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Baobab: The Tree of Life • Chamomile Herb Profile • Lavender Aroma Increases Trust • Cranberry Juice & Inflammation • Amazonian Traditional Medicine Encyclopedia

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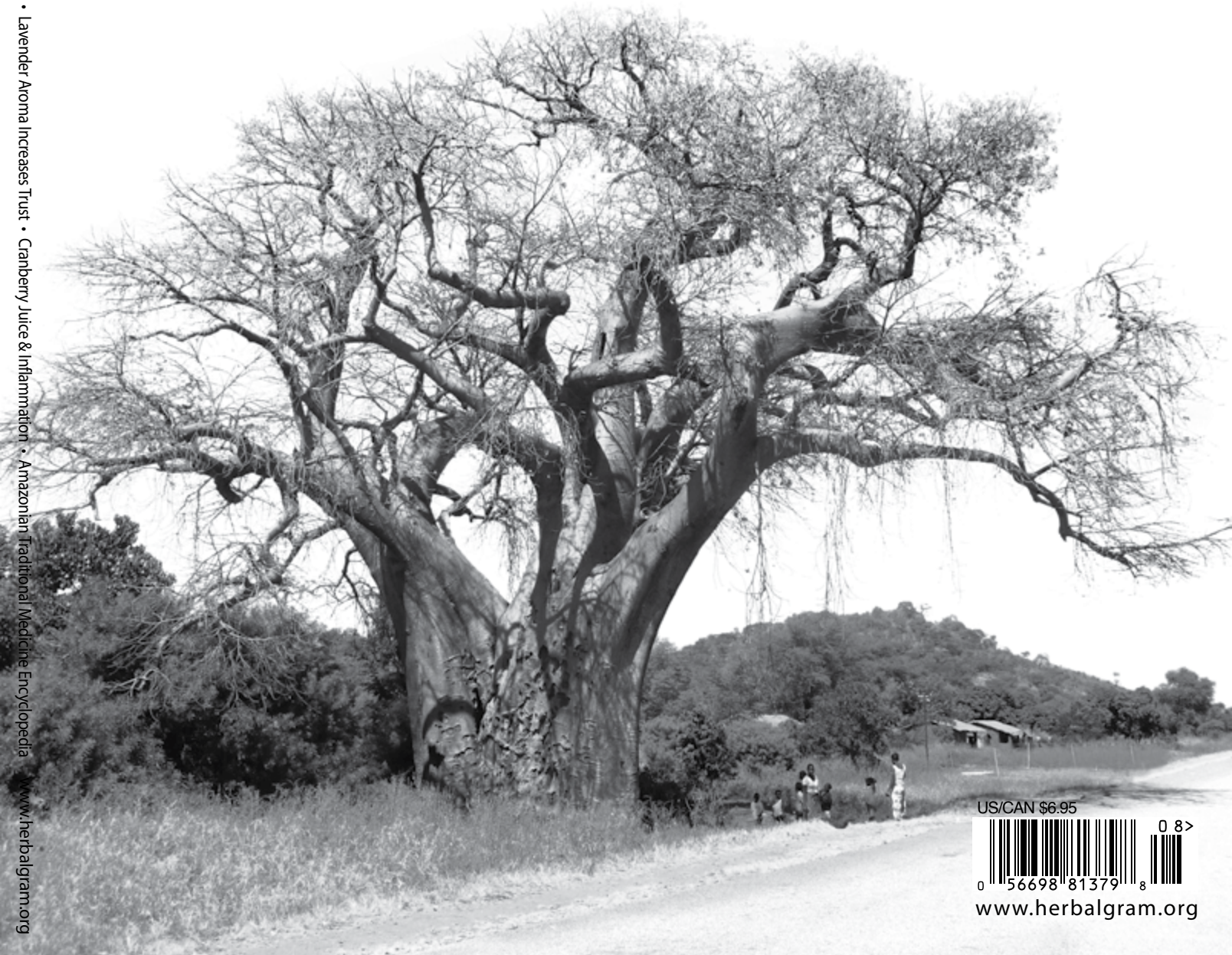

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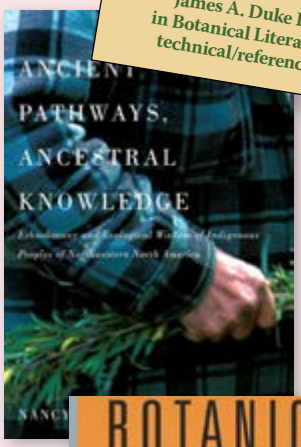

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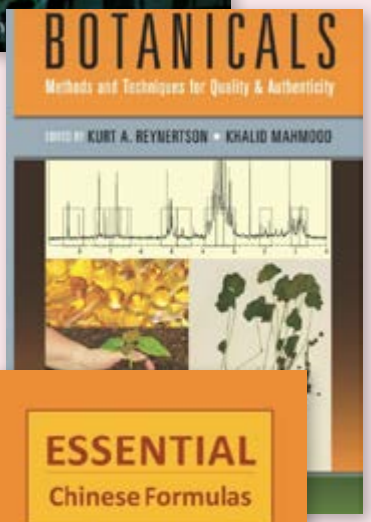

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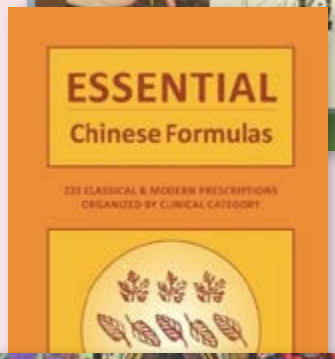

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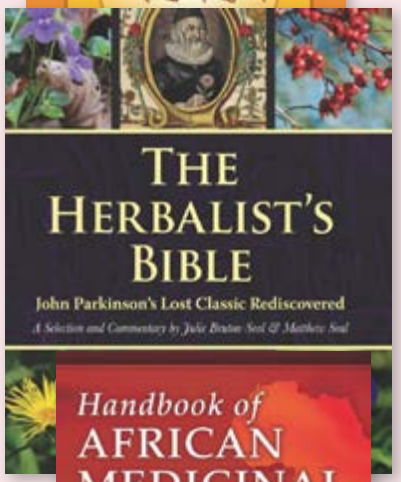

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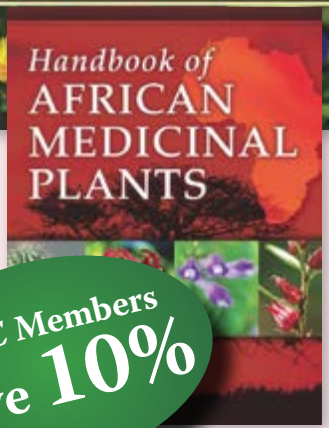

Handbook of African Medicinal Plants, 2nd ed. by Maurice M. Iwu, 2014. An overview of 2000 species of plants available in Africa as medicinal agents, with information about botany, chemistry, pharmacology, and usage, including traditional healing methods. Provides a pharmacognosy-based profile of 170 of the major herbs, with a brief description of the diagnostic features of the leaves, flowers, and fruits and monographs with botanical names, common names, synonyms, African names, habitat and distribution, ethnomedicinal uses, chemical constituents, and reported pharmacological activity. Hardcover, 506 pages**. $125.96 ($113.36 ABC Member Price)**

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dear *reader*

The iconic African baobab tree is our cover story this issue. We are grateful to Simon Jackson and co-author Anabel Maldonado for their work in compiling ethnobotanical, chemical, and pharmacological data on this famous African tree, the fruit of which is becoming increasingly popular in developed nations as a vitamin C-containing food and dietary supplement ingredient. This is Dr. Jackson's second cover article in *HerbalGram,* his first being the sausage tree article in issue number 94 in 2012.

Our herb profile series continues with an extensive review of German/Hungarian chamomile by veteran ABC staff member Gayle Engels and long-time ABC friend and contributor Josef Brinckmann of Traditional Medicinals, the largest medicinal tea maker in the United States. We started the herb profiles in issue number 65 with pine, the idea being that we would provide readers with some basic and useful information on the very first page of each issue, even prior to the table of contents. As is frequently the case, the length and comprehensiveness of these profiles increased, especially with the valuable additions each issue from Josef, who specializes in global trade data and quality control information from various international monographs. After being such a valuable reviewer for many years, we eventually determined that Josef should be a co-author with Gayle, and his additions to Gayle's research and compilations have helped produce some excellent information on each herb they've profiled.

Like most of our botanical medicine colleagues, ABC is keenly interested in conservation of plants, people, and their cultures. Ever mindful of our readers' interests in ethnobotany and the documentation of traditional uses of medicinal plants, our new assistant editor, Connor Yearsley, has written about the Matsés, an Amazonian tribe that recently documented their traditional knowledge of medicinal plants in an encyclopedia written only in their native language, thereby reducing the potential for biopiracy. Their efforts bring to mind the phrasing of ethnobotanist Mark Plotkin about the loss of indigenous knowledge: "Every time a shaman dies, it's as if a library has burned down."

Continuing our conservation coverage, we present an article from Susan Leopold, director of the United Plant Savers, a nonprofit organization dedicated to conserving native American and Canadian medicinal plants. She has contributed an extensive article on the need to conserve sandalwood trees in Hawaii. Long cherished for the fragrant oil distilled from its bark, sandalwood trees are disappearing due to high demand, the introduction of invasive species, and a lack of adequate regulation and consumer awareness. In the article, Dr. Leopold describes the history of Hawaiian sandalwood, current efforts to save the species, and steps that must be taken to ensure a sustainable future for wild medicinal and aromatic plants.

Medicinal fungi products are becoming increasingly popular as research on their immunopotentiating effects and many other health benefits is reported. Jeff Chilton, one of North America's leading mushroom and fungi experts, presents his professional views on the labeling of fungal materials sold in US commerce in a guest editorial. He hopes that this article will help bring some agreement among industry members regarding the establishment of uniform, common nomenclature for mushroom and other fungal products sold in commerce.

In US regulatory news, the New York Attorney General has again made national headlines — this time by sending cease-and-desist letters to manufacturers of devil's claw dietary supplements, citing DNA research at the New York Botanical Garden showing that some products contain *Harpagophytum zeyheri* while labeled to contain *H. procumbens.* As we pointed out in a news release in September, the two species are recognized as interchangeable in the *European Pharmacopoeia* and by other regulatory authorities in Europe, and the NY AG's use of taxpayer funds to regulate such arcane issues is missing the boat with respect to more serious and compelling issues related to the adulteration of botanical materials.

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Each issue of *HerbalGram* is peer reviewed by members of the ABC Advisory Board and other qualified experts before publication.

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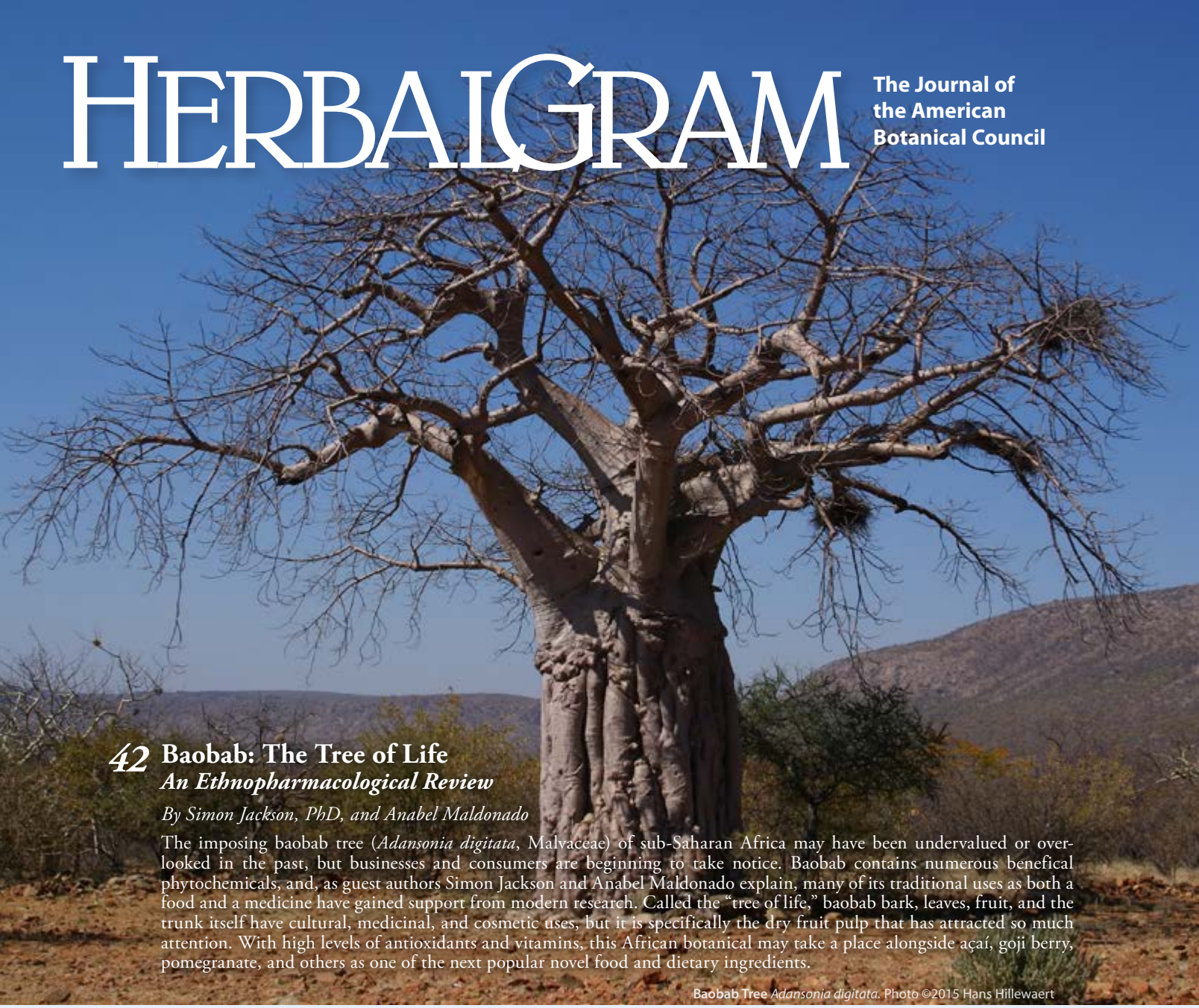

Baobab Tree *Adansonia digitata*. Photo ©2015 Hans Hillewaert

departments

On the Cover
Baobab Tree *Adansonia digitata*.
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Errata

In issue 106, on page 74, James Lauritz Reveal's birth year was listed as 1937. The correct year is 1941.

In issue 107, on pages 3-7, the Arnica Herb Profile should include the following reference: 67. Walker KM, Applequist WL. Adulteration of selected unprocessed botanicals in the US retail herbal trade. *Economic Botany*. 2012;66(4):321-327. Additionally, each of the in-text citations for references 42-66 should be one number higher. The *HerbalGram* staff laments the errors.

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Chamomile

***Matricaria chamomilla* (syn. *M. recutita, Chamomilla recutita*)**

Family: Asteraceae

INTRODUCTION

Chamomile, also called German or Hungarian chamomile, is known by the Latin binomial *Matricaria chamomilla*, although the synonyms *M. recutita* and *Chamomilla recutita* are still used by some.[1] The common name chamomile and specific name *chamomilla* come from the Greek *chamos*, meaning ground, and *melos*, meaning apple, which refers to the plant's low-growing habit and apple-like scent.[2] The generic name, *Matricaria*, comes from the Latin *matrix*, meaning womb, because it was used historically to treat disorders of the female reproductive system.[3]

Growing up to 30 inches (76 cm) in height, chamomile is an herbaceous annual plant with ferny, fragrant leaves. It has heterogamous (having multiple sexes) inflorescences with tubular yellow disc florets surrounded by white ray flowers.[3,4] The brownish-yellow fruit, or achene, contains a single seed that does not split open upon drying.

Chamomile is native to eastern and southern Europe as well as parts of western Asia, and now occurs throughout almost all of Europe as well as Turkey, the Caucasus region (Georgia), and parts of Iran and Afghanistan. The material of commerce is obtained, for the most part, from farms in Egypt, Germany, Argentina, Poland, and, to a lesser extent, Chile, the Czech Republic, Slovakia, Spain, and several of the Balkan countries (Bosnia and Herzegovina, Bulgaria, Croatia, and Serbia).[5] It is also wild-collected for commercial trade in Hungary,[6] as well as in Albania, Bulgaria, Croatia,[7] Kosovo,[8] and Macedonia.[9]

This article addresses only *M. chamomilla* and not the many other herbs also referred to in commerce as chamomile, such as English or Roman chamomile (*Chamaemelum nobile*, syn. *Anthemis nobilis*), corn chamomile (*A. arvensis*), dyer's chamomile (*Cota tinctoria*), Moroccan chamomile (*Cladanthus mixtus*), Moroccan blue chamomile (*Tanacetum annuum*), rayless chamomile (*M. discoidea*), and scentless chamomile (*Tripleurospermum perforatum*), all of which belong to the family Asteraceae.[10,11] Although chamomile and Roman chamomile have been used interchangeably, their growth habits and essential oils are vastly different.[3]

Roman chamomile sometimes causes allergic reactions in individuals who are sensitive to ragweed (*Ambrosia artemisiifolia*, Asteraceae), which rarely occur with *M. chamomilla*.[3,12] However, the World Health Organization (WHO) contraindicated chamomile use in people with known sensitivities to plants in the Asteraceae family.[13] Proper identification of plant material is imperative to avoid allergic reactions. In one notable instance, a voucher specimen was misidentified as chamomile but was, in fact, dog's chamomile (*Anthemis cotula*, Asteraceae), which is highly allergenic due to its anthecotulid content.[14]

Chamomile *Matricaria chamomilla*. Photo ©2015 Steven Foster

HISTORY AND CULTURAL SIGNIFICANCE

Ancient Egyptian, Greek, and Roman medicine texts contain descriptions of using chamomile as a calming tisane (herbal tea infusion) and for treating erythema (superficial reddening of the skin) and xerosis (abnormally dry skin) caused by dry weather.[12] Both the Egyptians and Saxons held chamomile sacred, and, in Slovakia, a person was supposed to bow to chamomile plants when he or she encountered them. Chamomile is found in the writings of early Greek botanists/

physicians Hippocrates (5th century BCE) and Dioscorides (1st century CE), and the Roman physician Galen (2nd century CE).[2] By the 16th and 17th centuries, chamomile was used extensively for intermittent fever.[12]

The Unani system of medicine, which is practiced on the Indian subcontinent, uses chamomile (called *Gul-e-Babuna*) by itself or in combination with other herbs for the following conditions: headache, gonorrhea, conjunctivitis, chest pain, renal calculi (kidney stones), vesical calculi (bladder stones), general debility, hysteria, dyspepsia, and fever.[15]

Chamomile was first cultivated in the United States by German settlers and became an important medicine employed by 19th century American Eclectic physicians, who used it specifically for conditions in pregnant women and young children.[2,16] Traditionally, chamomile flower extracts have been used internally for the following: nervous system conditions (e.g., restlessness and anxiety), depression, insomnia, flatulence, indigestion, constipation, diarrhea, hemorrhoids, amenorrhea (abnormal absence of menstruation), dysmenorrhea (painful menstruation), anorexia nervosa, asthma, bruxism (teeth grinding), bronchitis, colic, dentition and infantile convulsions caused by teething, gout, gum bleeding and soreness, canker sores (ulcers), malaria, travel sickness, alcohol withdrawal, mastitis (breast inflammation or infection), neuralgia, skin irritations, eczema, bruises, burns, and wounds.[12,16,17]

Externally, chamomile extracts have been used to address cracked nipples, chicken pox, diaper rash, eye conditions (e.g., blocked tear ducts and conjunctivitis), ear infections, nasal conditions, and poison ivy reactions.[17] They also have been used in cosmetics and body care products such as hair dyes, shampoos, sunscreens, mouthwashes, toothpastes, deodorants, and bath preparations.[18] Chamomile essential oil has been included as an ingredient in creams, lotions, perfumes, soaps, and detergents.

Germany has always been a major producer and consumer of German/Hungarian chamomile. The herb enjoys relatively widespread use and cultural acceptance in the country. (In addition to its German name *Kamillenblüten,* it is also known there as *alles zutraut*, which means "capable of anything.") Between 1930 and 1945, Germany's average annual demand was about 1,000 metric tons (MT), most of which was wild-collected with only six hectares (ha) being cultivated.[5] And as late as 1955, Germany was still its own main source of chamomile (mainly from the state of Saxony and the Franconia region of Bavaria) followed by imports from Hungary, the Balkan countries, the former Soviet Union, Czechoslovakia, and Yugoslavia, among others.

In the 1950s, an estimated 40-50% of world demand could be satisfied with wild-collected chamomile from Hungary.[6] But, in the 1990s, lower-cost production of cultivated chamomile, particularly in Egypt and Argentina, scaled up and eventually ruined the market for wild Hungarian chamomile.

In 1984, the German Commission E approved the use of chamomile flower preparations as internal nonprescription medicines for gastrointestinal spasms and inflammatory diseases of the gastrointestinal tract, and as external medicines for skin and mucous membrane inflammation, bacterial skin diseases (including those of the oral cavity and gums), and inflammation or irritation of the respiratory and anogenital tracts. The *British Herbal Compendium* lists chamomile for internal use for spasms or inflammatory conditions of the gastrointestinal tract, peptic ulcers, and mild sleep disorders, and for external use for eczema, inflammation, and irritation of skin or mucosa.[2]

CURRENT AUTHORIZED USES IN COSMETICS, FOODS, AND MEDICINES

In 1982, the US Food and Drug Administration (FDA) considered the inclusion of chamomile flower as an active ingredient in its establishment of a monograph for over-the-counter (OTC) digestive aids.[19] But, in 1993, due to an insufficient amount of human clinical evidence submitted to the FDA, the agency ruled that chamomile flower was not generally recognized as safe and effective (GRASE) for use as a digestive aid active ingredient.[20]

However, in 2000, the FDA ruled that some OTC drug monograph claims would now be acceptable as structure/function claims for certain dietary supplement products.[21] At that point, it became clear that chamomile flower could

be labeled and marketed as a dietary supplement with "digestive aid," "relief of occasional indigestion," or similar claims, so long as the product's marketer had fulfilled all of the regulatory requirements for the manufacture and marketing of dietary supplements (e.g., substantiation of claim[s], submission of FDA notification letter within 30 days of marketing, etc.).

For use of chamomile flower as an ingredient with an associated structure/function claim, the United States Pharmacopeia (USP) has established a quality standards monograph (for dried flower heads) that can serve as the basis of a company's specifications for verifying composition, identity, quality, purity, and strength.[22]

For use in conventional food products, the FDA has determined that (German/Hungarian) chamomile flower is generally recognized as safe (GRAS) for use as a spice, natural seasoning, or flavoring.[23] Furthermore, the FDA classifies essential oils, solvent-free oleoresins, and natural extracts (including distillates) of chamomile as GRAS for use in food products.[24] The *Food Chemicals Codex* (FCC) includes a quality standards monograph for "German Type Chamomile Oil" for use as a food flavoring agent. The monograph is available from USP.[25]

In Canada, German chamomile is regulated as an active ingredient of licensed natural health products (NHPs), requiring pre-marketing authorization from the Natural and Non-prescription Health Products Directorate (NNHPD).[26] The authorized uses for labeling of German chamomile NHPs vary depending on buccal, oral, or topical application:

- Buccal: "to help relieve minor inflammation and/or irritation of the mucous membranes of the mouth and/or throat";
- Oral: (1) "to help relieve inflammatory conditions of the gastrointestinal tract"; (2) "to help relieve mild digestive disturbances (such as dyspepsia, flatulence, bloating, and/or belching)"; (3) "as a calmative and/or sleep aid"; and
- Topical: "to help relieve minor inflammation and/or irritation of the skin."

German chamomile is also listed in the NNHPD draft "Cognitive Function Products" monograph as a sedative active ingredient.[27] German chamomile essential oil is listed in the draft "Aromatherapy – Essential Oils" monograph with the following proposed claim statements:

- Topical: (1) "for symptomatic relief of acne/boils"; (2) "to relieve minor skin irritation/cuts/bruises/burns"; and
- Topical and/or inhalation: (1) "as a nervine/calmative"; (2) "to help relieve joint/muscle pain associated with sprain/strain/rheumatoid arthritis"; (3) "to help relieve headache"; and (4) "as a carminative/antispasmodic for symptomatic relief of digestive discomfort."[28]

At the time of this writing (September 2015), there were 960 chamomile-containing licensed NHPs in Canada (521 listed as *Matricaria chamomilla*, 329 as *Matricaria recutita*, and 110 as chamomile), of which 723 product licenses list chamomile, in some form, as a medicinally active ingredient.[29] German chamomile flower water is allowed as a non-medicinal fragrance ingredient of topical NHPs. The essential oil is also allowed as a non-medicinal fragrance ingredient and skin-conditioning agent.

In the European Union (EU), various defined chamomile preparations — in particular, herbal tea infusions (for oral ingestion, oromucosal use [gargle and rinse], topical application [dressings and washes], and steam inhalation), essential oils, and varying strengths of dry and liquid extracts — are regulated as traditional herbal medicinal products (THMPs), requiring registration and pre-marketing authorization.[30] Therapeutic indications for the herbal tea, dry extract, and liquid extract forms include:

- Oral: "for the symptomatic treatment of minor gastrointestinal complaints such as bloating and minor spasms";
- Steam inhalation: "for the relief of symptoms of common cold";
- Oromucosal: "for the treatment of minor ulcers and inflammations of the mouth and throat";
- Cutaneous (sitz bath): "for adjuvant therapy of irritations of skin and mucosae in the anal and genital region, after serious conditions have been excluded by a medical doctor"; and
- Cutaneous (dressings and washes): "for the treatment of minor inflammation of the skin (sunburn) and superficial wounds and small boils (furuncles)."

The therapeutic indications for the essential oil are the same as those for the above-listed cutaneous use (sitz bath).[31]

For quality control, applicants must show that the herbal drug or preparation complies with a quality standards monograph of the *European Pharmacopoeia* (i.e.,"Matricaria Flower," "Matricaria Liquid Extract," or "Matricaria Oil") and the relevant corresponding general monographs, such as "Essential Oils," "Herbal Drug Extracts," "Herbal Teas," and "Herbal Preparations."[32]

There are two distinct European chamomiles with "Protected Designation of Origin" (PDO) standards under EU regulations: *Alföldi kamillavirágzat* ("Wild Alföld Chamomile") from Hungary and *Chamomilla Bohemica* ("Bohemian Chamomile") from the Czech Republic.

The *Alföldi kamillavirágzat* PDO standard requires that it is hand-picked using a chamomile comb (made from wood, iron, or tin) from the saline soils of the Great Hungarian Plain (specifically in the counties of Szabolcs-Szatmár-Bereg, Borsod-Abaúj-Zemplén, Heves, Jász-Nagykun-Szolnok, Hajdú-Bihar, Békés, Csongrád, Bács-Kiskun, and Pest). The unique characteristics of this low-growing wild chamomile are attributed to the traditional methods of harvesting and processing and the area's ecological features, including saline soil, high temperatures, abundant sunshine (approximately 2,000 hours/year), and low annual precipitation (500-600 mm, or about 20-24 inches).[33]

When harvested, dried, and handled according to the

PDO specifications, the herb's quality should, at a minimum, conform to the requirements of the Hungarian Pharmacopoeia. Depending on the year, the alpha-bisabolol content of the essential oil fraction should be at least 20%, and possibly as high as 58%, which is significantly higher than the norm for cultivated chamomile of any origin.[34] The *Alföldi kamillavirágzat* PDO standard correlates its high alpha-bisabolol content with antispasmodic, anti-inflammatory, and anti-ulcerative effects.

The *Chamomilla Bohemica* PDO standard requires the plant to be grown in Bohemia (including the regions of Prague, Central Bohemia, South Bohemia, Plzeň, Karlovy Vary, Ústí nad Labem, Liberec, Hrádec Králové, Pardubice, and Vysočina, as well as the districts of Havlíčkův Brod, Jihlava, and Pelhřimov).[35] The unique characteristics of this chamomile are attributed to a combination of factors such as climate (altitude, plentiful sunshine, and average rainfall of 500-700 mm, or about 20-28 inches), soil (pH of 7.3-8.1 and loamy/sandy-type), and traditional harvesting methods.

When harvested, dried, and handled according to the PDO specifications, *Chamomilla Bohemica* should have a blue essential oil content of up to 1%, which is 2.5 times the minimum requirement of the Czech Pharmacopoeia (min. 0.4%).[34] Furthermore, the chamazulene content must average 0.06-0.07%, or about twice the pharmacopeial minimum level of 0.035%. The *Chamomilla Bohemica* PDO standard also correlates its flavonoid content (about 0.015%) with spasmolytic effects and its spiroether content (0.03%) with bacteriostatic and fungicidal effects.

Besides the Czech and Hungarian national pharmacopeias and PDO specifications, there are English-language quality standards monographs for various forms of chamomile published in the European Pharmacopoeia ("Matricaria Flower," "Matricaria Liquid Extract," and "Matricaria Oil"),[32] *Food Chemicals Codex* ("German Type Chamomile Oil"),[25] International Organization for Standardization (ISO) standards ("Oil of Blue Chamomile"),[36] and the *United States Pharmacopeia* ("Chamomile [dried flower heads]"),[22] as well as in *WHO Monographs on Selected Medicinal Plants* ("Flos Chamomillae").[13]

MODERN RESEARCH

In pharmacological and animal studies, chamomile extracts have exhibited the following properties: anti-anxiety and stress relieving, anticancer, anti-inflammatory, anti-insomnia, antioxidant, antimutagenic, antinociceptive (reducing sensitivity to pain), antipeptic, antispasmodic, antistaphylococcal, anti-ulcerative, anti-itch, cytotoxic, immunomodulating, hepatoprotective, neuroprotective, skin-metabolizing, stress-relieving, and wound-healing.[2,12,15,16] Chamomile essential oil and its constituents have demonstrated antispasmodic, anti-inflammatory,

Chamomile *Matricaria chamomilla*
Photo ©2015 Steven Foster

antimicrobial, antiedemic, antipeptic, anxiolytic, bactericidal, chemopreventive, fungicidal, and wound-healing properties.[15]

In 1985, a controlled, bilateral, comparative study investigated the effects of chamomile cream on inflammatory dermatoses.[37] Patients (N = 161) who had previously been treated with 0.1% difluocortolone valerate were given one of four preparations to apply for three to four weeks: Kamillosan® cream (a dry extract of chamomile flowers [2.75:1, ethanol 95.4% (v/v)] in a fatty ointment base containing no less than 0.2 mg volatile oil and no less than 0.07 mg (-)-a-bisabolol; VIATRIS GmbH & Co; Frankfurt, Germany), 0.25% hydrocortisone, 0.75% fluocortin butyl ester, or 5% bufexamac. Kamillosan was as effective as hydrocortisone and superior to fluocortin butyl ester and bufexamac in treating inflammatory dermatoses. Additionally, Kamillosan was comparable to hydrocortisone and superior to other tested products in treating neurodermatitis.

A 2009 randomized, double-blind, placebo-controlled study investigated the efficacy of chamomile extract on generalized anxiety disorder (GAD).[38] Over an eight-week period, 57 patients with mild-to-moderate GAD took either chamomile extract (n = 20) standardized to 1.2% apigenin (Spectrum Pharmacy Products; New Brunswick, New Jersey) or placebo (n = 29) at the rate of one 22 mg capsule per day for the first week, increasing one capsule per day for each week through week four. Patients with a 50% reduction in symptoms or less were increased to five capsules daily for weeks five through eight of therapy. Symptoms were measured at baseline and after two, four, six, and eight weeks of treatment. A statistically significant superiority in anxiety test scores (P = 0.047, Hamilton Anxiety Rating, or HAM-A) was seen in the chamomile group compared to placebo.

Using data from the previous study, Amsterdam et al. investigated whether the chamomile extract also treated depression.[39] Of the 57 participants in the 2009 study, 19 had anxiety with depression, 16 had anxiety with a history of depression, and 22 had anxiety with no history of depression. Researchers analyzed the Hamilton Depression Rating (HAM-D) questionnaire completed by participants (before, during, and after treatment) and discovered significantly greater reductions in scores over time for the chamomile group versus the placebo group (P < 0.05), and a meaningful but nonsignificant reduction in participants with current depression (P = 0.062).

A randomized, pre-post study performed in 2009-2010 investigated the efficacy of chamomile in treating irritable bowel syndrome (IBS). Patients diagnosed with IBS (N = 45) took 20 drops per day of a chamomile extract (69.47 mg/100 mL bisabolol and chamazulene; SohaJissa Company; Tehran, Iran) for four weeks.[40] Patients filled out a questionnaire on day one, at weeks two and four, and two and four weeks after the end of the intervention. Symptoms were significantly reduced at weeks two and four (P = 0.001), and relief from symptoms continued up to two weeks after the intervention ended.

A few studies have assessed the usefulness of chamomile in treating stomatitis, a painful inflammation of the oral mucosa that can include ulceration. In two experiments, chamomile was found to be as effective as the conventional pharmaceutical comparison drugs (allopurinol mouthwash vs. chamomile mouthwash,[41] and triamcinolone in Orabase® vs. chamomile in Orabase,[42] respectively). In the first study, the allopurinol and chamomile mouthwashes were equally effective in reducing stomatitis in chemotherapy patients, but the authors noted that the lower cost and greater availability of chamomile (i.e., it does not require a physician's prescription) may make it a better choice for some patients. In the second study, while chamomile did not resolve all symptoms as rapidly as the conventional pharmaceutical drug triamcinolone, pain intensity reduction and patient satisfaction scores were similar between groups.

In a third study, chamomile mouthwash was more effective in treating recurrent aphthous stomatitis (RAS; canker sores) than placebo.[43] In this triple-blind study, 50 patients with aphthous lesions were randomized to receive either chamomile tincture (amount not specified; Matrica Drop; Iran Darouk, formerly Barij Essence; Tehran, Iran) or placebo. Patients were instructed to apply 10 drops three times per day, rinse for three minutes, expectorate, and refrain from eating for 30 minutes. Patients were examined after two, four, and six days, then weekly. The changes in the chamomile group — fewer number of lesions (P = 0.025), smaller lesion size (P = 0.03), and less pain and burning sensation (P = 0.001) — were statistically significant at each examination compared to the placebo group.

In a 2015 study that investigated the efficacy of chamomile in treating knee osteoarthritis (OA), 84 patients with OA were randomized to three groups and instructed to apply their assigned medication to the knee and surrounding area three times per day for three weeks.[44] One group applied 1.5 mL chamomile oil (prepared at Shiraz University in Iran by traditional direct-heat extraction*); the second group applied diclofenac gel; and the control group

*A number of the more recent human clinical studies rely on a chamomile extract obtained through a "direct heat" or "traditional direct heat" method. Unfortunately, the study that describes this method was still in press as of September 2015. However, Hashempur et al. have described the method as follows:

"We purified the flowers and turned it to powder form. Then 600 g of the powder was boiled in 4.5 L of distillated water for 3 h. Then, after removing the plant powder from aqueous extract, 1 L of sesame oil was added to it and was boiled until the whole content was evaporated and oil remained. The final product was standardized based on its essential oil content (2.05% of chamazulene as the main pharmacological ingredient and 62.35% of Bisabolone Oxide as the major ingredient), and analyzed with gas chromatographic with Mass detector (GC/MS) method and also 2.7640 ± 0.1776 mg/L total flavonoid and 11.0043 ± 0.4514 mg/L total polyphenol content."[46]

Chamomile *Matricaria chamomilla*. Photo ©2015 Steven Foster

applied paraffin. Patients were allowed to take 500 mg acetaminophen as needed, and use of the analgesic was examined as one of the outcome measures, along with a self-administered Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) questionnaire at the beginning of the study and every week during the study. The number of acetaminophen tablets taken by the chamomile group was significantly lower than those taken by the other two groups, and, while the chamomile oil showed some beneficial effects on pain, stiffness, and physical activity, these effects did not differ significantly different from the other two groups. The authors recommended further research with larger study populations.

A 2014 prospective, randomized, double-blind study compared chamomile extract to mefenamic acid (MA; a non-steroidal anti-inflammatory drug [NSAID] used to treat pain) for reducing the intensity of mastalgia (breast pain) associated with premenstrual syndrome.[45] Ninety female university students were randomized to receive either 100 mg chamomile (capsules prepared from plant material purchased from Zarband; Tehran, Iran; no further information supplied) or 250 mg MA three times per day from the 21st day of their menstrual cycle until onset for six months. Both chamomile and MA relieved mastalgia intensity with no significant difference between the groups. The authors recommended further studies that do not rely on data collection through subject self-reporting.

In a randomized, double-blind, placebo-controlled pilot study published in 2015, chamomile oil obtained through traditional direct-heat method was investigated for its efficacy in treating severe carpal tunnel syndrome (sCTS) when applied topically as a complementary therapy.[46] Twenty-six patients with documented sCTS were randomized to apply chamomile oil or placebo (paraffin, sesame oil, and 1% chamomile essential oil to mimic the aroma of the chamomile oil) twice daily for four weeks, in addition to wearing an immobilizing wrist splint at night. Primary and secondary outcomes were measured at enrollment and after four weeks. The patients in the chamomile oil group showed significant improvements in severity of symptoms (P = 0.019) and functional ability (P = 0.016) compared to placebo.

Chamomile performed well in a 2011 controlled study comparing its efficacy in managing peristomal skin lesions in colostomy patients versus treatment with hydrocortisone ointment.[47] Participants were assigned to the chamomile group (n = 36) or control group (n = 36) based on matching demographics, history, and skin-condition variables. Patients in the experimental group applied a chamomile compress (6 g air-dried and powdered flower heads steeped in 150 mL boiled water for 10 minutes, strained, and applied to gauze) to the wound for one hour once per day. The control group applied 1% hydrocortisone ointment to their wound once per day. Lesions were evaluated every three days for 28 days, and healing occurred significantly faster in the chamomile group than in the hydrocortisone group (8.89 ± 4.89 days versus 14.53 ± 7.6 days, respectively). Additionally, pain and itching around the stoma was relieved more quickly in the chamomile group.

A 2005 controlled, double-blind, crossover study investigated a chamomile mouthwash for its ability to reduce dental plaque and gingival inflammation.[48] For two four-week periods separated by a washout period of two weeks, 25 randomly assigned patients with gingivitis rinsed with either a chamomile mouthwash (air-dried and powdered chamomile flowers percolated at room temperature with 55% ethanol, extracts filtered, evaporated under vacuum at low temperature, dried residue suspended in water) or control (solvent with no other ingredients). Both groups were instructed to dilute 20 drops of mouthwash with 20

mL water and rinse twice a day for two minutes, once before bedtime. Plaque, gingival inflammation, and stain indices were recorded at baseline and measured at the end of each experimental period and the end of the washout period. Mean reduction for plaque (22 ± 17.83 vs. 5.4 ± 7.93) and gingival indices (0.31 ± 0.23 vs. 0.03 ± 0.11) were significantly greater for the chamomile mouthwash than for the control. Also, there was no significant staining or reduction in baseline staining in the chamomile group.

A prospective epidemiological study published in 2015 explored the connection between chamomile tea consumption and all-cause mortality over the course of seven years in a sample of older Mexican-Americans in the southwestern United States.[49] Of the sample, 13.95% consumed chamomile. Per the Kaplan-Meier estimator, chamomile consumers showed increased overall survival (P = 0.008), with women consumers demonstrating even greater survival (P = 0.011). In the Cox proportional hazards model for all-cause mortality, chamomile was linked to a 29% reduction in mortality risk for the entire sample, a 33% reduction in risk for women, and a nonsignificant reduction for men.

In a 2015 age- and gender-matched case-control study, chamomile tea consumption was associated with a reduction in both benign and malignant thyroid diseases (P < 0.001).[50] The odds of developing any type of thyroid disease decreased significantly with increased frequency of chamomile consumption. Additionally, the risk of developing benign thyroid diseases or thyroid cancer was significantly reduced in those who had consumed chamomile tea for 30 or more years.

FUTURE OUTLOOK

Today, the most important chamomile cultivation areas in Germany are in the states of Thuringia, Bavaria, Saxony, Saxony-Anhalt, and Lower Saxony.[51] Chamomile ranks as Germany's third most popular herbal tea in terms of volume purchased, with an overall 2014 demand of 4,095 MT.[52]

Annual global trade volume for chamomile flower has been estimated to be up to 8,000 MT, mainly supplied by farms in Egypt, Germany, Poland, Argentina, and Slovakia.[5] The area of farmland dedicated to chamomile cultivation is approximately 1,500 ha in Egypt and 1,200 ha in Germany (1,000 ha of which are in the state of Thuringia).[5] Poland has an estimated 750 ha of chamomile cultivation.[53] Other countries that produce and consume significant amounts of chamomile are not included in external trade data. For example, Iran has an estimated 1,000 ha of chamomile production.[5]

While Egypt is the world's top producer and exporter of chamomile, Germany is the top importer. According to El-Shrief et al., Egypt exported an average of 2,592 MT of chamomile annually between 1996 and 2008. Germany imported an average of 1,025 MT (39.5%) followed by 391 MT imported by Spain (15.1%), 202.6 MT by the United States (7.8%), 185 MT by Italy (7.1%), and 131.5 MT by the Netherlands (5.1%).[54] However, a market study funded by the German Ministry for Economic Cooperation and Development (BMZ) found that Egypt's annual export of chamomile was significantly higher, at 5,878 MT, of which 4,013 MT (68.3%) was imported by member states of the EU (mainly Germany, Poland, and the Netherlands), followed by the United States (405 MT; 6.9%), Venezuela (365 MT; 6.2%), and Russia (234 MT; 3.9%).[55] On average, Germany's annual demand accounts for more than half the estimated global d emand, at about 4,500 MT, of which about 600 MT are produced domestically and about 3,900 MT are imported.[56]

There are several quality grades of chamomile, each playing a distinct role in the market:

- Chamomile flower (Matricariae flos) is of pharmacopeial quality and consists of the capitula (infloresence) separated from leaf and stem. It is used in medicinal teas, tinctures, and other phytomedicinal preparations;
- Chamomile fines (Camomile fines) is what is left after removing the capitula. If the essential oil content is high enough, it may be used in pharmaceutical preparations; otherwise, it is used in food products;
- Chamomile herb with flowers (Chamomillae cum floribus herba) is machine-harvested with a high stem content. This material does not conform to pharmacopeial standards and is used in food products or nonmedicinal beverage teas; and
- Chamomile herb (Chamomillae herba) is not produced by plucking the flowers, but rather by cutting the entire aerial parts and without further post-harvest sorting or separating. Due to the high content of plant parts other than the flower heads, this material is used primarily to make extracts for the cosmetics industry.[5]

There are other lower-quality grades as well. One of the authors of this article (JB) has observed the blending

Chamomile *Matricaria chamomilla*. Photo ©2015 Steven Foster

of inferior grades destined for the low-price beverage tea market, comprised mainly of chamomile herb (stems and leaves) after the flowers have been mostly sifted out, with as much as 25% chamomile seed admixed.

For reasons including quality assurance, safety, and traceability, there has been a resurgence of interest in the cultivation of medicinally and economically important herb crops in Europe, especially chamomile. A 2014 market analysis determined that at least 7,200 ha of chamomile cropland in Germany would be necessary for the country to produce 100% of its herbal industry's demand. Presently, Germany produces roughly 16% of its annual chamomile demand.[57]

Cultivation of chamomile is also increasing in other European countries. For example, there is an ongoing US Agency for International Development (USAID) project in Kosovo to support the development of cultivated medicinal and aromatic plant crops for its export market. More than 60% of the acreage in this project is dedicated to chamomile.[58] Chamomile cultivation in neighboring Serbia is also increasing with an estimated 250 ha in 2013.[59]

Serbia is home to Euro Prima, one of the world's leading producers and suppliers of harvest and post-harvest machines specifically designed for German chamomile crops.[60] Because pharmacopeial-quality chamomile is composed of only the capitula, specialized equipment is needed when machine-harvesting the entire aerial parts in order to effectively separate the inflorescence from the stalks before drying.

If they are not picking flowers manually, most chamomile farmers around the world are still using mechanical harvesters developed in the mid-1970s. Until recently, very little research has been conducted to improve the technology. A four-year study from 2010-2013 funded by the German Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) evaluated current methods and equipment used for mechanical harvesting of chamomile with the goal to develop a modernized harvesting machine for improved efficiency and quality.[61-63] A related one-year German government-funded project in 2014-2015 aimed to optimize the newly developed chamomile flower harvester in order to finalize the design of a production-ready prototype.[64]

Chamomile flower remains one of the most in-demand medicinal plants in global trade, and annual demand predictably will continue to grow. Up until the mid-20th century, market requirements were satisfied by wild collection in eastern and central Europe — particularly in Germany, Hungary, and the Balkan countries — but, in recent decades, cultivation has scaled up in certain African and South American countries (e.g., Egypt and Argentina, respectively) where production costs are lower.

In the 21st century, increasing demand for sustainable (organic and fair trade) chamomile has become a new factor for producers to consider.[65] While still considered a niche market, dual-certified "organic and fair trade" herbs, particularly chamomile, have been showing triple-digit growth rates.

While certified organic, wild-collected chamomile is available from Albania, Hungary, and Macedonia, and certified organic and fair trade cultivated chamomile is available mainly from Egypt, market demand has consistently exceeded supply in the past few years. Producers in several countries are working to increase production of organic and fair trade chamomile to catch up with demand. The trend of sustainable chamomile production in developing countries in Africa, Asia, and South America is expected to continue, as is the concurrent trend to increase sustainable chamomile production (both cultivated and wild) in areas within the herb's geographical origin in Europe and western Asia. HG

—Gayle Engels and Josef Brinckmann

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Teawolf Sponsors South American Herb Guayusa Through ABC's Adopt-an-Herb Program

Natural ingredients manufacturer Teawolf has agreed to sponsor the caffeine-rich South American herb guayusa (*Ilex guayusa*, Aquifoliaceae) through the American Botanical Council's (ABC's) Adopt-an-Herb Program. Teawolf's three-year commitment helps ABC keep its HerbMedPro™ database up to date with the latest scientific and clinical research on guayusa, a member of the holly family. HerbMedPro is an interactive database available on ABC's website that provides access to comprehensive research data underlying the use of approximately 250 herbs and their effects on human health.

"This herb has become increasingly popular in the specialty herbal tea market in the past few years," said ABC Founder and Executive Director Mark Blumenthal. "ABC is pleased that Teawolf has joined the growing family of companies participating in the ABC Adopt-an-Herb Program. We appreciate Teawolf's commitment to ensuring that ABC has the resources to keep up with scientific research papers on guayusa in ABC's information-rich HerbMedPro database."

Ilex guayusa is a small tree that is native to Ecuador, Peru, and Colombia. Guayusa is one of three plants in the holly family that contains caffeine. Its use as a stimulating beverage by the indigenous peoples of the region has led to its recent popularity in the herbal tea market. In the 2014 US herbal beverage tea (bag) category,[1] guayusa was one of the five top-selling botanicals. Guayusa contains theobromine, a stimulant found in chocolate, and L-theanine, a compound found in green tea that has been shown to reduce physical and mental stress. In addition, guayusa contains guanidine, a known anti-hypoglycemic substance. In animal studies, a concentrated aqueous preparation of guayusa was shown to significantly reduce excessive thirst, uncontrolled appetite, and weight loss associated with diabetes.

Among its other traditional uses, guayusa has been taken in relatively large doses by certain South American tribes for use as an emetic for ritualistic and health purposes. The Amaguajes tribe used it to treat diabetes, and, in Ecuador, it was used to counteract female sterility. In Peru, the tea is used to treat infertility and venereal disease, and as an emetic, fever reducer, stimulant, and tonic.

Teawolf joins 35 companies that have supported ABC's ongoing educational efforts — to collect, organize, and disseminate reliable, traditional, science-based, and clinical information on herbs, medicinal plants, and other botanical- and fungal-based ingredients — through the Adopt-an-Herb Program. Adopt-an-Herb encourages companies and individuals to "adopt" one or more specific herbs for inclusion and ongoing maintenance in the HerbMedPro database. To date, 40 herbs have been adopted.

The HerbMedPro record for each adopted herb is continuously updated with new articles and studies, ensuring that it stays current and robust. The result is an unparalleled resource, not only for researchers, health professionals, industry, and consumers, but for all members of the herbal and dietary supplements community, and others.

HerbMedPro can be accessed via ABC's website and is available to members at the academic level and higher. Its sister site, HerbMed®, is free and available to the general public, which increases the number of people who benefit from updated herbal information in accordance with ABC's mission. In keeping with ABC's position as an independent nonprofit organization, herb adopters do not influence the scientific information that is compiled for their respective adopted herbs.

Teawolf, LLC is an ingredient manufacturing company servicing the food, beverage, and nutritional industries. Founded in 2009, the company maintains its headquarters in Pine Brook, New Jersey. Teawolf focuses exclusively on extraction of a wide range of natural products, including tea, vanilla, cocoa, coffee, guayusa, and hibiscus. More information about the company is available at www.teawolf.com. HG

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New Employee Profile: Candice Jensen

Candice Jensen's experience working for nonprofit organizations helped prepare her for her new role as the American Botanical Council's (ABC's) communications and marketing coordinator. A native of San Antonio, Jensen moved to Phoenix in 2010, where she worked for the Arizona Science Center and then the Arizona Humane Society. Those experiences, and others, helped hone skills that are now assets to ABC.

When she moved from Phoenix to Austin in 2014, Jensen knew she wanted to find the right nonprofit, and she thought the position at ABC was well-suited to her skills. "I felt like I could really fit this position well, not to say that I don't have lots of room to grow, because there are a lot of things that I'm learning here at ABC," she said.

Jensen, who received her associate's degree in communications from the University of Phoenix in 2012, describes herself as a life-long learner. "I have a thirst for knowledge," she said. She also considers herself to be realistic, goal-oriented, and organized. "I laugh when I'm uncomfortable," she added with a laugh.

She has a good sense of humor and brings an optimistic, ebullient disposition to the organization. "I would consider myself a pretty positive person." she said. She tries to see the good that comes out of all situations.

Jensen started at ABC in late July, and she has already hit the ground running. Perhaps the biggest project on the horizon for her is the update of ABC's website, which she will help manage. Her knowledge of web development and knack for digital marketing will come in handy for the project, which will be done in-house.

"I love web development and different applications," she said. The website overhaul won't happen overnight, though. "It'll be a long road to get to that goal," she said. "And that whole journey is going to be a lot of fun."

The redesign process will require a deeper understanding of the demographics of people who benefit from ABC's many educational services, including members and others who visit the website out of curiosity. "That's part of the challenge for the new website, but just knowing [the demographics] will be really great," Jensen said. "We're going to learn so much about who we are and how we can grow even more."

Some of her other responsibilities include maintaining the website (including troubleshooting), making sure educational content is frequently updated, answering user questions, maintaining social media, and interacting with the community via those channels.

"Candice is a fantastic addition to the ABC team," said Denise Meikel, ABC's development director and Jensen's supervisor. "She's a unique blend of great technical skills, a delightful personality, and a drive to see projects completed, and completed well. We're grateful to have her with us!"

Jensen's job is all about expanding ABC's audience and publicizing its unique nonprofit educational mission. "Really bringing that awareness to people who don't quite know who we are is always part of the goal at the end of the day," she said.

Jensen enjoys interacting with her colleagues and figuring out everyone's roles in the organization. She admits her job has certain challenges, though. Sometimes, the content can be difficult. "It's quite dense, but there I think lies a good challenge for [me]. I hope to further my knowledge of the herbs, [and] everything that we're talking about, so I can speak to it in confidence myself," she said.

She has even considered taking classes or getting certifications to help improve her understanding of botany and increase the value of her contributions.

Jensen said she believes in ABC's nonprofit mission. "It really seems like there's a need for it, because herbal medicine has always been around. That was the first form of medicine. It's the best form of medicine. It's something to protect," she said. "And I don't think a lot of people think about that."

She has always had an interest in gardening. "I've always wanted to have my own garden, but really don't think I have been given a green thumb," she said laughingly, adding that most of her plants don't survive. But she hopes one day to dedicate more time to gardening.

Jensen likes living in Austin. She thinks the city's people are unique. "I love the people here, not to mention there are a ton of activities and things to do here, but the people really make it great," she said.

In her spare time, Jensen enjoys doing yoga, cooking healthy and organic meals, getting outdoors (e.g., hiking, paddle boarding, and kayaking), reading blogs, and watching all kinds of documentaries and TV shows on Netflix, including "Friends." She also enjoys seeing her niece and nephew as often as she can. She is married to her husband, Justin. HG

—Connor Yearsley

Professor Heather Boon Receives 2015 Dr. Rogers Prize for Excellence in Complementary and Alternative Medicine

Heather Boon, PhD, was named the 2015 recipient of the prestigious Dr. Rogers Prize for Excellence in Complementary and Alternative Medicine. Dr. Boon, professor and dean of the Leslie Dan Faculty of Pharmacy at the University of Toronto, received the prize on September 25, at a special gala event in Vancouver. The Dr. Rogers Prize "recognizes those who embody the same level of vision, leadership, and integrity as that of the late Dr. Roger Hayward Rogers … [and] highlights the important contributions of complementary and alternative medicine (CAM) to health care."[1]

Graduating as a pharmacist in 1991, Dr. Boon's interest in CAM was prompted by the relative lack of research in the field at that time. In 1996, she completed her doctorate, investigating the socialization of the naturopathic medicine practice in Canada. Throughout a career spanning almost 25 years, she has received funding for numerous research projects, supervised and taught many students, and authored more than 150 academic publications, many of which were focused on herbal medicine.

Heather Boon, PhD. Photo courtesy of University of Toronto.

Established in 2007, the Dr. Rogers Prize is awarded every two years. It is named in honor of the late Roger Hayward Rogers, MD, one of Canada's pioneers of complementary and alternative medicine. The $250,000 prize is funded by the Lotte and John Hecht Memorial Foundation. As one of its priorities, the foundation supports work and research in CAM and has been instrumental in the development of a robust, respectful, and collaborative CAM research community in Canada.

Dr. Boon's professional approach has emphasized the importance of collaboration and respect. It has also been centered on conducting research of the highest quality, and on building bridges and fostering dialogue between the complementary and conventional health care communities. Furthermore, she has helped advance core competencies for practicing pharmacists and students through the development of pharmacy program curricula and the delivery of continuing education courses.

In 2004, Dr. Boon, working with her colleague Marja Verhoef, PhD, from the University of Calgary, obtained funding from the Government of Canada to create the Canadian Interdisciplinary Network for CAM Research (IN-CAM). Building on her work with IN-CAM and recognizing the importance of establishing an international community, Dr. Boon was a founding member of the International Society for Complementary Medicine Research (ISCMR), serving as president from 2013 to 2015. Dr. Boon also is one of the primary forces behind the development of the new Centre for Integrative Medicine, a joint venture between the University of Toronto Faculties of Medicine and Pharmacy and the Scarborough Hospital in Scarborough, Ontario.

Dr. Boon was appointed to Health Canada's Expert Advisory Committee for Natural Health Products in 2003 and served as chair from 2006 to 2009. During this time, she played an important role in the development of Canada's *Natural Health Products Regulations*. Dr. Boon continues to play a key role in Canadian policy and regulation with her research evaluating the impact of the *Natural Health Products Regulations*, as well as the effects of CAM regulations on practitioners.

Herbal medicine has always played an important part in

Dr. Boon's work. In addition to co-authoring one of the first evidence-based books on herbal medicine, *The Botanical Pharmacy** (Quarry Press, 1999), which was updated in 2009, many of her academic publications center on the use and safety of herbal medicines.

Working with Sunita Vohra, MD, from the University of Alberta, Dr. Boon also is involved in research on adverse events related to herbal medicines. One project, the "Study of Natural Health Product Adverse Events" (SONAR), explored how active intervention by community pharmacists could help identify potential interactions between pharmaceutical drugs and herbal medicines.[2] This project was a collaboration among government, researchers, and practitioners. In addition, Dr. Boon was part of the team that developed an herbal medicine/drug interaction grid for health care professionals to help them provide accurate information to their patients.

In the 1990s and early 2000s, as randomized controlled trials (RCTs) of herbal medicines became more prevalent, investigators began to question whether the Consolidated Standards of Reporting Trials (CONSORT) Statement was adequate and appropriate for herbal products. Recognizing that RCTs of herbal medicines faced subject-specific challenges, Dr. Boon was part of the team that developed additional checklist items specific to botanical products. These supplementary items require descriptions of the plant part used and details on the methods of authentication, extraction, and identification. This important work, titled "Reporting randomized, controlled trials of herbal interventions: an elaborated CONSORT statement," was published in the *Annals of Internal Medicine* in 2006.[3] HG

—Michael Smith, BPharm (Hons), ND

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* The author of this article is a co-author of *The Botanical Pharmacy*.

European Medicines Agency Begins Issuing Consumer-Friendly Herb Summaries

The European Medicines Agency (EMA), which is responsible for the evaluation of medicines used within the European Union (EU), has announced that it will regularly publish consumer-friendly summaries of the findings of its Committee on Herbal Medicinal Products (HMPC) on its website. The main purpose of the HMPC is to review all available scientific data on the use of specific herbal medicines, including information on safety and effectiveness, and to issue conclusions in EU herbal monographs on how to use these medicines responsibly.

Since its establishment in 2004, the HMPC has issued more than 140 of these monographs, which include approved therapeutic uses, recommended dosages, possible adverse side effects, contraindications, and interactions with other medicines, among other information.[1] The monographs cover a range of therapeutic uses, with gastrointestinal disorders, urinary tract and gynecological disorders, and cough and cold being the most frequently covered. The monographs were initially meant to help EU Member States when reviewing medicinal applications for herbal products submitted by phytomedicine companies and others in the herb industry.[1]

These monographs support two bases (see table below) for marketing herbal preparations as herbal medicinal products (HMPs).

The new consumer-accessible summaries will abridge the monographs, which are also published on the EMA's website. Each summary will follow the same basic format. For example, the three-page summary on *Ginkgo biloba* leaf medicines, which contain a specific herbal preparation made by powdering the dried leaf or as a dry extract, includes a general description of the leaf, the HMPC's conclusions about the uses of medicines made from the two previously mentioned preparations, proposed mechanisms of action, evidence to support their use, and possible risks associated with use.

Well-established use basis	Scientific evidence supports safety and effectiveness, covering a period of at least 10 years in the EU[2]
	Fulfils usual requirements for medicines in the EU
	Also known as licensed medicines
Traditional use basis	Effectiveness is plausible despite insufficient evidence from human clinical trials, and evidence exists that they have been used safely in the same way for at least 30 years (including at least 15 in the EU)[2]
	Fulfils terms of the Traditional Herbal Medicinal Products Directive
	Considered by some to be the favored route
	Must comply with medicinal standards of quality assurance and safety monitoring
	Also known as registered medicines

The EMA has previously released summaries for some herbal substances, but it will now do this systematically for all newly assessed substances, as well as for previously assessed substances. The summaries are meant to complement information contained on the packages of the medicines that contain the substances and will eventually be made available in all official EU languages.[1]

Six new summaries were released on August 3, 2015, when the EMA announced this new feature:

- California poppy (*Eschscholzia californica*, Papaveraceae)
- Ginkgo (*Ginkgo biloba*, Ginkgoaceae)
- Comfrey root (*Symphytum officinale*, Boraginaceae)
- Capsicum pepper (*Capsicum annuum* var. *minimum* and *C. frutescens*, Solanaceae)
- Agrimony (*Agrimonia eupatoria*, Rosaceae)
- Mouse-ear hawkweed (*Hieracium pilosella*, Asteraceae)

Though millions of people throughout Europe use herbal medicines, confusion exists regarding the distinction between HMPs and botanical food supplements: the former are regulated as drugs and the latter as food supplements under different EU regulations and requirements. Simon Mills, noted author, medicinal plant expert, and secretary of the European Scientific Cooperative on Phytotherapy (ESCOP), a pan-European consortium of research experts, said the new summaries could help address this problem. "It is likely that the EMA is intent on raising public awareness of the status of herbal medicinal products, given the widespread ignorance of this category in some Member States," Mills said (email, August 14, 2015). Mills is a longtime member of the American Botanical Council Advisory Board.

A recent BBC investigation found that many of the botanical food supplements sold in the UK contained little or none of the product declared on the label.[3] Experts from the University College London analyzed 30 ginkgo food supplement products, and eight were found to contain little or no ginkgo extract. However, all of the HMPs analyzed contained what was stated on the label. "I'm sure this was a

California Poppy *Eschscholzia californica*
Photo ©2015 Steven Foster

Agrimony *Agrimonia eupatoria*
Photo ©2015 Steven Foster

Capsicum pepper *Capsicum annuum*
Photo ©2015 Steven Foster

shock to most of the public," Mills said.

HMPs make certain medical claims and therefore require a marketing authorization or registration. Although botanical food supplements must comply with food law legislation, they do not have to be authorized or registered to be sold in the United Kingdom because they do not make medical claims.[4] This has led some suppliers to produce low-quality, misleading products, whether out of dishonesty or ineptitude, according to the BBC article.[3]

Mills advised UK consumers to look for the traditional herbal registration logo that distinguishes a medicine from a botanical food supplement. In some Member States, botanical food supplements are penetrating the market because they are considerably less expensive to produce than HMPs. Mills said that in the face of this competition, the traditional herbal medicine sector is intent on getting the message out that HMPs are more expensive because they deliver results.

"To support this message, it will help to have more consumer-friendly information about licensed or registered herbal medicines," Mills said. HG

—Connor Yearsley

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Chinese Government Takes Action Against Companies Producing Substandard and Adulterated Ginkgo Extracts

Companies in violation will be dealt with 'severely and strictly'

The Chinese government has recently released a number of documents indicating its actions against pharmaceutical companies that have allegedly produced or re-sold adulterated, mislabeled, or otherwise improperly produced ginkgo (*Ginkgo biloba*, Ginkgoaceae) extracts, or manufactured finished products containing such extracts. The actions are in response to growing reports of this problem. Within a period of about 10 days in May 2015, and then again in July, the China Food and Drug Administration (CFDA) issued at least four regulatory documents related to the production, labeling, and sale of ginkgo extract.

The first regulatory action notice[1] was issued on May 19. The document detailed the results of the CFDA's recent inspections of facilities of companies offering "low-cost" ginkgo extracts and noted that some "serious illegal problems" were found.

The bulletin stated that an inspection of the Guilin Xingda Pharmaceutical Co. Ltd. detected the use of inappropriate solvents in the manufacture of ginkgo extract. The company allegedly used 3% hydrochloric acid (HCl), instead of ethanol and water. It also allegedly purchased ginkgo extract illegally from an "unqualified" enterprise to produce ginkgo tablets and sell the purchased extract to another drug manufacturer. In addition, the company allegedly made false raw material purchasing records, false batch production records, and false batch test records.

In the same notice, the CFDA documented problems with the Wanbangde (Hunan) Natural Pharmaceutical Co. Ltd., which reportedly purchased ginkgo extract to produce ginkgo tablets and capsules, while also allegedly creating "fake raw material purchasing" records and false batch production and batch test records.

The regulatory agency noted that the actions of both companies violate Article 9, Article 32, and other provisions of the Drug Administration Law of the People's Republic of China. The actions also violate the "Ginkgo Biloba Leaf Extract" standards of the *Pharmacopoeia of the People's Republic of China*.[2] The CFDA explained that the use of HCl can "decompose the effective constituents of medicine and affect the curative effect of medicine."[1]

As part of its investigation and regulatory action, the CFDA asked for all parties to discontinue the sale and use of ginkgo medicines produced by these two companies [Guilin Xingda Pharmaceutical Co. Ltd. and Wanbangde (Hunan) Natural Plant Pharmacy Co. Ltd.]. The provincial Food and Drug Administrations (FDAs) of Guangxi and Hunan provinces were instructed to monitor these enterprises and to recall the products in question. The FDAs of other provinces and autonomous regions were said to be responsible for recalls in their respective areas.

The investigation found that 24 drug manufacturers illegally purchased ginkgo extract from Guilin Xingda Pharmaceutical Co. Ltd. Regulatory authorities were instructed to review these companies and take immediate action, including recall of affected products. The authorities also advised *all* manufacturers of ginkgo extract and ginkgo extract preparations to conduct immediate internal examinations to determine if any of the previously noted irregularities could be found. Companies were given a deadline of May 24 to report to local FDA offices, cease all "illegal behaviors," recall any affected products, and seal all equipment, raw materials, inventory, and related purchasing, production, and sales records.

Finally, the first notice stated that the CFDA will conduct

a "comprehensive inspection of *Ginkgo biloba* preparations on sale in the market." It will also inspect "some enterprises" — with violators subject to punitive action — and publish the results.[1]

In the second notice published on May 20, the CFDA notified all regulatory parties in China of its investigations of Guilin Dayao Ye Ltd. "and other enterprises which illegally manufactured and sold *Ginkgo biloba* drug," instructing regulatory agencies to carry out inspections and related regulatory actions.[3] Such actions include taking "effective measures to stop any [further] use of these products, to effectively recall all the products in place," with appropriate reporting to local regulatory agencies and the CFDA General Office.

Per the notice, the CFDA required local regulatory agencies to inspect all 24 pharmaceutical manufacturers that purchased ginkgo extract from Guilin Xingda Pharmaceutical Co. Ltd., and to recall any ginkgo extract materials produced with diluted HCl. It also required any information on such actions to be sent to all relevant provinces, autonomous regions, municipalities, and to the General Office. According to the document, companies found to be operating illegally that did not respond appropriately would "be dealt with severely and strictly."[3]

Ginkgo *Ginkgo biloba*
Photo ©2015 Steven Foster

On May 29, the CFDA issued a short announcement concerning the results of surprise inspections of Shenzhen Neptunus Bioengineering Co. on May 21 and Ningbo Liwah Pharmaceutical Co. Ltd. on May 23. The inspection of Ningbo Liwah Pharmaceutical Co. Ltd., which supplies Shenzhen Neptunus Bioengineering Co. with ginkgo extract, revealed that the company had purchased ginkgo extract from eight companies — although the document lists only seven — that the CFDA deemed "unqualified" (i.e., the extract was either adulterated or produced using an improper manufacturing process).[4]

According to the CFDA, Ningbo Liwah Pharmaceutical Co. Ltd. purchased ginkgo extracts and tested them using Chinese pharmacopeial methods and their own business standards, then added their name to the extracts' labels. The CFDA document stated that the company sold these ginkgo extracts to Shenzhen Neptunus Bioengineering Co., Yangtze River Pharmaceutical Group Co. Ltd., and other companies (not named) for use in the production of drug products, and also to Wuxi Giant Pharmaceutical Co. Ltd. and others for use in the production of functional foods.

The document also noted that the Guangdong FDA instructed Shenzhen Neptunus Bioengineering Co. to stop producing related ginkgo products and that the agency would continue its investigation. The Zhejiang FDA reportedly made another inspection of Ningbo Liwah Pharmaceutical Co. Ltd. and opened a case for further investigation.

The CFDA's announcement on July 7 reported that 203 companies in China had registered health foods (also referred to as "blue hats," since the logo resembles a blue hat) containing ginkgo extracts.[5] Among them, 129 enterprises were in operation, while 74 companies had stopped producing ginkgo extract-containing health foods. Of the companies in operation, 12 used unqualified ginkgo extract raw materials. An inspection found 5.94 metric tons (MT) of unqualified raw material, of which 2.28 MT had been used, 1.37 MT had been destroyed, and 2.29 MT were in quarantine. The investigation also found 30.9 MT of substandard finished dietary supplement products, of which 10.4 MT had been recalled, 0.023 MT (24 kilograms) had been destroyed, and 20.4 MT had been quarantined.

Twelve companies were found to have bought substandard ginkgo raw material from nine suppliers. Companies that manufacture or sell ginkgo ingredients and products are required to verify the quality of their materials and report the results to the CFDA. At the same time, provincial FDA branches were asked to continue the inspections and to report the findings to the CFDA by August 10.[4]

It is not clear to what extent, if any, the ginkgo extracts and finished ginkgo products made by the companies noted above may be exported to the international botanical market. Reports from the past 13 years document adulteration of various commercial samples of ginkgo extracts.[6-16]

According to various insiders who are aware of the state

of the ginkgo extraction industry in China, the issue of whether Chinese ginkgo extracts are being exported to the United States is particularly complicated. First, the CFDA's actions targeted companies that produce ginkgo-containing pharmaceutical products and/or registered health foods. These producers are approved and qualified by the CFDA, and some export ginkgo extract to the US and other countries. According to industry sources, the CFDA has no authority over raw materials and extracts sold overseas; therefore, it seems as if the current regulatory event in China does not cover exports from CFDA-approved ginkgo raw material and extract producers. Further, a large number of ginkgo extract producers in China manufacture extracts for overseas markets only. These producers reportedly are not subject to any Chinese government agencies' supervision. Therefore, the quality of the extracts from these companies may be more suspect than those under the supervision of the CFDA.

According to Cal Bewicke, CEO of Ethical Naturals Inc., a San Anselmo**,** California-based importer and marketer of supplier-qualified herbal extracts, including ginkgo, in order to sell ginkgo products at retail in China, a company needs a pharmaceutical license and must also buy ginkgo leaf raw material from suppliers with pharmaceutical licenses (email, July 4, 2015).

The companies mentioned by the CFDA in its investigations and notices are pharmaceutical companies selling to the Chinese retail market, or pharmaceutical manufacturers selling ginkgo extract to these companies to make tablets, capsules, or liquid, Bewicke noted.

"Many of the problems mentioned in the reports from [the] CFDA have to do with these companies buying materials from unlicensed sources, falsifying documentation to cover this up, and in one case, using HCl as a solvent," Bewicke added. "They are not *directly* linked to adulteration problems in material supplied to the US market. However, the extent of the problems noted in these investigations underlines once again the importance of real supply chain custody documentation, supported by a full US-based testing program for all imported ginkgo extracts." HG

—Mark Blumenthal

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Cranberry *Vaccinium macrocarpon*. Photo ©2015 Steven Foster

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Cranberry Juice Cocktail Consumption Correlates with Lower Blood Levels of C-reactive Protein

Reviewed: Duffey KJ, Sutherland LA. Adult consumers of cranberry juice cocktail have lower C-reactive protein levels compared with nonconsumers. *Nutr Res*. February 2015;35(2):118-126.

Editor's note: *The authors of the journal article are scientific consultants for Ocean Spray Cranberries, Inc. (Lakeville-Middleboro, Massachusetts), which provided unrestricted funding for the study. The sponsor had no input in the study design or interpretation of the results.*

Consumption of sweetened drinks has been shown to correlate with weight gain, obesity, metabolic syndrome, and diabetes. However, unlike other sweetened beverages, fruit juice may provide certain health benefits due to beneficial components such as antioxidants, vitamins, and fiber. Cranberry (*Vaccinium macrocarpon*, Ericaceae) fruit juice is high in antioxidants, including proanthocyanidins and anthocyanins, which impart a dark red color to the juice. Cranberry juice is tart and naturally low in sugar, so sugar may be added to make the juice more palatable. Sweetened cranberry juice is often designated "cranberry juice cocktail" (CJC). The current observational study examined the association of CJC consumption with anthropometric parameters and concentration of inflammatory biomarkers, insulin, and lipids in the blood.

Data from participants (N = 10,891) aged 19 years or older were taken from the National Health and Nutrition Examination Survey (NHANES) conducted by the US Centers for Disease Control and Prevention between 2005 and 2008. Of these subjects, 557 were excluded because no data were provided on CJC consumption. The study consisted of a physical examination — which included fasting blood collection, anthropometric measurements (height, weight, waist circumference, and body mass index [BMI]), and dietary recall for the previous 24-hour period — and a phone interview 3-10 days later, in which subjects again recalled their diet from the last 24 hours. CJC consumption was calculated as the total consumption for both 24-hour periods.

Researchers collected demographic information and measured blood levels of total cholesterol, high-density lipoprotein (HDL), triglycerides (TG), glucose, insulin, and C-reactive protein (CRP), a marker of systemic inflammation in the body. (High levels of CRP in the blood can indicate an infection or inflammation caused by another source; some research suggests that CRP levels may also provide information about a patient's risk of cardiovascular disease.[1]) Low-density lipoprotein (LDL, sometimes referred to as "bad cholesterol") was calculated

by subtracting HDL and TG from the total cholesterol concentration. Data were analyzed with different statistical methods: the Student's t-test, chi-squared analysis, and linear and Poisson regression.

On average, CJC consumers drank 404 mL of CJC per two-day period, while "nonconsumers" drank 12 mL of the juice during the same period. CJC consumers had significantly higher carbohydrate and polyphenolic intake than nonconsumers ($P < 0.05$). In addition, CRP concentrations were lower in CJC consumers than nonconsumers ($P = 0.015$). CJC consumers tended to have smaller waist circumferences as well as lower BMIs and levels of fasting glucose, insulin, total cholesterol, and TG, but the differences were not statistically significant. CJC consumers also were more likely to be of normal weight. The authors suggest that this outcome may be directly related to, but not necessarily caused by, consumption of the sweetened fruit juice; alternatively, the authors propose that CJC consumption simply may be indicative of the juice consumers' generally healthy diet and lifestyle.

Although this study included a measure of total energy intake, it did not control for the consumption of specific food types, which would have been helpful in identifying confounding factors. Previous studies have found positive relationships between acute cranberry juice consumption and plasma antioxidant levels. This suggests that cranberry juice may lower oxidative stress and inflammation, which would be consistent with the lowered CRP levels found in this study. Yet, other studies have found no relationship between acute cranberry juice consumption and blood antioxidant or CRP levels. This study was limited by its observational nature, which made it difficult to infer a direct relationship between CJC consumption and lowered CRP levels and smaller waist circumferences. HG

—Cheryl McCutchan, PhD

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Cranberry *Vaccinium macrocarpon*
Photo ©2015 Steven Foster

Meta-analysis Shows Benefit of Ginkgo Extract as Adjunct Therapy for Chronic Schizophrenia

Reviewed: Chen X, Hong Y, Zheng P. Efficacy and safety of extract of *Ginkgo biloba* as an adjunct therapy in chronic schizophrenia: a systematic review of randomized, double-blind, placebo-controlled studies with meta-analysis. *Psychiatry Res*. 2015;228(1):121-127.

The exact cause of schizophrenia is unknown. One theory is that excessive production of free radicals, oxidative stress, and an increase in lipid peroxides may be involved in the pathogenesis. Therefore, free radical scavengers (e.g., antioxidants) may be useful as a treatment for schizophrenia. Ginkgo (*Ginkgo biloba*, Ginkgoaceae) leaf standardized extract is a free radical scavenger that has been evaluated as a treatment for schizophrenia with mixed results. However, according to the authors of this review, previous meta-analyses[1,2] have failed to take into account the numerous studies available only in Chinese. Hence, the purpose of this meta-analysis was to compile, without restricting language, studies that evaluated the safety and efficacy of ginkgo extract as an adjunct therapy for patients with schizophrenia. Curiously, only Chinese-language studies were ultimately included.

Ginkgo *Ginkgo biloba*
Photo ©2015 Steven Foster

The following electronic databases were searched from inception through March 23, 2014: PubMed/MEDLINE, EMBASE, PsycINFO, the Cochrane Library, China National Knowledge Infrastructure, WanFang Data Digital Periodicals, and Chinese Scientific Journals Database. Studies were included if they had a randomized, double-blind, placebo-controlled design with complete data analysis; involved participants with chronic schizophrenia; and used ginkgo as an adjunct therapy. The included studies did not restrict race or nationality of patients.

The primary outcome variables of the included studies were based on the Brief Psychiatric Rating Scale (BPRS), the Scale for the Assessment of Negative Symptoms (SANS), and/or the Positive and Negative Syndrome Scale (PANSS). These are all scales used to quantitatively measure the severity of different schizophrenia symptoms. The secondary outcome variables were adverse reactions, measured using the Treatment Emergent Symptom Scale (TESS) and the Rating Scale for Extrapyramidal Side Effects (RSESE). The methodological quality of the studies was evaluated according to the Cochrane Handbook. Repeated data articles and duplicate studies were excluded.

A total of 339 studies were retrieved from the initial search, but only eight Chinese articles met all of the inclusion criteria. Together, the studies included 1033 patients (571 treated with ginkgo and 462 treated with placebo) who had been diagnosed with schizophrenia at least three years prior to the study. The average onset age ranged from 30-50 years, and the number of participants ranged from 29 to 512.

Patients were treated with either 240 mg/day ginkgo extract (four studies) or 360 mg/day ginkgo extract (four studies), for eight weeks (one study), 12 weeks (three studies), or 16 weeks (four studies), while continuing to take their original antipsychotic medication. All studies report having used the standardized ginkgo extract product EGb 761® (Dr. Willmar Schwabe; Karlsruhe, Germany).

The authors stated that the pooled studies had a low overall risk of bias. However, only one randomized controlled trial out of eight reported its randomization method clearly and used allocation concealments, which indicates that the risk of bias was underestimated. Seven of the eight studies were combined into a meta-analysis to determine the effect of ginkgo as an adjunct therapy for total symptoms of chronic schizophrenia (e.g., delusion, disorganized thinking, and hallucinations), and all eight studies were included in the meta-analysis to deter-

mine the effect of ginkgo on negative symptoms of schizophrenia (e.g., avolition [lack of interest] and psychomotor poverty [lack of speech, decreased spontaneous movements, and blunting of emotion][3]). There was no statistical heterogeneity for either endpoint, which suggests consistent methodology among the studies. The ginkgo groups had significantly greater improvements in total symptoms and negative symptoms compared with placebo groups ($P < 0.01$ for both). However, the study with the largest sample size (n = 512) — which reported a benefit of ginkgo — contributed more heavily to these outcomes (28.5% and 48.5%, respectively).

Five of the studies reported adverse events (AEs). The adverse event scores (e.g., for behavioral toxicity, thirst, tachyarrhythmia, etc.) were similar among treatment and placebo groups. The AEs were scored lower in the ginkgo group, but the difference among groups was not significantly different. One study reported that two placebo-treated patients received 480 mg/day of ginkgo extract (after the end of the study) as an adjunct to their psychiatric treatment in an attempt to improve negative symptoms that were not responding to therapy. Both patients had severe persecutory delusions after 12 and 14 days of ginkgo use, a symptom that resolved after stopping ginkgo treatment and receiving additional antipsychotic drugs. The authors conclude that the safety of ginkgo as an adjunct therapy for schizophrenia may be related to its dose, and that additional research is needed.

The authors state that ginkgo adjunct therapy may be more beneficial than antipsychotics alone in people with chronic schizophrenia. The severity of adverse side effects associated with ginkgo may be related to the relatively higher dose of the herb that was administered to certain patients. The authors acknowledge that the meta-analysis was limited by the inclusion of only eight studies with Chinese participants. However, the authors note that the study is valuable because it fills a gap in Western-centered research publications. HG

—Heather S. Oliff, PhD

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Lavender Aroma Increases Interpersonal Trust in Healthy Young Adults

Reviewed: Sellaro R, van Dijk WW, Paccani CR, Hommel B, Colzato LS. A question of scent: lavender aroma promotes interpersonal trust. *Front Psychol*. January 2015;5:1486. doi:10.3389/fpsyg.2014.01486.

Previous studies have indicated that the scent of lavender (*Lavandula* spp., Lamiaceae) has calming effects and induces a more inclusive cognitive-control mode,[1,2] whereas the scent of peppermint (*Mentha* × *piperita*, Lamiaceae) has stimulating effects and induces a more exclusive cognitive-control mode. (Cognitive control "refers to processes that allow information processing and behavior to vary adaptively from moment to moment depending on current goals, rather than remaining rigid and inflexible."[3]) Other research suggests that interpersonal trust can be enhanced in a more inclusive cognitive-control state.[4] Based on these observations, the aim of this study was to test if aromas are linked to interpersonal trust in healthy young adults exposed to the scent of lavender or peppermint while playing a behavioral trust game.

A total of 90 subjects aged 18-24 years, consisting of 68 women and 22 men, participated in the study conducted at the Leiden Institute for Brain and Cognition at Leiden University in the Netherlands. Subjects were excluded if they used drugs or had a psychiatric disorder, as assessed by the Mini International Neuropsychiatric Interview (MINI).

Participants were randomly distributed into three groups (30 in each group) that included the following: those who played the trust game in a lavender-scented room, a peppermint-scented room, or in a non-scented room (control group). Subjects were told that they were in a decision-making study, but were not informed about the study's hypothesis or that there would be aromas in the room.

The aromas were produced by a candle diffuser containing four drops of lavender or peppermint essential oil (De Tuinen™ Aromatherapie; Beverwijk, the Netherlands) in 30 mL of water. The diffusers were out of sight and lighted 20 minutes before the testing session to ensure uniform diffusion. The experiment was conducted with unacquainted same-sex dyads (two-person groups). Subjects rated their affective state with an affect grid (a 9 × 9 pleasure × arousal grid) before and after the trust game.

The trust game lasted about three minutes and involved having two subjects believe that they were either playing the role of "trustor" or "trustee." In reality, all subjects were trustors. The participants were provided 5 euros and informed that any money would be tripled if given to the trustee. Once the trustor transferred the money, subjects were told that the trustee would decide how to distribute the money between both of them. Ultimately, this game was used to evaluate how much the subjects trusted one another with the money.

Overall, the researchers found that the trust score (defined as the amount of money transferred to the trustee in each experimental group) was impacted significantly by the aroma in the room ($P = 0.03$). Specifically, subjects in the lavender-scented room had a higher mean trust score (390 ± 125.5) than those in the peppermint-scented (323 ± 115.0; $P = 0.03$) or non-scented (320 ± 104.5; $P = 0.02$) rooms. No significant differences were found between the peppermint group and the control group ($P = 0.90$).

Based on the affect grid results, pleasure levels were found to be similar across groups and time. In contrast, multiple-comparison analysis indicated a significant group effect ($P = 0.005$) for arousal levels. Mean arousal scores were significantly lower in the lavender group (–0.07 ± 1.3) compared to the peppermint (0.90 ± 1.3; $P = 0.008$) and control (1.20 ± 1.3; $P < 0.001$) groups. The lack of correlation between the amount of money transferred and the levels of arousal or pleasure suggests that the subjects were not conscious of these feelings when transferring money.

The authors report that this is the first study to demonstrate that exposure to an aroma can affect interpersonal trust. However, the authors point out that this study could be improved by including physiological measurements and blind experimenters. Interestingly, only the lavender group had significantly different (higher) trust scores compared to the control group, which is consistent with a previous study that found similar effects when evaluating subjects with inclusive cognitive-control states.[5] The lack of effect in the peppermint group to reduce interpersonal trust, as was hypothesized, should be explored in future studies that include a range of aromas associated with inclusive and exclusive cognitive-control states. No mention was made by the authors that previous studies[6,7] of essential oil effects differed between males and females. HG

—Laura M. Bystrom, PhD

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Meta-analysis Concludes Echinacea Can Safely Reduce Risk of Respiratory Tract Infection Recurrence and Complications

Reviewed: Schapowal A, Klein P, Johnston SL. Echinacea reduces the risk of recurrent respiratory tract infections and complications: a meta-analysis of randomized controlled trials. *Adv Ther*. March 2015;32(3):187-200.

Respiratory tract infections (RTIs), including sinus infections and the common cold, with symptoms like runny nose, sore throat, and fatigue, are often recurrent and can cause associated health problems. Each year, adults and children experience an average of 5-12 infections, implying 4-11 recurrences, respectively. Overall, they pose a considerable burden to society and the economy, costing about $40 billion each year.[1] While normally self-limiting, up to 20% of RTIs are complicated and can lead to bronchitis or pneumonia, which themselves are associated with high morbidity and even mortality. Complicated RTIs frequently involve bacterial superinfections, which are the main motive for prescription of antibiotics by practitioners during acute infections. Prevention of RTI complications is a major medical goal but few, if any, medicines have shown promising effects so far.

Echinacea (*Echinacea* spp., Asteraceae) has traditionally been used by Native Americans for a variety of conditions, most of them unrelated to respiratory tract infections.[2] Today, echinacea is used for the prevention and treatment of RTIs, among other conditions. Previous preclinical studies have shown echinacea to have anti-inflammatory, antiviral, and immunomodulatory effects.[3] This meta-analysis included studies that examined the impact of echinacea on RTI recurrence and complications from these infections. The purpose of this work was to explore whether long-term application (2-4 months) of echinacea preparations could prevent recurrent RTIs and, in consequence, prevent complications from those infections.

A literature search was conducted on databases MEDLINE, EMBASE, CAplus, BIOSIS, CABA, AGRICOLA, TOXCENTER, SCISEARCH, NAHL, and NAPRALERT using the keywords "echinacea," "black Sampson," "coneflower," and "roter Sonnenhut." Trials with randomized, placebo-controlled study designs using echinacea preparations in healthy subjects over 2-4 months for the prevention of recurring RTIs were screened. Jadad scores of four or higher were used to indicate high-quality studies. Recurrent RTI was the primary outcome, as measured by number of RTIs, or number of subjects with repeat RTIs. Data were pooled for the meta-analysis, and RTI recurrence and complications in subjects taking echinacea or placebo were compared to the total overall population. Complications included conjunctivitis, sinusitis, otitis (ear inflammation), tonsillitis, pharyngitis, bronchitis, and pneumonia. Antibiotic use was also assessed, and adverse side effects were noted.

When using the search term "echinacea," 101 clinical trials were found. Of these, 89 did not meet the inclusion criteria. From the 12 remaining, six additional studies were eliminated due to issues with methodology, study quality, or test materials. (The authors of the meta-analysis mention that different types of preparations [lipophilic vs. hydrophilic] contain distinctive compounds.)

Two of the analyzed studies reported significant benefits of echinacea treatment (average relative risk [RR] ratio = 0.498, 95% confidence interval [CI] 0.386-0.642; $P <$

Echinacea *Echinacea purpurea*
Photo ©2015 Steven Foster

0.0001). [Note: An RR of less than 1, in this case, means that an RTI is less likely to recur in the echinacea group than the placebo group. An RR of 2, for example, would mean that the experimental group is twice as likely to develop the condition as the control group.]

The overall meta-analysis revealed an RR of 0.649 (95% CI 0.545-0.774; $P < 0.0001$). RR ratios of 0.663 and 0.734 were seen in the two largest studies, both of which used alcohol extracts of echinacea (*P* values not reported).

In the four studies that included data on subjects having at least one recurrent RTI, an RR of less than 1 was also observed (0.769, 95% CI 0.598-0.990; $P = 0.041$). When analyzing and comparing echinacea lipophilic extracts (e.g., alcoholic extracts) and hydrophilic preparations, like pressed juices, used in the prevention of recurring RTIs, the RR for the alcoholic extracts was 0.542 (95% CI 0.432-0.679; $P < 0.0001$), and the RR for echinacea pressed juices was 0.858 (95% CI 0.649-1.135; $P = 0.283$). This indicates a more pronounced effect for the alcoholic extracts.

The largest clinical study by Jawad et al. (n = 757) not only used patient-reported symptoms to indicate the presence of an RTI, but also measured viral infections in nasal samples from patients and identified an RR of 0.420 (95% CI 0.222-0.796; $P = 0.005$). This corresponds to a 58% reduction in the risk of viral re-infections by an alcoholic extract (Echinaforce®, 95% herb and 5% roots; Bioforce AG; Roggiwill, Switzerland).

Patients with risk factors (stress, poor sleep, active smoking, etc.) leading to increased susceptibility to RTIs were analyzed separately in two clinical trials. The preventative effect of echinacea on RTI recurrences in this susceptible group (RR = 0.501) was highly significant and more pronounced than in the whole study population (see above). In subjects (n = 165) exposed to above-average stress levels (Perceived Stress Scale [PSS-10] score > 13), there was a 77.7% reduction in the risk of recurrent infections ($P < 0.05$).

Data from the three studies that investigated the presence of complications (conjunctivitis, sinusitis, etc.) showed that there was a statistically significant RR in those taking echinacea (0.503, 95% CI 0.384-0.658; $P < 0.0001$). The 50% overall decrease in the risk of complications included a 64.9% risk reduction in pneumonia and similar outcomes for otitis and tonsillitis ($P < 0.0001$, 0.0001, and 0.021, respectively). In three studies, antibiotic use declined in those using echinacea as compared with control or standard treatment, although the significance is not mentioned.

Among 1,440 subjects taking echinacea and 1,326 subjects taking placebo, the number of adverse side effects was comparable (491 vs. 474, respectively). Gastrointestinal complaints were most common and considered "mild." Two serious cases of troubled breathing were seen with echinacea pressed juice treatment, and glandular fever was observed in a subject taking placebo. Despite this, laboratory parameters were not different between groups over four months. Subjects mostly rated the tolerance of echinacea as "good" or "very good."

This meta-analysis shows that, compared to placebo, the use of echinacea-containing preparations significantly reduced the risk of recurrent RTIs in healthy subjects and also in individuals with various risk factors. Additionally, echinacea preparations were shown to reduce the risk of specific RTI complications like pneumonia, bronchitis, or otitis media and may have reduced antibiotic usage. Taken together, these results suggest obvious benefits from the usage of echinacea for RTI and prevention of RTI-related complications.

There was not full homogeneity in the echinacea preparations used in the clinical trials included in this analysis. At least three of the trials employed echinacea products with additional botanical ingredients (e.g., *Eupatorium perfoliatum*, Asteraceae; *Baptisia tinctoria,* Fabaceae; or vitamin C). Additional benefits from these components remain uncertain. The largest study used Echinaforce and had results that were very similar to the overall observed effects. Thus, it is likely that the here-identified effects are due to the actions of echinacea. Of particular interest are the studies using echinacea extracts (lipophilic versus hydrophilic) from at least two species of *Echinacea* and observing the resulting difference in RR ratios. HG

—Amy C. Keller, PhD

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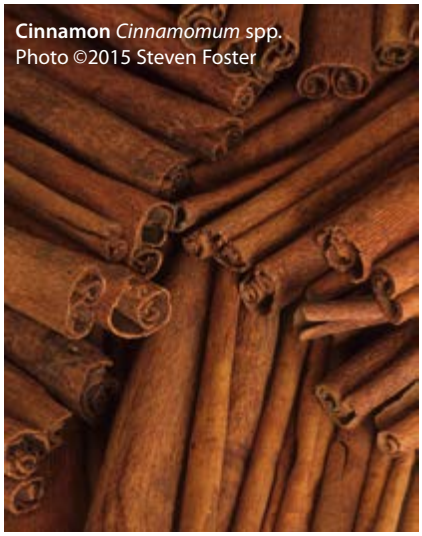
Cinnamon Consumption Reduces Symptoms of Primary Dysmenorrhea

Reviewed: Jaafarpour M, Hatefi M, Najafi F, Khajavikhan J, Khani A. The effect of cinnamon on menstrual bleeding and systemic symptoms with primary dysmenorrhea. *Iran Red Crescent Med J.* 2015;17(4):e27032. doi: 10.5812/ircmj.17(4)2015.27032.

Primary dysmenorrhea, or painful pelvic cramps occurring just before or during menstruation, can interfere with daily activities and can negatively impact a woman's quality of life. It is thought to be linked to the production of prostaglandins, especially $PGF_{2\alpha}$, from the uterine endometrium during menstruation. Pharmaceuticals, nonpharmacological treatments, dietary supplements, and medicinal herbs have been used to treat primary dysmenorrhea. Cinnamon (*Cinnamomum* spp., Lauraceae) has been used in traditional medicine to treat diarrhea, dyspnea (difficult breathing), impotence, vaginitis, rheumatism, and neuralgia, among other ailments. These authors conducted a randomized, double-blind clinical trial to assess the effects of cinnamon on menstrual bleeding and systemic symptoms in Iranian college students suffering from primary dysmenorrhea.



Cinnamon *Cinnamomum* spp.
Photo ©2015 Steven Foster

For the 2013-2014 study conducted at Ilam University of Medical Sciences in Iran, 76 subjects aged 18-30 years with moderate primary dysmenorrhea and regular menstrual cycles were enrolled. The healthy subjects had body mass indices ranging from 19-26 kg/m^2. Baseline characteristics of the subjects were similar. Patients were instructed not to use oral contraception or analgesics during the trial.

Thirty-eight subjects received placebo capsules containing starch, and 38 subjects received capsules containing 420 mg dried cinnamon bark powder. They were instructed to take two capsules three times daily during the first three days of their menstrual cycle. No other information was provided regarding the cinnamon capsules (e.g., the species, how the cinnamon was authenticated, or the level of marker compounds such as cinnamaldehyde, which is present in at least four species of *Cinnamomum* and in other species as well).

A standard visual analogue scale was used to determine the severity of pain and nausea. The number of vomiting episodes was counted daily, and daily menstrual bleeding was measured by the number of saturated pads. Pain severity was recorded at 1, 2, 3, 4, 8, 16, 24, 48, and 72 hours after the study intervention. At 24, 48, and 72 hours after treatment, the mean duration of pain, severity of nausea, number of vomiting episodes, and amount of bleeding were assessed.

The mean pain severity score and the mean duration of pain were less in the cinnamon group than in the placebo group at all measured intervals ($P < 0.001$ for both) after treatment. Overall, the amount of bleeding decreased significantly at various intervals in the cinnamon group ($P < 0.001$) but not in the placebo group. The number of subjects experiencing excessive menstrual bleeding (at least four pads per day) in the cinnamon group decreased significantly compared with the placebo group at 24 hours ($P = 0.037$) and at 48 and 72 hours ($P < 0.001$ for both). In both the cinnamon group and the placebo group, 12 subjects experienced excessive menstrual bleeding before treatment began. At 72 hours, those numbers decreased to zero in the cinnamon group and three in the placebo group.

The mean severity of nausea significantly decreased in the cinnamon group at 24 hours ($P = 0.01$) and at 48 and 72 hours ($P < 0.001$) compared with the placebo group, which also had significant reductions ($P < 0.05$) at various intervals. The number of vomiting episodes in the cinnamon group was significantly fewer ($P < 0.001$) than in the placebo group. No adverse side effects were observed, and there were no drop-outs from the study.

Results of this study suggest that cinnamon can significantly reduce pain, menstrual bleeding, nausea, and vomiting associated with primary dysmenorrhea, without any adverse side effects. "Cinnamon can be regarded as a safe and effective treatment for primary dysmenorrhea," the authors conclude. While the authors provide information regarding the dosage of cinnamon, they do not provide any information as to how the capsules were manufactured, the species of cinnamon, how or if the cinnamon aroma was masked, or if the cinnamon was standardized — a major limitation of this study. More detailed information regarding the cinnamon capsules should have been included.

A peer reviewer of this summary suggested that it may be helpful to compare the results of this study to similar research on valerian (*Valeriana officinalis*, Caprifoliaceae) and ginger (*Zingiber officinale*, Zingiberaceae). HG

— Shari Henson

Commercial Labeling of Medicinal Mushroom Products

By Jeff Chilton

Editor's note: *The views contained herein are those of the author's and do not necessarily reflect the views or policies of* HerbalGram *or the American Botanical Council.*

Medicinal mushrooms are fungal organisms sold as health foods, nutritional supplements, so-called nutraceuticals, and, on occasion, cosmetics ingredients. They are part of an extensive natural health products category in Asia, where traditional Chinese medicine has utilized mushroom preparations for thousands of years. China is the historical site of shiitake mushroom (*Lentinula edodes,* Marasmiaceae) cultivation, which is reported to have originated in the 12th century. Today, China is responsible for 85% of the world's mushroom production.[1]

The estimated worldwide market value of medicinal mushrooms was $6 billion in 1999 and $18 billion in 2014.[2,3] Over the last 25 years the market for these products has expanded greatly in North America, and, today, just about every dietary supplement company has one or more mushroom-related formulations in their product line. In light of this growth trajectory, medicinal mushrooms are destined to become a much bigger product category.

Category growth is likely to attract increased scrutiny by the US Food and Drug Administration (FDA) and other governmental bodies. It is, therefore, more important than ever to define medicinal mushrooms properly and ensure that products meet ingredient labeling requirements. This also raises ethical and liability issues for companies that may be selling products that do not conform to FDA standards for product authenticity.

It is well known that different parts of the same plant may contain varying levels of active compounds. Likewise, depending on the stage of growth or parts used, fungi may contain different levels of distinct medicinal constituents as well. This is an important consideration for traditional healers and herbalists, as well as commercial entities, all of which want to be certain that the medicinal values and benefits they seek are in fact present. This is also why the

FDA requires the "plant part" to be listed in the Supplement Facts panel for all botanical (and fungal) ingredients in dietary supplements.

Few companies realize that medicinal mushrooms as a category encompass more than just mushrooms. A mushroom is just one stage of these fungal organisms' life cycles. Most of the particular fungal organisms that are generally referred to as medicinal mushrooms belong to a taxonomic grouping called basidiomycetes. The genera *Ophiocordyceps* (family: Ophiocordycipitaceae) and *Cordyceps* (family: Cordycipitaceae) are exceptions and belong to the ascomycetes.[4]

Understanding the life cycle of a basidiomycete helps to define its respective components. What is commercially referred to as a medicinal mushroom is actually four distinct parts of a basidiomycete: mushroom, mycelium, sclerotium, and spore.

It is fitting to start with the spore, which is the beginning and end of the basidiomycete life cycle. Similar in function to a seed, fungal spores will germinate when environmental conditions are favorable. The germinating spore produces a hypha, a thread-like tube that spreads and branches in every direction. When multiple spores germinate and their hyphae grow together, a root-like network called a mycelium is formed.[4]

Mycelium is considered the vegetative stage of the basidiomycete.[5] In nature, one rarely sees the mycelium because it is naturally embedded in its food source, what is often referred to as the "substrate." Using the secretion of enzymes to digest its substrate, the mycelium grows in and feeds off a diverse menu of dead organic matter, such as trees, woody debris, fallen leaves, and annual plants of all kinds. Fungal mycelium is one of nature's premier recyclers and is especially adept at breaking down cellulosic materials.

When environmental conditions are conducive, a fertile mycelium will produce a mushroom. The mushroom is defined as a specialized reproductive structure. A mushroom can be separated further into parts such as the stem, cap, gills or pores, and spores, but other than spores, this level of differentiation has not yet been commercially promoted or supported by consistent scientific analyses. That may change in the future as more research is conducted on these specific parts of the mushroom, and certainly companies are free to differentiate using this subset.

Vegetative mycelium can also form a dense and often hardened, irregular mass called a sclerotium. This sclerotium is considered a means for many fungi to survive environmental extremes such as freezing. When conditions improve, sclerotia provide food reserves for the production of fruiting bodies. Two important medicinal basidiomycetes are used in the sclerotial form: chaga (*Inonotus obliquus*, Hymenochaetaceae) and poria (*Wolfiporia extensa*, Polyporaceae). Although these are commonly called "mushrooms," they are classified more accurately as sclerotium or mycelium.

The mushroom and mycelium are similar in that both are composed of hyphae, but they are meaningfully different in structure, composition, and function. Mycelium is

Shiitake mushroom *Lentinula edodes*
Photo ©2015 Steven Foster

the "vegetative body" of a fungal organism, whereas the mushroom is considered the "fruiting body."[6] Mushroom and mycelium are not synonymous — an important and necessary distinction. For example, with respect to *Ganoderma lucidum* (Ganodermataceae), one can correctly say "reishi mycelium" or "Ganoderma mycelium," but it is incorrect to say "reishi mushroom mycelium" since these are separate parts. Therefore, per existing regulation, it is not permissible for a company to have a product label that says "reishi mushroom" when the ingredients are primarily reishi mycelium or reishi spores. So one must be certain of the stage of the fungal organism that is being sold and label it accordingly.

Since mycelium is often propagated using grain as a substrate, many basidiomycete products consist of inoculated grain — what some call a "biomass." The overwhelming majority of these products are marketed and labeled as mushrooms. This is a classic case of mislabeling since there are no mushrooms (in the true sense of the word, as noted above) in these products. Furthermore, the presence of the grain needs to be listed on the label as an ingredient since these biomass products are not 100% pure mycelium but new and novel products. For example, it may be necessary to label a product as "reishi mycelium biomass," rather than "reishi mycelium," especially if the amount of mycelium is less than the residual grain. The actual amount of mycelium in the biomass can be readily tested by ergosterol analysis, and the grain residue can be measured by a starch test.[7-9] If the grain is not listed as an ingredient of this mycelium biomass product, it could reasonably be considered an adulterant.

In the case of a blend of different basidiomycete stages, proper labeling would state the percentage of each stage that was included. One could not simply say mycelium, mushroom, and spore. Some biomass manufacturers claim mushroom inclusion due to the presence of mushroom primordia. Primordia are not actual mushrooms, but simply the initial mycelium mass that, over time, becomes a mushroom.

In 1976, the FDA issued a statement in its Compliance Policy Guide, Section 585.525: Mushroom Mycelium – Fitness for Food; Labeling. It states: "Any food in which mushroom mycelium [*sic*] is used should be labeled to state that fact. Labeling should not suggest or imply that the food contains mushrooms."[6] It could not be clearer.

In conclusion, proper labeling of medicinal basidiomycete products is an issue that cannot be ignored. With five primary fungal ingredients in the marketplace — mushroom, pure mycelium, mycelium on grain biomass, sclerotium, and spore preparations — proper labeling is more essential than ever for manufacturers to know what they are selling. Just as important, practitioners and consumers need to know exactly what they are buying. HG

Jeff Chilton *started growing mushrooms commercially in 1973. In 1983, he co-authored the highly acclaimed book* The Mushroom Cultivator *(Agarikon Press, 1983). In the 1980s, he operated a commercial mushroom spawn laboratory, and, in 1989, he started one of the first medicinal mushroom businesses in North America. His company, Nammex, sells certified organic basidiomycete raw materials. Contact Mr. Chilton by email at jeff@nammex.com.*

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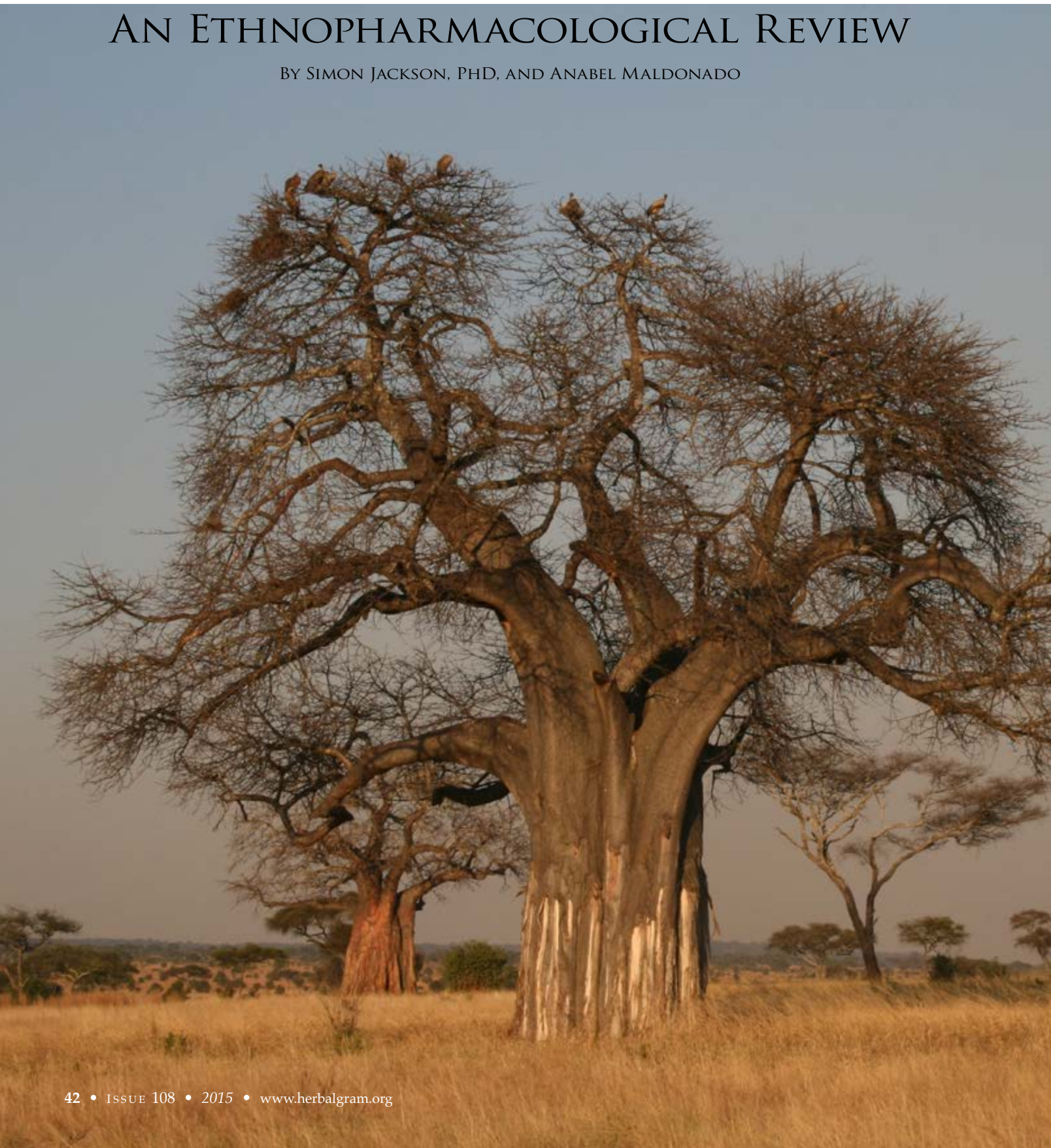
Baobab the Tree of Life

An Ethnopharmacological Review

By Simon Jackson, PhD, and Anabel Maldonado



Since the origins of human existence, people have looked to their natural surroundings for sources of nutrition and health remedies. One of the authors (SJ), after traveling in many parts of sub-Saharan Africa and talking to traditional healers in rural communities, has found that the plants in one's immediate vicinity often will contain a surprising amount of constituents with nutritional and medicinal benefits. One example is the baobab tree (*Adansonia digitata*, Malvaceae), one of the largest sub-Saharan botanicals, which the author has termed a "Cinderella species" — one that is often overlooked, but once properly researched and examined, is shown to be a novel foodstuff with significant health benefits. This article addresses some of the traditional nutritional and medicinal uses, the chemical and pharmacological profile, and scientific facts and myths of the iconic baobab tree.

Baobab Tree *Adansonia digitata*. Photo ©2015 Yoky

INTRODUCTION

With its distinctive silhouette, broad trunk, unusual root-like branches, and large, velvety fruit, baobab is the best known of all African trees. The tree is steeped in legend, and due to the many different uses of its various parts, it is known by the local people as the "tree of life." A large tree can hold up to 4,500 liters of water; its fibrous bark can be used for rope and cloth; its edible leaves and fruit can provide relief from sickness; and its hollow trunk can provide shelter for as many as 40 people.[1] So, it is easy to see why it has earned this name.

There has been a renaissance of ethnobotanical surveys of medicinal plants, especially in the cosmetics and nutrition sectors where industry chemists and product formulators are constantly looking for new and natural healthy ingredients.[2,3] Since its approval as a novel food ingredient by European Union (EU) food regulators in 2008,[4] the native African baobab tree has gained increasing market and media exposure. This paper presents a study of the ethnopharmacological uses of the tree in southern Africa and its significant array of ethnobotanical and potential commercial uses.

BOTANICAL DESCRIPTION

The baobab tree is also known as the upside-down tree, boab, boaboa, bottle tree, kremetart tree, cream of tartar (not to be confused with the multipurpose ingredient potassium bitartrate, which is made from fermented grapes [*Vitis vinifera*, Vitaceae]) tree, or monkey bread tree. The word "baobab" is derived from the Arabic *bu hobab*, meaning "fruit with many seeds." There are eight species of baobab: six are indigenous to Madagascar, one to Australia, and one to mainland Africa (*A. digitata*). *Adansonia digitata* grows in most countries south of the Sahara, although in South Africa it is restricted to the Limpopo and Mpumalanga provinces.[5]

A massive deciduous tree with a round or spreading crown, it can grow to heights of 20 m (approximately 65 ft). The trunk is stout, taper-

ing, and abruptly bottle-shaped, and it can be up to 12 m (39 ft) in diameter. The bark is smooth, grayish-brown, and has heavy folds. The bark on the lower part of the trunk often bears scars from local people who harvest it to retrieve the strong fibers, and from elephants that try to obtain water from the trees. However, even with trunk damage, baobab can continue to grow and regenerate new layers of bark. The leaves are alternate and palmately compound in mature plants. The flowers are waxy, white, crinkly, and mostly solitary, growing up to 20 cm in diameter. The ovoid-shaped fruits are roughly 15 cm long with a hard, woody shell covered by velvety hairs, and they contain kidney-shaped seeds that are embedded in a powdery pulp. In sub-Saharan Africa, baobab is harvested in April and May, and flowers are harvested from November to December. The tree favors a dry, woodland habitat with rocky, well-drained soil.

Baobab is a slow-growing tree and, as such, there has been much speculation about the age of large trees and their growth rate. Carbon-dating techniques and analyses of core samples suggest that baobab trees with 10 m diameters may be around 2,000 years old.[5]

TRADITIONAL MEDICINAL USES

Baobab leaves, bark, and fruit are used for food and medicinal purposes in southern Africa. The bark has astringent properties and has been used traditionally to alleviate colds, fevers, and influenza (a decoction made from the fresh bark is taken as a beverage for one week to treat the flu).[6] The wood, bark, and seeds of the tree are known to have anti-inflammatory properties.[7] The leaves may be used as an antiperspirant, and they also have been used to treat fever, kidney and bladder diseases, as well as asthma and diarrhea.[8-14] In African traditional medicine, baobab fruit pulp is used to treat fever, diarrhea, dysentery, smallpox, measles, hemoptysis (the coughing up of blood), and as a painkiller. For the treatment of infant diarrhea, a mixture made from the floury pulp mixed with millet flour and water is given to the child until cured.[8] For dysentery, baobab leaves are administered orally or crushed into a drink. Leaves can also be used in hip-baths to treat parasitic skin infections. The seed can be pulped and applied externally or added to water as a drink to treat gastric, kidney, and joint diseases.[15]

During the rainy season when the trees are in leaf, baobab is a good fodder tree, especially for game such as elephants, kudus, nyalas, and impalas. At the end of the season, cattle eat the fallen leaves, and various game species relish the fallen flowers. As far as humans are concerned, the roots can be tapped for water, and the young roots are cooked and eaten. Young leaves can be cooked and eaten like spinach or dried and powdered to be used later. The leaves are rich in ascorbic acid (vitamin C), sugars, and potassium tartrate.[16] The acid pith of the fruit is rich in vitamin C and can be used to make a refreshing drink. Baobab seeds, the oil of which is high in calories, can be eaten fresh, dried, or roasted as a substitute for coffee (*Coffea* spp., Rubiaceae). The pulp and seeds have high nutritional value in the form of iron, calcium, and vitamin C, and they can be fed to livestock toward the end of the dry season when grazing is poor.

The citric and tartaric acids found in the pulp inspired one of baobab's popular names, "cream of tartar tree." Baobab pulp is often used in baking as a milk-curdling agent, as a flavoring for yogurt and ice cream, and as a source of calcium for pregnant and lactating women. Due to its high pectin content, the pulp also has been used traditionally as a thickening agent for sauces and jams. In some African cultures, the pulp has been used as an ingredient in cosmetics.[17]

Baobab Tree *Adansonia digitata*. Photo ©2015 Simon Jackson. Malawi, Africa.

Baobab has a long history of use as a medicinal product. The botanist and physician Prospero Alpini (1553-1617) wrote in his book *De plantis Aegypti liber* that fresh baobab fruit had a very pleasing taste, and that the Ethiopians used it on burns and rashes and to cool the effects of serious fevers. For these afflictions, they either chewed the flesh of the fruit or pressed it into a juice with added sugar. Alpini also wrote that in Cairo, Egypt, where fresh baobab fruit was unobtainable, Egyptians made preparations from its powder to treat fevers, dysentery, and bloody wounds — an indication that this plant has been used medicinally for centuries.[18]

Local medicinal uses for baobab are richly varied.[15] The bark, along with dried leaves, is made into

a preparation called *lalo* that is used to induce sweating and reduce fever. The bark contains a quantity of edible, insoluble, acidic, tragacanth-like gum, which is used to disinfect skin ulcers and wounds. Mucilages made from baobab phloem sap in the bark are used as a remedy for gastrointestinal inflammation.[15,19] The bark also is popular as a cardiotonic; this traditional use has been confirmed experimentally by researchers who demonstrated the positive inotropic effect of an ethanolic bark extract on isolated atrial muscles of rats.[20]

In Sierra Leone specifically, the leaves and bark are used as a prophylactic against malaria. In the Congo, a bark decoction is used to bathe children with rickets, and in Tanzania, as a mouthwash to treat toothache. In Ghana, the bark is used as a substitute for quinine in cases of fever. In southern Zimbabwe, the leaf is eaten as a vegetable, while in central Africa it is used as a diaphoretic (perspirant) against fevers, and the seeds as a remedy for dysentery. In Messina, South Africa, the powdered seed is given to relieve hiccups in children.[1]

In Nigeria and Senegal, baobab fruits are reputed to be effective against microbial diseases. This has been confirmed in tests against certain bacteria and fungi, although the active constituents responsible for these effects have yet to be isolated.[21] A prepared root infusion is used as a bath for babies to maintain soft skin.[20] Conditions including asthma, sedation, colic, fever, inflammation, diseases of the urinary tract, ear trouble, backache, wounds, tumors, and respiratory difficulty are treated orally. The leaves are considered an emollient and diuretic, and leaf decoctions are used for earache and otitis (inflammation of the outer ear, middle ear, or ear canal).[15] In general, leaf preparations are used for the control of kidney and bladder diseases, asthma, fatigue, and as a tonic, blood cleanser, prophylactic, and febrifuge (a medication that reduces fever). They have also been used for diarrhea, inflammation, insect bites, the expulsion of guinea worms, internal pain, and other afflictions.

BIOLOGICAL PROPERTIES

The pulp of baobab fruit contains astringent compounds (e.g., tannins and cellulose), which exert an antidysenteric action due to an osmotic effect and an inhibitory interaction with acetylcholine, the neurotransmitter that is responsible for gut spasms. The fruit has anti-inflammatory, febrifuge, and analgesic properties due to the presence of saponins and sterols; experimental data have also shown the fruit to have hepatoprotective effects.[20] The leaves have both antihypotensive and antihistaminic properties, and the leaf powder, due to its antihistaminic properties, has been suggested as an anti-asthmatic.[22]

Anticancer Activity

Anticancer activity is virtually unheard of in plants in the family Malvaceae, yet research suggests that *A. digitata* may have antitumor properties.[1] In Senegal and Guinea, both a decoction and a poultice made from baobab fruit extract were shown to have antitumor activities.[23,24] The specific bioactive constituents responsible for these actions have not yet been identified.

Antisickling Activity

Sickle-cell anemia is a problem that has affected Africans for centuries. One Nigerian remedy is derived from a concoction of an aqueous extract of the bark of *A. digitata*, which is used locally for its antisickling activity. However, after testing various concentrations on washed sickle-cell blood samples, researchers in Nigeria found that the results did not support the anecdotal reports.[25]

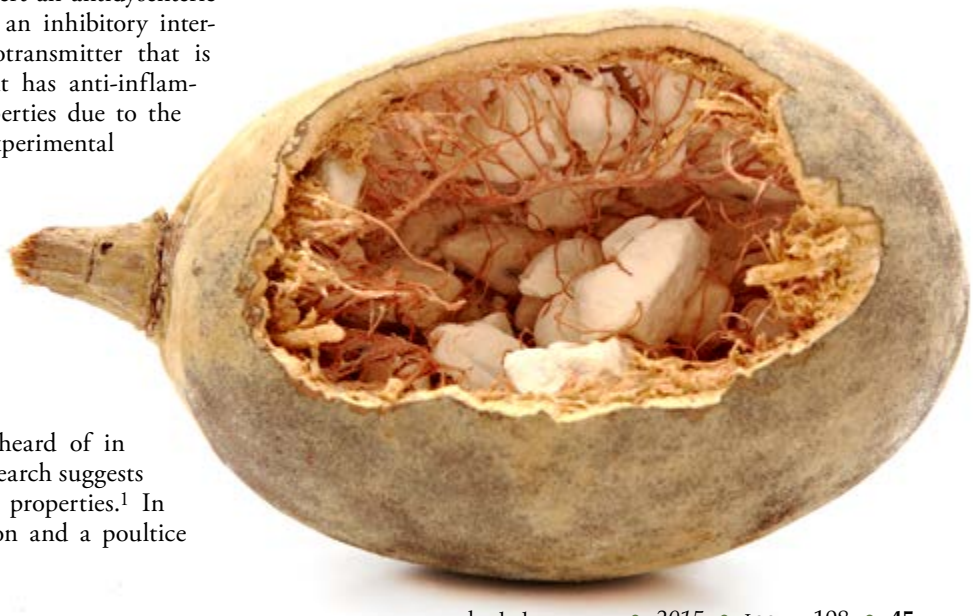
Hepatoprotective Influence

In vitro studies in Saudi Arabia have shown that aqueous extracts of *A. digitata* pulp demonstrate hepatoprotective activity against carbon tetrachloride administered in rats. Consumption of certain *Adansonia* fruits may play an important role in human resistance to liver damage. The mechanism of action for liver protection is unknown, but it may be due to the triterpenoids, beta-sitosterol, beta-amyrin palmitate, alpha-amyrin, and/or ursolic acid in the fruit.[26]

Antiviral, Antibiotic, Anti-inflammatory, Antipyretic, and Analgesic Effects

Researchers in Togo, western Africa, and Canada studied 19 medicinal plants of Togo and analyzed them for antiviral and antibiotic activity. Of the 19 species studied, 10 demonstrated significant antiviral activity, and all but two showed antibiotic activity. *A. digitata* was the most potent, exhibiting activity against each of the three tested viruses (herpes simplex, Sindbis, and polio).[27] Further antimicrobial tests undertaken in Nigeria confirmed the aforementioned results.[21]

Aqueous extracts of baobab fruit have exhibited marked anti-inflammatory, antipyretic (in rats given 400 and 800 mg/kg dosages), and analgesic (in mice two hours after administration) effects.[28,29] Phytochemical examination has revealed the presence of sterols, triterpenes, saponins,



Baobab fruit with red funicles. *Adansonia digitata*.
Photo ©2015 Nicolas Gaillard. Bristol, UK.

tannins, and glycosides, which may play a role in these actions.

Other studies support baobab's anti-inflammatory and antiviral activities as well. In one experiment, baobab leaves, fruit pulp, and seeds were extracted with three different solvents: water, methanol, and dimethyl sulfoxide (DMSO).[7] Researchers compared the three extracts to determine the minimum concentration required to inhibit 100% of three viruses (herpes simplex, influenza, and respiratory syncytial virus), and assessed their effects on cytokine secretion (interleukin [IL]-6 and IL-8) in human cell cultures. Cytokines are cell-signaling proteins that play an important role in the immune system. The leaf extracts exhibited the most potent antiviral properties, particularly the DMSO extracts, and the influenza virus was the most susceptible virus. Pulp and seed extracts were less active but still showed significant results. Cytotoxic activities of the extracts were evident only at much higher concentrations. Additionally, the researchers found that the extracts — particularly the leaf extracts — acted as cytokine modulators, meaning that they possessed anti-inflammatory activity. Overall, the results indicate the presence of multiple bioactive compounds in different parts of the plant, which may explain some of the medical benefits attributed to traditional leaf and pulp preparations. These promising results highlight the urgent need for more scientific research to be conducted on the baobab tree.

Antioxidant Capacity

Epidemiological evidence has linked intake of vitamin C and other antioxidant micronutrients to health benefits, by virtue of their capacity to trap reactive oxygen species (ROS) that are associated with degenerative diseases and damage to biological systems.[30] Current scientific evidence has helped boost consumer interest in supplementing the diet with antioxidants, especially those derived from natural sources. Baobab fruit pulp is a valuable source of vitamin C, while baobab leaves contain provitamin A.[13] The red funicles (threadlike stalks that connect seeds to the ovary wall) present in the fruit have an impressive antioxidant capacity, higher than in other parts of baobab and in many other fruits as well (Table 1).[12,31] However, the exact antioxidant composition in baobab has not yet been determined.

Table 1. Water-Soluble Antioxidant Activity of Baobab Parts Compared to Common Fruits[12]

Plant material	mmol Trolox/g
Baobab fruit pulp	6.96 ± 0.057*
Baobab dry leaves	6.39 ± 0.344
Baobab fruit shell, ground	9.35 ± 1.100
Kiwi fruit pulp	0.34 ± 0.007
Orange fresh pulp	0.10 ± 0.009
Strawberry fresh pulp	0.90 ± 0.004
Apple fresh pulp	0.16 ± 0.014

* The value is the mean of three measures ± the standard deviation.

The method most widely used to measure antioxidant activity involves generating radical species and analyzing the antioxidants that cause the disappearance of these radicals. The scavenging activity of antioxidants is measured against a reference compound, such as Trolox, a water-soluble equivalent of vitamin E. Most published antioxidant activity investigations conducted on baobab have focused on fresh leaves only.[12]

Vertuani et al. investigated the fresh fruit pulp, fruit shell, and dry leaves of baobab and compared the antioxidant values to those of other commonly consumed fresh fruits with high levels of vitamin C, including orange (*Citrus sinensis*, Rutaceae), kiwi (*Actinidia chinensis*, Actinidiaceae), apple (*Malus domestica*, Rosaceae), and strawberry (*Fragaria* × *ananassa*, Rosaceae).[12] In this study, antioxidant activity was measured with a photochemiluminescence method of aqueous/methanol extracts from baobab products. This method allows for the measurement of the antioxidant capacities of both water- and lipid-soluble components. In water-soluble fractions, antioxidants such as flavonoids and vitamin C can be detected, while in lipid-soluble fractions, tocopherols and carotenoids can be measured.[32,33] Baobab products displayed the highest capacity. Notably, dry leaves exhibited an antioxidant capacity of approximately 6.4 mmol (millimoles) of Trolox equivalents per gram of tested product (Table 1). In comparison to the baobab fruit pulp, kiwi, orange, strawberry, and apple all showed a much lower antioxidant capacity.[12] However, comparing fresh fruit to dry fruit is misleading since baobab fruit is naturally dry, but these figures represent the best data available, and are a fairly good indication of baobab's antioxidant capacity.

With regard to the lipid-soluble antioxidant component, baobab fruit pulp also showed the highest antioxidant capacity (4.15 mmol/g), followed by the dry leaves (2.35 mmol/g). The other fruit pulps had very limited capacity, which may be due to their low levels of lipid-soluble antioxidants.[12]

To account for the potential effects of secondary antioxidant products, and to avoid underestimation of antioxidant activity, the oxygen radical absorbance capacity (ORAC) assay can be used to follow reactions for extended periods of time. With this method, values are also reported as Trolox equivalents. Seasonal variation in fruit products, different methods of extraction, and treatment of samples can lead to differences in the outcome values. Absolute ORAC values are more significant when the test materials are in the same condition.[31]

In a study using ORAC values to compare the antioxidant capacities of baobab and so-called "superfruits" (Baobab Foods, unpublished data, 2011), the baobab red funicle was found to contain the highest level of antioxidants compared to goji berry (*Lycium barbarum*, Solanaceae), pomegranate (*Punica granatum*, Lythraceae), and cranberry (*Vaccinium macrocarpon*, Ericaceae), with the exception of the açaí berry (*Euterpe oleracea*, Arecaceae). Baobab fruit pulp has an ORAC value twice as

high as those of cranberry and pomegranate. These data suggest potential antioxidant benefits from the consumption of baobab-containing products, although these results have been difficult to replicate and validate.

In a separate study of African fruits and culinary spices, *A. digitata* fruit once again showed high antioxidant capacity along with the highest amount of total phenolics (237.68 mg gallic acid equivalents/g) and total flavonoids (16.14 mg vitamin E/g) of the botanicals tested.[34] Researchers reported IC_{50} (the half maximal inhibitory concentration) values of 8.15 µg/mL and 9.16 µg/mL using the DPPH (a standard antioxidant assay using 2,2-diphenyl-1-picrylhydrazyl) and ABTS (an enzyme assay using 2,2′-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid)) assays, respectively. The FRAP (ferric reducing ability of plasma) assay determined a Trolox equivalent antioxidant capacity of 0.75 mmol/g.

CONSTITUENTS

Small Molecules

Acids, terpenoids, and flavonoids

Adansonia digitata fruit contains organic acids such as citric, tartaric, malic, and succinic acids, and its seeds yield oil that contains oleic, linoleic, and linolenic acids, as well as cyclopropenic fatty acids.[8,16] Baobab also contains terpenoids, such as α- and β-amyrin palmitate, β-sitosterol, and ursolic acid.

In the 1980s, researchers in India identified two new flavonol glycosides from the roots of *A. digitata*, namely 3,7-dihydroxy flavan-4-one-5-O-β-D-galactopyranosyl (1→4)-β-D-glucopyranoside from the benzene extract of the water-insoluble fraction of the ethanolic root extract, and quercetin–7-O-β–D-xylopyranoside from spectral data and chemical studies of an ethyl acetate stem extract.[35,36] Further investigation has identified another flavanone glycoside, fisetin-7-O-α-L-rhamnopyranoside, in the roots of baobab.[37]

Macromolecules

Polysaccharides

Published research has shown that baobab fruit pulp contains sugars but no starch and is an excellent source of vitamin C, calcium, and pectin. The fruit pulp is composed of carbohydrates (75%), proteins (2.5%), and a limited amount of lipids.[20] It also contains fibers (50%), both soluble and insoluble, which are composed mainly of pectin. Pectin levels range from 23.4-33.8 mg/100 g depending on varieties and geographical location.[38,39]

Baobab fruit at a market. *Adansonia digitata*. Photo ©2015 Simon Jackson. Lilongwe, Malawi

Recently, researchers have focused on the potential gut health benefits associated with pectin, which exhibits health-promoting properties in the gastrointestinal tract. This polysaccharide has shown potential as a prebiotic, as it enhances the growth of probiotic bacteria in the large intestine. Studies have shown that pectin prevents pathogenic bacteria from binding to the intestinal wall, and that it chelates heavy metals, which are then excreted through urine.[40-42]

Adansonia digitata's leaves and bark have been reported to contain an alkaloid called adansonin, which is used as an antidote to strophanthin, a poisonous cardiac glycoside alkaloid that is present in vines of the genus *Strophanthus* (Apocynaceae). This is important to locals since strophanthin is used as an arrow poison in Africa. Previously, adansonin was sold as a substitute for quinine due to its febrifuge properties.[43,44] However, it is not clear whether adansonin is a pure compound or if it is indeed an alkaloid. It is possible that the substance is a mixture of compounds, but more structural research is needed. Baobab leaves are also rich in mucilage that contains uronic acids, rhamnose, and other sugars.

Micronutrients

Minerals and trace elements

Calcium, potassium, magnesium, and iron are abundant in baobab.[38] In general, it is rare for calcium to be found in large quantities in fruits and vegetables, but baobab dried fruit pulp contains large amounts of this micronutrient, ranging from 257-370 mg/100 g. The leaves contain even greater amounts (307-2640 mg/100 g dry weight).[45] These quantities rival those of other good dietary sources of calcium — for example, dried skim milk (960-1890 mg/100 g) — but it is much higher than levels present in other fruits and vegetables.[16] Baobab contains four times the amount of calcium found in dehydrated apricots (*Prunus* spp., Rosaceae), and 13 times that in dehydrated apples.[46] Whether or not the calcium is in a form suitable for absorption via oral administration is currently under review.

Baobab dried fruit pulp also has the highest concentration of potassium, magnesium, copper, and manganese among popular dehydrated fruits, and the second-highest concentration of zinc. The magnesium content of baobab is similar to that of dehydrated bananas (*Musa acuminata*, Musaceae), whereas iron levels are comparable to those found in dehydrated apricots and peaches (*Prunus persica,* Rosaceae).[38] Based on the European Recommended Daily Allowances (RDAs) for calcium, iron, and magnesium of 800 mg, 14 mg, and 375 mg, respectively, baobab powder could prove to be a useful dietary source of these minerals, provided that sufficient amounts could be added to a product to enable a label claim. In order to make an on-label claim in Europe, the product must contain 15% of the RDA of the vitamin or mineral per 100 g, or per single-serving package.[16,46]

Vitamins

The main vitamins found in baobab include vitamin C and various B vitamins. On average, baobab ripe pulp has a vitamin C content of approximately 107 mg/100 g, which will remain stable for months if protected from moisture. Even if no precautions are taken, appreciable quantities of the vitamin will endure in the pulp for many years. One study found that baobab ripe pulp stored in a glass bottle showed no signs of bacterial or fungal decomposition after two years.[47]

Baobab dried fruit pulp contains significantly higher levels of vitamin C than other commonly consumed dried fruits[16] (Table 2). Obtaining the dried pulp traditionally involves minimal processing, which helps preserve heat- and moisture-sensitive vitamins. Vitamin C is present in an amount of about 300 mg/100 g of dried fruit pulp[15] — six and a half times higher than that of oranges (46 mg/100 g), five times higher than that of strawberries (61 mg/100 g), and 10 times higher than that of dried peaches and apricots.[9,38] Baobab fruit pulp, naturally in powdered form, contains levels of vitamin C ranging from 34-499 mg/100 g. (According to the unofficial *African Herbal Pharmacopoeia*, such levels depend on the source, with pharmacopeial-grade material containing the largest amounts.[48]) Based on the European RDA of 80 mg of vitamin C, baobab fruit pulp powder added to an ingestible product could provide an adequate daily source of vitamin C.

In a study that assessed the vitamin B1 (thiamine) and B2 (riboflavin) contents in *A. digitata*, the leaves were found to contain higher levels of vitamin B2 than vitamin B1, with the most vitamin B2 (1.04 ± 0.05 mg/100 g dry matter) found in baobab leaves from Senegal. The highest iron content (26.39 mg/100 g) was found in leaves from Mali.[45]

Macronutrients

Fiber

In terms of macronutrients, baobab dried fruit pulp is low in fat and consists of approximately 50% fiber. It is rela-

Table 2. Vitamins in Baobab Dried Fruit Pulp and Other Dehydrated Fruits (in mg/100 g)[38,49]

Fruit	Type of Extract Tested	Vitamin C	Thiamine (B1)	Riboflavin (B2)	Niacin (B3)
Baobab	dried pulp	107.8	0.078	0.020	2.160
Apple	dehydrated (low-moisture), sulphured, uncooked	2.2	0.046	0.130	0.680
Apricot	dehydrated (low-moisture), sulphured, uncooked	9.5	0.043	0.148	3.580
Banana	dehydrated (low-moisture)	7.0	0.180	0.240	2.800
Peach	dehydrated (low-moisture), sulphured, uncooked	10.6	0.039	0.110	4.825

Data courtesy PhytoTrade Africa[13]

tively low in protein but contains numerous amino acids.[16] Baobab dried fruit pulp therefore would be ideal as a fiber-supplementing ingredient in foods, raising the overall nutritional profile. According to the EU Nutrition and Health Claims Directive (No. 1924/2006), a claim that a food is a *source of fiber* may be made only if the product contains a minimum of 3 g/100 g, or at least 1.5 g/100 kcal.[50]A claim that a food is *high in fiber* may be made only if the product contains a minimum of 6 g/100 g, or at least 3 g/100 kcal. No specific information is available on the glycemic index (GI) or satiating effects of baobab, but its profile, compared to other foods, would indicate that it may have the potential to be a low-GI and satiating ingredient due to its low sugar and high soluble fiber content.[43,51]

Baobab vs. Superfruits: Comparing Nutritional Content

To date, the oft-used marketing term "superfruit" does not have an official regulatory definition, but products marketed as superfruits are generally high in a variety of nutrients and thus are associated with health benefits. Fruits currently marketed as superfruits include açaí berry, blueberry (*Vaccinium* spp.), cranberry, goji berry, mangosteen (*Garcinia mangostana,* Clusiaceae), and pomegranate, and some have suggested adding baobab to the list as well.

When comparing the micronutrients found in baobab to those found in superfruits, one must take into account that values for baobab are for the dried fruit pulp, whereas the data for superfruits are for raw foods. The vitamin C content of baobab dried fruit pulp is up to five times higher than that of raw blueberries and 15 times higher than that of pomegranates. It has much higher levels of niacin (vitamin B3), slightly higher levels of vitamin B1, and about the same amount of vitamin B2 as the selected superfruits. Baobab dried fruit pulp has also been found to contain greater quantities of calcium, magnesium, and iron. It is worth noting that removing water from fresh fruit concentrates the nutrients, so it may be an unfair comparison. However, as baobab is naturally dry, the situation is unavoidable.

Baobab tree with elephant tusk damage. *Adansonia digitata*.
Photo ©2015 Simon Jackson. Zimbabwe.

In summary, baobab fruit pulp has the following:

- Vitamins B1 and B2, and a high natural vitamin C content (at least 100 mg/100 g);
- Strong antioxidant properties with an Integral Antioxidant Capacity of 11.1 mmol/g, which is significantly higher than that of orange pulp (10.2 mmol/g) and grape seed oligomers (10.25 mmol/g);
- Minerals, including calcium (293 mg/100 g), phosphorus (96-118 mg/100 g), iron (7-8.6 mg/100 g), and potassium (2.31 mg/100 g);
- Low amounts of fat and high levels of soluble fiber;
- High levels of pectin, making it a useful binding and thickening agent;
- Organic acids such as ascorbic, citric, malic, and succinic acids, which contribute to baobab's bitter taste.

COMMERCIAL USES

Nutritional Applications

Since baobab obtained approval from EU regulators in 2008 as a novel food ingredient, the United Kingdom has been increasing imports of powdered baobab fruit for use as a healthy additive to snack foods and beverages. In the UK, the amount of baobab dried pulp that can be added to foods, such as cereal bars and smoothies, ranges from 10-20% (typically 5-10 g).[16] This should be kept in mind when assessing baobab's contribution to the product's overall nutritional intake.

A 2008 report by the UK-based Natural Resources Institute estimated that trade in baobab fruit could be worth up to $961 million per year for African producers — it is currently valued at $11 million.[13] African producers export approximately 20 tons of baobab each year, and the growing industry is crucial in bringing money to local people who harvest and process the fruit.

Baobab fruit pulp is currently available as a milled and sifted, free-flowing, light-colored powder, as well as a de-pectinized extract, and in the form of leaf extracts, fruit fiber (funicles), or fruit seed oil. The powder can be taken in its pure form as is done traditionally, but it can also be stirred into porridge, yogurt, or smoothies to appeal to a Western diet. Companies in Europe and North America offer baobab food products in a variety of forms, including sauces, jams, bars, and fruit chews, among others.

Skin and Cosmetic Benefits

In addition to its nutritional value, baobab has been shown to be beneficial for skin care. Studies suggest that baobab preparations can promote skin cell regeneration and tone, tighten, and moisturize the skin.[17,20,52] These effects may be due, in part, to baobab's vitamin A, D, and E content. The fruit pulp provides a complex of vitamins that exerts a variety of positive, synergistic actions, including the following: emollient effects (vitamin A), the control of sebaceous gland excretion (vitamin B6), the induction of melanin synthesis (vitamin B1/B2 complex), antioxidant defense and collagen synthesis stimulation (vitamin C), improvement of cutaneous circulation (vitamin B4), action against lipid peroxidation (vitamin E), and defense from tissue matrix degradation (triterpenic compounds).[20]

Baobab seeds in white pulp with funicles. *Adansonia digitata*. Photo ©2015 Nicolas Gaillard. Bristol, UK.

Fiber contained in the pulp also promotes anti-aging and antioxidant effects on the skin. Leaf extracts have antioxidant, emollient, and soothing properties, keeping skin soft and elastic while also exerting antibacterial activity. The fatty oil from the seeds improves the firmness, hydration, and lightness of the skin. It also has soothing and anti-inflammatory effects due to essential oils, hydrocarbons, and sterols, making it an ideal treatment for dry skin and the prevention of wrinkles. Baobab seed oil can heal abrasions, sunburns, and hematomas, and promote tissue regeneration.[17]

CONTAMINANTS & ADULTERANTS IN BAOBAB DRIED FRUIT PULP

Foreign Matter and Silicon

Baobab fruit is sustainably wild-harvested and the fruit pulp is separated from the other unwanted parts of the fruit. This process can potentially introduce contaminants into the baobab dried fruit pulp from two sources: extraneous matter, such as soil, and endogenous matter, such as seed and plant fiber.

To quantify these potential sources of contamination, one of the authors (SJ) of this article analyzed samples of baobab dried fruit pulp to determine levels of both foreign matter and silicon (Jackson et al., unpublished data, 2013). The analysis found less than 0.026% of extraneous and endogenous matter (by weight) in tested samples of dried fruit pulp, which suggests that the producers used proper collection and handling practices. An acid-insoluble ash test (a method used to gauge the purity of a substance[53]) found silicon levels of 0.1 g/100 g baobab dried fruit pulp. This result suggests that there were no significant problems with soil, sand, or diatomaceous earth contamination during or after harvest.

Suppliers can address potential contamination issues (e.g., excess levels of foreign matter, pesticide residues, heavy metals, microbes, or mycotoxins) by adhering to the US Food and Drug Administration's (FDA's) current Good Manufacturing Practices (cGMPs). The baobab fruit pulp samples tested by the author were screened for each of these contaminants using the methods published in the *African Herbal Pharmacopoeia*.[48]

Botanical adulteration may be the result of accidental or intentional contamination. Microscopic analyses can help identify foreign matter in samples. For example, researchers can learn more about the quality of a sample by simple microscopic observation using a

polarizing filter and chloral hydrate, or iodine, which reveals any added starch grains.

Intentional adulterants (e.g., ascorbic acid) are sometimes added to fortify samples or make the raw material or extract appear more valuable. If ascorbic acid were added to a sample, for example, analyses would show abnormally high values of vitamin C (more than 500 mg/100 g). The authors and their colleagues have tested at least three different samples from various suppliers in different countries, and are confident in the results shown (Jackson et al., unpublished data, 2013).

Microbial Levels

In order to assess potential microbial contamination, the author tested baobab dried fruit pulp (in duplicate) for several microbial organisms, including *E. coli*, fecal *Streptococci*, and *Salmonella* (Jackson et al., unpublished data, 2013). The results were within the range that is generally accepted in cGMP guidelines for limits of microbial contamination (i.e., less than 1,000 colony-forming units [cfu]/g). *E. coli*, *Staphylococcus aureus*, fecal *Streptococci*, and yeasts were below the limit at which the numbers of the colonies are counted; *Salmonella* was not detected in the samples. Finally, both the total viable count and mold-produced colony counts ranged between 2,600 and 7,800 cfu/g. These counts are not unduly high or unexpected in a fruit that is wild-harvested and processed by a simple mechanical separation.

Pesticide Residues

The data in Table 3 show the results of a multi-residue pesticide analysis on the baobab dried fruit pulp. The results are presented in terms of the pesticide class rather than the individual pesticide, and the data clearly show that pesticide residues are below the limits of detection. These results are to be expected, as pesticides are not used at any stage during the growing or harvesting of wild-harvested baobab fruit.

Heavy Metals

The author (SJ) also analyzed three samples of baobab dried fruit pulp in duplicate for the presence of four heavy metals: arsenic, cadmium, lead, and mercury (Jackson et al., unpublished data, 2013). The levels of arsenic, cadmium, and mercury in the baobab dried fruit pulp samples were all below the detection limits (Table 4). Only lead was detected (at levels much lower than acceptable limits established by European food guidelines).[54]

Mycotoxins and Related Substances

The baobab dried fruit pulp samples were also analyzed in duplicate for mycotoxins, and the results are shown in Table 5. In each of the samples, the amount of total aflatoxins was below the limit of detection.

Summary: Contaminants & Adulterants

In all of these categories, the levels of potential food contaminants were found to be acceptable and unlikely to cause harm to consumers. According to the analyses performed by the author, the levels of pesticide residues and mycotoxins were below the limits of detection. Three out of four of the heavy metals analyzed were also below the limits of detection, and the content of lead was well below permitted safety limits. Additionally, the foreign matter content of the baobab dried fruit pulp was found to be less than 0.026% by weight, the microbial contamination level was in the acceptable range, and the total viable count and mold levels were low. It warrants mention that only a small number of samples were tested, and testing for possible contamination and/or adulteration of material from other commercial sources was not performed.

CONCLUSION

The fruit of *A. digitata* is nutritious and could have significant value as an ingredient in functional foods, dietary supplements, and skincare products, and as a novel

Table 3. Results of Multi-Residue Pesticide Screen of Baobab Dried Fruit Pulp Samples

Class of Pesticide	Residue Detected (in mg/kg)
Organophosphorus	< 0.05
Organochlorine	< 0.02
Organonitrogen	< 0.05
Dicarboximides	< 0.05
Strobilurin	< 0.05
Triazine	< 0.05
Pyrethroids	< 0.05

Data courtesy PhytoTrade Africa[13]

Table 4. Analysis of Heavy Metal Content in Baobab Dried Fruit Pulp Samples (in mg/kg)

Heavy Metals	Sample 1	Sample 2	Sample 3
Arsenic	< 0.10	< 0.10	< 0.112
Cadmium	< 0.01	< 0.01	< 0.013
Lead	0.09	0.08	0.135
Mercury	< 0.004	< 0.004	< 0.001

Data courtesy PhytoTrade Africa[13] *and Yobab (unpublished data, 2013)*

Table 5. Analysis of Ochratoxin A and Aflatoxin Content in Baobab Dried Fruit Pulp Samples (in µg/kg)

Mycotoxins	Sample 1	Sample 2	Sample 3
Ochratoxin A	< 0.20	< 0.20	-
Aflatoxin B1	< 0.09	< 0.09	-
Aflatoxin B2	< 0.09	< 0.09	-
Aflatoxin G1	< 0.09	< 0.09	< 0.20
Aflatoxin G2	< 0.09	< 0.09	< 0.20
Total Aflatoxins	< 0.36	< 0.36	< 0.80

Data courtesy PhytoTrade Africa[13] *and Yobab (unpublished data, 2013)*

source of anti-inflammatory and antiviral compounds. In addition, the vitamins and oils derived from baobab can be highly beneficial for skincare products due to their moisturizing, healing, and skin-regenerating effects.

Baobab is rich in vitamins and minerals, containing more than 100 mg vitamin C per 100 g of dried fruit pulp — higher than many other fruits. If added to a product in sufficient quantities, baobab could satisfy label claims as a source of vitamin C (12 mg or 15% of the RDA) in the UK market. The presence of vitamin C combined with its iron content may make baobab an effective optimizer of iron uptake. The African botanical is also a good source of calcium (317 g/100 g), iron (5.94 g/100 g), and magnesium (148 g/100 g) compared to other fruits. While the amount of baobab in consumer products (typically up to 20%) may be insufficient to claim it as a source of these minerals, baobab still can contribute to a product's total mineral content.

Based on its ORAC values, baobab fruit pulp has a higher antioxidant capacity than many berries — twice as high as those of pomegranate and cranberry. This is an added selling point for baobab, as consumers are increasingly interested in products high in antioxidants, and manufacturers have developed a variety of antioxidant superfood products, such as drinks and foods containing goji berry, pomegranate, or açaí.

Finally, since the potential contaminants of baobab are classified as avoidable contaminants, they should either not be present or be present at such low levels as to pose no health risk to consumers. HG

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Disclosure

Dr. Jackson is the founder and CEO of Dr. Jackson's Natural Products, which specializes in African-based cosmetic and herbal preparations. Some of these products contain baobab.

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MATSÉS

Amazonian Tribe Compiles 500-Page Traditional Medicine Encyclopedia

By Connor Yearsley

The Matsés, or Jaguar People, of Peru and Brazil, who number approximately 3,300,[1] have created a comprehensive, 500-page encyclopedia of their tribe's medicinal knowledge, which was on the verge of being completely lost.[2]

The *Matsés Traditional Medicine Encyclopedia* is a compilation of the rainforest medicinal knowledge (including knowledge of medicinal plants) of five shamans and is written exclusively in the native language of the Matsés, which is also called Matsés. The tribe inhabits a large area along the Peru-Brazil border and the Yaquerana and Javari rivers (see map).[2]

Since Amazonian peoples have historically passed traditions down orally, this written record is believed to be the first of its kind and scope. Granted, ethnobotanists have frequently worked with indigenous peoples to catalog their herbal knowledge. For example, the Huni Kuin people of the Brazilian state of Acre collaborated with an ethnobotanist to publish a 260-page book about the healing power of plants.[3] However, the Matsés encyclopedia is different in part because it was compiled without the aid of ethnobotanists.

"That is what made this initiative so revolutionary and the first of its kind. There were no outsiders coming in to document [the Matsés'] knowledge, no expeditions, no translations. The entire encyclopedia was written by the Matsés shamans in their own villages, in their own words, in their own language, and through their worldview," said Christopher Herndon, president and co-founder of the conservation group Acaté, which collaborated on the conceptual development and provided production and

Photo ©2015 Alicia Fox Photography

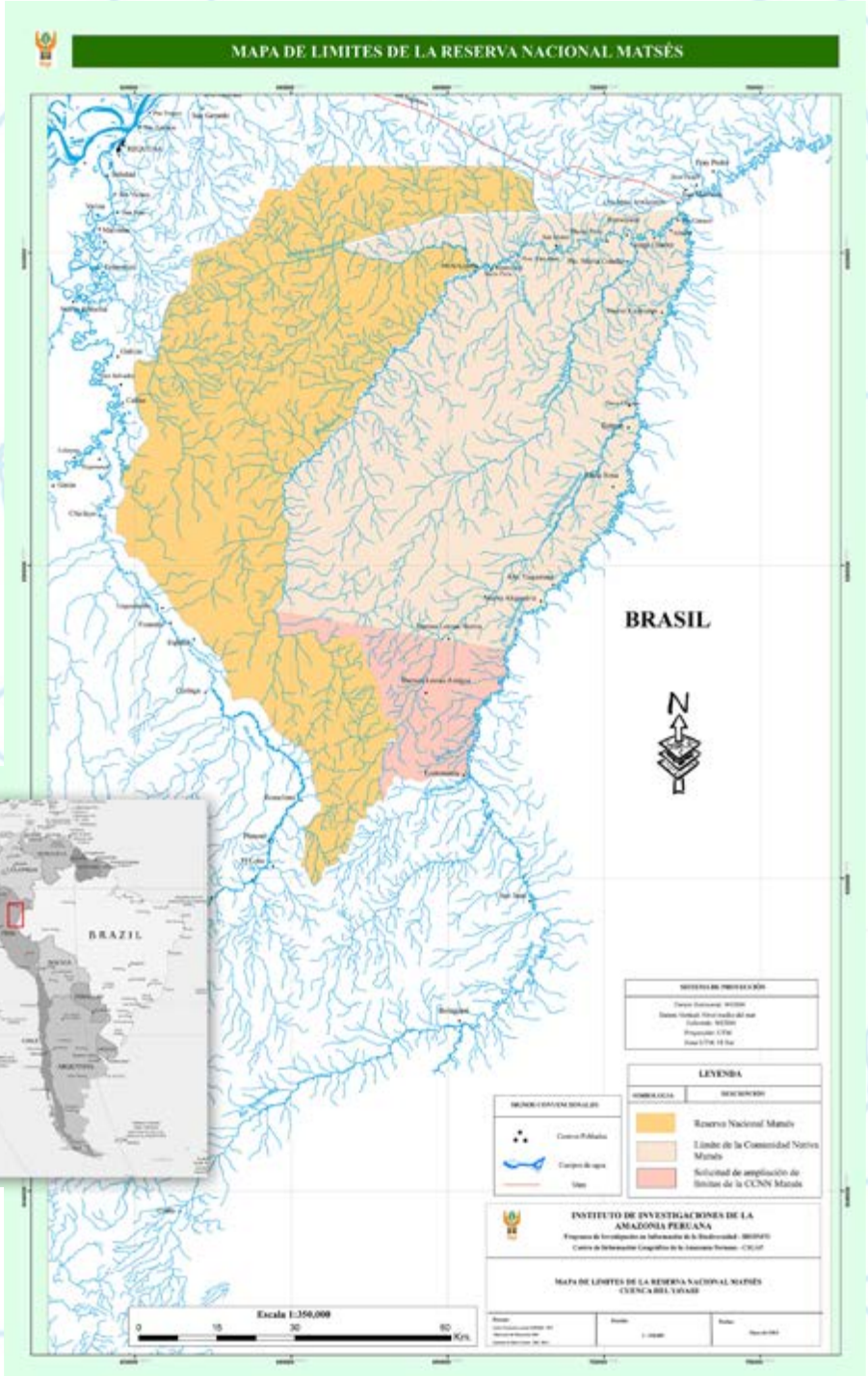
financial support for the project (email, August 14, 2015).

The encyclopedia has not been translated in order to prevent biopiracy, which is a real issue for the Matsés. For example, the skin secretions of the giant monkey frog (*Phyllomedusa bicolor*) have mind-altering properties and are used in Matsés hunting rituals. After learning about the skin secretions, several pharmaceutical companies and universities began conducting research and filed for patents without regard for the Matsés.[2] In addition, according to Herndon, the Matsés and the neighboring Matis tribe were the victims of another instance of biopiracy: Hunters from the tribes traditionally have applied the milky secretions of the bëcchëte plant (*Tabernaemontana undulata*, Apocynaceae) to their eyes to help them better distinguish textures. Seeds from this plant can now freely be purchased on the internet.

The Matsés encyclopedia contains disease names, symptoms, causes, the plants used as treatments, preparation instructions, alternative therapeutic options, illustrations made by a young Matsés artist, and photos of every plant used in Matsés medicine. The photos, which were all taken by the Matsés, are not detailed enough to allow outsiders to easily identify the plants, and no scientific names are provided for the same reason.[2] "The Matsés know the plants better than all of us and are highly specific about how the plants are harvested, the maturity of the plants at harvest, the parts of plants utilized and prepared, among other considerations. This information is conveyed in the encyclopedia," Herndon wrote.

This effort comes at a time when the traditions of many Amazonian indigenous groups are quickly disappearing. In fact, a renowned Matsés shaman died before his knowledge could be passed down, so Matsés leadership, along with Acaté ("acaté" is the Matsés taxon for the giant monkey frog[1]), prioritized the creation of the encyclopedia before additional knowledge was lost.[2] According to Herndon, the project began in 2012, with preliminary formative discussions beginning as early as July 2011, shortly after the shaman's passing.

The encyclopedia, which took more than two years to complete, was written not only to conserve the knowledge of the Matsés elders, but also to help maintain the tribe's self-sufficiency by preventing the need for total reliance on outside medical solutions. Many Matsés cannot



The Matsés hold title to the Matsés Communal Reserve (Límite de la Comunidad Nativa Matsés), the large area in light reddish-pink, which contains most of the Matsés villages. The Matsés National Reserve (Reserva Nacional Matsés), shown in orange, was established to protect additional areas of traditional lands, but the Matsés do not hold title to this forest reserve. According to Herndon, there are a few other annexes, some of which are not shown. The Yaquerana River becomes the Javari River at the confluence of the Rio Galvez, which is just south of Colonia Angamos.

Map courtesy of Acaté.

Children running through a Matsés village. Photo ©2015 Alicia Fox Photography

afford modern conventional medicine and have only the most rudimentary access to it due to the tribe's remoteness. However, the encyclopedia is only the first step in Acaté's three-step initiative.[2]

At the time the project was started, none of the Matsés shamans had apprentices to carry on their ancestral knowledge. Outside influences, particularly missionaries, often convince younger members of indigenous tribes that traditional medicine is primitive or altogether unnecessary.[2] In addition, young tribesman are pulled away by the high-tech world, said José Fragoso, PhD, a research associate at the California Academy of Sciences whose work focuses on the Neotropics. "They all unequivocally love gadgets and the aura that surrounds material goods," he said (email, August 13, 2015).

But most Matsés villages still rely on the few remaining shamans (all of whom were trained prior to sustained contact with the outside world). As a result, the second step of the process is for each elder shaman, most of whom are over 60, to be accompanied in the forest by an apprentice who will learn about the plants and assist in treating patients.[2]

The encyclopedia will serve as a guide for these future shamans and will help bridge a generational gap. "Having the encyclopedia will definitely help interest young [Matsés] in their culture," said Dr. Fragoso, but there is still a need to make it more appealing, "maybe by linking it to technological communication systems." Herndon pointed out though that there is no cellphone or regular electrical access throughout most of the remote

Matsés woman. Photo ©2015 Alicia Fox Photography

Matsés territories. Steven King, PhD, an ethnobotanist and senior vice president of ethnobotanical research and sustainable supply at Jaguar Animal Health, an ethnobotanically oriented drug discovery company, said that having data to help validate the efficacy of the tribe's herbal knowledge (from a Western medical perspective) could also help encourage new apprentices (email, August 13, 2015).

Reviewing the encyclopedia. Photo ©2015 Acaté

The Matsés decided that the apprenticeship program, which started in 2014 in the village of Esitrón under the supervision of shaman Luis Dunu Chiaid, should be expanded to as many villages as possible, with special attention being given to villages that no longer have a shaman.[2]

The third step of Acaté's initiative is for certain Western medical practices to be integrated with and complement traditional Matsés medicine. "It is the idea of merging the best of both systems in a respectful and cooperative manner. There are some health problems that can be managed well by both or either system," Dr. King said. For example, because of contact with the outside, the Matsés, like other indigenous peoples, have been exposed to foreign diseases such as falciparum malaria.[2] The Matsés tend to rely on outside medical solutions to treat these introduced and more virulent forms of malaria, according to Herndon.

The three-step initiative might have broader implications for the rainforest the Matsés inhabit. Acaté believes that empowering indigenous peoples is the best way to preserve large tracts of rainforest. In fact, many of the largest tracts of remaining rainforest are inhabited by these tribes. Industries like mining, petroleum, and timber have often taken advantage of tribes that have been weakened socially by outside influences, have limited resources, or that have developed an increasing dependence on the external world. The Matsés know that independence will make them and their home less susceptible to falling victim to outside influences.[2]

In fact, Canadian oil company Pacific Rubiales recently has become a threat to the Matsés. In 2007, Peru's oil and gas licensing body Perupetro granted the company licenses to two large tracts of land on Matsés territory. Many Matsés men have said they would fight with spears, bows, and arrows to protect their land and the waters of the Yaquerana River. Logging, both legal and illegal, is also a concern.[4]

Potentially at stake is one of the most biodiverse regions in the world and the Matsés' deep understanding of its vast plant and animal resources. In Peru alone, the Matsés inhabit nearly three million acres of rainforest on the eastern edge of the country.[2] This area, within the Peruvian region of Loreto, contains about two-thirds of the Matsés


Matsés man with bow and arrow. Photo ©2015 Alicia Fox Photography

Group photo, including shamans and Christopher Herndon (back row, second from the right). Photo ©2015 Acaté

population.[1] To the south lies La Sierra del Divisor, a region containing many rare plants and animals and uncontacted indigenous groups.[2] Within the Brazilian state of Amazonas,[1] Matsés communities — which contain the remaining one-third of the population — form the western edges of the Vale do Javari, a reserve containing the largest number of uncontacted tribes in the world.[2] The Peruvian and Brazilian Matsés are completely separate politically, but they intermarry and generally consider themselves to belong to the same tribe. In Brazil, the Matsés are better known as Mayoruna, although, according to Herndon, this term has also been used to refer to other tribes in the region.[1]

The Matsés first established contact with the Peruvian and Brazilian national cultures relatively recently, in 1969. Because of that, and the tribe's remoteness, they remain much more traditional than other contacted indigenous groups in the area, and still obtain most of their food by hunting, fishing, farming, and wild collecting. But now that they have more motorized canoes and travel more frequently to the city of Iquitos and Colonia Angamos (a Peruvian military outpost), they have more contact with non-tribal Peruvians, and they are increasingly reliant on money to buy goods. All Matsés still speak their native language, and many of their traditional beliefs remain intact. However, some young Matsés have lost pride in their culture. Some have even come to resent it because of the racism of local non-tribal Peruvians and other aforementioned factors. Others have left the tribe to work or join the army. The three pillars of Acaté's initiatives — sustainable economy, traditional medicine, and permaculture — are meant to help stop and reverse that trend.[1]

Acaté also helps the Matsés sustainably harvest and market natural products, such as copaiba resins (from trees in the genus *Copaifera*, Fabaceae) and sangre de grado (*Croton lechleri*, Euphorbiaceae), also known as dragon's blood. This allows the tribe to earn income and prevents

The Biopiracy Issue: To Document or Not to Document?


Giant monkey frog. Photo ©2015 Acaté

Despite the Matsés past experiences with biopiracy, Dr. Fragoso thinks they *may* eventually consider translating the encyclopedia into other languages. "Once mechanisms are in place to ensure the information cannot be misused or stolen for commercial purposes, they may find a way to make it broadly available. The important, labor-intensive step of recording the information for posterity has been taken," he wrote.

However, choosing to translate the encyclopedia could be a gamble for the Matsés. It is possible that doing so would allow them to take advantage of certain defensive protection options, like those made possible by the World Intellectual Property Organization (WIPO). For example, if the encyclopedia were made more broadly available, a "prior art" search could then preclude illegitimate patents. In other words, parties trying to file for patents could be denied if already-documented information prevented an invention from meeting the "novel" and/or "inventive" criteria necessary to be granted the patent.[5] In fact, a recent patent application submitted to the European Patent Office (EPO) by Pangea Laboratories, Europe's leading dermaceutical (a skin care product with claimed medicinal properties) laboratory, was thwarted.[6] The company proposed making a hair-loss treatment using turmeric (*Curcuma longa*, Zingiberaceae), pine bark (*Pinus* spp., Pinaceae), and green tea (*Camellia sinensis*, Theaceae), but was denied when prior art evidence contained in the Traditional Knowledge Digital Library (TKDL), which digitally documents existing literature on four of India's traditional medical knowledge systems,[5] showed that formula as being a traditional hair-loss remedy in India's Ayurvedic system of medicine.[6]

But documentation in repositories such as the TKDL provides no guarantees against misappropriation of traditional knowledge. The WIPO warns that documentation can sometimes destroy rights, as it does not prevent knowledge from being used by third parties and may, in fact, provide ideas for new inventions. If an invention meets the necessary criteria to be patented, it does not matter if traditional knowledge was the basis for the idea. Consulting the WIPO's Traditional Knowledge Documentation Toolkit can help indigenous groups develop an intellectual property strategy when deciding to document their traditional knowledge.[5]

Whether the Matsés eventually decide to translate the encyclopedia or not, Dr. Fragoso said he thinks fear of biopiracy is actually hurting some indigenous peoples by preventing more collaborations like the one between the Matsés and Acaté. Dr. King said he also thinks fear of biopiracy can be detrimental. "At times, this concern has indeed stifled research, cooperation, medical exchange, and ultimately useful benefit-sharing out of paranoia," he wrote.

Furthermore, Dr. King said he thinks some of these concerns are not as relevant today. "Ironically, there is actually not much interest by large or even medium pharma companies in natural products as leads for new drugs, but the fear of massive exploitation, which certainly did happen in the past century, has and continues to dominate the conversation. In truth, cosmetic, food, flavoring, and phytomedicine companies and their research arms are more likely to mine the literature for new sources of products than large pharma. Fortunately, there are more and more of these consumer companies that are being responsible and joining groups such as the Union for Ethical Biotrade (UEBT) in Europe, for example," he said.

—Connor Yearsley

them from having to take up destructive and dangerous timber-cutting jobs.[1]

The Matsés are taking proactive steps toward being able to determine their own fate and minimize the high rates of mortality and disease common among indigenous groups. This initiative can serve as a blueprint for other indigenous groups facing similar cultural erosion.[2] "Any and all efforts that help link the health of communities … to the health of their environment can and should be replicated and/or modulated to serve the needs of communities," Dr. King said.

"I would like to see all indigenous people produce similar encyclopedias. Letting others know the depth of knowledge held by societies is the best way we have of maintaining our cultures and showing our deep concern for others," Dr. Fragoso said. HG

—Connor Yearsley

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Matsés girl. Photo ©2015 Alicia Fox Photography

Matsés man. Photo ©2015 Alicia Fox Photography

Matsés boy. Photo ©2015 Alicia Fox Photography

BIG *Island,* SMALL *Planet*

CHALLENGES AND FAILURES IN CONSERVING HAWAIIAN SANDALWOOD TREES

By Susan Leopold, PhD

Sandalwood *Santalum* spp. Photo ©2015 Steven Foster

"Many problems in managing and protecting endangered species arise not from our ignorance of the species' ecology, but from Human conflicts of interest."

—Bobbi S. Low[1]

When Captain James Cook landed on the Hawaiian Islands in January 1778, they were covered in forests known for sandalwood (*Santalum* spp., Santalaceae) trees. Sandalwood, called *'iliahi* in Hawaiian, is a sacred species found in areas ranging from the islands' coastal lines to its high mountains. Hawaii is home to six endemic species, representing the highest sandalwood diversity of any region in the world.[2] Globally, there are 18 species of *Santalum*.

The Hawaiian sandalwood tree was a source of food with its edible nuts, and the oil and wood were used for waterproofing and scenting clothing, treating skin ailments, and making musical instruments and tools. The primary use of sandalwood transitioned from cultural to economic in the late 1700s, when trade between Hawaii and China ignited and the botanical material became a prized commodity; so important was the plant to the Chinese that they called Hawaii *Tahn Heung Sahn* or "Sandalwood Mountains." Now, just a few lonely fragment populations remain, and even these are threatened, as Hawaii is the only place in the world where there is no legislation specific to sandalwood conservation or trade.[2]

The tragic disappearance of Hawaiian sandalwood is particularly relevant to the discussion of conservation of at-risk medicinal and aromatic plants worldwide, where there is often scant regulation, little consumer awareness, complex environmental, social, and economic pressures, and high demand with finite supply. This is especially challenging when the at-risk medicinal plant is a wild-harvested tree, as is the case with the mountain sandalwood (*S. paniculatum*) endemic to the Big Island of Hawaii. This is the only species out of the six that is being commercially harvested at this time. Compounding its vulnerability is the fact that it is a hemiparasitic species, requiring a host plant for its survival. Other threats in Hawaii include grazing animals, pests, and diseases. The story of sandalwood in Hawaii becomes a lens from which to view what is happening to many species on a global scale.

Understanding the history, ecological threats, and limited legal and regulatory protections for Hawaiian sandalwood is essential to crafting a working, sustainable solution to this problem. Individuals and organizations such as United Plant Savers (UpS) have already begun to address the disappearance of sandalwood. UpS has mapped the recorded populations and used its "At-Risk Assessment Tool" to evaluate mountain sandalwood in the hope that what has occurred can inspire change in how decisions are made in regard to sourcing wild medicinals.

A History of Sandalwood Exploitation

The pressures on native Hawaiian sandalwoods have changed over time, but can generally be understood in terms of three distinct historical periods, each with their own dominant form of exploitation: (1) colonial trade, (2) cattle ranching and the introduction of invasive species, and (3) logging and the modern trade in essential oils.

1. Colonial Trade

The sandalwood export trade began with the legendary figure Kamehameha, who became King of Hawaii in 1791, not long after his encounter with Captain James Cook in 1779. By 1810, King Kamehameha had conquered and unified the islands of Hawaii. During his reign, he welcomed fur traders and whalers who discovered the Hawaiian Islands' sandalwood and knew of the demand for it in China. At the time, the availability of sandalwood trees for the Canton markets had declined because, in 1792, the Sultan of Mysore declared Indian sandalwood (*S. album*) a royal tree, limiting its sale to control the market and to address its overharvesting.[3]

The export trade in Hawaii from 1790 to 1840 changed the economy of the islands and brought about a terrible period of famine known as the Sandalwood Era. Many firsthand accounts from visitors to the islands described native peoples neglecting their fishing and crops to extract sandalwood from the mountainous regions in order to pay the tax the King demanded. The Sandalwood Era was very much driven by the Hawaiian monarchy's obsession with obtaining ships, guns, and traded goods.[4]

2. Cattle Ranching

William Hillebrand was a compassionate humanitarian, physician, and visionary botanist, who established a botanical collection on O'ahu and wrote the first *Flora of the Hawaiian Islands*, published just after his death in 1888. He addressed the monarchy in 1846 with a speech that is still relevant today, titled "The Relation of Forestry to Agriculture." In this speech he said, "Of all the destroying influences man brings to bear upon nature, cattle is the worst."[5] Hillebrand explained the value of native forests for enhancing rainfall and thus supplying water for drinking, irrigation, and the islands' native fish, wildlife, and plants. It is difficult to determine if the monarchy heard his plea to protect the native forests. With the support of the United States government, businessmen interested in land primarily for the sugar industry overthrew Queen Liliuokalani in 1893, just five years before Hawaii's annexation as a US territory.

In 1926, C.A. Judd — who was appointed super-

intendent for the Territorial Division of Forestry in 1915 — published his paper on the conservation of Hawaiian forests, reiterating that "damage to the forest consequent to the trade … was insignificant in comparison with the damage to the native forest wrought by cattle."[6] Cattle had been allowed to roam the islands and multiply since the time of King Kamehameha. Parker Ranch on the Big Island was at one time the largest cattle ranch of any US state. Both Hillebrand and Judd echoed the need to protect the forest, yet even after the sandalwood trade collapsed, the cattle industry and other agricultural pursuits continued despite warnings and an understanding of the islands' unique, fragile ecology. Had the forest been better protected — despite conservation attempts in 1903 via the establishment of the Forest Reserve System (FRS) — the Big Island would be in a position to manage healthy forests filled with sandalwood and other tropical hardwoods such as the magnificent koa (*Acacia koa*, Fabaceae), a native, nitrogen-fixing tree with which sandalwood grows as a hemiparasitic species.

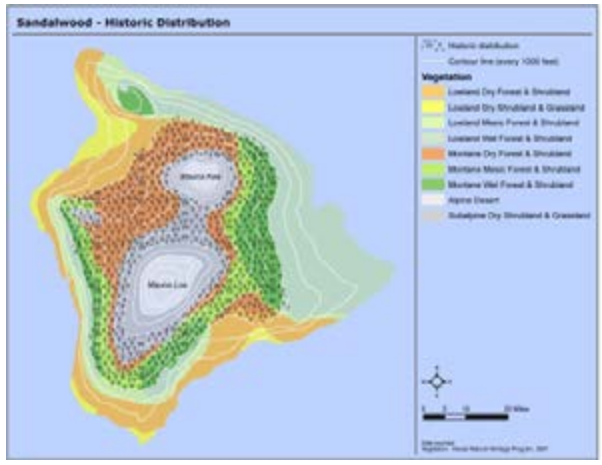
3. Sandalwood Logging

Now 123 years since the United States overtook an independent nation, Hawaii's sugarcane (*Saccharum* spp., Poaceae) plantations have been mostly abandoned, and ungulates (e.g., pigs, goats, and sheep) and non-native birds have been introduced — in most cases, for sport hunting. The military has become a significant landowner, and the cattle industry still dominates the inland landscape of the Big Island. The remaining sandalwood forests, the endemic birds, insects, plants, and unique island ecology all have suffered in ways that are immeasurable. The situation is now poised to get worse. Today, the market for sandalwood essential oil has spurred renewed logging of sandalwood.

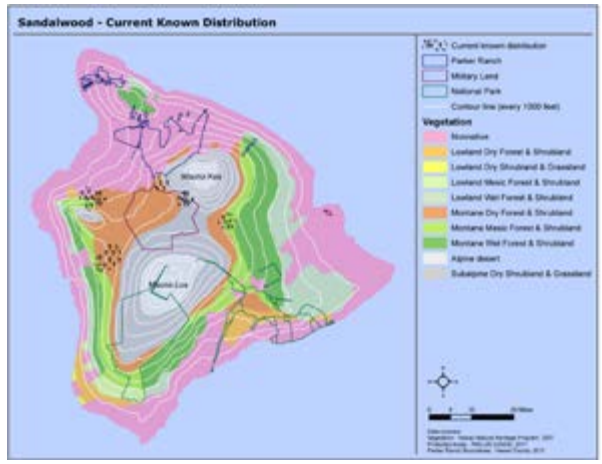
In 2010, the nonprofit publication *Environment Hawai'i*, under the leadership of editor Pat Tummons, first wrote about the logging of sandalwood that had been exposed due to a controversial bankruptcy case just southeast of the Big Island town of Kona. This area was designated on a historical map as the "sandalwood forest" noted to exist in 1906 by surveyors who mapped the *ahupua'a* land divisions of the Big Island. (*Ahupua'a* is a Hawaiian term for the traditional land divisions, usually wedge-shaped sections representing a single watershed, which run from the mountains to the sea.) Despite the agriculture, cattle, logging, and infestation of invasive rats, ungulates, and plants, this forest still persisted. It is important to know the land-use history in order to fully appreciate how fortunate humanity is that sandalwood has survived over the last 300 years of abuse to the landscape. The *Environment Hawai'i* article revealed that 3,000 acres of sandalwood forest had been sold and were actively being logged. Because Jawmin, the company that purchased the property, went into bankruptcy, the sale records of the sandalwood forest became public knowledge. According to the loggers, they had received orders for nearly $15 million in sandalwood from companies in Sri Lanka, Dubai, and China in 2010 upon purchase of the property, compared to merely $25,000 in orders for koa.[7]

An Attempt to Save Sandalwood – UpS At-Risk Listing

Given sandalwood's history and current threats, the UpS's Board of Directors — after working through the "At-Risk Assessment Tool" and evaluating the high score — voted unanimously in November 2011 to add all six native and endemic species (*S. freycinetianum* var. *lanaiense* [listed as federally endangered], *S. haleakalae*, *S. paniculatum*, *S. ellipticum*, *S. involutum*, and *S. pyrularium*) to the UpS's "At-Risk" List.[8,9] The intention in doing so was to create or enhance awareness in the plant community and to encourage landowners and state agencies to engage in stewardship of these living Hawaiian heirlooms.[7] The islands of Hawaii are rich in sandalwood diversity,



This distribution map shows that *S. paniculatum* grows in dry woodlands to wet forests at elevations between 450 and 2,500 meters (Wagner et al. 1990).



This distribution map is based on GPS points of populations documented in 2012.

yet these species are very sparse in population density. *Santalum paniculatum*, endemic to the Big Island, is the only species of the six that had a population that was harvestable on any significant scale at the time of the decision.

The logging of sandalwood in recent times is not some burgeoning trend. In fact, the impetus for holding the Sandalwood Symposium at the East-West Center in Honolulu in 1990 was concern over the harvesting of sandalwood that had taken place in the same region — though at the time it was owned by the Pace Family and known to most as Hokukano Ranch.[3] The logging taking place on the same property, but under different landowners, prompted the International Sandalwood Symposium (ISS) to be held in 2012, which was co-hosted by UpS and the International Sandalwood Foundation.[10]

At the close of the three-day international gathering, UpS presented the At-Risk Assessment Tool and its use in making the decision to add sandalwood to UpS's At-Risk List.[11] The tool is a series of questions divided into five categories, with each answer corresponding to a numerical value that quantifies the species' level of vulnerability. The first category is the plant's life history. In the case of sandalwood (*S. paniculatum*), it is a long-lived tree than can take more than 40 years to reach maturity. The second category assesses the effect of harvest, which is severe, since harvesting entails extraction of the entire tree, including its root ball. Sadly, almost no reproduction is occurring in the wild, since rats eat the seeds, and young suckers (new sprouts) are devoured by ungulates. The third category assesses the species' abundance and range. As *S. paniculatum* is found only on the Big Island in only a few locations, the tree scores high in this section as well. The fourth considers threats to the plant's habitat, which, for sandalwood, is both scarce and threatened. The fifth category is demand, and few trees are as valuable and in-demand as sandalwood.

After UpS's presentation at the conference, state employees distributed a survey that was used to gather feedback from attendees of the conference. The survey included questions about countries' conservation efforts and the government's role in conserving Hawaiian sandalwood. The opportunity for the state of Hawaii and the federal government to act keeps surfacing, but sadly there appears to be no political will to act. Hawaii, in general, is in an extinction crisis due to terrible land-use choices, which has resulted in the loss of vital habitats for native species and is compounded by an uphill battle in addressing invasive species. Activist Leigh-Wai Doo has been attempting, at the state level, to introduce legislation that would acknowledge the cultural and ecological value of native sandalwood. In 2012, Hawaii Senate Resolution 93 (HI SR93) was passed to form a sandalwood task force to study the possible conservation and regulation of harvesting, but sadly no study or assessment has taken place due to lack of appropriated funds.[12] As recently as 2015, legislation (SB319 and HB647) was again proposed to acknowledge the cultural and ecological significance of sandalwood, but both bills failed to survive the legislative process.[13,14]

Why Sandalwood Remains At Risk

It is important to recognize how the current dismal state of sandalwood and dry tropical forests is intimately tied to land-use decisions over the last 300 years. The failure to make an effective impact at this time, despite the best efforts of UpS and other interested, environmentally supportive stakeholders, is an essential piece of a much larger puzzle. Overburdened state and federal resources are struggling to keep up with the increasing number of endangered species. Researchers have documented[15] that over 90% of the original dry forest coverage in Hawaii has been elimi-

Santalum paniculatum flower. Photo ©2015 Susan Leopold

nated, and that the actual extent of native dry forest cover may be as low as 1%. Internationally, consumer awareness about the current state of affairs of sandalwood trade is low, despite being well-documented and studied.

Lack of Regulatory Protection and Conservation Attention

Even the small South Pacific nation of Vanuatu has laws to help manage native sandalwood, so it is difficult to grasp that the United States has not taken a stand on the conservation and management of such a valuable resource in Hawaii. The irony is that if Hawaii would take action toward sandalwood management, the islands could develop a viable sandalwood industry. Instead, the indifference to act has resulted in the decline of a limited resource that is now on the brink of collapse. Furthermore, there is conflict over the eradication of non-native ungulates on state-owned lands and federal parks. Some locals want to continue to see state lands managed for hunting instead of native species protection. Significant threats to the future viability of endemic sandalwood species include not only logging, but also the uphill struggle to address the tragedy of the endangered dry tropical forests of the Big Island and rapid extinction rates that are taking place. Currently, there are 367 plant species on the brink of extinction in Hawaii, and this list is growing rapidly.[16]

There are many tropical hardwoods that the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is trying to manage in the international wood trade. At the last CITES meeting in 2013, Kenya proposed adding *Osyris lanceolata* (Santalaceae) to Appendix II. (According to CITES, "Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled."[17]) *Osyris* is an unusual addition because its demand in international commerce is as an adulterant or "false/alternate" to sandalwood oil. Looking to the future, more wild-harvested plants, especially trees used in the essential oil industry, will probably be added to CITES. UpS petitioned for Hawaiian sandalwood to be considered for CITES listing in 2013 and re-petitioned in 2015. It has yet to be announced whether the US Fish and Wildlife Service will consider bringing the issue of Hawaiian sandalwood to vote during the next international CITES meeting in 2016. Even if sandalwood is added to CITES, it would not regulate trade to the United States since CITES governs international trade. The United States is the largest consumer of Hawaiian sandalwood oil and, therefore, there is still the need for the State of Hawaii to take a more active position in sandalwood conservation and management.

Lack of Consumer Awareness

Most sandalwood oil or incense consumers are probably not aware of the many endemic species of sandalwood found throughout island nations, or that many of these populations are endangered. For exam-

Sandalwood *Santalum* spp. Photo ©2015 Steven Foster

Table 1. Commercial Harvest of Various Sandalwood Species in 2011-2012[10]		
Species	**Market**	**Estimated Harvest**
S. acuminatum	Australia	250 tons, including 200 illegal
S. album	India and Southeast Asia to Timor	1,250 tons, including 1,000 illegal
S. austrocaledonicum	New Caledonia and Vanuatu	125 tons
S. lanceolatum	Australia	500 tons
S. macgregorii	Papua New Guinea	100 tons
S. paniculatum	Hawaii	600 tons
S. spicatum	Western Australia	3,300 tons, including 800 illegal
S. yasi	Tonga	250 tons; Tonga stated that they did not legally harvest any sandalwood last year, suggesting that 250 tons were poached.

ple, *S. fernandezianum*, endemic to the Juan Fernández Islands off the coast of Chile, has gone extinct due to human exploitation in just the last century.[18]

UpS hopes that, through the example of Hawaiian sandalwood, consumers of essential oils will think more deeply about this issue. Certainly, it is not just wild plants that are used in essential oils, as most are from cultivated sources, but the issues for those that are wild-harvested are heightened because of finite populations. In the case of sandalwood, these are long-lived trees that are cut down and take many decades to replenish. People who care about the future of sandalwood and other wild-harvested plants should use the UpS At-Risk Assessment Tool, which, as noted, can help assess the five core aspects that determine the at-risk status of a plant: its life history, effects of harvest, abundance and range, threats to habitat, and current demand.

Elements of the Solution

There is no single piece of legislation or conservation effort that will save sandalwood; rather, the problem must be approached from numerous angles and by a variety of stakeholders. Streamlined resource-extraction techniques and the ease of ordering exotic botanical products online and elsewhere necessitate conscientious action by companies, consumers, nonprofits, and others. Fortunately, responsible parties are already taking steps to address the conservation of wild-harvested plants such as Hawaiian sandalwood.

When asked why the natural products company Frontier Co-op, which owns the Aura Cacia® brand of essential oils, has chosen not to sell Hawaiian sandalwood products, aromatherapist and educator Tim Blakley explained: "When in doubt, the burden falls to the supplier to prove their harvesting model is sustainable, and in this case we saw no clear evidence that the model they were presenting would guarantee a long-term, steady supply of Hawaiian sandalwood."

As Bobbi Low, PhD, a professor in the University of Michigan's School of Natural Resources and Environment, has noted, "Many problems in managing and protecting endangered species arise not from our ignorance of the species' ecology, but from human conflicts of interest. As humans become ever more numerous, and more efficient in extracting resources, finding workable solutions becomes urgent."[1]

Government efforts to achieve a sustainable sandalwood industry have made Australia an interesting case study. Western Australia's Sandalwood Act of 1929 limited the harvest of the resource and put the majority of the sandalwood (*S. spicatum*) forest in the hands of the state, which facilitated management of the resource by allowing private, contracted companies to harvest, process, and market the trees.[19,20] Today, there is a significant effort in the northern, wetter part of Australia to establish large plantations of *S. album*.[21] This effort may help take the pressure off the Indian sandalwood trade — a conten-

Dying sandalwood trees. Photo ©2015 Susan Leopold

tious issue in India, where park authorities killed 20 sandalwood poachers in April 2015.[22]

Australia has put forth a serious effort to devise a long-term forestry management plan that includes intensive replanting for every tree harvested. Though poaching still occurs in Australia, the country has enacted a government-mandated model, making it the only place where wild populations are being managed by a defined regimen of sustainable forestry practices.

On another positive note, UpS acknowledged Mark Hanson, founder of the Hawaiian Reforestation Program Foundation, with the 2013 Medicinal Plant Conservation Award for his work in sandalwood seed collection, propagation, and restoration. Hanson, who has received UpS funding for his sandalwood nursery, is an advocate for a sustainable, sandalwood nut cottage industry as an alternative to harvesting the tree for essential oil. This idea has been launched in Australia, and the WA Sandalwood Nuts company is now actively selling the seeds of native *S. spicatum* as a specialty local food and reviving an indigenous traditional use.

Pressure also must be maintained on the public education front. To this end, UpS has a small video project on its website featuring interviews about key sandalwood conservation efforts, such as an interview with Neil Logan, co-founder of the FARM Center, highlighting his use of *S. paniculatum* as a secondary species in his successional agroforestry system. His interview shows thriving young sandalwood trees with food production in an area that was once a barren field of invasive grasses, demonstrating a successful conversion of cattle land into a food forest with the use of native trees.[23]

UpS also has a more detailed article covering the ISS that provides a more extensive global overview of sandalwood species and trade. The article was published in the Spring 2014 issue of the *Journal of Medicinal Plant Conservation*. The UpS website also contains information on the At-Risk Assessment Tool and an article detailing a case study of Hawaiian sandalwood.[24] Herb schools, consumers, herb companies, and educators are encouraged to engage the tool when conducting research and making important decisions.

Wild sources of sandalwood are quickly disappearing. Twenty years ago, an estimated 400 tons of sandalwood oil was being produced annually, and now, according to Tim Coakley — an expert on sandalwood trade and the executive chairman of Wescorp Group, which holds the government contract for harvesting and managing Australia's sandalwood lands — production has decreased to approximately 100 tons (See Table 1).[25] The example of Hawaiian sandalwood on the Big Island should be viewed on a global scale, particularly as it is emblematic of other wild-harvested species, especially those in the essential oil and resin trade.

Sandalwood seedlings from Mark Hanson's nursery. Photo ©2015 Susan Leopold

Creating a sustainable future for wild medicinal and aromatic plants will require global awareness and thoughtful intention regarding workable solutions to such problems — considerations that are especially important in regard to forest botanicals. We can no longer afford not to know the full story behind the plants a continually growing world population chooses to use, and we need to be engaged in and supporting workable solutions that safeguard biodiversity. HG

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New York Attorney General Targets 13 Manufacturers of Devil's Claw Supplements Containing *Harpagophytum zeyheri*

On September 9, 2015, the office of New York Attorney General (NY AG) Eric Schneiderman issued cease-and-desist letters to 13 companies* that market, distribute, or sell devil's claw (*Harpagophytum procumbens* or *H. zeyheri,* Pedaliaceae) dietary supplements. In addition, the NY AG asked the companies to identify and reimburse consumers who purchased these products.[1]

Devil's claw is an important African medicinal plant found in the Kalahari Desert region. Both *H. procumbens* and *H. zeyheri* are known as devil's claw and used interchangeably, which was pointed out in a press release from the American Botanical Council.[2] The European Medicines Agency's (EMA's) Community Herbal Monograph on devil's claw allows the use of both species in the "traditional use category" for relief of minor joint pain and mild digestive disorders, such as bloating and flatulence, and where there is loss of appetite.[3] However, the first edition of the American Herbal Products Association's (AHPA's) *Herbs of Commerce*, which was incorporated into federal regulations, lists only *H. procumbens* as devil's claw. (*Herbs of Commerce* is an industry self-regulatory publication that provides accepted labeling guidelines for common names of herbal and vegetable food ingredients in US commerce.[4]) On this basis, the NY AG established that all devil's claw products containing *H. zeyheri* are mislabeled and thus adulterated.

Devil's Claw *Harpagophytum zeyheri*
Photo ©2015 Steven Foster

The contents of tested products were identified using a DNA mini-barcode approach, which was performed by scientists from the New York Botanical Garden who specialize in DNA authentication of plant materials. A total of 23 commercial devil's claw supplements were analyzed, but only 18 were for sale in the United States. Of these 18 supplements, two were found to contain no DNA from any *Harpagophytum* species. (It is unclear if these two products contained devil's claw extracts that were processed in a manner that rendered the DNA undetectable by barcoding methods.)

The NY AG gave the companies 10 days to detail current quality control measures for their devil's claw products and plans to improve or reform these measures. Companies were also required to explain how they would identify and compensate affected consumers.

Nature's Way, which was not on the list of the 13 companies targeted by the NY AG, has already agreed to implement additional quality control measures, including DNA barcode testing for all its herbal dietary supplements that contain only one or two ingredients. In addition, the company has stated that their devil's claw products will be made exclusively with *H. procumbens*.[1]

The use of devil's claw for medicinal purposes by the San, Nama, and Khoi peoples of Namibia and South Africa dates back centuries. Investigations by Western nations into the medicinal properties of devil's claw began in the 1950s, but large-scale exports of the plant did not start until the early 1960s.[5] According to Thomas Brendler, CEO of the dietary supplement industry consulting firm Plantaphile and director of the Association of African Medicinal Plants Standards (AAMPS),** large-scale collection of *H. zeyheri* started only after 1975 when Namibia restricted the harvesting of *H. procumbens* in the wild. By 1986, about 65% of the wild material intended for export was apparently *H. zeyheri*.[6]

Older analytical technologies (e.g., the analysis of iridoid glycosides by thin-layer chromatography) were unable to distinguish the two species, so it is unclear which *Harpagophytum* species were used in clinical trials of devil's claw. However, high-performance liquid chromatography (HPLC) analyses of old batches indicate that many commercial products were made of a mixture of both species.[7] The interchangeable use is explicitly stated in the official "Harpagophyti radix" (*Harpagophytum* root) monograph of the *European Pharmacopoeia*,[8] and also in the proposed "*Harpagophytum* species root" monograph of the *Herbal Medicines Compendium* published by the US

* Despite the NY AG's press release and the media's reporting that cease-and-desist letters were sent to 13 companies, letters were sent to only 12 companies, since one company, Shine Supplements, could not be located by the NY AG and is not registered to conduct business in the state of New York.

** AAMPS is the publisher of the *African Herbal Pharmacopoeia* (2010), which Brendler co-edited.

Pharmacopeial Convention.[9]

Since botanical nomenclature and human knowledge of botanicals in commerce are constantly evolving, some of the entries in the second edition of AHPA's *Herbs of Commerce* (2000) are likely outdated, which may create some confusion in the US dietary supplement industry.[10] The constant revisions to botanical nomenclature were a problem recognized by the editors of the book, as was the fact that the addition of new species would be an ongoing process.

As stated by Michael McGuffin, president of AHPA, "The one piece that the attorney general seems to have missed is that *Herbs of Commerce* has a stated intention to have each common name listed there apply to only one individual species, except in cases where more than one species is considered in authoritative pharmacopeial literature to be interchangeable."[11] AHPA clarified the regulatory significance of *Herbs of Commerce* with regard to devil's claw labeling requirements in a press release issued September 18, 2015.[12]

Results from a scientific paper published in 2014, where over 300 samples of authentic *H. procumbens* and *H. zeyheri* materials were analyzed using ultra high-performance liquid chromatography-mass spectrometry (UHPLC-MS) and nuclear magnetic resonance (NMR) spectroscopy, have shown that the two species can be distinguished based on their chemical compositions, despite the fact that there can be variability even within the same species depending on the harvest location.[13] The notion that 6-*O*-acetylacteoside, a phenylpropanoid glycoside, can be used as a marker compound to distinguish the two species, as indicated in the recent letters from the NY AG, is not supported by the study of Mncwangi et al. which found the compound in both *Harpagophytum* species.[13]

Also, according to the paper by Mncwangi et al., the potentially active compound harpagoside occurs in both *H. procumbens* and *H. zeyheri*, but less than 50% of tested samples had the 1.2% harpagoside concentration specified by the *European Pharmacopoeia*.[8] However, at this time there is no pharmacological or human clinical evidence that *H. procumbens* and *H. zeyheri* produce different pharmacological effects.

Products that contain *H. zeyheri* but claim on their label to contain only *H. procumbens* are technically mislabeled under US law. However, for companies to receive cease-and-desist letters when official pharmacopeias (*British Pharmacopoeia*, *European Pharmacopoeia*, *United States Pharmacopeia*, etc.) and EMA monographs recognize the interchangeability of the two species seems to be splitting taxonomic hairs in a manner that does not afford any perceptible benefit to consumers. There are more compelling quality control problems currently occurring in US and international herb markets. HG

—Stefan Gafner, PhD

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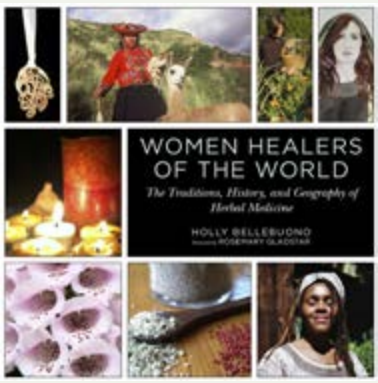
Women Healers of the World: The Traditions, History, and Geography of Herbal Medicine by Holly Bellebuono. New York, NY: Helios; 2015. Hardcover, 278 pages. ISBN: 978-1-62914-589-1. $24.95.



This beautifully photographed and illustrated book honors some of the best-known, wild-hearted, and dedicated women healers of world medicine traditions, from ancient times through modern day. Though the book's focus is on botanical traditions, it covers a range of other healing practices and topics, including allopathy, biochemistry, shamanism, homeopathy, midwifery, flower essences, essential oils, ethnobotany, plant conservation, and more. From the embalming herbs of Egyptian mummies to common (and not-so-common) herbs and healing practices of India, Asia, Australia, Central and South America, Africa, and Polynesia, the information presented is not merely focused on herbs. It exudes the "Science of Spirit" and reflects each woman's relationship with plants and people, and their diverse personal attitudes toward healing. It quietly emphasizes the significance of mentoring other women healers and the importance of passing on healing traditions.

Nearly every continent is represented. These wise women and their remarkable stories reveal passion, insight, dedication, wisdom, faith, immense heart, and diverse approaches to health-giving therapies. In traversing the myriad landscapes of world healing traditions, many women emphasize soul work through bathing, flower essences, praying, meditating, or entering the spirit realm. Others underscore the need to attend to the mental or physical condition of the body, or to connect to the earth and the plants themselves. The concept of medicine encompasses everything from intuition, or ingesting a simple herb or potent psychoactive plant, to participating in a ritual, watching the sunrise, calling upon the elements, being still in nature, and so much more. To quote the book, it is about "exploring the immense variety of customs and traditions with which botanical medicine tinctures our world…." All approaches hold the same strength and healing commitment, though it is almost universally understood that prayer and honoring the earth or ancestors solidifies the intent in nearly all traditions.

The book is divided into five parts, each with interviews and biographies of contemporary women or profiles of historic figures such as Cleopatra and Hildegard von Bingen. Each chapter begins with an overview of the topic.

"Part I: Plant Traditions" (Chapters 1-5) covers "Western Herbal Traditions"; "Native Nations Medicine"; "Polynesian Medicine"; "Folk Medicine, Gypsy, and Bedouin Traditions"; and "Alchemy and Aromatherapy." "Part II: Body Traditions" (Chapters 6-10) includes chapters on "Ayurveda"; "Eastern Oriental Medicine"; "Midwifery"; "Allopathic (Modern) Medicine"; and "Pharmacology." "Part III: Spirit Traditions" (Chapters 11-14) encompasses "Flower Essence Therapy"; "Homeopathy"; "Gaelic Pharmacy"; and "Shamanism and Spirit Medicine" (Chapters 11-14). "Part IV: Land Traditions" (Chapters 15-16) covers "Conservation and Gardening" and "Ethnobotany." "Part V: Handcrafting Traditions" (Chapter 17) includes information on "How to Make Herbal Remedies in Your Kitchen Inspired by World Traditions."

Names of organizations, a list of resources, and a bibliography are provided to further encourage the reader to continue their herbal quest and learn more about the women spotlighted and their organizations.

This is not your typical herbal where you can search for formulas or learn about body systems. It offers no *materia medica*, but instead highlights specific plants important to the healer or her native traditions. Interviews reveal details of the lives of 31 women and their unique healing traditions. These interviews include biographical information, life impressions, historical impacts, personal healing methodologies, and a useful timeline.

The book is sprinkled with anecdotes on etymology of Latin names and other word origins, as well as mythology and history, including information on the modern Western herbal renaissance and those who have fostered it. It lends as much credence to other traditional forms of healing as diverse as those interviewed. Each woman is a keeper of their ancestors' teachings and traditions. This book does a wonderful job of honoring the cross-cultural variety of divergent approaches to the very nature of healing and all that it encompasses — body, mind, and spirit — and all with stories of real-life experience. The chapter on conservation and gardening will enlighten the reader to the importance of protecting endangered plants and fostering their cultivation. The last chapter offers practical guidelines on creating a few kitchen and bath remedies, ointments, extracts, tinctures, and more.

Visually striking, this large, nearly ten-inch square "coffee table book" is an amazing value. What it lacks in depth of scientifically validated botanical research, it makes up for in the broad scope of included healers and the importance of their message: that the mystery and power of healing is important in our global history, yesterday, today, and tomorrow. This book is filled with pithy quotes, poetry, mythology, and magic, and it celebrates extraordinary women herbalists. If you want to be inspired by the timeless, honorable, and illustrious history of women healers, this book will open the floodgates. And if you listen carefully, you may hear the plants call your name. HG

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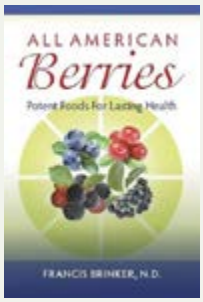
All American Berries: Potent Foods for Lasting Health by Francis Brinker. Sandy, OR: Eclectic Medical Publications; 2015. Paperback, 202 pages. ISBN: 978-1888483185. $16.95.



Francis Brinker, ND, a researcher and respected author of numerous previous books on botanical medicines, set out with two objectives for this book: (1) to provide scientific research on berries and their significance to modern health; and (2) to alert health care professionals about the importance of powerful foods, such as berries, in lowering the risk of chronic diseases.

For the first point, Dr. Brinker accomplished his goal. He provided an excellent and scholarly review of several indigenous American berry genera: *Vaccinium* (Ericaceae; e.g., blueberries, cranberries), *Rubus* (Rosaceae), and *Aronia* (Rosaceae; e.g., blackberries, raspberries, and chokeberries). What I particularly liked is that he thoughtfully reviews the literature and groups the findings according to in vitro, animal, and human studies. In addition, he presents a short literature review on the merits of consuming all fruits, not just berries, and vegetables for those at risk of chronic disease. This honest approach of presenting data is refreshing. I especially was pleased to see his coverage of blueberries from the Nurses' Health Studies I & II. I had just heard one of the study's authors present these same findings.

The review of studies that support eating berries is extensive. The meat of the book includes broad-ranging information about the polyphenol content, antioxidant capacity, bioavailability, effects of processing, animal data, and human health benefits (e.g., to treat or reduce the risk of disease) of berries in the heath and rose families. I wish that Dr. Brinker had inserted some tables and graphs to break up the dense text. He did include short sentences summarizing key findings, but I didn't find that enough. Dr. Brinker originally had planned to use the contents of this book as an appendix for another book, but decided against it based on the quantity of information available. He made the right choice and certainly satisfied his first objective of reviewing the literature on berries and health.

With respect to his second objective of alerting health care professionals about the importance of including berries in the diet, I would say that Dr. Brinker fell short. Most providers know that berries are healthy fruits and a good dessert or snack alternative to less desirable sugary or salty foods. I think they would find it too cumbersome to get through the information as presented. For subsequent editions, Dr. Brinker may want to consider including a summary table at the end of the book that shows the amount of berries (fresh or frozen) or equivalents (e.g., powders and extracts) one needs to consume to achieve a specific outcome. All of that information is in the book, but it is not summarized in a convenient way for busy health care providers.

I was quite taken with Dr. Brinker's breadth of knowledge. He knows the field of berries and botanicals well and can elegantly communicate difficult concepts like oxidative stress and the chemical compositions of plants. He has authored or co-authored numerous other books on the subject, and it is clear why. However, sometimes I wasn't sure what to do with the information. He spoke of "high bush" and "low bush" blueberries. When I go to the store I don't know what I am buying, and the two berries seem to have different effects.

I also found it a bit confusing as to which forms of the berries were best: fresh, frozen, powder, extracts, or juice. Based on his review of the literature at the beginning of the book, clinical efficacy was determined from studies using varying amounts and different preparations of berries. In particular, the studies in which a powdered version of the berries was used did not always state its composition or commercial availability. I live in New England, and berries are costly and not always available. If they are, they are not always appealing enough to buy. The powdered versions sound like good options. Dr. Brinker did devote a chapter about the different preparations of berries, but it still left me in the dark.

Good for Dr. Brinker for pointing out the side effects of getting too much sugar when taking berries in juice form. However, he failed to mention the dried cranberry craze. These are whole cranberries with their insides removed, and the remaining skins are pumped with sugar. Clearly, these can provide as much unneeded sugar as juices, and should be avoided. But this was a minor omission, and my overall opinion of the book was excellent. It was a treat to read and learn about the positive health effects of berries. HG

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The Ayahuasca Test Pilots Handbook: The Essential Guide to Ayahuasca Journeying by Chris Kilham. Berkeley, CA: Evolver Editions; 2014. Paperback, 231 pages. ISBN: 978-1-58394-791-3. $16.95.

The remarkableness of the ayahuasca experience has jumped out of its Amazonian source, reaching the world's peoples in their own lands as well as in the proliferating shamans' backyards.

Ayahuasca is the name for both the indigenous Amazonian vine *Banisteriopsis caapi* (Malpighiaceae) and the psychoactive multi-plant admixture that is famed throughout Amazonia, and now, in many other lands and countries. The ayahuasca vine is being cultivated in new farms, pounded to smithereens by traditional muscle, or chopped irreverently in a chipper-grinder to make the pungent, swampy drink. The vine is the source of the monoamine oxidase inhibitors (MAOIs) that make the psychoactive compound dimethyltryptamine (DMT), found in the other plant component(s) of the ayahuasca admixture, orally active. Beyond the jungle and escaping the traditional, as ayahuasca takes hold in the West, new admixtures of DMT-containing plants and chemicals — "pharmahuasca" — have arrived,

even including a palatable chocolate confection.*

The recognized religions of the sacramental brew, Santo Daime (a term that refers to ayahuasca[1]) and União do Vegetal (which means "the union of the plants"[2]), are both spreading. The United States and Europe have growing numbers who are singing their ritual songs at their diverse centers, with presiding itinerant maestros and numerous Westerners enlarging memberships. So the magic of the brew spreads and claims new aficionados, despite its bitterness and attendant purging, its levitating energetics, and often-difficult experiential passages. Not for everyone, for sure!

To me, as a psychiatrist familiar with the actions of psychoactive drugs and their effects on the human mind and psyche, there is only one explanation for the significant increase in ayahuasca use: the realms of mind that are accessed are transcendent, unpredictable, fantastic, and potentially transformative.

There is pleasure, as well as potential difficulty and upheaval, in changing and leaving our ordinary mental states. Attachments, desires, ignorance, and hatred are removed for a beyond-CinemaScope experience of what appear to be other worlds. But these are our own idiosyncratic worlds, accessible to no one else, however many uniformities of this particular mind-altering experience there may be, such as voyaging through fractal universes. However valuable the guidance of a shaman or a facilitator may be, in the end the ayahuasca realm is ours alone. In this sense it is a remarkable, validating example of the possibilities for personal experience.

The Ayahuasca Test Pilots Handbook is the psychedelic equivalent of a Lonely Planet® guide, and, in fact, it feels and looks like one. But, in this instance it is a guide to the "innerverse" and how to make that journey as smooth as possible by avoiding the Scyllas and Charybdises that stalk the unwary traveler upon his/her embarkation onto the high seas. In an everyhuman style, Kilham enthusiastically guides the reader on how to pick a shaman, discriminating between the deep, indigenous workers of 'huasca lands and the phonies out for the dollar opportunity; how to understand the ayahuasca brew itself by asking the appropriate, self-protective questions about its admixture, the attendant ceremonies, and rituals; and the culminating integration process following an experience that sets a changed self back on Mother Earth.

Clearly Kilham likes the stuff and preaches (with caveats) to the masses to get on board — which, as noted, they are doing, local drug laws notwithstanding. There is a real business going down in the humid zone, and beyond. Kilham gives his view of the healing potential of La Medicina with statements like, "I personally have found that ayahuasca has the capacity to rip my heart wide open and fill me entirely with pure love."

It is in his thorough explication of the possibilities of the ayahuasca journey, taken from the deep space of his own experiences, that there is the most value. Kilham lays out the experience from start to finish, beginning with the purging and getting stuck in what he aptly calls the "toilet vortex." It is especially his descriptions of the broad range of experiential possibilities, the phenomenal world of the inner journey, that make this little book so precious.

Kilham emphasizes the unique superiority of ayahuasca as a psychedelic experience as much as possible, extolling its virtues over all others, without a hint of the controversy he is stirring:

> Even if you are familiar with other psychedelic agents, you have not taken ayahuasca. The medicine is of an entirely other order of potency, depth, and efficacy, from a healing standpoint…. Many people who have previously experienced LSD, magic mushrooms, or peyote assume that they have a good idea of what to expect. This is only partially so…. As with all the psychedelics, you will find yourself in a state of non-ordinary reality. After that, all bets are off. Ayahuasca is of a whole other order of intensity and thoroughness…. I can say that ayahuasca possesses unimaginable oceanic powers. La Medicina is a living, conscious spirit with unlimited depth and energy.

Ayahuasca is indeed a remarkable, awful-tasting but psychedelically delicious concoction. How disparate tribal folk from various parts of South America put it together from so many vascular plants that grow in Amazonia undoubtedly will remain a mystery. Further ethnological and archeological research will be needed to even approximate its origin.[3,4]

The late and missed silver-tongued Pan, Terrence McKenna, shaped a view that is intriguing but probably incorrect in its hypothesis, namely that DMT and its source are responsible for all of the psychoactivity of the ayahuasca brew. McKenna posited that the vine provided the MAOI but was itself inactive. Through endless trial and error — they must have chewed on everything — the indigenous peoples somehow finally put the two together, which on their own did not produce the psychoactive experience. For those living within the extraordinarily varied botany of the Amazon with over 80,000 known plant species, this would have been ultimate synchronicity.

Alternatively, the shamanic view has been that the ayahuasca vine itself, *B. caapi*, creates the capacity for plant divination when imbibed that enables recognition of the properties of diverse species, including the psychoactive, and that was how the two were put together. This was a common practice and myriad ayahuasca and other admixtures were made based on intimate knowledge of the plant world and an insatiable curiosity to experience it.

To demystify a bit, DMT-containing snuffs have been found in 2,000-year-old ritual objects for the nasal intake of *Anadenanthera* spp. (Fabaceae). It was apparently discovered that the intranasal route produced a visionary DMT/5-MeO-DMT experience. 5-MeO-DMT is a potent, fast-acting derivative of DMT, which activates serotonin receptors and is four to 10 times more potent than DMT.[5]

The snuffs came from a widespread and perhaps well-traded source; the trade routes crisscrossed a very inhabited and organized pre-Columbian continent. This gave rise to many indig-

* The ritual ayahuasca admixture, and, presumably, ayahuasca-containing ingestible formulations, are legal in the United States when employed within the context of a religious ritual, as allowed by the 2006 Supreme Court of the United States decision, Gonzales v. O Centro Espirita Beneficente União do Vegetal. The Court based its decision on a 1990 Supreme Court decision in the First Amendment freedom of religion case involving the rights of Native Americans to utilize peyote (*Lophophora williamsii*, Cactaceae) as part of their religious ceremonies.

enous snuffs with different names but similar experiences. The knowledge of this alteration of consciousness was widespread, but apparently was not used in the Amazon itself.

Dating the first use of the ayahuasca vine is more uncertain but it is considered ancient and certainly arose many hundreds of years ago, most likely in the Napo River region of Ecuador and Peru, and as a vine-only practice. High doses produce a sedating effect, generally mild, but psychoactive. There seems to be little basis for attributing a dissociative effect. But the vine had widespread use in shamanic circles and knowledge of it clearly was diffuse. It was a source plant for divination and combining with other plants, including in the making of snuffs.

Unlike the McKenna proposition for inactivity, it is claimed by those deeply familiar with indigenous peoples' practices that the DMT source plants have other psychoactive effects when taken orally, apart from the effect the DMT would produce when combined with the ayahuasca vine. Several hundred years ago, in relatively modern times, it would seem, the two came together. The main DMT source used for potent brews has been *Psychotria viridis* (Rubiaceae), but other plants are also added to the ayahuasca vine to produce modern two-plant hallucinogenic mixtures. DMT and 5-MeO-DMT are widely represented in the plant world and are naturally occurring in tiny amounts in human brains, hence, quite likely, are the basis for our predilection for grand psychedelic journeys on large exogenous amounts of the stuff.

All of this extols the genius of the plant explorers of the South who knew their world by examining it and tasting it, no doubt with some attendant negative experiences and poisonings. To them, we and Chris Kilham are deeply grateful. HG

—Philip E. Wolfson, MD
San Francisco and San Rafael, California

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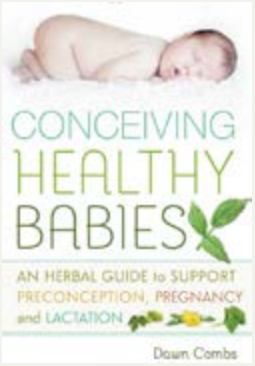
Conceiving Healthy Babies: An Herbal Guide to Support Preconception, Pregnancy and Lactation by Dawn Combs. Gabriola Island, BC, Canada: New Society Publishers; 2014. Paperback, 400 pages. ISBN: 978-0-86571-780-0. $24.95.



This book is described as "a unique herbal guide [that] focuses on plant-based strategies to help couples achieve balance in preconception, pregnancy, lactation and beyond." It is written for prospective and new parents, though it provides insights for the professional as well. The author aims to assist couples faced with fertility challenges through personal stories and information on diet and medicinal plant use.

Conceiving Healthy Babies consists of three main sections. The first section, "A Journey to Family," tells the story of the author's personal journey that starts with her medically diagnosed infertility, which she and her husband overcame with changes in every aspect of their lives. This resulted in the birth of their two children, both of whom she went on to breastfeed. The section includes her valuable story of the challenges she met.

In the second section, "Strategies for Building a Healthy Baby," the author provides information and advice on a wide range of topics, including foods and herbs for each stage of the perinatal period, techniques such as breast massage and chiropractic intervention, and breastfeeding aids for low milk supply. She writes heartfelt discussions of the role of the mind when challenged by infertility and low milk supply.

The following sections — "General Herb Use," "Determining the Quality of Herbs," and "Whole versus Isolated Constituents: The Side Effects of Ethnobotany" — are devoted to medicinal plants. In these pages, the author very briefly discusses botanical constituents of concern, though in an inconsistent and curious manner.

The safety tables presented throughout the book are well-organized and provide a fairly reliable guide to specific issues encountered in the prenatal, pregnancy, and lactation periods. Safety ratings are provided for 248 plants, and information on plant parts used, chemical constituents, and conservation status is easy to find. Galactagogue plants (or anti-galactagogues) are almost all reliably identified as such. However, the traditional Ayurvedic herb shatavari (*Asparagus racemosus*, Asparagaceae) was overlooked; it is a major galactagogue.

The author uses a simple three-level safety rating — "no contraindications," "use with caution," or "generally avoid." Additional notes are provided for each plant and alternatives are suggested for riskier plants. In most cases, the assigned caution level is accurate and well-considered. Some plants with safety concerns such as genotoxicity and carcinogenicity are not consistently rated, and the author's views on certain toxic

constituents are a concern for this reviewer.

Curiously, all caffeine-containing plants are cautioned based on a 1994 study,[1] which suggested that their use lowers the iron content of breast milk; however, the review concluded that coffee (*Coffea* spp., Rubiaceae) did not have a negative effect on breastfeeding. The most common side effect experienced by breastfeeding mothers who use caffeine-containing medicinal plants such as coffee or tea (*Camellia sinensis*, Theaceae) is infant over-stimulation, but this is not mentioned in the text.

On the other hand, the author tends to downplay the safety issues of other plant constituents such as beta-asarone, safrole, and, most astonishingly, pyrrolizidine alkaloids (PAs). The author does not address the PAs in degrees of known hepatotoxicity, nor does she mention that some species of comfrey (*Symphytum* spp., Boraginaceae) contain PAs of higher toxicity. She states incorrectly that Russian comfrey (*Symphytum* × *uplandicum*) leaf does not contain PAs. The safety ratings for medicinal plants with toxic PAs give some cautions, but the author does not recommend avoiding them entirely during the perinatal period. These plants include borage (*Borago officinalis*, Boraginaceae), comfrey (specified as *S. officinale*), coltsfoot (*Tussilago farfara*, Asteraceae), butterbur (*Petasites hybridus*, Asteraceae), and even liferoot (*Packera aurea* syn. *Senecio aureus*, Asteraceae). Although the author explains that women should "generally avoid" liferoot during pregnancy, she writes that mothers can "use with caution" during lactation. If she is really talking about *Senecio*, this is scary; the plant is widely known to be hepatotoxic due to its PA content.

With common comfrey (*S. officinale*), the author suggests limiting internal use to four to six weeks per year when breastfeeding. The additional warning to avoid the herb "if known liver problems exist" shows that the author has concern for mothers but overlooks potential risks to infants born with immature livers. The infant liver is not considered mature until two weeks of age, so it is at greater risk from exposure toxic PAs. The appendix promises further information to consider for the "special" case of comfrey, but it lacks detail. The reader is referred to a website that does not discuss the potential safety concerns of comfrey during pregnancy or lactation.

The medical literature contains a well-documented case[2] of neonatal liver damage and death attributed to prenatal consumption of toxic coltsfoot and butterbur root. A more recent case concerned a pregnant woman's daily use of "comfrey" (species unnamed) with an unnamed species of *Heliotropium* (Boraginaceae) that was purchased in Turkey.[3] The baby was born with liver failure and subsequently died. However, I don't think the inclusion of this case lets comfrey off the hook. The risk of liver damage from toxic PAs in humans is currently considered highest for the developing fetus; damage accumulates with every exposure and may not appear for decades. Toxic PAs have been detected in the milk of dairy animals as well as in research animals and honey. It is rational to assume that toxic PAs enter human milk. Therefore, starting a baby's lifetime load of toxic PAs at birth seems unwise. The reader is simply not given enough information to evaluate the potentially harmful claim that comfrey or any other plant containing known toxic forms of PAs are safe to consume at any dose during pregnancy or lactation.

Allergenic plants are inconsistently identified. Roman chamomile (*Chamaemelum nobile*, Asteraceae), for example, has been documented to cause allergic skin reactions when used as a nipple remedy,[4] but this is not mentioned in the notes on this plant.

While providing an interesting insight into the world of Sally Fallon and the Weston Price Institute, the author's nutrition recommendations may be of limited use for the vast majority of lay readers. Her tone insists that the consumption of grass-fed organic beef and fermented cod liver oil is imperative for success against infertility. Some step-down suggestions for those who cannot follow every dietary suggestion would have been charitable and helpful to many. As a professional lactation consultant, I *do* appreciate her accurate portrayal of the profession and the role that lactation consultants can play in helping mothers with low milk supply.

More referrals to online or text resources for breastfeeding would have been helpful. Some of the reference texts are older editions of good books, but the inclusion of Dr. Aviva Romm's medical text, *Botanical Medicine for Women's Health* (Churchill Livingstone, 2010), is appreciated.

Over-reliance on a single philosophy for nutritional guidance trips up the author at other points as well. For example, she dismisses the use of human milk from nonprofit donor milk banks as the next best option for feeding infants. I was shocked by this negative opinion, which is based on the fact that donor milk is pasteurized. Donor milk saves babies. Outside of medical circles, mothers are finding other sources of human milk — through nonprofit milk banks or milk-sharing with sisters or very good friends. Yet the author promotes only the use of raw cow's milk in a homemade infant formula (the incomplete recipe is provided in an appendix). The money needed for the ingredients would be better spent on buying human milk through a donor milk bank.

I cannot recommend this book to the general reader as it is too narrowly based on a certain dietary philosophy and provides herbal guidance to prospective parents that, in some areas, may be potentially harmful. HG

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Robert "Bob" Ullman 1933-2015

Long-time natural products industry lawyer Robert Ullman and his wife of over 60 years, Joan, passed away on August 15, 2015. Bob Ullman, senior counsel at Ullman, Shapiro, & Ullman, was an advocate for rational legislation from the US Food and Drug Administration (FDA), and he represented the dietary supplement industry in landmark cases that successfully paved the way for the Dietary Supplement Health and Education Act of 1994 (DSHEA).

Upon his retirement in 2005, Mr. Ullman received the National Nutritional Foods Association's (now the Natural Products Association's) President Award in recognition of his contributions to the natural products industry. Throughout his 45-year career, his tenacity and dedication were legendary, as were his day-to-day efforts to serve and represent his clients.

Mr. Ullman was born in Frankfurt, Germany, in 1933 and graduated magna cum laude from New York University in 1955. He earned his law degree from the same institution in 1961 and joined the firm of Bass & Friend with his colleague Milton Bass. Eventually, he became a partner, and the firm changed to Bass & Ullman in 1969. It was during this time that Mr. Ullman took on the cases that would define his career and shape the natural products industry into its modern form.

In 1979, Mr. Ullman represented FoodScience Laboratories in front of the 7th Circuit Court, defending the use of N,N-dimethylglycine (DMG) as an active ingredient in the company's "vitamin B-15" tablets. The company did not prevail, largely because DMG was deemed a "food additive," and food additives must be approved by the FDA before they are allowed on the market.

However, several years later, a similar case came up in front of the court. The FDA had seized barrels of blackcurrant (*Ribes nigrum*, Grossulariaceae) oil from Traco Labs in Champaign, Illinois. Once again, Mr. Ullman represented the industry and argued his case successfully in what marked a turning point for supplement legislation. The FDA claimed that the oil, which was packaged in gelatin capsules, was an unapproved food additive on the basis that the gelatin capsule counted as a "food." Showing a theatrical flair, Mr. Ullman brought a bottle of the oil with him into the courtroom and took a drink, asking if that same oil counted as a food in bottled format and, if so, how it differed when contained in gelatin capsules. The court ruled in favor of Traco Labs, and the ruling was upheld by the Court of Appeals, where the FDA's argument was described as an "Alice in Wonderland" approach. The phrase quickly became popular, and during the process of passing DSHEA, US Senator Orrin Hatch (R-UT) referred back to the case as a clear example of the need for legislative reform.

Mr. Ullman defended the industry in many other pivotal cases, including one in which the US Federal Trade Commission (FTC) attempted to categorize high-dose vitamin A and D caplets as drugs, and another in which the FTC took action against Metagenics regarding the claims made on their Bone Builder® calcium supplements.

In 1999, Bass & Ullman dissolved, and Mr. Ullman became senior council at the newly formed Ullman, Shapiro, & Ullman with partners Steven Shapiro and Marc Ullman, his son. When celebrating his father's receipt of the NPA's President Award in 2005, Marc Ullman was quoted as saying, "I grew up watching my father fight for the supplements industry with a passion that didn't accept failure or defeat. He has literally dedicated his life to defending this industry, and inspired us all by the passion he brings to defending his clients."[1]

Many of Mr. Ullman's friends and colleagues expressed their heartfelt gratitude for his tireless efforts. "I had the opportunity to meet Mr. Ullman many years ago when he accepted our NPA President's Award," said Daniel Fabricant, PhD, NPA's executive director and CEO. "I knew how important his contributions were to NPA and this industry. He has always been a staunch defender of the rights of both retailers and manufacturers to present their views and sell their products…. He truly transcended a lifetime of achievement in our industry and will be greatly missed."[2]

"Bob's contributions to the natural products and dietary supplement industries cannot be overstated," said Michael McGuffin, president of the American Herbal Products Association. "Bob's legacy will always be seen in the access enjoyed today to a wide array of products that promote health and well-being and in the prosperity of these industries."

"I will always remember Bob as a strong advocate for consumer rights to access to dietary supplements and as a 'bulldog-like' advocate on behalf of his numerous clients in the natural products and dietary supplements industry," said Mark Blumenthal, founder and executive director of the American Botanical Council. "Bob's excellent litigation in the now-famous Traco case demonstrated the absurdity of the FDA's untenable position on blackcurrant seed oil. … It was a key decision in favor of consumer access to dietary ingredients without the FDA's abuse of the food additive provision of the law."

Mr. Ullman and his wife are survived by their son, Marc, and daughter, Gail Ullman Corbett. HG

—Hannah Bauman

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Annemarie Colbin 1941-2015

Annemarie Colbin, PhD, left this earth on April 10, 2015 in Denver, Colorado, following a brain hemorrhage. Members of her family were by her side.

Annemarie was one of the early pioneers of the health food movement, daring to be different well before whole foods were mainstream and the connection between diet and health was readily accepted. In 1977, she founded the Natural Gourmet Institute (NGI), in New York City, now the oldest health-supportive culinary school in the United States, educating young cooks about the ins and outs of health-supportive cuisine before it was hip and trendy to eat clean.

Born in Holland in 1941, Annemarie and her mother fled to Hungary during World War II. Although they got separated from her father Rudolf, the family was reunited after the war when they moved back to Holland where her brother Michel was later born. They ultimately migrated to a small beach town in Argentina called Mar del Plata and opened a boutique hotel called The Carlton where the whole family worked.

When Annemarie's father fell ill, her mother took the family to a vegetarian spa run by Seventh-day Adventists where her parents went on a 21-day cleanse; Annemarie did it for 11 days, which marked the beginning of her understanding and appreciation of the connection between food and health. Sadly, when Annemarie was 19 years old, her father died of a heart attack in her arms.

Dr. Colbin was a healthy food visionary. She referred to her work as "natural foods cooking," and summed up her philosophy in seven principles. Good food, she said, should be seasonal, local, whole, traditional, balanced, fresh, and delicious. Although this philosophy is deceptively simple, it is grounded in her doctoral work in holistic nutrition, which included a dissertation that incorporated systems theory, complexity theory, chaos theory, and the theory of relativity into an integrated theory of nutrition.

As Annemarie's daughter Kaila stated at the memorial: "The purpose of being alive is to express what is inside you, and inside my mother was love, beauty, strength, and a vision for helping people take charge of their health through food."

Annemarie authored or co-authored multiple books including *Food and Healing* (Ballantine Books, 1986), *The Natural Gourmet* (1991), *The Book of Whole Meals* (1983), and *The Whole-Food Guide to Strong Bones* (New Harbinger Publications, 2009). Her work has also been featured in the *New York Times*, *Elle*, *Good Housekeeping*, *Natural Health*, *Longevity*, and *New Age Journal*.

She won numerous awards including an International Association of Culinary Professionals (IACP)/Seagram Book Award and the Avon/Small Business Administration "Women of Enterprise" Award. Annemarie was also granted a Fearless Food Advocate Award for her work "as a leader in the realm of whole foods and health-supportive cooking." Green Guerillas, the organization that issued the award, said it was in honor of her "commitment to convincing generations of culinary professionals and everyday people they should care about what's on their plate."

When asked what they learned from their mother, both daughters had this to offer:

- The world is not a safe place and all sorts of horrible things can happen, but that cannot stop you from living your life.
- Take responsibility for yourself and your health.
- You make the choices on how to handle your health. Take all of the advice given to you with love and respect, and then decide.
- The mainstream opinion isn't always the answer; sometimes it's okay to take the road less traveled.

And one of Annemarie's favorite sayings, as noted by her daughters, was that "there's no limit to what you can accomplish if you don't care who gets the credit."

Dr. Colbin was a leader, a teacher, a mother, a friend, and a role model for generations of chefs, and she deeply affected the lives of those around her. Annemarie is survived by her two daughters, her son-in-law, three stepchildren, two grandchildren, and two step-grandchildren. Her legacy will live on through the good work of everyone whose path she inspired. HG

—Stefanie Sacks, MS, CNS, CDN
Culinary Nutritionist

Heinz Schilcher 1930-2015

German pharmacognosy professor and medicinal plant researcher Heinz Schilcher, PhD, died in June at the age of 85.

Dr. Schilcher was born in 1930 in Burgheim, Germany, the first of three children of master miller Josef Schilcher and his wife Anna. Growing up surrounded by nature had a profound influence on him. Since there was no school the year after the Second World War began, he worked at his father's mill in a type of internship. From 1952 to 1956, he studied pharmacy under the supervision of Ludwig Hörhammer at the Ludwig Maximilian University of Munich, where he received his doctorate in 1959. During this time, he researched the constituents of bugleweeds (*Lycopus europaeus* and *L. virginicus,* Lamiaceae) and their effects on hyperthyroidism. He continued to work in Munich as an assistant to Dr. Hörhammer until 1963.[1]

Between 1963 and 1974, Dr. Schilcher worked as a control manager and as the head of the scientific department and production for the herbal drug manufacturer Salus, where he developed 75 herbal products and led pharmacological and clinical tests on more than 20 plant preparations. Notably, in 1964, he published the world's first proposal for a standardized herbal product based on chromatographic fingerprints and physical parameter measurements. Dr. Schilcher has since been called the "father of a reproducible herbal drug quality."[1]

From 1973 to 1977, Dr. Schilcher was a professor at the Institute of Pharmaceutical Biology at the University of Marburg, and then was appointed professor at the University of Tübingen. At the same time, he was a full-time member of the management at the herbal drug manufacturing company Fink. In 1983, Dr. Schilcher moved to Berlin to become a professor at the Free University of Berlin (FUB), and later served as dean of the faculty of pharmacy from 1986 to 1989 and as executive director of the Institute of Pharmaceutical Biology, a position that he held until his retirement in 1995.[1,2]

Dr. Schilcher had a prolific career as an author of more than 300 scientific papers and almost 20 books. Among his numerous publications, his textbook *Leitfaden Phytotherapie* (*Phytotherapy Compendium*; Elsevier, 2010) is considered a landmark text and is often referred to as the "bible of phytotherapy" in Germany. Dr. Schilcher also wrote a number of chapters in the outstanding book, *Chamomile: Industrial Profiles* (CRC Press, 2005), which he edited with Rolf Franke.

"He made enormous contributions in the field of phytotherapy," said Elizabeth Stahl-Biskup, a colleague of Dr. Schilcher's and a professor of biochemistry and molecular biology at the University of Hamburg.

Dr. Schilcher was the longest-serving member of the German Commission E, a special committee of medicinal plant experts founded in 1978 and convened by the German government's Federal Institute for Drugs and Medical Devices (BfArM) to review available safety and efficacy data on plant drugs sold in German pharmacies. The results were the renowned Commission E monographs, the English translations of which were published by the American Botanical Council (ABC) in 1998.

"Professor Schilcher was a wonderful man, full of life and energy — the embodiment of the German feeling of *Gemütlichkeit*," said Mark Blumenthal, founder and executive director of ABC and senior editor of the English translations of the Commission E monographs. "He was extremely helpful and cooperative with us in ABC's preparation of the publication of the monographs."

In his personal life, Dr. Schilcher loved nature, sports, and spending time with his family, whom he brought along on many of his travels. He enjoyed canoeing and was a Bavarian and South German champion in whitewater racing. He also was an excellent skier and won numerous medals in the Physicians and Pharmacists Ski Cup, most notably the gold medal in slalom at age 77 in the senior category. He was particularly proud that he finished the course faster than some of the younger participants.

Dr. Schilcher was not only the "father of a reproducible herbal drug quality," but also a father figure to his graduate students, as evidenced by the obituary written by four of his former students in the *Deutsche Apotheker Zeitung*: "He considered us [his doctoral students] as members of his 'family,' was always warm, open and without prejudice towards unorthodox partnerships and our better halves. He was excited about every offspring, his 'doctor's granddaughters and grandsons,' and he looked forward, in turn, [to] how thrilled the grandchildren would be about his jokes and his nonsense. Heinz Schilcher was a great family man who flourished and recharged his batteries in family environments."

"Professor Schilcher was able to convey enthusiasm, and he fully assumed his responsibilities as a supervisor," said Uwe Kötter, PhD, who earned his doctorate in pharmaceutical biology from Dr. Schilcher at the FUB. "He gave his graduate students maximum freedom during their work, and ensured steadily that the chosen paths were as easy to follow as possible. He motivated students not to give up and to continue their work, and worried about his 'children' (as he called his students later), even after they graduated from the university. He gave his doctoral students many things to be thankful for: his supervision of their PhD theses, the support and help in starting their own careers, the energy he put into staying in touch after graduation, and especially his importance as a role model for accepting and completing tasks with heart and soul."

Beatrice Gehrmann, PhD, a pharmacist in Husum, Germany, who is involved in a number of research projects with the FUB, said that Dr. Schilcher was known as someone who could go off on a rant, but had a big heart. She recalled a story from 2006, when she was on crutches at a conference in Grasse, France, after breaking a leg. While Dr. Gehrmann was relaxing next to a swimming pool, Dr. Schilcher asked what happened, and he spontaneously offered to drive her to the airport the next day. At the banquet in the evening, he brought food from the buffet to her table and made sure that she had all she needed. At the airport, noticing that Dr. Gehrmann was unable to carry her own bags, he carried her luggage to the check-in counter.

As Dr. Schilcher's graduate students wrote: "In our personal memories of him, he has become immortal. He remains anchored in our hearts."[3] He is survived by his first wife, Renate, their son Stefan, and his second wife Barbara. HG

—Stefan Gafner, PhD

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Motherwort
(*Leonurus cardiaca*, Lamiaceae)

Motherwort gained its common name from its history of use as a relaxant and uterine tonic for women during and after childbirth.[1] The species native to Asia (*L. japonicus, L. sibiricus*) have similar uses and are known as *yi mu cao*, or "benefit mother herb."[2] The "mother's herb" has been used in European and Chinese traditional medicine as an emmenagogue (to stimulate menstruation), a diuretic, and for "anxious conditions." In addition, motherwort medicinal preparations were approved by the German Commission E for nervous cardiac disorders and as an adjuvant for hyperthyroidism.[3] The herb is native to the European continent, but it has been naturalized in temperate climates around the world.[4] The genus name, *Leonurus*, comes from the Greek for "lion's tail" and refers to the arrangement of the lobed leaves on the stem, which resembles the tuft at the end of a lion's tail.

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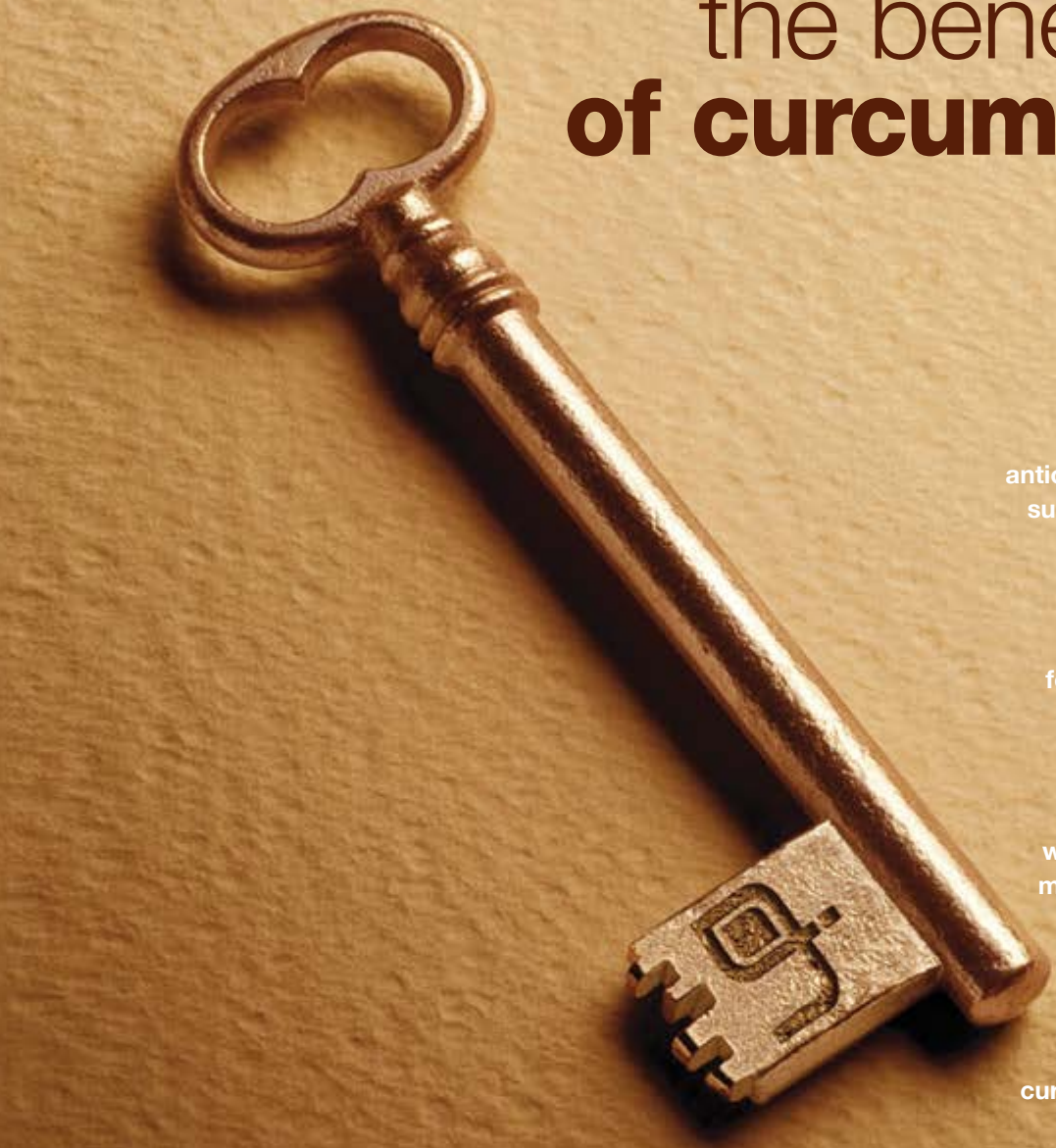

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