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History of Ginseng: Nomenclature, Taxonomy, and Trade • 2015 Herb Market Report • Rose Hip Profile • Kew's *State of the World's Plants* • Elderberry & Air Travelers

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HISTORY OF *Ginseng*

NOMENCLATURE, TAXONOMY, AND TRADE

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dear *reader*

Many ABC members say that they appreciate our in-depth coverage of various topics of interest to the global botanical community. Our cover story on ginseng counts among these comprehensive articles. This 22-page article with 112 references has crowded out other articles proposed for this issue, including some of our usually published Research Reviews, book reviews, and an obituary, which will be published in our next issue.

Steven Foster's excellent review of the history of the nomenclature, taxonomy, and trade in ginseng (i.e., plants of the genus *Panax*) — produced for the ABC-AHP-NCNPR Botanical Adulterants Program — is one of the most extensive articles we've ever published. Foster's first article for the Program in *HerbalGram* issue 92 covered the history of adulteration of herbs, spices, and botanical drugs in the past two millennia; it documented the unfortunate fact that people have cheated since the beginning of modern civilization (and, presumably, before). He has also written articles on the adulteration of skullcap (issue 93), bilberry (issue 96), and black cohosh, the latter being the cover story of issue 98 in 2013.

In order to fully understand the nuances related to ginseng adulteration, we believe that it is essential to have knowledge of its evolving nomenclature and taxonomic classification, as well as how it has been traded in the past several hundred years, particularly since the discovery of American ginseng in the early 18th century. Accordingly, Foster has spent a good portion of the past several years researching this subject, including his collecting data on the use and misuse of the common name "ginseng" in trade and in scientific research — nomenclatural nuances that have added significant confusion and misinformation in the global herb trade.

PubMed searches for trade names such as "Siberian ginseng" (eleuthero; *Eleutherococcus senticosus*), "Indian ginseng" (ashwagandha; *Withania somnifera*), and "Brazilian ginseng" (*Pfaffia paniculata*) result in numerous citations. It is disappointing to find that scores of researchers used these confusing common names in the titles of research papers. This misuse of the name "ginseng" only muddles and confuses issues, and does not further scientific accuracy.

Accompanying Foster's seminal article are historic images and illustrations of ginseng, some of which are the first publications in Western literature of ginseng images from the 17th and 18th centuries. This evinces Foster's knowledge of the historical literature on herbs in general, and ginseng in particular.

This article is the first of a two-part series on ginseng adulteration. The next ginseng article from Foster will focus on the types of ginseng adulteration and which laboratory analytical methods have been developed to detect such adulteration. We expect to publish it in the coming months as part of the growing educational coverage the Program is producing to inform members of industry and related stakeholders on the problems associated with accidental and intentional (fraudulent) adulteration of botanical raw materials and botanical extracts.

Editor Tyler Smith and colleagues have produced the annual *HerbalGram* Herb Market Report showing in detail how retail herb supplement sales in the US grew 7.5% in 2015 to almost $7 billion — a trend in line with past years of continue growth. This increase occurred despite significant negative publicity for the herbal supplement category resulting from the New York Attorney General's misguided DNA analysis of herb products at major retailers last year.

The maca market in China has experienced significant changes. Acupuncturist and Chinese herb expert Eric Brand contributes news about the fluctuations in price of Chinese-grown maca in the Chinese market.

In the arena of sustainability, we also include Assistant Editor Connor Yearsley's review of the Royal Botanic Gardens, Kew's recent sobering *State of the World's Plants* report, documenting the serious peril of many plants with respect to their survival. There are an estimated 391,000 vascular plants on earth and about 21% of them are threatened with extinction!

Finally, ABC's Gayle Engels and Traditional Medicinals' Josef Brinckmann continue their series of in-depth profiles on commonly used medicinal plants, this time focusing on the dog rose, also referred to as rose hip, a traditionally popular ingredient in many herbal teas and vitamin C dietary supplements.

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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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Georg Dionysius Ehret's illustration of American ginseng and dwarf ginseng in Christopher Jacob Trew's *Plantae Selectae* (1750), Plate VI. Source: Bibliotec Digital, Real Jardín Botánico.

departments

On the Cover

Aimé Henry's hand-colored plate of "*Panax schin-seng*" in Theodor F.L. Nees von Esenbeck's rare supplement volume of *Plantae officinales oder Sammlung officineller Pflanzen*, published in 1833. Courtesy of the Archives of the Gray Herbarium, Harvard University.

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Dog Rose Hip

Rosa canina

Family: Rosaceae

INTRODUCTION

Dog rose (*Rosa canina,* Rosaceae), also known by the common names dog brier, brier rose,[1] or simply "rose hip," refers to both the fruit and the entire plant. The species is native to Europe, and it is widely distributed throughout the continent. In fact, it is the most common *Rosa* species with the widest distribution in central Europe.[2] Dog rose also grows wild throughout Central Asia and in parts of Mediterranean northern Africa.[3] Hundreds of years ago, *R. canina* was introduced by European colonizers into the Americas, southern Australia, New Zealand, and southern Africa, where it escaped cultivation, naturalized, and now grows wild.[3]

Rosa canina is a large shrub or small tree with arching stems that grows rapidly up to 9 feet (2.74 meters) in height.[4] Single or small clusters of five-petaled flowers ranging in color from white to pink appear in June and July and are followed by bright red persistent fruit or pseudofruit (hips) in September and October. The actual fruit is the small hairy structure within the hip that contains one seed.[5] Dog rose reproduces by seed (generally dispersed by birds that eat the hips) and by suckering and layering. Its reproductive habits and large size make *R. canina* difficult to control. Some governments classify it as an invasive species and have implemented management plans to prevent its further spread.[6]

The commercial supply of *R. canina* is obtained primarily from wild-collection operations in Eastern Europe, particularly in Bulgaria, Hungary,[7] the Czech Republic,[8] and Romania;[9] in southern Europe, especially Albania, Bosnia and Herzegovina, Croatia,[10] Kosovo,[11] Serbia,[12] Slovenia,[13] and Macedonia;[14] in western Asia, including Armenia, Azerbaijan, Georgia,[15] and Turkey;[16] and in Central Asia, especially Uzbekistan.[17] Cultivation also occurs in areas where wild-collection remains prominent, particularly in Bulgaria[10] and Hungary.[18] The raw material used to manufacture the most widely clinically tested dog rose hip product (Hyben Vital; produced by Hyben Vital Int. ApS; Tranekär, Denmark) is a selectively bred cultivated variety. In the 1990s, agronomists and botanists with Hyben Vital developed a distinct variety that they named "Rosa Canina Lito" (more properly written "*Rosa canina* 'Lito'" taxonomically), which currently is grown in Denmark and in a few other European countries.[19]

There is significant commercial wild-collection in non-native regions where various species of *Rosa* escaped from domestication long ago, especially in Chile and Lesotho (in southern Africa),[9] but also in Argentina and South Africa. Chile is a major exporter of "*Rosa mosqueta*," a regional name used collectively for rose hips of at least three naturalized species: *R. moschata* (musk rose), *R. rubiginosa* (sweetbriar rose), and *R. canina*.[20] These species, especially *R. rubiginosa*, increasingly are being cultivated in Chile.

Dog Rose Hip *Rosa canina*
Photo ©2016 Steven Foster

The material of commerce is generally divided into four main quality grades. *European Pharmacopoeia* quality requires the "receptacle and the remains of the dried sepals with achenes removed" to contain a minimum of 0.3% ascorbic acid (vitamin C).[21] The International Organization for Standardization (ISO) provides food quality specifications for the dried ripe fruits with "stems cut off and calyx ends removed" (ISO 23391) in three grades: "Extra class" grade must contain a minimum of 0.2% ascorbic acid, "Class I" specifies a minimum ascorbic acid content of 0.175%, and "Class II" grade has a minimum of 0.15% ascorbic acid.[22]

Biotype and altitude, depending on geographical origin, are the main factors impacting ascorbic acid content.[23] Notably, researchers in Romania have found that higher harvesting altitudes correlate with higher ascorbic acid contents in *R. canina*. For example, in one study, the ascorbic acid content of fruit pulp was 0.27% when harvested at 630 meters (2,067 feet), but it was 0.45% when harvested at 807 meters (2,648 feet).[24] Earlier experiments in the mid-20th century found that *R. canina* fruits harvested in the Caucasus Mountains contained more than three times the ascorbic acid of fruits harvested from the Black Sea shore.[25] Another Romanian research group correlated higher ascorbic acid content with cold and rainy weather. Over a four-year period, *R. canina* was wild-collected from 42 biotypes during the second half of October and tested for ascorbic acid content. Fruits harvested in years with higher precipitation and colder temperatures showed higher vitamin C levels.[26]

While the *European Pharmacopoeia* includes both *R. canina* and *R. pendulina* (alpine rose) within the scope of its "Dog Rose – Rosae pseudo-fructus" monograph,[21] this article does not specifically address the fruits of *Rosa* species other than *R. canina*. In the United States, three federal agencies define rose hip quite differently. The US Department of Agriculture (USDA), in its List of Approved Names, defines "rose hips" as either *R. canina* or *R. rugosa* (rugose rose);[27] the US Food and Drug Administration (FDA) defines "rose fruit (hips)" as *R. alba* (white rose), *R. centifolia* (cabbage rose), *R. damascena* (damask rose), *R. gallica* (French rose), and varieties of these species;[28] and the US Environmental Protection Agency (EPA) defines "rose hip" as *R. rubiginosa*.[29]

Rose hips used in the Asian systems of medicine are also imported into the United States. For example, "Rosae laevigatae fructus," the dried ripe fruit of *R. laevigata* (Cherokee rose; Chinese: 金櫻子, *jinyingzi*; Korean: 금앵자, *kumaengja*), is specified in the *Hong Kong Chinese Materia Medica Standards*, the *Korean Pharmacopoeia*, the *Pharmacopoeia of the People's Republic of China*, and *Taiwan Herbal Pharmacopoeia*. Additionally, "Rosae multiflorae fructus," the pseudocarp of the fruit of *R. multiflora* (Japanese rose hip; Japanese: エイジツ; Korean: 영실), is specified in the *Japanese Pharmacopoeia* and in the *Korean Herbal Pharmacopoeia*. Furthermore, the "Fructus Rozae" monograph of the *State Pharmacopoeia of the* [former] *USSR* permitted the hips of 13 different species: *R. acicularis* (prickly wild rose), *R. beggeriana* (Begger's rose), *R. canina*, *R. corymbifera* (pale rose), *R. davurica* (Amur rose), *R. fedtschenkoana* (Fedchenkovskiy rose), *R. kokanica* (Kokand rose), *R. majalis* (May rose), *R. micrantha* (smallflower sweetbriar rose), *R. psammophila* (now considered a synonym of *R. micrantha*), *R. rugosa*, *R. tomentosa* (whitewoolly rose), and *R. zangezura* (Zangezurian rose).[30] Thus, what is traded and labeled as "rose hips" could be any of the many rose species in global commerce.

HISTORY AND CULTURAL SIGNIFICANCE

The species name *canina* stems from the Latin *canis*, meaning dog. The naming of this species may be attributed to writings of ancient Greek physician Hippocrates (460-377 BCE) and Roman naturalist Pliny the Elder (23-79 CE), in which it was suggested that a preparation of wild *R. canina* root could be used to treat the bite of a rabid dog.[6,30] Another, and perhaps more likely, theory is that the species was formerly known as the "dag rose" (from the Italian *daga*, for dagger, referring to its stout thorns), which was changed to "dog rose" through misunderstanding.[6]

In the 9th century Zoroastrian scripture *Bundahishn* ("Original Creation"), written in the Pahlavi (Middle

Iranian) language, each listed plant was associated with a particular angel. Dog rose (*nestarun*) belonged to *Rashn*, the Zoroastrian angel of justice, who judged souls of the dead.[31] The dog rose was believed to acquire thorns only when evil appeared in the world.[32] Some of the oldest documentation of traditional Bulgarian herbal remedies are found in a canon of early Bulgarian literature written in the Old Church Slavonic language. Here it is written that St. Ivan Rilski (876-946 CE) prepared communion bread from baked *R. canina* fruit powder. St. Rilski is known as Bulgaria's first hermit and as one of the most important saints in the Bulgarian Orthodox Church.[33] *Rosa canina* is also the second most frequently mentioned medicinal plant in the Chilandar Medical Codex, considered the most significant medieval Serbian pharmacological manuscript on European medical science from the 12th century to the 15th century.[34] In *Maister Constantini Buch* — a Schwabian-language formulary published in 1472, which contains prescriptions attributed to Heinrich Steinhöwel (1412-1482 CE), the personal physician to Eberhard I, the Duke of Württemberg — a preparation of dog rose hip wine was indicated for stopping excessive menstrual bleeding. Curiously, another 15th century formulary in the Middle Franconian language, *Bartholomäus-Handschrift*, prescribed dog rose hip wine as an emmenagogue to stimulate menstrual flow.[35]

Traditional uses of rose hip were based on its astringency. It was believed to strengthen the stomach and alleviate diarrhea, dysentery, thirst, cough, and "spitting of blood."[6] The 17th century English herbalist, botanist, physician, and astrologer Nicholas Culpeper (1616-1654) stated that ripe hips made into a conserve (a preparation typically made with sugar or honey) would "gently bind the belly, and stay defluctions [the flow of humors, or body fluids] from the head upon the stomach, drying up the moisture thereof, and promoting digestion."[36] He also said that the dried, powdered hips would break up stones, promote urination, and ease colic.

In the 1885 edition of the *British Pharmacopoeia*, rose hips had official, listed uses for their refrigerant and astringent properties. However, rose hips are no longer used in conventional medicine or pharmacy in Britain, except as a flavoring for medicinal preparations (a confection of rose hips is used in which the pulp is separated from the skin and hairy seeds, and beaten with sugar).[6]

Today, rose hip preparations are used for colds, diabetes, diarrhea, edema, fever, gastritis, gout, polydipsia (abnormal thirst), rheumatism, sciatica, conditions of the kidneys and lower urinary tract, as a diuretic and laxative, and for "blood purification."[37-39]

Rose hips are used in making jams, jellies, teas, soups,[37] infusions, syrups, beverages, pies, bread, wine, and marmalade,[40] sometimes just as flavoring, but often for their vitamin C content.

In northeastern Portugal, the fruit is eaten raw, and decoctions or brandy macerations are made with the fruit for their diuretic, antidiarrheal, antirheumatic, anti-inflammatory, respiratory, decongestant, stimulant, and tonic actions, as well as to treat skin infections.[41] The young shoots and hips are eaten raw, and the hips are used in making cakes and spirits in rural communities in the Campoo (Cantabria) region of northern Spain.[42]

In 1990, the German Commission E published negative monographs for "Rosae pseudo-fructus" (dog rose hip without seeds), "Rosae pseudo-fructus cum fructibus" (dog rose hip with seeds), and "Rosae semen" (dog rose seed). At the time of the evaluation, there was insufficient evidence of therapeutic efficacy for any traditional uses. However, the Commission E stated that there were no objections against the use of dog rose as a component of non-medicinal beverage teas.[43] That being said, the fruit of *R. canina* remains classified as both food and medicine, and appears on List B in the Government of Germany's List of Substances, meaning that restricted use in foods is recommended because pharmacological effects occur above a certain dose.[44] There is also a tradition in Germany of combining rose hip with "roselle flower" (calyces and epicalyces of *Hibiscus sabdariffa*, Malvaceae) as a so-called fruit tea ("*Hagebutte-Hibiskus-Früchtetee*"). In 2015, sales of rose hip/roselle flower combination teas accounted for 5.4% of all herbal and/or fruit tea sales in Germany in terms of volume (2,108 tons were sold out of a total of 39,249 tons of all herbal and/or fruit teas).[45]

CURRENT AUTHORIZED USES IN COSMETICS, FOODS, AND MEDICINES

In the United States, while the FDA does not expressly list *R. canina* as generally recognized as safe (GRAS) for use in food products, extracts and oils of rose hip (obtained from *R. alba*, *R. centifolia*, *R. damascena*, *R. gallica*, and varieties of these species) are listed as GRAS.[28] The USDA, however, lists rose hips (obtained from *R. canina* or *R. rugosa*) as food.[27] Rose hip, or an extract obtained from rose hip, is also permitted as a component of dietary supplement products, which require FDA notification within 30 days of marketing if a structure-function claim is made and product manufacturing according to current Good Manufacturing Practices (cGMPs). It is worth noting that "rosehips" is used 15 times in the preamble of the FDA's cGMPs for dietary supplement regulation; the FDA provides a lengthy discussion to clarify the specifications and different labeling requirements for a "rosehips dietary supplement" versus a "vitamin C from rosehips dietary supplement."[46]

In Canada, *R. canina* is regulated as an active ingredient of licensed natural health products (NHPs), requiring premarketing authorization from the Natural and Non-prescription Health Products Directorate (NNHPD). It is listed in Appendix 3 ("Other Medicinal Ingredients") of the NHP "Antioxidants" monograph. At the prescribed dosage equivalents (100 g fresh, or 45 g dry), licensed dog rose NHPs may be marketed with antioxidant claim statements, (i.e., as a "source of antioxidants that help protect against cell damage caused by free radicals").[47] Additionally, "Rosa Canina Fruit Extract," if used as the source of vitamin C for oral vitamin

C NHPs, or for products making claims as per the NHP Vitamin C monograph, must declare *R. canina* as the source of vitamin C. Both "Rosa Canina Fruit Extract" and "Rosa Canina Fruit Oil" may also be used as non-medicinal components of topical NHPs for skin-conditioning purposes.[48] At the time of this writing (July 2016), there were 512 licensed NHPs containing "rosehips": 302 of those NHPs listed "*R. canina*" as a medicinal ingredient, 78 listed "rosehips" (without Latin name) as a medicinal ingredient, 60 listed "*R. canina*" as a non-medicinal ingredient, and 72 listed "rosehips" (without Latin name) as a non-medicinal ingredient.[49]

For herbal medicinal product companies in the European Union (EU), or in non-EU countries where the *European Pharmacopoeia* is an official compendium (e.g., in Australia and Canada), there is a quality standards monograph established by the European Directorate for the Quality of Medicines (EDQM) for "Rosae pseudo-fructus" that can be used as the basis for an active ingredient specification.[21] The German Drug Codex (DAC) also provides a quality standards monograph for "Rosae pseudo-fructus cum fructibus."[50] For food applications, the aforementioned ISO 23391 standard can also be used as a basis for establishing quality specifications.[22] In the EU, while it is possible to register an Herbal Medicinal Product (HMP), including dog rose hip, as an active ingredient, the European Medicines Agency (EMA) has yet to develop a labeling standards monograph. Even the most widely clinically tested dog rose hip product is not a registered medicine but is labeled and marketed as a food supplement product.[51]

As of July 2016, according to the drug information database of the German Federal Institute for Drugs and Medical Devices (BfArM), there were 1,959 medicinal products containing "*Hagebutten*" (dog rose hip) in Germany, but in most cases it is listed as a non-medicinal ingredient of the preparation. In Switzerland, there are some licensed non-prescription medicines containing "*R. canina*" as an active ingredient. For example, each 1.8-g teabag of Sidroga Erkältungstee (a traditional European herbal medicinal tea for feverish colds with cough; Sidroga AG; Rheinfelden, Switzerland) contains equal parts of five active ingredients: dog rose hips, European elder (*Sambucus nigra*, Adoxaceae) flower, German chamomile (*Matricaria chamomilla*, Asteraceae) flower, linden (*Tilia cordata* or *T. platyphyllos*, Tiliaceae) flower, and wild thyme (*Thymus serpyllum*, Lamiaceae) herb.[52] For use in cosmetic products, the European Commission Health and Consumers Directorate lists "Rosa Canina Fruit Extract" for astringent, skin-conditioning, and tonic functions. "Rosa Canina Fruit Oil" is listed for emollient and skin-conditioning functions, and "Rosa Canina Fruit Juice" is listed for astringent functions.[53]

Dog Rose Hip *Rosa canina*
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MODERN RESEARCH

In vivo and in vitro studies have confirmed the antibacterial, anti-inflammatory, antioxidant, and anti-obesogenic activities of rose hips. These actions have been attributed to galactolipids (namely GOPO), phenolics, and vitamin C, as well as carotenoids such as lycopene, lutein, and zeaxanthin.[54] The hips also contain nutrients such as amino acids, bioflavonoids, pectins, sugars, tannins, tocopherol, beta-sitosterol, and long-chain polyunsaturated fatty acids,[54,55] as well as vitamins A, B3 (niacin), D, and E, folate, and minerals magnesium and copper.[37] Rose hips are considered to be one of the most abundant sources of vitamin C, second only to kakadu plum (*Terminalia latipes* ssp. *psilocarpa*, syn. *T. ferdinandiana*, Combretaceae) and camu-camu (*Myrciaria dubia*, Myrtaceae).[56] The stability and bioavailability of vitamin C in rose hips is enhanced by the presence of flavonoids and organic acids that inhibit oxidation.[55] There is a wide range in the content of chemical compounds in *R. canina*, presumably due to its great polymorphism (i.e., the appearance of different forms among the members of a specific population or colony).[54]

Known as Hyben Vital (HV) and Litozin in Europe, and as Litozin (until 2011) in the United States and Canada, a rose hip powder (RHP) made from the Lito variety of *R. canina* grown on the island of Langeland in Denmark is described by the company as a "biologically standardized powder" composed of the seeds and husks of the Langeland rose hip.[57] With only the small hairs on the seeds removed, the remainder of the fruit is processed via a patented drying procedure at temperatures not exceeding 40°C (104°F). One hundred grams of the RHP contains at least 500 mg vitamin C, 5.8 g pectin, 5.8 mg beta-carotene, 50 mg beta-sitosterol, 0.2 mg folic acid, 4.6 mg vitamin E, 170 mg magnesium, 1 mg zinc, and 10.9 µg copper. At least nine double-blind, placebo-controlled clinical studies have investigated the efficacy of HV or Litozin RHP in treating osteoarthritis (OA), hypercholesterolemia (dyslipidemia), Crohn's disease, chronic back and musculoskeletal pain, and reducing C-reactive protein (CRP), levels of which rise in blood plasma in response to inflammation. From 2011 forward, Litozin has been made with Chilean rose hip shell and no seed but with added vitamin C, carotenes, flavonoids, triterpenic acid, and galactolipids (trade name: Rosenoids), and has been studied only for its effect on OA. Therefore, studies using the "old" Litozin will refer to the product used as HV RHP or RHP.

In a 2013 randomized, double-blind, placebo-controlled (RDBPC) crossover study, 30 patients with OA of the dominant hand were randomized to take twice daily for three months either five 0.5 g-capsules of HV RHP or five placebo capsules (phase 1).[58] Patients taking prescribed nonsteroidal anti-inflammatory drugs (NSAIDs) were instructed to continue using them throughout the study, but patients using other analgesics (e.g., acetaminophen, codeine, or tramadol) were asked to reduce their consumption if possible. At the end of three months, patients in the HV group were switched to the placebo and vice versa and continued the study for an additional three months (phase 2). Joint pain in the dominant hand was evaluated by means of a 10-step categorical scale test prior to starting treatment, three weeks into treatment, and after three months of treatment in both phases. Test activities included various common actions: holding heavy items, opening containers, wringing a wet cloth, tying shoelaces, removing pills from a blister pack, and managing small items like forks or pens, among others. Patients also reported changes in joint stiffness during the pain assessment. Additionally, the use of rescue medications during the first 14 days of treatment was compared to the last 14 days of treatment.

In this study, after the first three months, the HV group reported a 90% reduction in pain, compared to a 36% reduction in the placebo group. The HV group continued to experience reduced pain for three weeks into phase 2 after they had switched to placebo. Reduction in pain during test activities varied, but was as high as 26% in the "handwriting a letter" task after three months. Stiffness declined after three weeks of treatment but did not attain statistical significance compared to placebo after three months. There was a 23% reduction in stiffness during test activities after three weeks, and a 25% reduction after three months. Additionally, treatment with HV resulted in a 33% decline in the number of analgesics used between the first 14 days and the last 14 days of phase 1. The authors opine that the consumption of analgesics may have "blunted some further impact on symptom scores from HV, but would have left us without the knowledge that HV treatment was strong enough to change the consumption of rescue medication." Blood samples were collected and CRP was evaluated in patients prior to starting phase 1 and at the end of each treatment phase. CRP could be detected in only eight patients and, although pre-treatment values fell after active treatment, there was no statistically significant difference between HV treatment and placebo. The authors suggest that further research should include a comparison of rose hip products since their contents of anti-inflammatory constituents can vary greatly.

In another RDBPC parallel study published in 2009, 89 patients with rheumatoid arthritis (RA) were randomized for treatment with 5 g daily of RHP (five capsules in the morning and evening) or placebo for six months.[59] At three and six months, scores on the Health Assessment Questionnaire (HAQ) disability index improved (i.e., numerically declined) in the experimental group, while they worsened in the placebo group. In the HAQ Patient Global Scale, a trend toward favoring treatment was seen after six months, but there were no significant differences between the treatment and placebo groups in the HAQ Patient Pain Scale. The disease activity score (DAS-28) for the treatment group showed greater improvement compared to placebo (P = 0.056), and the Physicians Global Scale showed strong improvement (approximately 30%) compared to placebo (7%) after six months. Quality of life assessments also showed improvement after treatment, but there was no significant reduction in pain

medication. The authors recommended further studies with larger sample sizes and multivariate analyses, as well as studies on dose-finding and testing of different rose hip extractions.

A 2008 meta-analysis assessed three randomized, controlled trials (RCTs) discussed in the following paragraphs.[60] It concluded that, despite a "sparse amount of data," HV RHP reduces pain in OA patients but that its efficacy and safety required further study. A 2016 review of animal and human studies noted that rose hip preparations containing seeds and shells (HV RHP) are supported by meta-analyses and have substantial anti-inflammatory activities, but that claims for the shell only preparations (RHSP) are preliminary and lacking in "suitable placebo-controlled randomized clinical trials," and thus cannot be advocated for in clinical settings.[61]

In 2005, a RDBPC crossover study showed that RHP reduced symptoms of knee and hip OA.[62] Patients (N = 94) were randomized to take 5 g RHP per day (five 0.5 g-capsules taken in the morning and evening) or placebo for three months. After three months, the patients in the RHP group were switched to the placebo and vice versa. Patients taking prescribed NSAIDs were instructed to continue taking them, but patients taking other analgesics (e.g., acetaminophen or synthetic opioids) were requested to reduce their consumption, if possible, after the first three weeks of treatment. Patients were asked not to change or start any new pain medications during the study. At the beginning of the study, at three weeks, and at three months of both treatment periods, the researchers used the Western Ontario and McMaster Universities (WOMAC) questionnaire to assess pain, stiffness, disability, and global severity of the patients' OA.

The RHP group experienced a statistically significant reduction in pain compared to the placebo group after three weeks. The same pattern was observed after three months of treatment, but it was not statistically significant, possibly because the patients were allowed to reduce their consumption of rescue medication after the first three weeks. Had they not reduced their consumption of analgesics, the reduced pain score might have been significant after three months and/or after three weeks. The RHP group also reduced its consumption of analgesics by 40% during the active treatment period. A sub-analysis of the consumption of analgesics in the first three months of treatment showed a significant reduction in the amount of pain medication taken during a two-week period in the RHP group, as opposed to an insignificant increase in the placebo group. Further, after three months, the active treatment group experienced a significant reduction in stiffness, less limitation of physical function, and a decline in the global assessment of disease severity compared to placebo. The authors suggested that future research should try to determine an optimal dose, test RHP impact in long-term treatment and compare that to NSAIDs, and investigate the biological activity of additional subtypes of rose hips.

Dog Rose Hip *Rosa canina*
Photo ©2016 Steven Foster

Another RDBPC crossover study published in 2004 investigated HV's efficacy in reducing pain and improving general wellbeing in 112 patients with OA of the hip, knee, hand, shoulder, neck, or some combination.[63] Patients were randomly assigned to treatment with either five 0.5 g-capsules of HV (group B) daily or placebo (group A) for three months, after which patients in each group were switched to the other group. Additionally, patients were advised to continue taking prescription NSAIDs but, three weeks into the study, patients taking other pain relievers were requested to reduce their use if possible. The primary outcome measures were changes in joint pain and the amount of pain relievers the patients used. While there was a nonsignificant decline in the use of analgesics, there was a significant reduction in pain with HV treatment after three months, and the patients favored treatment with HV. End-of-treatment subjective assessments of the 85 patients who

completed both phases of the study revealed that group A (placebo first) experienced a significant 50% reduction in pain after three months of treatment with HV, compared to just a 25% reduction in pain with placebo. Group B (HV first), on the other hand, experienced no significant difference between the HV and placebo treatments. The authors attribute this to a carryover effect of the HV treatment, a potential drawback of crossover studies.

Another RDBPC study in 2003 also assessed the effects of HV on knee and hip mobility, activities of daily living (ADL), quality of life, and pain in patients with OA.[64] Two groups of 50 patients each took either five 0.5 g-capsules of HV or placebo twice daily for four months. Knee and hip mobility was measured at the beginning of the study and after four months of therapy. Hip joint mobility improved significantly in the HV group compared to placebo, but not knee mobility, which the authors were unable to explain. Patients gave a subjective categorical assessment of pain after four months of treatment, and it decreased significantly in the HV group compared to placebo, with 64% of patients in the HV group reporting some reduction in pain. Additionally, the HV treatment group showed significant improvement in ADL after one, two, and four months, compared with baseline.

In a small pilot study published in 1999, eight volunteers (four with clinically diagnosed OA, and four without) were treated with a high dose (45 g) of RHP daily for four weeks.[65] Treatment was withdrawn for one month and restarted at a lower dose (10 g per day) for four more weeks. Chemotaxis (the movement of an organism in response to a substance; in this case, chemotaxis refers to a component of the inflammatory pathway) and CRP levels declined significantly during both the high-dose and the low-dose periods. A study published in 2011 was unable to reproduce the reduction in CRP with a 10.5-g dose of RHP over 28 days, leading the authors to opine that the dose was too low to have an anti-inflammatory or antioxidant effect.[66]

Chrubasik et al. (2008) conducted a one-year survey of patients with acute exacerbations of chronic pain in the back, hips, and knees.[67] Based on previous studies, patients were recommended a dose of 5 g of RHP per day (10 capsules of 0.5 g each). Clinical symptoms and well-being were assessed every six weeks, and patients kept a record of their pain and use of rescue medications. The first six-week review revealed that the pain relief provided was not strong enough for some participants, so the starting dose was doubled for the next 75 participants if their symptoms appeared to be unduly severe or prolonged. Additionally, existing participants were encouraged to adjust the dosage up or down according to their symptoms. Multivariate analysis at the end of the surveillance indicated substantial improvement overall with RHP treatment.

In 2014, Chrubasik et al. conducted a pilot study that investigated the effectiveness of a rose hip shell powder (RHSP) in treating chronic musculoskeletal pain.[68] Patients (N = 52, of whom 29 had participated in the 2008 survey) were provided up to 20 g RHSP without seed ("sine fructibus"; batch 119372 produced by Martin Bauer GmbH & Co. KG; Vestenbergsgreuth, Germany; no further information provided) per day for a period of three months. Patients were encouraged to adjust the dosage up or down according to their pain. At the beginning of the study and after six and 12 weeks, outcome variables (current pain, worst pain, and average pain over the preceding two weeks, disability component, aids/devices required to maintain quality of life, and patient assessment of treatment and tolerability) were assessed. During the three months of treatment, there were no differences in outcome measures between the RHSP study and the 2008 RHP survey. Participants in the 2014 study consumed significantly more RHSP than the 2008 participants consumed RHP, but the 2014 participants did not take any additional pain relievers. After three months of treatment, 12 of the 52 patients rated the effectiveness of RHSP as "very good," 22 said it was "good," and 14 thought it was "moderate." Patients who participated in both studies did not express a preference for RHSP or RHP.

Presentations at two conferences addressed the effects of RHP on cholesterol. In the first, unpublished results of a RDBPC crossover trial involving patients with OA[63] showed that three months of treatment with RHP resulted in a significant decline in LDL and total cholesterol, while no change was observed in HDL cholesterol levels.[69] It

was unclear if the cholesterol reduction was related to the treatment, or if it was a result of enhanced physical activity caused by a reduction of symptoms. The second conference presentation[70] addressed the same cholesterol-lowering effects observed in patients with OA in another study[62] in which a significant decline in total and LDL cholesterol levels were observed after three months of RHP treatment.

A RDBPC crossover study published in 2012 showed that daily consumption of rose hip powder drink over six weeks lowered systolic blood pressure (BP) and plasma cholesterol levels in 31 obese individuals with normal or impaired glucose tolerance.[71] Subjects were randomly assigned to take either 5 dL (approximately 2 cups) per day of the control drink or the rose hip powder drink (equal to 40 g of Chilean *R. canina* rose hips with seeds removed, ground and mixed with apple [*Malus* spp., Rosaceae] juice, citric acid solution, and sugar, then heated, cooled, and aseptically packaged; no further information provided). Subjects were instructed to restrict their caloric intake to 75% of their resting metabolic rate × 1.3. Every two weeks, subjects visited the clinic to have body weight measured and blood drawn, to give adverse effect reports, and to receive test drinks for the next two weeks. In addition, a meal-based glucose tolerance test was performed at the beginning and end of each period. Consumption of the rose hip powder drink for six weeks resulted in a small but significant reduction in total plasma cholesterol (by 4.9%), LDL cholesterol (by 6%), and LDL/HDL ratio (by 6.5%) compared to placebo, while HDL cholesterol was unchanged. No changes were observed in plasma triglycerides. The intake of rose hip powder significantly lowered systolic BP by 3.4%. These findings suggest that rose hip powder consumption can significantly reduce cardiovascular risk by an estimated 17% in obese, non-diabetic people, according to the algorithm for Reynold's risk assessment score.

A RDBPC study published in 2015 investigated the effects of daily intake of rose hip extract on abdominal visceral fat in pre-obese subjects.[72] Volunteers (N = 32) who had a body mass index (BMI) of 25-29 were assigned to take rose hip extract (Rosehip Polyphenol EX; 100 mg rose hip with seed aqueous ethanol extract and no less than 0.1% tiliroside [a glycosidic flavonoid]; Morishita Jintan Co. Ltd.; Osaka, Japan) or placebo, once daily for 12 weeks with no dietary intervention. Men and women (n = 16 each) were divided equally between groups to avoid bias related to sex, body fat percentage, and BMI; there were no significant differences between groups in any of these parameters. Assessments and measurements were done at baseline, and on weeks four, eight, and 12, with measurements of abdominal fat and body fat percentage being the primary outcomes and body weight and BMI being secondary outcomes. The rose hip group experienced significant decreases in body weight and BMI by week 12, and the decreases were significantly higher than in the placebo group. Further, at weeks eight and 12, abdominal visceral fat area in the rose hip group had decreased significantly compared with baseline measurements, and this decrease was significantly greater than in the placebo group. These results, the authors note, show that rose hip extract may be useful as a supplement to reduce abdominal visceral fat in pre-obese persons, thus reducing risk of cardiovascular disease.

Published in 2015, a randomized, double-blind study assessed the effectiveness of HV on skin cell longevity, wrinkling, moisture, and elasticity.[73] Thirty-four healthy subjects (35-65 years old) with well-defined crow's feet or other well-defined wrinkles on the face were randomized to take 3 g of HV or 4 g of astaxanthin (Astawell; Nutramedica; Bangkok, Thailand) added to yogurt daily for eight weeks. In comparing the two groups at the beginning of the study, there were no statistical differences in the mean depth of crow's feet, moisture content, or skin elasticity. After eight weeks of treatment, the HV group experienced a statistically significant reduction in the depth of crow's feet and an increase in skin elasticity and the moisture content of the forehead. Similar improvement was seen in the astaxanthin group, and no significant difference was found between the two groups. In vitro assessment showed that HV reduced the flux of hemoglobin through cell membranes, reducing the disintegration of cells, suggesting that antioxidants such as RHP can contribute to keeping cell membranes intact and extending their life. The authors concluded that HV may support the skin and cell longevity, but they recommended that large-scale, placebo-controlled studies be conducted to confirm their findings, and that these studies should focus on the active components of HV.

FUTURE OUTLOOK

The International Union for Conservation of Nature (IUCN) *European Red List of Medicinal Plants* assigns *R. canina, R. pendulina*, and *R. rubiginosa* to the conservation category of Least Concern (LC), meaning that these species are not threatened.[74] While tens of millions of kilograms of rose hips are harvested annually, wild populations appear to be abundant and continue to serve as an important source of household income in rural areas throughout Eastern Europe, southern Europe, and western Asia. Sustainable wild-collection of dog rose fruit requires harvesting in such a way that does not destroy twigs and branches on which new flowers and fruits will be produced. For example, it is recommended to use scissors or clippers to collect mature red fruits without the stem. Because dog rose reproduces by seed, it is suggested that about 20% of the fruits should be left on each bush to facilitate regeneration, and that about 20% of all dog rose bushes in the controlled collection area should be left entirely unharvested.[11,15]

With the available data, it is not possible to separately quantify the total global export trade of *R. canina* hips, because only some countries report quantities, and the harmonized system (HS) tariff codes used for rose hips include fruits of all *Rosa* species and sometimes even include certain other unrelated fruits. For example, Switzerland's tariff schedule lumps rose hips (of all species) together with European elderberries.[75] Chile, possibly the world's largest exporter of rose hip ingredients, uses codes for tracking

Dog Rose Hip *Rosa canina*
Photo ©2016 Steven Foster

exports of *Rosa mosqueta* (the hips of *R. moschata*, *R. rubiginosa*, and/or *R. canina*). Chile reportedly exports on average 6.8 million kg of rose hips annually, mainly to Germany,[76] as well as substantial quantities of value-added forms, such as the fatty oil of rose hip seeds. In 2013, the reported customs value of Chile's exports of various rose hip ingredients (classified under nine different HS codes) amounted to approximately $25.5 million.[77]*

In its native habitat, dog rose is one of the most important commercially-traded medicinal plants of Serbia,[78] where, in 2007, an estimated 5 million kg were wild-collected.[12] In 2005, Romania's annual average harvest of wild *R. canina* fruits was 4.03 million kg.[79] In 2003, dog rose hip was Bulgaria's number-one medicinal plant in terms of volume, with an estimated 1 million kg wild-collected annually, plus another 300,000 kg obtained from cultivation.[10] For the five-year period 2001-2005, Bulgaria's Ministry of Environment and Water reported an average annual export of various dog rose ingredients (both wild-collected and cultivated) of 1,088,795 kg "Fructus Rosae cum semini" (dried ripe fruit with seed), 676,836 kg "Fructus Rosae semini" (seeds), 268,688 kg "Fructus Rosae (frozen)," and 25,231 kg "Fructus Rosae."[80] Fruits of *R. canina* are also among the most widely reported wild plants sold at markets on both sides of the Bulgarian-Turkish border.[16]

The annual quantity of *R. canina* hips collected in Hungary is estimated to be between 200,000 to 250,000 kg.[81] Albania reportedly exports about 200,000 kg annually.[10] In the Caucasus, four medicinal plants account for more than 80% of total tonnage that is wild-collected in Georgia, including *R. canina* hips and bilberry (*Vaccinium myrtillus*, Ericaceae) fruits, most of which is exported to Ukraine.[82]

There is evidence that dog rose production is occurring increasingly through sustainable wild-collection methods as well as through sustainable agriculture practices. Many wild-collection operations have implemented the "organic wild-crop harvesting practice standard" for certified organic wild-collected *R. canina*, particularly in Albania, Armenia, Bulgaria, Chile (mainly *R. rubiginosa*), Macedonia, Hungary, Romania, Serbia, and Turkey (also *R. rubiginosa*).[83] An International Trade Centre (ITC) study estimated that in 2005 about 7.78 million kg of rose hips were wild-collected under organic certification rules, of which 3.51 million kg were wild-collected in Chile, 3.05 million kg in Romania, 1 million kg in Lesotho, 120,000 kg in Bulgaria, 50,000 kg in Albania, 10,000 kg in Macedonia, and 5,000 kg in Serbia and Montenegro.[9] Some organic wild dog rose operations, particularly in Armenia, Bulgaria, Hungary, and Macedonia, have also implemented

* Chile's 2013 rose hip ingredient exports by tariff code: HS 0813.4020 (dried *Rosa mosqueta*): $1,757,301; HS 1211.9071 (organic rose hip seeds): $61,339; HS 1211.9072 (organic rose hip shells): $714,876; HS 1211.9079 (other organic rose hip parts, cut or broken, fresh or dried): $586,235; HS 1211.9081 (other rose hip seed, cut, broken or powdered): $120,082; HS 1211.9082 (other rose hip shells, cut, broken or powdered): $15,523,030; HS 1211.9083 (*Rosa mosqueta* flower and leaves): $1,156; HS 1211.9089 (other parts of the hip, sliced, broken or ground): $3,636,977; and HS 1515.9011 (*Rosa mosqueta* seed oil): $3,141,978.

the FairWild Standard, which encompasses not only criteria for ecological sustainability but also economic and social sustainability for the harvesters and their communities.[84] Wild *R. canina* hip with Fairtrade certification also comes from three operations in Uzbekistan.[17] Given that the main *Rosa* species harvested and traded as "dog rose" are not endangered or threatened species, and that controlled cultivation is also increasing, ever more under organic agriculture rules, it appears that the huge global demand can still be met through sustainable production methods. HG

—Gayle Engels and Josef Brinckmann

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Complete Archive of *HerbalGram* Issues Now Available Online

The American Botanical Council (ABC) announced in July that every issue of *HerbalGram*, the nonprofit's quarterly, peer-reviewed journal, is now available online. Going back to issue 1 from the summer of 1983, the newly updated archive includes the first 21 issues, which have never been available in a digital format. The complete collection is available to ABC members at all levels.

Each issue of *HerbalGram* is available as a PDF file. Previously, only issues 85 through the latest issue were available in this format. The first 21 issues are available as PDF files only, while all subsequent issues also include HTML versions of individual articles. Issues 93 through the current issue are also available in a "page-flip" version, a reader-friendly format that was added to the ABC website in 2012.

The back issues that previously were unavailable as PDF files were scanned and digitized by the San Jose, California-based company 1DollarScan. ABC Art Director Matthew Magruder then went through the process of cleaning up the PDFs, resizing them to make them more web-friendly, and uploading them to the website.

"Through the process of prepping and digitizing, I really enjoyed getting a chance to look through the extensive back catalog, and am quite pleased that we can offer our members the complete *HerbalGram* archive," said Magruder.

A subscription to *HerbalGram* is included with all ABC memberships. Members can access the entire collection on ABC's website at http://cms.herbalgram.org/herbalgram/index.html. HG

—ABC Staff

French Supplement Manufacturer Pharmatoka Adopts Cranberry through Adopt-an-Herb Program

The American Botanical Council (ABC) announces the support of Pharmatoka for ABC's Adopt-an-Herb botanical education program. Pharmatoka has adopted cranberry (*Vaccinium macrocarpon*, Ericaceae), a fruit native to North America and traditionally used by indigenous populations for its nutritional and medicinal benefits. Pharmatoka's adoption supports ABC's extensive HerbMedPro database, ensuring that this essential resource remains up to date for researchers, health professionals, industry, students, consumers, and all members of the herbal and dietary supplement community.

"ABC is deeply grateful to Pharmatoka for its financial support of the curation and expansion of ABC's HerbMedPro database by adopting cranberry," said Mark Blumenthal, founder and executive director of ABC. "Pharmatoka is a world leader in the development of high-quality, clinically researched, standardized cranberry extracts that have applications in the dietary supplement and pharmaceutical industries."

HerbMedPro is a comprehensive, interactive online database that provides access to important scientific and clinical research data on the uses and health effects of more than 250 herbs. Each adopted herb is continuously researched for new scientific articles and pharmacological, toxicological, and clinical studies, ensuring that its HerbMedPro record stays current and robust.

HerbMedPro is available to ABC members at the Academic level and higher. Its "sister" site, HerbMed, is available free of charge to the general public. In keeping with ABC's position as an independent research and education organization, herb adopters do not influence the scientific information that is compiled for their respective adopted herbs.

About Cranberry

Cranberry is a trailing, evergreen shrub prized for its tart, red fruit. Historically, Native American tribes consumed cranberries for a variety of conditions, including blood poisoning, scurvy, stomach and liver problems, fever, and mumps. Increased research into cranberry juice and extract focuses on the ability of proanthocyanidins (PACs) found in cranberry to reduce the adhesion of uropathogenic bacteria, such as *E. coli*, to uroepithelial cells. This anti-adhesion effect may help prevent recurrent urinary tract infections (UTIs) and alleviate the symptoms of UTIs. Cranberry fruit also is being investigated for many other potential benefits for the immune system, cardiac health, stomach health, and more.

In 2016, the American Herbal Pharmacopoeia (AHP) published an updated, comprehensive monograph on cranberry, highlighting the exceptional potential health benefits of cranberry's numerous constituents.

About Pharmatoka

Since 2004, Pharmatoka has researched the efficacy of PACs, the primary bioactive flavonoids present in North American cranberries. The company's flagship product, branded Ellura and Urell, contains an active daily dose of 36 mg of PACs and was formulated after the French government granted a physiological health claim for cranberry fruit. Pharmatoka was integral to bringing this ingredient to the attention of the government. With more than 10 years of dietary supplement experience, Pharmatoka is committed to the highest level of quality of its products, and to their safety and efficacy.

"We also consider that Pharmatoka, being a leader in *E. coli* bacterial anti-adherence issues, has to provide education and access to all analytical, technical, and medicinal aspects of cranberries," said Gunter Haesaerts, founder and CEO of Pharmatoka. "Pharmatoka has been engaged in defining adequate PAC quantitation methods, promoting bioactivity of juice extracts, participating actively in providing information for the recent AHP cranberry monograph and the search for adequate analytical methods to pinpoint adulteration. Our worldwide promotion of the anti-adherence properties of PACs is useful in the fight against the growing resistance of pathogenic bacteria against existing antibiotic treatments. We are proud to work actively with ABC, and we follow ABC's leadership in keeping the botanical world clean and efficacious."

About ABC's Adopt-an-Herb Program

Pharmatoka is one of 40 companies that have supported ABC's educational efforts to collect, organize, and disseminate reliable, traditional, and science-based information, including clinical studies, on herbs, medicinal plants, and other botanical- and fungal-based ingredients through the Adopt-an-Herb program. This program encourages companies, organizations, and individuals to "adopt" one or more specific herbs for inclusion and ongoing maintenance in the HerbMedPro database. To date, 45 herbs have been adopted. HG

—ABC Staff

ADOPT-AN-HERB

HerbMedPro™ PROGRAM

The American Botanical Council's Adopt-an-Herb Program provides a mutually beneficial opportunity to support ABC's nonprofit educational efforts and promote a company's most important herbs.

One of the benefits of supporting the Adopt-an-Herb Program is that it ensures that the most current information on the adopted herb is available through ABC's powerful HerbMedPro™ database.

HerbMedPro provides online access to abstracts of scientific and clinical publications on more than 250 commonly used medicinal herbs. A free version, HerbMed®, is available to the general public. HerbMed features 20 to 30 herbs from HerbMedPro that are rotated on a regular basis with an emphasis on adopted herbs. HerbMedPro is available as a member benefit to all ABC members at the Academic Membership level and up.

In addition to ensuring that recently published information on an adopted herb is up to date on HerbMedPro, another benefit adopters enjoy is being included among their peers in each issue of ABC's acclaimed quarterly, peer-reviewed scientific journal, *HerbalGram*, on the ABC website, and at scientific, medical, and other educational conferences. Press releases also are issued on new adoptions, bringing attention to the program, the adopted herb, and the adopting company. Each adopted herb is featured on its own page on the ABC website.

Parties interested in taking part in the Adopt-an-Herb Program are invited to contact ABC Development Director Denise Meikel at 512-926-4900, extension 120, or by email at denise@herbalgram.org.

Herbal Adopters

DMH ingredients inc	**Baobab** *Adansonia digitata*
	Rooibos *Aspalathus linearis*
afrigetics BOTANICALS	**Bulbine** *Bulbine natalensis*
BRASSICA	**Broccoli** *Brassica oleracea* Broccoli Group
indena®	**Indian Frankincense** *Boswellia serrata*
DownUnder enterprises	**Tea Tree** *Melaleuca alternifolia*
Aromatics INCORPORATED	**Peppermint** *Mentha x piperita*
HERBALIFE	**Aloe vera** *Aloe vera*
la-n USA	**Monk Fruit** *Siraitia grosvenorii*
travel medic travelmedic.net	**Kratom** *Mitragyna speciosa*

utzy naturals	**Black Chokeberry** *Aronia melanocarpa*
	Elderberry *Sambucus nigra*
	Stinging Nettle *Urtica dioica*
AFS APPLIED FOOD SCIENCES, INC.	**Kava** *Piper methysticum*
AMAZING HERBS	**Black Cumin** *Nigella sativa*
FOUR ELEMENTS	**Lemon Balm** *Melissa officinalis*
Teawolf Natural Extract Solutions	**Guayusa** *Ilex guayusa*
biotropics MALAYSIA	**Tongkat Ali** *Eurycoma longifolia*
Gaia Trading Company, Inc.	**Hops** *Humulus lupulus*
THE ACTIVES FACTORY	**Birch** *Betula* spp.

Become an adopter today!

Visit us at **www.herbalgram.org/adopt**

Adopt-an-Herb is an exciting and mutually beneficial way to support ABC!

Contact Denise Meikel at 512-926-4900 x120 or by email at denise@herbalgram.org

Arnica *Arnica montana*
Photo ©2016 Steven Foster

Herbal Adopters

NATUROPATHICA HOLISTIC HEALTH	**Arnica** *Arnica montana*
FUTURE CEUTICALS	**CoffeeBerry®** *Coffea* spp.
KSM-66®	**Ashwagandha** *Withania somnifera*
INDFRAG®	**Garcinia** *Garcinia cambogia*
DIANA Performance from nature FOOD	**Acerola** *Malpighia* spp.
SCHWABE NORTH AMERICA™	**Black Cohosh** *Actaea racemosa*
	Ginkgo *Ginkgo biloba*
Nature's Way®	**Hawthorn** *Crataegus* spp.
Enzymatic Therapy®	**Umckaloabo** *Pelargonium sidoides*
INTEGRATIVE THERAPEUTICS™	**Lavender** *Lavandula angustifolia*
Natac	**Olive** *Olea europaea*
Natac	**Grape** *Vitis vinifera*
PHARMATOKA	**Cranberry** *Vaccinium macrocarpon*
ECOSO DYNAMICS	**Devil's Claw** *Harpagophytum procumbens*
EuroPharma	**Turmeric** *Curcuma longa*
CONTAINS Zembrin	**Sceletium** *Sceletium tortuosum*
MARS symbioscience	**Cocoa Flavanols** *Theobroma cacao*
RFI	**Hibiscus** *Hibiscus sabdariffa*
SFI	**Bacopa** *Bacopa monnieri*
Vit-Best Nutrition	**Cinnamon** *Cinnamomum verum*

New Bulletins Explore Adulteration of Black Cohosh and Goldenseal

In June, the ABC-AHP-NCNPR Botanical Adulterants Program published new Botanical Adulterants Bulletins (BABs) on goldenseal (*Hydrastis canadensis*, Ranunculaceae) and black cohosh (*Actaea racemosa*, Ranunculaceae). The publications are the fourth and fifth Bulletins, respectively, to be released by the Program.

The goal of the Bulletins is to provide accounts of ongoing issues related to botanical identity and adulteration, thus allowing quality control personnel and lab technicians in the herbal medicine, botanical ingredient, dietary supplement, cosmetic, and conventional food industries to be informed on adulteration problems that may be widespread and/or imply safety concerns. As with all publications in the Program, the Bulletins are freely accessible to American Botanical Council (ABC) members and registered users on the Program's website.

Black Cohosh

The Black Cohosh Bulletin begins with information on the plant species, its cultivation, harvest, market size, known adulterants, frequency of adulteration, potential therapeutic and/or safety issues with the adulterating species, and analytical approaches to detect adulterants. Seven expert reviewers provided input on the Black Cohosh Bulletin.

ABC AHP NCNPR
Botanical Adulterants Program
BOTANICAL ADULTERANTS
BULLETIN
on Adulteration of
Actaea racemosa

By Stefan Gafner, PhD*
American Botanical Council, PO Box 144345, Austin, TX 78723
*Corresponding author: email

Keywords: Adulterant, adulteration, black cohosh, *Actaea cimicifuga*, *Actaea dahurica*, *Actaea heracleifolia*, *Actaea racemosa*, Chinese cimicifuga, *Cimicifuga racemosa*

Goal: The goal of this bulletin is to provide timely information and/or updates on issues of adulteration of black cohosh (*Actaea racemosa*, Ranunculaceae) to the international herbal industry and extended natural products community in general. It is intended to complement the previously published works with information on black cohosh adulteration, e.g., the American Herbal Pharmacopeia monograph published by Upton et al.,[1] and the review paper by Foster,[2] by presenting new data on the occurrence of adulteration, the market situation, and consequences for the consumer and the industry.

1 General Information

1.1 Common name: black cohosh[3]

1.2 Other common names:

English: Black bugbane, snakeroot, rheumatism weed, fairy candle, tall bugbane, black bugbane, macrotys, macrotrys, battleweed, columbine-leaved leontice, cordate rattle top, rattleweed, false cohosh, papoose root.[4]

Chinese: Zong zhuang sheng ma (总状升麻)

French: Actée à grappes noires, cimicaire à grappes, chasse-punaises, cimifuge, herbe à punaise, serpentaire noire

German: Traubensilberkerze, Wanzenkraut, Frauenwurzel, langtraubiges Christophskraut, Nordamerikanische Schlangenwurzel, schwarze Schlangenwurzel

Italian: Cimicifuga, serpentaria nera, actea nera

Spanish: Cohosh negro, raíz de culebra negra

1.3 Accepted Latin binomial: *Actaea racemosa*[5,6]

1.4 Synonym: *Cimicifuga racemosa*

1.5 Botanical family: Ranunculaceae

Black Cohosh *Actaea racemosa*
Photo ©2016 Steven Foster

Black cohosh has been a popular ingredient in North American herbal medicine for centuries. Today, it is primarily used to alleviate menopausal symptoms. According to data published by ABC in its annual Herb Market Report, black cohosh has been one of the top six best-selling botanical dietary supplements in the mainstream market over the past three years.

"Black cohosh is a popular herb in the United States and other industrialized nations," said Mark Blumenthal, ABC founder and executive director and director of the Botanical Adulterants Program. "Our publication of this new Bulletin will help responsible companies in the herb and dietary supplement industry to exercise appropriate diligence in quality control testing to ensure that they are selling authentic North American black cohosh."

The new Black Cohosh Botanical Adulterants Bulletin complements a previous extensive article on this topic published in *HerbalGram* issue 98 in 2013 by noted author and photographer Steven Foster, titled "Exploring the Peripatetic Maze of Black Cohosh Adulteration: A Review of the Nomenclature, Distribution, Chemistry, Market Status, Analytical Methods, and Safety." The same issue featured a photo of black cohosh on the cover.

The Program produced an extensive Black Cohosh Laboratory Guidance Document in December 2015 that summarized and evaluated 36 analytical methods for accurately determining the identity of black cohosh botanical raw materials or extracts.

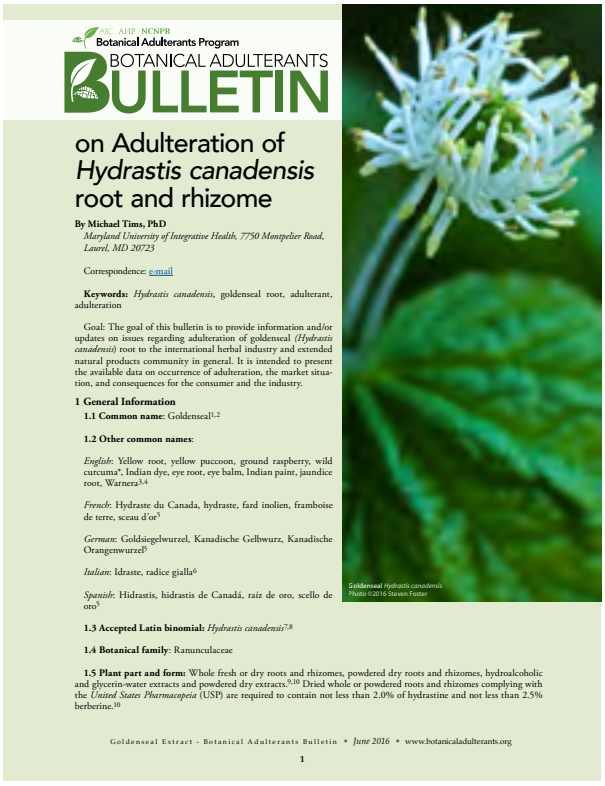
The new Black Cohosh Bulletin incorporates information compiled in these previous publications but adds new updates and advances.

Stefan Gafner, PhD, ABC chief science officer and Botanical Adulterants Program technical director, who wrote the Black Cohosh Bulletin, commented: "Adulteration of black cohosh continues to be a problem. Since the publication of Foster's *HerbalGram* review on black cohosh adulteration and the Laboratory Guidance Document last year, new studies have confirmed the illegal substitution of botanical material labeled as 'black cohosh' with closely related Asian plants; however, these Asian species are different from authentic North American black cohosh. The goal of this new Bulletin is to further increase awareness of black cohosh adulteration."

The Black Cohosh Bulletin is the fifth publication in a new series of Botanical Adulterants Bulletins, which provide timely information and updates on adulteration issues to the international herb and natural products communities. The Bulletin on goldenseal root and rhizome was published in early June, preceded in April by the first three Bulletins: bilberry (*Vaccinium myrtillus*, Ericaceae) fruit extract, grape (*Vitis vinifera*, Vitaceae) seed extract, and skullcap (*Scutellaria lateriflora*, Lamiaceae) herb. The Botanical Adulterants Program plans to release additional Bulletins in the coming months. The next in the series is a Bulletin on arnica (*Arnica montana*, Asteraceae) flower.

Goldenseal

The Goldenseal Bulletin was written by Michael Tims, PhD, academic director of herbal medicine at the Maryland University of Integrative Health. It begins with general information on the plant species, followed by data on its cultivation, harvest, and market size. The main section covers known adulterants, frequency of adulteration, potential therapeutic and/or safety issues with the adulterating species, and analytical approaches to detect the adulterant. In keeping with the Program's tradition of extensive peer-review of its publications, a total of 14 expert reviewers provided input on the Goldenseal Bulletin.


ABC AHP NCNPR
Botanical Adulterants Program
BOTANICAL ADULTERANTS
BULLETIN
on Adulteration of *Hydrastis canadensis* root and rhizome

By Michael Tims, PhD
Maryland University of Integrative Health, 7750 Montpelier Road, Laurel, MD 20723

Correspondence: e-mail

Keywords: *Hydrastis canadensis*, goldenseal root, adulterant, adulteration

Goal: The goal of this bulletin is to provide information and/or updates on issues regarding adulteration of goldenseal (*Hydrastis canadensis*) root to the international herbal industry and extended natural products community in general. It is intended to present the available data on occurrence of adulteration, the market situation, and consequences for the consumer and the industry.

1 General Information

1.1 Common name: Goldenseal[1,2]

1.2 Other common names:

English: Yellow root, yellow puccoon, ground raspberry, wild curcuma", Indian dye, eye root, eye balm, Indian paint, jaundice root, Warnera[3,4]

French: Hydraste du Canada, hydraste, fard inolien, framboise de terre, sceau d'or[5]

German: Goldsiegelwurzel, Kanadische Gelbwurz, Kanadische Orangenwurzel[5]

Italian: Idraste, radice gialla[6]

Spanish: Hidrastis, hidrastis de Canadá, raíz de oro, scello de oro[5]

1.3 Accepted Latin binomial: *Hydrastis canadensis*[7,8]

1.4 Botanical family: Ranunculaceae

1.5 Plant part and form: Whole fresh or dry roots and rhizomes, powdered dry roots and rhizomes, hydroalcoholic and glycerin-water extracts and powdered dry extracts.[9,10] Dried whole or powdered roots and rhizomes complying with the *United States Pharmacopeia* (USP) are required to contain not less than 2.0% of hydrastine and not less than 2.5% berberine.[10]

Goldenseal Extract - Botanical Adulterants Bulletin • *June 2016* • www.botanicaladulterants.org

1

Goldenseal *Hydrastis canadensis*
Photo ©2016 Steven Foster

"Goldenseal is one of the most consistently popular herbs sold in North America," said Blumenthal. "Most goldenseal is wild-harvested and is considered a relatively high-priced medicinal plant, thereby lending itself to potential adulteration with undeclared lower-cost plant material by unscrupulous sellers."

Gafner commented: "One of the characteristics of goldenseal root is its yellow color, which is mainly due to the presence of the alkaloid berberine. The abundance of other plant species, such as barberry (*Berberis* spp., Berberidaceae) or goldthread (*Coptis* spp., Ranunculaceae), containing this alkaloid has made it possible for unethical suppliers to find materials that can be passed on as goldenseal, even if the adulterating species are readily detected by commonly used chemical authentication methods."

Tims added: "Goldenseal has been a historically important herb in the materia medica of American herbalism. The cyclically high price of the commercial root over time has been an incentive for economic adulteration. The difference now is the knowledge and methodologies shared in the Goldenseal Botanical Adulterants Bulletin, which makes prevention of such adulteration much easier." HG

—ABC Staff

Native to North America and grows in much of the eastern half of the United States and Canada. Historically, Native Americans used preparations of goldenseal root and rhizome for a variety of conditions, including respiratory ailments, skin disorders, and infectious diseases. Goldenseal preparations still are used externally for their wound-healing and antimicrobial properties, but, more commonly, the herb is offered in combination herbal supplements — often with echinacea (*Echinacea* spp., Asteraceae) — for internal use that are marketed for immune support and other functions. In 2015, goldenseal-echinacea combination products were the 16th top-selling herbal supplement in US natural retail outlets.


Confident in your claims?
Minimize uncertainty.
The FDA requires brands to be able to prove their label claims using scientifically valid methods. Armed with the Alkemist Certificate of Analysis you'll finally have peace of mind that what's on the label is in the bottle. Why? Because testing natural products is the only thing we do.
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DESIGN: MSLK

National Animal Supplement Council Endorses Botanical Adulterants Program

The National Animal Supplement Council (NASC), an industry trade association of suppliers, manufacturers, and marketers of dietary ingredients and supplements for pets, has endorsed the ABC-AHP-NCNPR Botanical Adulterants Program. The Botanical Adulterants Program is a coalition of three nonprofits: the American Botanical Council (ABC), the American Herbal Pharmacopoeia (AHP), and the University of Mississippi's National Center for Natural Products Research (NCNPR).

Founded in 2001 by President and Chair of the Board of Directors Bill Bookout, the NASC is dedicated to protecting and enhancing the health of companion animals (e.g., cats, dogs, and horses) throughout the United States. NASC members include manufacturers, raw material suppliers, distributors, veterinarians, retailers, and other pet professionals. Through its innovative Preferred Suppliers Program, suppliers, manufacturers, and testing laboratories can submit documentation to verify consistent quality of raw materials and finished products along every step of the supply chain.

Bookout notified Mark Blumenthal, founder and executive director of ABC and director of the Botanical Adulterants Program, of NASC's endorsement in a letter dated June 7, 2016. "We applaud [the Program's] efforts to proactively address the issues surrounding quality and adulteration of these important raw materials," he wrote. "[H]aving trust, radical transparency, and verification in the supply chain is arguably the most important issue facing the human or animal supplement industries today."

NASC joins other leading natural products industry and professional associations that have underwritten and endorsed the Botanical Adulterants Program, including the Council for Responsible Nutrition, the Natural Products Association, and the United Natural Products Alliance. The Program is also supported by numerous professional research societies, trade associations, and research centers in the US, Canada, Europe, and in other parts of the world.

"We are grateful to welcome the members of NASC to our growing ranks of organizations and other responsible parties that are involved with the use of botanical ingredients for their myriad health benefits," Blumenthal said. "This is the first organization that focuses on animal health that has endorsed our educational efforts to try to prevent and reduce fraud in the sale of botanical raw materials and extracts used in the manufacture of dietary supplements, foods, cosmetics, and other consumer — and now, animal — products."

The ABC-AHP-NCNPR Botanical Adulterants Program publishes a quarterly e-newsletter, the Botanical Adulterants Monitor, which highlights new scientific publications related to botanical authenticity and analysis to detect possible adulteration, recent regulatory actions, and Program news. Issue 7 of the Monitor, released in June 2016, contains updates regarding detection of ginkgo (*Ginkgo biloba*, Ginkgoaceae) adulteration and maca (*Lepidium meyenii*, Brassicaceae) authentication in China, among other topics. These open-access articles are available on the Program's webpage.

Also available online is the Program's series of Laboratory Guidance Documents (LGDs), which help industry and third-party analytical labs determine the most effective analytical methods for detecting adulteration and authenticating botanical raw materials and extracts. The Program also publishes extensively peer-reviewed Bulletins and in-depth articles on adulterated herbs in the global marketplace. HG

—ABC Staff

The Rise and Fall of Maca in China

By Eric Brand, LAc

The voyage of maca (*Lepidium meyenii*, Brassicaceae) from Peru to the far corners of the world has captivated the attention of a global audience for several years now, but the remarkable tale of maca in China remains shrouded in mystery for many Western enthusiasts. In the past few years, many Western maca consumers have seen changing prices in response to a surge in demand for maca in China, and even mainstream newspapers have featured articles describing the complex politics and economic effects of the Chinese maca boom.[1,2] Indeed, few South American herbal medicines since the days of cinchona* (*Cinchona officinalis*, *C. pubescens*, Rubiaceae) have penetrated as deeply into Chinese pharmacies, and none have swept the nation quite like maca.

As a frequent visitor to herbal wholesale markets throughout China, I noticed the sudden arrival of maca several years ago. China has a complex network of traditional herbal wholesale markets, and some large herbal markets, such as those in Bozhou and Anguo, dominate entire cities and have an annual turnover of billions of dollars. Over the course of the past three years, a maca boom that defied belief took hold across China. One year, it seemed as if nobody in China had heard of maca; the next year, it was common in every major wholesale market. Fortunes were made as speculators, vendors, farmers, and advertisers rushed to cash in on maca's fame, which came to a sudden and spectacular halt several months ago, as prices began to crash and the giant bubble of Chinese maca burst.

Maca *Lepidium meyenii*
Photo ©2016 Steven Foster

For those on the front lines of the herbal industry in China, international headlines about maca seemed to show up a year too late. In late 2014, alluding to the rise of domestic Chinese maca cultivation, articles in *The New York Times* and *The Wall Street Journal* summarized the massive price hikes and booming Chinese market, while also raising the alarm that unauthorized raw maca was being smuggled out of Peru.[1,2] Unfortunately, the train had long since left the station by that time; those of us in China had already seen maca sweep the nation's markets, and massive crops of domestic Chinese maca were everywhere. But the real madness was just beginning.

By 2015, the maca craze had reached a peak in China. Maca was being promoted on television for its ability to increase energy levels, improve sexual function, and enhance longevity, among many other claimed benefits, and people were crossing over to Hong Kong to buy up imported Peruvian maca at exorbitant prices. At the time, wholesale prices surpassed $50 per kilogram ($22.68 per pound) for the lowest grades on the market. In the high mountains of Yunnan province in Southwest China, farmers began growing as much maca as they could plant, and in towns such as Lijiang, systems evolved to collect the domestic maca crop for distribution nationwide.

As luck would have it, I took a research trip to Yunnan province in the summer of 2015, and the abundance of maca was unbelievable. Specialized maca stores had sprouted up at the airport, maca billboards lined the roads, and even the urinals in the men's room were adorned with ads for maca. The ads would invariably feature dramatic health claims and pictures of wise old Andean villagers as symbols of longevity, with slogans such as "few people haven't tried maca, but even fewer have experienced the power of 'real' maca."

That summer, as our research group traveled deeper into the remote Yunnan countryside, maca came with us. Every

*Cinchona is the bark of a tree from the Peruvian Andes ("Peruvian Bark") that is used to make the antimalarial drug quinine. European colonists took the tree and introduced it for cultivation in other colonies around the world, thus taking the trade away from Peru. According to a peer reviewer of this article, this is possibly the earliest reported case of biopiracy of Peruvian traditional knowledge.

roadside rest station had a vendor selling maca roots, and public restrooms in tiny villages had tables for maca sales in front of the toilets. In fancy shops selling the "Emperor's Maca Liquor," to roadside outhouses without running water, maca was the dominant product for sale. Old mainstays of Yunnan herbal medicine fame, such as *sanchi* (*Panax notoginseng*, Araliaceae), were displayed off to the side. Not even ginseng (*P. ginseng*) itself could compete for shelf space next to maca in the summer of 2015.

However, even in the midst of the buzzing maca vendors, warning signs of the imminent crash of maca prices in China were already apparent. The rise of domestic maca cultivation was akin to a gold rush, spurred by grandiose advertisements promising that the right brand of maca would virtually transform the user into a legendary phoenix. Experts in Chinese herbal medicine looked on helplessly at the marketing hype and wondered if this humble but remarkable vegetable, a relative of the radish (*Raphanus sativus*, Brassicaceae), could deliver on the promises implied by the TV episodes and billboards driving the craze.

A few months after touring Yunnan, I helped a colleague collect samples of Chinese-grown maca for an analytical project to compare its constituent profile with that of authentic native Peruvian maca. Over a series of trips, I collected maca samples from dozens of wholesale vendors in China and Hong Kong, and conducted an informal survey of all the grades and types of maca sold on the Chinese market. By the time I collected the market samples, the cultivation gold rush from the year before had already reached its inevitable conclusion — an overproduction of domestically grown maca had caused the price of the dried tuber to plummet from more than $50 per kilogram to only $5 to $12 per kilogram ($2.27 to $5.44 per pound). A few months later, the price had fallen further. As of June 2016, the price of maca in Chinese wholesale markets was down to roughly $4 per kilogram ($1.81 per pound).

For a brief moment in time, the Chinese demand for maca seemed limitless, and even today I can walk down a road in Hong Kong to a neighborhood herb shop that is offering Peruvian maca at a stunning price of more than $10,000 per kilogram (more than $4,500 per pound).

Indeed, despite the complete collapse of prices at the raw material level in Yunnan, many herbal shops in Hong Kong and China are still trying to hold their prices at $30 to $50 per kilogram, but the market seems to have fallen off as quickly as it began. Genuine Peruvian maca still fetches a decent price, but even Peruvian maca has taken a hit in terms of its quality and price in Hong Kong, with some material surfacing that is unnaturally large, perhaps from overuse of fertilizers.

In recent years, a number of Chinese herbal medicines have been prone to fluctuating cycles of high prices, followed by overproduction and oversupply that results in inevitable price crashes, but the case of maca remains rather exceptional. Unlike herbs that are commonly used in Chinese medicine, maca never had a place in traditional Chinese medicine (TCM) theory, and clinical practitioners do not use it in formulas; thus, its market is inherently inconsistent, as it depends on the fast-moving trends of the public, rather than the steady pace of the clinic.

While collecting samples of maca, I invariably asked the vendors what they thought of its clinical efficacy and value, and they tended to say that it was a good general tonic, perhaps a bit "hot," with the black color fetching a higher price because black "enters the kidney" in TCM theory. Yet when pressed, many vendors didn't really have confidence that maca had potent medicinal properties, and more than once I heard vendors describe it as a "turnip" when no customers were nearby.

Differentiating the Materials on the Chinese Market

Unlike in the Western herbal market, Chinese herbs tend to be sold whole, either as intact whole pieces or as sliced materials that are designed for decoction. Macroscopic features are used to separate raw herbs into numerous grades. In the case of maca, this results in a wide range of grades based on uniformity, size, color, and aroma. Imported maca from Peru is sold separately from domestically grown Chinese maca, and both Chinese and Peruvian maca specimens are graded and priced accordingly. Peruvian maca is regarded as significantly superior and fetches a much higher price than Chinese maca. Although they appear similar, with experience Peruvian and Chinese maca can be differentiated from one another visually, and the Peruvian maca tends to have a more potent aroma and taste.

In the context of Peruvian maca, Chinese wholesalers differentiate three colors, which are described as "black," "yellow," and "purple" (which, in this case, is essentially an intermediate shade of gray). It is then graded by consistency, size, and aroma; roots

Maca being sold at a rural outhouse in Yunnan, China. Photo ©2016 Eric Brand

Maca *Lepidium meyenii*
Photo ©2016 Eric Brand

with a potent, acrid, "radish-like spiciness" are preferred. In Chinese wholesale markets, the black and "purple" Peruvian roots are valued more highly than the yellow Peruvian roots, while the price in Hong Kong is often similar regardless of color. As of late 2015, large, evenly shaped black Peruvian maca was fetching about $100 per kilogram in Guangzhou, with the price dropping down to about $40 per kilogram for the smaller black Peruvian roots. Yellow Peruvian maca was selling for about $15 to $25 per kilogram in Guangzhou in late 2015, depending on size. Around the same time, the price of Peruvian maca in wholesale herbal shops in Hong Kong was about $100 per kilogram for both black and yellow forms, which make up the bulk of the market.

Domestically grown Chinese maca is primarily produced in the high mountains of Yunnan province. It is widely available in only two colors: "yellow" and "black." As with Peruvian maca, the material is separated by color and graded based on size, consistency (an even radish-like shape is preferred), and aroma.

In China, domestically grown yellow maca tends to sell for about 30-50% of the price of black maca. By late 2015, the price had fallen from more than $50 per kilogram to as low as $5 per kilogram for irregular yellow Yunnan maca, with most yellow Yunnan maca selling for about $10 to $13 per kilogram, and average black Yunnan maca selling for about $30 per kilogram. Today, both black and yellow Yunnan maca can be purchased for as low as $4 per kilogram, and vendors that once turned extraordinary profits from this product are often desperate to unload their stock.

Conclusion

Just as the world market for goji berries (*Lycium barbarum*, Solanaceae) reverberated following their "discovery" by the Western health food market, the dramatic rise and fall of maca in China illustrates how the fickle fluctuations of consumer fashions can shake markets and ecosystems. In the case of both maca and quinoa (*Chenopodium quinoa*, Amaranthaceae), the world has seen once-obscure South American cultural foods rise as new celebrities, enriching some locals and traders while inadvertently pushing the price of these traditional foods out of reach for many of their original consumers.

This invariably raises sensitivities about topics such as resource preservation and cultural appropriation, and the expansion of once-traditional crops into new territories poses complex challenges for those in the area of herbal authentication and quality control. For example, more basic research is still needed to understand how different cultivation environments affect maca beyond its gross morphological features. Given that many new crops are sure to experience similar volatility as the world becomes increasingly prone to shared dietary trends, the interesting trajectory of maca may serve as a cautionary tale of the issues that must be kept in mind for a brighter herbal future. HG

Eric Brand, LAc, *is a Chinese medicine practitioner from the United States and a fluent Chinese speaker with extensive experience in mainland China, Hong Kong, and Taiwan. He is the author of* A Clinician's Guide to the Use of Granule Extracts *(Blue Poppy Press, 2010), the co-author of the text* Concise Chinese Materia Medica *(Paradigm Publications, 2008), and he has translated and edited a variety of modern and classical texts, including the recently acclaimed* Chinese Medicinal Identification: An Illustrated Approach *(Paradigm Publications, 2014).*

Brand has a particular passion for Chinese herbal processing, herbal authentication, and quality discernment. He is currently completing his PhD in pharmacognosy at the School of Chinese Medicine at Hong Kong Baptist University, and he is the owner of the herbal company Legendary Herbs. Brand serves as a Chinese medicine advisor to the American Herbal Pharmacopoeia (AHP) and is the current Chair of the US Delegation for the ISO TC 249 committee on international standards in traditional Chinese medicine.

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Topical Use of Chamomile Oil Reduces Frequency of Enuresis in Children

Chamomile *Matricaria recutita*
Photo ©2016 Steven Foster

Reviewed: Sharifi H, Minaie MB, Qasemzadeh MJ, Ataei N, Ghareh-beglou M, Heydari M. Topical use of *Matricaria recutita* L (chamomile) oil in the treatment of monosymptomatic enuresis in children: a double-blind randomized controlled trial [published online September 30, 2015]. *J Evid Based Complementary Altern Med*. doi: 10.1177/2156587215608989.

Monosymptomatic enuresis is defined as urinary incontinence in children who have no other lower urinary tract symptoms and no history of bladder dysfunction. Pharmacological treatment includes drugs such as tricyclic antidepressants, anticholinergics (drugs that inhibit the action of the neurotransmitter acetylcholine), and desmopressin (an antidiuretic drug), which can often have adverse effects. Because of this, complementary and alternative medicines are being investigated to treat enuresis in children. Chamomile (*Matricaria recutita*, Asteraceae) flowers are used in traditional Persian medicine to treat children with enuresis.

The goal of this double-blind, placebo-controlled, randomized clinical trial was to evaluate the efficacy and safety of a traditional preparation of chamomile oil in children with monosymptomatic nocturnal or daytime enuresis.

The authors evaluated, for eligibility, 125 patients attending the Pediatric Clinic of Golpaygani Hospital at Qom Azad University in Qom, Iran, between March 2014 and August 2014. The patients had been diagnosed with monosymptomatic nocturnal (patients aged seven and older) or daytime (patients aged four and older) enuresis. Eighty patients were chosen and all completed the study.

Chamomile flowers were purchased from a local herb shop and verified by a botanist at the Herbarium Center of the University's School of Pharmacy. Following traditional preparation methods, the dried chamomile flowers were ground, macerated in water for 24 hours, and decocted for 30 minutes. The resulting extract was boiled in sweet almond (*Prunus dulcis*, Rosaceae) oil until water was evaporated. Sweet almond oil was used as the placebo for the study. The patients' parents were instructed to apply six drops of the chamomile-infused oil (n = 40) or the placebo (n = 40) topically on the perineal and suprapubic area of the children once nightly.

Patients were evaluated at baseline and after two, four, and six weeks of treatment. The data of one patient in the chamomile group and three in the placebo group (who consumed drugs that were not included in the study protocol) were analyzed in their respective groups according to the intention-to-treat analysis protocol. The chamomile group included 24 (60%) boys and 16 (40%) girls; in the placebo group were 29 (72.5%) boys and 11 (27.5%) girls. The mean age of the chamomile group was 9.52 ± 1.88 years, and the mean age of the control group was 9.90 ± 2.51 years.

In the chamomile group, the mean frequency of enuresis decreased significantly at two, four, and six weeks ($P < 0.001$ for all time points) compared with baseline. Compared with the control group, the changes in the chamomile group were significantly greater at two ($P < 0.001$), four ($P = 0.03$), and six ($P < 0.001$) weeks. No significant correlation was seen between age and frequency of nocturnal enuresis after six weeks, and no significant differences were seen in outcome between girls and boys.

Although five parents complained about the greasy nature of the chamomile oil, no adverse effects were reported.

In this study, the mean frequency of enuresis in the chamomile group was significantly lower than in the placebo group at all measured time points. The authors attribute the observed effects to the spasmolytic and anticholinergic activities of chamomile's active constituents, and conclude that chamomile should be considered as a potential complementary treatment option for children with monosymptomatic enuresis. Admitted limitations of the study include the short duration of follow-up, absence of a standard treatment group as a reference control, and the lack of examination of the recurrence rate after discontinuing the treatment. HG

—Shari Henson

European Elderberry Reduces Duration and Symptoms of the Common Cold in Air Travelers

Reviewed: Tiralongo E, Wee SS, Lea RA. Elderberry supplementation reduces cold duration and symptoms in air-travellers: a randomized, double-blind placebo-controlled clinical trial [published online March 24, 2016]. *Nutrients*. doi: 10.3390/nu8040182.

Air travelers are often subject to stressors, such as fatigue, travel stress, and related compromised immune function. Close proximity to other travelers also may result in an elevated risk of contracting or spreading communicable diseases, such as the common cold. European elder (*Sambucus nigra*, Adoxaceae) berries have been shown in previous clinical studies to lessen the symptoms and duration of both colds and influenza infections.[1,2] This randomized, double-blind, placebo-controlled trial focused on whether or not a European elderberry extract (BerryPharma; Iprona AG; Lana, Bolzano, Italy) helped prevent respiratory symptoms and had a positive impact on the physical and mental health of air travelers.

The trial was conducted between April 2013 and December 2014, and study subjects were recruited from the Gold Coast region of Australia. Included subjects were at least 18 years old and healthy. Criteria for exclusion were participation in another clinical trial at the time of the study or within 30 days of the study; presence of plant allergies, respiratory problems, or other diseases; vaccination against influenza within 10 days of the study; and use of medications such as antibiotics or antivirals. Women who were lactating, pregnant, or intending to become pregnant also were excluded.

Subjects were economy-class passengers, who traveled for at least seven hours overseas from Australia (with a layover of less than 12 hours) and spent at least four days at their final destination. Subjects (N = 312) began either the treatment or the placebo 10 days prior to their flight and continued for five days after arrival at the destination. This resulted in a total treatment duration of 15 or 16 days. Subjects completed questionnaires addressing cold symptoms and duration, quality of life, and stress levels at baseline, two days before travel, and four to five days after travel.

The BerryPharma extract was packaged into capsules by Plantafood Medical GmbH of Leiningen, Germany. Capsules contained 300 mg of extract standardized to 22% of polyphenols, 15% anthocyanins, and 150 mg of rice (*Oryza sativa*, Poaceae) flour. Placebo capsules were considered to be "matched." The manufacturer and exact description of placebo content(s) are not given. The dosage was two capsules daily from 10 days until two days prior

Elderberry *Sambucus nigra*. Photo ©2016 Steven Foster

to travel, and three capsules daily starting one day prior to travel and continuing for four to five days after arrival at the destination. Remaining capsules were counted to gauge compliance.

To assess the presence and severity of cold symptoms, subjects completed the Jackson Score questionnaire. Symptoms such as nasal obstruction, sore throat, and cough were assessed in this questionnaire, with scores from 0 (absence of symptoms) to 3 (severe symptoms). Daily use of cold medications, as well as whether subjects thought they had a cold, were recorded. Colds were defined as a total symptom score of > 14 over six days with the belief of the presence of a cold for three or more days. Also assessed were the number, duration, and symptoms of colds that required medication.

To assess the impact of colds on quality of life, the Wisconsin Upper Respiratory Symptom Survey (WURSS-21) was used. This survey uses a seven-point Likert scale, in which a lower score indicates better health. Symptom severity, functional impairment, and global severity and change over the prior 24 hours were gauged. Another assessment for quality of life was the Short Form Health Survey (SF-12). This questionnaire measured physical and mental health based on 12 questions; the score ranged from 0 (worst health) to 100 (optimum health). To gauge stress, the Perceived Stress Scale (PSS) was employed. The PSS addresses how subjects experience stress in their lives, with higher scores indicating greater stress. A score of > 14 was considered indicative of a large degree of stress.

In total, 325 subjects were randomly assigned to either the elderberry or placebo group. Of these, 13 subjects did not take the treatments due to loss of material in the mail, pneumonia, alteration in travel or decision, or family emergency. The intention-to-treat analysis included 312 subjects, with 158 in the elderberry group and 154 in the placebo group. Most subjects were women (66%), non-smokers, around 50 years old, and conducted holiday air travel of more than 16 hours between April 2013 and December 2014. Subjects' PSS scores were > 14 at baseline. Around half the subjects had received an influenza vaccination at least 10 or more days prior to the start of the study. Demographics were not significantly different between groups at baseline.

During the study, 12 subjects in the elderberry group and 17 in the placebo group had a cold, according to the Jackson Score questionnaire (this difference between groups was not significant). Of these 29 subjects, symptoms were detectable in 11 subjects prior to travel, in three during travel, and in 15 upon arrival at their destination. The number of days that subjects in the elderberry group had a cold was less than in the placebo group, bordering on significance (57 days total versus 117 days, respectively; P = 0.05). The average cold symptom score over these days was significantly less in the elderberry group than the placebo group (247 versus 583, respectively; P = 0.02).

Half of the subjects with colds took medications to treat cold symptoms, but there was no significant difference between groups. The average WURSS-21 scores were not significantly different between the groups at any point; however, those in the elderberry group reported fewer cold symptoms prior to travel than those in the placebo group, approaching significance (P = 0.07). According to the SF-12 questionnaire, average physical health scores significantly decreased from baseline in the placebo group across the study (P = 0.005), while no change in scores was observed in the elderberry group. In total, 90% of subjects were 90% compliant with the protocol. Adverse side effects such as itchy throat, "cold-like" symptoms, and fatigue were reported in both groups (four subjects), while kidney pain was reported by one subject in the placebo group.

Based on the data shown here, the authors conclude that taking European elderberry extract may result in a shorter duration of a cold with less symptom severity. Previous studies have also found beneficial effects of elderberry extract on colds. The authors mention that many subjects used additional medications to treat their colds, and this may have confounded symptom reporting. In general, this study suggests that European elderberry extract can help alleviate colds associated with travel. Future studies will ideally include a broader population and other stressful environments, and elucidate potential mechanisms of action. The study was funded by Iprona AG, which also provided the European elderberry and placebo capsules and was partially involved in the design of the study. HG

—Amy C. Keller, PhD

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Cocoa Flavanol Beverage Improves Facial Wrinkles and Skin Elasticity in Women with Photo-Aged Skin

Reviewed: Yoon H-S, Kim JR, Park GY, et al. Cocoa flavanol supplementation influences skin conditions of photo-aged women: a 24-week double-blind, randomized, controlled trial. *J Nutr.* 2016;146(1):46-50.

Cocoa products derived from the dried, fermented fatty seeds of the cacao (*Theobroma cacao*, Malvaceae) tree reportedly have many health benefits. They are rich in polyphenolic antioxidants and flavanols, such as epicatechin, catechin, and procyanidins. Determining an adequate daily dose and duration of cocoa flavanol supplementation may help maximize potential antioxidant photoprotective benefits. However, previous clinical trials that have investigated the effects of high-flavanol cocoa product consumption on skin photoaging have had conflicting results. These authors conducted a 24-week, double-blind, randomized clinical trial to investigate whether a high-flavanol cocoa beverage would improve the moderately photo-aged facial skin of female subjects.

The study included healthy females (aged 43-86 years) with visible wrinkles. It was conducted between February 2014 and March 2015 at Seoul National University Hospital in Korea. Sixty-four subjects were randomly assigned to either the cocoa group or the placebo group (n = 32 for both). Of those subjects, one from each group failed to follow the protocol and did not complete the study.

Cacao *Theobroma cacao*
Photo ©2016 Steven Foster

The cocoa group's beverage contained 4 g fat-reduced cocoa powder (Barry Callebaut Belgium NV; Lebbeke-Wieze, Belgium) that was processed to preserve a high amount (320 mg) of cocoa bean flavanols. The placebo group consumed a nutrient-matched cocoa-flavored beverage that did not contain flavanols. Both beverage powders were dissolved in 150-200 mL hot water.

Wrinkles were measured in the crow's feet area on the outer corner of the eye using a visiometer (a skin topography tool) to assess the following five variables: skin roughness, maximum roughness, average roughness, smoothness depth, and arithmetic average roughness. Another cosmetological tool was used to measure skin elasticity on the cheek to assess gross elasticity, net elasticity, and biological elasticity. Finally, the authors evaluated skin hydration on each subject's cheek using two additional tools.

The facial skin of each subject was evaluated at baseline and at 12 and 24 weeks. Ten subjects in each group agreed to undergo short-wave ultraviolet (UV)-B irradiation. The minimal erythema dose (MED), or the minimal UV dose causing erythema (i.e., skin reddening), on all edges of an irradiated square of skin on the buttock was assessed at baseline and at 24 weeks in those subjects.

Adverse effects were evaluated at 12 and 24 weeks. Blood samples were drawn at baseline and at 24 weeks to measure aspartate aminotransferase and alanine transaminase levels (which can be used to gauge tissue damage), as well as glucose, blood urea nitrogen, creatinine, and hemoglobin and hematocrit concentrations. Overall compliance rates were 97.6% at 12 weeks and 98.4% at 24 weeks.

The authors report no significant between-group differences in skin roughness measurements after 12 weeks of supplementation. After 24 weeks, however, the mean percentage changes in average roughness (P = 0.023) and maximum roughness (P = 0.03) were significantly lower in the cocoa group than in the placebo group. "Because visiometer values decrease as wrinkles diminish, these results suggest that the cocoa group showed improvement in wrinkle severity compared with the placebo group," the authors explained. Changes in the other roughness variables were not significant at 24 weeks.

The only significant between-group difference in skin elasticity after 12 weeks was in the mean percentage change in gross elasticity of the skin, which was significantly greater in the cocoa group than in the placebo group (P = 0.02). After 24 weeks, significant between-group differences were observed in gross elasticity (P = 0.027), net elasticity (P = 0.027), and biological elasticity (P = 0.032), which were all greater for the cocoa group than for the placebo group. No

significant between-group differences were seen in epidermal hydration variables after 12 or 24 weeks of supplementation.

No adverse effects were reported, and no abnormal laboratory values were observed. Body weight changes were minimal; the placebo group gained more weight than the cocoa group after 24 weeks ($P = 0.021$). Although cocoa flavanols have been reported to have beneficial effects on obesity, in this study, the subjects' diets and physical activities were not controlled, so this finding "can only be interpreted as indirect evidence and was an unintended outcome." Furthermore, the authors did not report the test product's content of methylxanthines, which are thought to contribute to weight loss.

The MED of those in the placebo group who underwent UV irradiation did not change significantly during the study. In the cocoa group, however, a significantly increased MED was observed at 24 weeks ($P = 0.022$). Changes in MED at 24 weeks from baseline were significantly higher in the cocoa group than in the placebo group ($P = 0.035$).

Although this study found that a high-flavanol cocoa beverage can improve facial wrinkles and skin elasticity, the effects were not as great as those reported for direct curative therapies, such as topical tretinoin (a prescription acne treatment), laser resurfacing, or chemical peeling. "Therefore, the main effect of cocoa flavanols on photo-aging might be preventive rather than curative," the authors state.

According to the authors, the changes in wrinkle severity and skin elasticity in their study are consistent with those of previous trials.[1,2] Conflicting results regarding changes in MED after cocoa flavanol consumption remain, possibly because of the variations in age, skin phototype, and race of subjects used in other trials. The cocoa flavanols did show overall protective effects by raising MED.

The authors conclude that "in moderately photo-aged women, regular cocoa flavanol consumption had positive effects on facial wrinkles and elasticity," and that "regular cocoa flavanol consumption may be a good strategy for prevention of the progression of skin photo-aging." No mention was made about what company or agency sponsored the research. HG

—Shari Henson

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American ginseng plate from Jacob Bigelow's *American Medical Botany*, Vol. 2, published in 1818.

TOWARD AN UNDERSTANDING OF GINSENG ADULTERATION: THE TANGLED WEB OF NAMES, HISTORY, TRADE, AND PERCEPTION

By Steven Foster

Editor's note: *This article is produced under the aegis of the ABC-AHP-NCNPR Botanical Adulterants Program and is the fifth from Steven Foster in his series on herb adulteration. His previous article on the adulteration of black cohosh (*Actaea racemosa*, Ranunculaceae) was the cover story of issue 98, published in 2013. This article is the first part of a planned two-part series on the vast subject of adulteration of Asian and American ginseng. In order to adequately explain the methods employed to adulterate ginseng, it is constructive to understand the nomenclature, taxonomy, and trade history of this economically important medicinal plant.*

INTRODUCTION

If there is a single word that exemplifies global interest in medicinal plants, it is "ginseng." The commercial, scientific, and historical importance of ginseng (*Panax* spp., Araliaceae) includes at least 2,200 years of written history in traditional Chinese medicine (TCM) and, coupled with the European discovery of American ginseng (*P. quinquefolius*) in 1700, has created an iconic bridge between East and West that helps define both traditional and modern human experience with medicinal plants.

To simplify the discussion, *P. quinquefolius* will be referred to throughout this article as "American ginseng," the Standardized Common Name established by the second edition of the American Herbal Products Association's (AHPA's) *Herbs of Commerce*,[1] a reference text that includes common names and Latin binomials for herbs sold in the United States. (Some Canadian colleagues might scold this writer for not using the more diplomatically correct "North American ginseng.") To remain consistent with *Herbs of Commerce*, *P. ginseng* will be referred to as "Asian ginseng," in a general sense, although some prefer to use English common names that reflect the nation of origin (e.g., "Chinese ginseng" or "Korean ginseng").

The literature on ginseng is voluminous.[2,3] A PubMed search for the word "ginseng" yields more than 7,200 references to scientific papers, and a Google Scholar search for "Panax" results in 91,000 references (as of July 11, 2016). Almost any general work on medicinal plants, pharmacognosy, or herbal medicine includes ginseng, and hundreds of technical treatises, popular books, and monographs on ginseng have been published in dozens of languages.

Since the 1970s, numerous symposia on all aspects of ginseng — its botany, chemistry, clinical use, conservation, commerce, cultivation, pharmacology, and safety — have been held around the world. (Unfortunately, many important papers presented in symposia proceedings are not cataloged by indexing services, thus making that information more challenging to access.) Various organizations, such as the Korean Ginseng Research Institute, Wisconsin Ginseng Grower's Association, Ontario Ginseng Grower's Association, and others, also are dedicated to better understanding the chemistry, pharmacology, production, toxicology, and clinical applications of ginseng root and its extracts.

Intermixed source plants, rampant taxonomic confusion, and unrelated plants mislabeled as "ginseng" have created ever-evolving challenges in authentication. These issues, combined with the historically high value of ginseng roots, and the perceived value of plants and products offered under the name "ginseng," have made this botanical particularly tempting to economic adulterers.

This article reviews information related to the potential, perceived, or actual adulteration of material offered as "ginseng," including historical, commercial, botanical, pharmaceutical, and nomenclatural (in both technical and trade use) information, from 1655 to 1980.

Understanding Ginseng Adulteration

In the broadest sense, ginseng adulteration* falls into the following five categories, which are not necessarily mutually exclusive:

1. **Plant materials not from the genus *Panax* misbranded as "ginseng,"** including species from both inside and outside the Araliaceae family, in association with product labeling or marketing. In the herb trade, this extends to plants referred to in TCM as *seng* or *shen* (e.g., codonopsis or *dang shen* [*Codonopsis pilosula, C. tangshen*; Campanulaceae], which is sometimes regarded as a "poor man's ginseng") or lower-cost ginseng alternatives with perceived similar activity.[4]
2. **Intentional adulteration of one *Panax* species with another**, such as the adulteration of American ginseng with Asian ginseng, or vice versa. This is usually done for economic incentive (i.e., adulterating higher-priced species with lower-priced material), and depends on market conditions and the end-user market country. However, unintentional or accidental adulteration of one species with the other may occur as the result of carelessness or insufficient information in the supply chain. A cultural or national bias may also be a consideration. For example, in South Korea, various forms of Asian ginseng whole root offerings are preferred, and American ginseng is regarded as an adulterant. In fact, sale of American ginseng is not allowed in Korea. In southern China, where various product forms of

* This paper will not discuss potential contamination with agricultural chemicals, such as pesticides, herbicides, and fungicides; soil microbes; heavy metals; or other natural and artificial contaminants.

American ginseng are sought as a "cooling" tonic, lower-priced, domestic Asian ginseng may masquerade as American ginseng, sometimes sold under the trade name "Chinese white."

3. **Intentional adulteration of *Panax* species with other plant materials or substances of lesser value** that may have a casual visual resemblance to a *Panax* species, or the use of pharmacologically inert bulking agents, particularly in powders (e.g., the use of sawdust, or the addition of filling agents such as dicalcium phosphate).[4,5]
4. **Intentional admixing or substitution of various ginseng plant parts** without declaring all parts on the label. For example, ginseng leaf extracts purportedly are added to ginseng root extracts in an effort to increase the overall level of ginsenosides (panaxosides), the saponin glycosides widely considered the most important active constituents of *Panax* species. However, the ginsenoside profile of ginseng leaf is different than that of ginseng root. Admixing or substituting one part for another may affect product bioactivity, perhaps increasing or otherwise altering efficacy. Nonetheless, a ginseng root product containing ginseng leaf extract should be labeled as containing ginseng leaf extract. The chemistry of various plant parts in the genus *Panax* is also species-dependent.
5. **Intentional reduction of quality and strength** by selling waste material (e.g., dried marc, or raw material left over from commercial extraction) as "ginseng root," which is often mixed with varying percentages of the unextracted root, especially for powdered material.[4]

Unadulterated Ambiguity: On the Name 'Ginseng'

The names associated with "ginseng" vary depending on the context, which is important to keep in mind when discussing the history, trade, discovery, use, science, and nomenclatural complexities of ginseng over the last 300 years.

The late Harvard University botanist Shiu Ying Hu, PhD (1908-2012), explained that the word "ginseng" derives from the Romanization of the sounds of two Chinese characters: *Gin* is the sound for the word "man," and *seng* is very close in pronunciation, and equivalent in meaning, to "essence." According to Hu's interpretation, the name translates to "essence of the earth in the form of a man," which represents the spiritual phase of nature, or the vital spirit of earth that dwells in the material form of the root.[6] Often loosely translated as "man-shaped root," the proper Chinese translation, Hu suggested, is "man essence."[7]

Panax derives from the Greek *pan* ("all") and *akos* ("cure"), a reference to the mid-18th century Western understanding of the herb's medicinal reputation in China. However, as Hu pointed out, ginseng was never employed as a "panacea"; rather, its use is restricted and specific in TCM.[6]

In Chinese medicine (including formalized TCM and regional folk medicine), "seng" refers to fleshy rootstocks used as tonics. Modifiers can indicate the source plant or various qualities (e.g., "gin seng," "bitter seng," "black seng," "Mingtang seng," and "prince seng"). Not all *Panax* species are considered sengs, and there are sengs not in the genus *Panax*.[8,9] Hu used the metaphor, "A horse is a mammal, but not all mammals are horses. Likewise, ginseng is a *Seng* but not all sengs in Chinese medicine are ginseng." She documented 62 species of "seng-producing" plants in 40 genera from 20 botanical families. Once known as a type of "ginseng," the woody plant eleuthero (*Eleutherococcus senticosus*, Araliaceae) does not have a fleshy rootstock. Therefore, in a traditional Chinese sense, it is not considered a seng-producing plant.[10]

Since the revival of the US herb trade in the 1970s, the term "ginseng" has been applied to various herbal ingredients, often with qualifying adjectives that denote geographic origin or other details. Unsuspecting or under-informed consumers may assume that products deemed "ginseng" have tonic, aphrodisiac, or other properties that are casually associated with *Panax* species.

A 2003 *HerbalGram* article by American Botanical Council (ABC) Advisory Board member Dennis Awang, PhD, a natural products chemist and former Health Canada regulatory scientist, reviewed plants sold in the marketplace under the name "ginseng." Unless the plant material was American ginseng or Asian ginseng, Awang considered this practice to be an abuse by uninformed herbal vendors, or even unscrupulous vendors seeking to cash in on the reputation of the name. His list enumerated imposters within the Araliaceae family and from six other plant families (Table 1).[11]

The unique and illustrative cases of canaigre (*Rumex hymenosepalus*, Polygonaceae) — perhaps the most egregious example of outright fraud — and eleuthero are detailed briefly below.

Unadulterated Fraud: 'Wild Red Desert Ginseng'

The story of canaigre, sold as "wild red desert ginseng" or "wild red American ginseng" in the late 1970s, is one of the best examples of product mislabeling fraud associated with ginseng adulteration. One such product contained a red-colored root that was collected from wild habitats in the southwest United States. However, canaigre — also known as Arizona dock, tanner's dock, or canaigre dock[12] — is not remotely related to the genus *Panax* or the family Araliaceae. Its chemistry and expected health benefits also are unrelated to ginseng.[13] Due to its traditional use for tanning leathers, and its very high tannin content, the plant was developed as a commercial tanning agent by businessmen in Texas and Arizona in the late 19th century.[14]

The now-defunct Herb Trade Association (HTA; the predecessor of AHPA) investigated the "wild red American ginseng" issue and deemed the mislabeled products fraudulent. The results were published as the "Herb Trade Association Policy Statement No. 1 — Canaigre." After HTA's small educational campaign for the natural foods and herb industry, the product quickly disappeared from the market.[13,15]

Ussurian Thorny Pepperbush: The Best-Disguised Ginseng Imposter

In 1979, Russian researcher A.I. Baranov proposed the name "Ussurian thorny pepperbush" as an English technical name for the genus *Eleutherococcus*. He claimed the name was "guided by the botanical characteristics of the plant, by good taste, and by the spirit of English language," but Baranov's suggested name never stuck. The plant would go on to achieve widespread market appeal as "Siberian ginseng," but, today, it is known as eleuthero (*E. senticosus*, syn. *Acanthopanax senticosus*).[16] The case of eleuthero is perhaps the best example of a plant in the family Araliaceae but not in the genus *Panax* that was sold falsely as "ginseng."

Bruce Halstead, MD, (1920-2002) claimed to have coined the term "Siberian ginseng" shortly after returning from a trip to Vladivostok, Russia, in December 1967, to meet with pioneering Soviet eleuthero researcher I.I. Brekhman, MD, (1921-1994). "Siberian ginseng" was also used to refer to eleuthero in a popular 1973 book by Richard Lucas, titled *Eleuthero (Siberian ginseng): Health Herb of Russia*.[17] However, "Siberian ginseng" is used in small print on the cover of the book and that name is referred to only once elsewhere in the book. Otherwise, the name "eleuthero" is used throughout the book.

After successful discussions with Soviet officials, Halstead approached Beverly Hills businessman Milton Brucker about creating a company to import *E. senticosus* extract from the Soviet Union. Together, they formed Medimpex (later changed to Imedex International), and a deal was struck with the Soviet government for an exclusive franchise to distribute the Russian pharmacopeial extract of *E. senticosus* in the United States. The Pharmacological Committee of the USSR Ministry of Health approved the extract as a stimulant in 1962.[18]

The US Patent Office issued a trademark to Imedex International for a "dietary food supplement containing extract of ginseng," with the terms "Siberian," "ginseng," "extract," and "genuine" on the registered mark. It was registered on November 30, 1976 (with the date of first use listed as April 17, 1973), and cancelled less than seven years later, on April 26, 1983.[19]

Once Imedex International started selling "Siberian ginseng" in the US market, competitors began importing the herb from China (a relatively new option made possible by President Richard Nixon's historic 1972 trip to China, which opened the door for trade between the two countries). A state-owned export corporation in Harbin, China, was responsible for the shipment of raw materials and finished products to the United States.

In the mid-1970s, following nearly three decades of Soviet research and product development, the Chinese resurrected an obscure article of the Chinese materia medica known as "eleuthero root." Parts of its Chinese name (without key modifiers) were used in the descriptions of several

Early European illustration of *Panax ginseng* (from a Chinese work) in Andreas Müller's 1674 *Hebdomas Observationum de Rebus Sinicus*. Source: Bavarian State Library Digital Collections.

Table 1. Awang's List of 'Plants Improperly Sold as Ginseng'[11]

Common Name	Latin Binomial (Family)	Incorrect Name Given to Species
California spikenard	*Aralia californica* (Araliaceae)	"California ginseng"
Small spikenard	*A. nudicaulis* (Araliaceae)	"Wild ginseng" (also historically traded as "false sarsaparilla," "wild sarsaparilla," or "American sarsaparilla")
Eleutherococcus gracilistylus	*Eleutherococcus gracilistylus*, syn. *E. nodiflorus* and *Acanthopanax gracilistylus* (Araliaceae)	"Prickly ginseng"
Eleuthero	*E. senticosus* (Araliaceae)	"Siberian ginseng" or "eleuthero ginseng"
Devil's club	*Oplopanax horridus* (Araliaceae)	"Pacific ginseng"
Tongkat ali	*Eurycoma longifolia* (Simaroubaceae)	"Malaysian ginseng"
Ashwagandha	*Withania somnifera* (Solanaceae)	"Indian ginseng" or "Ayurvedic ginseng"
Maca	*Lepidium meyenii* (Brassicaceae)	"Peruvian ginseng"
Gynostemma	*Gynostemma pentaphyllum* (Cucurbitaceae)	"Southern ginseng" or "blue ginseng"
Suma	*Hebanthe eriantha*, syn. *Pfaffia paniculata* (Amaranthaceae)	"Brazilian ginseng"
Canaigre	*Rumex hymenosepalus* (Polygonaceae)	"Wild red desert ginseng" or "wild red American ginseng"

other items in the materia medica, further confusing the identity of the source plant. Actually containing eleuthero, products entered the US trade as "*wuchaseng*," "*wujiaseng*," "eleuthero ginseng," and "Siberian ginseng."[20]

Imports of eleuthero prompted heated debates among board members of the then-fledgling HTA. At a meeting of the organization's board in March 1980, some argued to allow eleuthero to be called "ginseng" in the US market, while others argued against it. The heart of the debate centered around the obvious physical differences between eleuthero and ginseng plants and the materials of commerce obtained from them. Ginseng roots from *Panax* spp. are harvested after at least four years in the ground, and once dug, the plant no longer exists. Contrastingly, the aboveground woody stalks of *E. senticosus*, a shrub that can grow up to three meters (9.8 feet) in height, was the material found in trade.

In the April 1980 issue of *Natural Foods Merchandiser*, Ken Murdock, former president of Nature's Way Herbs, noted these differences in a memorable quote that captured the essence of the debate. "*Panax ginseng* is a highly vulnerable plant that can only grow in a restricted habitat. Its roots are what are used for ginseng," he is quoted as saying. "But with eleuthero, we're talking about a cotton-picking tree. I don't think we should be calling something ginseng that you can harvest with a chain saw."[21]

An Ancient Supply Chain with Specialized Terminology

In the 1985 paper "On the role of botany in Chinese medicinal materials research," Hu highlights the case of eleuthero as an example of an herb whose common names in Chinese and whose English name in commercial trade ("Siberian ginseng") could lead to confusion and possible product adulteration.[22]

Decades earlier, in July 1942, while walking along sand dunes of the Min River in northwestern Sichuan province, Hu encountered thickets of *Periploca calophylla* (family: Apocynaceae or Asclepiadaceae), a shrubby vine with slender paired pods. She asked her guide about the name of the plant, and he told her it was called "*jia pi*" (a pod-bearing species, the bark of which is harvested for medicine). A week later, she and her guide encountered a species of *Eleutherococcus* with dense red spines (*E. gracilistylus*) in a river plain. Her guide told her it was called "*hong mao ci wu jia*." He harvested a section of the bark, and told her that, among herb traders, the bark is called "*wu jia pi*."[22]

In the 1985 paper, Hu explained that the green-yellow-flowered *P. calophylla* was the source plant of the drug *jia pi* from western China, and the maroon-flowered *P. sepium* was the source plant of *jia pi* from northern China. Local merchants dealing with crude drugs collected from the field know *P. sepium* from northern China as "*bei wu jia pi*" (also known as "*xiang jia pi*"), whereas *P. calophylla* from southern China was labeled "*nan wu jia pi*." (*Bei* is Mandarin for "north" and *nan* means "south.")

Hu used the *Eleutherococcus/Periploca* example to highlight the fact that Chinese drug plant collectors give plants different, yet similar, names that refer to distinct morphological features and/or different plant parts.

Field collectors, wholesale dealers, and herb shop owners are able to distinguish between the two distinct plant materials based on their appearance and smell. There is little confusion of the source plant in this centuries-old supply chain, in which crude drug names, often with modifiers of geographic origin or morphological features, are commonly used. These local Chinese drug names predate Linnaean scientific taxonomy by many centuries[22] and could be equally as exacting.

When West Meets East: Lessons in Translation from the Collector to the Consumer

Nomenclatural nuances caused confusion when "Siberian ginseng" was imported to the United States from China in the mid-1970s. Different traditional Chinese modifiers attached to "*wu jia pi*" apparently were reduced in communications to "*jia pi*." Confusion between *ci wu jia* (the root of *E. senticosus*) and the Chinese name of its relative *E. gracilistylus*, also listed as a source of *wu jia pi*, resulted in significant adulteration of North American (and, presumably, global) supplies of *E. senticosus* with *P. sepium* (*bei wu jia pi*).

By the early 1980s, some members of the North American herb trade suspected a possible adulteration problem with eleuthero. The American Herb Association (not to be confused with the HTA or AHPA) began gathering information on alleged adulteration, and published information in its newsletter alerting herbalists to the potential problem of adulteration of eleuthero with *P. sepium*.[23]

In 1986, Subhuti Dharmananda, PhD, a member of the ABC Advisory Board, published an article in his periodical *Update on Herbs* in which he described the confusion about the Chinese names and sources of *P. sepium* and *E. senticosus*. He also suggested that *E. sessiliflorus* (syn. *Acanthopanax sessiliflorus*) was being supplied as "eleuthero ginseng" from Korean sources. (In recent years, *E. sessiliflorus* has also been offered widely as "*E. senticosus*" in the horticultural trade, furthering confusion.) In the same issue, an article by researchers at the Heilongjiang Institute of Chinese Materia Medica presented old and new perspectives of eleuthero (as "*ci wu jia*"). They detailed its ancient history and explained how it had fallen into obscurity in recent centuries in China only to be revived by Chinese research in the 1970s, which was sparked by market interest following Soviet research.[24]

Despite modern references placing *E. senticosus* in the genus *Eleutherococcus*,[25-27] many researchers still use the obsolete genus name *Acanthopanax* and refer to it as *Acanthopanax senticosus*. A PubMed search for "Eleutherococcus" and "senticosus" yielded 81 references (as of July 11, 2016), whereas a search for "Acanthopanax" and "senticosus" retrieved 130 references.

The 'Hairy Baby' Case: Adulteration Leads to Safety Issues

In the early 1990s, the confusion surrounding *Panax* species and eleuthero emerged from the obscurity of herbal newsletters into mainstream media. The *Journal of the American Medical Association* (*JAMA*), in an issue

Plate from Jean-Baptiste Du Halde's 1741 English translation of *The General History of China* (4 vols.), with a variation of Jartoux's ginseng illustration (1713) in the upper right corner.

dated December 12, 1990, published a letter to the editor describing a case of adulteration of eleuthero with *Periploca sepium*.[28] Gideon Koren, MD, a pediatrician, clinical pharmacologist, and toxicologist, and colleagues in Toronto, Ontario, reported on a case of neonatal androgenization associated with maternal "ginseng" use — the so-called "hairy baby" case. The isolated incident was attributed to the mother's use of "pure Siberian ginseng." The authors erroneously cited information about *Panax ginseng* in their discussion of "Siberian ginseng," leading to even more confusion and misreporting.

Follow-up research by Awang (then head of the Natural Products Section of Health and Welfare Canada's Bureau of Drug Research) pointed out the errors in the report by Koren and colleagues. His lab obtained samples of the same lot from the manufacturer and compared the product to authenticated raw eleuthero material and herbarium specimens obtained from the Institute of Chinese Materia Medica at the Academy of Traditional Chinese Medicine in Beijing.

Awang's lab confirmed that the product did not in fact contain eleuthero, but instead contained *P. sepium*.[29,30] In conjunction with Awang's lab, Donald P. Waller, PhD, and colleagues at the College of Pharmacy at the University of Illinois at Chicago (UIC) performed pharmacological tests with the implicated plant material (*P. sepium*). They observed no androgenic activity and concluded that "the effects observed were specific to humans and possibly related to an undetermined peculiarity of the subject patient."[31]

Another Adverse Reaction Report

In 1996, the *Canadian Medical Association Journal* featured a case report by Shelagh McRae, MD, describing "elevated serum digoxin levels in a [74-year-old] patient taking digoxin and Siberian ginseng." The patient reportedly experienced no toxic effects. The physician ruled out common causes of high serum digoxin. Digoxin levels remained high even after digoxin therapy was discontinued. The patient revealed he was taking a "Siberian ginseng" product. After stopping use of the product, serum digoxin levels returned to normal, and treatment with digoxin resumed. Several months later, the patient started taking "Siberian ginseng" once

again, and serum digoxin levels rose. Use of "Siberian ginseng" was stopped, and serum digoxin levels returned to normal. McRae concluded that "Siberian ginseng contains eleutherosides, which are chemically related to cardiac glycosides such as digoxin."[32]

In a follow-up letter to the journal's editor, Awang suggested that this was another probable case of botanical misidentification and chemical inaccuracies. Contrary to McRae's report, Awang noted that eleutherosides from *E. senticosus* are not related to cardiac glycosides such as digoxin. *Periploca sepium*, however, does contain compounds related to cardiac glycosides. A regional forensic laboratory assayed the offending "Siberian ginseng" capsules for digoxin and digitoxin. Neither was found, and the package was discarded. Unfortunately, no further analyses were conducted, and the identity of the plant material remains unknown.[33] McRae's paper also sullied the good name of authentic ginseng products from the genus *Panax*.

Confusion Persists in the Scientific Literature

The 1996 case report by McRae is still cited without reference to Awang's caveats regarding nomenclatural confusion. For example, various studies by Amitava Dasgupta, PhD, and colleagues from the Department of Pathology and Laboratory Medicine at the University of Texas Health Science Center's McGovern Medical School in Houston continue to cite, uncritically, the McRae study. This adds to the rampant, dizzying confusion about the use of the word "ginseng." One of their publications, for example, was titled "Effect of Brazilian, Indian, Siberian, Asian, and North American ginseng on serum digoxin measurement."[34] Inexplicably, some of the products used in the studies by Dasgupta's research group did not contain the word "ginseng" in labeling. Incredibly, too, there was no apparent effort to authenticate the identity of these "ginseng" products, which were purchased from retail outlets in Houston, primarily in the city's Chinatown area.

The studies by Dasgupta's research group were designed to evaluate interferences of "ginsengs" in various commercial clinical assays used to determine digoxin levels in the serum of patients. Here, the researchers simply added the "ginseng" products to human serum samples in vitro, rather than analyze serum samples from humans who had consumed the products. The decision not to include human subjects, they explain, is due to the "reported toxicity of Asian ginseng and unknown toxicity of recently available Indian ginseng,"[35] although no reference is provided for the alleged toxicity.

Another paper that famously confuses the name "ginseng" was written by neuropsychiatrist Ronald K. Siegel, MD (then at the Neuropsychiatric Institute at the University of California, Los Angeles), and published in the April 13, 1979 issue of *JAMA*. Despite being debunked, this "clinical note" continues to be cited ad nauseam in the scientific literature. In his uncontrolled study of 133 "ginseng" users, 14 individuals (10%) self-reported what Siegel deemed "Ginseng Abuse Syndrome" (GAS; described as hypertension with nervousness, sleeplessness, skin eruptions, and morning diarrhea). All were self-reported consumers of caffeinated beverages, which may also account for these symptoms. Although the "ginseng" was not identified or analyzed, it was presumed to be either Asian ginseng or American ginseng. Siegel also suggested that the products may have contained canaigre and/or eleuthero.[36,37]

The late Norman R. Farnsworth, PhD, a professor and research pharmacognosist at UIC's College of Pharmacy and co-founding member of ABC's Board of Trustees, concluded that there is "no basis in fact for attributing these side effects to *Panax* or *Eleutherococcus*." Further, he states that "clearly this type of a report does nothing to establish the efficacy, safety, or real or potential side effects of a plant that has been used for more than 3,000 years by millions of people and for which adverse effects have been either minimal or nonexistent, based on reports in the literature."[38]

'Ginseng' Codified in Federal Law

As noted above, confusion about the use of the word "ginseng" in case reports in medical literature wrongly associates Asian and American ginsengs with various adverse effects. In the absence of analysis of the actual substance(s) ingested, toxicological conclusions cannot be drawn clearly.

Use of the word "ginseng" on product labeling was legally clarified in the United States with the passage of the Farm Security and Rural Investment Act of 2002, signed into law on May 13, 2002, by President George W. Bush. US Senator Russell Feingold of Wisconsin introduced the provision (presumably with counsel and advice from the Ginseng Board of Wisconsin), which effectively reserves the use of the term "ginseng" for any herb or herbal ingredient *only* from the genus *Panax*, in regard to labeling and advertising. In a later amendment, that legal definition extended to the Food, Drug, and Cosmetic Act.[39] The second edition of *Herbs of Commerce* was codified as the source of common names to be used on dietary supplement product labels,[40] establishing the name "Asian ginseng" for *P. ginseng*, "American ginseng" for *P. quinquefolius*, and "eleuthero" for *E. senticosus*.

Confounded Taxonomy

Understanding the pre-1970s botanical nomenclature of *Panax* is useful in searching for clues to ginseng adulteration and adulterants. From 1854 onward, *Panax ginseng* has been referred to by a variety of scientific names, including *Aralia quinquefolia*, *A. quinquefolia* var. *ginseng*, *A. quinquefolius* var. *ginseng*, *P. quinquefolius* var. *ginseng*, and, erroneously, as *P. quinquefolius* (American ginseng).

The genus name *Panax* originates in Carl Linnaeus's 1735 *Systema Naturae,* which serves as the first published foundation of his sexual taxonomic system for botanicals.[41] Despite not having seen the plant's flowers, Linnaeus preferred the genus name *Panax* over French botanist Sébastien Vaillant's (1669-1722) earlier genus name, *Araliastrum*, which was published in 1718 and broadly circumscribed several genera in the family

Araliaceae (which includes many flowering species).[42] Linnaeus also used the genus name *Panax* in his 1749 *Materia Medica*.[43]

In *Species Plantarum* (1753),[44] codified as the starting point of modern botanical taxonomy, Linnaeus provides the taxonomic underpinnings of the modern concepts of the two North American species "*P. quinquefolium*" and "*P. trifolium*." Like other 18th century European authors describing and classifying ginseng, Linnaeus treated *P. ginseng* as the same species as American ginseng.

Like Linnaeus and Vaillant, the Swiss botanist Augustin Pyramus de Candolle (1778-1841) broadly circumscribed various genera in the family Araliaceae. In 1830, he included 28 species in his broad generic concept of *Panax*, yet only two of those species are included in the modern concept of the genus.[45]

A lack of understanding of variation within the genus coupled with the plasticity of leaf and root morphology led 19th century botanical writers to attempt various taxonomic shifts of *Panax* into *Aralia*, further compounding confusion created by Linnaeus's initial ambiguity in circumscribing the morphology of *Panax*. Among them were the French botanists Joseph Decaisne (1807-1882) and Jules Émile Planchon (1823-1888).[46] The eminent American botanist Asa Gray (1810-1888), in the first edition of *Manual of the Botany of the Northern States* (1848), treated American ginseng as *P. quinquefolium* (following Linnaeus).[47] However, in the 1859 edition, Gray refers to American ginseng as *A. quinquefolia* and observes scarcity due to over-collection, describing it as "becoming rare." In another 1859 work, Gray treats Japanese ginseng (*P. japonicus*) as synonymous with American ginseng, cited as "*Aralia* (*Ginseng*) *quinquefolia*."[48] Other botanists followed Gray's authoritative lead. In 1870, Alphonso Wood attempted to make clarity out of the chaos, but instead added to the confusion: he assigns "True Ginseng" the binomial *Ginseng quinquefolium*.[49]

I.H. Burkill (1870-1965), noted for his East Asian and Southeast Asian botanical collections, further confounded the taxonomy of Asian species in a 1902 publication by creating seven varieties under "*Aralia quinquefolia*" (American ginseng) and refers to Asian ginseng as "*A. quinquefolia* var. *ginseng*."[50]

Well into the 20th century, medicinal plant literature continued to follow trends of confusing and sometimes erroneous taxonomic variants. A standard and often-cited work, the 19th edition of *King's American Dispensatory* (1905) by Harvey Wickes Felter and John Uri Lloyd uses "*Aralia quinquefolia*" as the primary name for American ginseng. Asian ginseng is referred to as "*Aralia Ginseng*, A. Meyer" and "*Panax Ginseng*, Nees," both with erroneous botanical authorities.[51]

In an 1868 paper, Berthold Carl Seemann (1825-1871) stated, "*Panax* has been one of the great lumber-rooms of our science, and none of the modern botanists have assigned it to intelligible limits."[52] His clear definition of the genus within prescribed limits is today's accepted description for the genus *Panax*. Although morphological delineation of the genus has remained relatively stable since the early 20th century, at the species level and below, the taxonomy of *Panax* still remains controversial and confusing.

Top: Leaf serration details of *Panax ginseng*. Bottom: Leaf serration details of *Panax quinquefolius*. Adapted from C.A. Meyer's 1842 paper that established the scientific name *Panax ginseng*. Source: Library of Braunschweig University of Technology.

Why *Panax ginseng* Is the Correct Name for Asian Ginseng

Carl Anton von Meyer's 1842 binomial *Panax ginseng* is the correct botanical name for Asian ginseng (encompassing *P. ginseng* from the geographical areas of Russia, Korea, and China).

What appears to be the first validly published scientific name for Asian ginseng — the 1833 binomial *Panax schinseng* T. Nees, (written as "*Panax schin-seng*") — is, in fact, invalid. Theodor F.L. Nees von Esenbeck (1787-1837) described *P. schin-seng* in his rare *Plantae officinales oder Sammlung officineller Pflanzen* supplement volume (1833), which also contained a hand-colored plate of the plant.[53] Nees, a pharmacist, was the younger brother of Christian Gottfried Daniel Nees von Esenbeck (1776-1858), who authored nearly as many Latin binomials as Linnaeus. The younger brother is sometimes confused with the older brother in botanical literature and citations.

Well into the 20th century, *P. schin-seng* was accepted by many botanists, including H.L. Li,[54] T. Nakai,[55] and H. Hara,[56] among others. Nakai, in *Flora Koreana* (1909), first preferred *P. ginseng* as a binomial.[57] However, in *Araliaceae Imperii Japonici* (1924), Nakai argued that *P. schin-seng* should have priority over Meyer's binomial, since Nees's 1833 description of *P. schin-seng* and unmistakable colored plate predated Meyer's 1842 description of *P. ginseng* by a decade.

Although Nees's binomial predates today's widely accepted scientific name *Panax ginseng* C.A. Meyer by nine years, his *P. schin-seng* was eventually deemed illegitimate and superfluous in favor of Meyer's binomial *P. ginseng* C.A. Meyer.[58] Meyer's lengthy 1842 paper was republished as abridged extracts in at least two 1843 publications, and these condensed versions from 1843 are frequently and erroneously cited as the original publication date of Meyer's binomial *P. ginseng*.[59,60]

Meyer himself refers to Nees's previous description and illustration(s) of the species in a footnote in his 1842 paper, which is not included in the 1843 abridgments. To quote Meyer: "The botanists may pardon me for not having accepted the name suggested by Nees von Esenbeck; in part because the name ginseng has been in use in Europe for one-and-a-half centuries, and then my *P. Ginseng* is substantially different from *P. Schinseng* Nees."[58]

Since Nees's circumscription (i.e., his overall definition of the genus *Panax*) included a species that had already been validly published, under the rules of the *International Code of Botanical Nomenclature,* his *Panax* species concepts were technically invalid when published in 1833.[61,62]

Further cementing Meyer's Asian ginseng binomial in botanical history, A.I. Baranov proposed Meyer's 1842 illustration as a lectotype** to represent the missing original type specimen collected by P.J. Kirilov (1801-1864), who deposited it in the Komarov Botanical Institute in St. Petersburg, which eventually misplaced the specimen.[63] In 1862, E. Regel included a reprint of the original illustration of Meyer's 1842 drawing of the apparently lost original European herbarium specimen of *P. ginseng,* but only added to confusion by reclassifying Asian ginseng as a variety of American ginseng: *P. quinquefolium* L. var. *ginseng* Rgl. et Maack.[64]

Evolving Understanding of the Genus and Species Concepts in *Panax*

In 1996, Wen and Zimmer delineated 12 species of *Panax* — two in North America and 10 in Asia, with a center of diversity in the eastern Himalayas and western, central, and southeastern China.[65] Revising her taxonomic treatment, Wen added *Panax vietnamensis* as a distinct species in 2001. At the same time, she relegated two binomials she created in 1996, *P. omeiensis* and *P. sinensis,* to synonyms of *P. vietnamensis,* reducing the overall number of *Panax* species to 11 (nine Asiatic and two North American).[66]

Sharm and Pandit published a more recent taxonomic treatment focusing on the *Panax* species complex from the Indian state of Sikkim in the Himalayas in 2009. In 2011, they published a paper describing a new species, *P. sokpayensis,* represented by only a few hundred specimens at 1,700-2,300 meters in elevation. This rare species is named after the nearby Sikkim village Sopakha, the local vernacular name of the Yeti ("Abominable Snowman").[67,68] This newly-discovered species brings the evolving count of *Panax* species to 12.

Modification of the taxonomy of *Panax* has continued since Linnaeus first described the genus in modern scientific terms. Variation in morphological characteristics within the genus presents challenges when attempting to define entities at or below the species level. The habit, type, and morphology of the rhizome, leaflets, bracts, and fruits have all been used to delimit species within the genus. Continuing research on *Panax* genetics may help clarify the taxonomy.

Little Difference in the Morphology of American and Asian Ginsengs

Many authors have failed to find morphological differences between American ginseng and Asian ginseng. As pointed out by Sharma and Pandit,[67,68] previous papers by S.A. Graham,[61] J. Wen and E. Zimmer,[65] and J. Wen[66] note no definitive distinguishing morphological characteristics that separate American ginseng and Asian ginseng, except for differences in the pattern of leaf serration. In 1859, Asa Gray observed, "The early missionaries were correct in their identification of the Ginseng of America with that of Tartary; and the Himalayan plant may be safely added to the species."[48]

The respected economic botanist James A. Duke, PhD, a founding member of ABC's Board of Trustees, observed the two species side by side and found little to distinguish between them. Duke wrote, "I myself am not sure how to distinguish occidental ginseng (*Panax quinquefolius* L.) from oriental ginseng (*Panax ginseng* L.)."[69] He suggests differences in teeth along margins of seedlings as a possible distinguishing factor, as do other authors,[70] including C.A. Meyer in a finely detailed graphic of differences in leaf margin serration.[58]

Beginnings of Ginseng Transoceanic Trade, Adulteration, and Authentication

The earliest European trade with China began during the Eastern Han dynasty (25-220 CE), though the first appearance of ginseng in European trade is attributed to the Moorish trader Ibn Hazm of Cordoba, who brought ginseng to Spain sometime around 850 CE.[71] The Venetian trader Marco Polo is said to have brought ginseng from the Far East in 1294.[72] In the early modern era, the earliest European account of ginseng originates with the Portuguese Jesuit Alvaro de Semedo (1585-1658; also spelled Semmedo), whose tome on the history of China

**A lectotype (i.e., in this case, an illustration of the original plant material chosen to represent the scientific name "*Panax ginseng*") can be designated if the original publication did not include such a "type specimen," or if that type specimen was lost.

was published in Portuguese in 1642, with an English edition issued in 1655, which was translated from the 1643 Italian edition. "The sixth and last Province is *Leaotum* [Liaoning] the Northern bound of that Kingdome, it is famous for a root which it produceth of so high esteem, that at my departure from thence it was sold for twice the weight in silver," Semedo wrote. "It is so excellent as a medicine, that if those which are in health doe take it, it augments their strength and vigour, and it if be given to a sick person it doth marvelously comfort and warme him: it is called *Ginsem*."[73]

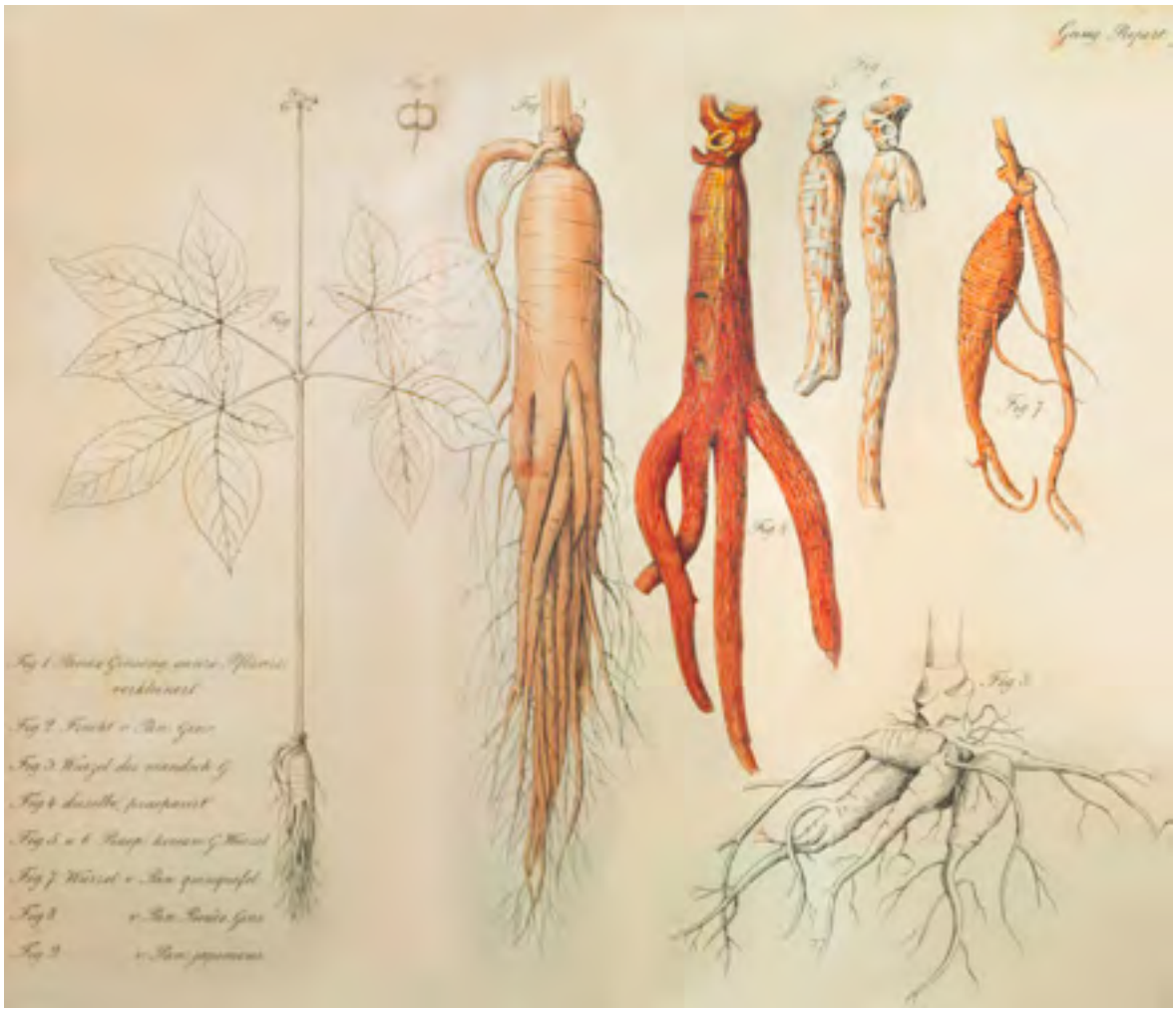
Within a few years after the formation of the British East India Company in 1600 and the Dutch East India Company in 1602, specimens of Asian ginseng began to trickle into European ports. Shortly after the inception of the Royal Philosophical Society of London in 1662, members became interested in the medicinal and monetary value of ginseng after reading translations of Semedo's comments. From 1666 until 1788, the Society's inquisitive and receptive attitude to further knowledge of the plant was followed by a more discriminating interest in the plant's cultivation, use, and trade.[74]

Melchisedech Thevenot's French edition of Semedo's *Relations of Divers Curious Voyages* was briefly reviewed in the inaugural volume of the *Transactions of the Royal Society* (1666). Among the highlighted items is the statement: "That they prise highly the Root *Ginseng*, as an extraordinary Restorative and Cordiall, recovering frequently with it agonizing persons; one pound of it being paid with 3 pounds of silver."[75]

Great hope was placed in the new drug from China for its potential in commerce and in medicine. *Some Observations Made upon the Root called Nean, or Ninsing* by John Pechey (1680) quotes one of the Royal Society's founders, Sir Robert Boyle (1627-1691), the Anglo-Irish scientist known as the Father of Modern Chemistry: "Mr. Boyle once told me, he thought it was a Medicine sent from Heaven to save the Lives of Thousands of Men, Women and Children."[76]

The breakthrough that catapulted ginseng from obscurity to fame in Europe was Pierre Jartoux's *Description of a Tartarian Plant, Call'd Gin-Seng; with an Account of Its*

Color plate showing different root products from various *Panax* species. Adapted from C.A. Meyer's 1842 paper that established the scientific name *Panax ginseng*. Source: Library of Braunschweig University of Technology.



Virtues. Jartoux (1669-1720), a Jesuit mathematician and cartographer working in China in the early 18th century, assisted two Jesuit colleagues, Joachim Bouvet and Jean-Baptiste Regis, in developing a map of the Chinese empire, which "procur'd us the Opportunity of seeing the famous Plant, call'd Gin-seng, so highly valu'd in *China* and as little known in *Europe*."[77]

In 1708, Jartoux traveled to Manchuria for the first time, then again in July of 1709, when he observed a harvest of wild Asian ginseng. He described the harvest in a letter addressed to the Jesuit General of the Missions of India and China dated April 12, 1711, and first published in French in 1713.[78] Jartoux was the first European to provide a detailed account of the ginseng harvest from firsthand observations. He would also be the first to witness the rapid decline of wild Asian ginseng.

Published in 1981, Van Jay Symons's comprehensive study of the imperial ginseng monopoly during the Qing dynasty[79] provides a backdrop for the ginseng trade that Jartoux observed. As the Manchus consolidated power and wrested all control of China from the ruling Ming dynasty, they established an imperial court monopoly of the ginseng trade by 1648. The Imperial Household controlled the gathering, transportation, and sale of ginseng root, which became their second leading source of income. Bannermen (military-social units known as "Banners") were charged with meeting court monopoly quotas for ginseng root.

By the early 18th century, the root was becoming scarcer and the area in which it could be found was shrinking. More than 300 years earlier, at the beginning of the Ming dynasty (1368-1644), ginseng had a broader natural range. However, overharvest and habitat loss due to an expansion of farming in the mountains of eastern Shanxi province and Hebei province shrunk that range, limiting ginseng's natural occurrence to far northeastern China.

By 1709, high court-issued quotas and an inability to stop illegal collection led to a breakdown of the bannermen system established in the previous 50 years. As the supply of root was diminishing and illegal competition was increasing, overharvesting of the declining wild populations became inevitable. Still, in 1709, the government monopoly sought 160,000 ounces (10,000 pounds) of wild ginseng. The Emperor reserved 1,600 ounces (100 pounds) of the highest quality root. The Imperial Household received 14,400 ounces (900 pounds), and the government sold the rest.[79]

By the mid-18th century, ginseng supply and demand was dictated by a variety of factors, such as overharvest, the vagaries of exotic export markets, and national and cultural differences. The prices, quantities, management, mismanagement, and dictates of the Chinese imperial ginseng monopoly also impacted Chinese demand for ginseng.

On the Korean Peninsula, cultivation of Asian ginseng began as early as 1,000 years ago. During the Seonjo era (1552-1608), habitat destruction and overharvest decimated wild ginseng populations, leading to widespread cultivation in mountain forest gardens.[80]

Meanwhile, in Japan, ginseng arrived as a medicine by 737 CE, and became an article of trade, barter, and/or gift-giving from Korea. Attempts to cultivate ginseng in Japan began nearly 1,000 years later in 1607. The Japanese believed in the value of the drug and demand exceeded supply. Tokugawa Ieyasu (1543-1616), the first shogun of the Tokugawa shogunate, or Edo period (1603-1868), ordered exploration of ginseng cultivation, which took more than a century to develop. By the 1670s, the country's treasury of gold and silver bullion was being depleted at an alarming rate to pay for imports, particularly ginseng. Imports of Korean ginseng reached as much as 3 metric tons (6,614 pounds) per year, leading the shogunate to limit ginseng trade by 1686. The eighth shogun, Yoshimune, ordered cultivation trials in the feudal domain of Aizu in Fukushima Prefecture in 1716 — the same year that Joseph Francois Lafitau (1681-1746), a Jesuit missionary at the Caughnawaga settlement near Montréal, found American ginseng. Shogunate-sponsored clandestine efforts resulted in seeds being smuggled out of China and Korea in 1725 and 1728, respectively. In 1728, Wada Chojun published the first Japanese guide to ginseng. In 1767, the shogunate appointed seven merchants to control ginseng cultivation and trade, but by 1790, cultivation and trade of ginseng was open to any farmer or merchant.[81]

By the late 18th century, Yoshimune's ginseng cultivation experiment had succeeded, and Japan became a net exporter of ginseng. By 1765, Japanese ginseng gained popularity and acceptance in China because, like China's ginseng, the ginseng from Japan was a warming tonic, unlike the cooling "French" ginseng from Canada. (One year earlier, in 1764, Nagasaki customs officers seized and publically burned 600 pounds of "Cantonese ginseng" — American ginseng imported from Canton, which they considered to be an imposter of Asian ginseng. In essence, national and cultural biases branded Cantonese ginseng an adulterant, and it was dispatched accordingly.) In China, the demand for Japanese-grown *P. ginseng* surpassed that of American ginseng. By then it was viewed as a valuable antidote to opium addiction. As Harvard University's Shigehisa Kuriyama, PhD, stated, "Local habitats still mattered in the reconfiguration of the geography of ginseng."[80,81]

Early Recognition of Ginseng Adulteration in the West

Jartoux's 1709 observations coincided with what was to become the last vestiges of mass harvest of wild *P. ginseng* for the Imperial Household. If logic dictates that a limited supply leads to conservation problems, then a reduction in supply followed by a spike in prices provides the perfect recipe to stimulate economic adulteration — Jartoux's description of the Chinese ginseng harvest foretold trouble ahead.

By the 1740s, wild roots were mixed with illicitly cultivated roots, which

Right page: Aimé Henry's hand-colored plate of "*Panax schinseng*" in Theodor F.L. Nees von Esenbeck's rare supplement volume of *Plantae officinales oder Sammlung officineller Pflanzen*, published in 1833. Courtesy of Missouri Botanical Garden.

Panax Schin seng nob.

were considered an adulterant. This was an inevitable consequence of declining wild root supplies and growing lawlessness in Manchuria. A long-held code of honor allowed a digger to erect a small fence around immature wild ginseng plants to claim them for future harvest. As law and order disintegrated, this tradition was no longer honored, so less valuable, immature roots were also harvested.

By the beginning of the 19th century, cultivated ginseng mixed with wild roots was becoming more commonplace. In 1810, an imperial edict criticized the quality of tribute-grade ginseng received at the court, some of which was cultivated and illegally weighted with lead added to the interior of the root.[79]

Several authors have reported the practice of spiking individual roots with lead to increase weight. In 1751, John Hill (1716–1775), the first superintendent of the Royal Botanic Gardens, Kew, observed: "With us it has been sold at a much higher price than there [China]; and such cheats have been the Chinese, who sold it, that, when cut, every root of it has often been found loaded with a long piece of lead, carefully let into it, which has given it three times its real weight."[82]

American ginseng root with the 1985 *Pharmacopoeia of the People's Republic of China* as background. Photo ©2016 Steven Foster

In 1905, H.A. Hare, C. Caspari, and H.H. Rusby described the same practice in *The National Standard Dispensatory*: "Adulteration, however, is largely practiced, chiefly by the Chinese, by introducing heavy bodies to increase its weights. They are frequently known to bore out the interior through a minute opening and to plug it with lead, afterward closing and concealing the orifice. In addition, roots of ginseng used previously for making an extract are not uncommonly dried and fraudulently sold for good roots."[83]

At the start of the 20th century, most of the Asian ginseng root harvested in Manchuria was cultivated, processed in Korea, and then returned to Chinese markets. In 1901, Sir Alexander Hosie, who served as the British Consul General at Tianjin and lived in China for more than 40 years, related that considerable quantities of ginseng from Manchuria were taken to Korea for processing as red ginseng. So-called "Korean ginseng" exported from Manchuria in the early 20th century was, in fact, Chinese-grown ginseng processed in Korea.

Hosie also described a clever deception intended to increase the visual age of the root if it was too young for market. "During the steaming process a thread is wound round the head," he wrote. "The steaming causes the root to swell, with the exception of the parts bound by the thread, and when the root contracts in drying the artificial wrinkles remain."[84]

By the early 20th century, the Chinese were also re-exporting American ginseng root as "clarified Chinese ginseng" back to the North American market. Adulteration in the form of offering ginseng as something it was not had become a subtle yet pervasive practice in the ginseng market.[84]

I.H. Burkill also warned of adulteration problems in 1902: "Adulteration is not uncommon. Rootstocks of *Centaurea*, *Adenophora*, *Angelica*, *Platycodon*, *Rehmannia*, etc., are used in the East, *Campanula glauca* being said to be common in Japanese Ginseng. *Sium Ninsi* [*Sium ninsi*, Apiaceae] was formerly confused with Ginseng, perhaps, because it was offered as a substitute."[50]

Sium ninsi, also known as ninzin, nindsin, ninzing, nin sing and radix ninsi, among others, was confused with various species of *Panax,* including *P. ginseng* and *P. japonicus*. The confusion began with the 1712 publication of Engelbert Kaempfer's *Amoenitatum Exoticarum*, a text that is noted for medical observations on acupuncture, information about tea production, and the first Western descriptions and illustrations of several important plants, including ginkgo (*Ginkgo biloba*, Ginkgoaceae). Apparently, Kaempfer (1651-1716), traveling in Asia from 1683-1695, believed that *S. ninsi* was synonymous with the source plant of ginseng. He spent the last two years of his journey in Nagasaki, Japan, as a physician for the Dutch East India Company. "Ninzin" is Kaempfer's phonetic transliteration of the sound of the Japanese name for ginseng, just as "ginkgo" was Kaempfer's pronunciation of the Japanese name for *Ginkgo biloba*.[85]

In researching their 1907 book on the *materia medica* of Chinese medicinal plants used in Vietnam — *Matiere Médicale et Pharmacopée Sino-Annamite*s[86] — French pharmacists Émile Perrot and Paul Hurrier published a separate pharmacognostic analysis of plant materials, which their research revealed were adulterants of or substitutes for Asian ginseng. More than any other plant, they found that ginseng was subject to many and varied falsifications due to its rarity, price, and that

Asian peoples considered it not only an aphrodisiac *par excellence*, but a universal panacea. They observed that, depending on quality, ginseng root sometimes reached a price of a thousand times its weight in silver. The roots were sold between 2,000-5,000 francs apiece. The average price for cultivated root material was 500 francs per kilogram. In short, they explained, the falsification of the root was very lucrative business.[87]

In 1906, Hurrier and Perrot indicated that it was almost impossible to find true ginseng from Manchuria in the European market, and that it was very rare to find unadulterated Korean ginseng. In addition, they suggested that after the whole root was macerated or decocted in water, it was dried again, then sold to consumers. In particular, ginseng root was adulterated by adding roots of members of the families Araliaceae, Umbelliferae (Apiaceae or parsley), and Campanulaceae (bellflower). Their original paper provides classical pharmacognostic details, such as cross-section microscopic illustrations of the adulterants' roots with detailed descriptions for proper identification. A list of the adulterants noted by Hurrier and Perrot is included in Table 2.[87]

Physician to the Russian Legation in Beijing, Emil Bretschneider (1833-1901) chronicled European botanical explorations to China and translated key passages of Chinese texts on medicinal plants. He recorded *Adenophora* and *Platycodon* as frequent adulterants, noting, too, that the wild ginseng from Manchuria was considered the highest quality, with Korean ginseng the next most desirable. Bretschneider, like Chinese authors of the Ming dynasty, reiterated that the highest quality ginseng in ancient times came from Hua Shan (Mount Hua) in the Qin Mountains of southeastern Shaanxi province (near the border of present Shaanxi), but it is long extinct in that region.[88]

Table 2. Ginseng Adulterants Noted by Hurrier and Perrot in 1906[87]

Nomenclature in Original	Current Nomenclature and Synonymy
Adenophora verticillata Fisch. (Campanulaceae)	*Adenophora triphylla* (Thunb.) A. DC. [Taiwan endemic]
Angelica polyclada Franch. (Apiaceae)	*Angelica pubescens* Maxim. Synonyms: *A. polyclada* Franch.; *A. myriostachys* Koidz.; *A. schishiudo* Koidz.
Campanula glauca Thunb. (Campanulaceae)	*Platycodon grandiflorus* (Jacq.) A. DC. Synonyms: *Campanula grandiflora* Jacq.; *C. glauca* Thunb.; *Platycodon autumnalis* Decne.; *P. chinensis* Lindl. & Paxton; *P. glaucus* (Thunb.) Nak.; *P. sinensis* Lemaire
Campanumoea pilosula Franch. (Campanulaceae)	*Codonopsis pilosula* (Franch.) Nannf.
Gynura pinnatifida (Lour.) DC. (Asteraceae)	*Gynura japonica* (Thunb.) Juel Synonyms: *Senecio japonicus* Thunb.; *Cacalia pinnatifida* Lour.; *C. segetum* Lour.; *Gynura aurita* C. Winkler; *G. flava* Hayata; *G. japonica* var. *flava* (Hayata) Kitamura; *G. pinnatifida* (Lour.) Candolle; *G. segetum* (Lour.) Merrill; *G. vaniotii* H. Léveillé; *Kleinia japonica* (Thunb.) Lessing
Panax sessiliflorum Rupr. & Maxim. (Araliaceae)	*Eleutherococcus sessiliflorus* (Rupr. & Maxim.) S.Y. Hu Synonyms: *E. sessiliflorus* var. *parviceps* (Rehder) S.Y. Hu; *Acanthopanax sessiliflorus* (Rupr. & Maxim.) Seem.; *A. sessiliflorus* var. *parviceps* Rehder
Phyteuma japonicum Miq. (Campanulaceae)	*Asyneuma japonicum* (Miq.) Briq. Synonym: *Campanula japonica* (Miq.) Vatke
Platycodon grandiflorum (Jacq.) A. DC. (Campanulaceae)	*Platycodon grandiflorus* (Jacq.) A. DC.
Rehmannia chinensis Libosch. ex Fisch. & C.A. Mey. (Plantaginaceae)	*Rehmannia glutinosa* (Gaertn.) DC. Synonym: *Digitalis glutinosa* Gaertn.
Sophora angustifolia Sieb. & Zucc. (Fabaceae)	Sometimes treated as a variety of, conspecific with, or synonymous with *Sophora flavescens* Ait.

American Ginseng Adds Further Complications

A need to differentiate between Asian ginseng and American ginseng arose sometime before 1720, as American ginseng began to be exported from Canada to China. In his 1713 publication describing the ginseng harvest in China, Jartoux proposed: "All of which makes me believe, that if it is to be found in any other country in the World, it may be particularly in *Canada*, where the Forests and Mountains, according to the relation of those that have lived there, very much resemble these here."[77]

Jartoux's description of Asian ginseng reached Lafitau at the Caughnawaga settlement near Montréal. Within months of learning of Jartoux's speculation in a 1718 publication, Lafitau claimed to have discovered American ginseng in Canada about three years earlier, in 1715 (as *Aureliana canadensis*).[89,90] Lafitau is best remembered as an ethnographer who advanced the theory of the Asiatic origin of indigenous peoples of North America, and he used his discovery of American ginseng to support that theory. Aside from his single paper on American ginseng (yet to be translated to English), he is largely overlooked in botanical history.

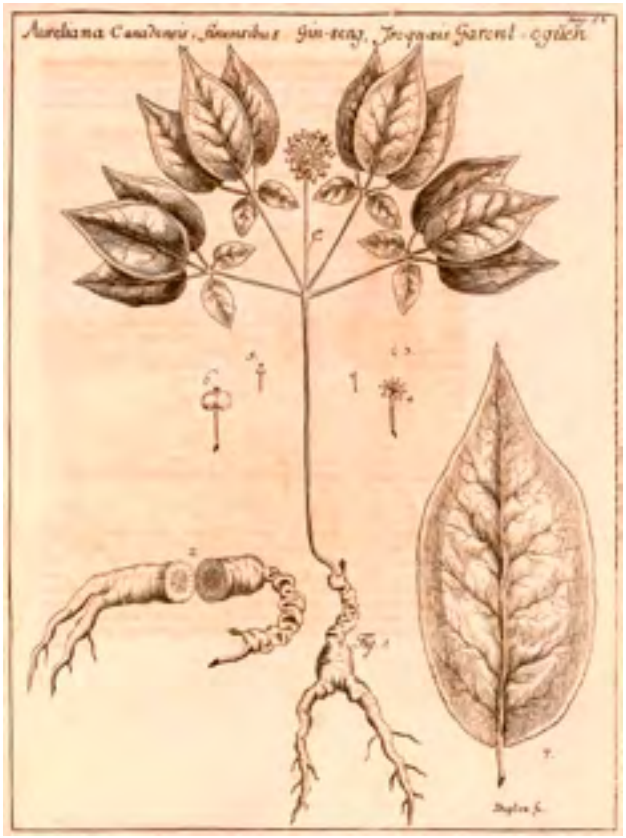
According to Jacques Rousseau (1905-1970), a professor at the Centre d'Études Nordiques at the Université Laval in Québec, Lafitau was not the first European to collect and describe American ginseng from Canada. Instead, Lafitau was the first to promote his discovery.

Also in 1718, Vaillant described American ginseng with a pre-Linnaean Latin phrase — *Araliastrum Quinquefolii folio majus* — and attributed a specimen collected in 1700 to physician and naturalist Michel Sarrazin (1659-1734), thus crediting him with the European discovery of American ginseng. Sarrazin, for whom Linnaeus named the insectivorous genus *Sarracenia*, was one of the earliest botanical collectors in Canada, but he left no significant publications.

Sarrazin was a student of the French botanist Joseph Pitton de Tournefort (1656-1708) and served as physician at the Court of Québec. In 1705, he dispatched a shipment of Canadian plant specimens to Tournefort at the Jardin Royal des Plantes in Paris. Vaillant, who had been employed at the garden since 1702, worked on Sarrazin's list of specimens; the list survives as two manuscript copies of his *Catalogue des Plantes du Canada*, one of which is in Vaillant's own hand, from 1708. As Jacques Rousseau explained, "I have seen the original plants and without any doubt Sarrazin was the discoverer of the plant in Canada, but Father Lafitau had the great merit of having recognized the close affinity between the Asiatic and Canadian species."[91]

According to botanist and physician Jacob M. Bigelow, MD, (1787-1879) descriptions of American ginseng from both Sarrazin and Lafitau were published in 1718; together, the descriptions left no doubt about the similarities between American ginseng and Asian ginseng. But, like many of his contemporaries, Bigelow had little understanding of why ginseng was so highly valued. He reiterated the comments of most medical authorities of his day who believed its medicinal value was overrated, as evidenced by the fact "that a whole root may be eaten without inconvenience. … As far as Ginseng has been tried medicinally in this country, and in Europe, its virtues do not appear, by any means, to justify the high estimation of it by the Chinese."[92]

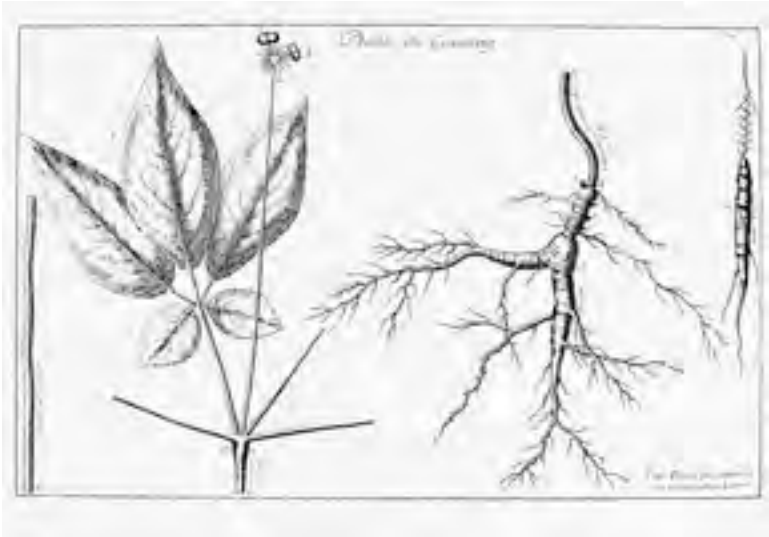
Soon after Lafitau's 1718 publication, the French began collecting American ginseng root for export, primarily employing Mohawk tribal members to dig the root to the exclusion of other work. English settlers in New York also engaged in the same traffic in hopes of fetching high export prices. Linnaean student Pehr (sometimes spelled "Peter") Kalm noted that, in 1748, the price was five to six livres a pound (a livre was the French monetary unit prior to introduction of the franc in 1795). By comparison, the average salary of a tradesman was 60-100 livres per year. Eighteenth century re-exports of American ginseng to China via France proved profitable, but in a short time the market was flooded, and the Chinese deemed American ginseng inferior to its Chinese counterpart, depreciating the value. By 1818, according to Bigelow, there was little export of American ginseng.[92]



Repurposed plate of Lafitau's American ginseng illustration, published in Jacob Breyn's 1739 *Prodromi fasciculi rariorum plantarum primus et secundus.* Source: Bibliotec Digital, Real Jardín Botánico.

Expanding and Bursting Bubbles of Trade

The slowdown of trade described by Bigelow in 1818 was just one trough in a wave of contraction and expansion of the 300-year-old ginseng trade between North America and Asia. Quality, price, availability, and adulteration have all contributed to the fluctuations. American ginseng is a trade good with a remarkably long history between North America and China. M.D. Block calls ginseng "the prototypical trade fantasy commodity." During the 18th century, there were two bubble cycles: one during the 1750s and another in the 1780s and 1790s.[93]



Jartoux's ginseng foldout originally published in 1713 in Jean-Baptiste Du Halde's (ed.) *Lettres Edifiantes et Curieuses, Ecrites Des Missions Etrangeres, par quelques Missionnaires de la Compagnie de Jesus*. Vol 10. Source: University of Toronto Library.

English-American merchants did not begin selling Native American-harvested ginseng until the 1750s. Seeing an opportunity for export through New York, Sir William Johnson (1715-1774), an Irish-Anglo 1st Baronet, was appointed as New York's agent to the Iroquois in 1743. He resigned the commission in 1751, but was reinstated as Indian commissioner three years later, in 1754. Most trade goods gathered by the Mohawks were sent north to the French in Canada. Up until this time, the root was primarily harvested in New France, shipped to France, then used as a barter item in trade between the French and Chinese.

In 1751, aided by Johnson's standing among the Iroquois and Mohawks, the British East India Company began manipulating the market, paying the equivalent of 33 francs per pound of ginseng, nearly three times the Québec market price of 12 francs. By 1752, English competition and simple greed overcame common sense, and traders began buying May-harvested roots that were spongy, soft, and highly wrinkled when oven-dried, creating an inferior product with little appeal to Asian buyers. Anglo-Europeans abandoned other crops to harvest ginseng. In the fall of 1752, the value of exports rose to 500,000 francs, but the resource was exhausted by 1754, when only a fraction, worth 33,000 francs, was exported.[92,94,95]

According to Block, after US independence, American ginseng became almost exclusively a Euro-American frontier settler product, rather than a Native American-harvested item. Like other wild-harvested "fantasy" commodities for export to China, an overharvest flooded the Chinese market and depleted the natural resource.

Famously, the *Empress of China* became the first American-flagged ship to trade with the Chinese. Loaded by Robert Morris and his associates with a cargo of 30 tons of choice New England and Appalachian American ginseng in 242 casks, the ship departed on February 22, 1784 — George Washington's 52nd birthday — with a 13-gun salute representing the 13 states, just five weeks after the Confederation Congress ratified the Treaty of Paris. When the *Empress of China* returned 14 months later, one of the investors in the ginseng trade made a profit of $55,000. The fortunes of other famous Americans, such as Daniel Boone (1734-1820), rose and fell with the American ginseng trade. In 1788, after recruiting Native Americans to harvest ginseng on the Western frontier, Boone lost a cargo of 12-15 tons of ginseng when a boat headed to market overturned on the Ohio River.[94-96]

Quality and adulteration problems persisted. Johann David Schoepf (1752-1800), chief surgeon to the Ansbach troops in service of English King George III during the American Revolution, authored one of the first works devoted to American medicinal plants: *Materia medica Americana potissimum regni vegetabilis* (1787).[97] One year later, a German edition of another of his books, *Travels in the Confederation (1783-1784)*, was published. In 1784, Schoepf met a man taking 500 pounds of ginseng root packed on two horses to Philadelphia. Schoepf commented: "Industrious people who went out for the purpose have gathered as much as 60 pounds in one day. Three pounds of the freshly gathered make only one pound of the well dried. … The physicians in America make no use of this root; and it is an article of trade only in China, where the price is not so high as it was, on account of the great adulteration. All manner of similar roots were mix in."[98]

American Ginseng Trade Fluctuations in the 19th and 20th Centuries

Wild ginseng harvest followed westward migration. Economic instability from 1857-1859 set the stage for a "ginseng rush" in the Minnesota Territory. From 1859 to 1862, thousands of people rushed to Minnesota forests to harvest ginseng for export. Nearly half of the Ameri-

can ginseng exported in 1860, 1861, and 1862 (395,909 pounds, 347,577 pounds, and 630,714 pounds, respectively) came from Minnesota, the eastern half of which became a state in 1858. One digger extracted as much as 20 to 50 pounds of roots per day. In 1865, the State of Minnesota passed "The Ginseng Law" to regulate harvest. By 1894, wild ginseng was nearly extinct in the state. Once again, a high price and ready market had depleted the resource, bursting another bubble in the American ginseng export trade.

Between 1860 and 1883, the United States exported an average of 417,500 pounds of ginseng each year.[99,100] In the 36-year period from 1858 to 1893 in the United States, more than 18.6 million pounds of American ginseng, almost all of it wild-harvested, was exported to China. By the early 20th century, pressure on wild populations resulted in the development of various laws in the US and Canada; wild harvest was restricted in Minnesota in 1865, followed by Virginia in 1875-1876, and Ontario in 1891. Early attempts at cultivating American ginseng in the 1870s produced little success. Finally, in the 1890s, there was considerable success with ginseng cultivation in New York, North Carolina, Kentucky, Pennsylvania, and elsewhere. The US Department of Agriculture began publishing handbooks on how to grow ginseng.[101]

By 1902, there were as many as 1,000 ginseng growers in the US, but that declined to 303 producers in 1929, and further declined during the Great Depression to only 112 growers in 1939. In the 1960s, American ginseng production became concentrated in Wisconsin, which created a six-fold increase in cultivated production from the 1960s to the mid-1980s.[102] However, since then, Wisconsin ginseng production has declined; there were 1,468 growers in 1995, but only 190 producers by 2006. Between 1995 and 2006, acreage declined by 50%, and the quantity sold decreased by as much as 95%. In recent years, American exports have also declined, given the serious competition from Australian, Canadian, and, in particular, Chinese producers. In 2012, The US exported 347,737 pounds of cultivated ginseng, and 45,351 pounds of wild-harvested ginseng.[103]

Clashing Perceptions of Value

Since the first European encounter with ginseng in the modern era, the medicinal value of ginseng in any form has been met with skepticism. From the first edition of *The American Dispensatory* published in 1806 to the ninth edition published in 1831, John Redman Coxe, MD, (1773-1864) speculates about conflicting perceptions of ginseng's worth: "The Chinese, probably on account of [ginseng's] scarcity, have a very extraordinary opinion of the virtues of the root, so that it sells for many times its weight of silver. The Americans, on the contrary, disregard it, because it is found plentifully in their woods."[104]

John Sims, MD, discussed American ginseng's value in an 1811 issue of *Curtis's Botanical Magazine*: "The sensible qualities of this root do not promise any particular efficacy, according to European ideas, and this prejudice may perhaps occasion us to under-value it. For although it can hardly be doubted but that its virtues are highly overrated by the Chinese, yet it does not seem credible that any absolutely inert remedy could for ages, and in distant countries, maintain so high a reputation."[105]

Monetary value aside, the disagreement about ginseng's medicinal value was well-summarized by Christison and Griffith in 1848. "[I]t can scarcely be possible that an article so long in use, and so highly prized, can be wholly worthless, and yet there is every reason to believe that its beneficial effects should be attributed rather to the effects of imagination, than to any extraordinary power in the root," they wrote.

Pokeroot (*Phytolacca americana*, Phytolaccaceae) is sometimes noted as an adulterant of ginseng, both in Asian and North American markets. Christison and Griffith provided evidence that, instead of being economically motivated, adulteration of ginseng with pokeroot may be a case of mistaken identity, noting that pokeroot in the fresh state has the rather distinctive fragrance of ginseng root.[106]

Quality of exported root was a problem, as described by physician, philanthropist, and plantsman John Fothergill, MD (1712-1780): "[L]eave me to say, that some considerable parcels of the root have been sent to China, and disposed of to great advantage: that this advantage would still have been greater, had those who gather the root, collected it at a proper season; and cured it in the Chinese manner," he wrote.

Fothergill, one of the most respected English physicians of his time, reflected on the herb's value in relation to other drugs. "Upon the whole thou it does not seem entitled to even a moderate share of those virtues that are romantickly ascribed to it by the Chinese, yet it is very well worth the attention of the faculty, and promises fair to be a more useful and efficacious medicine, than many now kept in the shops, as the *Sarsa China* [sarsaparilla; *Smilax aristolochiifolia*, Smilacaceae], and some others."[107]

American ginseng itself was sometimes considered as an adulterant of costlier drugs imported from the Americas. In 1880, Bentley and Trimen reported that American ginseng root was commonly found as an adulterant of Seneca snakeroot (*Polygala senega*, Polygalaceae). "It does not appear to be intentionally adulterated, but from carelessness in collection some other roots or rhizomes in small proportion may be frequently found mixed with it. American Ginseng root ... is that most commonly found, and is readily distinguished by its greater size, more or less fusiform shape, and by the absence of any projecting line," they wrote.[108]

By 1900, American ginseng imported by China seemed to be readily recognized as a distinct product that did not confuse ginseng traders. As S. Well Williams observed: "Ginseng is found wild in the forests of Manchuria, where it is collected by detachments of soldiers detailed for this purpose; these regions are regarded as imperial preserves, and the medicine is held as a governmental monopoly. The importation of the American root does not interfere to a very serious degree with the imperial sales, as the Chinese are fully convinced that their own plant is far superior."[109]

In 1905, Hare, Caspari, and Rusby complained that American ginseng's "medicinal value is almost *nil,* yet its great and growing commercial importance calls for a somewhat extended account."[83] According to them, the root should only be collected in the fall, and is more highly priced when of a fine light color. They continued:

> The best root is said to be that collected by the Sioux Indian women, who impart this white appearance by rotating it with water in a partly filled barrel, through which rods are run in a longitudinal direction. In no other way, it is said, can the surface be so thoroughly and safely cleansed. … Since the chief value of Ginseng depends upon its favor with the Chinese, and this in turn depends almost wholly upon fanciful considerations, its commercial value is determined in a high degree by its appearance … with their large size, and light color, their plumpness and firm consistent, their unbroken and natural form. … A Chinese trader, examining a lot of Ginseng, will eagerly … seek an opportunity for abstracting from a bale one or more select roots which may represent, in the Chinese market, a money value several times greater than that of the entire remainder of the lot.[83]

'Differentiating Appearance to Determine Quality'

Historically, form and appearance are very important factors in relation to quality, and they can help discourage economic adulteration. In a review of the recent book *Chinese Medicinal Identification: An Illustrated Approach* by Zhongzhen Zhao and Hubiao Chen, ABC Advisory Board member Roy Upton emphasized that evaluation of botanical ingredients using physical and organoleptic characteristics (taste, smell, appearance, etc.) is often overshadowed by reliance on chemical and molecular identification methods.[110]

Zhao and Chen outline "experience-based" authentication and macroscopic differentiation of herbal ingredients as essential skills for the traditional herbal pharmacist and others in the supply chain. In TCM, this knowledge is known as *bian zhuang lun zhi* or "differentiating appearance to determine quality." Chemical analysis sometimes challenges long-held beliefs of authenticity and quality. In the case of ginseng, it was traditionally thought that large main roots were of superior quality, but chemical analysis shows that the thin fibrous roots have a higher content of ginsenosides† (the active and marker compounds characteristic of plants in the genus *Panax*).[111]

Writing about the visual factors that distinguish cultivated *P. ginseng* (*yuan shen*) with wild *P. ginseng*, Zhao

† Ginsenosides also are found in *Gynostemma pentaphyllum* (Cucurbitaceae), a plant not related to *Panax* species.

The author in *Panax ginseng* beds at the Institute of Medicinal Plant Development in Beijing, China, in 1988. Photo ©2016 Steven Foster

and Chen note that special terminology is used. "Iron wire striations" refer to dark-colored circular striations at the upper part of the primary root of wild ginseng. So-called "pearl dots," or "pearl bumps," are small protrusions from the rootlets of wild ginseng. These unique morphological features of wild ginseng root are used to distinguish it from cultivated root. Sun-dried cultivated root is essentially a different product that sells at a much lower price compared to wild root.

Until the 1970s, traditional pharmacognosy tools, such as plant and root morphology and histological (i.e., relating to the study of microscopic structures of plant and animal tissues) characteristics, were used to authenticate ginseng products and species. In addition, thin-layer chromatography (TLC) and high-performance thin-layer chromatography (HPTLC) methods have been developed for *Panax* species. TLC was developed in 1961 and HPTLC, which includes software-controlled automated steps, was developed in the 1980s. Because of relatively minor chemical differences between American ginseng and Asian ginseng, distinguishing between the two requires expertise and experience. Introduced in the 1970s, the application of high-performance liquid chromatography (HPLC) to ginseng research offered a new tool for authentication. In the 1990s, the use of DNA authentication methods further enhanced the evolution of authentication of ginseng source plants and their adulterants.

Discussion

Ginseng adulteration can be as subtle as the medicinal effects attributed to the root by early European writers. Cultural preferences and socioeconomic factors can impact the market for ginseng in both the country of origin and the destination country. For example, in the early 1990s, when Hong Kong was the center of the ginseng trade, cultivated American ginseng from the US and Canada (primarily from Wisconsin, Ontario, and British Columbia) sold for 5-10 the price of cultivated Asian ginseng. Therefore, Asian ginseng roots became an adulterant of higher-priced American ginseng.

In addition, as Yip et al. has noted, consumers in Korea or China may prefer Asian ginseng from their own countries. In Korea, American ginseng is considered an adulterant of Korean ginseng and is not allowed in the market.

The two plants cannot be used interchangeably in practice. TCM classifies American ginseng as "cool" and recommends it for "yin-deficient" conditions. American ginseng consumption is greater in southern China as a cooling tonic, whereas Asian ginseng is considered "hot" and is used for "yang-deficient" conditions. Adulteration of one species with the other could produce unexpected clinical outcomes in TCM practice.[112] Each of these nuances points to an acute need for proper authentication. HG

Steven Foster *is an author, photographer, and herbalist, and he serves on the Board of Trustees of the American Botanical Council. His most recent book is the third edition of the* Peterson Field Guide to Medicinal Plants and Herbs of Eastern and Central North America *(Houghton Mifflin Harcourt, 2014), which he co-authored with James A. Duke, PhD.*

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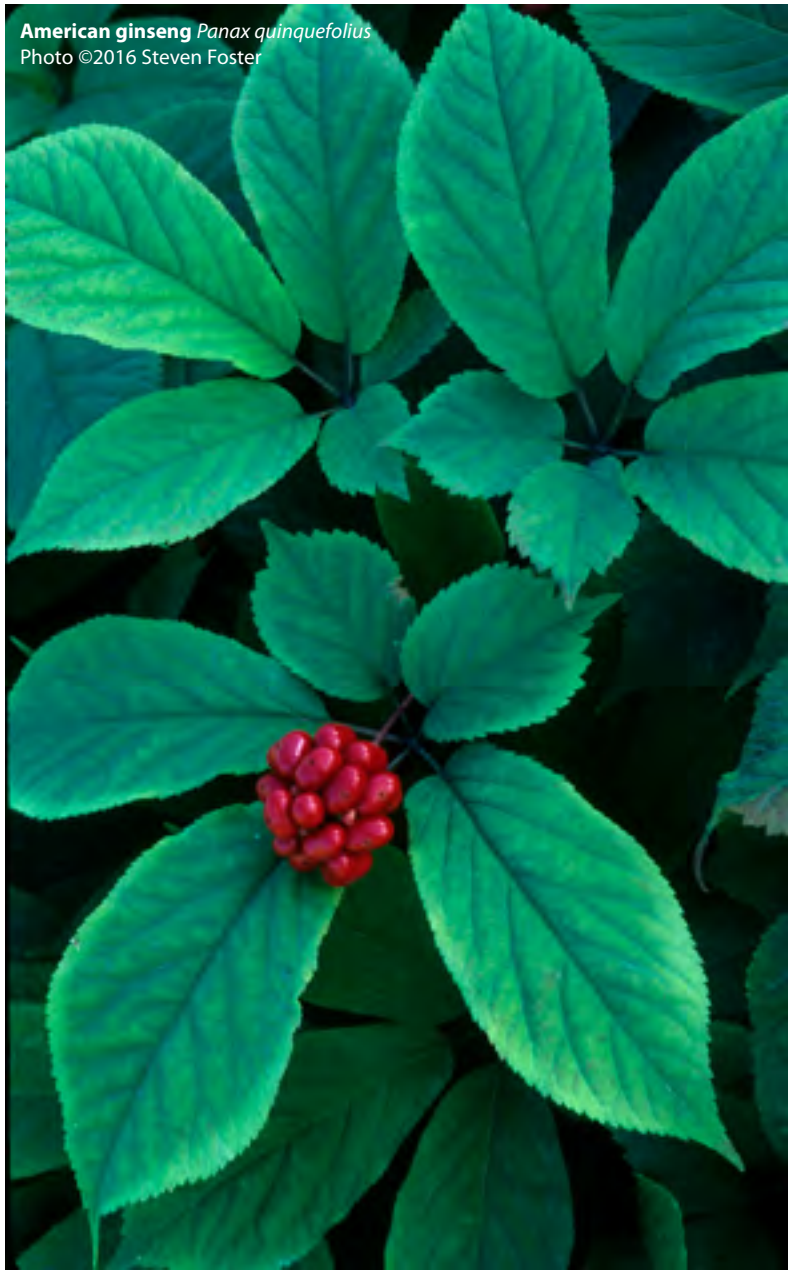

American ginseng *Panax quinquefolius*
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Kew's *State of the World's Plants* Report: A REVIEW

By Connor Yearsley

Amazon rainforest at sunset, Los Amigos Biological Station, (CICRA-*Centro de Investigación y Capacitación Rio Los Amigos*). Located in lowland Amazonian forest at the base of Peru's southern Andes. Photo ©2016 Steven Foster

The world-famous Royal Botanic Gardens, Kew (RBG Kew) recently released its first annual *State of the World's Plants* report, which took one year and the efforts of more than 80 scientists to complete. The report raises concerns about the need for increased global plant conservation efforts. Alarmingly, it states that an estimated 21% of plant species are currently threatened with extinction.[1,2]

The 84-page report, which is available online, is the first assessment of its kind and covers information about global plant diversity, threats to that diversity, and policies intended to manage threats and protect diversity.

"Plants are absolutely fundamental to humankind," Kathy Willis, PhD, director of science at RBG Kew, is quoted as saying in an article published by *The Guardian* about the new report. "Plants provide us with everything — food, fuel, medicines, timber, and they are incredibly important for our climate regulation. Without plants we would not be here. We are facing some devastating realities if we do not take stock and re-examine our priorities and efforts."[3]

RBG Kew is a center for botanical and mycological knowledge, with gardens at Kew in London and at Wakehurst in Sussex, England. Since its founding in 1759, RBG Kew has made many contributions to increasing the understanding of plants and fungi, according to its website. Its Board of Trustees is sponsored by the United Kingdom's Department for Environment, Food and Rural Affairs.

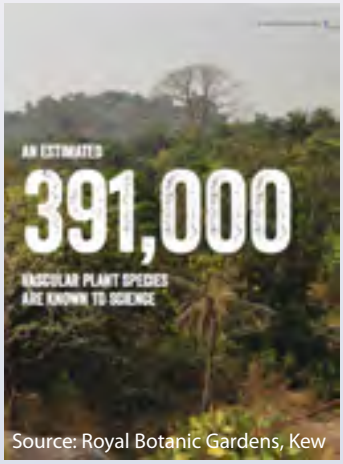
State of the World's Plants is divided into three main sections: "Describing the World's Plants," "Global Threats to Plants," and "Policies and International Trade."

Describing the World's Plants

The report states that there are an estimated 390,900 species of vascular plants known to science. Vascular plants, unlike nonvascular plants, have a nutrient-transport system composed of xylem and phloem.[4] Xylem is the plant tissue primarily responsible for distributing water and minerals absorbed by the roots, and the rigidity of xylem cells enables vascular plants to grow more upright than nonvascular plants. Phloem is primarily responsible for distributing sugars and nutrients made during photosynthesis. Vascular plants do not include algae, mosses, liverworts, hornworts, and lichens.

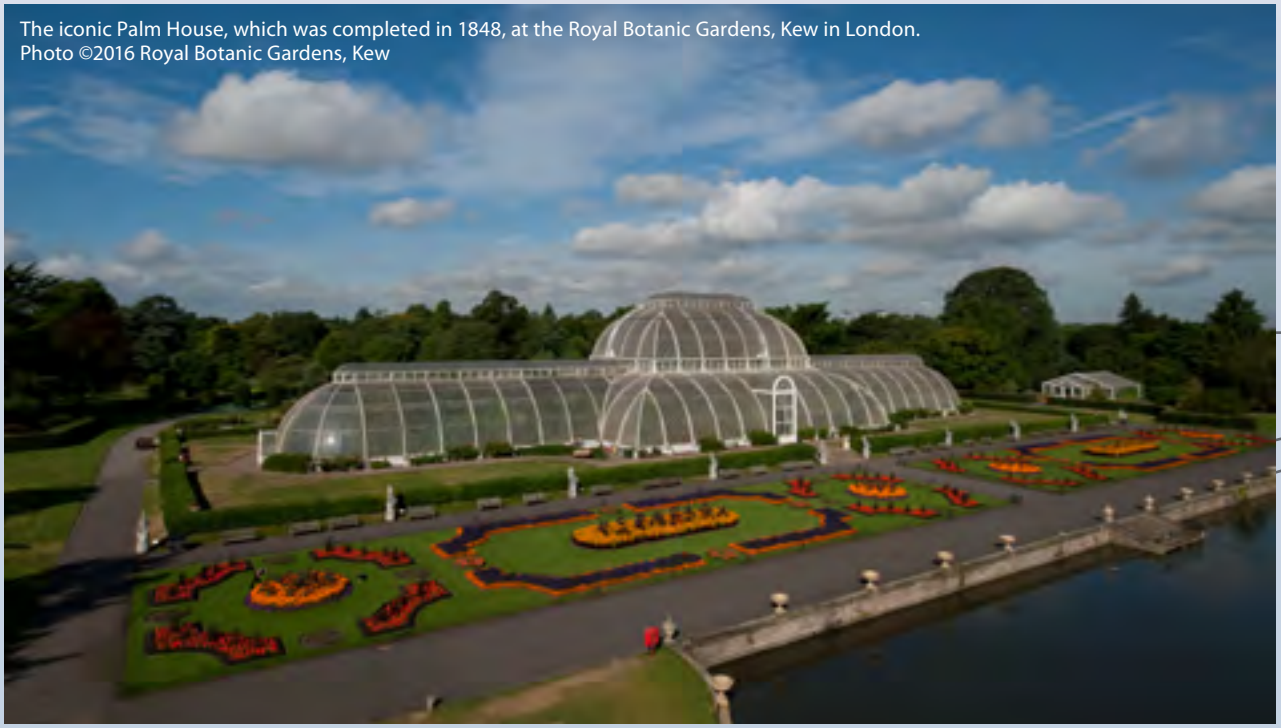
Of the known species of vascular plants, an estimated 369,400 (94%) are flowering plants (angiosperms), according to the report. Current knowledge of plant diversity is based on three plant databases. First, the International Plant Names Index (IPNI; www.ipni.org) is the most comprehensive and continuously updated list of scientific names for vascular plants. At the time of the report, the IPNI included more than one million species names, with an average of 2.7 scientific names (Latin binomials) per plant species (i.e., not including local or common names). Different scientific names given to the same plant are called synonyms. The IPNI records only nomenclatural synonyms (i.e., synonyms that result when the understanding of relationships among species improves, and when species are therefore moved from one genus to another). Second, the World Checklist of Selected Plant Families (http://apps.kew.org/wcsp) is limited to seed plants, but, unlike the IPNI, it contains information on global plant distributions and taxonomic synonyms (i.e., synonyms that result when researchers inadvertently rename species that have already been described). Third, The Plant List (www.theplantlist.org) is the most comprehensive list of *all* plant names (including mosses, liverworts, and hornworts), but it is not regularly updated or peer-reviewed.[1]

Currently, RBG Kew, with help from other organizations, is working on collating the information contained in these three resources into a single database called the Plants of the World Online Portal, which is scheduled for launch in late 2016.[1]



Source: Royal Botanic Gardens, Kew

In 2015, there were 2,034 vascular plant species new to science. In fact, there have been slightly more than 2,000 new species described *each year* for the past decade, and, each year, the majority of these have been discovered in Australia, Brazil, and China. Some of the more noteworthy discoveries of 2015 include a tree in the legume (Fabaceae) family called *Gilbertiodendron maximum*, which can grow to 45 meters (approximately 147 feet) and is one of eight threatened trees in this genus found in the Cameroon-Congolian rainforest. Also in the legume


The iconic Palm House, which was completed in 1848, at the Royal Botanic Gardens, Kew in London.
Photo ©2016 Royal Botanic Gardens, Kew

family, a succulent Namibian shrublet called *Oberholzeria etendekaensis* was discovered, which is not only a new species but belongs to a new genus. In Southeast Asia, more than 90 species in the genus *Begonia* (Begoniaceae) were discovered.[1]

Also, a Brazilian carnivorous plant in the sundew family called *Drosera magnifica* (Droseraceae) was discovered on Facebook when a sundew expert was reviewing pictures taken years earlier by an orchid hunter. The species can grow to 1.5 meters (five feet), making it one of the three largest sundews known to science.[1]

In addition, 13 new species in the genus *Allium* (Amaryllidaceae) — a genus that includes onion, garlic, scallion, shallot, leek, and chives — were discovered. Five of the new species are onions. Eighteen new species in the genus *Ipomoea* (Convolvulaceae), a genus that includes morning glories and many species that have historically been used medicinally, were discovered. One of these new species is a close relative of the sweet potato (*I. batatas*).[1]

The report also discusses how recent and significant advances in, and decreasing costs of, high-throughput genome sequencing technologies will continue to improve understanding of The Plant Tree of Life, a graphical depiction of how taxonomic groups are related to each other. Whole-genome sequencing can enable the discovery of additional species that are relevant to human well-being, impacting medicines, foods, biofuels, and fibers. In addition, this technology can help plant breeders develop new crops that are more productive, have greater nutritional content, and are more resilient to pathogens and environmental change. It can also help characterize endangered species and support conservation efforts.[1]

At least 31,128 plant species currently have at least one documented use, according to the report, and an estimated 17,810 (see "Analysis" section) of those have been used medicinally, accounting for the largest number of plants with a documented use. In addition, an estimated 5,538 species are used as food by humans. Not counted among these useful plant species are crop wild relatives (i.e., the cousins and ancestral species from which modern agricultural crops evolved). Extensive domestication of these species over thousands of years has resulted in the selection of traits that provide higher crop yields, but these are often not the traits that enable resilience to climate change and pathogens. Therefore, there is a need to collect and conserve these wild species so they can be used to breed crops with the traits necessary to ensure global food security. According to the report, there are 3,546 prioritized plant taxa identified as crop wild relatives, and many of these are not adequately represented in current germplasm collections. Recent analyses have identified geographical hotspots of crop diversity and gaps in conservation coverage, and are informing current conservation efforts in relation to these species.[1]

Globally, 1,771 Important Plant Areas (IPAs) had been identified at the time of the report. This designation is a formally recognized scheme that identifies plant sites that are in most urgent need of conservation. These priority sites are determined using three key measures: threatened species, exceptional botanical richness, and threatened habitats. After IPAs have been identified, the next step is to move toward protection and sustainable management of these sites. It is critical that local communities and authorities are invested in IPA programs from the beginning, since conservation efforts ultimately depend on them. Although IPA programs have produced encouraging results in places such as Turkey and the United Kingdom, many global IPAs currently have no conservation protection.[1]

Each year, RBG Kew's *State of the World's Plants* report will take an in-depth look at the status of plants in a particular area. Its first report looks at plants in Brazil. There are 32,109 Brazilian seed plants known to science, of which 18,423 are unique to the country. Basic distribution data are now available for all known species. In addition, conservation status according to the International Union for Conservation of Nature (IUCN) Red List criteria has been re-evaluated for all Brazilian plant species considered threatened.[1] The IUCN is made up of more than 1,300 member organizations, including government agencies, non-governmental organizations (NGOs), scientific and academic institutions, and business associations. Its *Red List of Threatened Species* is the world's most comprehensive information source on the conservation status of plant, animal, and fungi species. The *Red List Categories and Criteria* provide an explicit, objective framework for classifying species at high risk of global extinction, based on parameters such as population reduction and restricted geographic range.[5]

There are 32,109 Brazilian seed plants known to science, of which 18,423 are unique to the country.

The report focuses on Brazilian plants in the Bromeliaceae, Cactaceae, and Asteraceae families. Many of these plants are found only in Brazil, many have not yet been evaluated using Red List criteria, and many that have been evaluated are threatened. In addition, the report discusses the status of Brazil's six vegetation biomes and the biggest threats to each biome.[1]

Global Threats to Plants

The report states that more than 10% of the world's vegetated surface demonstrates high sensitivity to climatic variability, which is alarming given the dramatic increases in global temperatures and atmospheric carbon dioxide levels, as well as the alteration of hydrological systems. The expected impacts of these changes on world plant species include three possible outcomes: extinction, migration, or in situ adaptation.[1]

Although it is difficult to prove when an extinction has occurred as a sole result of climate change — and there is little evidence to demonstrate that such extinctions have

happened over the past decade — species-envelope models (i.e., models that rely on statistical correlations among projected environmental variables and what is known about species' environmental tolerances) indicate that widespread climate-related extinctions are expected. It is thought that many species are in an "extinction debt" (i.e., on borrowed time and will become extinct in the future due to events in the past). Furthermore, a changing climate will continue to impact interactions among species (e.g., by affecting distributions of plant pollinators and pathogens). In fact, these interactions have been shown to play an important role in plant population declines and potential extinctions.[1]

Significant shifts in plant distributions as a result of climate change have been observed over the past few decades in a number of places. In some cases, species have been shown to migrate northward and up mountainsides distances of a mile or more (e.g., Scots pine [*Pinus sylvestris*, Pinaceae]).[1]

In addition, significant in situ adaptations have been observed worldwide, including changes in the timing of leafing and flowering in some species, increases in the numbers of flowers in some species, and increases in carbon sequestration and growth rates in some tree species (larger trees are often more susceptible to drought).[1]

Interestingly, monthly satellite imagery from February 2000 through December 2013 indicates that precipitation and cloudiness are the main climate drivers of vegetation productivity in the tropics, while temperature is the main driver of vegetation productivity from mid-latitude regions to the poles.[1]

Also of concern, satellite imaging technology has shown that all but one of the world's 14 biomes saw greater than 10% change in land-cover from 2001 to 2012, with the greatest changes observed in mangrove forests (i.e., forests made up of shrubs or small trees that grow in coastal saline or brackish water that often support a wealth of life) and tropical coniferous forests. Loss of mangroves is largely attributed to human activity, especially the conversion of land for shrimp farming.[1]

Tropical forest loss is also largely due to changes in land use. The conversion of land to pasture and farmland is a major cause of this deforestation. In Southeast Asia, clearing forest for oil palm plantations, fiber (pulp and paper) plantations, and logging is a serious concern. While deforestation has accelerated over the past 12 years in some countries, such as Indonesia, Malaysia, Paraguay, Bolivia, Zambia, and Angola, the deforestation rate in the Brazilian Amazon forest, encouragingly, seems to have declined, with an increasing amount of forest being given some protection status. In addition, 10 of the world's 14 biomes saw a decrease in vegetation productivity between 2000 and 2013, but the other four, including the tundra and the taiga (i.e., the coniferous forest biome that lies to the south of the Arctic Circle, between the tundra to the north and the temperate forests to the south), actually saw an increase.[1]

The report also discusses the significance of invasive plant species. As a result of centuries of people moving plants around the world, at least 13,168 vascular plant species are known to have become naturalized outside their native range. If and when naturalized species start to compete with native species and spread to a degree that hurts the environment, the economy, and/or human health, they are considered invasive. Though most naturalized species do not become invasive, invasive alien plant species (IAPSs) are one of the most important causes of biodiversity loss. In addition, these species have socioeconomic impacts on people's livelihoods, as well as ecosystem impacts on agriculture, forestry, water, pollinators, and climate regulation. In fact, the costs of IAPSs have been estimated at nearly 5% of the world economy. There are 4,979 vascular plant species now considered invasive.[1]

The case of one species, Bermuda cedar (*Juniperus bermudiana*, Cupressaceae), raises the question of whether to protect, control, or eradicate IAPSs that have become threatened in their native habitat.[1]

The report emphasizes the need to establish a single global list of IAPSs that includes taxonomy, information about the threat posed by the IAPSs, distribution data, information about control efforts, etc. In addition, the risk of further introductions of IAPSs can be minimized with stricter enforcement of legislation and increased implementation of quarantine procedures. In relation to IAPSs, there is a need for research findings to be more effectively shared between scientists and practitioners who are managing natural areas and implementing interventions.[1]

There is also a section dedicated to plant diseases. Researchers estimate that plant pathogens may be responsible for annual global crop yield losses of up to 16%. Losses due to pathogens have increased over the last 50 years, probably due largely to increased trade and travel, and changes in cultivation techniques (e.g., using varieties that provide greater crop yields but that are often more vulnerable to diseases).[1]

Source: Royal Botanic Gardens, Kew

The top 10 scientifically, historically, or economically important viral, bacterial, and fungal pathogens are ranked in the report according to research effort, as recorded in research publications between 2010 and 2016. An assessment of 21,207 publications about these pathogens from 95 countries revealed some interesting and concerning trends. The majority of this research occurs in richer countries, and while many poorer countries grow plants that host these pathogens and are negatively affected by them, they are not always contributing to or benefiting from this research. Getting local scientists, especially in Africa and Central and South America, more involved in these research efforts would contribute to a better understanding of the global risk associated with plant pathogens, as well as their biology in different habitats.[1]

Most alarmingly, the report states that about a fifth of plant species are estimated to be threatened with extinction (i.e., they are vulnerable, endangered, or critically endangered), according to IUCN criteria. The dominant threat to the plant species on the Red List is the conversion of land for agriculture, followed by biological resource use (which includes logging and the gathering of plants). Figure 1 shows the breakdown of all threats to all plant species assessed on the IUCN Red List. More than 20,000 assessments of extinction risk for vascular plant species have been conducted, representing about a quarter of species on the Red List but only about 5% of the estimated 390,900 known species of vascular plants. This lack of coverage means that the Red List does not yet adequately represent overall extinction risks for plants. The orchid (Orchidaceae), mint (Lamiaceae), and heather (Ericaceae) families are all underrepresented on the Red List. The estimate that about a fifth of plant species are threatened with extinction was determined by taking a suitably large, random sample of plant species and assessing their risk.[1]

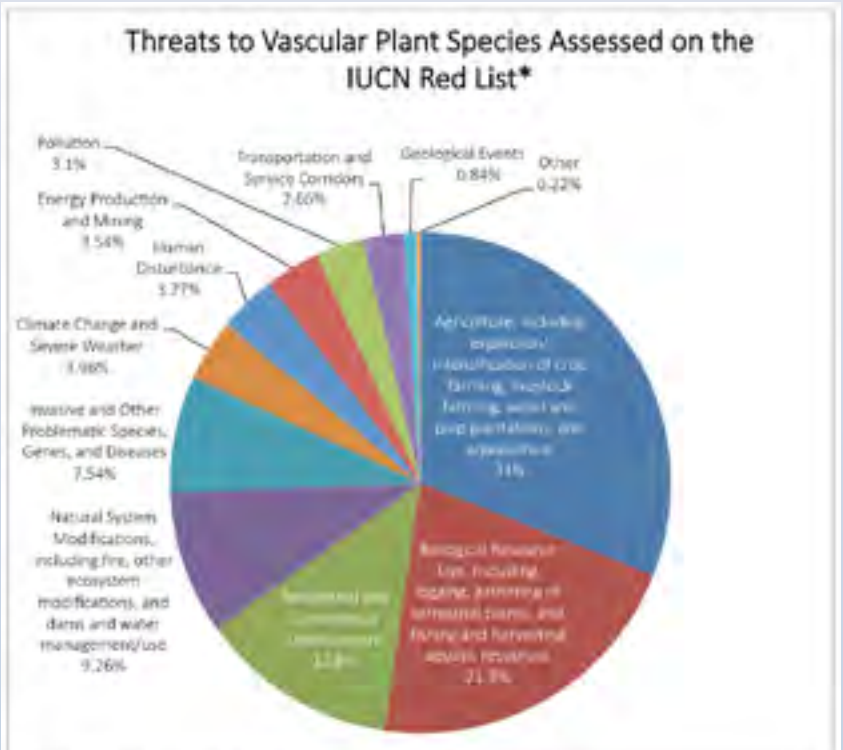
There is an obvious need to conduct more threat assessments at a quicker pace, while still ensuring scientific rigor. Certain advances, such as the opening up of global datasets (e.g., maps of forest loss), the digitizing of specimen data from herbaria around the world, and increasing access to species-occurrence data through various services, will enable threat assessments to be made more easily and with more complete information.[1]

The report discusses the interesting case of *Terminalia acuminata* (Combretaceae), a Brazilian hardwood timber tree native to a small part of the Atlantic Forest in Rio de Janeiro, Brazil. Over-exploitation of the species for its high-quality timber led to its presumed extinction in the wild, but it was rediscovered in 2015, 80 years after it was last seen in the wild. This rediscovery marks a success in the conservation of the Atlantic Forest biome. This tree is an example of a "Lazarus species," a reference to the biblical story of Jesus raising Lazarus from the dead.[1]

Policies and International Trade

The report discusses how international trade in plants, which is dominated by the agriculture, horticulture, and timber industries, plays such an important role in the global economy. Agriculture is estimated to be worth about $5 trillion globally per year, and agricultural production uses about 40% of the world's land area. In addition, though most timber traded globally is from plantations, timber from the tropics comes mostly from natural forests. In 2014, about $80 billion of tropical timber products were imported globally.[1]

The agriculture and timber industries threaten many species. In fact, degradation of habitat was identified as the main threat to 85% of threatened species on the IUCN Red List. In addition, the horticulture industry is increasing demand for some rare species (e.g., Asian slipper orchids), causing unsustainable harvesting of these species and pushing some close to extinction. (Slip-



* Source: RBG Kew's *State of the World's Plants* report.[1]

per orchids belong to five genera in the Cypripedioideae subfamily of the Orchidaceae family, of which *Cypripedium* and *Paphiopedilum* are native to Asia.)[1]

Created to address the burden that international trade imposes on many species, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) came into effect in 1975. There are currently 181 countries, or Parties, that have signed up to CITES and committed to protect more than 30,000 plant species from unsustainable or illegal international trade. Each Party must designate a Management Authority to regulate the import, export, and re-export of both wild and cultivated plants, as well as parts and derivatives of those plants. In addition, each Party must designate a Scientific Authority to advise the Management Authority on the effects of trade on the conservation status of species.[1]

According to the report, plants in the orchid family (including species of the genera *Disa*, *Satyrium*, *Habenaria*, and *Dendrobium*) are subject to widespread illegal trading. Orchids dominate the CITES appendices (species are listed in one of three appendices that afford varying degrees of protection). In addition, widespread trade in illegally-harversted rosewood (*Dalbergia* spp., Fabaceae) is also a concern.[1]

It is difficult to determine how effective CITES is in preventing illegal trade, since most of this trade is not documented. However, looking at 2015 data on illegal plant confiscations from London's Heathrow airport provides some insights. The data confirm the desirability of orchids and the need to retain species in this family in the CITES appendices, as well as the desirability of agarwood from species of the genera *Aquilaria* and *Gyrinops* (Thymelaeaceae). The data also indicate that orchid products can be difficult, if not impossible, to trace once they have been harvested and used in supplements and cosmetics. The report emphasizes that CITES enforcement needs to be robust and standardized to effectively control illegal trade in wildlife.[1]

The report also discusses the Nagoya Protocol on Access to Genetic Resources and Benefit Sharing, which came into effect in October 2014 and provides a legal framework for the fair and equitable sharing of benefits — ranging from monetary benefits to conservation knowledge — that arise from the use of genetic resources from a particular country. There are currently 74 Parties to the Nagoya Protocol, and it is necessary for them to have measures in place to monitor how resources are being used, and to take punitive action in cases of noncompliance.[1]

The Protocol comes at a time when many countries are increasingly recognizing the value of their natural resources and is a result of concerns about the unauthorized use of these resources. Because the Protocol is relatively new, few Parties have had adequate time to implement new and effective legislation, but a handful of these Parties (many of which contain unique and abundant biodiversity) are at various stages of approving new legislation that will hopefully offer incentives to conserve and sustainably use natural resources.[1]

Analysis

Danna Leaman, PhD, a research associate at the Canadian Museum of Nature in Ottawa, Ontario, co-chair of the Medicinal Plant Specialist Group (MPSG) of the Species Survival Commission (SSC) of the IUCN, and member of the American Botanical Council's (ABC's) Advisory Board, thinks RBG Kew's report is valuable. "The report has brought together, in a digestible summary, an enormous amount of information and resources as a baseline for where we are now on some important knowledge for plant conservation," she wrote (email, July 5, 2016).

Founded in 1994, the MPSG is one of more than 120 specialist groups that make up the SSC of the IUCN, and is a global network composed of specialists who contribute within their respective institutions and regions, and worldwide, to the conservation and sustainable use of medicinal plants.[6]

Of particular interest to *HerbalGram* readers, RBG Kew's estimate that 17,810 plant species have been used medicinally starkly contradicts previous estimates made by the MPSG. In 2002, it was estimated that between 50,000 and 70,000 species have at one time been used in some culture for medicinal purposes.[7] According to Leaman, that estimate was, at the time, "more sophisticated than 'back of the envelope,' but still a fairly rough calculation." The MPSG's estimate was determined under the assumption that the proportion of available flora used medicinally in a few key countries with published pharmacopeias was an adequate representation of the global situation.

Ochna dolicharthros, one of the 2,034 vascular plant species new to science in 2015, was discovered in the northeastern corner of Mozambique. Photo credit: Frances Crawford.

"While it could be a substantial overestimate if there are more countries/cultures that use a much smaller proportion of flora medicinally," Leaman wrote, "it could also be an underestimate, because it doesn't account for the many plant species used in local traditional medicine that may not have been included in the national pharmacopoeias on which the estimate was based."

Leaman said she is not aware of a more comprehensive list of medicinal plants than the Medicinal and Aromatic Plant Resources of the World (MAPROW) database, which was created by Uwe Schippmann, PhD, head of the Plant Conservation Section of the German Federal Agency for Nature Conservation (BfN) and former chair and current member of the MPSG. MAPROW includes more than 30,000 species names (Latin binomials) with referenced medicinal use. "Even admitting a number of undiscovered synonyms, this figure is already much higher [than RBG Kew's estimate]," Schippmann wrote (email, July 7, 2016).

MAPROW is supported and used by the MPSG and the FairWild Foundation, which promotes the sustainable use of wild-collected ingredients. The database requires at least one published source that documents medicinal use, and it incorporates earlier lists created by the World Health Organization (WHO) and the NAPRALERT database that is managed by the University of Illinois at Chicago (UIC) College of Pharmacy, a WHO collaborating center. MAPROW is one of the sources used by RBG Kew to create its Medicinal Plant Names Services (MPNS) list, and thus contributes to the 17,810 estimate.

"My understanding is that RBG Kew's MPNS is gradually cleaning up the synonyms in MAPROW, but this is still a work in progress, and there are likely more accepted species in MAPROW than yet appear in MPNS," Leaman wrote. "Although the sources used by RBG Kew are solid, they are certainly biased in favor of sources published in English and sources published at all, and this figure is a low-ball."

The sources and methods RBG Kew used to estimate the number of species in each useful plant category (e.g., medicine, food, fuels, materials, etc.) are provided in the supplementary materials on the *State of the World's Plants* website.[8,9]

It is not known exactly how many medicinal plant species are threatened with extinction, but, in 2010, the MPSG ran a comparison of MAPROW (which at the time included about 15,000 species names) and the IUCN Red List, and found the following: "Just 3% of the world's well-documented medicinal flora has been evaluated for global conservation status. The proportion of medicinal plants flora considered to be threatened appears to have remained relatively stable (ca. 40% to 45%) between 1997 and 2008. This stability however may be the artifact of a number of variables. The conservation status of medicinal plants is alarming if this pattern is maintained by assessment of a larger and more representative sample of medicinal plant species."[10]

The MPSG plans to run the comparison again soon with the more comprehensive MAPROW list, but is waiting until some very large conservation status assessments in South Africa and Brazil are added to the IUCN Red List.

RBG Kew's report does not provide a list of medicinal plant species, or any species for that matter, considered threatened, but a 2014 IUCN review of 400 European medicinal plant species found that nine species (2.3%) were threatened according to IUCN criteria (see Table 1) and that 125 species (31%) were considered to be declining in population size in Europe.[11]

Future Outlook

Leaman is both discouraged and encouraged by current global plant conservation efforts. "What discourages me is that plants are mostly invisible to major conservation initiatives and their donors, although most of the rest of the world's biodiversity relies on plant diversity," she wrote. "What encourages me is that the plant conservation community — RBG Kew being a leader here — is pushing hard for more attention and support."

> "We need more companies to become engaged with FairWild, and there needs to be greater consumer awareness and demand for responsibly sourced ingredients, which in turn will encourage companies to demonstrate traceability, sustainability, and equity in their sourcing practices."

She also thinks more attention needs to be given to useful and economically important plants "because I'm hopeful that this will draw more support for plant conservation in general," she wrote, "but I'm surprised by how little consideration there is for economically important plants (apart from timber trees, perhaps) as resources that need management and conservation."

In relation to the global trade in plants, Anastasiya Timoshyna, co-chair of the MPSG and the medicinal plants program leader at TRAFFIC, an NGO whose mission is to ensure that trade in wild plants and animals is not a threat to the conservation of nature,[12] said she is encouraged by the progress being made by TRAFFIC and other organizations. "Over the past decade, TRAFFIC, together with other partners, including the MPSG, WWF [the World Wide Fund for Nature], the FairWild Foundation, and others, have been working on developing and implementing the best practice guidelines on conservation and sustainable use of wild plants — the FairWild Standard," she wrote (email, July 10, 2016).

This standard is increasingly being adopted into the wild plant supply chain through the implementation of the FairWild certification scheme. According to Timoshyna, about

Table 1. Select European Medicinal Plants Considered Threatened Per IUCN Red List Criteria (as of 2014)[11]

Scientific Name	Family	Common Name*	Conservation Status
Artemisia granatensis	Asteraceae	Royal chamomile	Endangered
Atropa baetica	Solanaceae	Tabaco gordo	Endangered
Chimaphila umbellata	Ericaceae	Umbellate wintergreen	Vulnerable
Crataegus nigra	Rosaceae	Hungarian hawthorn	Endangered
Dactylorhiza iberica	Orchidaceae	—	Vulnerable
Himantoglossum comperianum	Orchidaceae	Komper's orchid	Endangered
Iris spuria	Iridaceae	Spurious iris	Vulnerable
Sideritis reverchonii	Lamiaceae	Zahareña	Endangered
Tetraclinis articulata	Cupressaceae	Sandarac	Endangered

* Common names vary with geographical location of usage.

300 tons (661,387 pounds) of certified ingredients, derived from 24 species of wild plants whose collection practices had met the FairWild Standard, were used by food, health products, and cosmetic manufacturers in 2014. In addition, more than 20 companies are involved in FairWild-certified value chains.

"Beyond certification, other companies are using the FairWild Standard as a basis for responsible sourcing of wild plants through their internal policies and sourcing practices, including some key traditional Chinese medicine (TCM) manufacturers," Timoshyna wrote.

Furthermore, reference to the FairWild Standard has been made within national conservation strategies in a number of countries and territories, including Japan, Hong Kong, and Mexico, and it has been recognized as a best-practice tool to support the delivery of the Global Strategy for Plant Conservation (a program of the United Nations' [UN's] Convention on Biological Diversity [CBD]) and other conventions, such as CITES.

Though progress is being made, Timoshyna said she thinks more attention needs to be focused on the sustainable use and trade in wild plant resources, which are often the primary source of health care for indigenous peoples, and whose collection, processing, and sale supports the livelihoods of millions of people. Furthermore, these plants are also essential sources of ingredients for billion-dollar industries that produce pharmaceuticals, cosmetics, and foods, with an estimated 4,000-6,000 species, the majority of which are wild-harvested, being traded internationally in significant quantities.

"We need more companies to become engaged with FairWild, and there needs to be greater consumer awareness and demand for responsibly sourced ingredients, which in turn will encourage companies to demonstrate traceability, sustainability, and equity in their sourcing practices," Timoshyna wrote. She also thinks more attention needs to be given to assessing the use, trade, and threat status of key

Crataegus nigra, one of nine species considered threatened according to a 2014 IUCN review of 400 European medicinal plant species. Photo credit: Krzysztof Ziarnek, Kenraiz, via Wikimedia Commons

wild plant resources; enhancing intergovernmental engagement (e.g., through CITES, CBD processes, etc.); enabling effective national regulatory systems that facilitate responsible trade; and empowering producers of wild-harvested plant ingredients.

Though global plant diversity faces a variety of threats, which are highlighted in RBG Kew's *State of the World's Plants* report, the FairWild Standard provides a viable means of ensuring the sustainable harvest of wild plant species.

Conclusion

RBG Kew's first *State of the World's Plants* report provides a helpful baseline assessment of global plant species and marks an important first step toward filling critical gaps in current knowledge about biodiversity and conservation status.

"But to have effect, the findings must serve to galvanize the international scientific, conservation, business, and governmental communities to work together to fill the knowledge gaps we've highlighted and expand international collaboration, partnerships, and frameworks for plant conservation and use," Willis is quoted as saying in a RBG Kew press release about the report.[2]

Josef Brinckmann, vice president of sustainability at Traditional Medicinals, the largest medicinal tea maker in the United States and the first company in the world to market FairWild-certified products, said he thinks it is important and relevant that the report emphasizes that habitat destruction (e.g., due to land use change for farming and cattle ranching, deforestation for timber, and residential and commercial development) threatens many species with extinction (email, June 26, 2016).

According to Brinckmann, who is also an ABC Advisory Board member, media outlets often overemphasize overharvesting as *the* main driver toward extinction. "My observations agree with the RBG Kew data in that it is changes in land use (to farming and ranching) and urbanization that are destroying biodiversity (where medicinal plants are traditionally wild-collected)," he wrote.

In *The Guardian* article, Willis is quoted as saying she is "reasonably optimistic" for the future. "Once you know [about a problem], you can do something about it," she said. "The biggest problem is not knowing."[3] HG

Himantoglossum comperianum, one of nine species considered threatened according to a 2014 IUCN review of 400 European medicinal plant species. Credit: Mr. Rosewater, via Wikimedia Commons

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Sales of Herbal Dietary Supplements in US Increased 7.5% in 2015

Consumers spent $6.92 billion on herbal supplements in 2015, marking the 12th consecutive year of growth

By Tyler Smith[a], Kimberly Kawa[b], Veronica Eckl[b], and James Johnson[c]

[a] *HerbalGram, American Botanical Council; Austin, Texas*
[b] *SPINS; Chicago, Illinois*
[c] *Nutrition Business Journal, New Hope Natural Media; Boulder, Colorado*

Introduction

Consumer spending on herbal dietary supplements in the United States reached an all-time high in 2015. Retail sales of herbal supplements totaled an estimated $6.92 billion in 2015 (Table 1), a 7.5% increase in sales from the previous year. Consumers spent approximately $480 million more on herbal products in 2015 than in the previous year — an increase that marks the 12th consecutive year of growth for these products.

These figures, and the rest of the data* presented in *HerbalGram*'s 2015 Herb Market Report, were generously provided by the following organizations: SPINS LLC, a market research firm based in Chicago, which collaborated with IRI (Information Resources Inc.), also a Chicago-based market research company, to determine mainstream multi-outlet retail sales of herbal dietary supplements, and the *Nutrition Business Journal* (NBJ), a publication of New Hope Natural Media, a specialty media company with headquarters in Colorado.

For the seventh year in a row, sales of herbal supplements increased in each of the three market channels — mass-market ("mainstream channel"), natural and health food ("natural channel"), and direct sales (Tables 2 and 3). Although the natural channel generally outperforms the other two channels in terms of percent growth, in 2015, the mainstream channel experienced the highest sales increase of 7.9%. Sales growth was slightly less for the natural (7.7%) and direct sales channels (7.2%).

Mainstream Retail Channel

Sales of herbal dietary supplements in the mainstream channel totaled $943 million in 2015, as determined by SPINS and IRI. This figure represents a 1.5% increase over 2014 sales in this channel of approximately $929 million. NBJ — which includes convenience store data in its mass-market channel — estimated higher total mainstream sales of $1.2 billion.

Table 1. Total Estimated Retail Sales of Herbal Supplements*

2000	$4.225 billion
2001	$4.361 billion
2002	$4.275 billion
2003	$4.146 billion
2004	$4.288 billion
2005	$4.378 billion
2006	$4.558 billion
2007	$4.756 billion
2008	$4.800 billion
2009	$5.037 billion
2010	$5.049 billion
2011	$5.302 billion
2012	$5.593 billion
2013	$6.033 billion
2014	$6.441 billion
2015	$6.922 billion

Source: *Nutrition Business Journal*

* Includes sales in all channels. NBJ primary research includes NBJ surveys of supplement manufacturers, distributors, MLM firms, mail order, internet, and raw material and ingredient supply companies, as well as numerous interviews with major retailers (Walmart, Costco, etc.), manufacturers, suppliers, and industry experts. Secondary sources include Information Resources Inc., SPINScan Natural, ACNielsen, Natural Foods Merchandiser, Insight, The Hartman Group, company data, and other published material.

Horehound, for the third year in a row, was the top-selling herbal supplement in the US mainstream multi-outlet channel. Sales of horehound supplements in 2015 reached almost $115 million (see Table 4), an 8.5% increase from the previous year. Since 2013, horehound supplement sales, which include lozenges with horehound as the primary ingredient, have increased by a total of almost $8 million in mainstream outlets, indicating strong, continued growth for this member of the mint (Lamiaceae) family.[1]

The first documented medicinal use of horehound was in the 1st century CE, when Roman physician A. Cornelius Celsus noted that horehound juice could relieve respiratory issues.[2] Almost two millennia later, 17th century herbalist Nicholas Culpeper recommended a horehound syrup preparation "as an excellent help to evacuate tough phlegm and cold rheum from the lungs of aged persons."[3] Horehound has also been used to relieve digestive and other issues, but, today, horehound supplements are still used primarily to support respiratory health.[4] Consumers are perhaps more familiar with horehound in the form of cough drops or lozenges. In recent years, the herb has been revived as an ingredient of cocktails, particularly the "Rock and Rye," a classic American whiskey cocktail popular in the 1930s.[5]

* Herbal supplement sales estimates do not include herbal teas, plant-based natural cosmetic products ("cosmeceuticals"), or over-the-counter (OTC) medications with US Food and Drug Administration (FDA)-approved botanical ingredients (e.g., psyllium [*Plantago ovata,* Plantaginaceae] or slippery elm [*Ulmus rubra*, Ulmaceae] bark).

Table 2. Retail Channel Definitions		
	SPINS	***Nutrition Business Journal***
Mainstream Multi-Outlet (Mass Market)	In collaboration with IRI. This channel coverage includes the food, drug, and mass-market sector (or "FDM"; supermarkets, drugstores, and mass market retailers), military commissaries, and select buyer's clubs and so-called dollar stores. SPINS/IRI data does not include convenience store sales.	Mass market includes food/grocery, drug, mass merchandise, and club and convenience stores, including Walmart, Costco, etc.
Natural (Natural & Health Food)	These data do *not* include sales data from natural foods retail giant Whole Foods Market, which does not report its DS sales to SPINS or other market tracking firms.	Natural and health food include supplement and specialty retail outlets, including Whole Foods Market (estimates), GNC, sports nutrition stores, etc.
Direct Sales		Direct sales include internet, mail order (including catalogues), direct mail, and direct response TV and radio; practitioners representing conventional and alternative products selling to their patients, including ethnic and herbal shops; and multilevel marketing (MLM) and network marketing firms.

Boswellia, commonly known as Indian frankincense, also had a remarkable year in 2015. Although it ranked 39th on the list of top-selling herbal supplements in the mainstream channel, the herb experienced a 673.6% increase in sales from the previous year. Native to parts of India, the Middle East, and northern Africa, the boswellia tree contains an oily gum resin that can be extracted from the trunk and made into a highly prized incense. For thousands of years, the resin has also been used for its anti-inflammatory properties in the traditional Indian medical system of Ayurveda (see "Natural Channel" section for more about Ayurveda).[6] Today, boswellia supplements are marketed primarily for their anti-inflammatory properties.[7] In clinical trials, various boswellia preparations have shown promising effects in subjects with osteoarthritis,[8] asthma,[9] and colitis[10] (an inflammatory condition of the colon).

An article from the November 30, 2015, issue of *The New Yorker* described inflammation as the year's latest medical "craze," noting a significant increase in coverage by both popular news media and scientific publications. "This explosion in activity has captured the public imagination," the article noted.[11] "In best-selling books and on television and radio talk shows, threads of research are woven into cure-all tales in which inflammation is responsible for nearly every malady, and its defeat is the secret to health and longevity."

Boswellia was just one of the herbal ingredients that benefitted from this "cure-all craze" in 2015. Many boswellia supplements promoted for their anti-inflammatory actions also are formulated with turmeric. In 2015, turmeric had the fourth highest percentage increase in sales (+117.7%) of the mainstream channel's 40 top-selling herbal supplements. This yellow-orange spice contains curcumin, which, among many other properties, is an antioxidant, and which is thought to be responsible, in part, for turmeric's anti-inflammatory properties. Turmeric and/or curcumin preparations have been studied for their ability to relieve a number of inflammation-related conditions, such as rheumatoid arthritis, inflammatory bowel disease, and various neurodegenerative disorders.[12]

Other herbal ingredients in the mainstream channel with greater than 100% increases in sales in 2015 include ivy leaf (+129.4%), beta glucans (+127.4%), and fenugreek (+106.2%).

Total sales of ivy leaf supplements in 2015, particularly as children's syrups, were more than double the amount from the previous year. The German Commission E approved ivy leaf for the treatment of respiratory inflammation, and the herb has been a popular component of cough-relieving formulas in Europe for years.[1]

Table 3. Total Herbal Supplement Sales Growth in US by Channel				
	2013	**2014**	**2015**	**% Change from 2014**
Mass Market	$1.063 billion	$1.116 billion	$1.204 billion	7.9%
Natural & Health Food	$ 2.029 billion	$2.186 billion	$2.356 billion	7.7%
Direct Sales	$2.941 billion	$3.139 billion	$3.363 billion	7.2%
Source: *Nutrition Business Journal*				

Table 4. US Mainstream Multi-Outlet Channel — The 40 Top-Selling Herbal Supplements in 2015

Rank	Supplement[a]	Latin Binomial	Total Sales	% Change from 2014
1	Horehound[b]	*Marrubium vulgare*	$114,876,098.60	8.49%
2	Cranberry	*Vaccinium macrocarpon*	$65,740,230.58	16.00%
3	Echinacea[c]	*Echinacea* spp.	$60,152,943.11	7.37%
4	Garcinia Cambogia	*Garcinia gummi-gutta*	$54,766,924.82	-23.27%
5	Green Tea	*Camellia sinensis*	$48,929,485.99	-23.43%
6	Black Cohosh	*Actaea racemosa*	$42,929,678.09	-5.08%
7	Flax Seed / Flax Oil	*Linum usitatissimum*	$36,349,306.17	-1.39%
8	Ginger	*Zingiber officinale*	$25,590,130.36	21.84%
9	Valerian	*Valeriana officinalis*	$25,286,504.96	4.02%
10	Bioflavonoid Complex[d]	—	$24,616,714.50	24.45%
11	Green Coffee	*Coffea arabica*	$23,376,803.61	-40.71%
12	Yohimbe	*Pausinystalia johimbe*	$21,849,287.45	9.12%
13	Ivy Leaf	*Hedera helix*	$18,561,687.32	129.43%
14	Aloe Vera	*Aloe vera*	$17,139,917.01	1.48%
15	Saw Palmetto	*Serenoa repens*	$16,849,068.89	-6.39%
16	Milk Thistle	*Silybum marianum*	$16,788,900.22	2.63%
17	Garlic	*Allium sativum*	$16,466,734.75	8.42%
18	Plant Sterols[e]	—	$16,245,133.35	46.53%
19	Turmeric[f]	*Curcuma longa*	$15,735,163.31	117.71%
20	Cinnamon	*Cinnamomum* spp.	$14,589,283.66	2.22%
21	Guarana	*Paullinia cupana*	$13,933,288.31	38.90%
22	Fenugreek	*Trigonella foenum-graecum*	$13,597,897.64	106.17%
23	Yerba Maté	*Ilex paraguariensis*	$13,551,338.77	19.08%
24	Ginkgo	*Ginkgo biloba*	$12,810,391.82	14.82%
25	Elderberry	*Sambucus nigra*	$12,805,269.89	27.33%
26	Goji Berry	*Lycium barbarum*	$12,529,097.97	-12.51%
27	Açai	*Euterpe oleracea*	$11,987,243.68	-24.58%
28	Beta Glucans[g]	—	$11,919,522.82	127.42%
29	"Horny Goat Weed"	*Epimedium* spp.	$11,350,822.13	-9.14%
30	Rhodiola	*Rhodiola* spp.	$10,624,592.09	-25.26%
31	Ginseng[h]	*Panax* spp.	$10,560,083.15	-10.67%
32	Coconut Oil	*Cocos nucifera*	$10,267,296.23	8.49%
33	Red Yeast Rice	*Monascus purpureus*	$9,928,104.41	-10.25%
34	Senna[i]	*Senna alexandrina*	$9,658,807.45	9.78%
35	Chia Seed or Oil	*Salvia hispanica*	$7,430,557.25	-4.15%
36	Maca	*Lepidium meyenii*	$7,194,682.83	8.19%
37	Fennel	*Foeniculum vulgare*	$6,180,987.74	32.38%
38	St. John's Wort	*Hypericum perforatum*	$6,046,189.63	8.35%
39	Boswellin or Boswellia	*Boswellia serrata*	$5,966,582.75	673.63%
40	Isoflavones[j]	—	$5,059,123.64	-27.55%

Source: SPINSscan Natural/IRI. 52 weeks ending December 28, 2015.

[a] Herb coded as primary ingredient.
[b] Horehound is the primary ingredient in many throat lozenges that may contain other herbs and other non-herbal ingredients.
[c] Echinacea collectively refers to supplements made from roots and/or aerial parts of plants from three species in the genus *Echinacea*: *E. angustifolia*, *E. pallida*, and *E. purpurea*.
[d] Bioflavonoids are present in citrus fruits. Many bioflavonoid supplements are extracted and manufactured from citrus fruits (e.g., *Citrus reticulata* and *C. aurantium*.)
[e] This category does not include policosanol, beta-sitosterol, or octacosanol.
[f] Standardized turmeric extracts with high levels of curcumin are included under the primary ingredient turmeric.
[g] Beta glucans are a type of naturally occurring polysaccharides.
[h] Excludes eleuthero (*Eleutherococcus senticosus*), formerly referred to as "Siberian ginseng."
[i] All supplements currently being captured with senna as the primary ingredient in the herbal dietary supplement category are representative of herbal senna. SPINS does capture sales of OTC stimulant laxative drugs containing senna's active compounds, sennosides, as well, but uses a separate ingredient tag so as to avoid crossover; accordingly, OTC laxative drugs containing senna are not included in these data.
[j] Isoflavones are a type of phytoestrogens found in legumes and other foods.

In previous years, *HerbalGram* has chosen not to include beta glucans, but it was added back into the data set for 2015 to reflect the American Botanical Council's (ABC's) increased coverage of beneficial fungi and their constituents. Beta glucans are a class of biologically active compounds that are typically derived from mushrooms, yeasts, barley, oats, etc. Beta glucans have been studied for their immune-enhancing and anti-inflammatory properties, among others.[13,14] In the top-40 list of the mainstream channel's bestselling ingredients, several other herbs known for their immune-enhancing effects also saw increases, notably elderberry (+27.3%) and echinacea (+7.4%).

Fenugreek supplements were the fifth product in the mainstream channel that saw a more-than-100% increase in sales from 2014. The seeds and leaves of the sprouts are often used in Indian and other cuisines.[15] Fenugreek has been used traditionally to increase breast milk production, for sexual health, to relieve digestive symptoms, and, more recently, for blood sugar control in patients with type 2 diabetes.[16] In 2015, the results of several human studies of fenugreek were published, including one that found that a fenugreek seed extract could increase "sexual arousal and desire" in healthy women,[17] and another that suggested an enriched fenugreek seed extract could "enhance testosterone levels and sperm profiles" in men.[18]

Mainstream sales of many well-known herbal supplements, such as the seven originally targeted in the New York attorney general's investigation that began in February 2015, remained fairly stable in 2015. There was a less-than-15% change from 2014 sales for each of the following of these herbs: echinacea (+7.4%), garlic (+8.4%), ginseng (-10.7%), ginkgo (+14.8%), St. John's wort (+8.4%), saw palmetto (-6.4%), and valerian (4.0%).

Green coffee extract experienced the greatest percentage decrease in mainstream sales from 2014, with a 40.7% drop in 2015. Although it ranked 11th in overall sales, green coffee extract was one of numerous weight-loss supplements that experienced reduced sales in 2015. In the mainstream channel, consumers purchased fewer green tea (-23.4%) and garcinia (-23.3%) supplements in 2015 than they did in 2014. Notably, beginning in 2012, each of these three products has been promoted by Mehmet Oz, MD, on his daytime talk show "The Dr. Oz Show."[19] In a widely publicized hearing of the US Senate Subcommittee on Consumer Protection, Product Safety, and Insurance in June 2014, Senator Claire McCaskill (D-MO) criticized the evidence supporting these popular weight-loss products. Since that time, the "Dr. Oz Effect" that once boosted sales of these herbs has diminished significantly. Still, garcinia and green tea ranked fourth and fifth, respectively, in terms of overall 2015 sales in the mainstream channel.

Other herbal ingredients in the mainstream channel that saw significant percentage sales decreases in 2015 include isoflavones (-27.6%), rhodiola (-25.3%), and acai (-24.6%). Sales of rhodiola, an herb with clinically supported cognitive health benefits,[20] may have been impacted by another Senate hearing led by McCaskill. In July 2015, she chaired a subcommittee hearing on dietary supplement products that claim "to provide protection against Alzheimer's, dementia, stroke, memory loss and cognitive decline."[21] Although rhodiola supplements were not implicated in the hearing,[22] their decline in sales may reflect consumers distancing themselves from this product category in the second half of 2015, although this potential association is difficult to establish with any certainty.

In addition, researchers at the University of Illinois Urbana-Champaign published mixed findings in April 2015 related to soy (*Glycine max*, Fabaceae) consumption and cancer.[23] Their negative findings surrounding purified isoflavones may partially explain the drop in sales for this ingredient, which is typically derived from soy.

Finally, acai's diminished sales in 2015 — its third consecutive year of reduced sales — may, in part, be due to the proliferation of new "superfoods" rising to take its place.[24]

Sales figures for the categories "Chinese herbs" and "whole food concentrate" were not included in *HerbalGram*'s top-40 mainstream channel rankings due to their relative broadness. Had they remained on the list, Chinese herbs would have been the second top-selling supplement (with a 10% decline in sales from 2014) and whole food concentrate would have ranked 43rd in this channel (with an 11% sales decline from 2014). Individual formulations not primarily derived from botanicals — such as biotin (a B vitamin found in some plants) and blue-green algae (a type of cyanobacteria) — also were excluded. As the only branded supplement on the list, Relora (InterHealth Nutraceuticals Inc.; Benicia, California), a proprietary blend of magnolia (*Magnolia officinalis*, Magnoliaceae) and phellodendron (*Phellodendron amurense*, Rutaceae) bark extracts, was removed as well.

Natural Channel

The natural channel saw a 4% increase in sales in 2015, with a total of $365 million spent on herbal supplements (Table 5), according to SPINS. This increase is slightly smaller than 2014's 5.2% increase[1] and 2013's significant 9.9% increase in sales.[25] Sales in the natural channel tend to come from what marketers call "core shoppers," who are committed to a more natural lifestyle, including natural-health modalities. So-called "peripheral shoppers," who have less of a personal commitment to a natural-health philosophy, are more likely to purchase dietary supplements in the mainstream channel.

For the third year in a row, turmeric was the top-selling herbal dietary supplement in the natural channel in 2015, with total sales of $37,334,821. It also had the second-highest percentage sales growth (+32.2%) over the previous year's sales.

Ashwagandha experienced the highest percentage growth in the natural channel; sales of this traditional Indian herb in 2015 were 40.9% higher than they were in 2014. Ashwagandha has been used in the Ayurvedic system of medicine for thousands of years for a variety of purposes: to reduce stress, combat fatigue, strengthen the immune system, reduce inflammation, and boost cognition, among many others.[26] Ashwagandha sales likely benefitted from a number

Table 5. US Natural Channel — The 40 Top-Selling Herbal Dietary Supplements in 2015

Rank	Supplement[a]	Latin Binomial	Total Sales	% Change from 2014
1	Turmeric[b]	*Curcuma longa*	$37,334,821.31	32.18%
2	Grass (Wheat or Barley)	*Triticum aestivum* or *Hordeum vulgare*	$23,086,136.09	-3.66%
3	Flax Seed / Flax Oil	*Linum usitatissimum*	$17,904,263.93	-3.91%
4	Aloe Vera	*Aloe vera*	$15,150,739.36	1.57%
5	Elderberry	*Sambucus nigra*	$10,723,256.73	11.43%
6	Milk Thistle	*Silybum marianum*	$10,425,640.59	5.73%
7	Maca	*Lepidium meyenii*	$8,763,802.73	6.69%
8	Echinacea[c]	*Echinacea* spp.	$8,290,162.80	10.11%
9	Saw Palmetto	*Serenoa repens*	$7,555,434.83	10.14%
10	Oregano[d]	*Origanum vulgare*	$7,555,387.40	3.46%
11	Valerian	*Valeriana officinalis*	$6,198,523.14	5.92%
12	Garlic	*Allium sativum*	$5,932,820.98	4.40%
13	Ashwagandha	*Withania somnifera*	$5,722,568.89	40.91%
14	Cranberry	*Vaccinium macrocarpon*	$5,670,346.63	26.35%
15	Chlorophyll / Chlorella[e]	— / *Chlorella vulgaris*	$5,439,228.07	5.97%
16	Echinacea / Goldenseal Combination	*Echinacea* spp. / *Hydrastis canadensis*	$5,321,098.99	4.15%
17	Garcinia Cambogia	*Garcinia gummi-gutta*	$4,960,218.60	-47.85%
18	Horsetail	*Equisetum* spp.	$4,780,374.65	7.94%
19	Coconut Oil	*Cocos nucifera*	$4,707,164.08	9.48%
20	Ginkgo	*Ginkgo biloba*	$4,659,416.90	7.85%
21	Red Yeast Rice	*Monascus purpureus*	$4,238,757.42	1.57%
22	Chia Seed or Oil	*Salvia hispanica*	$4,226,328.67	-33.01%
23	Mushrooms	—	$4,042,910.91	20.13%
24	Fenugreek	*Trigonella foenum-graecum*	$4,015,291.89	-1.75%
25	Stevia	*Stevia rebaudiana*	$3,827,319.71	-7.61%
26	Holy Basil	*Ocimum tenuiflorum*	$3,723,035.48	1.07%
27	Black Cohosh	*Actaea racemosa*	$3,675,810.84	3.85%
28	Olive Leaf	*Olea europaea*	$3,525,421.48	9.77%
29	Evening Primrose	*Oenothera biennis*	$3,337,253.56	-2.93%
30	Cherry	*Prunus* spp.	$3,249,502.97	13.54%
31	Kelp	*Laminaria digitata*	$3,093,476.89	-6.71%
32	Kava	*Piper methysticum*	$3,064,565.49	14.29%
33	Ginseng	*Panax* spp.	$3,025,546.61	9.48%
34	Burdock	*Arctium lappa*	$2,585,051.18	4.75%
35	Rhodiola	*Rhodiola* spp.	$2,529,898.02	-7.17%
36	Green Tea	*Camellia sinensis*	$2,524,976.42	-5.44%
37	St. John's Wort	*Hypericum perforatum*	$2,461,234.54	3.34%
38	Cinnamon	*Cinnamomum* spp.	$2,453,648.73	-0.27%
39	Hawthorn	*Crataegus* spp.	$2,446,111.62	5.36%
40	Ginger	*Zingiber officinale*	$2,310,558.87	7.76%

Source: SPINSscan Natural. 52 weeks ending December 28, 2015.

[a] Herb coded as primary ingredient.
[b] Standardized turmeric extracts with high levels of curcumin are included under the primary ingredient turmeric.
[c] Echinacea collectively refers to supplements made from roots and/or aerial parts of plants from three species in the genus *Echinacea*: *E. angustifolia*, *E. pallida*, and *E. purpurea*.
[d] Includes oregano oil as well as oregano leaf tinctures.
[e] Coding for this category includes chlorophyll or chlorella single or combination products.

of positive studies published at the end of 2014 and during 2015 that supported some of these traditional uses. Published in December 2014, a systematic review and meta-analysis of five randomized clinical trials of ashwagandha for anxiety concluded that subjects taking the herb had "greater score improvements (significantly in most cases) than placebo in outcomes on anxiety or stress scales."[27] In addition, an eight-week randomized controlled trial published in December 2015 found that an ashwagandha root extract increased strength and muscle mass in 57 males undergoing resistance training.[28] In vivo and in vitro studies published in 2015 suggested ashwagandha's potential use in conditions ranging from Alzheimer's disease[29] to cancer.[30]

The popularity of turmeric and ashwagandha in the natural channel — as well as boswellia's 674% sales increase in the mainstream channel — reflects a broader trend in herbal dietary supplements in 2015: increased consumer familiarity with and acceptance of Ayurvedic herbs. These herbal ingredients, which have been used for millennia in India, have been formulated in a range of products, from herbal supplements to cosmetics.

Garcinia and chia seed/oil had the only two significant percentage sales drops in the natural channel in 2015. Garcinia sales in 2015 were 47.9% less than sales in 2014. Chia sales during the same period dropped 33.0%. This was the second consecutive year with reduced sales for chia; in 2014, chia sales had declined 1.2% from 2013 sales. Like acai in the mainstream channel, chia sales may have declined, in part, due to an oversaturation of newly-hyped superfoods (e.g., hemp, kelp, and matcha powder).[31] Furthermore, in January 2015, the Centers for Disease Control and Prevention linked a salmonella outbreak that sickened 31 people in the US to organic chia seed powder;[32] chia was again linked to a salmonella outbreak, this time in Canada, in December 2015.[33] Both incidences may have impacted sales. In addition, one small human study published in May 2015 found that chia seed oil had no positive impact on distance runners,[34] but an association of this study with chia sales declines cannot be made.

Direct Sales Channel

In 2015, direct sales of herbal supplements in the US increased by 7.2% to a total of more than $3.36 billion, according to NBJ. Growth in this channel was slightly more pronounced than the 6.4% sales increase in 2014 from the year before. Direct channel sales of herbal dietary supplements include multi-level marketing companies (also known as network marketing companies). This channel also encompasses mail and internet order sales companies, direct response TV and radio sales, and sales by health practitioners.

Single vs. Combination Herb Supplements

Overall, total sales of single-herb supplements (monopreparations) were higher than those of combination herb supplements in 2015, but combination products outpaced single-herb products in terms of sales growth, according to NBJ (see Table 6). Combination supplement sales in all channels grew 10.7% compared to the previous year, and sales of monopreparations increased by 5.5% from 2014. Combination herbal supplements have outpaced single-herb supplements in terms of percentage sales growth since 2011.

Combination formulas generally use a blend of herbs that are marketed for a specific benefit, including maintaining healthy blood sugar and/or blood lipid levels, and easing the effects of menopause, among many others. Herbal blends, such as those used in traditional Chinese medicine, have a long history of traditional use, and modern research continues to explore their efficacy.

Table 6. US Retail Sales of Single-Herb vs. Combination-Herb Products*

2013	Total Sales	% Total Sales	% Growth
Single Herbs	$3.789 billion	62.8%	6.2%
Combination Herbs	$2.244 billion	37.2%	10.8%
Total Herbs	$6.033 billion		7.9%
2014	**Total Sales**	**% Total Sales**	**% Growth**
Single Herbs	$4.024 billion	62.5%	6.2%
Combination Herbs	$2.418 billion	37.5%	7.7%
Total Herbs	$6.441 billion		6.8%
2015	**Total Sales**	**% Total Sales**	**% Growth**
Single Herbs	$4.245 billion	61.3%	5.5%
Combination Herbs	$2.677 billion	38.7%	10.7%
Total Herbs	$6.922 billion		7.5%

Source: *Nutrition Business Journal*
* Includes sales in all channels.

Conclusion

In a period of just three years, from 2012 to 2015, total annual retail sales of herbal supplements increased by more than $1.3 billion. Despite frequent negative media coverage of herbal dietary supplements in 2015, including coverage of the New York attorney general's investigation,[35] the crackdown on illegal drugs masquerading as "dietary supplements" by federal agencies in November, and some publications associating some products with potential adverse health effects[36] — total sales of the entire herbal dietary supplement category remained strong. In fact, 2015's 7.5% increase in overall sales represents the second highest percentage growth for these products in more than a decade. HG

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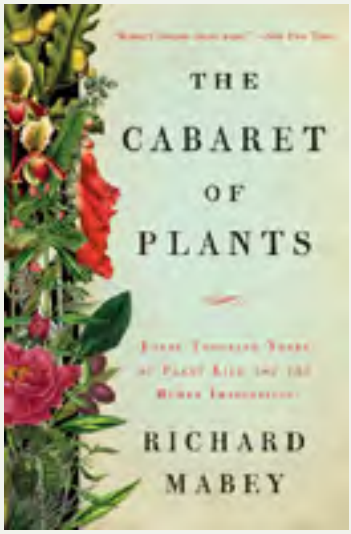
The Cabaret of Plants: Forty Thousand Years of Plant Life and the Human Imagination by Richard Mabey. New York, NY: W. W. Norton & Co Ltd.; 2016. Hardcover, 374 pages. ISBN: 978-0-393-23997-3. $29.95



Described by *The New York Times* as "Britain's foremost nature writer," Richard Mabey has produced another classic, one that is witty, erudite, wide-ranging, and compelling.

The Cabaret of Plants defies classification. This is a not a reference text, yet the book is scholarly, factual, and carefully researched. Beautifully illustrated and astutely designed, this is not a coffee table book, either. It could be seen as a biography of the plant kingdom. The style is detached yet personal, as Mabey weaves in anecdotes and reflections from a lifetime of exploring plants, their habits, and habitats — chiefly from his own backyard. Mainly it is a celebration, indeed a *Cabaret,* of plant life.

The pivotal theme of the book is the idea of plants as autonomous, yet linked to us by a common existence. Mabey evokes our enduring sense of wonder at their variability and adaptability. The vast Californian sequoias (*Sequoia sempervirens*, Cupressaceae), for example, continue to draw huge crowds of admirers, as do the giant Amazonian water lilies (*Victoria amazonica*, Nymphaeaceae) at the Royal Botanic Gardens, Kew. The huge, ribbed, floating leaves of these lilies inspired the structure of Joseph Paxton's Crystal Palace, which was built in Hyde Park, London, to house the Great Exhibition of 1851. "Plants, defined by their immobility, had evolved extraordinary life-ways by way of compensation: the power to regenerate after most of their body had been eaten; the ability to have sex by proxy; the possession of more than twenty senses whose delicacy far exceeded any of our own," Mabey writes.

Throughout the book, Mabey unravels the interwoven relationship between humans and plants. At pains to acknowledge that he is not a botanist, he nevertheless effortlessly and eloquently ranges between botanical science, natural history, literature, art history, paleontology, psychology, politics, and personal experience. The 40,000 years mentioned in the book's subtitle covers Ice Age relics and ancient cave art through current concerns about climate change and the central role of plants for survival. The dearth of Paleolithic depictions of plants, in contrast to the vitality of animal cave paintings, is attributed to plants' perceived lack of *animus*, or spirit. Not until the dawn of agriculture were plants represented as symbolizing the human life cycle.

The depiction of an enclosed garden in the biblical book of Genesis inspired early 17th-century botanic gardens as reconstructions of the lost order of Eden and the relationship between people and plants. Alongside the ensuing advancement of botanical science and taxonomy were waves of cultural shifts, from myth-making and the sentimental plant worship of the Victorians, through the rapacious collecting mania and destructive appropriation of plant species, to the current neo-liberal perception of nature as "natural capital," as a provider of ecosystem services.

Through references to art and literature, Mabey explores these themes. In William Wordsworth's poem *I Wandered Lonely as a Cloud*, daffodils (*Narcissus pseudonarcissus*, Amaryllidaceae) represent beauty and the human spirit. Romantic poets and writers viewed plants as existing for our delectation, with the extreme being John Ruskin, who was disgusted at the very idea of photosynthesis and the independent existence and reproduction of plants through insect pollination. However, Mabey does not review Ruskin's own accomplishments as a botanist and botanical artist.

According to Mabey, the olive (*Olea europaea*, Oleaceae) helped shape our visual sense and may have even stirred the birth of Impressionism. In many of their works of art, Cezanne, Van Gogh, and Renoir featured the olive in a Provencal setting. Renoir bought an olive grove to save it from destruction; now, ancient olives are sold off for vanity gardens of the rich and famous.

The book covers a range of subjects, including individual plant species, people, cults, bizarre events, and specific trees, such as the Fortingall yew (*Taxus baccata*, Taxaceae). Mabey maintains his humor when describing the egregious destruction of what proved to be the oldest known tree in the early 1950s: a Californian bristlecone (*Pinus longaeva*, Pinaceae). A geography graduate student used the tree, which was loved locally and known as "Prometheus," to study how growth rings can reveal climate information. When his boring drill got stuck, he felled the tree to retrieve his drill and cut a cross-sectional slice so as to count the rings at his leisure — there were more than 5,000. Mabey remarks, "Whatever its exact age, at the moment of its summary execution Prometheus then succeeded Methuselah as the oldest known tree in the world."

Geographically, the book spans continents, major mountain ranges, forests, and rivers. One remarkable English botanical artist, Margaret Mee, spent almost 15 years in Brazil painting the plants and campaigning against mineral companies, loggers, and government to expose their encroachments on and destruction of the Amazon forest. Its fragile ecosystem is depicted in Mee's acclaimed 1988 painting of the moonflower (*Selenicereus wittii*, Cactaceae), a cactus that blooms for just one night each year; it is depicted against an Amazonian full moon.

It is not difficult to think of animals as having a separate existence and independent survival strategies from humans, but the same is true for plants. Their potent chemicals

evolved for their benefit rather than ours. As the author comments, they simply do not need us in the same way that we need them. Plant breeding has revolutionized human habitations and the production and consumption of food. Yet plants such as maize (*Zea mays*, Poaceae) were already diverse before they were cultivated. Apples (*Malus* spp., Rosaceae) continue to evolve despite the commercial drive to uniformity.

In his final chapter on plant intelligence, Mabey tentatively explores current experiments on plant reactions to music, or to threats and violence. Monica Gagliano, an Australian ecologist, demonstrated apparent plant memory by training them to ignore "drop-and-jolt" stimuli.[1] Chemical communication allows plants to alert neighbors to danger whether by air-blown messages or through root systems. Suzanne Simard coined the term "wood-wide web" to describe cooperative systems of signaling and protection in forests.

In *The Cabaret of Plants*, Mabey celebrates the robustness, strategies, and independence of plant life. These persistent, adaptable organisms, he writes, provide "different models of being alive." HG

—Jacqueline Wootton
Founder and First Director, HerbMedPro
Former Director, Alternative Medicine Foundation
North Yorkshire, UK

Reference

1. Pollan M. The Intelligent Plant. *The New Yorker*. December 23, 2013. Available at: http://michaelpollan.com/articles-archive/the-intelligent-plant/. Accessed June 21, 2016.

Phytomedicines, Herbal Drugs, and Poisons by Ben-Erik van Wyk and Michael Wink, eds. Chicago, IL: University of Chicago Press; 2014. Hardcover, 304 pages. ISBN: 978-0-226-20491-8. $45.00.

This is a lovely reference book that is great fun to just browse through. The first third of the book is, in effect, a quick course in "Ethnobotany 101." These chapters contain discussions of traditional medical systems, phytomedicines, mind-altering drugs, plant poisons, extraction methods, quality control, and regulatory matters, among other topics.

The most interesting and unusual chapter (and longest, at 44 pages) is a quick course in phytochemistry titled "Overview of secondary metabolites." This chapter discusses eight categories of chemicals, including phenolics, organic acids, and amino acids. The only thing missing here, from my perspective, is any account of what functions these chemicals have for the plants that produce them. Nevertheless, it remains a rich and interesting account of the subject.

This precedes the core of the book, which consists of brief, half-page illustrated descriptions of 360 plants, arranged alphabetically by genus from the highly toxic precatory (*Abrus precatorius*, Fabaceae) to jujube (*Ziziphus jujuba*, Rhamnaceae). According to the authors, these plants are commercially relevant and well-known species, but it is not clear to me just how they chose what to include. I imagine that everyone will be disappointed by not finding particular favorites: I missed my old friends cranesbill (*Geranium maculatum*, Geraniaceae) and southern prickly ash (*Zanthoxylum clava-herculis*, Rutaceae). But I was pleased to find other friends, such as mayapple (*Podophyllum peltatum*, Berberidaceae) and uva-ursi, also known as kinnickinnick (*Arctostaphylos uva-ursi*, Ericaceae). Any such selection inevitably would both include and exclude someone's favorites.

The included plants are handled in a remarkably concise, but rich way. Each entry contains two photographs: one of the flowering or fruiting plant and one of the material as it is often found in commerce. The latter image is overlain by a chemical diagram of one of the most important chemicals found in the plant, such as arbutin in kinnickinnick, podophyllotoxin in mayapple, hypericin in St. John's wort (*Hypericum perforatum*, Hypericaceae), and caffeine in coffee (*Coffea arabica*, Rubiaceae).

Each monograph includes sections on classification (where and how it is used, where it is cited), uses and properties, origin, botany, chemistry, pharmacology, and toxicology. It's amazing what they can get on half a page!

The photographs are worth the price of the book. Such fine photography is a hallmark of van Wyk's books. The photographs in his classic *People's Plants: A Guide to Useful Plants of Southern Africa* (Briza Publications, 2000) and in my wife's favorite, *The Garden Succulents Primer* (Briza Publications, 2008), are all marvelous. Though perhaps not quite as artistic as Steven Foster's, they are at least as informative.

There is also a glossary of botanical, chemical, and other terms; several pages of further reading; and a very detailed index.

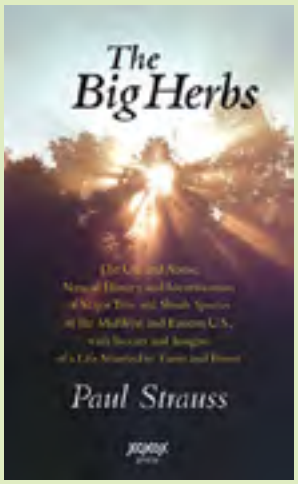
The editors say the book is "to be a handy desktop reference book." I recommend the book for casual, enlightening daily reading, two or three pages a day, with reference to the front matter, especially the chemistry. Anyone who cares about plants will deeply enjoy this book, a wonderful one-volume reference to hundreds of fascinating plants. HG

—Dan Moerman, PhD
William E. Stirton Professor Emeritus of Anthropology
University of Michigan – Dearborn
Ypsilanti, Michigan

New Book Profiles

The Big Herbs by Paul Strauss. Gambier, OH: XOXOX Press; 2014. Softcover, 205 pages. ISBN: 978-1-880977361. $25.00.

In *The Big Herbs*, Paul Strauss tells the story of how he returned to nature, reclaiming land in Appalachian southeastern Ohio devastated by strip mining and nurturing it back to its original wild and abundant nature. Strauss has spent 40 years bringing the land back to life, creating a sanctuary for both flora and fauna, and bringing high-quality botanical medicines to a growing audience. In "Part I: Conceiving Sanctuary," Strauss describes his trek across the American Southwest to learn from and be inspired by herbalists and Native American plant knowledge, the difficulties he faced in Ohio, and the slow but rewarding journey of seeing the land bloom again. "Part II: The Big Herbs" details the trees and shrubs that Strauss preserves on his sanctuary. These "big herbs" often are overlooked by herb books, but Strauss has a story behind the aspens (*Populus* spp., Salicaceae), oaks (*Quercus* spp., Fagaceae), maples (*Acer* spp., Aceraceae), and elms (*Ulmus* spp., Ulmaceae), and how humans can form a beneficial relationship with each one. "Part III: Maintaining Sanctuary" explores the duality of life and death on the land, as Strauss describes the natural disasters that both challenged and strengthened the ecosystem of his sanctuary.

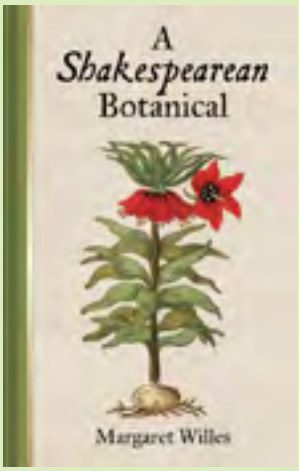


The Strains of War: A True Story, and Still Growing… by R. Gage Amsler. North Charleston, SC: CreateSpace; 2015. Softcover, 170 pages. ISBN: 978-1-5142599696. $14.95.

In his intensely personal autobiography, Gage "Doc" Amsler shares his experiences as a combat medic in Kuwait, Iraq, and Afghanistan and his struggles with post-traumatic stress disorder (PTSD). Since his discovery of a rare cannabis (*Cannabis* spp., Cannabaceae) cultivar in the Hindu Kush mountain range, Amsler has become a staunch advocate for veterans with PTSD and cannabis research, citing the poor quality of life of those affected, the lack of infrastructure for mental health care for veterans, and the untapped medicinal potential of cannabis. This book takes an on-the-ground look at the modern soldier, the fight for medicinal cannabis, and the daily realities of living with PTSD.

A Shakespearean Botanical by Margaret Willes. Chicago, IL: The University of Chicago Press; 2015. Hardcover, 200 pages. ISBN: 978-1-85124-437-9. $22.50.

William Shakespeare's enduring artistic legacy includes a deep knowledge of botanicals: He references fruits, herbs, vegetables, and flowers in his plays, giving insight into Elizabethan uses for plants in the home, garden, kitchen, and medicine cabinet. Willes presents Shakespeare's words with beautiful illustrations from his contemporary John Gerard, an herbalist (1545-1612). As Falstaff contrasts chamomile (*Matricaria recutita*, Asteraceae) to youth, Juliet fears the shrieking of mandrakes (*Mandragora officinarum*, Solanaceae), and Oberon uses pansies (*Viola tricolor*, Violaceae) to drug a sleeping Titania, Willes gives a fascinating history of Elizabethan botany.



Healing Ways: An Integrative Health Sourcebook by Matilde Parente. Hauppauge, NY: Barron's Educational Series; 2016. Softcover, 240 pages. ISBN: 978-1-4380-0637-6. $14.99.

Matilde Parente, MD, FCAP, guides patients through the intricacies of complementary health care, with an aim toward successfully integrating conventional medicine with natural therapies. In *Healing Ways*, she discusses how to combine mainstream medical therapies with high-quality, evidence-based alternative solutions, covering herbal medicine, acupuncture, traditional Chinese medicine, and many others. The book is arranged by modality and includes common-sense precautions to help readers choose the safest and most effective mode of care for their individual needs. The section about herbal supplements includes basic material on popular botanicals, with a list of resources where readers may seek out further information.

Rachel Perry
1938-2016

Natural cosmetics pioneer Rachel Perry passed away on March 13, 2016, after complications from chronic obstructive pulmonary disease. From 1977 to 2010, her company, Rachel Perry Inc., provided holistic skin care products that combined aromatherapy, natural ingredients, and color therapy through their eye-catching labels and designs. Perry was also a devoted environmentalist and animal rights activist who promoted sustainable harvesting techniques and rainforest preservation.

Born Carol Solat in New York City, Perry's family moved to Hollywood, California, when she was seven. As a teen, Perry decided to pursue a career in the music industry and began working for Coty Inc., a cosmetics company, to support herself. Through her work in cosmetics, she began to learn about dermatology and the chemistry of skin care, and saw promising results from natural and herbal preparations.

"I spend a great amount of my time studying books on dermatology, chemistry, and natural chemistry," Perry was quoted as saying in an *Awareness Magazine* article.[1] "I am always keeping up on the latest finds in health and nutrition because if it is good for the body, why not the skin?"

Working as a cosmetologist, Perry began teaching skin care classes and formulating her own recipes for facial scrubs in her kitchen. Her all-natural formulations were tested by her friends and students in conventional and unconventional ways. "One of my favorite memories is from back in the late 60s, when she was living in Laurel Canyon [Los Angeles] and conjuring up potions in her kitchen," recalled longtime friend Jorjana Kellaway (email to M. Blumenthal, June 1, 2016). "[Her boyfriend] got hungry in the middle of the night and got up to rummage through her refrigerator. In the morning, she was mortified to find that he had eaten a whole jar of her sea kelp facial scrub on crackers!"

Perry's students encouraged her to form her own line, which was originally called Potions Eternal and became Rachel Perry Inc. in 1977. The products' eye-catching packaging, with bold, bright colors and art-deco inspired label designs, followed what Perry called "Radiant Light Color Therapy," with each color aligning to one of the seven chakras. Each product also had soothing aromatherapeutic qualities, ensuring user engagement even before the product was applied.

"I was always very impressed by her personal excitement when expressing concepts and ideas she had for new skin care products," said Stephen Sturm of Threshold Enterprises (email, June 22, 2016). "I can still see the twinkle in her eyes when she would ask me to try a new creation that was still in the development stage. She created many innovative and exceptional products long before our industry had anything notable to offer."

The holistic quality of Perry's line was influenced by her love of music, as well. "To add to the phenomenon, natural and organic fragrance chemistry describes all aromas (scents/essences) as being made up of the top notes, middle notes, and bottom notes," Perry told *Awareness Magazine*. "This most certainly correlates to musical notes and chords as well as specific colors and fusions of color."

Perry, who was a member of the Rainforest Network, later introduced a line inspired by rainforest preservation that used only sustainably harvested rainforest products, the proceeds of which funded conservation efforts. In recognition of her achievements, Perry was a recipient of the Entrepreneur of the Year award from the Small Business Administration and appeared on the cover of the first issue of *Entrepreneurial Woman*.

In addition to her achievements in skin care and cosmetics, she earned a gold record for writing the song "Fine, Fine Day." The song was recorded by Roberta Flack and debuted on her 1977 album *Blue Lights in the Basement*.

"She was intelligent, creative, dynamic, energetic, effervescent, and brilliant," said Mark Blumenthal, founder and executive director of the American Botanical Council, and whose former herb company in Austin, Texas, was an early distributor of Perry's cosmetic line in the late 1970s and early 1980s. "One of the interesting and inspiring aspects of the natural products business is the quality of people who are attracted to it. I never met anyone like Rachel. She was one of a kind!"

Rachel Perry is survived by her husband, pianist and songwriter Jon Mayer. HG

—Hannah Bauman

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1. Walburger K. Rachel Perry Reveals Secrets of Reversing the Aging Process of Your Face! *Awareness Magazine*. March/April 2002. Available at: www.awarenessmag.com/marapr2/ma2_rachel_perry.html. Accessed June 16, 2016.

Horst Mueggenburg 1928-2016

Described as one of the herbal industry's early pioneers, Horst Mueggenburg passed away on April 30, 2016, at the age of 88. Following in his father Paul's footsteps as a botanical merchant, Mueggenburg's career took him all over the world, including to Argentina and the United States, and he played a crucial role in the development of the fledgling US herb market in the '70s and '80s.

"Our families go back at least three generations," said Peter Landes, co-owner of KHL Flavors and, along with Mueggenburg, one of the co-founders of the American Herbal Products Association (AHPA), "and I know that my father did business with Horst's father in Hamburg, Germany in the 1930s. He always spoke well of the Mueggenburgs" (email to M. Blumenthal, May 6, 2016).

Ben Zaricor, who partnered with Mueggenburg to found Botanicals International, a major US importer, processor, and distributor of botanicals and extracts, recalled Mueggenburg's impact on the herb industry. "He influenced the capabilities of the industry to meet the growing demand and the direction and level of development here in [the US]," Zaricor said (email to M. Blumenthal, May 7, 2016). "Without him in the very initial period, the blossoming of the industry would have been much slower and quite different. The other German suppliers were five to seven years behind Horst. ... He was willing to take risks."

Mueggenburg certainly did not shy away from risk in his life, personally and professionally. Born in Hamburg, he enlisted in the German army during World War II at the age of sixteen and was detained as a prisoner of war until the end of the conflict. Following the post-war depression in Germany, he made the decision to leave the continent entirely and formed a botanical import and export company, Plantadroga S.A., in Argentina. Friends and colleagues recalled his quick adoption of the Argentinian "gaucho" lifestyle. He often invited guests to his ranch, where he cultivated chamomile (*Matricaria recutita*, Asteraceae), milk thistle (*Silybum marianum*, Asteraceae), and rose (*Rosa* spp., Rosaceae) hips.

The concept of a US market for high-quality, pharmaceutical-grade herbal ingredients drove Mueggenburg's business interactions. Susan Patterson and Caroline MacDougall, both of whom worked for Celestial Seasonings tea company during the 1970s, remember Mueggenburg as a strategic thinker with energy and vision, as well as, according to Patterson, an "admirably wry sense of humor" (email to M. Blumenthal, June 14, 2016).

His insistence upon quality and integrity became his legacy. After forming Botanicals International with Zaricor, Kenneth Wilcox, Jay Hughes, and Jimmy Chan, Mueggenburg established an analytical laboratory in Hamburg, the trading company Addipharma, and Mueggenburg Extract, which he sold in 1998. In 2000, he founded the Horst Mueggenburg Foundation, which funds and encourages scientific research of the use of botanical materials in medicine. The Foundation is currently working with the Hamburg University Hospital to dedicate the child therapy and rehabilitation center in his honor and name.

"During my tenure running Celestial Seasonings herb purchasing department in the 70s, as well as serving on the Board of Directors of the Herb Trade Association, I had many occasions to work with Horst Mueggenburg," said Patterson. "Horst was an urbane, sophisticated thinker, and our discussions often took on a challenging, if not philosophical, tone, made all the more interesting by our sometimes very different points of view. I came to think of him as a Renaissance man and always looked forward to our time together."

"Horst loved his work and he was a force in the herb trade business, as he held a global vision [that] included establishing a company here in the US with other [US] partners," said MacDougall (email to M. Blumenthal, June 13, 2016). "He is remembered by many of us for both the fun and the serious moments we shared with him. We are thankful for all his energy and vision that propelled the herbal tea business forward."

Horst Mueggenburg is survived his wife Lieselotte, brother Gerhard, three sons, five grandchildren, and two great-grandchildren. His son Dirk continues his family's legacy as the third generation at Mueggenburg Botanicals, the company founded by Horst's father. HG

—Hannah Bauman

Publications

American Herb Association Quarterly Newsletter: $20/yr. AHA, P.O. Box 1673, Nevada City, CA 96969.

Australian Journal of Herbal Medicine: Quarterly publication of the National Herbalists Association of Australia (founded in 1920). Deals with all aspects of Medical Herbalism, including latest medicinal plant research findings. Regular features include Australian medicinal plants, conferences, conference reports, book reviews, rare books, case studies, and medicinal plant reviews. AUD/$96 plus AUD/$15 if required by airmail. National Herbalists Association of Australia, P.O. Box 696, Ashfield, NSW 1800, Australia.

Medical Herbalism: Subtitled "A Clinical Newsletter for the Herbal Practitioner." Edited by Paul Bergner. $36/yr, $60/2 yrs. Canada $39/yr. Overseas $45/yr. Sample/$6. Medical Herbalism, P.O. Box 20512, Boulder, CO 81308.

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Photo taken by Andie Kolbeck, MS, NC, in Sebastopol, California, with a 50mm lens at F1.8 with a Canon Rebel XSi.

San Pedro Cactus

Echinopsis pachanoi, Cactaceae

The San Pedro cactus, a plant with psychoactive properties, is a member of the genus *Echinopsis*, previously known as *Trichocereus*.[1] Native to the Andes Mountains, the high-altitude, columnar cactus has been used in Andean healing and religious ceremonies for more than 3,000 years, often in conjunction with other psychoactive plants, such as ayahuasca (*Banisteriopsis caapi*, Malpighiaceae; a psychoactive plant that is one of the principal components of the psychoactive, multi-plant mixture also known as ayahuasca). The San Pedro cactus contains several different psychoactive alkaloids, including mescaline, which is also found in the peyote (*Lophophora williamsii*, Cactaceae) cactus. Mescaline interacts with the central nervous system, producing visual hallucinations and, occasionally, tactile, olfactory, and auditory hallucinations.[2] Though the US government considers mescaline-containing plants in the genus *Echinopsis* "controlled substances," their cultivation for ornamental purposes is legal.

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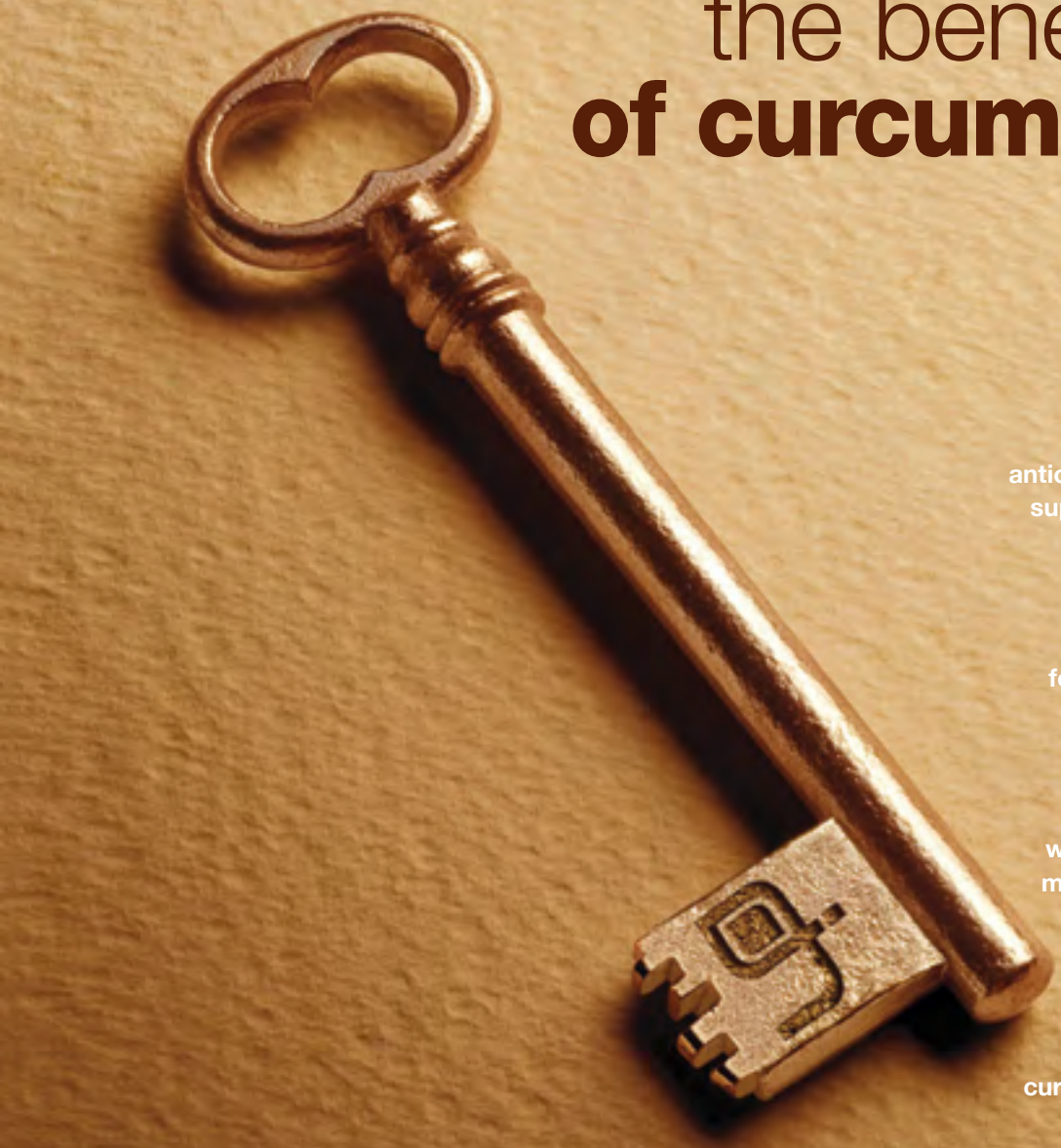

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