al.* 1993). One *in vivo* study with nude mice fed a diet supplemented with 10% flaxseed showed a decrease in tumor growth rate and metastasis as well as lowered extracellular levels of vascular endothelial growth factor (Dabrosin *et al.* 2002). Another study testing spermatogenesis and testis structure in Sprague-Dawley rats showed no effect on maternal ingestion of flaxseed during lactation and gestation followed by postnatal consumption of the same diet as the mother (Sprando *et al.* 2000).

In a randomized, crossover trial of two 3-week periods with defatted flaxseed lignans there was a reduction in LDL cholesterol, total cholesterol, and apolipoprotein B and A-1 and no significant effect on HDL cholesterol. However, consumption of flaxseed did reduce protein thiol groups as compared to the controls, which may suggest increased oxidative activity (Jenkins *et al.* 1999). A 12-week study of 145 women with climacteric complaints showed a reduction in menopausal symptoms (including hot flush and vaginal dryness) with the consumption of a diet rich in phytoestrogens (including soybean foods and flaxseed) (Brzezinski *et al.* 1997). Before radical prostatectomy, a powdered flaxseed and low-fat diet was tested in a pilot study; although beneficial, the estrogenic effects were not determined. Significant decreases in total testosterone and free androgen were observed which may be due to reduced fat intake (Demark-Wahnefried *et al.* 2001). Additional studies are needed to elucidate the estrogenic activity of lignans in flax.

Licorice

The licorice (*Glycyrrhiza glabra*, Fabaceae) plant is a perennial and is indigenous to Eurasia. In Greek *Glycyrrhiza* means “sweet root” (Wang and Nixon 2001). The sweet yellow wood of the licorice root has been consumed for thousands of years in China for its health benefits and detoxification effects as well as its use as a flavoring and sweetening agent (Foster and Tyler 1999;

Wang and Nixon 2001). The earliest recorded medicinal use is most likely around 2100 BC (Gibson 1978). Medicinally it has been used as a demulcent and expectorant and has been shown to have antioxidant and antimicrobial activity. In the United States, licorice is added to tobacco as well as candies, toothpaste, and beverages (Wang and Nixon 2001). Other medicinal uses are as a tonic, to quench thirst, for asthma, fever, and externally for burns and sores (Gibson 1978; Li 1973). Although it is not indigenous to North America, reports indicate that it was purchased by Native Americans and used for female troubles (Smith 1928) as well as for coughs, asthma, and as an expectorant (Hamel and Chiltoskey 1975). The main components of licorice are glycyrrhizin (glycyrrhizinic acid), which is sweeter than sugar, and glycyrrhetinic acid. Both have been clinically used in the treatment of hyperlipidemia, allergic inflammation, atopic dermatitis, and atherosclerosis (Tamir *et al.* 2001).

The estrogenic activity of licorice was first published by Costello and Lynn (1950). Licorice has shown antiprogestin activity, which may be mediated by other compounds because purified glycyrrhizin did not bind to ER or *PR* (Zava *et al.* 1998). However, in another study licorice extracts showed weak binding affinity to both the ERs as well as weak stimulation of *PR* expression (20 µg/mL) (Liu *et al.* 2001b). Glabrene, glabridin, and isoliquiritigenin, 2′,4′,4′-three hydroxyl chalcone (ILC) found in the ethanol extract of licorice root showed estrogenic activity (Tamir *et al.* 2001). Glabrene, an isoflavene, has been reported as a new class of phytoestrogens and glabridin is a novel phytoestrogen that is lipophilic and structurally similar to E2 (Tamir *et al.* 2001). It has been isolated from licorice extract and appears to have ER mediated estrogen effects. Glabridin binds to human ER and *in vitro* showed biphasic effects on estrogen-dependent human breast cancer cells and increasing concentrations showed biphasic effects on the growth of anchorage-independent growth MCF-7 cells (Tamir *et al.* 2000). Another compound in licorice, licochalcone-A, has shown estrogenic activity with ERs and induced apoptosis in MCF-7 and HL-60 cell lines (Rafi *et al.* 2000).

Additional *in vivo* results demonstrated the ability of licorice root to double activity in skeletal and cardiovascular tissue (Tamir *et al.* 2000) and its effect on reducing testosterone production in rats (Moyad 2002). Daily consumption of 7 g of a licorice dietary supplement (0.5 g of glycyrrhizic acid) in seven men significantly reduced serum testosterone within four days (Armanini *et al.* 1999). Health risks such as hypermineralocorticoidism involving potassium loss and sodium retention, edema, and increased blood pressure have been associated with the human consumption of glycyrrhizinic acid and need to be considered when administering licorice (Stormer *et al.* 1993; Wang and Nixon 2001). More research is needed to evaluate the beneficial and adverse effects of licorice as a source of phytoestrogens.

Hops

Hops (*Humulus lupulus*), a perennial climbing vine in the Cannabaceae family, has been extensively cultivated for its bitter properties found in the female flowers used in beer and medicine. Medicinally hops have been valued as a sedative, anti-inflammatory, and tonic (Foster and Tyler 1999). The Native American Cherokee used the plant for inflamed kidneys, as a sedative, for pain relief, and for breast and female complaints where the womb was debilitated (Hamel and Chiltoskey 1975). Menstrual disturbances were frequently observed in women hops pickers and associated with the estrogenic activity of hops (Verzele 1986).

The following compounds in hops have been identified as estrogenic: 8-prenylnaringenin, 6-prenylnaringenin, xanthohumol, and isoxanthohumol. The female flowers of hops are considered estrogenic. Estrogenic activity of hops is variable between 0 and 300 μg E_2 equivalents/g, which may be due to the physiological state of the plant and/or environmental effects (Verdeal and Ryan 1979). This variation should be kept in mind when evaluating studies based on plant extracts versus isolated, purified compounds. The most potent phytoestrogen in hops is 8-prenylnaringenin, which was found in beer in low quantities (18 ng/ml) (Milligan *et al.* 1999). Isoflavones, most notably formononetin, have also been reported in beer, although they are thought to be from barley seeds before brewing (Lapcík *et al.* 1998). Other studies have found hops present in dietary supplements used for breast enhancement (Coldham and Sauer 2001; Fugh-Berman 2003). Further testing is needed *in vivo* and in humans to adequately evaluate the potential estrogenic activity of these hop-based dietary supplements.

Hops extract *in vitro* did show significant binding affinities to both ERα and ERβ, estrogenic activity with AP induction, and up regulated *PR* expression in

Ishikawa cells; however, it showed strong cytotoxicity (Liu *et al.* 2001b). Hops extract has also acted as a growth inhibitor and showed significant antiproliferation effects in serum stimulated T-47D cells at 0.1% and 0.01% concentration (Dixon-Shanies and Shaikh 1999) and stimulated T-47D and MCF-7 cells in depleted serum at 0.2% (Zava *et al.* 1998). In various bioassays, 8-prenylnaringenin has shown estrogenic potency (Coldham and Sauer 2001; Milligan *et al.* 2000). However, hops showed little uterotrophic activity in prepubertal and adult ovx mouse bioassays (Coldham and Sauer 2001). Presently, there is limited scientific evidence concerning the estrogenic activity and health benefits of hops.

Dong quai

Dong quai (*Angelica sinensis*, Apiaceae) has been used extensively in traditional Chinese medicine for many years (Mei *et al.* 1991). Dong quai has been referred to as the "female ginseng" and is used for a variety of conditions; for example, it is used as a blood tonic and as a decongestant for organs in the body (Hardy 2000). The root is used by women as a tonic often in combination with other herbs. Other women's conditions treated with dong quai are dysmenorrhea, irregular menstruation, anemia, constipation, and abdominal pain (Zhu 1987).

In vitro dong quai has acted as a growth inhibitor with breast cancer cell lines (Dixon-Shanies and Shaikh 1999; Zava *et al.* 1998) but has also been observed to stimulate the growth of MCF-7 cells (Amato *et al.* 2002). It has shown weak binding affinity for ERα and ERβ and weak stimulation of *PR* expression (Liu *et al.* 2001b).

A randomized, controlled trial using a combination of 60 mg soy isoflavones, 100 mg dong quai, and 50 mg black cohosh taken by women who suffered from menstrual migraines showed that this reduced the frequency of migraine attacks, and their severity after one month of initiation (Burke *et al.* 2002). A double-blind, randomized, placebo-controlled clinical trial with dong quai did not significantly reduce hot flushes or endometrium thickening in postmenopausal women over a 24-week period (Hirata *et al.* 1997).

Further studies are needed to evaluate the active compounds and estrogenic effects of dong quai. Psolarens identified in dong quai may cause photosensitization and therefore health risks should also be considered (Hann *et al.* 1991).

Other Botanical Sources

Other botanical sources tested for their estrogenic effects and potential health benefits are: evening primrose oil (*Oenothera biennis*, Onagraceae); chasteberry (*Vitex agnus-castus*, Verbenaceae); alfalfa (*Medicago sativa*, Fabaceae); and ginseng (*Panax* spp. and *Eleutherococcus senticosus* (Rupr. & Maxim.) Maxim., Araliaceae) (Amato *et al.* 2002; Glazier and Bowman 2001; Kronenberg and Fugh-Berman 2002; Liu *et al.* 2001b). Coffee (*Coffea arabica*) has also shown weak estrogenic activity (Kitts 1987). Other plants that have shown ER binding activity or activity in estrogen dependent breast cancer cells are presented in Table 6.1 (at end of Chapter 6), using phylogenetic relationships based on Daly and coworkers (2001). Additional plants reported in the Dominican study sites for women's health conditions will also be discussed below.

Evening primrose is a common herb in North America that has been used medicinally by the Native Americans (Grieve 1985). A randomized controlled trial of oral gamolenic acid from evening primrose oil on hot flushes showed no significant benefits over the placebo group (Chenoy *et al.* 1994).

For centuries the dried ripe fruit of chasteberry tree has been used medicinally for its beneficial effects on female reproduction and to decrease sexual desire, specifically of monks, hence the name (Hardy 2000). Chasteberry extract has shown growth inhibition with T-47D breast cells (Dixon-Shanies and Shaikh 1999) and estrogenic activity based on *in vitro* assays (Liu *et al.* 2001b). Several other studies have evaluated chasteberry for premenstrual syndrome with beneficial effects (Berger *et al.* 2000; Loch *et al.* 2000).

Alfalfa is a perennial herb that has a limited history of medicinal use although it is a common forage plant. The homeopathic physician Alexander L. Blackwood made the association that if alfalfa fattened cows it might work the same way with humans and it was purported by homeopathic and eclectic physicians to "increase the appetite and the flesh" (Foster and Tyler 1999). Coumestrol was the first phytoestrogen identified in alfalfa (Bickoff *et al.* 1957), which is considered one of the richest food sources for this phytoestrogen (Kurzer and Xu 1997). Alfalfa did not show affinity to ER or *PR* binding (Zava *et* *al.* 1998) and therefore may act through a different mechanism. More studies are needed on serum levels of phytoestrogens after alfalfa consumption to elucidate the effects of metabolism on estrogenic activity (Hwang *et al.* 2001).

Ginseng has a long history of medicinal use in Asia as a tonic and stimulant. There are several different plants that are referred to as ginseng and all are in the Araliaceae family: *Panax ginseng* C. A. Mey. (Chinese or Korean ginseng), *P. quinquefolium* L. (American ginseng), and *Eleutherococcus senticosus* (Siberian ginseng). Case studies have shown postmenopausal vaginal bleeding with *Panax* sp. intake, which may suggest weak estrogenic effects (Punnonen and Lukola 1980), although a randomized, double-blind, placebo-controlled multicenter trial of postmenopausal women consuming Ginsana® (100 mg of standardized ginseng extract from *Panax ginseng*) did not show significant differences in menopausal symptoms between groups (Wiklund *et al.* 1999).

Historically, Bradbury and White (1954) as well as Farnsworth and coworkers (1975a, b) compiled extensive data about plant species with estrogenic activity and compounds. Some of these studies have been further confirmed with more advanced laboratory techniques. As techniques continue to be refined, they will provide researchers with higher resolution to detect phytoestrogenic activity and compounds. These methods coupled with phylogenetic analysis can offer effective ways to search for new sources of phytoestrogens in the plant kingdom.

Adverse effects of phytoestrogens

The mechanisms and potencies of phytoestrogens are not completely understood, because they are considered potential endocrine disrupters, caution should be exercised when taking them. Some concerns have been discussed about risks associated with phytoestrogens such as increased plasma concentration of isoflavones in babies that ingest soymilk, the ability of non-hormonal secondary plant metabolites to modify sex steroid metabolism, and the effects of phytoestrogens on thyroid (Ibarreta *et al.* 2001). In addition, the genetic toxicity potential of phytoestrogens has recently been reviewed (Kulling *et al.* 2002). As discussed earlier, sheep consuming large amounts of clover showed infertility and reproductive disorders (Adams 1995; Bennetts *et al.* 1946). Cheetahs in captivity also had reduced fertility rates when consuming a feline diet composed of a soybean product, which was reversed when it was removed from the diet (Setchell *et al.* 1987). Toxicities associated with herbal medicines that include phytoestrogens have also been presented in the literature (Sheehan 1998).

Several articles have discussed the potential risks involved with soy-based infant formulas (Fitzpatrick 1998; Murphy *et al.* 1997; Setchell *et al.* 1998; Zung *et al.* 2001). Some negative effects of phytoestrogens may be the result of receiving high levels of isoflavones during fetal development (Setchell *et al.* 1998). Studies by Setchell *et al.* (1997) showed that infants fed soy-based formula have high concentrations of daidzein and genistein in their plasma, 13,000 to 22,000 times higher than E_2 in early life and proportionately higher than normal adult intake of isoflavones (Setchell *et al.* 1997). This has raised concern about the health benefits and long-term effects that phytoestrogens may have on developing and mature neuronal function and the interaction of phytoestrogens with E_2 during perinatal development of the brain (Belcher and Zsarnovszky 2001). Postnatal rats showed estrogenic activity, including induced permanent estrus with a 40 mg/kg dose of isoflavones, while no effects were observed at the 4 mg/kg dose which was the dose predicted of infants fed soy formula (Lewis *et al.* 2003). Some propose that soy-based formulas might offer health benefits to infants (Murphy *et al.* 1997). Zung and collaborators (2001) reviewed studies on soy-based formulas in relation to growth rate and concluded that there is no significant effect on growth, although with premature infants there is conflicting data. More studies conducted on infants who consume soy-based formulas are needed to further understand the beneficial and adverse effects of phytoestrogens.

As potential endocrine disrupters, phytoestrogens may act as antiestrogens and harm the reproductive health of males (Santti *et al.* 1998; Sharpe and Skakkebaek 1993). Reduced sperm quality, undescended testes, and urogenital tract abnormalities were increased in sons of mothers taking DES, the miscarriage preventative drug, as compared to those who did not take it (Sheehan 1998). Animal studies conducted with DES resulted in male genital abnormalities during development, including cysts, testicular lesions, and lack of growth of the seminal vesicles; and therefore, concern has been raised about the effects of phytoestrogens on male development (Santti *et al.* 1998). High doses of genistein are shown to alter pituitary responsiveness and basal luteinizing hormone (LH) secretion in castrated postpubertal rats. Coumestrol consumption by rat pups suppressed testicular testosterone concentrations and resulted in abnormal sexual behavior in adulthood (Whitten and Naftolin 1992). Studies in cultured human lymphoblastoid cells reported that coumestrol was mutagenic and clastogenic (Domon *et al.* 2001). Recent work has shown that prenatal exposure to phytoestrogens may interact with platelet-derived growth factor during testis development (Thuillier *et al.* 2003). However, Kurzer (2002) reviewed studies on adult men that showed the consumption of soy isoflavones caused no adverse effects on sperm quality. A recent study evaluating long-term reproductive effects of genistein (0 - 10 mg/kg per day) during gestation and lactation in mice showed no significant effect on sperm count, the number of motile sperm, or sperm mobility, nor was there any effect on testicular gene expression (Fielden *et al.* 2003). In adolescent boys, isoflavone supplementation showed no significant effect on bone turnover and growth (Jones *et al.* 2003). Additional studies are needed to further evaluate the risks of phytoestrogen consumption in male development.

Concern has been associated with thymic weight and effects on the immune system. Ovariectomized adult mice injected with genistein produced dose-responsive decreases in thymic weight of up to 80% (Yellayi *et al.* 2002). Other concerns related to phytoestrogens are their effect on thryoxine, insulin, and glucagon (Ohno *et al.* 1993). Hypothyroid cases were associated with infants fed soybean diets (Fort *et al.* 1990). Thyroid hormone concentrations were observed in ovariectomized ewes fed red clover silage which showed changes in the area of the thyroid follicles and significantly higher concentrations of total T_3 and free T_3 in plasma; however, no differences were observed between the total T_4 and free T_4. These results suggest that men and women with thyroid conditions should use caution when consuming phytoestrogens (Madej *et al.* 2002).

In the United States, regulation of phytoestrogen products is limited on standardization, preparation, and extraction methods being sold and marketed as nutritional supplements. As nutritional supplements these products are not supported by clinical trials and therefore should be administered and taken with caution (This *et al.* 2001).

Evaluating Dominican plants for estrogenic activity

Plant species reported in the surveys and interviews in the Dominican Republic for all 10 health conditions except vaginal infections and morning sickness were selected and investigated for estrogenic activity using a literature review. Vaginal infections and morning sickness were not included because they do not involve estrogenic activity. A list of 192 plant species was generated from the responses to eight health conditions. Using this list, I reviewed the literature for each plant to find studies that reported estrogenic activity *in vivo* and/or *in vitro*. Then 11 plants were selected and further tested in the laboratory using a bioassay.

Literature review

The results of the literature review are presented in Table 6.2 (at end of Chapter 6). The following *in vivo* and *in vitro* estrogenic tests were reported in the literature: estrogen receptor binding test, cell lines that test estrogenic activity, cell lines that test anti-estrogenic activity, and a uterine weight test. A total of 32 plants (17%) demonstrated estrogenic activity out of the list of 192. When possible, the phytoestrogen responsible for the estrogenic activity was included in Table 6.2. In some cases, the species reported in the Dominican Republic was not in the literature but a related species demonstrated estrogenic activity and therefore was reported in the table.

From the selection of Dominican plants, the botanical orders that showed the highest number of plant species with estrogenic activity are Fabales, Apiales, Lamiales, Caryophyllales, and Asparagales. The order Apiales showed the highest number of plant species that demonstrated estrogenic activity. The literature results in Table 6.2 help to corroborate the traditional uses from the field data.

Table 6.2 displays the number of corresponding field reports for each plant species. Two species had as few as a single field report (*Hibiscus rosa-sinensis* L., Malvaceae and *Linum usitatissimum*) and others had as many as 123 (*Matricaria recutita*). Often in ethnobotanical studies, only species that have been cited by three or more informants are reported in the results (Browner 1985b; Johns *et al.* 1990). However, there are cases in which a plant that has been mentioned by only one informant is active (Orozco 2003); and therefore, plants with low consensus should not be excluded from results. In this analysis of estrogenic activity, I included plants that were reported by one individual in the Dominican Republic.

The challenges of using literature to corroborate field data are that not all plants in the list have been tested for estrogenic activity using bioassays, in some cases different tests for estrogenic activity were employed, and negative results are often not published; therefore, it is difficult to compare the results.

In addition to investigating estrogenic activity of these selected plants by means of a literature review, several plants reported in the interviews were selected for further analysis using the Ishikawa bioassay, an *in vitro* bioassay for estrogenic activity. These plants were selected based on two criteria: 1) being reported for one of the eight health conditions that could potentially involve estrogenic activity, and 2) their chemotaxonomy. Plants from the Fabaceae-Papilionoideae were selected because of the concentration of phytoestrogens in that botanical family. Plants were also selected if they were from botanical families located in the same clade as the Fabales or neighboring clades (according to the phylogenetic tree presented by Daly *et al.* (2001)).

Ishikawa bioassay

The Ishikawa *in vitro* bioassay is a quick, effective, inexpensive technique for testing general estrogenic and anti-estrogenic activity (Pisha and Pezzuto 1997). The Ishikawa cell line is a human endometrial carcinoma that shows estrogen-inducible alkaline phosphatase, which can be utilized to detect estrogen and anti-estrogen activity (Pisha 1998). In this cell line, estrogen binds with the estrogen receptor, dimerizes, and then binds to the estrogen response elements, which activates a gene promoter, thus inducing alkaline phosphatase. In addition, test samples can also be evaluated for cytotoxic activity with this bioassay. As mentioned earlier, several methods have been used to identify phytoestrogens: the isolated estrogen receptor, *in vivo* studies using uterine weight, and yeast bioassays. The Ishikawa bioassay was selected for this study because it is a simple, inexpensive method that captures general estrogenic and anti-estrogenic activity of test samples.

All plant extractions were conducted at the Phytochemistry Laboratory of Dr. Dennis Stevenson at The New York Botanical Garden (NYBG) with the assistance of laboratory technician, Juan Carlos Saborío Mora. The Ishikawa bioassay was conducted at the laboratory of Dr. Ruth Lupu of Evanston Northwestern Healthcare Center, Illinois with Research Associate, Dr. Emily Pisha following the procedure of Pisha and Pezzuto (1997) with slight modifications.

Materials and Methods

Plant material

Twelve plant samples were purchased for this study during May 2003. Two of the samples were purchased at a food market in the Bronx and the other 10 samples were also bought in New York City, at a *botánica* located in Washington Heights, Manhattan. In total eleven species were tested in the Ishikawa bioassay because two of the twelve plant samples were leaves and roots of the same species, *Agave antillarum* (Table 6.3). All plant samples were purchased dried except for *Momordica charantia*, *Ruta chalepensis*, and the leaves of *Agave antillarum*. Voucher specimens were prepared for each species and deposited at the herbarium of The New York Botanical Garden. The identification of all samples was confirmed with botanists at NYBG.

Table 6.3. Plants tested in Ishikawa bioassay.

Order	Family	Scientific Name {Voucher}[a]	Plant Part	No. of Field Reports
Cucurbitales	Cucurbitaceae	*Momordica charantia* L. {PV194}	Plant	64
Fabales	Fabaceae	*Cajanus cajan* (L.) Millsp. {PV204}	Seed	5
		Canavalia nitida (Cav.) Piper {PV195}	Seed	8
		Desmodium affine Schltdl. {PV196}	Plant	20
		Phaseolus vulgaris L. {PV205}	Seed	5
	Polygalaceae	*Securidaca virgata* Sw. {PV197}	Root	57
Sapindales	Rutaceae	*Ruta chalepensis* L. {PV198}	Plant	30
Lamiales	Bignoniaceae	*Catalpa longissima* (Jacq.) Dum. Cours. {PV199}	Bark	46
Gentianales	Rubiaceae	*Spermacoce assurgens* Ruiz & Pav. {PV200}	Plant	116
Ranunculales	Papaveraceae	*Argemone mexicana* L. {PV201}	Plant	65
Asparagales	Agavaceae	*Agave antillarum* Descourt. {PV202}	Leaf	104
		Agave antillarum Descourt. {PV203}	Root	104

[a]All numbers are A. Ososki collections

Extraction

The samples were extracted using a modified version of the standard procedure for plant extractions at the NYBG Phytochemistry Laboratory. All dried plant samples (100 - 200 g) were ground and all fresh samples (100 - 250 g) were chopped. Samples were then extracted overnight in 80% MeOH (2 L) on a rotator. This extract was filtered and evaporated *in vacuo*. After the extracts were dried, they were placed in a speed vacuum for further evaporation, and then weighed.

Solution preparation

Cell wash (Phosphate buffered solution [PBS]): One package of PBS pH 7.4 (Sigma-Aldrich) was added to 1 L of distilled water and autoclaved.

Maintenance media: Bottles (500 ml) of IMEM with phenol red (Biofluids) were supplemented with 25 ml of fetal bovine serum (FBS) to make a 5% solution and then 5 ml of glutamine were added.

Test media: Bottles (500 ml) of IMEM phenol red-free media (Biofluids) were supplemented with 25 ml of CCS to make a 5% solution, then 5 ml of glutamine were added.

Cytotoxicity assessment solution (Tris/Triton solution): A 100 mM solution of Tris at pH 9.8 was prepared by mixing Trizma powder (12 g) in water (1 L) and adjusting the pH to 9.8 to make a 0.1 molar solution. Then 1 ml of Triton liquid was added to make a 0.1% solution.

Enzyme induction solutions (Paranitrophenyl phosphate solution): Phosphatase substrate powder (15 mg) (Sigma) was added to a vial. Then 15 ml of 100 mM

Tris pH 9.8 solution were added to the vial. For each 96-micro well plate, 15 ml of this solution were used.

Cell cultures

Maintenance: Cells were maintained in T25 and T75 tissue culture flasks (ISC Bioexpress) with loose caps in maintenance media in a humidified 5% CO_2 incubator. The medium of each flask was changed every three days until the cells were 80 - 90% confluent. Cells were grown in phenol red maintenance media because if they were grown in estrogen-free test media they would loose their alkaline phosphatase activity. To prepare cells for the assay, the medium was changed to estrogen-free medium without phenol red 24 hours prior to plating cells to lower background induction from estrogens present in the maintenance medium. In a laminar flow hood, the medium was changed by removing the maintenance medium and washing the cells twice with PBS wash solution (3 - 4 ml for T25 flasks and 5 - 7 ml for T75 flasks). Then the test medium was added to each flask (4 ml for T25 flasks and 12 ml for T75 flasks).

Preparing cells and plating: Twenty-four hours after changing the medium to estrogen-free test medium, cells were trypsinated in a laminar flow hood. The medium was vacuumed off cells and the cells were washed twice with sterile PBS (10 ml). Then 0.5 ml of trypsin were added to each T25 flask to cover the cells and left for 5 minutes at room temperature. After 5 minutes the solution appeared cloudy and the flask was shaken to detach the cells. Trypsin (0.5 ml) was deactivated by adding estrogen-free test medium (4.5 ml). The ratio of trypsin to estrogen-free test medium was 1 ml to 9 ml. Cells were then measured with a coulter counter by adding 100 µl of cell solution to a vial with 10 ml of isotone. For the induction plates 5,000 cells were needed per well (26 x 10^4 cells/ml) and for cytotoxicity plates 2,000 cells were needed per well (10 x 10^4 cells/ml). For each induction plate, a cytotoxicity plate was prepared. The cell solutions were placed in sterile troughs. Using an 8-channel pipet, 190 µl of cell solution were added to each well in a sterile 96-well plate. The plates were labeled, covered, and placed in an incubator overnight to reduce background induction resulting from the trauma of sub-culturing.

Test sample preparation

In the laminar flow hood, each plant extract sample was dissolved in dimethyl sulfoxide (DMSO) (10 mg plant extract/100 ml DMSO) in capped centrifuge tubes, if possible Wheaton vials are preferred. The samples were vortexed to bring them into solution and then placed in a freezer prior to adding them to the plates. Two plates were prepared, one to test toxicity and the other to test induction. Each test plate had negative and positive controls: one well with cell solution and no medium, one with medium and cells, one with estradiol (10 nM), and one with ICI 182,780, an anti-estrogen similar to tamoxifen (50 nM). For induction, each plant extract was plated at four different doses (5, 1, 0.1, and 0.04 µg/ml). For toxicity, each extract was plated at four different doses (50, 10, 2, and 0.4 µg/ml).

A master induction plate was made with the controls and samples and then divided in triplicates for induction and cytotoxicity. Ethanol (18 μl) was added to each well followed by 180 μl of medium and 2 μl of the test samples. The master toxicity plate had the same amount of medium and test samples without the ethanol. For the test samples, 12 μl of DMSO were added to each well. Twelve microliters of sample were added to the first dose and 3 μl were added to the second dose. The second dose was mixed and 3 μl were removed and added to the third dose. The third dose was mixed and 3 μl were removed and added to the fourth dose. From the fourth dose 3 μl were removed and discarded. The plates were then covered and put in an incubator for four days at 37 °C.

Harvesting the plates

<u>Induction of AP</u>: The medium was flipped out of the plates into a sink. The cells were then washed three times with PBS medium (200 μl). This removed any contaminant from the media or plant material that could interfere with AP. Following the wash, the plates were placed face down on a paper towel to dry. Then 50 μl of Tris/Triton solution 100 mM Tris pH 9.8 plus 0.1% Triton were added to each well. The plate was covered and placed in an -80 °C freezer overnight. This procedure did not need to be sterile and therefore was not done in the hood.

<u>Toxicity</u>: The cells were harvested four days after adding the extracts. The medium was removed with vacuum because the cells are adherent and stay fixed to the bottom. The medium was removed to eliminate any compounds that might inhibit the enzymes before adding tetrazolenol salt (MTT). Fresh medium (IMEM phenol red-free, 100 µl) was added, then 15 µl of MTT. The MTT was warmed in a water bath for 15 minutes prior to adding it to the cells. The plate was placed in an incubator for 4 hours (could be left for less time if cells change color more quickly). Salt oxidized inside the cells and turned them blue, if the cells were dead they remained yellow. The stop solution (100 µl) was added to each well turning the solution blue. The cells were then left overnight in an incubator. This procedure was done in a hood to prevent contamination of the enzymes.

Readings

<u>Induction measurement</u>: The plates were removed from an -80 °C freezer and placed in an 37.5 °C water bath for 15 minutes to break open the cells. The plates were then removed from the water bath and 115 µl of para-nitrophenylphosphate solution was added to each well. The estrogenic activity was measured by reading the production of para-nitrophenol. If the test sample induced AP, the AP in the solution would cleave the phosphate group of the para-nitrophenylphosphate leaving only para-nitrophenol, which is yellow and can be measured.

The plate was covered and placed in a kinetic reader. The time was set for 15 minutes with interval readings at 30 seconds at 405 nm. The ELISA reader software provided a calculation of the slope for each well. The program calculated the slope as a measurement of the change in optical density (OD) over time. To measure induction, the percentage of induction was calculated by comparing the estrogen control using the formula below. A ten-fold increase (50 - 100%) was desirable.

Percentage of Induction = [Slope of compound – Slope of media/Slope of estradiol – Slope of media] x 100

Toxicity measurement: The plates were removed from the incubator and one reading was taken with the endpoint at 560 nm. Dead cells were yellow and living cells were blue. For toxicity, a decrease in cell growth of 50% or greater is desirable. The following formula was used to calculate the percentage of cell growth:

$$\text{Percentage of cell growth} = \frac{\text{Optical density of compound}}{\text{Optical density of media}} \times 100$$

A scatter plot was created in Excel and used to calculate IC_{50} values.

Results

The 12 plant samples tested did not show estrogenic activity nor cytotoxicity in the Ishikawa bioassay.

Discussion

This analysis was not able to corroborate the ethnobotanical data with laboratory studies. Factors that may have affected the results are that not all plant parts were tested for each species, and some plants were extracted as dried samples whereas others were extracted as fresh samples. Other factors that may explain the results are that perhaps the phytoestrogenic compounds in the tested plants are active only after they are metabolized as reported by other researchers (Miksicek 1994). The plants tested in the Ishikawa bioassay were often reported in herbal mixtures. Individual plants were tested in this analysis and, therefore, any synergistic effects of mixtures were not captured. The results are not surprising considering Pisha (1998), who tested 982 plant extracts for estrogenic activity and six showed estrogenic activity (1%) and six (1%) showed anti-estrogenic activity.

Studying medicinal plant activity is complex. The plants used for Dominican women's traditional medicine may function through different mechanisms that are not estrogenic or that are estrogenic but work via non-genomic pathways. To more rigorously test these plants, different plant parts could be assayed separately and together. Additional estrogen assays could be coupled with HPLC analysis to identify phytochemical constituents. In addition, the plants could be consumed and then the urine could be tested.

Conclusions

Research in phytoestrogens has increased dramatically in the last several years as seen by the numerous publications; however, many questions remain. Research is still needed to evaluate the safety of phytoestrogens on human systems, beneficial and harmful doses, gender differences in response to phytoestrogens, differences of chemical classes of phytoestrogens, and the effects phytoestrogens may have when combined with other drugs or dietary products. Due to the functional and structural differences of phytoestrogens, their biological activities are also highly variable, and there may be other effects that have not yet been studied.

Phytoestrogens are common in the human diet and able to exert many biological effects that have been observed in cell, animal, and human systems. The majority of these effects are seen as beneficial to our health, although contradictory effects have been shown and further research is needed to confirm these findings. Estrogenic compounds and their activities are complex and often species specific. The complexity of phytoestrogens suggests that interpretations need to be made with caution.

Table 6.1. Plants with estrogen receptor binding activity and activity in estrogen dependent breast cancer cell lines.

Order[a]	Family	Scientific Name (Common name)	Phytoestrogen (Class)	Literature
Rosales	Cannabaceae	*Humulus lupulus* L. (hops)	8-Prenylnaringenin (flavone)	(Dixon-Shanies and Shaikh 1999; Eagon *et al.* 1997; Hesse *et al.* 1981; Liu *et al.* 2001b; Milligan *et al.* 1999; Zava *et al.* 1998)
	Moraceae	*Maclura pomifera* (Raf.) C. K. Schneid.	(sterol or isoflavone)	(Maier *et al.* 1995)
	Moraceae	*Morus microphylla* Buckley	Not identified	(Maier *et al.* 1995)
Fabales	Fabaceae-Caesalpinoideae	*Senna obtusifolia* (L.) H. S. Irwin & Barneby syn. *Cassia obtusifolia* L.	Not identified	(Matsuda *et al.* 2001)
	Fabaceae-Mimosoideae	*Prosopis ruscifolia* Griseb.	Not identified	(Pisha 1998)
	Fabaceae-Papilionoideae	*Erythrina rubrinervia* Kunth	Not identified	(Pisha 1998)
		Glycine max (L.) Merr. (soy)	Genistein, daidzein, formononetin, biochanin A, glycitein (isoflavone), coumestrol (coumestan)	(Boue *et al.* 2003; Song *et al.* 1999; Zava *et al.* 1998)

Table 6.1. Continued

Order[a]	Family	Scientific Name (Common name)	Phytoestrogen (Class)	Literature
Fabales	Fabaceae-Papilionoideae	*Glycyrrhiza glabra* L. (licorice)	Glabridin (flavonoid), glabrene (isoflavene), isoliquiritigenin (flavonoid), licochalcone-A, 2′,4′,4′-three hydroxyl chalcone (chalcone)	(Rafi *et al.* 2000; Tamir *et al.* 2000, 2001; Zava *et al.* 1998)
		Kummerowia stipulacea (Maxim.) Makino	Not identified	(Pisha 1998)
		Medicago sativa L. (alfalfa)	Coumestrol (coumestan), apigenin (flavone), daidzein, genistein (isoflavone), secoisolariciresinol (lignan)	(Boue *et al.* 2003; Mazur 1998)
		Phaseolus vulgaris L. (bean)	Daidzein, genistein (isoflavone), secoisolariciresinol (lignan)	(Boue *et al.* 2003; Mazur 1998)
		Pueraria lobata (Willd.) Ohwi (kudzu)	Puerarin, daidzin, genistin, daidzein, and genistein (isoflavone), secoisolariciresinol (lignan)	(Boue *et al.* 2003; Mazur 1998)
		Strophostyles umbellata (Muhl. ex Willd.) Britton	Not identified	(Pisha 1998)

Table 6.1. Continued

Order[a]	Family	Scientific Name (Common name)	Phytoestrogen (Class)	Literature
Fabales	Fabaceae-Papilionoideae	*Tephrosia purpurea* (L.) Pers.	Not identified	(Pisha 1998)
		Trifolium pratense L. (red clover)	Genistein, daidzein, formononetin, biochanin A (isoflavone), coumestrol (coumestan)	(Boue *et al.* 2003; Liu *et al.* 2001b; Zava *et al.* 1998)
		Uraria lagopodioides (L.) Desv. ex DC.	Not identified	(Pisha 1998)
		Vigna radiata (L.) R. Wilczek (mung bean)	Coumestrol (coumestan), (isoflavone)	(Boue *et al.* 2003)
Malpighiales	Linaceae	*Linum usitatissimum* L. (flax)	Matairesinol, isolariciresinol (lignan)	(Adlercreutz *et al.* 1992)
Sapindales	Rutaceae	*Casimiroa edulis* La Llave ex. Lex.	Not identified	(Pisha 1998)
Malvales	Sterculiaceae	*Waltheria indica* L.	Not identified	(Pisha 1998)
	Thymelaeaceae	*Gnidia kraussiana* Meisn.	Not identified	(Pisha 1998)
Brassicales	Brassicaceae	*Brassica oleracea* L. (cabbage, brussel sprout)	Secoisolariciresinol (lignan)	(Ju *et al.* 2000; Mazur 1998)
Asterales	Asteraceae	*Gutierrezia microcephala* (DC.) A. Gray	Not identified	(Pisha 1998)

Table 6.1. Continued

Order[a]	Family	Scientific Name (Common name)	Phytoestrogen (Class)	Literature
Apiales	Apiaceae	*Angelica sinensis* (Oliv.) Diels (dong quai)	Not identified	(Dixon-Shanies and Shaikh 1999; Eagon *et al.* 1997)
	Araliaceae	*Eleutherococcus senticosus* (Rupr. & Maxim.) Maxim. (Siberian ginseng)	Not identified	(Pearce *et al.* 1982)
		Panax notoginseng (Burkill) Chow (San-chi or Tien-chan ginseng)	Ginsenosides Rg1 (saponin)	(Chan *et al.* 2002)
Solanales	Solanaceae	*Mandragora autumnalis* Bertol. (mandrake)	Not identified	(Zava *et al.* 1998)
Lamiales	Lamiaceae	*Ajuga genevensis* L.	Not identified	(Pisha 1998)
		Leonurus cardiaca L. (motherwort)	Not identified	(Zava *et al.* 1998)
		Thymus vulgaris L. (thyme)	Not identified	(Zava *et al.* 1998)
	Verbenaceae	*Verbena officinalis* L. (vervain)	Not identified	(Zava *et al.* 1998)
		Vitex agnus-castus L. (chasteberry)	Not identified	(Dixon-Shanies and Shaikh 1999; Liu *et al.* 2001b)
Gentianales	Apocynaceae	*Cerbera manghas* L.	Not identified	(Pisha 1998)
	Rubiaceae	*Coffea arabica* L. (coffee)	Matairesinol, secoisolariciresinol (lignan)	(Kitts 1987; Mazur *et al.* 1998)
		Uncaria tomentosa (Willd. ex Roem. & Schult.) DC. (cat's claw)	Not identified	(Salazar and Jayme 1998)

Table 6.1. Continued

Order[a]	Family	Scientific Name (Common name)	Phytoestrogen (Class)	Literature
Cornales	Loasaceae	*Mentzelia hispida* Willd.	Not identified	(Pisha 1998)
Saxifragales	Daphniphyllaceae	*Daphniphyllum calycinum* Benth.	Not identified	(Pisha 1998)
Caryophyllales	Cactaceae	*Opuntia humifusa* (Raf.) Raf.	Not identified	(Pisha 1998)
	Polygonaceae	*Fallopia multiflora* (Thunb.) Czer. syn. *Polygonum multiflorum* Thunb.	(anthraquinone)	(Matsuda *et al.* 2001)
		Polygonum cuspidatum Siebold & Zucc.	Emodin, emodin 8-*O*-β-D-glucopyranoside (anthraquinone)	(Matsuda *et al.* 2001)
		Rheum coreanum Nakai	(anthraquinone)	(Matsuda *et al.* 2001)
		Rheum officinale Baill.	(anthraquinone)	(Matsuda *et al.* 2001)
		Rheum palmatum L.	(anthraquinone)	(Matsuda *et al.* 2001)
		Rheum rhabarbarum L.	(anthraquinone)	(Matsuda *et al.* 2001)
		Rheum tanguticum Maxim. ex Regel	(anthraquinone)	(Matsuda *et al.* 2001)
		Rheum undulatum L.	(anthraquinone)	(Matsuda *et al.* 2001)
		Rumex acetosella L. (sheep sorrel)	Not identified	(Zava *et al.* 1998)
		Rumex crispus L. (yellow dock)	Not identified	(Zava *et al.* 1998)
Ranunculales	Papaveraceae	*Sanguinaria canadensis* L. (bloodroot)	Not identified	(Zava *et al.* 1998)

Table 6.1. Continued

Order[a]	Family	Scientific Name (Common name)	Phytoestrogen (Class)	Literature
Zingiberales	Zingiberaceae	*Curcuma longa* L. (tumeric)	Not identified	(Zava *et al.* 1998)
Commelinales	Commelinaceae	*Tradescantia virginiana* L.	Not identified	(Pisha 1998)
Arecales	Arecaceae	*Serenoa repens* (W. Bartram) Small (saw palmetto)	Not identified	(Di Silverio *et al.* 1992)
Liliales	Liliaceae	*Aloe arborescens* Mill.	Not identified	(Matsuda *et al.* 2001)
		Aloe ferox Mill.	Not identified	(Matsuda *et al.* 2001)
		Dracaena loureiri Gagnep.	5,7-Dihydroxy-3-(4-hydroxylbenzyl)-4-chromanone (homoisoflavone), 4,4'-dihydroxy-2,6-dimethoxy-dihydrochalcone (retrodihydrochalcone)	(Ichikawa *et al.* 1997)
Asparagales	Agavaceae	*Agave lecheguilla* Torr.	Not identified	(Pisha 1998)
		Yucca sp.	Not identified	(Zava *et al.* 1998)
Magnoliales	Annonaceae	*Anaxagorea luzonensis* A. Gray	8-Isopentenylnaringenin (prenylflavonoid)	(Kitaoka *et al.* 1998)

[a]Ordered by botanical orders according to phylogenetic tree in Daly *et al.* 2001.

Table 6.2. Dominican plants used for women's health with *in vitro* and *in vivo* estrogenic activity.

Order[a]	Family	Scientific Name {Voucher}[b]	No. of Field Reports	Phytoestrogen (Class)	Estrogenic Test[c]	Literature
Fabales	Fabaceae-Caesalpinoideae	*Cassia fistula* L. {R3, R78}	29	Not identified	UW	(Yadav and Jain 1999)
	Fabaceae-Papilionoideae	*Phaseolus vulgaris* L. {R139}	4	Formononetin, daidzein, genistein, secoisolariciresinol	ER, E2	(Boue *et al.* 2003; Franke *et al.* 1994; Mazur 1998)
		Glycine max (L.) Merr. {SR4}	2	Genistein, daidzein, formononetin, biochanin A, glycitein (isoflavone), coumestrol (coumestan)	ER	(Boue *et al.* 2003; Song *et al.* 1999; Zava *et al.* 1998)
Malpighiales	Linaceae	*Linum usitatissimum* L. {R164}	1	Matairesinol, secoisolariciresinol (lignan)	Not reported	(Adlercreutz *et al.* 1992)
	Euphorbiaceae	*Ricinus communis* L. {153, 201, R171, R172, R173}	34	Not identified	UW	(Okwuasaba *et al.* 1991; Sahasrabudhe 1945)
Sapindales	Rutaceae	*Citrus aurantium* L. {503}	9	Narigenin	ER	(Shiizaki *et al.* 1999)
		Casimiroa edulis La Llave & Lex. {307}	2	Not identified	AE (seed)	(Pisha 1998)

Table 6.2. Continued

Order[a]	Family	Scientific Name {Voucher}[b]	No. of Field Reports	Phytoestrogen (Class)	Estrogenic Test[c]	Literature
Malvales	Malvaceae	*Hibiscus rosa-sinensis* L. {451}	1	Not identified	UW	(Kamboj and Dhawan 1982; Kholkute *et al.* 1976; Murthy *et al.* 1997)
	Tiliaceae	*Tilia mandshurica* Rupr. & Maxim. {R108}	14	Not identified	UW (*Tilia cordata, T. platiflora*)	(Fontán-Candela 1960)
Brassicales	Brassicaceae	*Brassica integrifolia* (H. West) Rupr. {303}	2	3,3'-diindolylmethane	ER	(Riby *et al.* 2000; Shilling *et al.* 2001)
Myrtales	Myrtaceae	*Psidium guajava* L. {310, 443, PV132, PV145}	5	Secoisolariciresinol	Not reported	(Mazur 1998)
Asterales	Asteraceae	*Matricaria recutita* L. {R163, R72, R76}	123	Apigenin (flavone)	E2 (chamomile tea)	(Garrett *et al.* 1999; Rosenberg *et al.* 2001)
		Artemisia cf. *absinthium* L. {269}	13	Not identified	ER (*Artemisia anomale*)	(Li *et al.* 1992)

Table 6.2. Continued

Order[a]	Family	Scientific Name {Voucher}[b]	No. of Field Reports	Phytoestrogen (Class)	Estrogenic Test[c]	Literature
Apiales	Apiaceae	*Cuminum cyminum* L. {R135, R95}	11	Not identified	UW (seed), ER	(Adlercreutz and Mazur 1997; Charles *et al.* 2002; Malini and Vanithakumari 1987)
		Daucus carota L. {PV176}	5	Not identified	UW	(Kamboj and Dhawan 1982; Sharma *et al.* 1976)
		Foeniculum vulgare Mill. {326, 454, R5}	4	Not identified	UW (seed)	(Albert-Puleo 1980; Malini *et al.* 1985)
		Petroselinum crispum (Mill.) Nyman ex A. W. Hill {PV165}	5	6”-acetylapiin, petroside (flavone)	ER (aerial parts)	(Yoshikawa *et al.* 2000)
Solanales	Solanaceae	*Solanum americanum* Mill. {277}	2	Not identified	UW (*S. dulcamara*)	(Fontán-Candela 1960)

Table 6.2. Continued

Order[a]	Family	Scientific Name {Voucher}[b]	No. of Field Reports	Phytoestrogen (Class)	Estrogenic Test[c]	Literature
Lamiales	Acanthaceae	*Ruellia tuberosa* L. {160, 356}	54	Not identified	UW (*Ruellia praetermissa* Sceinf. ex. Lindau)	(Salah *et al.* 2002)
	Lamiaceae	*Salvia micrantha* Vahl {444}	6	Geraniol	UW (*S. lavandulaefolia S. miltiorrhiza*)	(Li *et al.* 1992; Perry *et al.* 2001)
	Verbenaceae	*Vitex agnus-castus* L. {130, PV121}	6	Not identified	ER	(Dixon-Shanies and Shaikh 1999; Liu *et al.* 2001b)
Gentianales	Rubiaceae	*Coffea arabica* L. {PV160}	58	Matairesinol, secoisolariciresinol (lignan)	Not reported	(Kitts 1987; Mazur *et al.* 1998)
Caryophyllales	Cactaceae	*Opuntia ficus-indica* (L.) Mill. {257, 274, PV53, PV72}	43	Not identified	AE (leaf, root, and stem of *Opuntia humifusa* (Raf.) Raf.)	(Pisha 1998)
	Chenopodiaceae	*Beta vulgaris* L. {PV168}	66	Not identified	UW (leaf)	(Elghamry *et al.* 1971)
	Polygonaceae	cf. *Rumex* sp. {R82}	18	Not identified	ER (*R. acetosella, R. crispus*)	(Zava *et al.* 1998)

Table 6.2. Continued

Order[a]	Family	Scientific Name {Voucher}[b]	No. of Field Reports	Phytoestrogen (Class)	Estrogenic Test[c]	Literature
Zingiberales	Zingiberaceae	*Zingiber officinale* Roscoe {PV167}	4	Not identified	ER	(Shiizaki *et al.* 1999)
Commelinales	Commelinaceae	*Tradescantia spathacea* Sw. {380, PV52}	6	Not identified	AE (entire plant of *Tradescantia virginiana*)	(Pisha 1998)
Liliales	Liliaceae	*Allium cepa* L. {R169}	3	Quercetin	UW (*A. porrum)*	(Fontán-Candela 1960; Franke *et al.* 2002)
Asparagales	Agavaceae	*Agave antillarum* Descourt. {241, 378, PV138}	79	Not identified	ER, E2 (entire plant of *Agave lecheguilla* Torr.); UW (*A. americana*)	(Fontán-Candela 1960; Pisha 1998)
		Yucca aloifolia L. {421}	5	Not identified	UW, ER (*Yucca* sp.)	(Fontán-Candela 1960; Zava *et al.* 1998)
	Asphodelaceae	*Aloe vera* (L.) Burm.f. {PV170, PV124, PV139, PV87, R105}	25	Not identified	ER (*Aloe arborescens*, *A. ferox*)	(Matsuda *et al.* 2001)

Table 6.2. Continued

Order[a]	Family	Scientific Name {Voucher}[b]	No. of Field Reports	Phytoestrogen (Class)	Estrogenic Test[c]	Literature
Laurales	Lauraceae	*Cinnamomum verum* J. Presl {R133}	76	Not identified	UW (*Cinnamomum* sp.)	(Nöding *et al.* 1950)

[a]Ordered by botanical orders according to phylogenetic tree in Daly, Cameron, and Stevenson 2001.
[b]All vouchers A. Ososki collection
[c]ER = estrogen receptor binding test, E2 = cell line that tests estrogenic activity, AE = cell line that tests anti-estrogenic activity, UW = uterine weight test

Chapter 7. Conclusions

Summary of findings

Use of traditional medicine for Dominican women's health care

This study focused on the use of medicinal plants by women and healers of the provinces of La Vega and San Cristóbal for a selected number of women's health conditions. A total of 205 plant species were reported for the treatment of 10 women's health conditions in four study sites. This research highlights the richness and diversity that exists for traditional Dominican medicine in rural and urban communities.

The health conditions that had the highest percentage of women who reported a remedy and the greatest number of reported traditional treatments were postpartum care and vaginal infections. The fact that the 10 health conditions are qualitatively different (i.e., some are illnesses or infections and others are part of a normal cycle) may suggest possible implications for the varied results in the number of reports and women familiar with remedies for each condition. In the case of postpartum care, which is not a health problem but a natural part of the pregnancy cycle, these results may suggest a prominent post-birth healing practice that has a long history in the Dominican Republic. The frequency of treatments reported for vaginal infections most likely refers to the prevalence of this health problem among Dominican women in these two provinces and that it is a condition that can affect women of all ages. The most widely reported traditional remedy was a *botella*, which was reported for all 10 conditions and was predominately used as a postpartum treatment. Sixteen plant species were reported in common by 45% of the 11 healers for the *botella*.

Studying the variation in ethnobotanical knowledge sheds light on several aspects of plant use: 1) it can reveal plants that have wide spread use suggesting cosmopolitan habitats and possible therapeutic effectiveness; 2) it may indicate distinct plants that are used in a specific community perhaps because they fulfill a cultural niche; and 3) it can demonstrate the range of ethnobotanical knowledge within a community. In this study, I used three hypotheses to examine differences and similarities in plant use knowledge. I compared rural and urban communities, generalists and specialists, and all study participants to further understand the distribution and role of medicinal plants in women's health in the Dominican Republic.

Ethnobotanical knowledge of study participants was compared using composition and frequencies of plant species, the percentage of individuals reporting remedies for a health condition, diversity indices, and an ethnobotanical knowledge index. I initially proposed that women in the urban communities would have a more diverse ethnopharmacopoeia than the rural communities due to better access to markets and people from other regions of the country and abroad. Based on the comparison of plants known and the percentage of participants that reported a plant/remedy for the 10 health conditions, this was not the case. The rural women in this study proved to hold a greater depth of knowledge about medicinal plants for women's health than urban women. There are several factors that may explain this difference. Based on my observations, rural women showed a greater reliance on their natural resources and were surrounded by tracts of native vegetation and cultivated land unlike urban women who may have had small home gardens or a plant market close by. Residents of rural communities had less access to modern medical facilities such as hospitals and clinics and therefore may have relied more on traditional medicine.

The survey results indicate that ethnobotanical knowledge of women's health in rural and urban communities varies; yet, there are similarities in the kinds of plant species used. This variation is patterned by demographic characteristics such as age and location of residence. I used an ANOVA to compare the individuals in the study sites (excluding healers) and found that there was more variation within each community than across communities. These results suggest that individual study sites are composed of more heterogeneous populations than I had originally expected. This pattern may indicate that individuals within a community were less likely to share ethnobotanical information with each other and perhaps prefer to use traditional medicines passed down from their own family members. The reliance on family members for health care is not surprising and confirms previous observations that traditional knowledge is often shared among kin (Boster 1986). Such information may be applied to effectively design culturally sensitive health care programs.

Differences and similarities were also apparent between generalists and specialists. Within each category of generalists and specialists, individuals tended to report similar herbal treatments suggesting more homogeneous populations. I used an ANOVA to compare the two groups and found that there was more variation between the groups than within each group. As would be expected, healers have greater knowledge than generalists about medicinal plants. Specialists were more familiar than generalists with remedies for all 10 conditions, particularly infertility. An individual healer was able to report a higher number of plant species for the 10 health conditions as compared with a generalist. While generalists tended to know that a *botella* could be used as a postpartum treatment, they often did not know the ingredients of this herbal preparation. These differences may be explained because plants and remedies known by specialists are used to treat rarer health conditions, or the plants may be more toxic and thus require particular skills or knowledge. However, the healers' pharmacopoeia is not necessarily exclusive of the generalists' pharmacopoeia. Both groups reported a number of plant species in common, and at least one study participant from both categories reported a remedy for each health condition.

In this study, I made preliminary observations about gender differences between male and female healers. Female healers often reported distinct herbal preparations and a greater number of remedies for each condition, whereas male healers tended to report the same remedies for multiple conditions and a smaller number of treatments for each health condition. One interpretation is that male healers rely on more powerful plants or remedies than their female counterparts as proposed by Quinlan (2000) or perhaps female healers have more refined or specialized knowledge for these conditions because they are women. Additional studies that include greater sample size and query about additional health conditions could provide data to further compare healing practices and gender.

Information collected during this project regarding herbal therapies for women's health in the provinces of La Vega and San Cristóbal suggests that there is erosion of traditional knowledge. This process is probably accelerated by better access to modern medical technologies and to reduced reliance on natural resources. Erosion of traditional knowledge of women's herbal medicines is more evident in the urban communities than in the rural communities. This was determined by comparing the number of plant species reported in each study site and the percentage of women reporting a remedy for a health condition. Plants reported in La Colonia and Los Calabazos account for the majority of the total species reported and a higher percentage of women in rural communities reported remedies for the health conditions than in the urban communities. Although the results suggest a lose of knowledge in urban communities for the majority of health conditions (except uterine fibroids), it is interesting to note the few cases of urban women who had acquired knowledge about new plant medicines through magazines.

Estrogenic activity and Dominican plants used for women's health

In this study, I reviewed the present state of research on phytoestrogens, plant compounds influential in women's health. I also examined selected Dominican plants for estrogenic activity using a literature review and laboratory analysis. Of the total plant species (*n* = 205) reported by study participants, 192 were evaluated for estrogenic activity using a literature review and 11 plants were tested using the Ishikawa bioassay. The literature review showed that 32 plant species had tested positively for estrogenic activity in previous studies. In this study it was not possible to identify a correlation between the plant species with greater consensus (numerous field reports) and those that had a large number of published studies. There was high variation in the number of field reports per species. For example, two species (*Linum usitatissimum* and *Hibiscus rosa-sinensis*) had single field reports, and one species (*Matricaria recutita*) had 123 field reports. It is challenging to corroborate these two data sets (field data and literature) because of the gaps that appear in the literature. These gaps can be interpreted in two ways. Negative data about a plant is often not published in scientific literature; the plant may have been tested for estrogenic activity but the results were not published. The other interpretation is that the plant had never been tested for estrogenic activity or for the presence of phytoestrogens. Comparing field reports with literature reports provides an approximate measure and may identify areas in need of further research.

I tested 11 of the 192 plants using the Ishikawa bioassay. None of the plant species showed signs of bioactivity. The negative results may be explained by the specificity of the bioassay, perhaps these plants treat women's health via different biological pathways. In addition, to accurately test traditional practices, the treatments reported by the study participants should be tested following the same preparation and administration as described in the field reports. However, this is not always possible or realistic. For example, I tested these plants individually even though the majority was used in herbal mixtures; therefore, I was unable to judge possible synergistic effects. The compounds may need to be metabolized to be active. Another factor is that plants are complex organisms that have a multitude of phytochemicals and biochemistry that may function differently depending on their environment. Environmental factors such as soil, climate, and pests may also influence levels of phytochemicals. The presence and concentration of compounds in plant material may vary by plant part and whether the material is tested fresh or dried. Plants in the wild may produce more phytoalexins or active secondary defense compounds than plants produced in cultivation.

Exploring different methodological approaches

Several methodological approaches were explored in this thesis: I used health conditions to elicit ethnobotanical information, tested ethnobotanical knowledge using an index, and applied ecological tests to ethnobotanical data. The mobile herbarium of digital photographs was a fairly effective method to confirm botanical identification of medicinal plants. Herbarium specimens lack color and dimension that make it difficult to recognize a living plant. Although not systematically tested against dried herbarium specimens, participants were more easily able to identify plants from photos than from dried herbarium specimens. The mobile herbarium of digital photographs was an easy way to transport plants and allowed me to work in urban areas where it was difficult to collect plants.

The ethnobotanical knowledge index provides a tool that can measure traditional knowledge using pre-selected variables. It offered a model to objectively evaluate individual knowledge and to determine the range of information gathered in a sample. In future studies, it could be modified to include additional variables that measure ethnobotanical knowledge as well as be applied to general traditional knowledge.

In this study I explored the usefulness of testing ethnobotanical data with two ecological forms of analysis. I explored diversity indices used in ecology as done by Begossi (1996) and Figueiredo *et al.* (1993) to evaluate medicinal plant use in the provinces of La Vega and San Cristóbal. The results of this technique provided a basis to compare communities. The challenge of using this form of analysis is that data can be interpreted from multiple angles. For example, low diversity of medicinal plants in a community may indicate traditional knowledge erosion or it may suggest specialization due to reliance on a few dominant species that have been selected perhaps based on their therapeutic effectiveness. The analysis of diversity provided an opportunity to consider other variables that affect knowledge diversity and to explore how knowledge diversity evolves.

Another ecological concept that I used to examine data from the survey was a modified 'species-area curve' which I refer to as the 'multiple species curve.' This technique offered an approximate estimation of the data that had been collected and helped gauge the needed sample size. The end points provide values that can be interpreted in data analysis and offer useful information on plant use and number of plant species known in a community or for a health condition. In future studies, the application of other ecological techniques may provide ethnobotanists with additional tools to interpret their data.

Applications and considerations

Public health care

Dramatic cuts in government spending on health in the 1980s and 1990s (Whiteford 1992) continue to affect the Dominican population. Reduced health resources have led various non-governmental organizations and community organizations to address the consequences of this reduction through workshops and seminars about alternative forms of health care. These groups have prepared and distributed health manuals compiled of traditional knowledge gathered from local communities (Colectivo de Salud Popular (COSALUP) 1990; Enda-Caribe 1993; Enda-Caribe and PROSAIN 1990, 1991; Instituto de Medicina Dominicana 1997, 1999). The traditional knowledge documented in this study may be applied to further support these efforts as well as to encourage the preservation of cultural practices, traditions, and Dominican identity.

In examining traditional medicine and medicinal plants, this study contributes to the knowledge of Dominican women's health care. As discussed in the initial chapter, studies that focus on women's health have tended to concentrate on reproductive aspects. During the surveys and interviews I tried to expand this focus and learn how Dominican women use traditional medicine to cope with a range of health conditions that affect women at different times in their life cycle. In this study, I advocated a broader consideration of women's health that took into account more than reproductive health and included the reliance on traditional remedies.

Health care programs that are initiated from a biomedical perspective tend to ignore the role of traditional medicine in health care. Defining health needs within a community can lead to more beneficial health initiatives and research agendas. Others have reported that to improve health for women and to develop effective health care programs, policies and research, it is imperative for the health community to first listen to women to determine local needs (Brems and Griffiths 1993). The grassroots-up approach can lead to more culturally sensitive and valuable treatment that addresses local needs of women and their communities, such as improved access to health care information and resources (Brems and Griffiths 1993).

More specifically, findings from this study can inform health care providers treating Dominican women about potential treatments that their patients may use. In addition, this study offers preliminary information on Dominican health beliefs and conceptualization of women's health conditions. Such data, when applied to community health efforts, can provide more culturally sensitive methods for handling diverse patient populations, potentially facilitate physician-patient communication, and contribute to improving the overall effectiveness of public health care. Perhaps, the results of this study may be more valuable to non-

Dominican physicians treating Dominican patients. For example, this study may inform physicians working with Dominican communities in New York City, which has the largest Dominican population (ca. 424,850 people) of any city in the United States according to the United States Census Bureau (2000).

Plants and women's health

In this study I reported on a number of plants used for women's health in the Dominican Republic that could be further evaluated for their therapeutic effectiveness and efficacy. Some of these plants have been investigated; however, additional laboratory studies could further examine these plants for their biochemical composition and pharmacological actions. Such information can suggest plants that are recommendable and safe to use, others that should be taken with caution, and those requiring further evaluation. A Dominican woman living in New York City, who gives workshops on traditional medicine to physicians, asked the question: why isn't traditional medicine tested using the same parameters as biomedicine? I hope this study will encourage additional research on traditional medicines used in the Dominican Republic using the biomedical model. This information can provide valuable information for individuals who continue to depend on herbal therapies for health care and at the same time furthers the preservation of this valuable knowledge.

Community resources

During my field work, I often had conversations with women about the possibility of selling medicinal plants or processed plant products for instance soaps, tinctures, or salves in urban medicinal plant markets, such as those in La Vega, San Cristóbal, Santo Domingo, and Santiago. These products could also be sold within a community. In La Colonia, a local non-governmental organization had started an animal husbandry project with women in the community as a way to generate additional income. Some women were raising pigs and others chickens. Medicinal plant cultivation may be another source of income. Cultivation of medicinal plants at home or in a community garden could serve as a commercial venture to raise funds for community associations and schools, may provide a sustainable medicine source for communities, or be used as an educational tool to teach children about medicinal plants. During the past few years, more research has been conducted on the cultivation of selected medicinal species (Balick *et al.* 2002; Ocampo Sánchez and Valverde 2000). These data could be modified and applied to medicinal plants in the Dominican Republic. Initial economic studies would be useful to evaluate the potential profit that could be gained from such an endeavor. There would be expenses, such as transportation costs to deliver plants and time involved to cultivate the plants. It may be difficult for women to take a full day to sell plants at a market. Perhaps, women in rural and urban communities could form a collective where rural women could provide plant resources and urban women could market them in cities.

It is imperative that researchers help local communities to both protect their environment and traditions as well as assist communities to improve their lives, health, and economic situations. This study provides a foundation of information that could be applied to community-based projects to help improve the overall living conditions of Dominican women. Particularly in rural communities, where women have limited access to job opportunities outside of their homes and could benefit from income generating projects.

Future research directions

In this study I have striven to contribute to the ethnobotany of the Caribbean by bringing various perspectives and analytical tools from a variety of fields (anthropology, botany, ecology, ethnobotany, ethnomedicine, and phytochemistry) to study traditional medicine and women's health in the Dominican Republic. My desire to study traditional women's medicine evolved from my interest to explore alternative forms of health care. Specifically, this study was shaped by my field work experience with Dominican healers in New York City and by reading ethnobotanical and ethnomedical studies. Through this study I have formulated several issues that could be further developed. My observations and the information that I gathered during my field work lead me to suggest that there are important areas of research in women's health of Dominican populations.

Future studies could address the flow of ethnomedical knowledge or ethnobotanical information, which is constantly being exchanged, incorporated, transferred, and appropriated as people adapt to new surroundings and new generations. Knowledge is acquired through multiple channels that have become blurred with the ease and rapid access to more information through Internet, decreased transportation costs to travel regionally and outside the country, and media sources. For example, several urban women interviewed in this study had learned about flax and soy by reading magazine articles and by listening to radio programs. They were reporting plant medicine, but can it be considered traditional medicine?

Knowledge is transferred at a much higher rate than ever before. For example, an urban woman mentioned learning about *noni* (*Morinda citrifolia* L., Rubiaceae) from the Internet. A waiter at a little cabana located in a remote beach town in the Dominican Republic rattled off the multiple uses of the same plant. I soon saw *noni* being sold in medicinal plant markets and on major highways. A healer in La Vega requested that I bring him seeds from Santo Domingo. Is this plant now part of Dominican traditional medicine? When did this Pacific Island medicine become a medicinal plant in the Dominican Republic? It was not reported as a medicinal plant in any of the general free-lists and was reported by one woman as a treatment for women's health, which leads me to propose that this is a recently introduced use for a plant that is part of the Dominican flora.

As the above examples illustrate, ethnobotanists are continually faced with new research challenges of how to describe, organize, and catalog healing knowledge and botanical information. Such changes encourage researchers to develop new models and systems to analyze their data. New categories perhaps need to be constructed for these kinds of field reports. In addition, researchers must continually re-evaluate their own biases and assumptions about the interactions of plants, people, and culture.

The Dominican Republic offers a unique population to examine these kinds of questions because of the strong transnationalism that exists. In addition, a limited number of publications have been written about the Dominican ethnomedical system suggesting the need to further understand, describe, and document this system, as well as examine how this system changes and evolves as it is transferred between New York City and the Dominican Republic. The large majority of Dominicans that I met either had been to New York City or had family or friends living in New York City. As people migrate back and forth between the Dominican Republic and New York City, they also transport ideas, healing practices, and in some cases medicinal plants. This is an exciting time and place to be conducting ethnobotanical studies because of the dynamic nature of plant and people interactions, which are constantly adapting to increasing technologies, varying social factors, and changing environments.

Appendix

Appendix A: Letter of support from Lic. Milcíades Mejía, Director of Jardín Botánico Nacional, Santo Domingo, Dominican Republic

JARDIN
BOTANICO NACIONAL
Dr. Rafael M. Moscoso
Fundado el 15 de Agosto de 1976

July 28, 1999

Andreana Ososki
Institute of Economic Botany
New York Botanical Garden
200 Southern Blvd.
Bronx, NY 10458-5126

Dear Andreana,

We are interested in your project "Medicinal plants and women's health care in the Dominican Republic." At the Jardín Botánico de Santo Domingo (JBSD), we are involved in many botanical projects, including economic botany. Several of these studies have focused on the use of medicinal plants in local communities and urban markets. In the Dominican Republic many people use medicinal plants for health care, although there are few in-depth studies documenting these plants and their uses. Your project could make an important contribution, both academically and for the communities, in the valorization and rescuing of traditional knowledge of medicinal plants. In addition, the results of your study will be valuable for future health plans, conservation plans, and potential economic plants for the committees.

Many community organizations, such as CONAMUCA and ENDA-caribe, are interested in women's health care in rural communities and will be able to facilate you with relations in the communities. As we had discussed, coordinating with one of these organizations will be helpful, and they can also aid you to disseminate the results of your study through educational workshops and seminars. Daisy Castillo, director of the Department of Botany at the garden, has worked with several community health organizations and could assist you with further contacts. Also you discussed your interest in toxicological studies. There is the possibility that Manuel Vasquez Tinero of QUIPRONA at the Universidad Autonoma de Santo Domingo, can provide you with laboratory facilities, when you begin to conduct your chemical studies.

We would be pleased to offer you the botanical support and the use of our Herbarium (JBSD) as a base of operation. We can assist you with the necessary scientific research permits. In addition we can provide you with botanical specialists and field assistants. There are plant dryers and freezers available for

Avenida República de Colombia esq. Avenida de Los Próceres • Los Jardines del Norte • Apartado 21-9 • Santo Domingo, República Dominica
Tels.: (809) 567-6211 / 13 • Faxes: (809) 563-2525 / (809) 562-3046 • E-mail: ja.botanico@codetel.net.do.

your specimens as well as the herbarium and library collections to aid you in your research and plant identification.

As we discussed, you will increase our herbarium and living collection by providing quality vouchers from your studies which will be databased and maintained at JBSD. In addition vouchers will be maintained and databased at the New York Botanical Garden. A copy of your thesis will be deposited at the JBSD library as well as the publication of your results in the scientific journal of JBSD, Moscosoa. The participation of technicians of JBSD will also participate in your study. As we had discussed you will also provide us with assistance in databasing specimens and books of JBSD and donating any herbarium equipment or materials from your study when you finish which will facilatate our studies.

We welcome you to conduct your year long project beginning next year, August 2000 in the Dominican Republic and will act as your national couterpart. We look forward to further correspondence.

Sincerely,

LIC. MILCIADES MEJIA
DIRECTOR GENERAL
JARDÍN BOTÁNICO DE SANTO DOMINGO

Appendix B: Letter of support for plant permits from Lic. Milcíades Mejía, Director of Jardín Botánico Nacional, Santo Domingo, Dominican Republic

Ososki, Andreana

From:	Jardin Botanico Nacional [jardin.botanico@codetel.net.do]
Sent:	Tuesday, March 14; 2000 8:16 PM
To:	aososki@nybg.org
Subject:	RE: Miliciades Mejia

Sra. Andreana Ososki
New York Botanical Garden
USA

Estimada Andreana:

Pláceme saludarle y a la vez dar respuesta a su comunicación de fecha 8-3-2000, en la cual nos expresa su interés en obtener los permisos de colecta de plantas para su investigación de tesis doctoral.

En cuanto a los permisos, puede usted decir a la universidad que su investigación es apoyada por el Jardín Botánico Nacional de Santo Domingo, que es una institución oficial de la República Dominicana, por lo que las muestras colectadas serán manejados en el Herbario Nacional de Santo Domingo (JBSD) desde donde serán enviados a USA, según las normas y reglas de la Rep. Dom. y como intercambio con el NYBG.

En caso de que necesite algún permiso especial para alguna área protegida de la Rep. Dom., el Jardín Botánico Nacioanal le ayudará a usted a tramitar dicho permiso de manera institucional.

En lo referente a su visado, le recomendamos que se comunique con el Consulado Dominicano en New York, para que le den las informaciones, pues lamentablemente no tenemos informaciones al respecto.
Cuando hable con el personal del consulado hagale referencia de que usted estará desarrollando su investigación en coordinación y con el apoyo del Jardín Botánico de Santo Domingo.

Atentamnete,

Lic. Milcíades Mejía
Director General

Appendix C: Letter of support from Lic. Daisy Castillo, Director of Botany Department, Jardín Botánico Nacional, Santo Domingo, Dominican Republic

JARDIN
BOTANICO NACIONAL
Dr. Rafael M. Moscoso
Fundado el 15 de Agosto de 1976

Santo Domingo, D. N.
31 de agosto, 1999.

Srta. Andreana Ososki
New York Botanical Garden
Bronx, New York
USA

Fax: (718)220-6504

Distinguida Srta. Ososki:

Cortésmente, tengo a bien dirigirme a usted con la finalidad de comunicarle, que estamos en la mejor disposición de ayudar a contactar las organizaciones gubernamentales y no gubernamentales (ONG'S) de nuestro país, para que le permitan desarrollar su trabajo en la República Dominicana.

Sin otro particular, queda de usted.

Atentamente,

DCastillo
LIC. DAISY CASTILLO
Directora Depto. Botánica

DC/ic

Avenida República de Colombia esq. Avenida de Los Próceres • Los Jardines del Norte • Apartado 21-9 • Santo Domingo, República Dominicana
Tels.: (809) 567-6211 / 13 • Faxes: (809) 563-2525 / (809) 562-3046 • E-mail: ja.botanico@codetel.net.do.

Appendix D: Letter of support from Librada Dionico, General Coordinator of Confederación Nacional de Mujeres del Campo, Dominican Republic

Confederación
Nacional
de Mujeres
del Campo
CONAMUCA
Ave. Independencia No. [illegible]
Zona Universitaria
Sto. Dgo., D. N.
Tel.: 686-7617
Fax: (809) 682-0079
Apartado Postal 907-2 FERIA

Santo Domingo, Rep.Dom.-
13 de Septiembre de 1999.-

Compañera :
Andreana Ososki
Ciudad.-

Apreciada Amiga :

Recibe saludos de nuestra parte, nosotras todas estamos bien, esperamos que tu lo esté también, en contestación a tu carta del 1ero de Septiembre, te expresamos que si , podemos trabajar contigo en el futuro y nuestras sugerencias sobre el Proyecto.-

Podemos ayudarte a establecerte en nuestro pais, en varias comunidades, en las cuales nuestra organización tiene trabajo, podriamos localizarte la zona de trabajo que acertadamente necesita estos conocimientos y de la aplicación del proyecto, ya que en las comunidades rurales es que más se siente la necesidad de la implementación de la medicina natural; debido a la escasé de recursos económicos para atender a la salud , además que contamos con los recursos (Plantas medicinales), para la elaboración de la medicina natural y para la ejecución del mismo.-

Esperamos que esta sea una buena noticia para ti.-

Atentamente,

Librada Dionicio
Coordinadora General

Appendix E: Approval of City University of New York Graduate Center Institutional Review Board for Human Subjects, 2000-2001

THE GRADUATE CENTER
THE CITY UNIVERSITY OF NEW YORK

Office of the Vice President for Research and Sponsored Programs

Committee on the Protection of Human Subjects

The Graduate School and University Center
The City University of New York
365 Fifth Avenue
New York, NY 10016-4309
TEL 212.817.7523 FAX 212.817.1629

July 19, 2000

Andreana Ososki
(Biology)

Re: Proposal No. 6-01-06-00 • "Medicinal Plants and Women's Health Care in the Dominican Republic"

Dear Ms. Ososki:

The Committee on the Protection of Human Subjects reviewed and approved the revisions to the Spanish language flier and consent forms on your above-referenced proposal.

This approval is effective for one year and your proposal must be reviewed annually should your research extend beyond one year. Please be advised that any changes made to your proposal must receive Committee approval.

Enclosed is the dated consent form which must be used in obtaining consent.

Sincerely,

Kay Powell

Kay Powell
For the Committee

c: Michael Balick

Please return one copy of this letter to my attention at the above address:

By signing below, I acknowledge that I have received this letter and am aware of and agree to abide by all of its stipulations in order to maintain active approval status, including prompt reporting of adverse events/serious problems and annual continuing review. I am aware that it is my responsibility to be knowledgeable of all federal and state regulations including CUNY's Multiple Project Assurance (MPA) with the Department of Health and Human Services.

Andreana Ososki ________ August 2000
Signature Date

Appendix F: Approval of City University of New York Graduate Center Institutional Review Board for Human Subjects, 2001-2002

Office of the Vice President for Research and Sponsored Programs

Committee on the Protection of Human Subjects

The Graduate School and University Center
The City University of New York
365 Fifth Avenue
New York, NY 10016-4309
TEL 212.817.7523 FAX 212.817.1629

Date: July 25, 2001

To: Ososki, Andreana (Biology)

STUDY: 6-10-06-01 • "Medicinal Plants and Women's Health Care in the Dominican Republic" Continuing.

The Institutional Review Board (IRB) of The Graduate Center of the City University of New York has approved the above study involving humans as research subjects. This study was approved through **expedited review based on 45CFR46.110a(9).**

IRB Number: *(IRB#6-10-06-01)* **This number is an IRB number at The Graduate Center which should be used on all consent forms and correspondence.**

Approval Date: *July 24, 2001* **Expiration Date:** *July 23, 2002*

This approval is for a one-year period. You should receive a courtesy renewal notice approximately four weeks before the expiration of this project's approval. However, it is your responsibility to insure that an application for continuing review approval has been submitted by the required time. In addition, you are required to submit a final report of findings at the completion of the project.

Consent Form: The approved and stamped consent form must be used by all subjects. You are responsible for maintaining signed consent forms for a period of at least three years after study completion.

Reporting: The principal investigator must report to the IRB any serious problem, adverse effect, or outcome that occurs with frequency or degree of severity greater than that anticipated. In addition the principal investigator must report any event or series of events that prompt the temporary or permanent suspension of a research project involving human subjects.

Modifications: All modifications of protocols involving subjects must have prior approval except those involving the prevention of immediate harm to a subject which need to be reported within 24 hours to the IRB.

If you have any questions, please do not hesitate to contact me through the IRB Office at 817-7525.

Sincerely,

Richard G. Schwartz, Ph.D.
Chairperson, IRB

Please return one copy of this letter to the attention of Kay Powell at the above address:

Verification: By signing below, I acknowledge that I have received this letter and am aware of and agree to abide by all of its stipulations in order to maintain active approval status, including prompt reporting of adverse events/serious problems and annual continuing review. I am aware that it is my responsibility to be knowledgeable of all federal and state regulations including CUNY's Multiple Project Assurance (MPA) with the Department of Health and Human Services.

Andreana Ososki August 2001

Signature of Principal Investigator Date

Appendix G: Oral consent form

Ph.D. Program in Biology

The Graduate School and University Center
The City University of New York
365 Fifth Avenue
New York, NY 10016-4309
TEL 212.817.8100 FAX 212.817.1504

Información para el participante

Mi nombre es Andreana Ososki y soy una estudiante del Departamento de Biología de la Escuela de Graduados de la Universidad de la Ciudad de Nueva York (CUNY). Estoy realizando un estudio sobre la salud de la mujer y las plantas medicinales. El objectivo de mi estudio es hacer una lista de remedios naturales que se usan para la salud de la mujer en la República Dominicana. Espero que este proyecto aumente el conocimiento de la medicina popular para la salud de la mujer y la apreciación sobre la importancia de preservar la medicina popular y las áreas donde las plantas medicinales son colectadas.

Me gustaría que me permitiera entrevistarla/lo sobre su uso de hierbas medicinales. Esta entrevista va a durar aproximadamente una hora. Si, en cualquier momento, usted quiere terminar esta entrevista y dejar de participar en este estudio, por favor, déjemelo saber. Recuerde, su participación es voluntaria, pero espero que conteste el máximo de preguntas que pueda.

Si usted lo permite, me gustaría tomar notas y grabar la entrevista, así yo puedo documentar correctamente la información. Durante este estudio cualquier información sobre usted va a ser confidencial. Los casetes y las notas escritas van a tener una marca con un número de identificación. Mis profesores y yo vamos a ser las únicas personas con acceso a estos casetes, que estarán guardados en un archivo con llave. En cualquier momento, usted puede revisar los casetes y decidir si se pueden o no usar en el estudio.

Usted no corre ningún riesgo, ya que toda la información va a ser confidencial; sin embargo, tal vez se sienta incómoda/o al responder algunas preguntas sobre la salud de la mujer. Su participación va a ayudar a aumentar la información sobre medicina popular usada para la salud de la mujer. Los resultados de este estudio quizás sean publicados, pero no se darán nombres o detalles. Si quiere una copia del estudio, por favor, déme su dirección y le mandaré una copia en el futuro.

Si usted tiene preguntas sobre el estudio, contácteme al (809)385-2611 o a aososki@nybg.org. También puede comunicarse con mi profesor, Michael Balick, Ph. D. al (718)817-8763 o a mbalick@nybg.org. Si tiene preguntas sobre sus derechos como participante en este estudio, contacte a Hilry Fisher, Sponsored Research, City University of New York (212) 817-7523 o a hfisher@gc.cuny.edu.

Muchas gracias por su interés y participación en este estudio.

Graduate School & University Center / CUNY
IRB
Approved
Approved: 4/24/00 To Expired: 4/25/01

Appendix H. Non-herbal ingredients for women's medicine in the Dominican Republic.

Non-herbal ingredient [English] {Voucher}[a]	Use[b]	Preparation
Acido borico [boric acid] {R146}	1	Add to boiled water for vaginal wash
Aqua bendita [holy water]	8	Add to fresh plant juice
	10	Add to coffee
Aguardiente blanco [alcoholic beverage] {PV163}	4	Mix with a little bit of chalk and drink
Alcanfor [camphor] {R152}	5,6,8,10	Leave in water
Alcohol [alcohol]	2	Smell
Alumbre [alum] {R107}	1,4	Add after boiling plant mixture
	3	Put in *cerveza malta*
Aspirina [aspirin]	4,5,10	Make powder and take with *cerveza malta*
Azucar [sugar] {PV161}	1,2,3,6,7	Boil it and use as part of *botella* preparation
	4,5,9	Boil in tea or add to juice
	4	Add to water, make syrupy juice
Azucar de leche [lactose]	9	Make a beverage
Bicarbonato [sodium bicarbonate]	9	Add to coconut water and drink
Bocarax {R106}	1	Mix with water
	1,2,5,6,7,9	Add to plant mixture
Calcio [calcium] {R158}	6,7,10	Add after boiling plant mixture
Cerveza alemana, malta alemana cerveza negra, cervezita [malted barley beverage] {PV172}	6,7,10	Add after boiling plant mixture
Cerveza India, Malta India [malted barley beverage] {PV171}	6,10	Add after boiling plant mixture

Non-herbal ingredient [English] {Voucher}[b]	Use[a]	Preparation
Cerveza Morena, extracta de malta, trata de malta, malta, Malta Morena [malted barley beverage] {PV170}	2,3,5,6,8,10	Add after boiling plant mixture
	6	Take with castor oil
	10	Take with aspirin or with *manzanilla* (*Matricaria recutita*)
Compuesto Vegetal [manufactured tincture] {R110}	6,10	Purchase and take as is
Forte Man [vitamin liquid]	10	Purchase and take as is
Ginebra [gin] {PV173}	1,6,7,8,10	Add after boiling plant mixture
	5	A shot with salt
Hierro [iron] {R147}	1,2,5,6,7,9,10	Add after boiling plants or boil with plant mixture
Huesos de culebra [snake bones]	8	Make a necklace with bones
Huevo [egg]	2	Boil it
	4	Boil it
	7	Leave raw egg in lime juice
Jicotea [turtle]	2	Make a soup or add to wine
Leche de burra [mule's milk]	10	Drink
Leche de chivo [goat's milk]	4	Drink with *algarroba* (*Hymenaea courbaril*)
Leche de magnesia [milk of magnesia] {R156}	4,9	Add to water with sugar
Mentol [menthol] {R157}	1	Add to water and use as vaginal wash
Miel de abeja [honey] {PV174}	1,2,5,6,7,10	Boil it and use as part of *botella* preparation or add after plants have been boiled
	8	Blend with beet juice
Moscota [notebook paper]	4	Burn it
Ollin [ashes]	10	Add to coffee and steep
Pan [bread]	2	Eat dipped in red wine
Paramo	6,7,10	Boil for tea

Non-herball ingredient [English] {Voucher}[b]	Use[a]	Preparation
Permanganato de potasio [potassium permanganate]	1,2,5,6,7,9	Add after boiling plants
Ron blanco [white rum] {PV163}	3,6,7,9,10	Add after boiling plant mixture
Sal [salt] {PV158}	1,2,4,5,9,10	Add to *Malta Morena*, gin, or plant mixture
Tela [fabric]	10	Boil for tea
Orines [urine]	2	Add urine from father of baby to *malta* or coca cola and drink; rub on belly button
Vinagre blanco [white vinegar] {PV159}	1	Mix with water
Vino tinto [red wine]	1,6,7,10	Add after boiling plants
	4	Burn cork, add to wine
Vitamina [vitamin]	9,10	Purchase and use as is

[a]All numbers are A. Ososki collections (PV=photo voucher, R=reference collection)

[b]1 = vaginal infections, 2 = morning sickness, 3 = pregnancy prevention, 4 = excessive menstruation, 5 = menstrual cramps, 6 = postpartum care, 7 = infertility, 8 = uterine fibroids, 9 = hot flashes, 10 = suspended menstruation

Appendix I. Resampling Stats program by Dr. Dwight Kincaid, Department of Biological Sciences, Lehman College, City University of New York.

```
Start execution.

species_diversity.sta
'Species diversity indices after Simpson
'and Shannon-Weiner, plus evenness. By boot-
'strapping species list, we get confidence
'intervals of Simpson and Shannon indices.
'
'A Resampling Stats program by Dwight Kincaid
'
' Forest trees in PA by Hough(1936) as in Krebs(1989)
DATA 1,11 species ' 11 species
DATA (1940 1207 171 134 97 93 34 22 15 7 4) number '
occurrences of each species
SIZE species richness
SUM number cases
'=========================================================
'============== get Simpson index & evenness ============
'=========================================================
'
DIVIDE number cases p
MULTIPLY p p p_square
SUM p_square Simpson ' Simpson's (1949) original formula
let Simpson = 1 - Simpson ' Simpson diversity
let p1 = 1/richness
MULTIPLY p1 p1 p_square
SUM p_square D_max
let D_max = 1 - D_max
let SIMPeven = Simpson/D_max
'===========================================================
'============= get Shannon-Weiner index & evenness ========
'===========================================================
'
LOG p p_log ' natural log of proportions
MULTIPLY p p_log temp1
SUM temp1 temp2
let Shannon = -1 * temp2 ' Shannon-Weiner diversity
let H_max = LN(richness)
let evenness = Shannon / H_max ' range 0 to 1
PRINT richness cases
PRINT Simpson D_max SIMPeven
PRINT Shannon H_max evenness
' source code continued on next page
```

```
'==============================================================
'============== bootstrap the species list ==============
'==============================================================
'
MAXSIZE Simpson$ 1000000 Shannon$ 1000000
let NS = 1000000
REPEAT NS
GENERATE richness 1,richness pointer$ ' maintain case
correspondence
TAKE species pointer$ species$
TAKE number pointer$ number$
'DEDUP species$ temp$ ' cull repeated species <= not
necessary
'SIZE temp$ rich$ ' count species <= not necessary
SUM number$ cases$
DIVIDE number$ cases$ p$
MULTIPLY p$ p$ p_sq$
SUM p_sq$ temp
let temp = 1 - temp ' Simpson diversity
SCORE temp Simpson$
' Shannon
LOG p$ p_log$ ' natural log of proportions
MULTIPLY p$ p_log$ temp1
SUM temp1 temp2
let temp = -1 * temp2 ' Shannon-Weiner diversity
SCORE temp Shannon$
END
HISTOGRAM Simpson$
MEAN Simpson$ mean$
MIN Simpson$ min$
MAX Simpson$ max$
PERCENTILE Simpson$ (2.5 97.5) CI_95 ' 95% confidence
interval
PRINT NS mean$ min$ max$ Simpson CI_95
HISTOGRAM Shannon$
MEAN Shannon$ mean$
MIN Shannon$ min$
MAX Shannon$ max$
PERCENTILE Shannon$ (2.5 97.5) CI_95 ' 95% confidence
interval
PRINT NS mean$ min$ max$ Shannon CI_95
' end of species_diversity.sta
'

RICHNESS =         11
```

CASES = 3724

SIMPSON = 0.61872

D_MAX = 0.99174

SIMPEVEN = 0.62388

SHANNON = 1.2677

H_MAX = 2.3979

EVENNESS = 0.52867

Vector no. 1: SIMPSON$

Bin Center	Freq	Pct	Cum Pct
0.05	1	0.0	0.0
0.1	82	0.0	0.0
0.15	438	0.0	0.1
0.2	1736	0.2	0.2
0.25	5021	0.5	0.7
0.3	12436	1.2	2.0
0.35	24445	2.4	4.4
0.4	38429	3.8	8.3
0.45	47841	4.8	13.0
0.5	47423	4.7	17.8
0.55	63183	6.3	24.1
0.6	151776	15.2	39.3
0.65	137754	13.8	53.1
0.7	172518	17.3	70.3
0.75	125107	12.5	82.8
0.8	90986	9.1	91.9
0.85	73720	7.4	99.3
0.9	7104	0.7	100.0

Note: Each bin covers all values within 0.025 of its center.

NS = 1e+006

MEAN$ = 0.64711

MIN$ = 0.066423

MAX$ = 0.90531

SIMPSON = 0.61872

CI_95 = 0.33864 0.8591

Vector no. 1: SHANNON$

Bin Center	Freq	Pct	Cum Pct
0.2	12	0.0	0.0
0.4	724	0.1	0.1
0.6	7406	0.7	0.8
0.8	34051	3.4	4.2
1	102548	10.3	14.5
1.2	229286	22.9	37.4
1.4	292456	29.2	66.6
1.6	178828	17.9	84.5
1.8	68645	6.9	91.4
2	65578	6.6	98.0
2.2	20255	2.0	100.0
2.4	211	0.0	100.0

Note: Each bin covers all values within 0.1 of its center.

NS = 1e+006

MEAN$ = 1.405

MIN$ = 0.22023

MAX$ = 2.3768

SHANNON = 1.2677

CI_95 = 0.82728 2.083

Successful execution. (401.7 seconds)

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