

About the Editors



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David Picking, Ph.D. came to Jamaica as a Commonwealth Scholar, completing his doctorate in biochemistry at The University of the West Indies (UWI), having previously graduated as a medical herbalist and naturopath from the University of Westminster’s School of Integrated Health, London. David is currently a Research Fellow at the Natural Products Institute, UWI, where his research focuses on the contemporary use of medicinal plants by Jamaicans and screening medicinal plants for their potential interaction with pharmaceutical drugs, a key aspect of medicinal plant safety. David was part of a team that successfully undertook a TRAMIL survey and completed Jamaica’s first contribution to the TRAMIL database and online plant pharmacopeia (www.tramil.net), adding to the body of knowledge from over 50 surveys completed across the Caribbean to date (the name TRAMIL is derived from “Traditional Medicines in the Islands”).

This book is for educational purposes only.



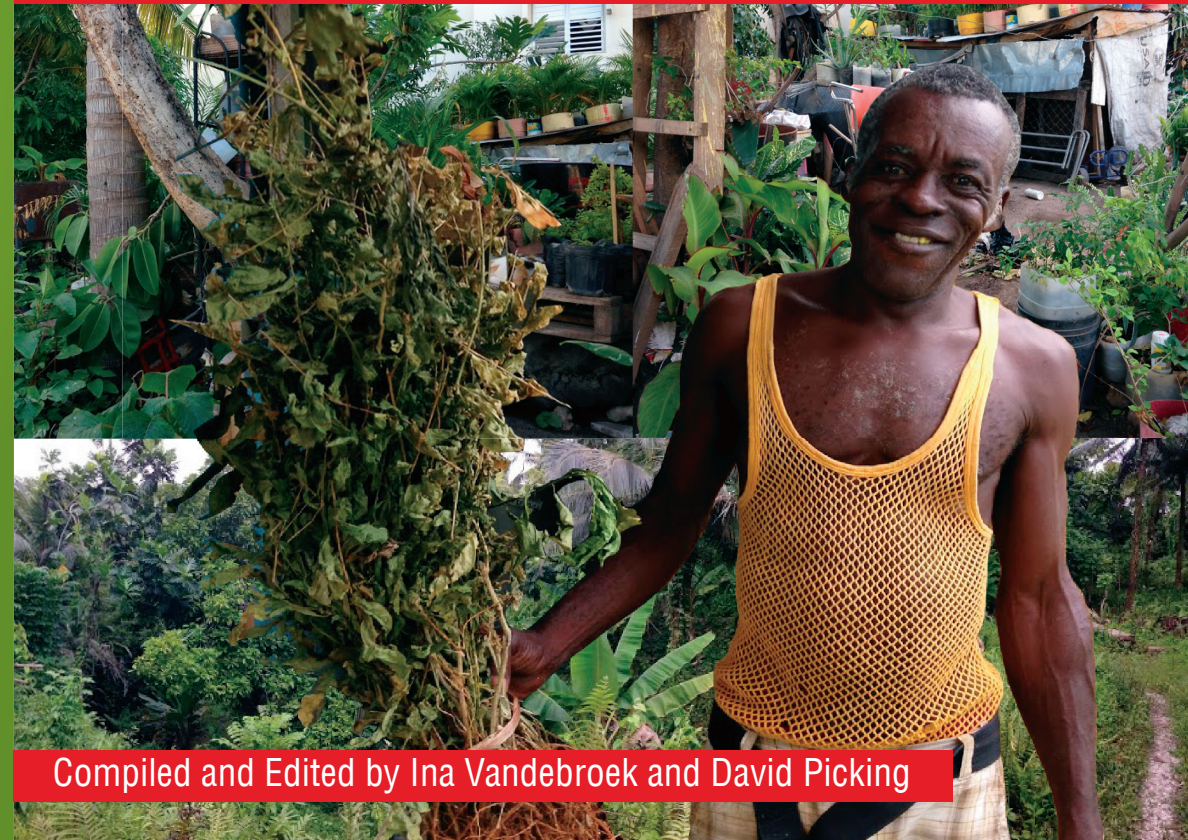
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Popular Medicinal Plants in Portland and Kingston, Jamaica

Compiled and Edited by Ina Vandebroek and David Picking



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Contributors: The editors greatly acknowledge the valuable assistance of the following scientists in making this research project a success and would like to extend special gratitude to them for their contributions: **Stacey Aiken**, M.Sc. helped with fieldwork in Kingston. **Patrick Albert Lewis**, M.Sc., **Andreas Oberli**, B.Sc., **Richard Abbott**, Ph.D. and **Robbin Moran**, Ph.D. were always there to assist with plant identification. **Sylvia Mitchell**, Ph.D. oversaw the project in Jamaica and advised on the plant monographs together with **Rupika Delgoda**, Ph.D. **Brian Boom**, Ph.D. oversaw project progress at The New York Botanical Garden and advised together with **Elizabeth Kiernan**, B.Sc. on GIS conservation analysis of Jamaican plant species.

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Acknowledgments

As humans, we excel when we put our strengths together. The richest collaborations are those that transcend boundaries. Regardless of field of occupation or culture, they bring together like-minded individuals, who are driven by a similar passion for what they do, even when they grew up on opposite sides of the planet. The wisdom that complements us is like a puzzle, one that can only be solved when all the pieces, held by different individuals, come together.

Wisdom of plants comes in many forms. The farmer, man or woman, who works the land stands each day in a living and breathing laboratory. Just like the student who attends school to learn, the bush is a very powerful teacher. The farmer observes the seasons, sky and stars, phases of the moon, and the behavior of the animals in the bush. Learning about plants is so much more than just learning about plants. It is ultimately about learning how humans, plants, and the environment depend on each other for survival. The farmer understands that humans are but a speck in the web of life. Even without an official degree, farmers have already graduated with honors from bush school, and - faced with continuous challenges brought about by climate change, drought, crop failure or illness - continue to deepen their wisdom every day.

When I first arrived in Windsor Forest in Portland parish in July 2010, I went on a bush trip with Juney (Edna Percy). We climbed a hill, and there, overlooking a green oasis of bush in front of us,

Juney asked me “isn’t this beautiful?” I knew then and there that I wanted to learn more about the plants growing in those mountains, and their uses. I wanted to know if other people like Juney, who roamed the bush and worked the land, loved their hills so much.

The National Geographic Society supported this idea, and collaborators from Jamaica and the University of the West Indies partnered to develop it further. Together we embraced the opportunity to do research about plants and people in Kingston as well, to better understand the rural-urban connections of plant knowledge and use. Ultimately, all this work has resulted in this book. Collaborating with the University of the West Indies, Mona Campus, has been an incredibly rewarding experience.

So in 2016, here we are, and we could not have done this without you. Thank you, Juney, for taking me up that mountain in 2010. Thank you, Calvin, for being such a great cook of real Jamaican food, and for making me laugh with your stories. Thank you Peter, for taking me deep into hills to look for blossoms on vines way up in the trees, and for your incredible wisdom about plants. The same goes for Dalman and many others. Thank you, Enny Penny, for rhyming about the bush like no one else. Remember, Straw, that I am looking forward to your spoken-word performance. Thank you, Jason, for being the best shoulder to lean on and for watching over me in so many ways. Thank you, Professor Davidson, for connecting us with the community

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My parents have instilled in me a sense of wonder for nature since I was a baby who proudly posed in front of the camera holding a little daffodil, even though I could barely walk. Jos and Rosa Vandebroek-Verhoeven were the first organic kitchen-garden farmers in my life. They continue to be so today, at the age of seventy-six and seventy-two. Their straightforward and firm position in life has given me the endurance to take on any task.

Michael J. Balick, Ph.D. continues to be a great source of inspiration to me. He carries forward the legacy of the founding father of modern ethnobotany, Richard Evans Schultes, Ph.D. It is a privilege to keep learning from his field experiences and wisdom.

This book is dedicated to the people of Jamaica, their stories, their humor, their language, their creativity and skills, and last but not least, their knowledge of plants for medicine, roots tonics and culinary delights. May you always carry forward the melodic Patois language

about the bush, and its secrets, held by the moon and the stars.

It is my sincere hope that this book will stimulate Jamaican youth to follow in the footsteps of their farming relatives, and learn from them as much as I did. Lesson number one, always walk with a clean heart, watch the moon, and don't forget to drink your jelly water. The true riches of Jamaica are in the land. This land will require continued attention and protection from the government and the community to enable it to continue to be as precious as it is today.

Ina Vandebroek, 12 May 2016.

Windsor Forest, Portland Parish.

Introduction

The flora of Jamaica is quite rich and diverse, with 3,218 distinct species and varieties of seed plants. The country's flora has a high degree (34 percent) of endemism, a term referring to plants that only occur in Jamaica and nowhere else (Acevedo-Rodríguez and Strong, 2008). Seventy-three percent of Jamaicans popularly use medicinal plants to treat illness and maintain health (Picking et al., 2011); and at least 334 species growing in Jamaica have been identified as medicinal plants (Mitchell and Ahmad, 2006).

Medicinal plants in Jamaica are commonly called “bush medicines”, regardless of their habit as herbs, shrubs, trees, grasses or vines. This book is a compilation of cultural and scientific information on 25 popular medicinal plants that are used today in urban Jamaica (Payne Land, Kingston) and rural Jamaica (Windsor Forest, Portland parish). It is the result of ethnobotanical research carried out in 2014 and 2015, during which we interviewed 79 people in Payne Land and 40 people in Windsor Forest about their knowledge and use of medicinal plants. Information from interviews was entered into databases to record common plant names, and the medicinal uses of these plants. Subsequently, fieldtrips were made with knowledgeable people in the surrounding areas of the communities to collect plants, make herbarium specimens, and identify the botanical names of these plants, a methodology called botanical authentication.

The goal of this research was to preserve

people's cultural knowledge about plants, use this information as a tool to educate the next generations, and ultimately draw attention to the importance of biological diversity in Jamaica. The information gathered in the field through original research was supplemented with a review of the scientific literature concerning the safety of use and clinical effectiveness of the collected plants.

Even though the specific focus of this research project was on medicinal plants and their uses to treat health problems, it soon became clear at the start of the project that people possess a much broader knowledge base about plants. This knowledge transcends a narrow focus on medicines and health, including the use of plants for spiritual purposes, as regular teas and wild foods, as utensils and tools, and to maintain healthy animals. These uses are listed in the book under “cultural uses and beliefs”, as they embody important cultural dimensions of plant knowledge. As such, this cultural knowledge adds depth to medicinal plant use data for human health, and should be valued on its own merit. As ethnoscientists exploring the links between traditional knowledge and scientific knowledge, we look at plants as more than chemical factories for which the biological activity needs to be corroborated or refuted by laboratory data. Instead, we equally value the “emic” or insider's perspective, an insight borrowed from anthropological study. Ultimately, all knowledge is useful when considered within its own cultural context. Cultural beliefs are also important agents

of transmission, and thus preservation, of plant knowledge for future generations. Therefore, this book does not shy away from talking about spiritual uses of bush medicines, as they not only represent the reality of life in contemporary rural and urban Jamaica, but also put health in a context as defined by the World Health Organization, which is “not merely the absence of disease, but a state of complete physical, emotional and social well-being.”

Plants can heal or poison, depending on the species, its chemical components, preparation and dosage used. The consumption of herbal remedies to treat illness is often considered harmless because of their natural origin. However, worldwide, some herbal products have been reported to induce toxicity. Many plants, including several that are listed in this book, have been understudied for their biological activity and safety of use. For those plants, additional research is required to clarify issues of safety, toxicity, proper dosage, contamination, and potential interactions with synthetic (pharmaceutical) and other

natural drugs.

Geographic location of research

Our research efforts were focused in two communities, one in rural Jamaica (Windsor Forest, Portland parish), and one in urban Jamaica (Payne Land, downtown Kingston). Figure 1 shows the location of Windsor Forest and Kingston on a map of Jamaica (map courtesy of Logan Sander, M.Sc.).

Windsor Forest in Portland parish is a rural subsistence farming community of about 1000 residents. The community is located at the fringes of the John Crow Mountains, about 2 kilometers inwards from the coastal road between Boston Bay and Long Bay, and about 30 kilometers from the town of Port Antonio. No biomedical healthcare is available in the community. The nearest hospital is located in Port Antonio, but for serious health problems people need to travel to Kingston to receive more specialized biomedical care. Payne Land is an inner-city community in

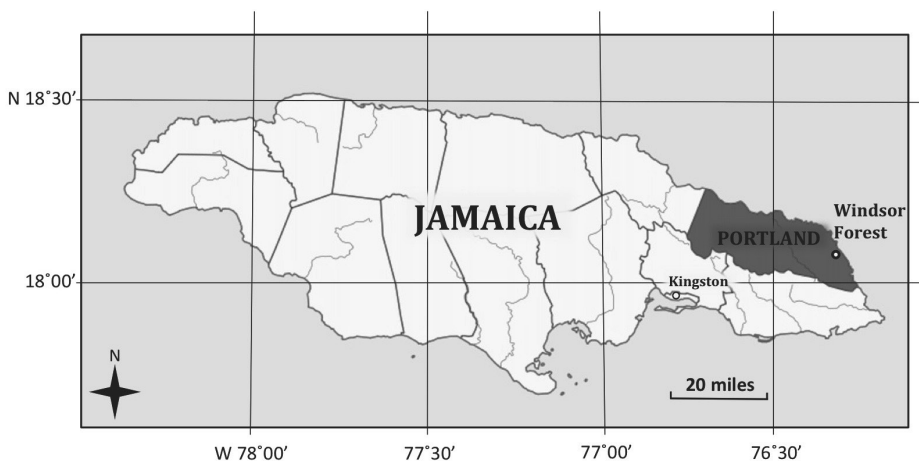


Figure 1: Location of the study areas

downtown Kingston, within the parish of St. Andrew, with a population of around 3,000 inhabitants.

Research methodology

We carried out ethnobotanical fieldwork during 2014 to 2015. The methodology consisted of interviewing adults who have previously used bush medicines, to record common plant names and medicinal use data, combined with botanical methods to identify plant species and cross-link their common names with their scientific names. In Windsor Forest, Ina Vandebroek completed 20 photo interviews and 20 semi-structured interviews (with 20 men and 20 women). In Kingston, a team of 3 people (Ina Vandebroek, David Picking and Stacey Aiken) conducted 41 photo interviews and 38 semi-structured interviews (with 40 men and 39 women).

A) Ethnobotanical interviews

In Windsor Forest and Kingston, we carried out two types of interviews (Alexiades, 1996): (1) Photo interviews featuring 45 plant species growing in Jamaica, and; (2) semi-structured interviews based on a questionnaire containing 36 questions. Participants for interviewing were recruited according to the following inclusion criteria: (a) Residency in the community; (b) age 18 years or older; (c) having previously used medicinal plants for treatment of health problems; (d) confirming a willingness to be interviewed. We tried to balance gender and interview equal numbers of men and women. We did not specifically look for people who were plant specialists or healers; rather, anyone who said they had previously used bush medicine was considered qualified to participate in an interview.

The main approach to find people to interview was through referrals made by others who had previously completed an interview. These people were subsequently approached in person and asked if they wanted to participate in the study. If they agreed, details about the study were explained and they were asked to provide their Prior Informed Consent (PIC) before the interview was started.

During photo interviews, the interviewer showed a picture of each plant, and verified if the plant was recognized. If a person confirmed knowing the plant, information was recorded about its common name(s), medicinal uses, and other cultural information about the species.

During semi-structured interviews, the interviewer asked questions based on a previously developed questionnaire, and recorded the answers in writing. The first question involved free-listing all the plants a person knew, together with their medicinal uses, preparation and mode of administration.

Ethics Committee approval for this research project was obtained from the University of the West Indies, Mona Campus.

B) Plant collection and identification

Interviews yielded extensive lists of common plant names in both communities. The next step was to verify the proper botanical identity of each bush remedy through original botanical fieldwork, and use of plant identification techniques to associate a common plant name with a scientific (botanical) name. Common plant names are known

to vary considerably across countries, as well as within different regions of the same country. In popular books and on the internet, it is not uncommon to find no mention of plant identification, and one is only left guessing if and how the authors were able to authenticate the plants for which they are describing the uses. It is a common mistake to impose scientific names onto common plant names without botanical verification of actual plant material. Without properly identified plant species, the results of any study are at best dubious, and at worst useless.

After completing the interviews, we compiled a list of plants by common name, and ranked them according to how frequently they were mentioned by all study participants. Next, guided by a knowledgeable person from the community, we set out into the surroundings of each community to collect all the plants that were mentioned independently by at least three people during interviews. In addition, plants indicated as medicinal by the guide were collected as well, even if they were not previously mentioned during interviews.

During plant collection, the researcher prepared a voucher number consisting of 3 to 4 specimens of the same species that are pressed and stored in individual newspaper until transferred to a herbarium where they are properly mounted on special paper. This voucher number is documented in a notebook containing descriptive data about the plant and locality information. A voucher specimen can be an entire herb (for small plant species), or a branch of a bush or tree. It is important to look for fertile specimens that are flowering

and/or fruiting, as these details of the plant material are important for its authentication by means of botanical keys in scientific books, such as Adams (1972) for Jamaica.

In total, we collected 224 different voucher numbers (654 plant specimens) that were dried, pressed, and deposited at the herbarium of the University of the West Indies (UWI) and the herbarium of The New York Botanical Garden (NYBG), and will be distributed to the Institute of Jamaica (IOJ) as well. The NYBG collection duplicates will be digitized and made freely available on-line on the C.V. Starr Virtual Herbarium (<http://sciweb.nybg.org/Science2/VirtualHerbarium.asp.html>) in the near future. To date, at least 90 percent of the collection has been identified to botanical species name. This collection contains more than 145 botanical species that are cross-linked with their common names.

A permit for plant collection was obtained from the National Environmental Protection Agency (NEPA).

While in the field collecting plants, Ina Vandebroek took pictures of each species to develop a comprehensive photo library (containing more than 2000 pictures) that serves as visual support material for our data in this book.

A scientific (botanical) plant name always consists of three parts: (a) A genus name (always capitalized); (b) a species name (never capitalized); and, (c) an author name (from the person who first described the species in specialized scientific literature). For example,

Solanum torvum Sw., consists of the genus name *Solanum*, the species name *torvum*, and the abbreviated author name Sw. Note that the botanical name (minus the author name) is always italicized. The correct spelling of botanical names in this book was verified with The International Plant Names Index (www.ipni.org). Denomination of plant families followed the Angiosperm Phylogeny Group Classification, based on molecular data. Botanical names can be subject to review and change. For example, *Chromolaena odorata* was formerly known as *Eupatorium odoratum*, the latter now being an outdated name.

C) Data entry and analysis

Data obtained from interviews were entered into databases, yielding a total of 847 and 780 distinct plant use-reports in Windsor Forest and Kingston, respectively. An example of a plant use-report is: “rub the leaves of King-of-the-Forest (botanical name *Senna alata* (L.) Roxb.) on the skin for liver spots [a fungal skin infection]”. Seventeen percent of all plant use-reports were confirmed by at least three people in Windsor Forest, whereas in Kingston this proportion amounted to 21 percent.

Analysis of our research data showed 44 plant species with medicinal uses that were confirmed independently by at least 20 percent of the people (one in five persons) we interviewed in each community. About half of these species (48%) are native to Jamaica. From this list, we selected 25 plant species for the monographs in this book.

D) Review of the scientific literature

We searched the scientific literature

(PubMed, Biological Abstracts, Science Direct, Google Scholar) for clinical and safety information about each plant species, using the following key-words: “adverse”, “safety”, “toxic”, “toxicity”, “interaction”, “clinical”, “poison”, “poisoning”, “breastfeeding”, “pregnancy”, “medicine”, “medicinal”. Database searches with these key-words led to individual scientific articles that were downloaded, read, and summarized in a few sentences to be added to the plant monographs. The bibliographic references of these articles are available at the end of each monograph. Major Caribbean reference books, such as those produced by TRAMIL (Traditional Medicine in the Islands), were also consulted, for example Germosén-Robineau (2014).

Our criteria for inclusion of scientific studies in the monographs were: (a) Animal studies of whole plant extracts that were water- or alcohol-based, and in dosages that correspond with the traditional use of these extracts; (b) human case reports and clinical studies; (c) ethnobotanical studies in the Caribbean and worldwide, describing the traditional use of the plant species in other cultural groups.

Articles excluded from the monographs reported on: (a) Intravenous administration of plant extracts (for example, an article that demonstrated that soursop administered intravenously had a blood pressure-lowering effect), because traditional administration was never done intravenously; (b) *in vitro* studies (research with plant extracts in test tubes), because those are too far removed from human physiology; (c) the effects of individual (purified) plant

compounds (chemicals); (d) extracts that did not correspond with traditional preparations, for example n-butanolic extracts. An exception was made for *in vitro* studies about herb-drug interactions. We do report on those type of *in vitro* studies in the plant monographs (when they are available in the literature), because they are a useful first line of investigation to identify those plants that are likely to interact with pharmaceutical products.

When scientific information on a plant species was scarce, we repeated literature searches with synonyms, for example in the case of *Clinopodium brownei*. Some plants, such as guinea henweed (*Petiveria alliacea*), are well-studied because they grow in tropical regions around the world and their use is very popular. The amount of information we were able to retrieve about this species stands in contrast to many understudied plants, such as pennyroyal (*Clinopodium brownei*) or breadfruit (*Artocarpus altifolius*).

How to use this book

This book is meant as an educational resource, not as an herbal guide for self-medication. It is for this reason that we did not include a separate section in the plant monographs on recommended dose and methods of preparation. Our aim was to develop a reference work that provides an overview of traditional (cultural) knowledge related to the use of bush medicines, as well as scientific studies highlighting the clinical effectiveness and safety of these plants from human clinical studies and animal safety studies. These two bodies of knowledge (traditional and scientific knowledge) can be considered complementary. After reading this book,

one can conclude that many plant species remain understudied for their safety, but especially from a clinical (human) perspective. It is our hope that this book will also be used by healthcare providers in their clinical practice to start a dialogue with patients about medicinal plants or bush medicines. Especially, since the use of bush medicines remains a very popular practice in rural and urban Jamaica today. In light of this popularity, in-depth discussion about medicinal plant safety, including potential plant-drug interactions, is overdue.

There exists the common belief that bush medicines are safe because they are natural. However, some plants can pose real toxicity issues for human health, and potentially lead to serious side effects if taken at the same time as pharmaceutical drugs, so it is very important to not start experimenting with bush medicines without supervision. One should always consult with a person knowledgeable about bush medicine, and talk openly with a physician about such use.

A previous study identified that 27 percent of Jamaicans who use medicinal plants to treat illness and maintain health did so in combination with pharmaceutical drugs, and that only 19 percent of physicians knew about such practices (Picking et al., 2011). Extra care should be taken about dosage and possible toxicity before administering bush medicines to pregnant women and children. In most cases, it is not advisable to give bush remedies to pregnant women.

In this book, multiple types of preparations are mentioned, including: a decoction (plant parts are boiled), an infusion (plant parts are steeped in hot water), a poultice

(a compress of plant parts is applied to the skin), a maceration (plant parts are shredded in pieces, oftentimes in water, by rubbing the hands), and others.

Each plant monograph has a section on “Reported traditional medicine uses across the Caribbean.” In that section, we often refer to the recommendations from TRAMIL (Traditional Medicine in the Islands), whenever that information is available. TRAMIL is a network of researchers and healthcare professionals that aims to study, validate and expand medicinal plant use in primary healthcare and has completed over 50 surveys across the Caribbean to date. TRAMIL provides recommendations for medicinal plant use, based on their surveys and follow-up research, that are generally accompanied by a number of cautions. For example, for oral consumption relating to conditions such as asthma and pneumonia, an initial medical evaluation is recommended. In addition, where appropriate, the use of traditional treatments should be considered complementary to medical treatment. For topical applications, strict hygiene measures should be observed in order to avoid contamination or additional infection. For all recommendations, should there be a notable worsening of a patient’s condition, medical attention should be sought without delay.

Another section in each plant monograph is about “Clinical efficacy (effectiveness) studies in humans.” There, we report on, and summarize, information we encountered in the biomedical literature about clinical studies. Clinical studies are carried out with human volunteers, to firstly make sure that the medicine being tested is safe, and secondly to establish whether it works. Different types of clinical

studies exist. “Randomized, double blind, placebo controlled trials” are those in which groups of volunteers are randomly chosen to receive the medicine (either a plant extract or a pharmaceutical drug), and others are randomly chosen to receive a placebo (dummy or inactive treatment). No one, neither the researchers, nor the human volunteers, know who gets the real treatment, and who gets the placebo. Both the researchers who are giving the treatment, and the human volunteers who are receiving the treatment, are “blind” to the type of treatment, hence the wording “double blind”. Placebos are important because if researchers notice that the “treatment group” is different from the “placebo group”, they will know that the difference is because of the treatment. Without a “placebo group”, researchers cannot know if those changes would have happened anyway, no matter which medicine people had taken. “Open randomized trials” are those studies in which both the researcher and volunteer know which treatment they are receiving. There is no “blinding” in this type of study. A “crossover study” is one in which all the volunteers receive the same number of treatments, but at different times. For example, Group A might initially receive the medicine and Group B the placebo for one week, then in week two they would swap and Group A receives the placebo and Group B the medicine.

Future studies

Upon finishing this book, we realize that we have only touched the surface of Jamaican plant knowledge. The information about medicinal uses that we have recorded comes from two field sites in Portland and Kingston, namely Windsor Forest and Payne Land. Therefore, we do

not claim this information to be representative of the rich diversity of medicinal plant uses and preparations encountered all over Jamaica. Future studies will be conducted to add to this wealth of information. We hope to expand on this work in other parishes, using the same systematic research methodology to ultimately develop a medicinal plant guidebook that covers the whole of Jamaica.

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Bitter orange, sour orange, Seville orange

Scientific Name: *Citrus × aurantium* L., Botanical Family: Rutaceae

Erect tree that is 3 to 10 meters high with thorny branches (it has more thorns than the sweet orange and has a denser canopy), white fragrant flowers and relatively large aromatic leaves with a slightly winged petiole. The leaves have diminutively toothed margins. The bitter-tasting fruit has a fairly thick and fragrant skin. The species is native to Southeast Asia. When farmers find suckers along trails, they often transplant them on their farm land to add to their collection of fruit trees. They also throw seeds on their land to obtain new plants.

Where to find the plant

Sour orange grows commonly on people's farm land.

Part used

The fruit and leaf.

Jamaican cultural uses and beliefs

The leaf and fruit skin are used to prepare a regular tea. The juice makes nice lemonade that has vitamin C. The fruit juice can clear rust from a utensil. Burning the dry fruit skin chases away mosquitoes. Animals are bathed with the fruit juice to treat mange and fleas. The inner part of the fruit is roasted for the goat when "him hurt him foot."

Jamaican medicinal uses

Sour orange is a popular remedy for the common cold, both in Kingston and Windsor Forest.

Major uses (mentioned by more than 20% of people):

- Common cold (including cough): The fruit is roasted in the fire, after which the juice is squeezed, and honey is added; 2 teaspoons are taken. Or, the juice is drunk with salt. The roasted fruit flesh can be scraped and eaten with sugar. Alternatively, a tea is boiled with the leaves.

Minor uses (mentioned by more than 5% of people, but less than 20%):

- Fever (and to keep cool): The roasted fruit is eaten, or used to bathe. The fruit is roasted in the fire and the juice is drunk with salt, or mixed with

Dragon stout.

Reported traditional medicine uses across the Caribbean

According to the Caribbean pharmacopeia, the plant is recommended for colic (fresh leaf decoction or infusion), cough (fruit juice), inflammation of the eye (conjunctivitis) (juice), diarrhea (juice), fever (fresh leaf decoction or infusion; fruit peel decoction), flatulence (fruit peel infusion), flu (fresh leaf decoction or infusion; juice), headache (fresh leaf decoction or infusion), and intestinal parasites (fresh leaf decoction). These recommendations are based on TRAMIL surveys, toxicity studies, scientific validation and available published scientific information (Germosén-Robineau, 2014).

Reported traditional medicine uses internationally

In Africa, the cut-open fruit is applied directly to ulcers, yaws (a type of chronic bacterial infection), and areas of the body affected by arthritis (Morton, 2013).

In Latin America and Italy, a leaf decoction is used as an anti-spasmodic, diaphoretic (induces sweating), stimulant, stomachic (improves action of the stomach and increases appetite) and tonic. The flowers are prepared as a syrup with reported sedative properties for nervous disorders and to help induce sleep. Infusions of the bitter bark are prepared and taken as an antipyretic (to reduce fever), stimulant, tonic and vermifuge (to expel intestinal worms) (Morton, 2013).

In China, *Citrus aurantium* preparations have a history of use in Traditional Chinese

Medicine (TCM) for the treatment of a number of health conditions, including constipation, diarrhea, dysentery, indigestion, and as an expectorant (clears mucus) (Stohs and Shara, 2007). The dried fruit, and, less commonly, the peel are used to treat a prolapsed uterus and anus, and for blood in the stool (Leung and Foster, 1996).

In the USA, *Citrus aurantium* was traditionally used by the Eclectic physicians (early American herbalists) in the late 19th and early 20th centuries as a digestive tonic and as a flavoring agent for other herbal medicines (Blumenthal, 2004; 2005).

In Europe, the peel of *Citrus aurantium* is traditionally used to treat indigestion and related conditions, and in Germany, as a supportive measure in treating stomach complaints, such as insufficient formation of gastric juice, and as an appetite stimulant (Bisset and Wichtl, 1994). The German Commission E Monographs recognize the medicinal value of *Citrus aurantium* peel in the treatment of appetite loss and digestive complaints (Blumenthal et al., 1998).

Clinical efficacy studies in humans

The use of *Citrus aurantium* and its primary phytochemical, p-synephrine, increased significantly following a United States ban on the sale of a similar phytochemical (ephedra) due to growing concerns about adverse events about the latter, including a number of fatalities of ephedra. Both ephedra and p-synephrine are thought to support weight loss by increasing the metabolic rate, and/or decreasing energy intake and energy absorption. *Citrus aurantium* extracts and p-synephrine are

promoted as a safe alternative to ephedra (Haaz et al., 2006).

A number of clinical studies are reported in the literature, with the majority relating to the use of *Citrus aurantium* extracts for weight loss and as athletic performance aids, with few studies looking into the more traditional uses listed above. In a review of the literature, up to the year 2002, Blumenthal (2004; 2005) identified two studies relating to weight loss, three to increased thermogenesis (energy expenditure) and one assessing the safety profile of *Citrus aurantium* extracts.

A more recent review of clinical studies, also involving *Citrus aurantium* extracts and p-synephrine, identified sixteen published studies. Eight of the studies measured the impact on metabolism and/or weight loss, seven studies measured the impact on cardiovascular outcomes (e.g. blood pressure, heart rate), and one study measured the impact on key drug metabolizing enzymes (highlighting potential drug-herb interactions). The authors of the review concluded that *Citrus aurantium* extracts, used in combination products, and p-synephrine used alone, increased energy expenditure and metabolic rate, with modest increases in weight loss when given for 6 to 12 weeks. They recommended longer term studies with larger study groups to further assess the efficacy of these products (Stohs et al., 2012).

In one of the seven safety studies, a randomized, placebo controlled, crossover, double blind study with 25 healthy volunteers, was used to investigate the cardiovascular effects of a dietary supplement containing *Citrus aurantium* extract, green tea extract and caffeine. The

authors reported that no effects of the supplement were observed on heart rate, systolic and diastolic blood pressure, or mean arterial pressure (Seifert et al., 2011).

In one of the studies on weight loss, a double blind, randomized, placebo controlled study with 23 overweight healthy volunteers, in combination with a prescribed diet and exercise program, was used to investigate a supplement containing *Citrus aurantium* extract, St. John's wort, and caffeine. The authors concluded that the supplement was safe and effective, when combined with mild caloric restriction and exercise for promoting both weight and fat loss in healthy, overweight adults (Colker et al., 1999).

Safety information

- Side effects:

The use of a supplement containing multiple plant ingredients, including *Citrus aurantium*, gave rise to two reports of mild gastric problems, in a review of adverse events from plant food supplements across six European countries (Restani et al., 2016).

Citrus aurantium was among the ten most frequently reported plant-based supplements for adverse events between 2006 and 2010, documented across selected European and Brazilian poison centers. However, most cases involved mild gastric symptoms that resolved without clinical intervention (Lüde et al., 2016).

The use of plant-based supplements with multiple ingredients makes it difficult to attribute the side effects specifically to *Citrus aurantium* (Lüde et al., 2016; Restani

et al., 2016).

A review of 22 United States Food and Drug Administration (FDA) adverse event reports and ten published clinical case reports over a five year period, from 2004 to 2009, concluded that no serious adverse events could be directly attributed to *Citrus aurantium* extracts or p-synephrine (Stohs, 2010).

- Toxicology:

The Caribbean pharmacopeia, based on toxicity studies, has validated the safe use of several traditional preparations of *Citrus aurantium*, namely, fresh leaf decoction and infusion, fruit peel decoction and infusion, and fresh juice (Germosén-Robineau, 2014).

A review of *Citrus aurantium* and p-synephrine concluded that bitter orange extract is safe for human consumption, and that there are no credible adverse effects associated with oral ingestion of bitter orange or p-synephrine (Stohs and Preuss, 2010).

- Contraindications:

There are conflicting reports in the literature regarding contraindications for *Citrus aurantium*. According to one study, the blood pressure of healthy young adults increased after taking a *Citrus aurantium* supplement containing 6 percent p-synephrine (Bui et al., 2006).

However, according to an extensive review of the scientific literature, the juice of *Citrus aurantium* showed no effect on blood pressure or heart rate in healthy subjects (Brinker, 2010). The author suggests the following contraindications for *Citrus aurantium* in patients who suffer from the following afflictions:

stomach or intestinal ulcers, due to bitter orange's tonic effect on the gastrointestinal tract; severe high blood pressure, rapid heart rate, and narrow-angle glaucoma (a disease that damages the eye's optic nerve and may lead to blindness), due to its p-synephrine content (noted as speculative by the author). Its use is also contraindicated in children due to the presumption that excessive doses can produce "toxic effects"; and in combination with ultraviolet light due to the potential photosensitizing effect.

- Use in pregnancy and breast-feeding:

Traditional Chinese Medicine (TCM) texts advise caution in the use of *Citrus aurantium* preparations during pregnancy (Dharmananda, nd).

- Drug interactions:

The impact of crude extracts of *Citrus aurantium* were tested and found to inhibit the activity of an important human drug metabolizing enzyme, CYP3A4 in laboratory-based screens (Guo et al., 2001). In addition, *Citrus aurantium* contains two phytochemicals, 6'- and 7'-dihydroxybergamottin and bergapten, both of which have been shown individually to potently inhibit the same enzyme, CYP3A4 (Fugh-Berman and Myers, 2004). Known inhibitors of CYP3A4 include grapefruit juice which has, to date, been shown to interact with over forty pharmaceutical drugs, giving rise to dangerous increases in drug levels and serious adverse drug reactions (Delgoda and Picking, 2015).

However, tests in the laboratory, whilst providing a useful first stage indication of potentially harmful drug interactions, require confirmation using human clinical studies. Gurley et al. (2004) conducted

studies in 12 healthy human subjects, who were given 350 mg of *Citrus aurantium* extract (standardized to 4 percent p-synephrine) twice a day for 28 days. A comparison of the results before and after supplementation demonstrated weak inhibition of the key drug metabolizing enzymes tested, CYPs 1A2, 2D6, 2E1 and 3A4. The authors concluded that the *Citrus aurantium* extract tested posed minimal risk for cytochrome P450-mediated drug-herb interactions in humans.

However, the authors noted that *Citrus aurantium* extracts are generally prepared by hot water extraction and that the key phytochemicals, 6'- and 7'-dihydroxybergamottin and bergapten, present in the fresh fruit juice were notably absent from the tested extract (Gurley et al., 2004). Therefore, caution is advised in the use of the fresh fruit juice of *Citrus aurantium* in combination with a significant number of pharmaceutical drugs, such as the immunosuppressant drug tacrolimus (Lin et al., 2011), the anti-hypertensive drug felodipine (Malhotra et al., 2001), the anti-retroviral drug indinavir (Penzak et al., 2002) the anti-tussive (to treat cough) dextromethorphan (Di Marco et al., 2002), and other drugs metabolized by CYP3A4, including acetaminophen, codeine, cyclosporin, diazepam, and erythromycin (Edwards et al., 1999).

Recommendations

The United States Food and Drug Administration (FDA) has classified the use of bitter orange in food as Generally Recognized as Safe (GRAS). According to the Natural Standard (2007), bitter orange is probably safe when used orally in quantities available in food. It may be safe to use the essential oil of bitter

orange applied topically or inhaled in aromatherapy. It may not be safe to use bitter orange in higher doses because it contains the substance p-synephrine, which is a stimulant. However, this view is controversial and not universally accepted. Current research indicates that ingestion of bitter orange and p-synephrine in the form of supplements, fruit, juice and other citrus food products, are safe (Stohs et al., 2011). No credible adverse events have been directly attributed to bitter orange, or its primary phytochemical, p-synephrine. However, research does indicate that caution is necessary for those people taking a number of over-the-counter and prescription drugs with the fresh juice (theoretical concern), and the guidance of a qualified physician or pharmacist should always be sought. The use of bitter orange during pregnancy is traditionally cautioned against in Traditional Chinese Medicine (TCM). The effects of bitter orange in nursing women are not known, and its use should best be avoided during pregnancy or breastfeeding.

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Breadfruit

Scientific Name: *Artocarpus altilis* (Parkinson) Fosberg, Botanical Family: Moraceae

An evergreen tree of up to 20 meters high with dark green, deeply lobed leaves. When a part of the tree is broken off, a white latex (called “milk”), will come out. The fruit is round to oval, with a smooth skin texture and a yellowish-green color when mature. The fruit flesh is creamy white. Fruits are mature and ready to cook or roast in 15 to 19 weeks. A breadfruit tree starts bearing around 3 to 5 years of age and does so for several decades. The species is thought to be native to northern New Guinea, but it has been widely cultivated in southeast Asia and the Pacific region for thousands of years, and is now cultivated throughout the tropics. In rural Jamaica, farmers transplant suckers found underneath a breadfruit tree to other places; they also exchange suckers of much-appreciated varieties with each other, such as the “jackfruit breadfruit”, also called “maca breadfruit”, a variety that is considered “easier to roast.”

Breadfruit trees grow everywhere in the community, and on people's farm land.

Part used

The leaf is used medicinally. The fruit is eaten.

Jamaican cultural uses and beliefs

Breadfruit is considered a tonic fruit. It is part of the Jamaican national dish. The fruit can be boiled and blended to make juice and punch. The ripe fruit is also used to bake pudding. There is a saying "if yuh eat too much breadfruit, it make yuh coward." The leaf of breadfruit is appreciated as a regular tea in the morning and evening, sometimes with sweet milk, vanilla and nutmeg added. Milk from the chopped breadfruit tree can serve as chewing gum. The milk ("gum") of the breadfruit tree is sometimes used to catch birds by putting it on a bamboo stick that is placed in an ackee tree (*Blighia sapida*). A lesser-known use is as a cosmetic: An ounce to a pint of leaf and flowers of breadfruit is steeped and added to the bath water as a hydrating substance.

Jamaican medicinal uses

Breadfruit leaf is applied to the head, and drunk as a tea, to treat high blood pressure.

Major uses (mentioned by more than 20% of people):

- Blood pressure: In Kingston, people treat high blood pressure by tying a warm leaf on the head, together with white or blue rubbing alcohol. Alternatively, in Kingston and Windsor Forest, people boil or draw the ripe (yellow) breadfruit leaf for as

little as 2 minutes, or up to an hour, in water. Some people say that when you pick a leaf from the tree for tea it "cannot drop on the ground." Breadfruit leaf is sometimes steeped or boiled together with the leaf of guinep (*Melicoccus bijugatus*).

Reported traditional medicine uses across the Caribbean

All parts of *Artocarpus altilis* are used medicinally in the Caribbean and Pacific, especially the latex, leaf tips, and inner bark. In the West Indies, the yellowing leaf is brewed into a tea and drunk to lower high blood pressure, and to treat asthma. The leaf tea is also believed to control diabetes. The latex is massaged into the skin to treat broken bones and sprains, and is bandaged on the spine to relieve sciatica (pain affecting the back, hip and outer side of the leg, caused by compression of a nerve). It is commonly used to treat skin ailments and fungus diseases such as "thrush," which are also treated with crushed leaves. Diluted latex is taken internally to treat diarrhea, stomachache, and dysentery. The sap from the crushed stems or leaves is used to treat ear infections or sore eyes. The root is astringent and used as a purgative; when macerated it is used as a poultice (compress) for skin ailments. The bark is also used to treat headache in several islands (Ragone, 2006).

In Martinique, a decoction of breadfruit leaf is drunk to treat high blood pressure, liver disease and diabetes, while the milk of the fruit is ingested for diabetes and applied externally for pain in the back (Longuefosse and Nossin, 1996).

In Trinidad and Tobago, breadfruit leaf is used to treat high blood pressure as well (Lans, 2006).

Reported traditional medicine uses internationally

In Mauritius, a leaf decoction of *Artocarpus altilis* is drunk to treat diabetes, one cup twice per week (Mootoosamy and Mahomoodally, 2014).

In Indonesia, a decoction of the leaves has been used traditionally for the treatment of liver cirrhosis, hypertension (high blood pressure), and diabetes (Wang et al., 2006).

In Taiwan, the leaves are used to treat liver disease and fever, and an extract from the flowers is said to be effective in treating ear swelling (edema) (Orwa et al., 2009).

In the Pacific Islands, latex and juice from the crushed leaves are both traditionally used to treat ear infections. The root is an astringent (able to tighten body tissues), and is used as a purgative, and when macerated it is used as a poultice for skin ailments. The bark is used to treat headache (Orwa et al., 2009).

Clinical efficacy studies in humans

No information available.

Safety information

- Side effects:

One respondent in the Jamaican TRAMIL survey reported experiencing hypotension (low blood pressure) as a result of drinking breadfruit leaf tea (Picking et al., 2015).

- Toxicology:

In an acute toxicity study of breadfruit leaf and bark extracts in rats (2 g per kg body weight administered orally for 2 weeks), no toxic reaction or mortality was observed. These results suggest the safety of the extracts in therapeutic uses (Sairam and Urooj, 2014).

- Contraindications:

No information available.

- Use in pregnancy and breastfeeding:

No information available.

- Drug interactions:

Traditionally prepared water extracts of the dried leaves of *Artocarpus altilis* were tested in the laboratory for their effect on a number of key human enzymes that are responsible for processing many pharmaceutical drugs in the body (cytochrome P450, CYPs 2D6, and 3A4). The results showed moderate to weak impact, indicating that clinically significant interactions with drugs metabolized by the same enzymes are unlikely (Nwokocha et al., 2012; Murray, 2014; Delgoda and Picking, 2015).

Recommendations

Absence of human (clinical) studies warrants caution for use of breadfruit leaf tea as a medicine in humans, especially in pregnant or breastfeeding women, and in children. Hypertension (high blood pressure) is a serious condition that needs to be followed up by a qualified healthcare provider. People who self-medicate with breadfruit leaf tea should disclose this information to their physician.

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