Devil's Claw Profile • Sustainable Wild Plant Harvesting • Rhodiola & Burnout
Chinese Herbs in Appalachia • Spearmint & Memory • ABC Herbal Excellence Awards

HERBALGRAM

The Journal of the American Botanical Council

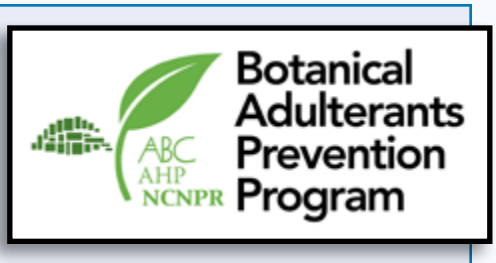
Number 118 May — June 2018

Joseph Banks' HISTORIC FLORILEGIUM

US/CAN $6.95

HerbalGram 118 • May – June 2018 Devil's Claw Profile • Sustainable Wild Plant Harvesting • Rhodiola & Burnout • Chinese Herbs in Appalachia • ABC Herbal Excellence Awards www.herbalgram.org

Join more than 200 responsible companies, laboratories, nonprofits, trade associations, media outlets, and others in the international herb and natural products/natural medicine community.



Become a valued underwriter of the ABC-AHP-NCNPR Botanical Adulterants Prevention Program, a multi-year, supply chain integrity program providing education about accidental and intentional adulteration of botanical materials and extracts on an international scale.

For more details on joining the program, and access to the free publications produced to date, **please see www.botanical adulterants.org or contact Denise Meikel at denise@herbalgram.org.**

Underwriters, Endorsers, and Supporters of the ABC-AHP-NCNPR Botanical Adulterants Prevention Program*

As of April 17, 2018

Financial Underwriters

21st Century Healthcare
AdvoCare International L.P.
Agilent Technologies, Inc.
Aloecorp, Inc.
Amen Clinics
Amway/Nutrilite Health Institute
Arbonne International
Arizona Nutritional Supplements
Artemis International, Inc.
Atrium Innovations
Aveda Corporation
Beachbody, LLC
BI Nutraceuticals
Bioceuticals
Bionorica SE
Biotropics Malaysia
Blackmores
Botanical Liaisons
Bruker BioSpin
Capsugel
Cepham, Inc.
Chemi Nutra
CNCA Health
Complete Phytochemical Solutions
Crila Health
dicentra, Inc.
Doctor's Best
Dr. Bronner's Magic Soaps
DolCas Biotech, LLC
dōTERRA International, LLC
Douglas Laboratories
Draco Natural Products
ECONET, Inc.
Emerson Ecologics
Enzymatic Therapy, Inc.
Ethical Naturals, Inc.
Eu Yan Sang International
EuroMed
EuroMedica
EuroPharma
Flavex Naturextrakte GmbH
Flordis
FoodState/MegaFood
Fruit d'Or
Gaia Herbs
GE Nutrients, Inc.
Ginsana SA
Global Health Industries
GNC, Inc.
Healthy Lifestyle Brands, LLC
Helios Corp.
Herb Pharm
Herbalife International, Inc.
Horphag Research
iHerb
Indena USA, Inc.
Indfrag Limited
Ingredient Identity
International Vitamin Corporation
Ixoreal Biomed Inc.
Jarrow Formulas
JDS Therapeutics LLC
Klaire Labs
Layn USA, Inc.
Linnea
Markan Global Enterprises, Inc.
Martin Bauer, Inc.
MediHerb / Integria Healthcare
Metagenics, Inc.
Mountain Rose Herbs
Natreon, Inc.
Natrol
Natural Alternatives International, Inc.
Natural Factors Nutritional Products, Inc./Bioclinic Naturals
Natural Grocers by Vitamin Cottage
Natural Partners, Inc.
Natural Remedies Pvt. Ltd.
Nature's Sunshine Products
Nature's Way
Naturetech
Naturex, Inc.
NBTY, Inc.
Nektium Pharma SL
Network Nutrition – IMCD
New Chapter, Inc.
The New Frontier Foundation Fund of the Greater Cedar Rapids CommunityFoundation
Ningbo Greenhealth Pharmaceutical Co., Ltd.
Novel Ingredients
NOW Health Group
Nu Skin Enterprises/Pharmanex
Nutraceutical Corp
Nutrition 21
OmniActive Health Technologies, Inc.
Organic India
Ortho Molecular Products
Pacific Nutritional Inc.
Paragon Laboratories
Pathway International Pty Limited
Perrigo Company
Pharmatoka SAS
Pharmavite, LLC
Phoenix Formulations
PLT Health Solutions, Inc.
Polyphenolics, Division of Constellation Brands, Inc.
Potter's
ProThera
Pure Encapsulations
Rainbow Light Nutritional Systems
RFI Ingredients, LLC
Rosenbush and Zimmerman Family Fund
Sabinsa Corporation
Schwabe North America
Seroyal
SFI Research
Shaklee Corp.
Soho Flordis International
SOHO Global Health
Standard Process, Inc.
Strategic Sourcing, Inc.
Thorne Research, Inc.
Tishcon Corp.
Traditional Medicinals, Inc.
Trust Transparency Center
TSI Group
Unigen
Univera, Inc.
Valensa International
V.D.F. FutureCeuticals
Verdure Sciences
Vitamin Shoppe
VitaQuest International
Whole Foods Market
ZMC-USA

Trade Associations

American Herbal Products Association (US)
Australian Self Medication Industry (Australia)
Australian Tea Tree Industry Association (Australia)
British Herbal Medicine Association (UK)
Canadian Health Food Association (Canada)
Complementary Medicines Australia (Australia)
Consumer Healthcare Products Association (US)
Council for Responsible Nutrition (US)
Global Curcumin Association (GCA)
International Alliance of Dietary/Food Supplement Associations (IADSA)
National Animal Supplement Council (US)
Natural Astaxanthin Association (NAXA)
Natural Products Association (US)
Natural Health Products New Zealand (NZ)
United Natural Products Alliance (US)

Nonprofit/Professional Associations

Academy of Integrative Health & Medicine
American Association of Naturopathic Physicians
American Herbalists Guild
American Society of Pharmacognosy
AOAC International
Council of Colleges of Acupuncture and Oriental Medicine
Homeopathic Pharmacopoeia Convention of the United States
Integrative Healthcare Policy Consortium
Irish Register of Herbalists (IRE)
National Institute of Medical Herbalists (UK)
Natural Health Products Research Society of Canada (NHPRS Canada)
Personalized Lifestyle Medicine Institute
Society for Medicinal Plant and Natural Product Research (GA)
US Pharmacopeia (USP)

Colleges/Universities

Bastyr University
Boucher Institute for Naturopathic Medicine
Center for Natural Products Technologies, College of Pharmacy, University of Illinois-Chicago
Hong Kong Baptist University's School of Chinese Medicine
Maryland University of Integrative Health
National University of Natural Medicine
Southwest College of Naturopathic Medicine
University of Bridgeport College of Naturopathic Medicine

Third-Party Analytical Laboratories

Alkemist Labs
NSF AuthenTechnologies
Bent Creek Institute
BotaniCert (France)
British Columbia Institute of Technology
ChromaDex
Covance Laboratories
Creative Accord, LLC
Eurofins Scientific Inc.
Flora Research Labs
NSF International
PhytoLab (Germany)
Spectrix Labs
Tampa Bay Analytical

Media

Alive Publishing Group
Delicious Living
Engredea
Holistic Primary Care
IMPACT Health Media, Inc.
Informa Exhibitions US
Integrator Blog
Media Relations, Inc.
Modern Healthcare Practitioner
Natural Foods Merchandiser
Natural Medicine Journal
Natural Products INSIDER
Newhope360.com
Nutraceuticals World
NutraingredientsUSA.com
Nutrition Business Journal
Nutrition Industry Executive
Nutritional Outlook
Vitamin Retailer
WholeFoods Magazine

Law Firms & Regulatory Consultants

Amin Talati & Upadhye, LLC
Greenberg Traurig, LLP (James Prochnow)
Law Office of Holly Bayne, P.C.
Robert Forbes & Associates
Susan Brienza, LLC
Ullman, Shapiro & Ullman, LLP

Contract Research Organizations

KGK Synergize

Research Institutes

Korean Ginseng Research Institute
Shanghai Research Center for TCM Modernization/Shanghai Institute of Materia Medica of the Chinese Academy of Sciences

*By acknowledging the generous support of these companies and organizations, ABC, AHP, and NCNPR are not endorsing any ingredients or products that may be produced or marketed by them.

dear *reader*

In this issue we feature beautiful engravings of botanicals that come from Captain James Cook's first historic voyage to the South Pacific in the 18th century. The head botanist on Cook's *HMS Endeavour* was Joseph Banks, who, after the voyage, produced 743 copper-plate engravings based on the artwork of Sydney Parkinson, who skillfully depicted many of the plants collected during the *Endeavour*'s circumnavigation of the Earth. The engravings are known as Banks' Florilegium and were printed and published in color for the first time in the 20th century.

Publisher Thames & Hudson's new book, which recently received the 2017 ABC James A. Duke Excellence in Botanical Literature Award in the consumer/popular category, includes 147 of these prints, making them available to the public for the first time. Thanks to Thames & Hudson for providing nine beautiful prints from the book, and to *HerbalGram* Assistant Editor Connor Yearsley for his compelling and in-depth account of this important contribution to the world's botanical knowledge.

Many medicinal and aromatic plants are harvested from wild populations in areas all over the world. Accordingly, the issue of sustainability and appropriate harvest of wild plants has become increasingly important in the botanical industry. Guest author Chuck Peters, PhD, a botanist at the New York Botanical Garden, writes about his 35 years of experience in assisting tropical communities with scientific methods to survey and safeguard future availability of economically important wild plant populations.

This issue's herb profile describes devil's claw from the deserts of southern Africa. The plant's secondary tubers have been used traditionally for analgesic and other properties. Numerous clinical trials support the plant's ability to relieve lower back pain and symptoms of osteoarthritis. As always, we are grateful to ABC's Gayle Engels and Traditional Medicinals' Josef Brinckmann for compiling traditional, pharmacopeial, and modern research information on this botanical medicine.

We also offer an extensive review of the book that received the 2017 ABC James A. Duke Excellence in Botanical Literature Award in the reference/technical category: a massive tome on the identification of Chinese traditional herbs and drugs with about 3,000 color photos. The groundbreaking book is the product of an almost 20-year collaboration between botanists at the Royal Botanic Gardens at Kew and the Institute of Medicinal Plant Development (IMPLAD), a major research center in Beijing, China.

Besides the two books that received ABC's recognition this year, ABC awarded the Norman R. Farnsworth Excellence in Botanical Research Award to Professor Raphael Mechoulam, PhD, and its Varro E. Tyler Commercial Investment in Phytomedicinal Research Award to the French company Pharmatoka. These and other ABC awards are described in this issue.

The myth of the unregulated herb industry in the United States is a theme we've addressed in previous years, with a seminal article on the numerous ways that herbs are regulated as dietary supplements by federal agencies in issue 93. In this issue, Karen Raterman writes on how the American Herbal Products Association (AHPA), the leading trade association in the US that deals primarily with herbs, has implemented numerous self-regulatory initiatives. Establishing voluntary policies and standards for responsible members of industry in various key areas in which they have expertise is a common practice in most industries. This article explains AHPA's pioneering work on self-regulation, including the standardization of common names for herbal products and its publishing of a highly reliable guide to herb product safety labeling, plus numerous other policies and programs intended to guide its members in practices of responsible commerce.

And finally, this space in our previous issue was devoted entirely to my tribute to ABC co-founder, the beloved ethnobotanist Jim Duke, PhD. There was not space to discuss our publication of the systematic review of 19 clinical trials on ivy leaf extract, a phytomedicine of increasing popularity for its potential benefit for cough and upper respiratory tract infections. We frequently summarize systematic reviews and meta-analyses in our Research Reviews section, but this is only the second time ABC has published an original systematic review on a specific herb (the first was a review of clinical trials on ginkgo extract in normal, healthy adults in issue 67).

Mark Blumenthal

AMERICAN BOTANICAL COUNCIL

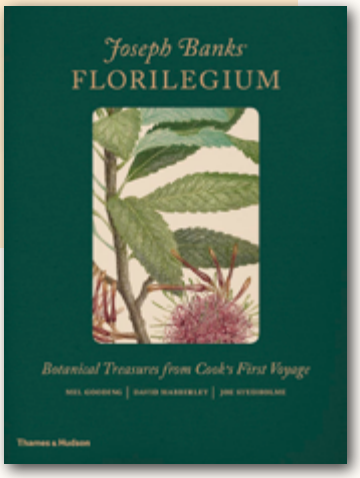
NOW IN OUR 30th YR

Mission: Provide education using science-based and traditional information to promote responsible use of herbal medicine—serving the public, researchers, educators, healthcare professionals, industry, and media.

ABC Advisory Board

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

HERBALGRAM
The Journal of the American Botanical Council



Top image: *Dysoxylum spectabile*, Kohekohe, Meliaceae, *Handbook of the New Zealand Flora*. Copper plate by Gerard Sibelius, based on Frederick Nodder's undated watercolor, derived from Parkinson's surviving pencil drawing.

Book cover courtesy Thames & Hudson.

When the *HMS Endeavour* set out from Plymouth, England, in 1768 on Captain Cook's first of three historic around-the-world voyages, 25-year-old Joseph Banks, a high-spirited, rakish civilian, was in tow. Banks was an extremely wealthy fellow of the Royal Society of London and recruited a small, highly skilled team to help him document the natural history encountered during the nearly three-year voyage to the South Pacific and back. Among Banks' team was Scottish artist Sydney Parkinson, who skillfully depicted many of the plant specimens that were collected. After the voyage and Parkinson's tragic death, Banks had 743 copper-plate engravings made from Parkinson's artwork. But Banks did not live to see the engravings, now known collectively as Banks' Florilegium, published. In fact, they were printed and published in color for the first time in the late 20th century. Thames & Hudson's new book, which received the 2017 James A. Duke Excellence in Botanical Literature Award in the consumer/popular category, provides a stunning sample of 147 of these prints, making them available to the general public for the first time, almost 250 years after the voyage. This feature article includes nine of the historic prints from the book.

departments

On the Cover

Bougainvillea, *Bougainvillea spectabilis*, on the Caribbean island of Saint Lucia. Photo ©2018 Steven Foster

***HerbalGram*® is printed on recycled paper at Craftsman Printers, Inc. Lubbock, Texas**

Published by the American Botanical Council, P.O. Box 144345, Austin, TX 78714-4345.

Subscriptions to *HerbalGram* are a benefit of ABC membership at every level. One year memberships: Individual $50; Academic $100; Professional $150; Organization $250; Retailer $250; HerbClip Service $600; Small Business; Sponsor. Add $20 for memberships outside of the U.S. Student and Senior discounts are available. For information about Small Business or Sponsor Memberships, contact Denise Meikel at denise@herbalgram.org or 512-926-4900.

Devil's Claw

Harpagophytum procumbens, H. zeyheri

Family: Pedaliaceae

INTRODUCTION

A weedy, spreading perennial with gray-green, lobed leaves, devil's claw (*Harpagophytum procumbens* and *H. zeyheri*) emerges in the rainy season from a fleshy, central tap root, which has additional lateral, tuberous roots. The trumpet-shaped flowers have been described as entirely red, purple, or pink, or any of these colors, with a yellow base and throat. The fruit, which gives the plant its common name, has numerous long arms with sharp, hooked thorns that cling to passing animals and aid in its dispersal.[1-3] *Harpagophytum procumbens* can be distinguished from *H. zeyheri* to some extent by the shape of the leaves,[4] but also by the length of the arms of the fruit; the arms of *H. procumbens* fruit are longer than the width of the fruit, and the arms of *H. zeyheri* fruit are shorter than the width of the fruit.[1] The fleshy secondary roots of these species have been used interchangeably in South African folk medicine, as they have similar chemical constituents.[1]

Devil's claw is indigenous to deciduous forests and arid savannah areas of southern Africa and occurs between 15 degrees and 30 degrees latitude in Namibia, Botswana, South Africa, and Angola, and also to a lesser extent in Zambia, Zimbabwe, and Mozambique.[5] In commerce, devil's claw root is supplied by the two main species: *H. procumbens* and *H. zeyheri*.[6] Although several subspecies are described in the literature, overlaps in habitat coupled with potential introgressive hybridization complicate subspecies identification and differentiation.[4] "Devil's claw root" is defined in the *European Pharmacopoeia* (PhEur) as the cut and dried, tuberous secondary roots of *H. procumbens* and/or *H. zeyheri*.[7] In 2009, it was estimated that 55% (208,286 kg) of Namibia's devil's claw root exports were *H. zeyheri*, while 45% (170,416 kg) were *H. procumbens*.[8]

Devil's Claw
Harpagophytum procumbens
Photo ©2018 Steven Foster

More than 90% of the global supply of devil's claw root comes from wild collection in Namibia, with smaller amounts from Botswana, Angola, and Zambia. Roots need to be at least four years old before they are ready to harvest. While cultivation trials began in the 1970s, the first devil's claw farm was established in 1997 by Professor Earle Graven of Grassroots Natural Products at Groenvlei Farm in Western Cape, South Africa (N. Gericke personal communication, March 2, 2018). South Africa's Plant Production Directorate states that commercial devil's claw plantations were first established in South Africa and Namibia in 2002,[9] and that these farms still account for a relatively small percentage of the total commercial trade. Devil's claw root sourced from Namibia is harvested mostly by members of rural communities in communal areas, such as in the Kavango, Caprivi, Otjozondjupa, and Omaheke regions.[10]

HISTORY AND CULTURAL SIGNIFICANCE

Devil's claw root tuber is a traditional medicine of the San and Khoikhoi peoples of southern Africa. San names for devil's claw include *//x'aatataba** and *tloutaxaba*. In the Afrikaans language, spoken in Namibia and South Africa, the plant is called *Duiwelsklou*, which phonetically is very similar to the names used in Dutch (*Duivelsklauw*), English (devil's claw), and German (*Teufelskralle*).[10]

In his 1822 book *Travels in the Interior of Southern Africa*, English botanist and naturalist William John Burchell (ca. 1781-1863) referred to devil's claw as "grapple plant" and initially placed it in the genus *Uncaria* (Rubiaceae). Burchell also assigned the species name *procumbens* from the Latin word meaning "prostrate" or "lying down."[11] The genus name *Harpagophytum* stems from the Greek words *Harpagos*, meaning "grappling hook," and *phyton*, meaning "plant."[12] Sometime between 1824 and 1839, Swiss botanists Augustin Pyramus de Candolle (1778-1841) and son Alphonse de Candolle (1806-1893) nullified *Uncaria* and placed the species into the *Harpagophytum* genus.[13] The de Candolles (DC) made their findings available to another Swiss botanist, Charles Frédéric Meissner (1800-1874), when Meissner was preparing his own work, *Plantarum vascularium Genera* (1836-1843).[14] Thus, Meissner first published the genus name *Harpagophytum* DC around 1840,[15] which explains why the botanical name used today (i.e., *H. procumbens* [Burch.]

* The // symbol represents the lateral click in some Khoisan languages.

DC. ex Meissn) includes abbreviations of all three botanists involved in the nomenclature evolution from *Uncaria* to *Harpagophytum*. As for the second species of devil's claw, Belgian botanist Joseph Decaisne (1807-1882) assigned the species name *zeyheri*,[16] which referred to the German botanist Karl Ludwig Philipp Zeyher (1799-1858), who had worked extensively in southern Africa.

The tuber has been used traditionally as a laxative and to treat arthritic and blood conditions, headache, fever, indigestion, pain after childbirth, and malaria.[2,3,17] It is considered an analgesic, and a devil's claw ointment is applied topically to boils, sprains, sores, and to ease childbirth. It has been used as a bitter tonic and for its anti-inflammatory properties, both internally and externally.[3] Devil's claw preparations also have folk uses in diabetes, gout, and tuberculosis, as a mouthwash for bleeding gums, and for hypertension, menstrual cramps, peptic ulcers, snakebites, lumbago (lower back pain), and wound and burn healing.[2,18]

European awareness of devil's claw as an effective therapeutic agent reportedly traces back to observations of a German soldier-cum-farmer in Namibia, Gottreich Hubertus Mehnert (1880-1967), who was interested in devil's claw and other local medicinal plants used by the Nama people.[19] Dr. phil. nat. Otto Heinrich Volk (1903-2000) also played a central role while he was a prisoner of war from 1940 to 1944 at the Internment Camp Andalusia in Bloemfontein, South Africa.[20] There, he met Mehnert, the initial marketer of a devil's claw herbal tea called "Harpago-Tee," and other German scientists including botanist Heinrich Johann Wilhelm (Willi) Giess (1910-2000), who made color illustrations of devil's claw during internment in Andalusia.[21] In the 1950s, the Mehnert family sent samples of devil's claw root for analysis to Volk and Prof. Dr. Paul Tunmann, at that time both working at the University of Würzburg Institute of Pharmacy and Food Chemistry, and also to Prof. B. Zorn at the University of Jena (former East Germany). In 1957, Zorn carried out studies in rats with formaldehyde-induced arthritis and demonstrated anti-arthritic action from subcutaneous injection as well as oral ingestion of a decoction of the roots. In 1962, Tunmann co-authored a paper on the constituents of devil's claw root, and, in 1964, Volk published information on its ecology, harvesting and yields, macroscopic description, and traditional uses.[22,23]

Commercial harvesting of devil's claw began in the early 1960s in Namibia and Botswana. The formal export trade commenced in 1962 when the Namibian company Harpago Proprietor Limited began exporting dried devil's claw root tubers to the German company Erwin Hagen Naturheilmittel GmbH, mainly for the production of herbal medicinal tea products indicated for the treatment of arthritis and rheumatism.[24] Commercial harvesting in South Africa began closer to the end of the 20th century.[25]

In the United Kingdom, a monograph titled "Harpagophytum" was published in part three of the second edition of the *British Herbal Pharmacopoeia* in 1981, with therapeutic indications including rheumatism, arthritis, gout, myalgia (muscle pain), fibrositis (an outdated term for fibromyalgia), lumbago, and pleurodynia (sudden occurrence of stabbing chest pain or abdominal pain attacks).[26]

Therapeutic uses approved by the German Commission E authority in a 1989 monograph (revised in 1990) for devil's claw root tuber (*südafrikanische Teufelskrallenwurzel* – Harpagophyti radix), prepared as an herbal tea infusion or equivalent preparations, were for loss of appetite, dyspepsia, and as supportive therapy of degenerative disorders of the locomotor system.[27] Also in 1989, a quality standards monograph titled "Harpagophyton" entered the 10th edition of the *French Pharmacopoeia*,[28] followed by the addition of a monograph for devil's claw dry extract (*Extrait d'Harpagophytum sec* – Harpagophyti extractum siccum) in 1992.[29] In 1990, French health authorities approved the oral and topical use of devil's claw root tuber as a traditional herbal medicine used for symptomatic treatment of minor painful articular conditions.[30] In Germany, a quality standards monograph first entered the second supplement to the 10th edition of the *German Pharmacopoeia* (DAB 10.2) in 1993.[31]

In 1994, the European Directorate for the Quality of Medicines (EDQM) published its first draft quality stan-

Devil's Claw
Harpagophytum procumbens
Photo ©2018 Henri Pidoux

dards monograph for devil's claw root (Harpagophyti radix PhEur) for public comment.[32] Three years later, in 1997, an official monograph entered the third edition of the PhEur, at that time specifying *H. procumbens* only.[33] However, in the 1970s, Prof. Dr. Franz-Christian Czygan and Almuth Krüger at the Institute of Botany and Pharmaceutical Biology, University of Würzburg, carried out studies, published in *Planta Medica*, which concluded that due to the lack of significant differences in anatomy, morphology, and histochemistry, the secondary root tubers of both species should be accepted as equivalent sources of the herbal drug Harpagophyti radix.[34] In 2000, researchers at Finzelberg GmbH (Andernach, Germany) carried out a retrospective study of retention samples of Harpagophyti radix (from 1995 to 1999) using a new analytical method that could chemically differentiate the two species, and found that batches were composed of either *H. procumbens* or *H. zeyheri* or, in some cases, mixtures of both species.[35]

In recognition of these facts, and with awareness that the commercial supply of devil's claw originated from either *H. procumbens* or *H. zeyheri* (or a combination of both), the monograph was corrected in PhEur 4 (2002) in order to formally add the second species, *H. zeyheri*. In 2006, the EDQM published a draft monograph for devil's claw root dry extract, after which the final monograph was added to PhEur 6 in 2008. With the entering of these monographs into the PhEur, former monographs of the national pharmacopeias of Germany and France were retired. In 2007, a comprehensive monograph (quality and therapeutics) for "Radix Harpagophyti" entered volume three of the *WHO Monographs on Selected Medicinal Plants*.[36]

Also in the early 21st century, national labeling standards monographs of European Union (EU) member states, such as the aforementioned German Commission E monographs, became superseded by new monographs of the European Medicines Agency (EMA). The EMA initially published a labeling standards monograph for devil's claw root in 2008 (which was superseded by a revised monograph in 2016), applicable when used as an active ingredient of registered traditional herbal medicinal products (THMPs) in the European Union.[37]

CURRENT AUTHORIZED USES IN COSMETICS, FOODS, AND MEDICINES

In the EU, registered THMPs composed of Devil's Claw Root PhEur prepared in the dosage forms of herbal tea infusion, tincture (1:5), liquid extract (1:1), soft extract (2.5-4.0:1), or in solid dosage forms containing Devil's Claw Root Dry Extract PhEur, may be labeled and marketed for "relief of minor articular pain" and "relief of mild digestive disorders such as bloating and flatulence and where there is temporary loss of appetite," at the dosages prescribed in the EMA labeling standards monograph.[37]

In Canada, devil's claw root is regulated as an active ingredient of licensed natural health products (NHPs), which require pre-marketing authorization from the Natural and Non-prescription Health Products Directorate (NNHPD). Labels of licensed NHPs prepared from PhEur-quality devil's claw may carry the following claim statements: "Traditionally used in Herbal Medicine as a bitter to help stimulate appetite;" "Traditionally used in Herbal Medicine to help relieve digestive disturbances such as dyspepsia;" and "Used in Herbal Medicine to help relieve joint pain associated with osteoarthritis."[38] Additionally, devil's claw is listed as an active ingredient in the NNHPD's "Multiple Ingredient Joint Health Products" monograph.[39]

In the United States, devil's claw root may be used as a component of dietary supplement products, which require US Food and Drug Administration notification within 30 days of marketing if a structure-function claim is made and product manufacturing that adheres to current Good Manufacturing Practices (cGMPs).[40] It should be noted that *H. procumbens* is considered a pre-1994 old dietary ingredient and is listed in the American Herbal Products Association's *Herbs of Commerce*, 2nd ed. (although the book's disclaimer states that listing of a species is not, in and of itself, evidence that the species was marketed in the United States before October 15, 1994).[41] Due to a lack of awareness in the early 1990s that both species or mixtures of both species were being imported into the United States labeled as *H. procumbens*, coupled with the lack of an analytical method that could differentiate the two species at the time, *H. zeyheri* was inadvertently omitted from the *Herbs of Commerce*.

MODERN RESEARCH

The characteristic bitter taste of devil's claw root is due to iridoid constituents such as harpagoside. In the late 1970s, initial studies in Germany found bitterness values between 5,000 and 12,000 using the method of the eighth edition of the *German Pharmacopoeia* (DAB 8, 1978). Due to a correlation between bitterness and harpagoside content, it was suggested at that time that therapeutic-quality devil's claw root should have a minimum harpagoside content of 0.5% and a minimum bitterness value of 6,000.[23] Today, for use in medicinal products, the PhEur requires devil's claw root to contain a minimum 1.2% harpagoside content, but does not prescribe a bitterness value.[7] Using a bitterness test adapted from PhEur and World Health Organization methods, Olivier and van Wyk (2013) determined bitterness values ranging from 1,440 to 14,400 in samples of *H. procumbens*, and suggested that the traditional uses of devil's claw may be attributable, in part, to a bitter tonic (*amarum*) effect (i.e., the stimulation of gastric juices by way of the vagus nerve).[42] Mncwangi et al. (2014) compared harpagoside levels of the two official species by analyzing 348 samples obtained from 10 different localities in three countries (South Africa, Namibia, and Zimbabwe). Significant variation in harpagoside content was found, ranging from 0.17% to 4.37% in *H. procumbens* samples, and from 0.00% to 3.07% in *H. zeyheri* samples. Only 41% of the *H. procumbens* samples and 17% of the *H. zeyheri* samples met the PhEur standard of a minimum 1.2% harpagoside content.[43]

Published in 2012, a thorough review of the ethnobotany, phytochemistry, and biological activity of *H. procumbens* confirmed the presence of iridoid glycosides (harpagoside, harpagide, procumbide, procumboside, 8-*O*-p-coumaroyl-harpagide, and 6'-*O*-p-coumaroylprocumbide) as well as harpagoquinones, amino acids, flavonoids, phytosterols, and carbohydrates. This review also substantiated that *H. procumbens* exerts anti-inflammatory, analgesic, antioxidant, anti-diabetic, antimicrobial, antimalarial, anticancer, cardiovascular, central nervous system, and uterotonic effects. The authors opine that while the phytochemistry of the species is well researched, research on the additive or synergistic effects of the major compounds is lacking.[44]

They state that "*Harpagophytum zeyheri* is a close taxonomic ally of *H. procumbens* but *H. procumbens* is the favoured species of commerce, and contains higher levels of the pharmacologically active constituents. The two are used interchangeably and *H. procumbens* raw material is often intentionally adulterated with *H. zeyheri* and this may [have an] impact on the efficacy of inadequately controlled health products." Use of the term "adulterated," however, is problematic in that the PhEur expressly defines devil's claw root as the tuberous secondary roots of *H. procumbens* and/or *H. zeyheri*. The authors also discuss botanical and chemical identification of *H. zeyheri* and quality control methods that can be used to avoid substitution when a customer specifies one species over the other.[44]


Devil's Claw
Harpagophytum procumbens
Photo ©2018 Steven Foster

Chrubasik and Wink (1998)[45] reported on early clinical studies in the 20th century that investigated the efficacy of devil's claw extracts in improving osteoarthritis (OA) of the hip, knee, fingers, and spine[46,47]; rheumatic joint pain[48,49]; and lower back pain (LBP).[50-52] All of these studies showed positive outcomes in pain reduction with specific dosages of either 1.5% to 3% iridoid glycosides or 30-100 mg harpagoside.

An article by Tankred Wegener in *HerbalGram* issue 50 (2000)[53] discussed the results of six of the studies mentioned above[46-50,52] and addressed four more. One randomized, controlled trial demonstrated improvements in pain and the Lequesne index (a measurement of the severity of OA) over six months of treatment with 2.6 g dried tuber per day (Harpadol; Arkopharma; Carros, France).[54] A double-blind, placebo-controlled study showed reduction of pain in radiating LBP in a dose-dependent manner, with patients receiving a devil's claw preparation that contained 100 mg harpagoside (WS 1532; Dr. Willmar Schwabe; Karlsruhe, Germany) twice daily for four weeks experiencing the greatest relief.[55] In an uncontrolled study, patients with OA and rheumatoid arthritis who took a daily dose of 750 mg powdered tubers (Arkogélules Harpagophyton; Arkopharma; Carros, France) for 30 days achieved significant improvement in symptoms.[56] In another uncontrolled study, 13 seropositive arthritis patients who took 1.23 g per day of devil's claw extract (no additional information provided) attained insignificant improvements in grip strength and flexibility.[57]

Since 2000, at least four systematic reviews have evaluated studies from the late 20th and early 21st centuries that investigated the effects of devil's claw on OA and LBP. In one that reviewed studies on *H. procumbens* as a treatment for OA,[58] the authors identified eight observational studies, two comparator studies, and four randomized, double-blind, placebo-controlled studies[47-49,59] that "provide some support for the potential therapeutic value" of devil's claw in treating OA, despite "a considerable number of methodologic caveats that make further clinical investigations warranted."

In a 2007 systematic review of randomized, controlled trials of herbal medicines used for non-specific LBP, Gagnier et al. concluded that "Two high-quality trials utilizing *Harpagophytum procumbens* (devil's claw) found strong evidence for short-term improvements in pain and rescue medication for daily doses standardized to 50 mg or 100 mg harpagoside with another high-quality trial demonstrating relative equivalence to 12.5 mg per day of rofecoxib" (a nonsteroidal anti-inflammatory drug [NSAID] that has since been withdrawn from the market due to adverse effects).[60] However, in a 2016 follow-up review, Gagnier et al. downgraded the two studies that compared devil's claw to placebo[50,51] to "low quality" based on "imprecise data" and sample sizes of less than 400. They also downgraded the study that compared devil's claw to rofecoxib[61] to "very low quality" based on problems with allocation concealment and compliance, and its small sample size.[62] Oltean et al. (2014) reviewed the same studies and stated that, while devil's claw appeared to reduce pain more than placebo, evidence was "of moderate quality at best" and that researchers should follow the Consolidated Standards of Reporting Trials (CONSORT) statement extension when reporting studies on herbal medicine interventions.[63]

One randomized, double-blind, placebo-controlled study published in 2017 investigated the efficacy of a combination product in treating symptoms of gonarthritis (OA of the knee). Rosaxan (MA212; Medagil Gesundheitsgesell-

schaft mbH; Friedrichshafen, Germany) contains 20 g rose hip (*Rosa canina*, Rosaceae) ripe fruit puree, 4 g *R. canina* ripe fruit juice concentrate derived from fruit puree, 160 mg stinging nettle (*Urtica dioica*, Urticaceae) leaf dried aqueous extract (10:1), and 108 mg *H. procumbens* or *H. zeyheri* root dried aqueous extract. For 12 weeks, patients (N = 92) with clinically diagnosed unilateral or bilateral gonarthritis and moderate pain symptoms consumed either 40 mL of Rosaxan or placebo daily. At baseline, six weeks, and 12 weeks, Western Ontario and McMaster Universities Arthritis Index (WOMAC) scores, quality of life (QoL) ratings, and analgesic consumption were recorded. The test group experienced a significant improvement in WOMAC scores from baseline compared to placebo. Additionally, both physical and mental QoL ratings improved significantly with Rosaxan compared to placebo, and there was a trend toward taking less pain medication in the test group.[64]

FUTURE OUTLOOK

From 1992 to 2013, Namibia exported more than 9,500 tons of dried devil's claw root, with an average annual export quantity of approximately 435 tons. The main importing countries between 2009 and 2013 were France, Italy, Germany, Poland, Spain, and South Africa.[65]

In 2000, there was a proposal from Germany to list *Harpagophytum* species in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Ultimately, the proposal was rejected because, at the time, insufficient data were available covering the extent, distribution, age, and biology of devil's claw populations that would confirm the need for protection under CITES.[65] Furthermore, the range states (i.e., the exporting countries) rejected the proposal, in part due to concerns about potential negative impacts on the livelihoods of impoverished and marginalized communities that depend on the devil's claw trade for income.[66] In the meantime, *Harpagophytum* species became protected in Namibia under Schedule 9 of the Nature Conservation Ordinance, and, in 2010, the Namibian government ratified a devil's claw resource management policy, which is enforced by the Ministry of Environment and Tourism (MET). Per this policy, permits are required for all stages of devil's claw production, with the wild harvesting and sale of devil's claw permitted only between March 1 and October 31. In addition, traders and exporters are required to pass a test and be registered with MET.[65] In Botswana, *Harpagophytum* species are protected under the Agricultural Resources Conservation Act. Harvest, trade, and export of devil's claw from South Africa also require a permit. Similar legislation for the protection of devil's claw wild populations has been enacted in Zambia, but not in Angola.

Namibia's continual development of legislation for implementation of the *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilisation* is likely to impact devil's claw trade relationships in the future.[67] An Interim Bioprospecting Committee (IBPC) was established in 2007 to focus on the issue of access and benefit sharing (ABS) in the use of genetic resources such as Namibian indigenous medicinal plants, including devil's claw. The IBPC was established for Namibia to fulfill its obligations under the Convention on Biological Diversity (CBD) and to facilitate ABS agreements for commercial use of indigenous knowledge and associated genetic resources. The aim is for local and indigenous communities to benefit from the use of their traditional knowledge, practices, and innovations.[68]

Over the past 20 years, Namibia has made significant investments in implementing policies and practices necessary for sustainable resource management and trade of its indigenous plant products, most notably devil's claw root. This includes frameworks for protecting the traditional ecological and medical knowledge of indigenous communities for commercial access and use of genetic resources like devil's claw. Namibia also has seen an increase in devil's claw production operations that implement international sustainability standards such as organic and fair trade. For example, several Namibian devil's claw wild harvesting operations (Balyerwa Conservancy, Dzoti Conservancy, Kwandu Conservancy and Community Forest, Masida Community Forest, and Wuparo Conservancy) have organic wild crop certification as per the US Department of Agriculture's National Organic Program (NOP).[69] Additionally, organic farms like EcoSo Dynamics (Okahandja, Namibia) are marketing both cultivated and wildcrafted devil's claw root with "Fair for Life – Social & Fair Trade Certification,"[70] and operations in Zimbabwe like Organic Africa are implementing the Ethical BioTrade Standard for sustainable wild collection of devil's claw.[71]

For a wild medicinal plant of southern Africa that has been commercialized and exported for only about 60 years, significant progress has been made in understanding the chemical composition, quality grades, and appropriate therapeutic uses of devil's claw. The range states, Namibia in particular, with the local and indigenous communities that make their livelihoods by managing genetic plant resources, appear to be laying the groundwork necessary for equitable and sustainable trade and use of devil's claw. HG

—Gayle Engels and Josef Brinckmann

References

1. van Wyk B-E, van Oudtshoorn B, Gericke N. *Medicinal Plants of South Africa.* Arcadia, Pretoria, South Africa: Briza Publications; 1997.
2. van Wyk B-E, Gericke N. *People's Plants: A Guide to Useful Plants of Southern Africa.* Arcadia, Pretoria, South Africa: Briza Publications; 2000.
3. Iwu M. *Handbook of African Medicinal Plants.* Boca Raton, FL: CRC Press; 1993.
4. Ihlenfeldt HD, Hartmann H. Die Gattung Harpagophytum (BURCH.) DC. ex MEISSN. (Monographie der afrikanischen Pedaliaceae II). *Mitt Staatsinst Allg Bot Harnburg.* 1970;13:15-69.
5. Hachfeld B, Schippmann U. Conservation data sheet 2: Exploitation, trade and population status of *Harpagophytum procumbens* in southern Africa. *Medicinal Plant Conservation.* 2000;6:4-9.

6. Strohbach M, Cole D. *Population Dynamics and Sustainable Harvesting of the Medicinal Plant Harpagophytum procumbens in Namibia. Results of the R+D Project 800 86 005.* Bonn, Germany: German Federal Agency for Nature Conservation; 2007.
7. European Pharmacopoeia Commission. *European Pharmacopoeia, Ninth Edition, Supplement 9.5 (PhEur 9.5).* Strasbourg, France: European Directorate for the Quality of Medicines; 2018.
8. Millennium Challenge Account Namibia. Devil's claw. *INP Market Bulletin.* September 2010(1):2-3.
9. Plant Production Directorate. *Devil's Claw Production Guideline.* Pretoria, South Africa: Department of Agriculture, Forestry and Fisheries 2015.
10. Brinckmann JA. Taking a closer look at the devil's claw trade from Namibia. *Market News Service (MNS) for Medicinal Plants & Extracts.* September 2010:7-12.
11. Burchell WJ. *Travels in the Interior of Southern Africa, Volume I.* London, England: Printed for Longman, Hurst, Rees, Orme, and Brown; 1822.
12. Eckel PM, ed. Correspondence of Peter MacOwan (1830–1909) and G. W. Clinton (1807–1885). *Res Botanica, Missouri Botanical Garden Web site.* 2015.
13. de Candolle AP, de Candolle A. *Prodromus Systematis Naturalis Regni Vegetabilis, sive, Enumeratio contracta ordinum generum specierumque plantarum huc usque cognitarium, juxta methodi naturalis, normas digesta.* Paris, France: Sumptibus Sociorum Treuttel et Würtz; 1824-1873.
14. Little EL. Three proposals toward stabilization of botanical nomenclature. *Taxon.* 1957;6(7):188-194.
15. Meissner CF. *Plantarum Vascularium Genera : secundum ordines naturales digesta eorumque differentiae et affinitates tabulis diagnostacis expositae.* Lipsiae (Leipzig): Libraria Weidmannia; 1836-1843.
16. Muzila M. *Doctoral Thesis: Genetic, Morphological and Chemical Variation in the Genus Harpagophytum*. Alnarp, Sweden: Department of Plant Breeding Swedish University of Agricultural Sciences; 2016.
17. Brendler T, Gruenwald J, Ulbricht C, Basch E. Devil's Claw (*Harpagophytum procumbens* DC): an evidence-based systematic review by the Natural Standard Research Collaboration. *J Herb Pharmacother.* 2006;6(1):89-126.
18. Neuwinger H. *African Traditional Medicine: A Dictionary of Plant Use and Applications.* Stuttgart, Germany: medpharm GmbH Scientific Publishers; 2000.
19. Ender U. Gottreich Hubertus Mehnert. 2014; http://www.namibiana.de/namibia-information/who-is-who/autoren/infos-zur-person/gottreich-hubertus-mehnert.html. Accessed April 3, 2018.
20. Glen HF, Perold SM. Obituaries: Otto Heinrich Volk (1903–2000). *Bothalia.* 2000;30(2):215-218.
21. Kolberg H, Strohbach B. Obituary: Heinrich Johann Wilhelm Giess (1910-2000). *Dinteria.* 2000;26:146-150.
22. Boje K. *Phytochemische und biopharmazeutische Untersuchungen an Harpagophytum procumbens DC.* . Münster, Germany: Pharmazeutische Biologie und Phytochemie, Westfälischen Wilhelms-Universität Münster 2002.
23. Wegener T. *Zur klinischen Wirksamkeit der südafrikanischen Teufelskrallenwurzel (Harpagophyti radix) bei Patienten mit Cox- und Gonarthrose. Ergebnisse und Bewertung einer klinischen Studie der Phase IV*. Rheda-Wiedenbrück, Germany: Biologie / Gesundheitswissenschaften, Universität Osnabrück; 2005.
24. Mosoabisane MFT. *Variation in chemical composition of Harpagophytum species as a function of age and locality*. Bloemfontein: Department of Chemistry Faculty of Agricultural and Natural Science University of the Free State Bloemfontein 2009.
25. Raimondo D. The devil's claw and CITES. *CITES World - Official Newsletter of the Parties.* 2002(9):11-12.
26. British Herbal Medicine Association Scientific Committee. *British Herbal Pharmacopoeia.* 2nd Edition. Keighley, England: British Herbal Medicine Association; 1981.
27. Blumenthal M, Busse WR, Goldberg A, et al., eds. *The Complete German Commission E Monographs—Therapeutic Guide to Herbal Medicines.* Austin: American Botanical Council; Boston: Integrative Medicine Communication.1998.
28. Committee on Herbal Medicinal Products (HMPC). Assessment report on *Harpagophytum procumbens* DC. and/or *Harpagophytum zeyheri* Decne., radix. London, UK: European Medicines Agency; 2016.
29. Commission nationale de pharmacopée. *Pharmacopée française.* 10e édition. Saint-Denis, France: Agence Française de Sécurité Sanitaire des Produits de Santé (AFSSAPS); 1992.
30. Ministère des Affaires Sociales et de la Solidarité. Médicaments à base de plantes médicinales. Avis aux fabricants concernant les demandes d'autorisation de mise sur le marché. *Bulletin officiel No. 90/22* 1990.
31. Wenzel P, Wegener T. Teufelskralle. Ein pflanzliches Antirheumatikum. *Dtsch Apoth Z* 1995;135(13):1131-1144.
32. European Pharmacopoeia Commission. Devil's claw root. *Pharmeuropa.* 1994;6:243-244.
33. European Pharmacopoeia Commission. *Europäisches Arzneibuch 3. Ausgabe 1997.* Stuttgart / Eschborn: Deutcher Apotheker Verlag / Govi-Verlag - Pharmazeutischer Verlag GmbH; 1997.
34. Czygan F-C, Krüger A. Pharmazeutisch-biologische Untersuchungen der Gattung Harpagophytum. 3. Mitteilung: Zur Verteilung des Iridoid-Glycosids Harpagosid in den einzehzen Organen von Harpagophytum procumbens DC und Harpagophytum zeyheri DECNE *Planta Medica.* 1977;31(4):305-307.
35. Feistel B, Gaedcke F. Analytische Identifizierung von Radix Harpagophyti procumbens und zeyheri. *Zschr Phytother.* 2000;21:246-251.

36. World Health Organization. *WHO Monographs on Selected Medicinal Plants.* Vol 3. Geneva: World Health Organization; 2007.
37. Committee on Herbal Medicinal Products (HMPC). *European Union herbal monograph on* Harpagophytum procumbens *DC. and/or* Harpagophytum zeyheri *Decne., radix.* London, UK: European Medicines Agency; 2016.
38. Natural and Non-prescription Health Products Directorate. *Devil's Claw - Harpagophytum.* Ottawa, Ontario: Health Canada; 2017.
39. Natural and Non-prescription Health Products Directorate. *Multiple Ingredient Joint Health Products.* Ottawa, Ontario: Health Canada; 2014.
40. US Food and Drug Administration. 21 CFR Part 111 Current Good Manufacturing Practice in Manufacturing, Packaging, Labeling, or Holding Operations for Dietary Supplements; Final Rule. *Federal Register.* 2007;72(121):34752-34958.
41. McGuffin M, Kartesz JT, Leung AY, Tucker AO. *American Herbal Products Association's Herbs of Commerce.* 2nd ed. Silver Springs, MD: American Herbal Products Association; 2000.
42. Olivier DK, van Wyk BE. Bitterness values for traditional tonic plants of southern Africa. *J Ethnopharmacol.* 2013;147(3):676-679.
43. Mncwangi NP, Viljoen AM, Zhao J, Vermaak I, Chen W, Khan I. What the devil is in your phytomedicine? Exploring species substitution in *Harpagophytum* through chemometric modeling of 1H-NMR and UHPLC-MS datasets. *Phytochemistry.* 2014;106:104-115.
44. Mncwangi N, Chen W, Vermaak I, Viljoen AM, Gericke N. Devil's Claw–a review of the ethnobotany, phytochemistry and biological activity of *Harpagophytum procumbens*. *J Ethnopharmacol.* 2012;143(3):755-771.
45. Chrubasik S, Wink M. Treatment of osteoarthritic pain with herbal drugs. *8th World Congress The Pain Clinic*. Bologna, Italy: Monduzzi Editore SpA; 1998.
46. Belaiche P. Etude clinique de 630 cas s'arthrose traite ar le nebulisat aqueus d'*Harpagophytum procumbens* (Radix). *Phytotherapy.* 1982;1:22-28.
47. Guyader M. Les plantes antirheumatismales. Etudes historique et pharmakoligique, et etude clinique du nebulisat d'*Harpagophytum procumbens* DC chez 50 patients arthrosiques suivis en service hospitalier. (Dissertation). Paris, France: Universite Pierre et Marie Curie.; 1984.
48. Schmelz H, Hämmerle D, Springorum H. Analgetische Wirkung eines Teufelskrallenwurzel-Extraktes bei verschiedenen chronisch-degenerativen Gelkenkerkrankungen. In: Chrubasik S, Wink M, eds. *Rheumatherapie mit Phytopharmaka.* Stuttgart, Germany: Hippokrates-Verlag; 1997:86-89.
49. Lecomte B, Costa J. *Harpagophytum* dans l'arthrose: Etudes en double insu contre placebo. *37°2 Le Magazine.* 1992;15:27-30.
50. Chrubasik S, Zimpfer C, Schutt U, Ziegler R. Effectiveness of *Harpagophytum procumbens* in treatment of acute low back pain. *Phytomedicine.* 1996;3(1):1-10.
51. Chrubasik S, Junck H, Breitschwerdt H, Conradt C, Zappe H. Effectiveness of *Harpagophytum* extract WS 1531 in the treatment of exacerbation of low back pain: a randomized, placebo-controlled, double-blind study. *Eur J Anaesthesiol.* 1999;16(2):118-129.
52. Chrubasik S, Schmidt A, Junck H, Pfisterer M. Wirksamkeit und Wirtschaftlichkeit von Teufelskrallenwurzelextrakt bei Rückenschmerzen: Erst Ergebnisse einer therapeutischen Kohortenstudie. *Forsch Komplementärmed.* 1997;4:332-336.
53. Wegener T. Devil's claw: From African traditional remedy to modern analgesic and antiinflammatory. *HerbalGram.* 2000; 50:47-54.
54. Chantre P, Cappelaere A, Leblan D, Guedon D, Vandermander J, Fournie B. Efficacy and tolerance of *Harpagophytum procumbens* versus diacerhein in treatment of osteoarthritis. *Phytomedicine.* 2000;7(3):177-183.
55. Chrubasik S, Junck H, Conradt C, Zappe H, Chrubasik J. Effectiveness of oral *Harpagophytum* extract WS 1531 in treating low back pain. *Arthr Rheum.* 1998;41(suppl. 9):S261.
56. Pinget M, Lecomte A. Die wirkung der "Harpagophytum Arkocaps" bei degenerativen rheuma. *Naturheilpraxis.* 1997;50:267-269.
57. Grahame R, Robinson BV. Devils's claw (*Harpagophytum procumbens*): pharmacological and clinical studies. *Ann Rheum Dis.* 1981;40(6):632.
58. Brien S, Lewith G, McGregor G. Devil's claw (*Harpagophytum procumbens*) as a treatment for osteoarthritis: a review of efficacy and safety. *J Altern Complement Med.* 2006;12(10):981-993.
59. Frerick H, Biller A, Schmidt U. Hip osteoarthritis: double-blind study with devil claw [in German]. *Der Kassenarzt.* 2001;5:34-41.
60. Gagnier J, van Tulder MW, Berman B, Bombardier C. Herbal medicine for low back pain: a Cochrane review. *Spine (Phila Pa 1976).* 2007;32(1):82-92.
61. Chrubasik S, Model A, Black A, Pollak S. A randomized double-blind pilot study comparing Doloteffin and Vioxx in the treatment of low back pain. *Rheumatology (Oxford).* 2003;42(1):141-148.
62. Gagnier J, Oltean H, van Tulder MW, Berman B, Bombardier C, Robbins C. Herbal medicine for low back pain: a Cochrane Review. *Spine (Phila Pa 1976).* 2016;41(2):116-133.
63. Oltean H, Robbins C, van Tulder MW, Berman BM, Bombardier C, JJ. G. Herbal medicine for low-back pain. *Cochrane Database Syst Rev.* 2014(12):CD004504.
64. Moré M, Gruenwald J, Pohl U, Uebelhack R. A *Rosa canina – Urtica dioica – Harpagophytum procumbens/zeyheri* combination significantly reduces gonarthritis symptoms in a randomized, placebo-controlled double-blind study. *Planta Med.* 2017;83(18):1384-1391.
65. Cole D. *Indigenous Plant Products in Namibia.* Windhoek, Namibia: Venture Publications; 2014.
66. Setshogo MP. To list or not to list? Arguments for and against listing *Harpagophytum* species on Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). *J Med Plants Res* 2013;7(48):3492-3498.
67. Suleman KK. *The interface between access and benefit-sharing and biotrade in Namibia: exploring potential areas of synergy.* Johannesburg, South Africa: South African Institute of International Affairs (SAIIA); 2017.
68. Ndeinoma A, Wiersum KF, Arts B. The governance of indigenous natural products in Namibia: A policy network analysis. *Environ Manage.* 2018.
69. Organic INTEGRITY Database. USDA Agricultural Marketing Service; 2018. https://organic.ams.usda.gov/integrity/. Accessed February 9, 2018.
70. Certified operators. Fair for Life – Social & Fair Trade Certification Programme. 2018. http://www.fairforlife.org. Accessed February 9, 2018.
71. KAITE Pvt. Ltd. *Annual self-assessment against UEBT membership obligations.* Amsterdam, The Netherlands: Union for Ethical BioTrade; 2014.

Verdure Sciences Adopts Pomegranate through ABC's Adopt-an-Herb Program

The American Botanical Council (ABC) welcomes Verdure Sciences' adoption of pomegranate (*Punica granatum*, Lythraceae) through ABC's Adopt-an-Herb botanical education program.

Verdure Sciences' adoption supports ABC's extensive HerbMedPro database, ensuring that this essential educational resource remains up to date for researchers, health professionals, industry, students, consumers, and other members of the herbal and dietary supplements community.

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, spices, and medicinal plants.

"Pomegranate is highly recognized for its antioxidant properties and has become increasingly popular with the masses over the past decade," wrote Kristen Marshall, marketing coordinator for Verdure Sciences. "It is important to continue to strive for excellence in the industry, even with a well-established ingredient like pomegranate."

She also noted that expanding research and emerging evidence are supporting the safety and efficacy of punicalagins (characteristic antioxidant constituents of the pomegranate fruit). According to Marshall, Verdure Sciences believes the adoption is important because Pomella Extract, the company's branded, patented, and proprietary standardized pomegranate extract, was developed to deliver punicalagins and other beneficial metabolites to the body.

"Verdure is excited to partner with ABC to recognize the increasing clinical initiatives on pomegranate and curate scientific and clinical research into HerbMedPro through this adoption," Marshall continued.

Ajay Patel, founder and CEO of Verdure Sciences, wrote: "It is our responsibility to strive for continuous improvement by ensuring that supplements have proven identity, are safe, and meet label claims."

According to Patel, pomegranate adulteration is a growing concern that can be addressed with effective traceability programs and by testing raw materials with validated methods. "In addition to focusing on sound quality-control practices and traceability, we must create supplements that deliver clinically efficacious doses of active compounds," Patel added. The company believes the adoption will help achieve these goals.

ABC Founder and Executive Director Mark Blumenthal said: "ABC is deeply grateful to Verdure Sciences for its generous adoption of pomegranate on ABC's HerbMedPro database. Pomegranate's popularity in beverages and dietary supplements has made it a major food and dietary ingredient in international markets. Verdure's adoption of pomegranate will allow ABC to keep up with the scientific and clinical literature on pomegranate for the benefit of scientific researchers, industry members, and consumers."

ADOPT-AN-HERB
HerbMedPro™ PROGRAM

About Pomegranate

Pomegranate is a multi-stemmed shrub or small tree that can grow to more than 20 feet tall. It has been cultivated for millennia for its edible, orange-sized fruits and as an ornamental plant. Native to Persia, pomegranate reportedly was one of the first domesticated fruit crops, along with fig (*Ficus* spp., Moraceae), date palm (*Phoenix dactylifera*, Arecaceae), grape (*Vitis vinifera*, Vitaceae), and olive (*Olea europaea*, Oleaceae). The species was cultivated and naturalized throughout parts of the Mediterranean region at such an early date that it sometimes has been considered indigenous to some of these areas. Pomegranate, which is fairly drought-tolerant and generally adapts well to a wide range of climate and soil conditions, was domesticated independently in various locations.

There is evidence that pomegranate was domesticated in the Middle East about 5,000 years ago. Pieces of pomegranate peel from the Early Bronze Age were discovered at Jericho and Arad (both in present-day Israel). In addition, excavations of the Uluburun shipwreck, a shipwreck thought to be from the 14th century BCE (the Late Bronze Age) that was discovered in 1982 off the Mediterranean coast of present-day Turkey, yielded remains of pomegranate among the cargo. In 1323 BCE, a pomegranate-shaped silver vase and painted ivory pomegranate spoon were among more than 5,000 objects that were entombed with the Egyptian King Tutankhamun. To the Egyptians at the time, pomegranate symbolized the promise of an afterlife. Pomegranate also was mentioned in Homer's *Odyssey* as being a fruit common to the gardens of Phoenicia and Phrygia.

In his *Naturalis Historia*, the first-century Roman naturalist Pliny the Elder wrote: "The branches of the pomegranate keep away snakes, the little buds neutralize the stings of scorpions, and the fruit is in request for easing the nausea of women with child." Also in the first century, the Greek physician Dioscorides, in his *De Materia Medica*, recommended pomegranate to treat various ailments, including earaches and ulcers.

VERDURE SCIENCES®

Pomegranate
Punica granatum

The pomegranate is significant in the religions of Buddhism, Christianity, Hinduism, Islam, Judaism, and Zoroastrianism. It often is associated with fertility and invincibility. Some scholars believe that it was a pomegranate, not an apple (*Malus* spp., Rosaceae), that the serpent used to tempt Eve in the biblical Book of Genesis, since apples are not believed to be native to the geographical area of the Eastern Mediterranean.

The common name "pomegranate" derives from the Latin *pomum*, meaning "apple," and *granatum*, meaning "seeded" or "many seeded." The Romans reportedly called the species *malum punicum*, meaning "apple of Carthage," which evolved to *Punicum granatum*. Eventually, 18th-century Swedish botanist Carl Linnaeus assigned the Latin binomial *Punica granatum* to the species.

More information about pomegranate can be found on the pomegranate adoption page in ABC's HerbMedPro database and its HerbMedPro record.

About Verdure Sciences

Established in 1997, Noblesville, Indiana-based Verdure Sciences is a supplier of plant-based ingredients. The company's commitment to quality control and its global procurement network enable it to offer both new and traditional ingredients with traceability and scientific validity, according to its website. The company believes in the intrinsic synergy of plants that have been used as medicine for centuries. It focuses on developing what it calls "natural spectrum" extracts that reflect a plant's natural phytochemical profile. A research network of universities, medical centers, and laboratories helps Verdure Sciences develop its ingredients. The company screens ingredients for biological activities, safety, and chemical characterization. It also evaluates the environmental impact of sourcing botanical raw materials. Ingredients that meet the company's initial criteria are then evaluated with a variety of studies, often including human clinical research. Verdure Sciences serves and supplies customers around the world with botanical ingredients, and it offers product support through innovative marketing and educational efforts.

About Adopt-an-Herb and HerbMedPro

Verdure Sciences is one of 54 US and international 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, 60 herbs have been adopted.

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. Access to the studies is conveniently organized by publication type, with each study condensed to a one-sentence summary with a link to the official abstract on PubMed (the US National Library of Medicine's free-access database) or other publicly accessible database.

HerbMedPro is available to ABC members at the Academic level and higher. Its "sister" site, HerbMed, is available to the general public at no cost, with access to 25-30 herb records from the larger HerbMedPro database. 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. HG

—ABC Staff

Pomegranate
Punica granatum
Photo ©2018 Steven Foster

American Botanical Council Hosts 13th Annual Botanical Excellence Awards

The American Botanical Council (ABC) hosted its 13th annual American Botanical Celebration and Awards Ceremony on March 8, 2018, at the Hilton Anaheim in conjunction with the Natural Products Expo West and Engredea trade show and conference in Anaheim, California.

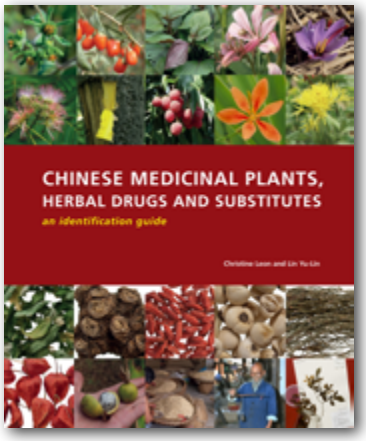
More than 350 guests attended the event and enthusiastically celebrated ABC's nonprofit educational mission and the honored recipients of the 2017 ABC Botanical Excellence Awards. The guest list was composed largely of ABC Sponsor Members and members of ABC's Board of Trustees, Advisory Board, and Director's Circle. The evening was a delightful melding of lively conversation, vegetarian appetizers, and cocktails.

ABC chose two books to receive its 2017 ABC James A. Duke Excellence in Botanical Literature Awards. The first, *Chinese Medicinal Plants, Herbal Drugs and Substitutes: An Identification Guide* (Kew Publishing, 2017), is the recipient of the Duke Award in the reference/technical category, and the second, *Joseph Banks' Florilegium: Botanical Treasures from Cook's First Voyage* (Thames & Hudson, 2017), was chosen for the consumer/popular category. This is the third time that ABC has awarded the Duke Award in both categories in the same year, and the first year that the award has been given to a text on Chinese medicinal herbs. [Editor's note: A review of *Chinese Medicinal Plants, Herbal Drugs and Substitutes* appears on page 74 of this issue. See page 54 for our feature article on *Joseph Banks' Florilegium*.]

The ABC Norman R. Farnsworth Excellence in Botanical Research Award for 2017 was presented to Professor Raphael Mechoulam, PhD, an Israeli organic chemist and the "father of cannabis research." Mechoulam was the first researcher to isolate, determine the structure of, and synthesize delta-9-tetrahydrocannabinol (THC), the primary psychoactive and intoxicating component of cannabis (*Cannabis* spp., Cannabaceae).

Pharmatoka SAS, a French company that specializes in the research, development, and production of herbal dietary ingredients for urogenital health conditions, was the recipient of the 2017 Varro E. Tyler Commercial Investment in Phytomedicinal Research Award.

ABC also presented its first annual Fredi Kronenberg Excellence in Research and Education in Botanicals for Women's Health Award to Tieraona Low Dog, MD, a highly respected expert in integrative medicine and women's health.



Richard "Dick" Griffin was the recipient of the ABC Champion Award for 2017. Griffin has consistently served ABC and other organizations in the natural products community through partnerships with his insurance companies, Grifcon Enterprises and Griffin Insurance Services, and his consulting work with R-T Specialty, LLC.

The 2017 ABC Mark Blumenthal Herbal Community Builder Award was presented to Jon Benninger, vice president of Informa Exhibitions' Global Health & Nutrition Network.

James A. Duke Botanical Literature Award Presented in Reference and Consumer Categories

ABC gives the Duke Award annually to books that contribute significantly to the medicinal plant-related literature and the fields of botany, taxonomy, ethnobotany, pharmacognosy, phytomedicine, and other related disciplines.

The Duke Award was created in 2006 to honor economic botanist and author James A. Duke, PhD, who died on December 10, 2017. Duke's prestigious career achievements in economic botany and ethnobotany include decades of work at the United States Department of Agriculture and the authorship of more than 30 reference and consumer books. Among his many other positions, he was also a co-founding member of ABC's Board of Trustees.

Reference/Technical Category

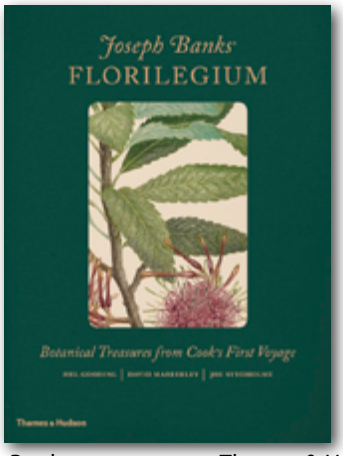
Chinese Medicinal Plants, Herbal Drugs and Substitutes was written by Christine Leon, PhD, and Lin Yu-Lin as the culmination of a 20-year collaboration between the Royal Botanic Gardens, Kew, in England, and the Institute of Medicinal Plant Development (IMPLAD) at the Chinese Academy

of Medical Sciences and Peking Union Medical College in Beijing, China. The Kew-IMPLAD collaboration included 14 field expeditions into 15 geographical regions in China, in which 4,500 reference specimens were collected and cross-referenced with herbarium vouchers.

Gina Fullerlove, head of publishing at Kew, thanked ABC for its recognition and acknowledgement. "This was a challenging and hugely collaborative project for Kew as its publisher," she said. "Our specialist expertise in developing and designing highly illustrated reference works, our understanding of content and how it is used, along with experienced botanical editorial skills, were deployed throughout the project. The Kew Publishing team worked with the authors at all stages to develop a reference work that we hope will be accessible and of value to the plant science and phytomedicine communities it aims to serve."

In order to help prevent accidental or intentional adulteration, this text provides an accurate and authoritative resource for the purpose of herb industry quality control. The text contains more than 3,000 full-color, annotated images of medicinal plants in situ and of specific plant parts used in traditional formulas labeled with both Chinese Pinyin names and current scientific names.

Co-author Leon commented: "Accurate species identification of Chinese plants used in traditional medicines and other natural products is vital if they are to be safe and fit-for-purpose. Our joint Kew-IMPLAD field expeditions across China these last 20 years provide the backdrop to our morphological identification guide, which aims to provide the tools for resolving, at least in part, some of this challenging issue. Aware of ABC's excellence in herbal quality-assurance initiatives, it is a huge honor and privilege, therefore, for my co-author Lin Yu-Lin and me to accept the ABC James A. Duke Excellence in Botanical Literature Award for 2017."



Book cover courtesy Thames & Hudson.

Consumer/Popular Category

Joseph Banks' Florilegium was written by Mel Gooding; David Mabberley, PhD; and Joe Studholme. The 320-page book highlights 147 full-page, color botanical prints that resulted from the work of the English botanist and naturalist Joseph Banks and the skilled team he oversaw on Captain James Cook's famous South Pacific voyage on the *HMS Endeavour* from 1768 to 1771. After the voyage, Banks had 743 copper-plate engravings made from the artwork of the Scottish artist Sydney Parkinson, who was part of Banks' team on the expedi-

Sponsor banners and awards prior to the American Botanical Celebration. Photo ©2018 ABC

tion. The engravings, known collectively as Banks' Florilegium, were printed and published in color for the first time between 1980 and 1990, with a limited number of complete sets being produced. The selection included in the book comes from those prints, making them available to the general public for the first time in one volume.

Studholme, who helped oversee the printing process, expressed his pleasure at seeing Banks' work recognized. "We feel greatly honored that *Joseph Banks' Florilegium* has received the James A. Duke Excellence in Botanical Literature Award," he said. "Ever since we first embarked on the Florilegium project in 1980, it was always my ambition to publish a well-illustrated accompanying book so that more people would learn about the extraordinary achievements of Joseph Banks and Daniel Solander on the *Endeavour* voyage and the wonderful skills of their draughtsman, Sydney Parkinson."

Philip Watson, commissioning editor of Thames & Hudson, the publisher of the book, commented: "It's fitting that Joseph Banks's work should be recognized now, 250 years after he set sail with Captain Cook, gathering plant specimens, [some of which] were then still unknown to science. *Joseph Banks' Florilegium* includes some of the most precise and exquisite examples of botanical illustration ever made. They continue to demonstrate the power of the relationship between art and botanical science. It's an honor for Thames & Hudson to publish these exceptional prints for the first time in book form."

Mark Blumenthal, founder and executive director of ABC, said: "As a science-based research and education organization, ABC is committed to recognizing excellent publications in the various fields related to herb and medicinal plant sciences. These two landmark volumes of this past year are particularly poignant, since 2017 is the year that Jim Duke died. We at ABC are certain that Jim would have heartily agreed with our selection of these two uniquely significant contributions to the world's botanical literature."

Past Duke Award recipients include *Handbook of Essential Oils: Science, Technology, and Applications*, 2nd edition (2016); *Clinical Aromatherapy*, 3rd edition (2015); *Ancient Pathways, Ancestral Knowledge* (2014); *Principles and Practice of Phytotherapy*, 2nd edition (2013); *Medicinal Plants and the Legacy of Richard E. Schultes* (2012; reference/technical category) and *Smoke Signals* (2012; consumer/popular category); the American Herbal Pharmacopoeia's *Botanical Pharmacognosy* (2011; reference/technical category) and *Healing Spices* (2011; consumer/popular category); *Botanical Medicine for Women's Health* (2010); *An Oak Spring Herbaria* (2009); and *Mabberley's Plant-Book*, 3rd edition (2008).

Raphael Mechoulam Receives ABC Norman R. Farnsworth Excellence in Botanical Research Award

ABC presents this annual award, named in honor of the late, celebrated Professor Norman R. Farnsworth, PhD, to an individual who has made significant research contributions in the fields of pharmacognosy, ethnobotany, ethnopharmacology, or other related scientific disciplines. Farnsworth, who died in 2011, was a highly published and internationally renowned research professor of pharmacognosy, a senior university scholar in the College of Pharmacy at the University of Illinois at Chicago, and one of the co-founding members of ABC's Board of Trustees.

Mechoulam, a professor of medicinal chemistry at the Hebrew University of Jerusalem in Israel, has been investigating *Cannabis* compounds for more than 50 years. "Cannabis has been known for millennia both for its therapeutic effects and for its effects on mood and behavior. However, as the chemistry of the cannabis constituents had not been well established when we started our research in the 1960s, there was essentially no modern medical use of cannabis," he said. "Present-day pharmacology and clinical work with any drug — including drugs from plants — [are] based on reliable chemical knowledge."

In the 1960s, his research team became the first to isolate THC and elucidate its structure. They also established the structure of cannabidiol (CBD), a psychoactive but non-intoxicating constituent of cannabis, and isolated other cannabinoids, including precursors of THC and CBD. "Later we synthesized these constituents and thus made them available for research," Mechoulam said.

HerbalGram Associate Editor Hannah Bauman and ABC Board of Trustees member Steven Foster presenting the James A. Duke Botanical Literature Awards. Photo ©2018 ABC

Subsequently, Mechoulam and colleagues began to investigate the effects of various cannabinoids on human health. In the 1980s, he discovered that CBD has potent antiseizure properties and that THC can help alleviate certain side effects of chemotherapy in children with cancer. He also was part of the research team that found the first evidence of an endogenous ligand for cannabinoid receptors in the brain.

"ABC is pleased and honored to bestow the Norman R. Farnsworth Award to Professor Mechoulam," said Blumenthal. "He is recognized internationally for his many compelling and pioneering discoveries regarding the chemistry and pharmacology of cannabis. These accomplishments created new research opportunities in the novel field of the human endocannabinoid system, one of the most important regulatory systems in human physiology."

Mechoulam has published more than 380 scientific journal articles to date, and he continues to investigate cannabinoids and serve as an advocate of the healing properties of cannabis. "I strongly believe that plant and endogenous cannabinoids or their derivatives will become major drugs," he said.

Throughout his career, Mechoulam has received numerous awards and recognitions, including a NIDA (National Institute on Drug Abuse) Discovery Award, an EMET Prize in Exact Sciences, and lifetime achievement awards from the International Cannabinoid Research Society, the Eicosanoid Research Foundation, and the European College of Neuropsychopharmacology, among others.

Stefan Gafner, PhD, ABC's chief science officer, noted: "Professor Mechoulam is truly a giant among natural products scientists. He made some of the most impactful discoveries in the area of botanical research. With the elucidation of the structures of THC, CBD, and many of the minor cannabinoids, he laid the foundation for scientific research on cannabis. The discovery of endogenous ligands for cannabinoid brain receptors provided an avenue for numerous researchers to investigate the physiological processes in which the endocannabinoid system is involved."

Ethan Russo, MD, the director of research and development at the International Cannabis and Cannabinoids Institute, praised Mechoulam's groundbreaking research on cannabis and its compounds. "The work of Professor Mechoulam has been exemplary, not only to cannabinoid science, but in demonstrating the complexity and applicability of botanical medicine to therapeutic frontiers," said Russo, who is also an ABC Advisory Board member.

Past recipients of the ABC Farnsworth Award include Ameenah Gurib-Fakim, PhD (2016); John T. Arnason, PhD (2015); Harry Fong, PhD (2014); Gordon Cragg,

PhD (2013); De-An Guo, PhD (2012); Djaja Soejarto, PhD (2011); A. Douglas Kinghorn, PhD (2010); Rudolf Bauer, PhD (2009); Ikhlas Khan, PhD (2008); Hildebert Wagner, PhD (2007); Edzard Ernst, MD, PhD (2006); and Joseph Betz, PhD (2005).

Pharmatoka Receives ABC Varro E. Tyler Excellence in Phytomedicinal Research Award

The ABC Tyler Award was created to honor one of the most respected scientists in late 20th-century herbal medicine and pharmacognosy. Varro E. Tyler, PhD, was an early member of ABC's Board of Trustees and vice president of academic affairs and dean of the College of Pharmacy and Pharmaceutical Sciences at Purdue University. He was the senior author of six editions of a leading pharmacognosy textbook and numerous other professional and popular books and academic articles. Tyler encouraged scientific and product integrity, and envisioned a rational phytomedicinal health care sector that valued the proper evaluation of products' quality, safety, and efficacy.

"Pharmatoka is an excellent example of a phytomedicine manufacturer that has focused on funding clinical research on its key formulation, and, as such, is highly deserving of the ABC Tyler Award," said Blumenthal. "Pharmatoka is respected for its research leadership on cranberry [*Vaccinium macrocarpon*, Ericaceae], and its research has helped set a therapeutic standard for cranberry extracts."

Gafner said: "I congratulate Pharmatoka for this award, which is well deserved due to the company's efforts to support its cranberry extract with clinical evidence. Of the many clinical trials that Pharmatoka initiated, I am particularly impressed by the study into the safety and efficacy of cranberry for infants and children between one month and three years of age. Clinical data on the benefits and adverse event potential in infants are lacking for a majority of herbal ingredients, despite the fact that parents often welcome safe and effective botanical dietary supplements for this age group. It is my hope that the pioneering work of Pharmatoka will inspire other suppliers and manufacturers of dietary supplements to follow suit."

In 2004, Pharmatoka began developing a cranberry fruit juice extract for urinary tract heath, and the company launched its flagship product, ellura (sold as urell in European markets), two years later. Each ellura capsule contains 36 mg of bioactive cranberry proanthocyanidins (PACs), which have been shown to be able to reduce the adherence of certain bacteria to the lining of the urinary tract. In clinical trials, ellura has been shown to help reduce the frequency of recurrent cystitis (inflammation of the bladder), a type of urinary tract infection. To date, seven clinical trials have been conducted on ellura.

"I very much appreciate the honor that ABC has bestowed on the work that Pharmatoka has done during the past 12 years," said Gunter Haesaerts, founder and CEO of Pharmatoka. "Pioneering the fundamental science of cranberry PACs and clinical observation of bacterial anti-adhesion was challenging but rewarding in the end. All that work eventually led to the creation of the first-ever cranberry PAC-based traditional herbal medicine," he added, referring to the European regulatory approval of an herbal medicine based on traditional use and modern research.

According to its website, "Pharmatoka selects only top-quality [active ingredients] with full scientific support and drug master files…. We partner with an active scientific committee of international scientists from various fields of medicine and research." In 2014, Pharmatoka created its second product, Prostaril, an extract of saw palmetto (*Serenoa repens*, Arecaceae) for prostate health, and the company is in the process of developing other phytomedicinal products.

Previous recipients of the ABC Tyler Award include Brassica Protection Products (2016), MediHerb/Integria Healthcare (2015), SFI Flordis International (2014), Wakunaga Pharmaceuti-

Gunter Haesaerts accepting the Varro E. Tyler Commercial Investment in Phytomedicinal Research Award for Pharmatoka. Photo ©2018 ABC

cal Company (2013), Horphag Research (2012), Bioforce AG (2011), New Chapter (2010), Bionorica AG (2009), Indena SpA (2008), and Dr. Willmar Schwabe Pharmaceuticals (2007).

Tieraona Low Dog Receives Inaugural ABC Fredi Kronenberg Excellence in Botanicals for Women's Health Award

This inaugural award is named in honor of distinguished researcher, educator, and longtime ABC Board of Trustees member Fredi Kronenberg, PhD, who died in April 2017. Kronenberg dedicated her professional life to the study of medicinal plants and phytomedicines for women's health conditions, and was particularly interested in phytoestrogen-containing botanicals, such as black cohosh (*Actaea racemosa*, Ranunculaceae), for the treatment of menopause symptoms.

Kronenberg was a champion of integrative medicine and co-founded a complementary and alternative medicine (CAM) center at Columbia University: the first CAM program at an Ivy League school. For 10 years, she also co-directed an onsite five-day continuing education course for physicians and other health care providers interested in botanical medicine.

"I am honored and humbled to receive the inaugural Fredi Kronenberg award from the American Botanical Council," said Low Dog. "I share [this award] with all of my colleagues who are dedicated to using the best of scientific research and traditional wisdom to improve the lives of women through the gifts of herbal medicine.

"Fredi was brilliant and unassuming: a scientist who loved the natural world," Low Dog continued. "We shared a passion for herbal medicine and women's health, exchanging notes, ideas, and papers. She was a fabulous photographer, and we spent many afternoons wandering through gardens and forests. We served together on editorial and advisory boards, and nurtured a friendship that spanned more than two decades."

Low Dog has dedicated her career to integrative medicine research and education, and she is a passionate advocate of and expert in natural medicine for women's health. She is the founding director of Medicine Lodge Ranch, a natural medicine school for clinicians and health care providers located in the Santa Fe National Forest in New Mexico. She also directed the first Interprofessional Fellowship in Integrative Health and Medicine at the University of Arizona's Center for Integrative Medicine.

Previously, Low Dog served on the United States Pharmacopeia's Dietary Supplements and Botanicals Expert Information Panel, which she chaired for 10 years. She also has served on the advisory council for the National Institutes of Health's National Center for Complementary and Alternative Medicine (now known as the National Center for Complementary and Integrative Health) and was an appointed member of the White House Commission on Complementary and Alternative Medicine Policy. In addition, Low Dog is a founding member of the American Board of Integrative Medicine and the Academy of Women's Health, and is on the editorial board of *Menopause: The Journal of The North American Menopause Society.* She is also a long-time member of the ABC Advisory Board.

"The ABC Board of Trustees believed that establishing an award in Fredi's name was an appropriate way to honor Fredi's extensive professional commitment to research in and integration of herbs and phytomedicines in women's health, both in selfcare and health care" said Blumenthal. "It was clear to ABC that our friend and colleague Dr. Low Dog, due to her considerable educational efforts in the growing area of botanicals in women's health, should be the initial recipient of this award."

Michael Balick, PhD, a member of the ABC Board of Trustees and the vice president and director of the Institute of Economic Botany at the New York Botanical Garden, said: "There is no one more deserving of the first ABC Fredi Kronenberg Award than Tieraona Low Dog. She has been a leader in the field of women's health for years, and a mentor to so many in this field."

Throughout her career, Low Dog has received numerous honors and recognitions, including lifetime achievement awards from the *Nutrition Business Journal* (2017) and

ABC Executive Director Mark Blumenthal giving his cartoon talk to the crowd at the American Botanical Celebration. Photo ©2018 ABC

Mark Blumenthal and Denise Meikel with Rene Kim and Nicole Griffin accepting the ABC Champion Award on behalf of Dick Griffin. Photo ©2018 ABC

Scripps Health (2017), an Herbal Insight Award from the American Herbal Products Association (AHPA; 2015), and The People's Pharmacy Award for Excellence in Research and Communication for the Public Health from NPR's "The People's Pharmacy" radio show (2010). In addition, she has spoken at more than 550 conferences and authored or co-authored more than 45 peer-reviewed scientific journal articles, 22 chapters for medical textbooks, and multiple books, including *Healthy At Home: Get Well and Stay Well Without Prescriptions* (National Geographic Books, 2015), *Integrative Women's Health* (Oxford University Press, 2010 and 2015), and *Women's Health in Complementary and Integrative Medicine: A Clinical Guide* (Churchill Livingstone, 2005).

"Dr. Low Dog much deserves this inaugural ABC Fredi Kronenberg Award," said Gafner. "She has made countless contributions to improve women's health through lifestyle interventions and herbal medicine in everyday practice as a physician, through publication of scientific texts, and presentations and discussions at symposia, trade events, and on TV shows. Without a doubt, she has been one of the most impactful people in the area of herbal supplements and women's health over the past two decades."

Dick Griffin Named ABC Champion for 2017

The ABC Champion Award was created to recognize individuals who have been outstanding supporters of ABC and have helped the organization promote and achieve its nonprofit educational mission, whether through monetary support or contributions of time. The generosity of ABC's friends and members is vital to the nonprofit's continued success and growth.

"Dick is an extraordinarily generous man," said Blumenthal. "He created a great business opportunity for himself and others when he foresaw an opportunity to pool the positive safety records of many companies in the herb and dietary supplements industry to produce the industry's premier product liability insurance program. This has resulted in great savings for many leading companies, allowing them to invest in other areas of product development, research, and growth. Dick has shared this good fortune, which has been greatly beneficial to ABC, its members, and its educational mission."

ABC Development Director Denise Meikel commented: "Dick is kind, funny, and a true gentleman. As an ardent supporter of ABC, both personally and professionally, his efforts have helped continue and expand ABC's reach throughout the years."

Griffin is a commercial lines insurance broker with more than 50 years of experience in the natural products industry. In 1996, he formed the National Products Liability Insurance program for the US dietary supplement industry with the goal of creating insurance products that fit the specific, unique needs of manufacturers and suppliers. Through his idea of pooling applicants, he was able to provide these services with lower premiums and higher standards of safety coverage.

Griffin thanked ABC for the award, stating: "I've worked with members of the American Botanical Council and other innovators in the natural products space for many years, and I'm so honored to be awarded this significant recognition. I've spent my life's work finding insurance solutions that help individuals and businesses succeed. I wanted to be sure the innovators could focus on developing products to improve customer health goals while our insurance programs protected their companies."

Through his work and connections with other companies and organizations in the natural products industry, Griffin has fostered a beneficial partnership with ABC and provides the nonprofit with quarterly override contributions. This effort, in addition to other donations initiated by Griffin, has provided ABC with approximately $100,000 since 2010.

Currently, the scope of Griffin's program has expanded to the cannabis industry, with the goal to provide all lines of insurance coverage to medicinal cannabis dispensaries and related businesses in states where these enterprises have been legalized.

ABC created the Champion Award in 2015. Previous recipients include medicinal plant expert Josef Brinckmann of Traditional Medicinals (2016); Ed Smith, co-founder of HerbPharm (2015); and Terry Lemerond, founder of Europharma, Inc. and Enzymatic Therapy (2014).

Griffin's daughters, Nicole Griffin and Rene Kim, accepted the award on his behalf at the ceremony.

Jon Benninger Receives 2017 ABC Mark Blumenthal Herbal Community Builder Award

Named for ABC Founder and Executive Director Mark Blumenthal, this award is given to an individual who has played a significant role in creating a sense of community among herbalists, researchers, members of the herb and natural products communities and industries, and others who work in the area of medicinal plants.

At Informa, Benninger is in charge of the strategic direction and growth of two of the largest natural products trade shows in the United States, SupplySide West and SupplySide East. He also works closely with Informa's *Natural Products INSIDER*, a leading industry publication. In addition, he frequently collaborates with those responsible for other Informa events and publications, such as Natural Products Expo West and Vitafoods, and the *Nutrition Business Journal*.

"It is an incredible honor to be associated with the people who have received the Mark Blumenthal Community Builder Award in prior years," said Benninger. "I must share this recognition with all of my colleagues in our company and our industry who have been a part of SupplySide over the last two decades. It is a privilege to work with all of you toward our shared vision of healthy people, healthy markets, and a healthy world."

Blumenthal noted: "Jon is largely responsible for creating and growing one of the global herb industry's most significant events: the SupplySide West trade show and conference held every year in Las Vegas. Through the SupplySide events, Jon has brought together thousands of people: herb growers, producers, brokers, manufacturers, consultants, and numerous other stakeholders in the global botanical industry and extended community. Many people in the fast-growing herb and dietary supplements industry owe a debt of gratitude to Jon for his vision and foresight in creating the highly beneficial SupplySide shows."

Mark Blumenthal with Jon Benninger, recipient of the 2017 ABC Herbal Community Builder Award. Photo ©2018 ABC

Benninger began working for the Phoenix, Arizona-based media company Virgo Publishing in 1995 as the founding editor of *Natural Products INSIDER*. One year later, in 1996, he helped launch Virgo's first SupplySide trade show, which was held in Scottsdale, Arizona. In 2014, Virgo was acquired by London-based Informa. Before his current position, Benninger worked in a variety of roles at Virgo, including editor, publisher, group publisher, business development director, and vice president of business development.

Benninger also serves on the boards and committees of various organizations in the natural products community. Currently, Benninger is a member of the AHPA's communications committee, the Council for Responsible Nutrition's communications and media outreach committee, and the United Natural Products Alliance (UNPA). In addition, he is a member of ABC's Director's Circle and on the board of trustees of the Southwest College of Naturopathic Medicine in Tempe, Arizona.

Previous recipients of the Community Builder Award include Ikhlas Khan, PhD, the director of the University of Mississippi's National Center for Natural Products Research (2016); Michael Tierra, herbalist and co-founder of the American Herbalists Guild (2015); Loren Israelsen, president of UNPA (2014); Sara Katz, co-founder of Herb Pharm and past president of the United Plant Savers (UpS) (2013); and Rosemary Gladstar, herbalist, teacher, author, and founder of UpS (2012). 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

valensa	**Saw Palmetto** *Serenoa repens*
CENTROFLORA GROUP *Partnerships for a better world.*	**Yerba Maté** *Ilex paraguariensis*
Nature's Gift	**Helichrysum** *Helichrysum italicum*
PHARMACTIVE BIOTECH PRODUCTS	**Saffron** *Crocus sativus*
NATURE'S SUNSHINE	**Cayenne** *Capsicum annuum*
EMBRIA Health Sciences	**EpiCor® Fermentate** *Saccharomyces cerevisiae*
JIAHERB essentials of nature	**Rhodiola** *Rhodiola rosea*
neem BIOTECH A ZALUVIDA COMPANY.	**Garlic** *Allium sativum*
	Artichoke *Cynara cardunculus* Scolymus Group
DMH ingredients inc	**Baobab** *Adansonia digitata*
	Rooibos *Aspalathus linearis*
Friends of the Honey Bee	**Propolis**
Natural Health International Conscious | Leading | Empowering	**Maca** *Lepidium meyenii*

natural Factors	**Echinacea** *Echinacea* spp.
ARTEMIS INTERNATIONAL	**Purple Corn** *Zea mays*
utzy naturals	**Black Chokeberry** *Aronia melanocarpa*
	Elderberry *Sambucus nigra*
	Stinging Nettle *Urtica dioica*
FOUR ELEMENTS	**Lemon Balm** *Melissa officinalis*
afrigetics BOTANICALS	**Bulbine** *Bulbine natalensis*
BRASSICA PHYTOCHEMICALS	**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*
AFS APPLIED FOOD SCIENCES, INC.	**Kava** *Piper methysticum*

AMERICAN BOTANICAL COUNCIL

NOW IN OUR 30th YR

Become an adopter today!

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

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

Arnica *Arnica montana*
Photo ©2018 Steven Foster

Herbal Adopters

VERDURE SCIENCES®	**Pomegranate** *Punica granatum*	NATUROPATHICA® HOLISTIC HEALTH	**Arnica** *Arnica montana*
FUTURE CEUTICALS	**Coffee Fruit** *Coffea spp.*	AMAZING HERBS	**Black Cumin** *Nigella sativa*
KSM-66®	**Ashwagandha** *Withania somnifera*	Teawolf Natural Extract Solutions	**Guayusa** *Ilex guayusa*
INDFRAG®	**Garcinia** *Garcinia cambogia*	Gaia Trading Company, Inc.	**Hops** *Humulus lupulus*
RFI FROM FIELD TO FORMULA	**Hibiscus** *Hibiscus sabdariffa*	THE ACTIVES FACTORY	**Birch** *Betula spp.*
SFI™	**Bacopa** *Bacopa monnieri*	Natac Science to Market	**Olive** *Olea europaea*
Vit-Best Nutrition	**Cinnamon** *Cinnamomum spp.*		**Grape** *Vitis vinifera*
Nature's Way®	**Ginkgo** *Ginkgo biloba*	Pharmatoka	**Cranberry** *Vaccinium macrocarpon*
biotropics MALAYSIA	**Kesum** *Persicaria minor*	ECOSO DYNAMICS	**Devil's Claw** *Harpagophytum spp.*
	Tongkat Ali *Eurycoma longifolia*	EuroPharma	**Turmeric** *Curcuma longa*
lafn USA	**Monk Fruit** *Siraitia grosvenorii*	CONTAINS Zembrin	**Sceletium** *Sceletium tortuosum*
travel medic travelmedic.net	**Kratom** *Mitragyna speciosa*	DIANA Performance from nature FOOD	**Acerola** *Malpighia spp.*

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

Pomegranate Laboratory Guidance Document Issued by ABC-AHP-NCNPR Botanical Adulterants Prevention Program

New LGD, the program's 40th publication, evaluates strengths and weaknesses of various lab methods to verify authenticity of pomegranate juice and extracts

The ABC-AHP-NCNPR Botanical Adulterants Prevention Program (BAPP) has released a Laboratory Guidance Document (LGD) on pomegranate (*Punica granatum*, Lythraceae) juice and extracts. Pomegranate is a popular food and dietary supplement ingredient. As a food, the fleshy seeds are used raw or pressed into juice. For dietary supplements, the whole fruit, rind (or husk), seed, or seed oil is processed into various forms (e.g., powders, extracts, etc.).

The predominant adulteration issue reported for pomegranate juice is dilution with lower-cost fruit juices, but undeclared colorants also have been reported. In the dietary supplement category, the main problem seems to be the addition of ellagic acid from extraneous (i.e., non-pomegranate) sources. Ellagic acid is a naturally occurring polyphenolic compound found in pomegranate and many other plants. It can be obtained in highly purified form from a number of lower-cost botanical sources, including various tree barks, and it can be made via chemical synthesis. Some commercial "pomegranate" extracts contain up to 90% ellagic acid; these extracts are adulterated presumably to enhance the perceived value of the product.

The new pomegranate LGD was written by John H. Cardellina II, PhD, an expert in natural products chemistry and analysis and the chief technical consultant for BAPP. The guidance document details the chemical composition of pomegranate fruit and includes summaries of published analytical methods for juice and extract identity testing. The main advantages and disadvantages of each analytical method are listed, and the usefulness of these methods to detect adulteration of pomegranate juice and extract products is described. The LGD was peer reviewed by 20 experts from academia and industry.

ABC AHP NCNPR

Botanical Adulterants Prevention Program

American Botanical Council • the American Herbal Pharmacopoeia • the University of Mississippi's National Center for Natural Products Research

Pomegranate Products Laboratory Guidance Document

By John H. Cardellina II, PhD*
*ReevesGroup, Virginia Beach, VA 23451
Correspondence: email

Pomegranate *Punica granatum*
Photo ©2018 Steven Foster

Keywords: pomegranate, adulteration, *Punica granatum* L., Lythraceae, Punicaceae, ellagic acid, punicalagins, punicalins, HPLC, HPLC-UV

1. Purpose

Pomegranate has rapidly become one of the most popular 'healthy' fruits, with an array of extracts appearing in the botanical dietary supplement markets and a plethora of juice products in the beverage industry. There is considerable evidence that both product categories have been subjected to adulteration with various undeclared, lower-cost exogenous ingredients.[1] Therefore, this Laboratory Guidance Document presents a review of the analytical technologies used to determine whether pomegranate juice or extract products are adulterated and to identify the adulterants involved.

2. Scope

The analytical challenge arising from adulteration of pomegranate products is complex because different products are adulterated in different ways. Pomegranate juice has been found to be diluted by a variety of lower-cost, more readily-available juices, and colorants may be added to adjust the color to approximate true pomegranate juice more closely. Pomegranate extract products have been adulterated by addition of exogenous ellagic acid (EA) or made entirely from unknown or unidentified source materials, with little-to-no pomegranate constituents, but significant amounts of EA present. The methods discussed in this guidance document were developed for either juice or extract products, but may not be applicable to other pomegranate food products (e.g., yogurt or jelly) or medicinal products derived from pomegranate plant parts other than the fruit (e.g., leaves).

The evaluation of a specific analytical method or methods in this Laboratory Guidance Document for testing pomegranate materials does not reduce or remove the responsibility of laboratory personnel to demonstrate adequate method performance in their own laboratory using accepted protocols outlined in various domestic (in the United States) or international legal and/or regulatory documents, e.g., the 21 CFR Part 111 (Dietary Supplement GMPs, in the US Code of Federal Regulations) and Part 117 (Food Safety Modernization Act Final Rulemaking for Current Good Manufacturing Practice and Hazard Analysis and Risk-Based Preventive Controls for Human Food, in the US Code of Federal Regulations), and by AOAC International, International Standards Organization (ISO), World Health Organization (WHO), and the International Council on Harmonisation (ICH).

3. Common and Scientific Names

3.1 Common name: Pomegranate

3.2 Other common names

French: grenade, pomme de grenade (Quebec Province, Canada)
Spanish: granada
Italian: melograno
German: Granatapfel
Dutch: granaatappel
Persian: anâr (انار)
Sanskrit: dalim or dadima

3.3 Accepted Latin binomial: *Punica granatum* L.

3.4 Synonyms: *Punica nana* L.

3.5 Botanical family: Lythraceae

Note: Pomegranate was previously classified in the botanical family Punicaceae, which has been combined with the family Lythraceae on the basis of genetic and morphological characteristics.[2]

Pomegranate Products - Laboratory Guidance Document • 2018 • www.botanicaladulterants.org 1

"As is too often the case with relatively high-cost ingredients like pomegranate, unethical producers have found ways to sell diluted or counterfeit 'pomegranate' ingredients that contain lower-cost materials," said Mark Blumenthal, founder and executive director of the American Botanical Council (ABC) and founder and director of BAPP. "Our new Lab Guidance Document on pomegranate provides industry quality control personnel with the tools they need to use only laboratory methods that can successfully authenticate true, unadulterated pomegranate ingredients and determine if any adulterants are present."

Cardellina added: "While the nature of adulteration may be different for juice or other food forms of botanical materials relative to supplements, the motivation for the fraudulent behavior is the same: higher profits. The analytical targets and laboratory methods may be different in the two product categories, but the challenge is the same: identifying effective methods and tools to ensure that products in the marketplace are properly composed and convey the expected nutrients and benefits. This might be a great opportunity for the food and supplement sectors to recognize common ground and work toward resolving this challenging issue."

Stefan Gafner, PhD, chief science officer of ABC and technical director of BAPP, commented: "The concentrations of ellagic acid in pomegranate supplements have become a marketing tool, with product labels prominently featuring the percent of ellagic acid, which may suggest to the consumer that higher levels represent more potent and thus more efficacious extracts. But high concentrations of ellagic acid may actually be an indicator of adulteration, since these materials may be from plants other than pomegranate. As explained in this LGD, there are no simple analytical methods to distinguish ellagic acid derived from pomegranate or other botanical sources. However, the absence of characteristic polyphenols, such as the punicalagins, in ingredients labeled as pomegranate extracts, should raise a red flag."

The pomegranate LGD is the 40th peer-reviewed publication published by the program and the fifth in the series of LGDs. As with all publications in the program, the LGDs are freely accessible to all ABC members, registered users of the ABC website, and all members of the public on the program's website (registration required).

BAPP LGDs identify the most suitable analytical methods for detection of certain adulterants and authentication of specific botanical materials in various forms (whole, cut, powdered raw materials, extracts, juices, and/or essential oils). Assessments of analytical methods are based on a thorough review of available methods from official compendia, relevant methods in the published peer-reviewed literature, and sometimes those provided by botanical ingredient suppliers, manufacturing companies, and independent third-party analytical laboratories.

About the ABC-AHP-NCNPR Botanical Adulterants Prevention Program

The ABC-AHP (American Herbal Pharmacopoeia)-NCNPR (National Center for Natural Products Research) Botanical Adulterants Prevention Program is an international consortium of nonprofit professional organizations, analytical laboratories, research centers, industry trade associations, industry members, and other parties with interest in herbs and medicinal plants. The program advises industry, researchers, health professionals, government agencies, the media, and the public about the various challenges related to adulterated botanical ingredients sold in commerce. To date, more than 200 US and international parties have financially supported or endorsed the program. HG

—ABC Staff

ABC AHP NCNPR Botanical Adulterants Prevention Program

Appalachian Herb Growers Consortium: Fostering Chinese Herb Cultivation in the United States

The verdant mountains and forests of the Appalachian region in southwestern Virginia may not be the first place that comes to mind when thinking about sourcing herbs for traditional Chinese medicine (TCM). However, the terrain and climate of Appalachia are similar to some of the primary herb-growing areas of China, and the region is well-suited for cultivating medicinal herbs used in TCM.[1] Thanks to the efforts of a group of herbalists, growers, and practitioners, Appalachia has now become renowned for producing raw herbal materials to address the growing demand for high-quality Chinese herbs as TCM continues to gain popularity in North America.[2]

The Appalachian Herb Growers Consortium (AHGC) was established in 2014 and now represents 50 small farmers in southwestern Virginia who are using ecologically sustainable practices to grow Chinese medicinal herbs. The consortium's mission is to bolster farmers' incomes and crop diversity; provide high-quality, effective herbs for practitioners of acupuncture and TCM; and grow and process herbs with respect for nature and the traditions of TCM.[3]

The consortium began as a way to support the Blue Ridge Center for Chinese Medicine, a community health facility established in 2006 in the town of Pilot, Virginia, an open-minded community with a strong alternative culture harkening back to the 1970s and 80s. Practitioners at the center offer a range of services from acupuncture to massage and provide a variety of classes and workshops for the public.[4]

The Blue Ridge Center was founded to provide a new type of health care for the rural community, according to Nile Bachmann, LAc, MSOM, a clinical supervisor and practitioner at the center, who provides input on herb quality and efficacy for the consortium (oral communication, October 12, 2017). People in the area are surprisingly receptive to TCM, he noted. "We have a lot of pain conditions here, and Chinese medicine uses herbal medicine to address those conditions."

The center has been well-received by locals, but the biggest obstacle has been to make the treatments accessible and affordable. "This is a wonderful place to live, but it's hard to make a living here," said Naomi Crews, an herb production coordinator at AHGC (oral communication, October 12, 2017). "Our hope is that by increasing the quality of life and economic opportunities, it will help make the Blue Ridge Center accessible and give the community resources to seek out these services."

The AHGC was created in part to support Blue Ridge Center practitioners who wanted to grow herbs for use in a clinical setting, Bachmann recalled. They began by growing herbs at the center's garden, but as they realized the potential of the local climate and growing conditions, the production of Chinese herbs on a bigger scale was an obvious next step. With expanding interest in herbal and Chinese medicine, establishing a homegrown source of raw materials and adding to the domestic production of some of the more obscure and difficult-to-obtain herbs were additional benefits.

"The quality of the herbs we were getting was also at the back of our minds," Bachmann said. "[Suppliers in China] are not always very transparent about what they send, and we don't necessarily get China's best product. They keep that for themselves. Herbs also go through natural degradation when shipped, so we wanted to address that as well."

Trichosanthes kirilowii fruit on a drying rack. Photo ©2018 AHGC

To get the consortium off the ground, seed was obtained from reputable sources including the Chinese Medicinal Herb Farm in Petaluma, California, and High Falls Gardens in Philmont, New York, the latter of which is part of the Eastern Forest Chinese Herbal Medicine Consortium, which became an early partner of the AHGC.

Recruiting Farmers

Getting farmers on board to grow herbs for the consortium has been a tough sell. There was substantial interest, Crews noted, "but the nature of this is different for most farmers here. It is peren-

nial agriculture." Many farmers were unfamiliar with this model, and they needed faster returns on their investments. In some cases, farmers may have to wait several years to harvest and see a profit. "It has taken a while to court them and help them learn to cultivate the plants without taking too much of a financial risk," Crews said.

AHGC members come from a wide variety of backgrounds, from home gardeners to wholesale vegetable producers. To become a member, growers need to have some experience in agriculture (three to five years is preferred), but they don't have to have specific experience with Chinese medicine or herbs, explained Adam Fisher, an herb production coordinator for the AHGC (oral communication, October 12, 2017).

All growers are required to practice ecologically sound growing methods, which, at a minimum, means they need to avoid use of synthetic fertilizers, pesticides, and herbicides. Growers do not need to have organic certification, but they do need to follow Good Agricultural Practices as established by the United States Department of Agriculture.[5]

Beyond that, the consortium farmers also practice perennial polyculture, which is a specific cultivation technique designed to mimic natural relationships among plants in the wild. The plots in this system should contain a variety of plants, with different heights or structures that form a network of supporting plants to attract insects, accumulate nutrients, and maximize soil biodiversity. "We ask the farmers to plant a minimum of three species [that belong to] different plant families that can offset the challenges of pests and disease," Fisher explained. For example, in a full sun area, a good grouping would be red root sage (*Salvia miltiorrhiza*, Lamiaceae) in the mint family and flowering herbs like chrysanthemum (*Chrysanthemum* × *morifolium*, Asteraceae) and Chinese bellflower (*Platycodon grandiflorum*, Campanulaceae).

The polyculture system is designed to mimic ancient traditional methods for growing Chinese herbs in order to ensure their potency, Bachmann said.

AHGC growers are instructed not to modify their farm for the plants, but rather to fit the right plants in the proper place, Crews added. "For most of the crops, we have to teach the farmers to not use nutrient amendments like organic fertilizers. But there are always exceptions," she said. "A few species like the fruit-producing vine *Trichosanthes kirilowii* [Cucurbitaceae] seem to appreciate additional nutrients, just like pumpkins [*Cucurbita pepo*, Cucurbitaceae] or squash [*Cucurbita* spp.]. For some of the root crops, we have to help [the growers] understand that it is acceptable to have some insect pressure to help produce a stronger, healthier plant."

The AHGC also provides education and monitors growers along the way, conducting site visits to ensure that plants are placed appropriately and providing instruction on how and when to harvest. The consortium also offers an advantageous model in which farmers can diversify crops and minimize financial risks involved with food spoilage and shipments. "If you are a tomato [*Solanum lycopersicum*, Solanaceae] farmer and you have a truck load of nice, ripe tomatoes, you need to get them delivered quickly," Fisher said. "What we are selling is dried herbs. The farmers don't have to worry about that with these plants."

After the plants are harvested, the consortium washes, processes, and chops the plants to their preferred specifications, and then gently dries the raw materials in custom-

Platycodon grandiflorum flower
Photo ©2018 AHGC

ized dehydrators to ensure potency and freshness. Once the herbs are dried, the farmers get paid. The consortium is responsible for marketing and distributing the herbs to TCM practitioners around the country.

The raw materials are also continuously reviewed for quality and identity, with input from practitioners, like Bachmann, and from practitioners' customers. The input is invaluable, according to Crews. "We are constantly reviewing the product, looking at form, taste, and smell," she said.

The meticulous care for the plants is paying off, according to Bachmann, who is familiar with the properties of herbs shipped from China. "What we have found is that the herbs grown here have a high intensity in scent and flavor." As AHGC began comparing its herbs with product from China, it found consistently superior organoleptic profiles in the US-grown material, Bachmann said. "I didn't understand the difference until I tasted our chrysanthemum. The flavor profile fits much better with the traditional uses than the samples I have accessed previously. I won't say the plants from China are bland, but they don't pack the same punch."

In this era of increased scrutiny of herbal ingredients and focus on identification and adulteration, the consortium acknowledges that it does not currently test products for potential contaminants. Crews explained that the "AHGC is based at a small non-profit Chinese medicine clinic and has not achieved the size to afford these types of tests" (oral communication, October 24, 2017). "Since contaminant concern is one of the primary reasons US practitioners and product makers are interested in domestically grown herbs, we are committed to doing everything we can to produce and deliver clean products that will pass standardized tests for both chemical and biological contaminants, even if we can't yet afford to pay for them ourselves," she said.

Although AHGC's primary market is practitioners of TCM, the consortium also sells to dietary supplement manufacturers that produce various products (e.g., formulas, tinctures, and granules). According to Crews, these practitioners and manufacturers test the herbs and reject the botanical materials that do not pass inspection. "We understand that as we grow, [authentication] is one of the many future steps we will need to take as a business," she said. "In the meantime, we work under the assumption that any material we grow has the potential to be tested at any time by any customer, and we have implemented many practices to support producing the cleanest herbal raw material possible."

The consortium also takes extensive measures to qualify growers and assure soil quality, and its processing center is inspected by the Virginia Department of Agriculture, as required by law. (In Virginia, the herbs are considered dried agricultural food products and are therefore subject to food-grade standards.) The Blue Ridge Center's processing facility also is subject to inspections, and as a part of that process, the water supply has been tested to ensure that no contaminants are being added in the wash process.

Looking to the Future

The AHGC's program has come a long way in the four years since its inception. The Blue Ridge Center's herb garden now serves as a living seed garden that provides high-quality seed for the AHGC growers. The program now also receives support from the Virginia Tobacco Region Revitalization Commission, which requires that the consortium serve growers within the historical range of tobacco (*Nicotiana tabacum*, Solanaceae)-growing counties, a region that encompasses farms within about a 150-mile radius of the Blue Ridge Center. As the program grows, the consortium hopes to work with farmers outside of that region as well.

Fisher and Crews are constantly looking to the future and discussing the appropriate scale for the consortium that will allow it to remain sustainable both financially and agriculturally. Demand for Chinese herbs in North America is still somewhat small, Crews noted, so there is a risk of getting too big to maintain the current standards, impeccable processing, and grower support. "Our goal is not to compete with China, but to provide exceptional quality and meet the demand for these herbs in the United States," she said.

At the same time, Crews said, the consortium is at a critical juncture when it comes to getting support and business from the market. "Our products have been reviewed as exceptional and grown to the highest standards," she said "The question is, 'Will people be able to pay for the production costs?' If practitioners aren't willing to pay enough to support the farmer, then these herbs won't be available." HG

—Karen Raterman

References

1. About the herbs. Appalachian Herb Growers Consortium website. Available at: https://appalachianherbgrowers.com/about/about-the-herbs/?v=7516fd43adaa. Accessed October 11, 2017.
2. Harris R. Chinese herbs growing in Virginia. Radio WVTC (Virginia Public Radio). Available at: http://wvtf.org/post/chinese-herbs-growing-virginia. Accessed October 11, 2017.
3. Homepage. Appalachian Herb Growers Consortium website. Available at: https://appalachianherbgrowers.com/?v=7516fd43adaa. Accessed October 11, 2017.
4. Blue Ridge Center for Chinese Medicine. Appalachian Herb Growers Consortium website. Available at: https://appalachianherbgrowers.com/about/blue-ridge-center-for-chinese-medicine/?v=7516fd43adaa. Accessed October 11, 2017.
5. About the growers. Appalachian Herb Growers Consortium website. Available at: https://appalachianherbgrowers.com/about/about-the-growers/?v=7516fd43adaa. Accessed October 11, 2017.

Individuals, organizations, and companies support ABC through membership

The American Botanical Council Invites You To Join Us

The American Botanical Council is the leading nonprofit education and research organization using science-based and traditional information to promote the responsible use of herbal medicine.

Founded in 1988, the member-supported American Botanical Council:

- SERVES members in more than 81 countries worldwide
- EDUCATES consumers, healthcare professionals, researchers, educators, industry and the media on the safe and effective use of medicinal plants
- ADVOCATES responsible herbal production and use
- ADVISES the media on emerging herbal science
- PROMOTES a healthier world through responsible herbal use.

Join Us!

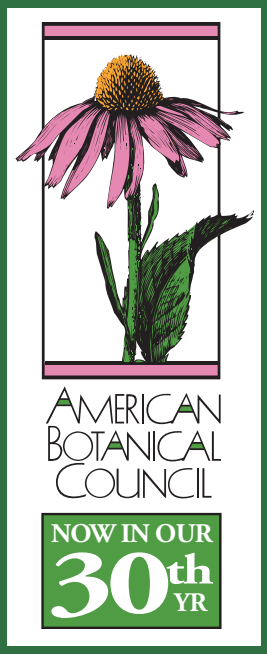
In return, you'll receive access to a wealth of herbal data via:

- ABC's acclaimed quarterly journal, *HerbalGram*
- 10 online databases of herbal information (depending on membership level)
- Regular electronic updates on herbal news that matters to you
  - 12 Monthly HerbalEGrams, 4 Botanical Adulterants Monitors, 51 Weekly Herbal News & Events updates, and 360 HerbClip per year, plus other Member Advisories
- And much more.

Learn more at

www.herbalgram.org

or contact Denise Meikel at denise@herbalgram.org or (512) 926-4900 ext. 120.



Rosehip, Nettle Leaf, and Devil's Claw Root Formulation Improves Symptoms of Knee Osteoarthritis

Reviewed: Moré M, Gruenwald J, Pohl U, Uebelhack R. A *Rosa canina* – *Urtica dioica* – *Harpagophytum procumbens*/*zeyheri* combination significantly reduces gonarthritis symptoms in a randomized, placebo-controlled double-blind study. *Planta Med*. December 2017;83(18):1384-1391. doi: 10.1055/s-0043-112750.

Knee osteoarthritis (KO), or gonarthritis, is one of the most common disorders of the musculoskeletal system. KO is characterized by the destruction of articular cartilage and results in joint pain and stiffness. The formulation MA212, or Rosaxan (medAgil Gesundheitsgesellschaft mbH; Friedrichshafen, Germany), is a liquid "food for special medical purposes" (per the EU regulatory definition) that is used to manage KO pain. The authors conducted a placebo-controlled, randomized, double-blind study to examine the safety and efficacy of MA212 in reducing pain and improving symptoms in patients with KO.

MA212 contains 20 g rosehip (*Rosa canina*, Rosaceae) fruit puree, 4 g rosehip juice concentrate (concentration factor 7.1) derived from fruit puree, 160 mg stinging nettle (*Urtica dioica*, Urticaceae) leaf dry extract (drug extract ratio [DER] 10:1), and 108 mg devil's claw (*Harpagophytum procumbens* or *H. zeyheri*, Pedaliaceae) root extract (DER 1.5-2.5:1). Rosehip, stinging nettle, and devil's claw have been used in folk medicine for their anti-inflammatory and pain-relieving effects. Three-dimensional high-performance liquid chromatography identified isoquercitrin, rutin, and harpagoside, which are markers specific to rosehip, nettle, and devil's claw, respectively.

The study enrolled 92 patients (30-70 years of age) with KO who were randomly assigned to the MA212 or placebo group, with 46 patients in each group. The patients had been diagnosed with unilateral or bilateral KO with moderate pain based on the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). The study was conducted from July 2015 until November 2015 in two German medical practices. The patients were evaluated at baseline and after six and 12 weeks. At baseline, all patients had similar characteristics, including WOMAC pain scores. Several patients in both groups had comorbidities, such as hypertension, OA in other joints, hypothyroidism, hypercholesterolemia, and diabetes mellitus.

The test group took 40 mL of MA212 with a tablet containing 200 IU vitamin D once daily after breakfast for 12 weeks. The placebo group ingested a vegetable mixture that consisted predominantly of tomato (*Solanum lycopersicum*, Solanaceae) juice plus minor vegetable components to match the color and taste of MA212. Study physicians rated the compliance as "very good" for 85% and "good" for 15% of the patients in the MA212 group. For the placebo group, they rated the compliance "very good" for 51% and "good" for 49% of the patients.

Study Details: At a Glance	
Participants	• 92 men and women • 30-70 years of age • Diagnosed with unilateral or bilateral knee osteoarthritis
Study Design	Randomized, double-blind, placebo-controlled
Study Length	12 weeks
Active Treatment	Multi-herb formula Rosaxan (medAgil Gesundheitsgesellschaft mbH; Friedrichshafen, Germany)
Control	Placebo containing a vegetable juice mixture
Disclosures	M. Moré and J. Gruenwald are affiliated with Herbalist & Doc (H&D; Berlin, Germany), for which they planned, conducted, and evaluated this study. H&D is affiliated with medAgil, the study sponsor and manufacturer of Rosaxan. U. Pohl and R. Uebelhack are affiliated with analyze & realize GmbH (Berlin, Germany), which H&D engaged to conduct the study and Gruenwald co-founded.

Nettle *Urtica dioica*
Photo ©2018 Steven Foster

Mild adverse effects were reported by 11 patients in the MA212 group and 16 in the placebo group. Two patients in the MA212 group were excluded from the valid case analysis set (VCAS) because they used an unapproved medication to treat KO pain. Two patients in the placebo group dropped out from the full analysis set (FAS) before the onset of the study. One further patient dropped out after the six-week visit but was included in the FAS for the duration of the treatment received, leaving 44 and 43 patients in the MA212 and placebo VCAS, respectively.

The authors reported significant improvements in WOMAC pain scores in both groups at weeks six and 12 ($P < .001$) compared with baseline. The mean change in pain score at week 12 was 29.87 in the MA212 group and 10.23 in the placebo group, with a significant between-group difference ($P < .001$). Specifically, the baseline WOMAC pain score of 60.0 in the MA212 group decreased to 41.0 after six weeks and to 30.2 after 12 weeks. The placebo group began the study with an average WOMAC pain score of 60.1; those scores decreased to 52.1 after six weeks and to 49.9 after 12 weeks. After 12 weeks, 91.3% of patients in the MA212 group reported an improvement of at least 21 index points. In the placebo group, most patients experienced improvements of 1-20 points. The between-group difference was significant ($P < .001$).

The WOMAC scores for stiffness and function, and the overall scores, significantly improved in both groups ($P < .001$) but more so in the MA212 group ($P < .001$). VCAS analyses yielded identical significances.

Three patients in the MA212 group took acetylsalicylic acid (i.e., aspirin) daily; more patients in both groups took other analgesics as needed for various ailments other than those related to KO. The number of patients who used analgesics for KO totaled 13 in the MA212 group and 17 in the placebo group.

Both physical and mental quality of life improved significantly in the MA212 group compared with the placebo group ($P < .001$). These improvements "are likely to be caused by the reduced pain and stiffness, as well as the improved knee function," wrote the authors.

The authors noted that "A significant placebo effect has been observed in the majority of osteoarthritis studies," and that the vegetable juice content of the placebo may have had an impact on the subjects' OA symptoms. In addition, due to the chronic nature of OA, the duration of the study was relatively short.

MA212 received a better overall rating than the placebo by physicians and by patients ($P < .001$ for both), and its tolerability was rated superior to placebo by physicians and patients ($P = .005$ for both). The authors concluded that "This study demonstrates excellent efficacy for MA212 in gonarthritis patients." HG

—Shari Henson

Dog Rose *Rosa canina*
Photo ©2018 Steven Foster

Proprietary Spearmint Extract Improves Working Memory in Subjects with Age-Associated Memory Impairment

Reviewed: Herrlinger KA, Nieman KM, Sanoshy KD, et al. Spearmint extract improves working memory in men and women with age-associated memory impairment. *J Altern Complement Med*. 2018;24(1):37-47. doi: 10.1089/acm.2016.0379.

Age-associated memory impairment (AAMI) is a normal part of aging, but slowing this decline can improve quality of life. Spearmint (*Mentha spicata*, Lamiaceae) aerial parts contain polyphenols such as rosmarinic acid and salvianolic acid, which have been shown to have anticholinesterase, antioxidant, and anti-inflammatory activities in neuronal cells. The authors hypothesized that a spearmint extract with high levels of polyphenols could improve cognitive performance.

Study Details: At a Glance	
Participants	• 90 men and women • 50-70 years of age • Healthy, with age-associated memory impairment
Study Design	Randomized, double-blind, placebo-controlled
Study Length	90 days
Active Treatment	Proprietary spearmint extract (Kemin Industries; Des Moines, Iowa)
Control	Cellulose placebo
Disclosures	The study was funded by the manufacturer of the test product (Kemin). The authors have either received research funding from or are employees of Kemin.

Using traditional breeding techniques, chemotypes of spearmint that produce significantly higher levels of bioactive polyphenols have been developed. A proprietary dried aqueous extract of these spearmint chemotypes has been shown to improve learning and memory in a mouse model of aging.[1] Additionally, in an open-label 30-day study of healthy, older adults with self-reported memory impairment, the polyphenol-rich extract was well-tolerated and improved cognitive performance.[2] The purpose of this randomized, double-blind, placebo-controlled study was to evaluate the effects of this proprietary spearmint extract on cognitive performance, sleep, and mood in healthy, older subjects with AAMI.

Healthy subjects (N = 90) aged 50-70 years were recruited from Addison, Illinois, from August 2013 through January 2014. They were assessed to have AAMI according to National Institute of Mental Health criteria (scores of ≥ 25 on the Memory Assessment Clinic Scale Questionnaire [MAC-Q], ≤ 29 on the Verbal Paired Associates [VPA] I and/or ≤ 9 on VPA II of the Wechsler Memory Scale IV, and ≥ 24 on the Mini-Mental State Exam [MMSE]). Included subjects had body mass indices between 18.5 and 35.0 kg/m^2, had at least a high school diploma, were willing to maintain their habitual diet and exercise routines, and were willing to maintain consistent sleep duration the evening before study visits.

Subjects were excluded for the following reasons: had clinically significant abnormal laboratory test results; had a history or presence of cancer (except non-melanoma skin cancer), or clinically significant cardiac, renal, hepatic,

Spearmint
Mentha spicata
Photo ©2018 Steven Foster

endocrine, pulmonary, biliary, gastrointestinal, pancreatic, or neurological disorders; had a history of alcohol or substance abuse within the previous 12 months; had a history of depression within the past 24 months or used psychotropic medications within one month of screening; had a history of heavy smoking (more than one pack per day) within the past three months; had heavy caffeinated beverage consumption (more than 400 mg of caffeine per day) within the past two weeks; were pregnant, lactating, planning to become pregnant during the study period, or of childbearing potential and unwilling to use a medically approved form of contraception; had an occupation that resulted in disruption of sleep-wake cycles; used medications or supplements known to alter cognitive function within the past two weeks; or had an inability to complete or understand the cognitive function practice tests.

Subjects were randomly assigned to take a placebo (cellulose) or 600 mg/day or 900 mg/day spearmint extract for 90 days. The proprietary spearmint extract (Kemin Industries, Inc.; Des Moines, Iowa) contained ≥ 14.5% rosmarinic acid and 24% total polyphenols. Cognition was assessed on days 0, 45, and 90 with the Cognitive Drug Research (CDR) System, which is a validated computerized testing instrument. Mood was assessed with the Profile of Mood States (POMS) questionnaire on days 0 and 90. Sleep was assessed with the Leeds Sleep Evaluation Questionnaire (LSEQ) on days 0 and 90. Before and during all test visits, subjects were instructed to avoid vigorous physical activity for 24 hours, alcoholic beverages for 24 hours, caffeine for 10-14 hours, and tobacco (*Nicotiana tabacum*, Solanaceae) use for one hour.

Compliance was excellent (≥ 98.1% for all groups). One subject in the placebo group and two subjects in the 600-mg spearmint group discontinued the study due to adverse effects (AEs). Only one AE (heartburn) was considered probably related to the 600-mg spearmint treatment.

At 90 days, participants in the spearmint groups showed improvements in working memory and spatial working memory. (According to the authors, "Working memory pertains to the ability to use and manipulate information stored within short-term memory." Spatial working memory is working memory of visuospatial information.) Comparisons between active groups showed that subjects taking 900 mg spearmint had a significantly greater improvement (22%) in quality of working memory compared with a 5% improvement in the 600-mg spearmint group (P = .021) and 7% improvement in the placebo group (P = .047). Subjects taking 900 mg spearmint also had a significantly greater improvement (17%) in spatial working memory compared with a 3% improvement in the 600-mg spearmint group (P = .017) and 6% improvement in the placebo group (P = .046). There were no other significant improvements in cognitive performance.

Of the seven mood factors assessed, there were significant overall treatment effects for the vigor-activity factor (P = .039) and the composite total mood disturbance (TMD) (P = .037) after 90 days of spearmint supplementation. However, comparisons between groups for the vigor-activity factor showed a trend toward significance only for the 900-mg group versus placebo (P = .065). Similarly, for the TMD, comparison showed a trend toward significance only for the 900-mg group versus placebo (P = .083). There were no significant improvements in the other mood factors.

Significant overall treatment effects also were observed in subjective ratings of ease of getting to sleep (P = .017) and behavior following wakefulness (P = .042) for subjects supplemented with spearmint. Comparisons indicated that the 900-mg spearmint group had significantly improved ability to get to sleep compared with placebo (P = .005). Comparisons also showed a significant improvement in behavior following wakefulness in the 900-mg versus the 600-mg group (P = .014) but not versus placebo (P value not reported). There were no significant differences among groups in quality of sleep or ease of awakening from sleep.

In summary, subjects with AAMI who took 900 mg per day of the proprietary spearmint extract had significantly improved working memory, spatial working memory, and self-reported ability to get to sleep after 90 days. (It was not discussed whether the odor of the test capsule was detectable, which could have impacted blinding.) There were overall spearmint treatment effects for vigor-activity, TMD, and behavior after waking, with trends toward statistical significance compared to placebo. Also, 900 mg per day spearmint for 90 days was well-tolerated in this population. This study bears repeating with a longer duration (age-related cognitive impairment increases over time) and with additional measures of cognitive function, preferably assessed at additional time points throughout the study. HG

—Heather S. Oliff, PhD

References

1. Farr SA, Niehoff ML, Ceddia MA, et al. Effect of botanical extracts containing carnosic acid or rosmarinic acid on learning and memory in SAMP8 mice. *Physiol Behav*. 2016;165:328-338.
2. Nieman KM, Sanoshy KD, Bresciani L, et al. Tolerance, bioavailability, and potential cognitive health implications of a distinct aqueous spearmint extract. *Functional Foods in Health and Disease*. 2015;5(5):165-187.

Turmeric and Boswellia Formulation Found to Be More Effective in Treatment of Osteoarthritis than Turmeric Supplement Alone

Reviewed: Haroyan A, Mukuchyan V, Mkrtchyan N, et al. Efficacy and safety of curcumin and its combination with boswellic acid in osteoarthritis: a comparative, randomized, double-blind, placebo-controlled study. *BMC Complement Altern Med*. 2018;18(1):7. doi: 10.1186/s12906-017-2062-z.

Symptoms of osteoarthritis (OA), including pain, morning stiffness, joint swelling, limited range of motion, and decreased physical function, typically are treated with nonsteroidal anti-inflammatory drugs (NSAIDs) and cortisone. Although those drugs help manage pain and inflammation, they are associated with adverse effects, drug interactions, and are contraindicated in certain populations. Curcumin, a component of turmeric (*Curcuma longa*, Zingiberaceae) root and rhizome, has been reported to be a potent anti-inflammatory agent. The boswellic acids found in boswellia (*Boswellia serrata*, Burseraceae) possess anti-inflammatory and anti-arthritic properties.

The primary objective of this randomized, double-blind, placebo-controlled study was to compare the efficacy of curcumin, a combination of boswellic acid and curcumin, and placebo in treating OA by assessing their effects on joint pain, morning stiffness, and limitations of physical function. The secondary objective was to investigate the safety of the treatments.

The study was conducted between September 2014 and May 2016 and included 201 patients (40-77 years of age) from the Erebuni Medical Center in Yerevan, Armenia, who had been diagnosed with degenerative hypertrophic OA of the knee.

The active treatments were Curamin and CuraMed (both from EuroPharma USA; Green Bay, Wisconsin). Each 500-mg Curamin capsule contained 350 mg BCM-95 (Arjuna Natural Ltd.; Kerala, India) and 150 mg boswellia gum resin extract (BosPure; DolCas Biotech, LLC; Landing, New Jersey) consisting of 75% total organic and boswellic acids, including 10% 3-*O*-acetyl-11-keto-boswellic acid. Each 500 mg placebo capsule contained maltodextrin, calcium phosphate, gelatin, magnesium stearate, silica dioxide, FD&C yellow 5, FD&C yellow 6, and titanium dioxide. Each 750-mg capsule of the curcumin supplement CuraMed* contained 552-578 mg of BCM-95, a dry turmeric extract with 500 mg curcuminoids and 49-52 mg essential oil from turmeric rhizome. Excipients

Study Details: At a Glance	
Participants	• 201 men and women • 40-77 years of age • Diagnosed with degenerative hypertrophic osteoarthritis of the knee
Study Design	Randomized, double-blind, placebo-controlled study
Study Length	12 weeks
Active Treatment	Curamin and CuraMed capsules (EuroPharma USA; Green Bay, Wisconsin)
Control	Placebo capsule
Disclosures	This study was supported in part by EuroPharma USA.

Turmeric
Curcuma longa
Photo ©2018 Steven Foster

* In the journal article, the authors list two different amounts of curcuminoids for the "500 mg CuraMed" capsules. In the abstract, they state that each capsule contains "333 mg curcuminoids," whereas each capsule is later described as containing "500 mg curcuminoids." Company representatives clarified that a 750-mg CuraMed capsule was used that contains 500 mg curcuminoids.

(120-149 mg) included phosphatidylcholine, medium-chain triglycerides, glycerol, gelatin, and yellow beeswax.

The patients were randomly assigned to the Curamin (n = 67), CuraMed (n = 66), or placebo group (n = 68), and were instructed to take one capsule three times daily for 12 weeks. No significant differences in demographic and other measured characteristics were observed among the patients at baseline. The mean age was 56.2 years, the average body mass index was 29 kg/m^2, and 93% of the patients were female.

In the Curamin group, dropouts during the study included two patients who did not return, one who lost interest because of lack of improvement, one who was injured, and one who reported nausea and vomiting. In the CuraMed group, dropouts included three patients who did not return, one who was unable to attend the study visits, one who lost interest because of lack of improvement, and three who did not trust the medication. In the placebo group, three patients did not return, three lost interest because of lack of improvement, and three reported adverse effects (weight gain, stomach pain, dyspepsia, rash, and itching).

During the study visits at baseline, four weeks, and 12 weeks, the patients underwent radiography and sonography, completed the Western Ontario and McMaster Universities Osteoarthritis (WOMAC) index and physical performance measures (PPM) tests, and provided blood samples.

After four weeks of treatment, significant decreases were seen in total WOMAC index scores in all groups ($P < .05$ for all). The scores gradually decreased in the Curamin and CuraMed groups until the end of the study. However, in the placebo group, no significant changes were seen at 12 weeks. At the end of the study, the improvements in the CuraMed ($P < .001$) were 3.6-fold and Curamin ($P < .001$) 2.7-fold greater than the improvement seen in the placebo group ($P = .154$).

Statistically significant pain relief was observed in all groups, as reported on the WOMAC index. In the placebo group, the pain index decreased significantly after four weeks of treatment ($P < .01$); however, after 12 weeks, the change was not significant ($P > 0.05$). Significant decreases in pain were seen in the Curamin and CuraMed groups ($P < 0.001$ for both) after 12 weeks of treatment.

The significant decrease in pain reported in the placebo group after four weeks is similar to results from other studies that have reported placebo effects of OA treatments; meta-analyses have indicated that more than 50% of OA study subjects respond positively to placebo treatment.[1,2] Placebo effects can be influenced by the strength of the active treatment, the severity of disease at baseline, the route of medication delivery, and the study's sample size.[1]

After 12 weeks of treatment, patients in the Curamin and CuraMed groups reported significantly less difficulty in moving their knees and less stiffness compared with baseline ($P < .05$ for both groups). In the placebo group, significant improvement was seen only after four weeks ($P < .05$) of treatment. Differences in changes during the study between the Curamin and placebo groups, and between the CuraMed and placebo groups, were not significant at any time point.

Among the PPM tests was the chair stand test. The maximum number of chair stand repetitions in 30 seconds increased significantly during the study in the Curamin and CuraMed groups ($P < .001$ for both). Significant differences between the Curamin and placebo groups ($P < .05$) and between the CuraMed and placebo groups ($P < .01$) were observed, with greater improvements in the Curamin and CuraMed groups. A timed walking test (40-m walking speed) revealed significantly increased walking speeds from baseline to week 12 only in the Curamin ($P < .001$) and CuraMed ($P < .01$) groups. Comparing the changes from baseline among the groups revealed significant differences between the CuraMed and placebo groups ($P < .05$) and between the Curamin and placebo groups ($P < .01$), with faster speeds reported in the active treatment groups.

In a separate walking test, patients were timed as they rose from a chair, walked three meters, turned around, walked back to the chair, and sat down. They wore regular footwear and used a walking aid if needed. The time to complete this task significantly decreased only in the Cura-

Boswellia
Boswellia serrata
Photo ©2018 Steven Foster

min ($P < .001$) and CuraMed ($P < .05$) groups. Comparing the changes from baseline to the end of the study revealed greater improvement in the Curamin group compared with the placebo group ($P < .01$); improvements in the CuraMed and placebo groups were not significantly different ($P > .05$).

The time required to go up and down a flight of stairs significantly decreased by week 12 only in the Curamin ($P < .001$) and CuraMed ($P < .01$) groups. Comparing the changes from baseline to the end of the study revealed greater improvement in the Curamin group compared with the placebo group ($P < .01$); improvements in the CuraMed and placebo groups were not significantly different.

Inflammation markers (i.e., erythrocyte sedimentation rate index and C-reactive protein levels) significantly increased ($P < .05$) in all groups compared with baseline, but were still within normal ranges, with no significant differences seen among the groups.

Adverse effects were observed in 13 of the 201 patients: four in the placebo group, two in the Curamin group, and seven in the CuraMed group. None of these effects were serious. The types and frequency of adverse effects were similar in all groups and were not considered related to the treatment.

Compared with placebo, Curamin significantly improved the patients' performance on all physical performance tests and factors of the WOMAC index, and patients treated with CuraMed saw improvements in two physical performance tests and in the WOMAC joint pain index. These results suggest that "these plant extracts are more effective in combination," wrote the authors, possibly because "boswellic acid may increase the bioavailability of curcumin. However, to our knowledge, there is no published study demonstrating the effect of boswellic acid on the bioavailability of curcuminoids."

In this study, the 12-week use of curcumin complex (BCM-95) or its combination with boswellic acids reduced pain-related symptoms in patients with OA. The authors conclude that the combination of curcumin and boswellia extracts "increases the efficacy of treatment of OA, presumably due to synergistic effects of curcumin and boswellic acid." HG

—Shari Henson

References

1. Zhang W, Robertson J, Jones AC, Dieppe PA, Doherty M. The placebo effect and its determinants in osteoarthritis: meta-analysis of randomized controlled trials. *Ann Rheum Dis*. 2008;6712):1716-1723.
2. Zou K, Wong J, Abdullah N, et al. Examination of overall treatment effect and the proportion attributable to contextual effect in osteoarthritis: meta-analysis of randomized controlled trials. *Ann Rheum Dis*. 2016;75(11):1964-1970.

Rhodiola Extract Reduces Burnout and Stress Symptoms in Exploratory Study

Reviewed: Kasper S, Dienel A. Multicenter, open-label, exploratory clinical trial with *Rhodiola rosea* extract in patients suffering from burnout symptoms. *Neuropsychiatr Dis Treat*. 2017;13:889-898. doi: 10.2147/NDT.S120113.

"Burnout" refers to stress-related emotional and physical exhaustion and is associated with a decrease in performance. Symptoms can be physically and mentally debilitating, and there is a considerable risk of developing psychiatric and somatic disorders (e.g., depression, anxiety, and cardiovascular conditions). Conventional medications for these disorders, such as antidepressants and anxiolytics, may result in unpleasant side effects, so researchers are looking for alternative treatment options. Traditionally used as an adaptogen to manage symptoms of anxiety, depression, stress, and associated fatigue, rhodiola (*Rhodiola rosea*, Crassulaceae) root and rhizome preparations previously have demonstrated therapeutic potential for relieving symptoms of burnout.[1]

Study Details: At a Glance	
Participants	• 117 men and women with symptoms of burnout • 30-60 years of age
Study Design	Exploratory, open-label, single-arm, multicenter study
Study Length	12 weeks
Active Treatment	Rhodiola root extract (Vitango; Dr. Willmar Schwabe GmbH & Co. KG; Karlsruhe, Germany)
Control	None
Disclosures	A. Dienel is employed by Schwabe, and S. Kasper has received grant/research support, consulting fees, and/or honoraria from various pharmaceutical companies, including Schwabe.


Rhodiola *Rhodiola rosea*
Photo ©2018 Steven Foster

This exploratory, open-label, single-arm, multicenter study investigated the effects of rhodiola on patients (N = 117) aged 30-60 years with comparable stress burdens (e.g., home caring of family members with disabilities) and who exhibited burnout symptoms. The study was conducted at four locations in Vienna, Austria, and took place from July 2011 through October 2012.

The experimental rhodiola preparation was a 200-mg tablet of Vitango (also known as Vitano; Dr. Willmar Schwabe GmbH & Co. KG; Karlsruhe, Germany) taken twice daily, before breakfast and lunch, for a treatment duration of 12 weeks. The active ingredient of Vitango is WS 1375 (also known as Rosalin; Dr. Willmar Schwabe GmbH & Co. KG), a proprietary dry ethanolic extract (60% w/w) of *R. rosea* roots (1.5-5:1), corresponding to 300-1,000 mg of rhodiola root.[2]

The severity of symptoms of stress and burnout, mood state, and physical function were assessed at the screening visit prior to treatment and at week 12 through a combination of validated questionnaires (self-reported), clinician assessments, physical examinations (including vital signs), laboratory tests (not described), and an electrocardiogram (ECG). Along with the other measures, seven subjective stress symptoms were evaluated in patients four times during the trial using Numerical Analog Scales (NASs). The results showed a significant improvement beginning on day 7 of treatment and improvement continued until week 12, with a decrease in mean overall scores for all seven NAS measures.

In addition, each patient was assessed by a clinician at the beginning of the trial, on day 7, week 8, and the end of the trial using the Clinical Global Impression (CGI) scale to evaluate the severity of burnout and stress symptoms and their change from baseline. The CGI scores showed a marked improvement by week 12 in 41.9% of patients.

The authors concluded that treatment with rhodiola extract improved most outcome measures of life-stress and burnout symptoms, but their findings remain preliminary and should be confirmed in randomized controlled trials. HG

—Kathleen Bennett, MS

References

1. Brown RP, Gerbarg PL, Ramazanov Z. *Rhodiola rosea*: A phytomedicinal overview. *HerbalGram*. 2002;(56):40-52.
2. Vitano Rhodiola Rosea Product Monograph. Dr. Willmar Schwabe Pharmaceuticals website. Available at: www.schwabepharma.co.uk/wp-content/uploads/2015/06/Vitano-Monograph-PRINT.pdf. Accessed April 16, 2018.

News Organizations Warn about the Potential for Herb-Drug Interactions

CBS News and other media outlets uncritically report the results of a flawed study that attempts to evaluate causality in alleged herb-drug interactions

On January 24, 2018, CBS News released a three-minute video segment titled "Why herbal supplements taken with prescription drugs may be risky," based on a recent study that analyzed reports of serious herb-drug interactions (HDIs) from published clinical trials.[1]

In the "CBS This Morning" segment, medical correspondent Tara Narula, MD, an assistant professor of cardiovascular medicine at the Zucker School of Medicine in New York, explained that "herbal supplements are pharmacologically active" and that they "could interact with medication."[1] Cranberry (*Vaccinium macrocarpon,* Ericaceae), ginkgo (*Ginkgo biloba,* Ginkgoaceae), ginseng (*Panax* spp., Araliaceae), green tea (*Camellia sinensis,* Theaceae), and St. John's wort (*Hypericum perforatum,* Hypericaceae) were singled out as botanical ingredients that can cause HDIs; however, the report failed to mention any specifics about the type of conventional drugs with which these botanical ingredients might interact.

While CBS News did not cite the source of its information, other recent media coverage on the topic, such as online reports from Science Daily[2] and *TIME*,[3] refers to a study by researchers from the South African Medical Research Council and the University of Stellenbosch published in the *British Journal of Clinical Pharmacology* (BJCP).[4]

The study assessed 49 case reports and two observational studies out of 5,113 retrieved articles that were published between 2001 and 2017. Using various assessment methods, the reported adverse drug reactions were classified according to the probability that HDIs were the cause. Based on their analysis, the authors ranked the likelihood of HDIs causing the reactions as "highly probable" (8%), "probable" (51%), "possible" (37%), or "doubtful" (4%).

The four "highly probable" case reports include alleged interactions between noni (*Morinda citrifolia,* Rubiaceae) juice and phenytoin (an antiseizure drug), cranberry juice and warfarin (a blood-thinning drug), goji (*Lycium barbarum,* Solanaceae) berry and warfarin, and St. John's wort and cyclosporine (an immunosuppressant drug).

Ginkgo, ginseng, St John's wort, and goji each were involved in three case studies. Patients were being treated for a variety of conditions, including heart disease, cancer, kidney transplants, depression, schizophrenia, anxiety disorders, and seizures. These patients were taking conventional pharmaceutical drugs (e.g., warfarin, statins, chemotherapeutics, antidepressants, or immunosuppressants) and a majority had multiple conventional drugs prescribed.

The potential for clinically relevant HDIs is a significant concern for many health care practitioners. Since sufficiently rigorous clinical studies on the issue are lacking, in vitro research, a small number of case reports, and even hypothetical and theoretical concerns often are used as data sources to identify potential HDIs. The data from in vitro studies, particularly those on isolated liver enzymes, have been shown to be of little clinical relevance,[5-7] and relying on such data may deprive a patient of using a beneficial herbal supplement.

Unfortunately, most media reports on the BJCP paper did not identify the reported interactions that were clinically relevant, but rather suggested that herbal ingredients, in general, may put one's well-being at risk when taken with conventional drugs. As such, the herb-drug information reported in the mainstream media based on this new paper is inadequate.

Unfortunately, most media reports on the BJCP paper did not identify the reported interactions that were clinically relevant, but rather suggested that herbal ingredients, in general, may put one's well-being at risk when taken with conventional drugs.

Bill Gurley, PhD, a professor of pharmaceutical sciences at the University of Arkansas for Medical Sciences who has researched clinically relevant HDIs for more than 20 years, commented: "In my opinion, this current media reporting is much ado about nothing, especially given the confounding variables in most of the case reports. Case reports are fraught with unknowns, and supplement dosage forms are also oftentimes fraught with unknowns."

Gurley continued: "As far as the [BJCP] paper goes, it's really nothing we didn't already know, except that several of the case reports they cited for botanicals like goji, ginseng, and ginkgo are simply too speculative to give them much clinical merit. There are some botanicals that do pose a significant risk for drug interactions, but goji, ginseng, and ginkgo are not among them. At least, they do not pose a risk when taken responsibly."

The following eight herbs and common household foods, depending on levels of intake, are known to produce potential clinically relevant HDIs of which both consumers and health care practitioners should be aware: black pepper (*Piper nigrum,* Piperaceae), goldenseal (*Hydrastis canadensis,* Ranunculaceae) root, grapefruit *(Citrus paradisi,* Rutaceae), green tea, licorice (*Glycyrrhiza* spp., Fabaceae), milk thistle (*Silybum marianum,* Asteraceae), schisandra (*Schisandra chinensis,* Schisandraceae), and St. John's wort.

Consumers who are using pharmaceutical drugs and are considering taking any of these herbs and foods should discuss possible interactions with their pharmacist, physician, or other qualified health care professional. HG

—Stefan Gafner, PhD

References

1. Why herbal supplements taken with prescription drugs may be risky. CBS News. January 24, 2018. Available at: www.cbsnews.com/video/why-herbal-supplements-taken-with-prescription-drugs-may-be-risky/. Accessed February 14, 2018.
2. Herbal products may compromise prescription drugs and cause serious side effects. *ScienceDaily.* January 24, 2018. Available at: www.sciencedaily.com/releases/2018/01/180124085359.htm. Accessed February 14, 2018.
3. Macmillan A. Herbal supplements may be dangerous when you take certain prescription drugs. *TIME.* January 24, 2018. Available at: http://time.com/5116664/are-herbal-supplements-safe. Accessed February 14, 2018.
4. Awortwe C, Makiwane M, Reuter H, Muller C, Louw J, Rosenkranz B. Critical evaluation of causality assessment of herb-drug interactions in patients. *British Journal of Clinical Pharmacology.* Published online January 24, 2018. Available at: http://onlinelibrary.wiley.com/doi/10.1111/bcp.13490/full. Accessed February 14, 2018.
5. Gurley BJ, Fifer EK, Gardner Z. Pharmacokinetic herb-drug interactions (part 2): Drug interactions involving popular botanical dietary supplements and their clinical relevance. *Planta Med.* 2012;78(13):1490-1514.
6. Sprouse AA, van Breemen RB. Pharmacokinetic interactions between drugs and botanical dietary supplements. *Drug Metab Dispos.* 2016;44(2):162-171.
7. Gurley BJ. Pharmacokinetic herb-drug interactions (part 1): Origins, mechanisms, and the impact of botanical dietary supplements. *Planta Med.* 2012;78(13):1478-1489.

Sustainable Harvest of Wild Plant Populations

By Charles M. Peters, PhD

Harvesting plant resources from wild populations affords a number of benefits. For many medicinal and aromatic species, wild material is thought to be qualitatively superior to cultivated stock because plants that grow in natural, more adverse environments typically produce increased amounts of secondary metabolites.[1] Wild-harvested plants frequently provide an important source of income for local communities and can also offer a powerful incentive for conserving natural habitats.[2,3] Finally, harvesting plants from the wild, as opposed to cultivating them, allows their populations to keep growing, regenerating, and evolving in response to an ever-changing array of selective pressures. Wild plant populations typically exhibit a high degree of genetic diversity; cultivated plants, as a rule, do not.

The risk of harvesting wild populations is that they can be overexploited and degraded easily. Unfortunately, this appears to be happening with increasing frequency all over the world. It is estimated that about 20% of the wild-harvested sources of medicinal plants worldwide are currently exhausted or threatened by overexploitation.[4] For example, several of the most valuable wild rattan species (from various genera in the Arecaceae family) in the Greater Mekong region of Southeast Asia are seriously depleted,[5] numerous native fruit trees in Amazonia are disappearing,[6] and the *gaharu* (*Aquilaria malaccensis*, Thymelaeaceae) trees of Indonesia and Malaysia — whose fungal-infected heartwood is a valuable incense, perfume, and medicine — have been in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) since 1995.[7] The interaction between wild plant populations, uncontrolled exploitation, and demanding market economies has been, to say the least, rather dismal.

There is a finite quantity of leaves, stems, roots, fruits, seeds, or exudates that can be harvested each year from a wild population of plants. Once this limit is passed, the regeneration dynamics of the population are affected and the number of individuals that compose it will decrease. If exploitation continues at the same intensity, the population will eventually disappear. To avoid the dangers of overexploitation, several assessment tools have been developed with criteria for ranking a species' resilience to harvesting based on life history characteristics, habitat specificity, and demand.[8,9] For species that receive a low score (i.e., "high-risk" species), cultivation rather than wild harvesting is recommended. While these efforts are undeniably useful, it is important to note that even the most "low-risk" species can be overexploited and depleted, and wild populations of even the most vulnerable species can be harvested sustainably. What is needed to avoid the former and achieve the latter is a clearer understanding of the productive capacity of the resource, a conscientious management effort, and a modicum of control over both the people and the plants.

Over the past 35 years, I have been involved with numerous projects in collaboration with local communities focused on the management and sustainable harvest of wild populations of valuable plant resources.[10,11] This work was conducted in tropical regions around the world with different ethnic groups and different types of botanical resources. Most of the resources I studied were trees (harvested for timber, carving wood, fruit, oleoresin, or useful bark) and vines (such as rattan), but several species of woody perennials or herbaceous annual plants were included in the management initiatives of some communities. Similar management protocols were used in every case. Building on this research, the purpose of this article is to review the conceptual foundation that underlies the sustainable harvest of wild plant populations and outline the basic data requirements for developing a management plan. The benefits of harvesting botanicals from the wild are numerous, and doing so in a sustainable manner is not as complicated or difficult as it might seem.

Basic Population Management Concepts

From a management perspective, a wild resource is most usefully described in terms of two parameters. The *stock* of a resource is the number of stems or individual plants of the resource-producing species (whether tree, shrub, or herb) that is found in the forest or field at one point in time. The *yield* is the rate at which a particular resource grows, multiplies, or increases in quantity each year. The amount of new timber (cubic meters/hectare), rattan cane (m/ha), bark (kg/ha), or latex (liter/ha), or the number of fruits, leaves, or stump sprouts that a species produces each year is the yield of that resource.

There is a close relationship between the current stock and the yield of a wild resource. Abundant species with dense populations have a large stock and produce a large amount of harvestable resource each year, while sparse, low-density populations exhibit a much lower yield. As the stock of the resource increases within a given area, so does the annual yield. The converse is also true.

The relationship between stock and yield can have profound consequences for the sustainable exploitation of a wild plant resource. In order to exploit the same species year after year in the same place, it is important to harvest no more than its annual growth each year. Harvesting more than the annual growth in a single year will diminish the current stock of the resource, and the resource will be depleted over time. This functions in much the same way as the relationship between the principal and the interest of an endowment or a savings account. As long as annual withdrawals are less than or equal to the interest generated by the principal each year — and the principal is left intact — such withdrawals can continue (theoretically) for perpe-

tuity. However, if withdrawals are larger than this each year, the principal gets smaller and the account is eventually overdrawn.

Resource Depletion Scenario

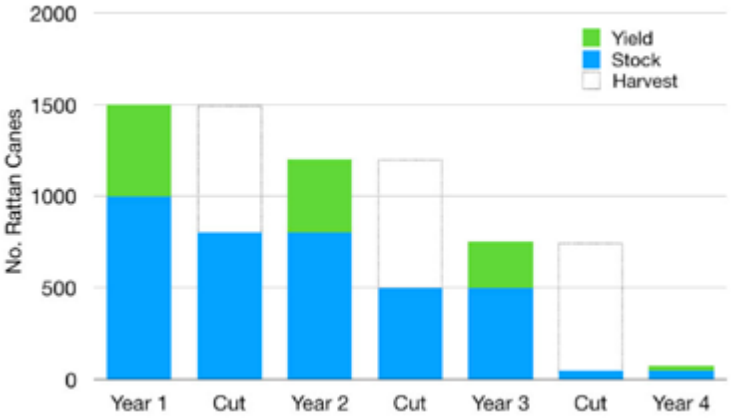
A graphic example of this process is shown in Figure 1. The initial stock of rattan in the forest is assumed to be 1,000 commercial canes (at least four meters long), with each of these canes exhibiting an annual growth rate of two meters per year. Based on the stock and the growth rate, the annual yield from this rattan population is estimated to be 500 canes. By the end of Year 1, the initial stock of 1,000 rattan canes has produced 500 new canes (i.e., the existing stock is now 1,500 canes). During the first harvest, an order for 700 canes is fulfilled, reducing the stock to 800 canes. In Year 2, the reduced stock yields less new material (i.e., 400 canes), but harvest rates are held constant at 700 canes to satisfy the demanding buyer. By Year 3, the population now exhibits a stock of 500 canes and barely grows enough to produce 250 new canes. The final harvest of 700 canes reduces the stock to 50 canes, which will produce only 25 new canes and certainly not support another commercial harvest. In this example, the rattan population is severely overexploited in only a few years. To repeat, it is of utmost importance that no more than the annual growth of a wild resource be harvested each year. Defining this critical harvest limit will inevitably require the collection of baseline data.

Data Requirements

The ability to exploit a wild plant population with minimal ecological impact improves dramatically when more is known about the species.[12,13] Regardless of the species, habitat, or plant part harvested, the most important ingredient required to achieve a truly sustainable form of resource use is information,[14] such as quantitative data on the stock and annual yield of the plant.

The stock of a population is assessed through a forest inventory. Foresters and ecologists have developed a variety of plot sizes and shapes and methodologies to survey wild plants, and trade-offs of time, cost, and statistical precision are inherent in each one.[15,16] Inventories conducted at the village level are strongly recommended, but they require a sampling methodology that is easy to understand and implement and that does not involve the use of specialized or expensive

Figure 1. Graphic representation of the relationship between stock and yield of a forest resource.



Villagers in Sagaing Region, Myanmar, inventory the timber, rattan, bamboo, palm thatch, and medicinal plant resources in their forest. Photo ©2018 Chuck Peters

field equipment. Based on these considerations, and after many years of experimentation with different inventory methods in collaboration with villagers, a systematic sample composed of parallel, 10-meter-wide transects appears to work best for counting and measuring forest resources.

Transects should run straight along a pre-determined compass bearing. The bearing should be chosen so that the transects run across topographical features (i.e., up and down slopes and across rivers, rather than parallel to them). Orienting the transects in this way will maximize the number of different habitats encountered in the inventory and provide a more representative sample of local habitats. The distance between transects determines the sample intensity (i.e., the percentage of the total area that is included in the inventory). The closer the transects are together, the higher the sample intensity. For example, separating each 10-meter-wide transect by 100 meters would give a sample intensity of 10%, while separating the transects by 200 meters would yield a sample intensity of 5%. Given the paucity of density data that exists for even the most economically important forest resources, a 5% sample would be sufficient to estimate the existing stock of a wild resource.

Finally, in addition to counting the plants of a particular species in the inventory, individual specimens should also be measured or visually estimated into size classes. Diameter at breast height (DBH) is the most convenient measurement for trees, and basal diameter is an appropriate size-class parameter for shrubs. Height classes can be used for vines, palms, and smaller woody perennials, and life stages (i.e., seedling, sapling, juvenile, adult) can also be used for species such as agaves (*Agave* spp., Asparagaceae) that are difficult to measure. The reason for assigning individuals to size classes or life stages is to divide the population into groups that are likely to be experiencing the same growth conditions.

The yield of different plant resources is quantified through a growth or yield study. Growth studies are used when the resource of interest is stem or root tissue (e.g., timber, rattan, ginseng [*Panax* spp., Araliaceae] roots); yield studies are used to measure fruit production, latex yield, or bark growth. The objective is the same: to quantify the size-specific annual production of the resource of interest in different habitats. How much rattan, timber, bark, latex, or floral nectar, or how many native fruits or leaves, are produced by a given species within a particular habitat? This is an important consideration, because it will ultimately determine how much of a given resource can be harvested from the wild.

In selecting the sample individuals to measure for yield studies, care should be taken to choose individuals that represent a range of different sizes (or ages), canopy covers, and habitats. Plants typically grow faster (i.e., produce more wood, leaves, or fruit) when there is more available light and/or nutrients; taller plants with a better canopy position also usually grow faster than suppressed individuals. Both fast-growing and slow-growing specimens should be included in the selection of sample plants for the yield study. If only fast-growing individuals are sampled, the annual yield of the population will likely be overestimated, and too much of the resource will be harvested from the area. Conversely, if the selection of sample plants contains too many slow-growing individuals, yield will be underestimated, and resources that could have been harvested sustainably will be left in the field. While this may seem obvious, it is often tempting to bias the selection of sample individuals toward the smaller-size classes, which are often more numerous, accessible, and easier to measure. These individuals also usually grow more slowly.

Defining a Sustainable Harvest

With data on the density and size-class distribution of a plant population and relatively precise yield estimates, it is possible to calculate the total quantity of the resource produced by the species in a single year. Multiplying the size-specific growth rate by the number of individuals in that class and then totaling the result over all classes provides an estimate of total population productivity. For resources like timber, rattan cane, bark, and roots, the harvest of which inevitably kills the plant, this estimate represents the limit of how much material can be sustainably harvested from the population in one year. If the population produces a total of 1,000 kilograms of new bark each year, then this is all that can be exploited. The exact number of trees that are harvested will depend on the size and bark volume of the trees that are felled or de-barked, but the total amount of bark extracted from the site in a single year should never exceed 1,000 kg.

> The risk of harvesting wild populations is that they can be overexploited and degraded easily. Unfortunately, this appears to be happening with increasing frequency all over the world.

For fruits and seeds, which can be harvested without killing the plant but impact the regeneration dynamics of the population, defining a sustainable harvest limit is a bit more complicated. Clearly, not all of the fruit produced by the population can be harvested year after year. It is necessary to determine how many fruits need to be left on the site to facilitate the recruitment of new seedlings into the population. This can be accomplished in two main ways: through successive approximation (i.e., harvesting a certain percentage of the fruit crop, monitoring the impact on regenera-

Forester in the Selva Maya of Quintana Roo, Mexico, affixes a dendrometer band around a *tzalam* (*Lysiloma latisiliquum*) tree to measure its annual growth. Photo ©2018 Chuck Peters

tion, and adjusting subsequent harvests as warranted[17]) or by dividing the management area into separate harvest units of comparable size and leaving one unit untouched or fallow each year; the fallow plot should be rotated sequentially and be different each year.

Impact Monitoring

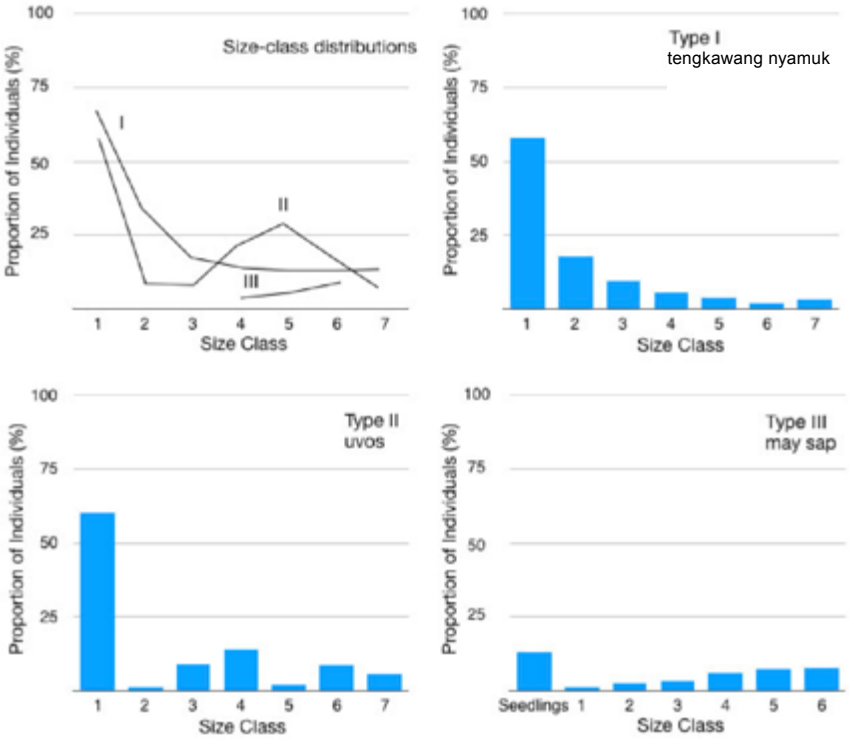
Even when harvest limits are respected and maintained, collecting commercial quantities of resources from wild plants can cause changes in the population being exploited. Shifts in biophysical parameters (e.g., rainfall, temperature, presence or absence of pollinators or predators) can cause plant populations to produce varying numbers of seedlings or to exhibit varying rates of mortality each year. These demographic changes, in either direction, should not go undetected. It is best to set up a series of permanent plots in the forest and re-inventory them every five years or so.[14]

In particular, changes in the size-class distribution of the harvest population that suggest adverse effects on rates of regeneration should be noted. To assess this change, the results from the initial inventory should be used to produce a size-class histogram (i.e., a graph that shows the number of individuals in each size class). A histogram serves as a baseline and represents the initial structure or "pre-harvest" condition of the population.

In spite of the variety of different reproductive and growth strategies used by plants, wild populations exhibit a limited number of size-class distributions. Three of the most common distributions are shown in Figure 2 with a representative example of each type. Size classes indicated are diameter classes (cm DBH) for the tree species (*tengkawang nyamuk* and *uvos*) and height classes (m) for the rattan species (may sap).

The Type I size-class distribution, illustrated by *tengkawang nyamuk* (*Shorea atrinervosa*, Dipterocarpaceae), a valuable seed oil-producing tree in western Borneo, displays a greater number of small individuals than large ones and an almost constant reduction in number from one size class to the next. This type of population structure is characteristic of shade-tolerant plants that maintain a relatively constant rate of recruitment. It is probable that the death of an adult tree will be supplanted by the growth of individuals from the smaller size classes.

Figure 2. Size-class distributions exhibited by wild plant populations and an example of each type.



The Type II size-class distribution, illustrated by *uvos* (*Spondias mombin*, Anacardiaceae), a popular native fruit tree from the Peruvian Amazon, is characteristic of species that show discontinuous or periodic recruitment. The actual level of seedling establishment may be sufficient to maintain the population, but its infrequent recruitment causes notable discontinuities in the structure of the population as the newly established seedlings and saplings grow into the larger size classes. This type of diameter distribution is common among tree species that depend on canopy gaps for regeneration. Many of the mast-fruiting Dipterocarpaceae in Southeast Asia also exhibit a Type II distribution (although not *tengkawang nyamuk*, which fruits every year).[18] The large number of individuals in the first size class, as shown in the *uvos* histogram, suggests that gap colonization by this species was particularly successful in the past.

Harvesting plants from the wild, as opposed to cultivating them, allows their populations to keep growing, regenerating, and evolving in response to an ever-changing array of selective pressures.

The final size-class distribution, Type III, is illustrated by may sap (*Calamus dioicus*, Arecaceae), an important commercial rattan from the Greater Mekong Region. A Type III distribution is seen in species whose regeneration is severely limited for some reason. Population density is low, seedling numbers are greatly reduced, and very few individuals are in the intermediate size classes. Type III distributions are frequently encountered among light-demanding, pioneer species that require large canopy gaps for regeneration. In the absence of factors required for regeneration, these species may disappear from the forest. The situation with may sap is aggravated by intensive commercial harvesting of adult plants for their cane.

The size-class distribution of a population is extremely sensitive to the population's regeneration rate. A Type I distribution can easily change into a Type II if existing recruitment levels are diminished or interrupted. Further constraints on regeneration may drive the population to a Type III distribution. It is perhaps most useful to view these three distribution types as a single sequence through which a wild species passes on its way to extinction.

Size-class histograms should be constructed every time a harvest area is re-inventoried, and the distribution of individuals in the current population should be compared to the "baseline" histogram from the original inventory. Are there notable changes in the shape of the distribution? Have the number of individuals in the initial size class decreased (i.e., is the population recruiting fewer new individuals)? Or, ideally, has the general shape of the size-class distribution remained relatively unchanged over the five-year period?

Pronounced changes in the size-class distribution should be accompanied by immediate reductions in the amount of material harvested from the population each year. These harvest reductions should be maintained until the structure of the population returns to baseline conditions. If, after five years, the number of individuals in the smaller size classes continues to decline, the harvest intensity should be further decreased and the response should be monitored. By conscientiously monitoring the population response to different harvest levels, a level of resource extraction that the population can support will eventually be determined. This is where sustainability happens.

Recommendations and Next Steps

The sustainable management of wild plant populations is both a science and an art. In most cases, the actual sustainability of an enterprise hinges more on the willingness of the collectors and buyers to follow the prescribed harvest limits than on the statistical rigor of the data used to estimate them. It is important not only to count the plants and measure the growth as accurately as possible, but also to make sure that everyone understands how and why these data were collected and to continually affirm that things will get better if the harvested controls are respected.

In terms of next steps:

- Start small. Identify a specific plant resource-collector-market system in which information exists about the biology of the plant species, market conditions for the resource are favorable, and stakeholders are enthusiastic about the prospects of using wild resources sustainably.
- Conduct a quantitative inventory of the plant population and start a yield study, ideally involving the collectors and/or local community.
- Calculate a sustainable harvest level in collaboration with all stakeholders and initiate harvesting. Promote the sustainability initiative as much as possible.
- Periodically re-inventory the harvest area to assess the impact of harvesting. Adjust harvest rates as necessary and carefully explain to all stakeholders the reason(s) for the modification.
- Freely share information with colleagues, local authorities, retailers, business representatives, and the general public.
- Both the harvested and the harvester ultimately benefit from sustainable resource use. HG

***Charles M. Peters, PhD**, is the Kate E. Tode Curator of Botany at the Institute of Economic Botany at the New York Botanical Garden and an adjunct professor of tropical ecology at the Yale School of Forestry and Environmental Studies. His recent book,* Managing the Wild: Stories of People and Plants and Tropical Forests *(Yale University Press and NYBG Press, 2018) describes more than three decades of fieldwork with local communities in tropical forests to sustainably manage wild plant resources.*

References

1. Schippmann U, Leaman D, Cunningham AB. A comparison of cultivation and wild collection of medicinal and aromatic plants under sustainability aspects. In: Bogers RJ, Craker LE, Lange, D, editors. *Medicinal and Aromatic Plants*. Wageningen, the Netherlands: Springer Netherlands; 2006;75-95.
2. Shackleton C, Shackleton S. The importance of non-timber forest products in rural livelihood security and as safety nets: A review of evidence from South Africa. *South African Journal of Science*. 2004;100(11-12):658-664.
3. Townson IM. *Forest Products and Household Incomes: A Review and Annotated Bibliography*. Tropical Forestry Papers No. 31. Oxford, UK and Bogor, Indonesia: Oxford Forestry Institute and Center for International Forestry Research; 1995.
4. Hamilton AC. Medicinal plants, conservation and livelihoods. *Biodiversity and Conservation*. 2004;13(8):1477-1517.
5. Evans TD. The status of the rattan sectors in Lao People's Democratic Republic, Vietnam and Cambodia-with an emphasis on cane supply. In: Dransfield J, Tesoro F, Manokaran N, eds. *Rattan: Current Research Issues and Prospects for Conservation and Sustainable Development*. Rome, Italy: Food and Agriculture Organization; 2002;115-144.
6. Vazquez R, Gentry AH. Use and mis-use of forest harvested fruits in the Iquitos area. *Conservation Biology*. 1989;3(4):350-361.
7. Wyn LT, Anak NA. *Wood for trees: A review of the agarwood (*gaharu*) trade in Malaysia*. Petaling Jaya, Malaysia: TRAFFIC Southeast Asia; 2010.
8. Castle LM, Leopold S, Craft R, Kinscher K. Ranking tool created for medicinal plants at risk of being overharvested in the wild. *Ethnobiology Letters*. 2014;5:77-88.
9. American Herbal Products Association. Section 4: Wild collection assessment tool. In: *Good Agricultural and Collection Practices (GACP)*. Silver Spring, MD: AHPA. July 7, 2017. Available at: www.ahpa.org/Resources/GACP-GMPAssessmentTools/TabId/405/ArtMID/1249/ArticleID/825/Section-4-Wild-Collection-Assessment-Tool.aspx. Accessed March 4, 2018.
10. Peters CM. Community forestry and sustainability research at The New York Botanical Garden. *Brittonia*. 2016;68(3):290-298.
11. Peters CM. *Managing the Wild: Stories of People and Plants and Tropical Forests*. New Haven, CT: Yale University Press; 2018.
12. Foster S. Harvesting medicinals in the wild: The need for scientific data on sustainable yields. *HerbalGram*. 1994;24:10-16.
13. Cunningham AB. *Applied Ethnobotany: People Wild Plant Use and Conservation.* London, UK: Earthscan; 2001.
14. Peters CM. *Sustainable Harvest of Non-timber Plant Resources in Tropical Moist Forest: An Ecological Primer*. Washington, DC: Biodiversity Support Program; 1994.
15. Husch B, Beers TW, Kershaw JA. *Forest Mensuration*. 4th ed. Hoboken, NJ: John Wiley and Sons, Inc.; 2003.
16. Peters CM. Beyond nomenclature and use: A review of ecological methods for ethnobotanists. In: Alexiades MN, ed. *Selected Guidelines for Ethnobotanical Research: A Field Manual*. Bronx, NY: NYBG Press; 1996;241-276.
17. Peters CM. *The Ecology and Management of Non-Timber Forest Resources*. World Bank Technical Paper No. 322. Washington, DC: The World Bank; 1996:82-85.
18. Peters CM. Illipe nuts (*Shorea* spp.) in West Kalimantan: Use, ecology, and management potential of an important forest resource. In: Padoch C, Peluso NL, eds. *Borneo in Transition: People, Forests, Conservation, and Development*. Kuala Lumpur, Malaysia: Oxford University Press; 1996;230-244.

AHPA's Self-Regulatory Initiatives in the US Herb Industry

The American Herbal Products Association adheres to its mission as it pursues responsible commerce in 30 years of self-regulatory efforts

By Karen Raterman

In June of 2017, more than 30 years after the passage of the signature legislation dealing with supplements, the Dietary Supplement Health and Education Act of 1994 (DSHEA), several industry trade associations, including the American Herbal Products Association (AHPA) and the Council for Responsible Nutrition (CRN), went to Capitol Hill to meet with members of Congress to discuss past accomplishments and ongoing efforts regarding industry self-regulation.[1]

Such visits are a never-ending requirement for an industry often suffering from a mistaken view of its efforts and a long-held misperception that it is unregulated.[2]

Michael McGuffin, president of AHPA, knows this as well as anyone. Although he acknowledges the many other industry groups that are committed to long-term self-regulatory efforts, such as CRN, the Natural Products Association (NPA), and the United Natural Products Alliance (UNPA), he stated that AHPA, founded in 1982, has been a central player in relation to self-regulation and has long forged a trail in these programs (oral communication, December 5, 2017).

McGuffin said that the efforts were not from some prescient knowledge of issues to come, but rather because doing so was consistent with AHPA's mission, which is "to promote the responsible commerce of herbal products to ensure that consumers continue to enjoy informed access to a wide variety of herbal goods."[3]

Supporting Responsible Commerce

"I think it is fair to say we were a trailblazer in these types of efforts, and [it is] accurate that we established standards of practice early in our existence to respond to circumstances as we became aware of them," McGuffin said. "We have always felt that this was part of our identity and service to the trade, which extends beyond our members. But I will tell you, it is directly associated with our mission to support responsible commerce. We weren't just trying to support 'commerce,' but 'responsible commerce.' By adding the word 'responsible,' it made our jobs a lot harder."

Loren Israelsen, president of UNPA, was an early officer of AHPA and remembers the pioneering days when AHPA was "working to build a new voice for the still-adolescent herb industry" (email, December 11, 2017).

"For reasons beyond me, I was elected a founding officer of AHPA in 1982," said Israelsen. "AHPA was my 'hood,' and many of my oldest and most cherished relationships came out of those early days. While AHPA board meetings are now highly organized and committees tackle the toughest issues of the day, at the heart of AHPA remains a deep commitment to advancing the safe and beneficial use of herbs."

McGuffin noted that AHPA programs have always evolved and reflected a balance between the reactive and the proactive. AHPA may have adopted certain programs earlier, he said, if, for example, it could have foreseen the need for *Herbs of Commerce* or restrictions on caffeine-containing products. "But that is not how the world works," he said. "What we are expected to do is respond to situations as they arise. We do try to predict or adopt some initiatives before there is a problem to be fixed. That is the nature of things as we move through our business lives. There are always new issues to deal with" (oral communication, November 28, 2017).

That being said, AHPA didn't see a clear or significant problem when they set out to publish the *Botanical Safety Handbook*, the 1997 publication intended to evaluate herb safety and ensure safe access to a wide range of herbs and herbal products, which is arguably one of the group's signature achievements. However, there was a realization within the organization that it would be best to address the issues of botanical safety internally rather than leave the issue to other groups without the knowledge and expertise in herbs or with a position contrary to supporting consumer use of herbs.

McGuffin largely attributed the genesis of this philosophy to one member: Daniel Gagnon, a Santa Fe, New Mexico-based herbalist and owner of Herbs, Etc., a retail store and extract manufacturer, who was standing for election to the AHPA board during the mid-1990s when the association was working on the *Botanical Safety Handbook*. "Daniel said that AHPA needed to control the message on botanical safety rather than let our detractors control that message," he said.

The book, which was years in the making, started with this concept, and McGuffin, Gagnon, and other members investigated potential models from other organizations that had done self-regulatory work. They found one such model from the Flavor and Extract Manufacturers Association (FEMA), which had developed an industry-sponsored generally recognized as safe (GRAS) assessment program after the US Food and Drug Administration (FDA) took action to reclassify flavors as food additives (substances requiring premarket safety approval from the FDA before they can be added to food products). It has become an extensive program with a sound record of scientific rigor and transparency.[4,5]

McGuffin, Gagnon, and other AHPA representatives went to John Hallagan, general counsel for FEMA, to discuss the program. "He was very supportive and encouraged us to take on the task," McGuffin said. He recalled that Hallagan was very stern and advised them to be thorough and not look for shortcuts. "He told us 'you can't exonerate everything.'"

"The point is," McGuffin added, "people at the time were not talking about unsafe herbs. There weren't gross numbers [of consumers] being harmed by chamomile [*Matricaria chamomilla*, Asteraceae] and echinacea [*Echinacea* spp., Asteraceae]. But one in our community said: 'We need to take responsibility for this. It is not a clear and present danger, and we are not being damaged by a regulator. We must do this because it is the right thing to do and we have the expertise.'"

Lessons Learned

It was a premise that has since served AHPA well, and the association continuously strives to adapt and bring as many players to the table as possible to develop the programs. It was a lesson, McGuffin said, that he learned early.

AHPA's first initiative, established in 1988 to prohibit the international and domestic trade of wildcrafted lady slipper (*Cypripedium* spp., Orchidaceae), is a good example of this thinking. At the time, the entire orchid family was listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), a designation that lists species that are not currently threatened with extinction but may become so unless trade is closely controlled.[6]

AHPA leaders knew that lady slipper had the attention of the international treaty, but that it wouldn't have an impact on domestic trade, which made up a majority of the market.

AHPA quickly learned that these types of programs would not be an easy sell. In establishing the lady slipper policy, for example, McGuffin said they considered the impact of the ban on its members and the community beforehand, and recognized that there were adequate herbal substitutes for lady slipper that could offer beneficial value and provide quality products. "We felt that the impact would be minimal," he said. However, initial reaction to the initiative was mixed. "We did hear from some companies that were marketers of wild material and herbal ingredient suppliers who thought that our action was unnecessary, and that the plant was not at risk due to harvest pressure," he said. "But mostly, what I remember was that members said they would have liked to have been more a part of the discussion."

The early feedback was that such programs were not completely wrong, he said, but the stronger message was that the decision-making process was not inclusive of the broader community. To address these concerns, AHPA now engages a broad cross-section when it initiates a new self-regulatory recommendation.

Bringing stakeholders to the table is an ongoing process that continues to develop. In 2017, McGuffin said, AHPA adopted a policy for supplements containing fungal ingredients and had to deal with widely divergent points of view regarding the value of the fruiting body and the mycelium and how products should be labeled. "We kept bringing both sides together to create a respectful forum to talk. There were still disagreements, but we pushed each side for what they could give," he said. It is a difficult process, he added, but "one way to know you have a good compromise is that neither party likes it much. Is everybody happy? Maybe not, but we are seeing compliance."

Throughout the 1990s, AHPA established a number of initiatives, such as labeling guidelines and usage cautions for herbs and products, such as chaparral (*Larrea tridentata*, Zygophyllaceae), stimulant laxatives, pyrrolizidine alkaloids, and kava (*Piper methysticum*, Piperaceae), as well as policies regarding added constituents and claims that a supplement can mask the presence of illegal drugs in the body.[2] One of the self-regulatory highlights of the decade was the 1992 publication of the first edition of *Herbs of Commerce*, which established a single standardized common name for each of the herbs listed, with a goal to help prevent potential confusion and misuse of botanicals by manufacturers and consumers.

"We realized that the same ingredients were being sold in the market under different names and, to a degree, the consumer couldn't tell what they were buying," McGuffin explained. For example, eleuthero (*Eleutherococcus senticosus*, Araliaceae) was being sold under various names such as "Siberian ginseng," and kola nut (*Cola* spp., Malvaceae) was being sold as "bissy nut." There was concern that the name was being used instead of kola nut to move consumers away from the idea that the product contained caffeine, McGuffin explained. AHPA took on the task of becoming the authority for standardizing these common names, contracting with author and botanical expert Steven Foster to produce the document.

One of the self-regulatory highlights of the decade was the 1992 publication of the first edition of *Herbs of Commerce*, which established a single standardized common name for each of the herbs listed.

The publication eventually became incorporated in 1997 into the Food and Drug Administration's (FDA) rules for labeling dietary supplements as directed in DSHEA.[7] The regulation was codified in 21 CFR 101.4 (h) and states that "The common or usual name of the ingredients of dietary supplements that are botanicals (including fungi and algae) shall be consistent with the names standardized in *Herbs of Commerce*, 1992 edition, which is incorporated by reference in accordance with 5 U.S.C. (a) and 1 CFR part 51."[8]

AHPA published a second edition of *Herbs of Commerce* in 2000, which includes nearly 1,500 more species than the first edition (2,048 separate species as opposed to 550). The second edition allowed many ingredients that had been used in products to be identified from then on by their common names rather than their Latin binomials.[7]

"The incorporation of *Herbs of Commerce* was a great acknowledgement of the value of our work," McGuffin said,

"and, more importantly, it was a stepping stone to help move industry self-regulatory efforts into formal regulatory references."

From Self-Regulation to Law

This was not the only time that an AHPA program served as a credible and authoritative option for regulators. AHPA's position on adverse event reporting in 2002 moved from an industry self-regulatory effort all the way to law and is an example of how these policies can progress. It began when the AHPA board took the position that the FDA should establish a requirement for marketers of dietary supplements to communicate reports of serious adverse events caused by their products to the FDA.[9] The process took several years, with AHPA filing a Citizen Petition in 2003 asking the FDA to create regulations that would mandate adverse event reporting and noting that the administration had in numerous instances exercised its rulemaking authority to put in place requirements that would advance its public health objectives.[9]

The FDA originally said it did not have the authority to do this, McGuffin recalled, but AHPA believed that it was wrong and partnered with other groups, such as the Consumer Healthcare Products Association (CHPA), to convince them otherwise. Beyond CHPA, AHPA also garnered support from numerous industry watchers with a wide spectrum of views about supplement regulation. "We got bipartisan support from industry leaders in Congress, including some of our staunchest allies, such as Sen. Orrin Hatch [R-UT] and our most committed detractors, like Sen. Dick Durbin [D-IL], as well as support from consumer groups like CSPI [the Center for Science in the Public Interest] and Consumers Union. It was a remarkable exercise, but everyone recognized the need," he said.

The adverse event proposal was eventually adopted as part of the Dietary Supplement and Nonprescription Drug Consumer Protection Act, which was signed into law in December 2006, with compliance required a year later.[10] "There was initially some support and some resistance to this, but we felt we had a responsibility to support responsible commerce and that included informing regulators when something goes wrong. In this instance, we took something that started as a self-regulatory initiative to engage our members and support the community and then moved to make it a formal, public initiative," McGuffin said.

Another signature program is AHPA's Botanical Authentication Program that was established in 1997, originally as AHPA's *Guidance on Known Adulterants*.[11] At the time, McGuffin said, AHPA recognized that there were potential mix-ups or intentional substitutions of certain herbs, so the program set out to identify herbs and potential adulterants that were known to be in trade. "We didn't evaluate whether it was an intentional adulteration or simply an accident. In each case, there was a known substitute that had the potential to cause significant [adverse] health effects, so we were focused on safety issues." The program started with a list of four ingredients, including aristolochic acids (a family of phytochemicals commonly found in the family Aristolochiaceae), stephania (*Stephania tetrandra*, Menispermaceae) root, skullcap (*Scutellaria lateriflora,* Lamiaceae) herb, and eleuthero root, which were identified as potentially adulterated. The program provided guidance to help manufacturers dealing with those ingredients, so they could double- and triple-check that they had the correct ingredient.

The ongoing and dynamic program has evolved over the past 20 years as part of AHPA's Botanical Authentication Program with additional ingredients, such as black cohosh (*Actaea racemosa,* Ranunculaceae) as well as grapefruit (*Citrus paradisi*, Rutaceae) seed extract added to the list. The program also provides members and industry with online tools to ensure ingredient identity and quality.

AHPA also has led the way with guidance documents that provide specific and detailed information about herbal ingredients. "AHPA's 2000 Guidance Policy on extract retail labeling continues to be instructive to companies that want to increase their supply chain knowledge and transparency," said Steven Dentali, PhD, a former AHPA chief science officer. "Knowing the precise nature of the extracts manufacturers purchase from suppliers is made easier when the basic botanical principles are understood. AHPA continues to be at the forefront of trade associations focused on developing herbal standards and communicating them to the wider stakeholder community."

AHPA continues to be at the forefront of trade associations focused on developing herbal standards and communicating them to the wider stakeholder community.

What Has the Industry Learned?

Despite AHPA's extensive list of self-regulatory accomplishments, the investigation by New York attorney general Eric Schneiderman that began in early 2015 once again indicated that the botanical and dietary supplement industries still faced many powerful detractors and significant misconceptions about regulatory status. While the allegations against numerous manufacturers and retailers prompted an unprecedented industry effort to work together toward self-regulation, it still rankles McGuffin for a number of reasons. "The primary issue that I challenge is the idea that world history went like this: Step one: We are bad. Step two: Eric Schneiderman said, 'You are bad.' Step 3: We decided to be good. That is a false narrative. The true story is, we were good to begin with. We were always involved with these issues. We didn't start self-regulating in 2015."

Correcting the record is a common theme when McGuffin speaks. In his keynote address of the 2016 Rocky Mountain Dietary Supplement Forum, he rejected the idea that the

2015 investigation by the New York attorney general was the sole event that prompted the industry to behave honorably. "These new initiatives do not represent the industry's first foray into self-regulation, and I reject any suggestion that we have arrived at the point of creating new programs under duress."[12]

He does acknowledge that the investigation has provided a stepping-off point for more self-regulatory initiatives. One such effort, he said, is the re-emergence of AHPA's Good Agricultural and Collection Practices (GACPs), first established in 2006 in partnership with Roy Upton and the American Herbal Pharmacopoeia. The initiative was modeled after various other programs around the world. Some ideas were original, and some were borrowed with a focus on the US market, McGuffin explained. "We produced it. We posted it, but we didn't keep our attention on it."

That is, until consultants for GNC, facing legal issues from Schneiderman, copied the document from the AHPA website and then crafted a revised version with a more contemporary focus and input from herbal suppliers and manufacturers to establish appropriate controls all the way back to seed and harvest, McGuffin said. GNC then gave the document back to AHPA to put in additional context from a trade association perspective. The document, which now includes Good Manufacturing Practices for Botanical Material, as well as GACPs, was formally approved in March 2017 and has since been endorsed by a variety of other industry associations, such as CHPA, CRN, and UNPA. The free assessment tools are designed to help the herbal products industry evaluate and document policies and procedures that ensure high-quality herbs and herbal ingredients throughout the supply chain.[2]

In a letter of endorsement for the guidance, Israelsen wrote: "UNPA is confident that this comprehensive guidance and its accompanying assessment tools will help promote proper identification of and reduce the adulteration of botanical raw materials, with a goal of providing high-quality ingredients for dietary supplements and other natural health products. We will encourage our member companies to incorporate the AHPA GACP-GMP into their own growing, procurement and processing operations."[13]

A New Era

Though the challenges will likely continue, McGuffin remains optimistic for the future and believes there is still strong momentum going forward. "I think there is still a lot of interest in countering the image of the dietary supplements industry as unregulated," he added. "We know it's false, but we also recognize now that we are not going to change that by just saying 'nu uh.' The only way to change that is with respect for the foundational companies that are making the best-quality products, and then indicating to consumers in a public manner that they are going a step beyond what is required."

In the end, McGuffin added, it comes down to the consumer who will continue to demand access to herbal products and, as they become more knowledgeable and information is more accessible, they will buy from companies that meet appropriate quality standards and share their values. The industry in turn will have no choice but to continue with self-regulatory initiatives that meet this demand. "One thing is not leading the other," he said. "There is a valuable and productive tension between consumers and industry, and the next generation will keep the process going and industry self-regulation will be a part of the program then, just as it is today." HG

References

1. Crawford E. Dietary supplement industry promotes self-regulation, need for increased access on Capitol Hill. FoodNavigator-USA. June 21, 2017. Available at: www.foodnavigator-usa.com/Article/2017/06/21/CRN-AHPA-promote-self-regulation-increased-supplement-access#. Accessed December 6, 2017.
2. AHPA Staff. Herbal supplement industry's long history of self-regulation. *AHPA Report*. October 2016. Volume 31. Number 10.
3. AHPA's mission. AHPA website. Available at: www.ahpa.org/AboutUs/AHPAsPolicies.aspx. Accessed December 6, 2017.
4. FEMA GRAS Program. Available at: www.femaflavor.org/gras. Accessed December 7, 2017.
5. Hallagan JB, Hall R. Under the conditions of intended us — New Developments in the FEMA GRAS program and the safety assessment of flavor ingredients. *Food Chemical Toxicology*. February 2009; 47(2): 267-278. Available at www.sciencedirect.com/science/article/pii/S0278691508006443.
6. The CITES Appendices. Available at: https://cites.org/eng/app/index.php. Accessed December 6, 2017.
7. *Herbs of Commerce* becomes law of the land for labeling. [press release]. Silver Spring, MD; American Herbal Products Association. November 7, 2005. Available at: www.newhope.com/supply-news-amp-analysis/herbs-commerce-2nd-edition-becomes-law-land-labeling. Accessed December 8, 2017.
8. US Food and Drug Administration. 21 CFR §101.4. Food for human consumption: food labeling. In: *Code of Federal Regulations*. Washington, DC: US Government Printing Office; 2017. Available at: www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=101.4. Accessed February 1, 2018.
9. American Herbal Products Association Supports Serious Adverse Event Reporting for Dietary Supplements [press release]. Silver Spring, MD. American Herbal Products Association. June 6, 2004. Available at New hope.com. www.newhope.com/supply-news-amp-analysis/american-herbal-products-association-supports-serious-adverse-event-reporti. Accessed on December 8, 2017.
10. Adverse Event Reporting: Considerations and Med Watch Worksheet for Receiving AERs Associated with Dietary Supplements. AHPA website. Available at: www.ahpa.org/Resources/TechnicalGuidance/AHPAGuidanceDocuments/TabId/401/ArtMID/1244/ArticleID/222/Adverse-Event-Reporting-Considerations-MedWatch-Worksheet-for-Receiving-AERs-Associated-with-Dietary-Supplements.aspx. Accessed Dec. 8, 2017.
11. AHPA Botanical Authentication Program. AHPA website. Available at: www.ahpa.org/Resources/TechnicalGuidance/ScientificAffairs/BotanicalAuthenticationProgram.aspx. Accessed December 8, 2017.
12. AHPA Launches GACP-GMP Assessment Program. AHPA Website. Latest news. Available at www.ahpa.org/News/LatestNews/TabId/96/ArtMID/1179/ArticleID/847/AHPA-Launches-GACP-GMP-Assessment-Program.aspx. Accessed December, 8, 2017.
13. UNPA Endorses AHPA's Good Agricultural and Collection Practices and Good Manufacturing Practices for Botanical Material [press release]. Salt Lake City. November 28, 2017. Available at: www.ahpa.org/News/LatestNews/TabId/96/ArtMID/1179/ArticleID/890/UNPA-endorses-AHPAs-Good-Agricultural-and-Collection-Practices-and-Good-Manufacturing-Practices-for-Botanical-Material.aspx. Accessed December 10, 2017.

The BOTANICAL ENDEAVOUR *of* SIR JOSEPH BANKS: *Historic Prints from his* FLORILEGIUM *Now Available Like Never Before*

By Connor Yearsley

Almost 250 years after Captain James Cook's (1728-1779) *HMS Endeavour* circumnavigated the globe, *Joseph Banks' Florilegium: Botanical Treasures from Cook's First Voyage* (Thames & Hudson, 2017) has been published. The 320-page book showcases 147 stunning, full-page, color botanical prints that resulted from the extensive work of the English botanist and naturalist Sir Joseph Banks (1743-1820) and the small, highly skilled team he oversaw onboard the *Endeavour* from 1768 to 1771.[1]

When the *Endeavour* set out in 1768 on Cook's first of three around-the-world voyages, roughly a third of the world's map remained blank or filled with fantasies.[2] While Cook changed that, Banks and his team collected an estimated 30,000 plant and animal specimens during their nearly three-year voyage of

Sydney Parkinson's watercolor of breadfruit (*Artocarpus altilis*). On April 28, 1789, the *HMS Bounty*, led by William Bligh, was transporting 1,015 breadfruit saplings from Tahiti to the British West Indies when members of the crew famously mutinied near Tonga and set Bligh and 18 others adrift in a small boat, probably partly because they were thirsty (water was rationed for the plants). The mission was the brainchild of Banks, who thought to introduce the nutritious, high-carb fruit (which he encountered on the *Endeavour* voyage) to the West Indies to feed slaves on sugar plantations. A single tree can produce 450 pounds of fruit per season. After the mission failed, it was reattempted successfully in 1791 on the *HMS Providence*, also led by Bligh. (Amazingly, Bligh survived after the *Bounty* mutiny by navigating the overcrowded boat for 47 days and 3,618 nautical miles to the island of Timor using just a pocket watch, a sextant, and his memory [no charts or compass], and lost just one of the 18 crew members on the journey.) Bligh delivered 678 live breadfruit plants to St. Vincent and Jamaica. At first, the slaves refused to eat the fruit, feeding it to the pigs instead. Now, however, breadfruit is a staple of Jamaican cuisine. Artwork courtesy of JSTOR Global Plants Database. Source: Library & Archives, Natural History Museum, London.

discovery to the South Pacific and back. This collection yielded "some 3,600-odd described species, of which it is probable that the plant species new to science may exceed 1,400," according to Banks' biographer Harold B. Carter (1910-2005). To put this achievement in perspective, the Swedish botanist Carl Linnaeus' *Species Plantarum* (1753), which formed the basis of modern plant taxonomy (the binomial system for naming plants), included about 6,000 plant species known to Linnaeus at the time. Thus, the plant species that the *Endeavour* expedition introduced to Western botany expanded Linnaeus' list by almost 25% or more (if Carter's estimate is accurate) and helped disprove Linnaeus' belief that the world contained no more than 10,000 plant species.[2-4]

After the voyage, Banks had 743 copper-plate engravings made, at great personal expense, from the original artwork (finished watercolors and precise sketches) of the Scottish artist Sydney Parkinson (1745-1771), who was part of Banks' team on the expedition. The engravings, almost a literal ton of the finest copper in total, are known collectively as Banks' Florilegium, and each one depicts a plant species that was encountered on the voyage.[1,5] As far as is known, all of these species are still extant, and many, if not most, were new to European botany at the time. The new book's aim was to provide a representative sample of some of the most aesthetic of these 743 engravings, especially those that depict economically and ecologically important species. The 147 prints that were chosen are perhaps among the most beautiful and precise botanical prints ever created.[1]

According to Mel Gooding, art historian and co-author of the book, the motives of Banks and his team were to identify and record as many plants as possible in the circumstances of the voyage (email, January 10, 2018). "Banks and [Swedish naturalist Daniel] Solander were driven by the demands of Linnaean taxonomy and the disinterested discovery and classification of plants rather [than] by any utilitarian criteria," he wrote. "That is why the selection of reproductions [in the book] was generally, and in the first place, arbitrary, determined by requirements of botanic variety and visual interest." However, many of the selected species do have ethnobotanical uses, and nine of these species are included in the following pages.

For a variety of reasons, Banks' Florilegium was never published in Banks' lifetime. In fact, the plates were printed and published in color for the first time between 1980 and 1990 by Alecto Historical Editions (a Salisbury, England-based publisher of limited edition prints, engravings, and facsimiles), in association with the Natu-

Portrait of Banks by Benjamin West, painted in 1771, after the *Endeavour* voyage. In his 20s, Banks stood six feet tall (unusually tall for his day) and weighed about 180 pounds. He is depicted with items from the voyage, including Māori weapons, and is wearing a Māori cloak made of woven *harakeke*, or New Zealand flax (*Phormium tenax*), fringed with dog hair. The book at his feet is open to an image of *harakeke*.

Artwork courtesy of Lincolnshire County Council, Usher Gallery, Lincoln, UK, and Bridgeman Images.

ral History Museum in Kensington, London. A limited number of complete sets were produced over this decade, and the selection in the new book comes from those prints, thus making them available to the general public for the first time.[1,5] All the plants in the Florilegium, except one (not included in the book), were depicted life-size, and the digital reproductions in the book are reduced to about 75% of the size of the original plates, which are almost all the same size (about 18 x 12 inches [approx. 46 x 31 centimeters]).[1]

In the book, commentaries by botanist David Mabberley, PhD, accompany each print, and these include information about the botany and utility of the depicted species, and, in some cases, historical details about the expedition's observations of, and experiences with, the species. There are also detailed sections by Gooding about the voyage itself and the making of the Florilegium, and a section by Joe Studholme, the co-founder and director of Alecto Historical Editions, about the modern printing of the Florilegium.[1]

The term "florilegium" is derived from the Latin *flos*, meaning "flower," and *legere*, meaning "to gather" (literally a flower gathering or an anthology). This term was not used by Banks, but was adopted for the 20th-century publication of the engravings. As Gooding explains in the book, Banks intended the Florilegium to be "a major contribution to science…; the authoritative historical basis of a new taxonomy; the initiation of the publication of Australasian botany. For the modern viewer, however, it constitutes, above all, a work of outstanding graphic achievement and a radiant revelation of natural beauty in its infinite variety and particularity."[1]

A replica of the *Endeavour*. The original was made mostly of hemp (*Cannabis* spp.), flax (*Linum usitatissimum*), elm (*Ulmus* spp.), oak (*Quercus* spp.), pine (*Pinus* spp.) tar, and bits of iron and brass. In 1778, during the American Revolution, the British formed a blockade by scuttling the *Endeavour* (then called *Lord Sandwich*) and other vessels in Newport Harbor, Rhode Island, when a French fleet threatened the harbor. Image courtesy of the Australian National Maritime Museum, which owns the replica.

The Voyage

On August 25, 1768,* the *Endeavour*, with 39-year-old Cook† at the helm, departed from Plymouth, England, with 94 people onboard and provisions (including pigs, poultry, and a milking goat) for 18 months.[1-3] The *Endeavour* was a type of vessel called a bark, which the British Admiralty chose at least partly because she

* According to a peer reviewer, in the 18th century, naval officers used ship's time instead of civilian time, meaning that each day began at noon (pm coming before am). The *Endeavour* left Plymouth at 2 pm, so Cook, a naval man, recorded that it was August 26, while Banks, a civilian, wrote that it was August 25.

† One peer reviewer noted that Cook, at the time, held the rank of lieutenant, the minimum rank necessary for him to lead the expedition. But, anyone in charge of a ship is called captain, regardless of rank.

was more likely than a heavier vessel to float off if she grounded in shallow water, a fact that likely helped prevent disaster later when she grounded and almost sank on Endeavour Reef, part of the Great Barrier Reef off the eastern coast of Australia. The 368-ton, 105-foot-long vessel had ample room for stowage in her hold, which was necessary for the vast collections, botanical and otherwise, that would be gathered during the journey.[6]

Cook's instructions from both the Royal Society and the Admiralty were to travel to King George's Island (Tahiti) in the South Pacific and observe the transit of Venus across the face of the Sun, which was expected on June 3, 1769.[1-4] Data from this observation would enable the calculation of the distance from Earth to the Sun, which, in turn, would make calculations of longitude more accurate and thus aid navigation.[1] Readings were needed in the Southern Hemisphere, and Tahiti was deemed a suitable viewing location.[4] Observations of Venus' previous transit in 1761 had failed, and the next transit would not occur until 1874. The Royal Society first met in 1767 to prepare for this rare occurrence and eventually gained the support of the government and King George III.[7]

Cook ultimately was chosen to lead the expedition, partly because of his naval service as well as his skills as a navigator and cartographer[7] (some of his maps reportedly remained in use as late as the 1990s[2]). The Admiralty purchased a merchant collier (a coal-carrying cargo ship), the *Earl of Pembroke*, which was refitted for the voyage and renamed *Endeavour*.[7] The Admiralty also gave Cook sealed instructions to find a mythical "Southern Continent," *Terra Australis Incognita*, which was thought by some to exist in the Southern Hemisphere, and claim it for Britain.[1]

Although the astronomical mission was the Royal Society's initial, main focus, it responded with some enthusiasm when Banks, one of the Society's fellows, asked to join the expedition. In an official application to the Admiralty, the Council of the Royal Society wrote: "Joseph Banks …,

The route that Cook followed on the *Endeavour* from 1768 to 1771.
Map courtesy of David Rumsey Map Collection (www.davidrumsey.com). Red line added.

a gentleman of large fortune, who is well versed in Natural History, being desirous of undertaking the same voyage, the Council very earnestly request their Lordships, that in regard to Mr. Banks's great personal merit, and for the advancement of useful knowledge, he also, together with his suite … be received on board of the ship."[8]

Banks' friends generally were interested in the prospect of his voyage, but some tried to persuade him to make the "Grand Tour" of Europe instead (like many other upper-class European young men at the time), to which he responded: "Every blockhead does that; my Grand Tour shall be one round the whole globe."[8]

The high-spirited 25-year-old had been fascinated with nature and botany from a young age.[1,4] As a boy, he loved to explore the meadows, woods, stream banks, and fens that surrounded Revesby Abbey, the family's estate in Lincolnshire, England. He enjoyed fishing for trout and hunting ducks and wood pigeons, and was known to rub toads on his face to prove that they were harmless. At age 21, after his father died, Banks inherited the family's estates (totaling 9,000 to 10,000 acres) and a considerable fortune, which reportedly made him one of England's wealthiest men.[4] His expedition to Newfoundland and Labrador in 1766 had helped prepare him to oversee the *Endeavour*'s scientific program.[1]

Banks and Cook could scarcely have been more different. According to *Blue Latitudes: Boldly Going Where Captain Cook Has Gone Before* (Picador, 2002): "The two men were fifteen years apart in age and hailed from opposite ends of the class system: Cook of peasant stock, with little schooling; Banks a nobleman's son, educated at Harrow, Eton, and Oxford…. Cook was a family man and naval careerist, Banks a rakish dilettante…. Yet the day laborer's son and the landed gentleman would forge one of the great partnerships in the history of exploration, akin to that between Meriwether Lewis and William Clark."[2]

Among Banks' entourage was Daniel Solander (1733-1782), an esteemed Swedish naturalist and taxonomist and a favorite pupil and colleague of Linnaeus. In 1760, Solander had come to London at Linnaeus' arrangement to give "instruction in Linnaean principles," and, in 1763, he began to catalog the collections, using the Linnaean system, at the then-new British Museum. In 1764, Solander was elected to the Royal Society. He volunteered to accompany his friend Banks on the voyage and would be his close collaborator until Solander's death in 1782. Throughout the voyage, he collected specimens, which he then dried, recorded, and named. With Solander came his secretary, Herman D. Spöring (1733-1771), a Finn whose talents included botanical and topographical drawing and clock- and instrument-making.[1]

Banks also recruited, at his own expense, the young artists Sydney Parkinson and Alexander Buchan (d. 1769). Parkinson, a Quaker from Edinburgh and a child of the Edinburgh Enlightenment, was a skilled botanical artist. Buchan, also from Edinburgh, was a talented depicter of people and landscapes.[1]

The supernumeraries, or the "gentlemen," as Banks and his entourage were known onboard, had separate quarters, dined with Cook in the stern's great cabin (far removed from the mess deck), and were largely exempt from naval duties and discipline.[2]

Banks paid for himself, his staff, and the materials they used on the journey. According to Carter, Banks and his entourage may have brought some 20 tons of baggage and equipment onboard.[3] In a letter to Linnaeus, the English naturalist John Ellis wrote: "No people ever went to sea better fitted out for the purpose of natural history, nor more elegantly. They have got a fine library of natural history: they have all sorts of machines for catching and preserving insects; all kinds of nets, trawls, drags, and hooks for coral fishing; they have even a curious contrivance of a telescope by which, put into the water, you can see the bottom at a great depth, where it is clear. They have many cases of bottles with ground stoppers, of several sizes, to preserve animals in spirits. They have the several sorts of salts to surround the seeds; and wax, both bees'-wax and that of the *Myrica*…. [I]n short, Solander assured me this expedition would cost Mr. Banks £10,000."[9] This amount was more than twice what King George III contributed to the expedition, and is equal to roughly $1 million today.[2] It is also significantly more than the £2,840 that originally was paid for the *Endeavour*.[6]

The "fine library" onboard comprised about 40 books, including, critically, Linnaeus' *Systema Naturae* and *Species Plantarum*, in addition to recent books about South Seas

Great Bougainvillea (*Bougainvillea spectabilis*, Nyctaginaceae) – Brazil Landfall – [BF Plate 355]

Native to South America, great bougainvillea is a perennial, tropical, evergreen shrub or vine that climbs with the aid of thorns and can grow to 12 meters (39 feet) tall.[1,11,12] It has been introduced as an ornamental plant around the world, mostly in warmer climates.[12] The flowers come in clusters of threes inside the bracts (specialized or modified leaves) that vary in color (orange, bright red, purple-red, pink, or white) and resemble a single flower.[1,12] The species is pollinated mostly by butterflies and moths.[1] Leaf preparations of the plant reportedly have been used to treat diabetes, diarrhea, cough, and sore throat; to reduce stomach acidity; and as an expectorant and febrifuge. In addition, the leaves (boiled in water) have been used as a laxative, and the decocted dried stems have been used to treat hepatitis.[11] The genus is named for the explorer and scientist Louis-Antoine de Bougainville (1729-1811), who was the first Frenchman to circumnavigate the globe and visited Tahiti not long before the *Endeavour* arrived there.[1,11] The species name *spectabilis*, meaning "notable" or "remarkable," reportedly owes to the fact that it has the largest bracts of any cultivated *Bougainvillea* species.[1]

Bougainvillea spectabilis, Great bougainvillea, Nyctaginaceae, *Species Plantarum*. Copper plate by Gabriel Smith, based on Parkinson's 1769 watercolor. Artwork ©2018 Editions Alecto Ltd and the Trustees of the Natural History Museum, London

exploration by the French polymath Charles de Brosses and the Scottish geographer Alexander Dalrymple.[1]

Madeira, Brazil, and Tierra del Fuego

On September 13, 1768, the expedition made first landfall at Funchal in Madeira, a Portuguese archipelago in the North Atlantic. Parkinson depicted 21 previously unknown species collected here, 11 of which were later engraved. After five days, the *Endeavour*, with new provisions (including Madeira wine), headed for Brazil.[1]

On November 13, 1768, landfall was made at Rio de Janeiro, but the Portuguese governor allowed only Cook to go ashore, to the dismay of everyone, perhaps especially Banks and his team. However, unauthorized trips ashore and vegetation brought onboard for the livestock yielded some specimens. Of nearly 40 specimens that Parkinson was directed to depict, 23 were later engraved.[1]

From Brazil, the *Endeavour* sailed southwest toward Tierra del Fuego (the "Land of Fire," an archipelago at the southernmost tip of South America), with the weather becoming progressively colder the further south she went.[1] Cook opted to avoid passing through the often-hazardous Strait of Magellan (named for the Portuguese explorer Ferdinand Magellan, who navigated it in 1520)[7] and would stock up on firewood and fresh water in Tierra del Fuego.[1]

On January 15, 1769, Cook anchored in the Bay of Good Success, which would not live up to its name.[3] Banks, Solander, and others went inland to gather plants, but bad weather trapped them on the hills above the shore for multiple nights. On the second night, two of Banks' servants froze to death. Parkinson depicted 70 of the specimens collected here.[1]

Society Islands

The *Endeavour* then continued southwest, rounded Cape Horn, and headed northwest toward Tahiti. During this stretch, as with each later long leg of the journey, Banks and his team worked in the great cabin. Parkinson spent his time depicting the specimens given to him and had to contend with the sea swell. Throughout the journey, he had to work quickly to depict the specimens before they wilted and lost their color in the tropical or subtropical conditions.[1]

After months at sea, Cook finally anchored in Matavai Bay on the north coast of Tahiti on April 13, 1769. Not long after arrival, Buchan died from epilepsy before he had been able to accomplish much on the voyage. Banks lamented this, not only because Buchan was "an ingenious and good young man," in Banks' words, but also because it prevented Banks from being able to bring back to England pictures of the landscapes and native people encountered on the voyage.[1]

Banks spent much of the expedition's three-month stay in Tahiti engaged in diplomacy and ethnography, but he did find some time for botanical activities.[1] In his journal, on July 4, 1769, he wrote: "I employd myself in planting a large quantity of the seeds of Water melons, Oranges, Lemons, limes … which I had brought from Rio de Janeiro." This exemplified what scientists eventually called the "antipodean exchange" — the transportation of plants (and later animals) among European nations, the Americas, and the lands of the South Seas — which impacted the subsequent look of the world and played an important part in Banks' later life and work.[4]

With the astronomical mission complete, Cook set sail on July 13, 1769, to explore the other islands that, along with Tahiti, form the archipelago he called the Society Islands.[1] The voyage brought many of these islands, including Tahiti, Bora-Bora, Moorea, and Raiatea, into the British sphere of influence.[4] Then, on August 14, Cook sailed south to search for the unknown Southern Continent, as the Admiralty had instructed. After sailing for about 1,500 miles, in increasingly bad weather, Cook finally turned west toward New Zealand, without finding the sought-for Southern Continent. During this stretch,

Sweet Potato (*Ipomoea batatas*, Convolvulaceae) – Society Islands Landfall – [BF Plate 627]

This member of the morning glory family is cultivated for its starchy, edible, swollen tubers. It is indigenous to the New World and may provide evidence of trans-Pacific contact more than 1,000 years ago.[1,13] Excavations at Tangatatau, a rockshelter on Mangaia Island of the Cook Islands, uncovered sweet potato remains and reportedly established the presence of the species in central eastern Polynesia by about 1,000 CE, long before Europeans arrived there.[13] It has been proposed that sweet potato plant parts may have floated or been carried by birds across the Pacific, but it seems more likely that the Polynesians made landfall in South America and took the species back with them.[13,14] It is believed that they had sophisticated, double-hulled canoes similar to catamarans that could stay at sea for months and possibly carry up to 80 people.[14] Similarities between the terms for sweet potato in Polynesian languages (*kuumala* and its derivatives) and in Quechuan languages (*kumara*, *cumar*, or *cumal*) spoken by Andean natives may also indicate pre-Columbian interaction between these peoples.[13,14] The Māori, a Polynesian people, took the species with them to New Zealand.[1] Because they had no cereal crops, sweet potato became their staple crop. They also reportedly have used sweet potato-derived liquor to treat fever and sweet potato-derived lotion to treat skin conditions.[15]

Ipomoea batatas, Sweet potato, Convolvulaceae, *Tableau Encyclopédique et Méthodique*. Copper plate by Gabriel Smith, based on Parkinson's 1769 watercolor. Artwork ©2018 Editions Alecto Ltd and the Trustees of the Natural History Museum, London

Parkinson depicted specimens from the Society Islands, from which 89 plates were later engraved.[1]

New Zealand

The *Endeavour* landed on the east coast of the North Island of New Zealand in early October 1769.[1] It stayed in New Zealand for almost six months,[‡] but spent only about a third of that time anchored near land. While ashore, the expedition had some tense encounters with the Māori.[2] "I suppose they live intirely [sic] upon fish dogs and Enemies," Banks wrote of the Māori.[4] Parkinson, however, skillfully depicted their facial markings, carved weaponry, boats, and dwellings.[1]

Most of the time in New Zealand was spent charting the coastline.[2] Cook circumnavigated[**] the two main islands and determined there was a strait between them (Cook Strait). With Parkinson's help,[1] he charted the archipelago so skillfully that Julien Crozet, a French navigator who followed in Cook's wake, remarked, "I doubt much whether the charts of our own French coasts are laid down with greater precision."[2] The ship put in when and where possible, and Banks and his team gathered an impressive collection of specimens, with the islets and headlands of Queen Charlotte Sound (at the northern tip of the South Island) being especially fruitful.[4] Of the New Zealand specimens depicted by Parkinson, 182 were later engraved.[1]

Australia

From New Zealand, the ship sailed west to Australia (then called New Holland, so named by the Dutch explorer Abel Tasman) and became the first European expedition to reach the eastern coast of the continent.[1,4] On April 28, 1770, Cook sailed between what he called Cape Banks and Point Solander and anchored in a large bay, just south of present-day Sydney.[4] This was the first of a series of landfalls on the eastern coast.[1] Here, Banks and his team collected hundreds of specimens, including the first species of *Banksia* (Proteaceae), a genus later named for Banks.[4] "The great quantity of New Plants … Mr Banks and Dr Solander collected in this place," Cook wrote, "occasioned my giveing it the name of Botany Bay." This bay later figured prominently in the establishment of the Australian penal colony.[1,4]

Cook continued north, charting the coast and naming landmarks as he went,[1] but on the night of June 11, 1770, about 13 miles offshore, the *Endeavour* struck the Great Barrier Reef,[2] which Cook did not know existed until then.[1] Surf thrashed the ship against the reef so violently that "we could hardly keep our legs upon the Quarter deck," Banks wrote. At first, Cook sent out small boats, which were anchored and then wound up with winches to try to pull the ship off the coral. When the ship still didn't budge, about 50 tons, including cannons, firewood, water casks, and food stores, were jettisoned.[2]

After the ship began to leak the next morning, the men, including Banks, took turns using suction pumps. By nightfall, water in the hold rose to almost four feet. Finally, after great effort, with men pulling cables and anchor lines, the ship lifted off the reef, at which point water rushed into the hold — or so one crewman reported. "Fear of death now stard us in the face," Banks wrote. "I intirely gave up the

[‡] Whether Cook claimed New Zealand for the Crown is debatable, according to a peer reviewer. After an event in Mercury Bay, North Island, in November 1769, Cook wrote, "after displaying the English Colours, I took formal possession of the place in the name of His Majesty." But, Cook did not know he was on New Zealand at the time. He hoped he was on the mythical Southern Continent. It was not until later that he realized he was on land previously named by Abel Tasman. It is unclear if he was claiming Mercury Bay only, the North Island only, all of New Zealand, or the Southern Continent (which he did not find, thus making his claim invalid). Also, the Admiralty instructed Cook, "You are also with the Consent of the Natives to take possession of Convenient Situations." There is no record that Cook received consent.

** According to a peer reviewer, Cook circumnavigated New Zealand to determine whether it was part of the unknown Southern Continent. "He even sailed away south from New Zealand when people onboard thought they could see land," the reviewer noted. "None was ever found, only clouds in the distance that looked like high mountains of ice."

Kava (*Piper methysticum*, Piperaceae) – Society Islands Landfall – [BF Plate 642]

Solander and Parkinson were probably the first Europeans to see and record kava,[16] which is in the large tropical genus *Piper* (with more than 1,000 species, including the widely familiar spice black pepper [*P. nigrum*]).[1] Solander named kava "Piper inebrians," and Parkinson wrote: "The expressed juice of this plant they drink to intoxicate themselves."[1] The term *kava* (or *kawa*) refers to both the plant and the narcotic (literally sleep-inducing) beverage made from its roots,[16] which has been used in ceremonies for more than 3,000 years in Oceania.[1] The drink historically has been so widespread throughout Oceania that it might be the one material cultural item that most Oceanic peoples have in common. Oceania reportedly was one of the only culture areas not to have had alcoholic beverages at the time of the first major contact with Europeans in the 18th century. Kava has been used as a social drink by chiefs and noblemen; to welcome distinguished guests; to celebrate important births and marriages; to treat illnesses; and as a prelude to tribal wars. It was highly valued in Hawaii, where, at one time, no drink besides water and coconut milk was known. There and elsewhere, kava was used to soothe the nerves, to relax, to stave off fatigue, and more.[16] Recent research has investigated kava's ability to treat anxiety, insomnia, and stress disorders.[1]

Piper methysticum, Kava, Piperaceae, *De Plantis Esculentis Insularum Oceani Australis Commentatio Botanica.* Copper plate by Jean-Baptiste Michell, based on Parkinson's 1769 watercolor. Artwork ©2018 Editions Alecto Ltd and the Trustees of the Natural History Museum, London

Candlenut (*Aleurites moluccanus*, Euphorbiaceae) – Society Islands Landfall – [BF Plate 654]

In his journal, Parkinson wrote: "Of the bark of this tree, soaked in water, they make that gummy substance which they put upon their dark-coloured cloth to make it glossy, and keep out the rain. The fruit of this tree is a sort of nut, which yields a very fat kernel, of which they make their black dye, used in Tataowing [tattooing], by burning them, and receiving the smoke. Strung upon a reed or stick they serve instead of candles, and give a very good light."[1] Candlenut is a culturally significant and widespread species in the Pacific and can thrive on otherwise useless land.[1,17] Almost every part of the plant can be used for some purpose. Prehistorically, the Polynesians introduced the species throughout much of Southeast Asia and Oceania as a so-called "canoe plant," so its original range is unclear but is believed to be the Indo-Malaya region.[17] The nutlike seeds (candlenuts) are high in oil that can be burned for light (hence the plant's common name) or used to make soaps and varnishes. The oil also has been used as a general folk remedy and laxative. All parts of the tree, however, especially the seeds, reportedly are toxic to humans if ingested.[17,18] The tree itself can be ornamental and a living fence or windbreak.[17] In 1959, it became the official state tree of Hawaii, where the plant was naturalized. In Hawaii, it is called *kukui*, meaning "light."[18]

Aleurites moluccanus, Candlenut, Euphorbiaceae, *Species Plantarum*. Copper plate by Gerard Sibelius, based on Parkinson's 1769 watercolor. Artwork ©2018 Editions Alecto Ltd and the Trustees of the Natural History Museum, London

ship and packing up what I thought I might save prepard myself for the worst."[2]

To everyone's relief, it eventually was realized that the situation was not as grave as reported, and the men continued at the pumps. In addition, Cook used a technique called fothering, which involved covering a sail with a mix of oakum (tarred rope fiber), wool, and "sheeps dung or other filth," as Cook described. The sail then was guided under the ship to cover the largest gash. Finally, on June 18, a full week after the *Endeavour* ran aground, Cook sailed the crippled ship into a nearby, narrow river (which he called Endeavour River) and moored beside a steep bank.[2]

When Cook examined the ship, he found "a large piece of Coral rock that was sticking in one hole." This had broken off and plugged the gash it created.[2] If not for this fortunate break and everyone's extensive efforts, everyone and everything onboard, including the natural history collections, Parkinson's artwork, and Cook's charts, may have been lost to the sea and history.[1,2] The botanical specimens, stored in a bread hold in the stern, had been soaked in seawater during the ordeal, but Banks and Solander brought them ashore to be dried, and Cook wrote that most "were, by [their] indefatigable care and attention restored to a state of preservation."[1]

The ship was beached at Endeavour River for almost seven weeks while she was repaired.[1,2] In the meantime, the men became fascinated by the kangaroo, which they referred to as "the wild animal" or "the beast so much talkd of," and had multiple encounters with the Aborigines.[2] In addition, Banks and Solander had a chance for a flurry of botanizing.[1] On August 4, 1770, the *Endeavour*, barely seaworthy, hauled out from the river and continued north.[2] Soon, she was in serious danger of wrecking again, but Cook eventually escaped through what he called Providential Channel.[1,2] On August 22, 1770, Cook claimed the entire eastern coast of Australia for the British Crown.[1] His charts of that coast filled in a major gap of the continent's map and helped establish its true extent, which previously had been only speculated about.[4] Parkinson depicted almost 700 of the specimens collected in Australia, from which at least 337 plates were engraved.[1]

Batavia

Before landing at Batavia, Java (the primary port of the Dutch East Indies and site of present-day Indonesia's capi-

Continued on pg. 68

Beefwood (*Casuarina equisetifolia*, Casuarinaceae) – Society Islands Landfall – [BF Plate 663] – on Page 66

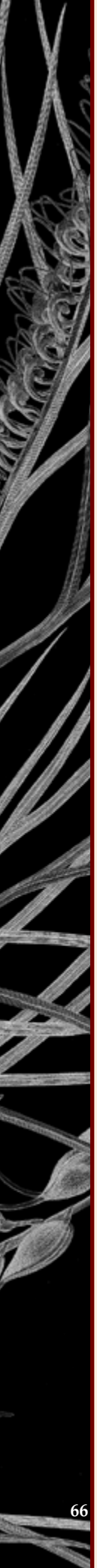
Beefwood is a seashore pioneer that has been introduced to more than 60 countries.[1,19] In fact, it is now a common part of the coastal landscapes of most tropical and subtropical countries. Because its high rate of litter deposition, fast growth rate, and extensive shade prevent the growth of native flora, it often grows in single-species stands with little or no understory. The tree's leaf litter can increase soil acidification to levels that are toxic to nearby plants. It therefore is considered highly invasive in some places.[19] However, it often is used effectively for sand dune stabilization, land reclamation, and erosion control, and is grown as bonsai.[1,19] It can tolerate strong winds and is used in shelterbelts to minimize damage from typhoons and cyclones. Root extracts of the tree have been used to treat dysentery, diarrhea, and stomachache. In New Zealand, the tree's bark and twigs have been used to treat beriberi (thiamine deficiency).[19] Banks noted that the tree was a source of red dye, and Parkinson wrote: "This is one of the best woods they have; it is very hard and heavy, and coloured like mahogany. They make their clubs, lances, cloth-beaters, and several other knick-knacks and utensils of it."[1] The species name derives from the Latin *equinus*, pertaining to horses, and *folium*, meaning "leaf," because the drooping shoots resemble horse hair.[19]

Casuarina equisetifolia, Beefwood, Casuarinaceae, *Amoenitates Academicae seu dissertationes variae physicae, medicae, botanicae*. Copper plate by Gabriel Smith, based on Parkinson's 1769 watercolor. Artwork ©2018 Editions Alecto Ltd and the Trustees of the Natural History Museum, London

Ti (*Cordyline fruticosa*, Asparagaceae) – Society Islands Landfall – [BF Plate 671] – on Page 67

Native to the western Pacific, ti has been spread widely (as far as New Zealand, Hawaii, and Easter Island) by the Polynesians over the last 4,000 years.[1,20] It has been introduced to most tropical parts of the world and is grown for ornament in gardens, hedges, and indoors.[20] Ti is a thick-stemmed small tree whose leaves emerge pinkish-red and mature to deep green. Many small, scented, white to pale lavender flowers appear in panicles (loose, branching flower clusters).[21] Because it is sterile in a large part of its range, ti reproduces by stem pieces or rarely by seed, both of which can be spread by floods.[20] The sweet, swollen tubers are edible and can be fermented.[1] The juice of the squeezed leaves and stalks of ti (mixed with water) has been drunk to treat diarrhea and dysentery. Leaf infusions have been used for amenorrhea (absence of menstruation), tuberculosis, and blood clotting. Flower infusions have been used for fever, and poultices of ti have been used for wounds.[11] Ti is spiritually significant in the Pacific, and is associated with good luck and commonly found in cemeteries.[1,20] In Hawaii, it is planted at the four corners of a house, and the leaves are used to make *hula* skirts. Parkinson wrote: "Of this plant there are five different sorts, yielding a large root, which is eaten, and counted very good food, by the islanders of the South-seas."[1]

Cordyline fruticosa, Ti, Asparagaceae, *Catalogue des Plantes du Jardin Botanique de Saigon.* Copper plate by Gerard Sibelius, based on Parkinson's 1769 watercolor. ©2018 Editions Alecto Ltd and the Trustees of the Natural History Museum, London



tal, Jakarta), on October 5, 1770, the expedition generally had remained in good health. In fact, despite being at sea for more than two years, only eight (8.5%) of the original 94 who left Plymouth had died from disease or accidents.[2] Cook showed commendable concern for the well-being of all those under his command. He insisted that the lower decks be aerated and fumigated and that all quarters be cleaned rigorously and regularly. He also enforced a dietary regime intended to prevent scurvy (a severe vitamin C deficiency).[1] This included regular amounts of sauerkraut, which contains vitamin C.[10] Although a few suffered mildly from scurvy, remarkably, none died from it on the journey.[1] In his journal, Banks noted that lemon (*Citrus limon*, Rutaceae) juice seemed to combat signs of his own scurvy.[10]

But landing at Batavia, where the ship was refitted and re-provisioned for the voyage home via the Indian Ocean and Cape Town, changed things.[1,2] The port's canals, in which dead animals and sewage were dumped, were breeding sites for mosquitoes and disease. Ships from around the world also brought their own diseases. During the three-month stay, many became sick or died.[2] Parkinson somehow managed to depict 43 plant specimens he collected, of which 30 were later engraved.[1] Not soon enough, the ship, now full of disease, left Batavia. On the way to Cape Town, Spöring, the astronomer Charles Green, and 25-year-old Parkinson (the artistic star of the voyage), died from dysentery.[1,2] Banks and Solander also suffered with, but ultimately survived, the "bloody flux."[1] Banks may also have had typhus.[4]

England

When the ship moored in England on July 12, 1771, only 56 (60%) of the original 94 had survived.[1,2] The *Endeavour* had traveled an estimated 82,000 kilometers (50,952 miles), according to the Captain Cook Society (email from Ian Boreham, editor with the Captain Cook Society, December 11, 2017). Banks returned to greater celebrity than Cook did.[1] He and his team had collected everything from insects to the shells of mollusks to the skins and skeletons of kangaroos. The collection, much of which was completely novel in Europe at the time, would not be matched until the expeditions of the Prussian explorer and naturalist Alexander von Humboldt to tropical America 30 years later.[4]

When Linnaeus learned that Banks and Solander planned to accompany Cook on the *HMS Resolution* on Cook's second voyage, he feared that the "matchless and truly astonishing collection" from the first voyage, as Linnaeus described it in a letter to John Ellis, might be "thrust into some corner, to become perhaps the prey of insects and of destruction."[4]

Linnaeus did not need to worry, however, because the *Resolution* ultimately sailed in July 1772 without Banks, who had wanted to bring 17 people, including six servants and two horn players, and a pack of greyhounds onboard. Though the Admiralty agreed, refitting the ship to accommodate Banks' entourage made it so prone to capsize that it failed a sea trial. When the modifications were stripped out, Banks "swore and stamp'd upon the Warfe, like a Mad Man," according to one midshipman, and he took his entourage on a consolation trip to Iceland instead.[2,4]

According to *Blue Latitudes*: "Banks would spend the rest of his long life reaping the rewards of his youthful adventures, and dining out on them. Cook, lacking Banks's fortune and status, had more to prove. Even after his second voyage, which sealed his fame and brought him the offer of a comfortable retirement, Cook chose to set off again, ultimately at the cost of his life."[2]

Carter noted the uniqueness of the *Endeavour* voyage. It was "a collaboration of civilian science under royal patronage with royal finance, joined with private enterprise funded from a county rent roll and executed under Admiralty management," he wrote. "That these elements were compounded without undue heat of fusion into a three-year circumnavigation successful in its main intentions is a testimony to the character and abilities of Banks, the young landsman from Lincolnshire, and Cook, the older Yorkshire seaman."[3]

The Florilegium

During the voyage, Banks and Solander supervised Parkinson's work carefully. "We worked at the great table in the cabin with our draftsman opposite. We directed his

Kohekohe (*Dysoxylum spectabile*, Meliaceae) – New Zealand Landfall – [BF Plate 425]

Kohekohe is the southernmost member of its genus (which includes about 80 species) and the only member of the mahogany family native to New Zealand,[22] where it grows in coastal forests throughout the North Island and in the Marlborough Sounds in the north of the South Island.[1,23] Banks and Solander first came across the tree at Tolaga Bay, North Island, in October 1769. The tree can grow to 15 meters (50 feet) tall, and, in late fall to winter, produces waxy, white, bird-pollinated flowers that are followed by seed capsules coated with orange to scarlet arils (fleshy coverings).[1] The flowers and fruit grow directly from drooping main stems, rather than from buds at the end of leafy new growth. This is called cauliflory (derived from the Latin for stem and flower[1]), an unusual habit of some tropical tree species.[22-24] The tree's large, glossy, green leaves are extremely bitter, and the Māori have used leaf extracts as a tonic, to stop milk secretion in women, and to treat gonorrhea. They also have used bark and leaf extracts for cough, boiled leaves as a poultice, and leaves in baths. Kohekohe leaves reportedly are thought to have properties similar to gentian (*Gentiana* spp., Gentianaceae) and Peruvian bark (*Cinchona* spp., Rubiaceae), and have been used instead of hops (*Humulus lupulus*, Cannabaceae) in the making of beer. The attractive timber has been used to make furniture.[25]

Dysoxylum spectabile, Kohekohe, Meliaceae, *Handbook of the New Zealand Flora.* Copper plate by Gerard Sibelius, based on Frederick Nodder's undated watercolor, derived from Parkinson's surviving pencil drawing. ©2018 Editions Alecto Ltd and the Trustees of the Natural History Museum, London

drawing, and made rapid descriptions of our natural history specimens while they were still fresh," Banks wrote later.[1]

By the end of the voyage, Parkinson had completed about 269 watercolor paintings of the collected plant specimens. However, the ever-increasing number of specimens collected and given to Parkinson prevented him from completing hardly any paintings from the later parts of the voyage. Instead, he made precise outline drawings (at least 674) with detailed color notes, intending to complete them in color, in preparation for engraving and publication after the voyage.[1]

Banks believed in the importance of fine art for the presentation of scientific findings. He personally was connected to many of the best botanical artists of his day, and, sparing no expense, employed some of them to work on the Florilegium. In all, he hired five artists (principally Frederick Polydore Nodder) to complete Parkinson's sketches, and 18 engravers (principally Daniel Mackenzie, Gabriel Smith, and Gerard Sibelius) to create the copperplate engravings. Banks insisted that every detail be cut into each plate, so that even when the plates were printed in black, the prints could still be used for scientific study. The engraving process involved cutting directly into the polished copper, a relatively soft metal, with different-sized tools called burins.[1,5] According to a peer reviewer, the process also typically involves other tools, such as etching needles, roulettes, and burnishers.

By 1784, all 743 plates had been completed, but Banks never saw them published for various reasons.[1,5] First, Solander's death in 1782 hit him especially hard. In addition, the American Revolution took a toll on his finances, and he often was burdened by public duties (having become the president of the Royal Society, for example). Furthermore, he may have believed he had already fulfilled his obligation to science.[1] After all, his large London home at Soho Square had become a sort of salon-museum where scholars and the merely curious could visit and admire his collections.[1,4] It is worth noting that if Banks had published his discoveries, some of the plants depicted in the Florilegium would be the type specimens (i.e., specimens on which the descriptions and names of new species are based) for some species now recognized, according to Mabberley.[1]

It was not until October 1979 that Alecto Historical Editions signed an agreement to print and publish the plates in full color, in association with the Natural History Museum. Before then, the plates were stored on the bottom shelf of a cupboard in the Botany Library of the Museum, still in their original wrappers. The book is dedicated to Christopher Humphries, PhD, whose idea it was for the Natural History Museum (where he worked for most of his career) to collaborate with Alecto Historical Editions and finally bring Banks' Florilegium, a significant but largely unknown scientific and artistic achievement of the Enlightenment, to a broader audience. Humphries was a highly respected taxonomist, biogeographer, and theorist, and a passionate lover of botanical art.

After some dedicated trial and error, printers at Alecto Historical Editions realized the stunning results that could be achieved by printing the plates *à la poupée* (French for "with the dolly"). Basically a sophisticated exercise in "printing and coloring by numbers," this technique involves using a twist of cloth (the *poupée* or "dolly") to selectively and carefully apply, by hand, the appropriate color of ink into specific areas of the plate.[1,5]

After a plate is inked up with the various colors, it is laid on the press with a sheet of damp paper over it. The plate is cushioned by cover tissue and blankets to even out the pressure as it passes through the press rollers. The immense pressure from the rollers pushes the damp paper into the recesses of the plate, pulling the ink into the paper. The paper is then carefully and evenly peeled off to reveal the print. Each plate is printed (or "pulled" in printmaking terms) just once before it needs to be cleaned of leftover ink residue and re-inked for the next pull.[1,5]

Between 1980 and 1990, the 25-person team at Alecto Historical Editions produced more than 86,000 prints from the Florilegium using this method, and some individual prints are still available for sale on Alecto Historical Editions' website. On average, each print took just under one hour to

Black Bean (*Castanospermum australe*, Fabaceae) – Australia Landfall – [BF Plate 84]

Black bean, also called Moreton Bay chestnut, belongs to the legume family and is the only member of its genus.[26] The tree can grow to 40 meters (130 feet) tall and occurs in coastal forests and on beaches along the eastern coast of Australia, and on the nearby islands of New Britain, New Caledonia, and Vanuatu.[1,26] The tree develops a dense, rounded canopy when cultivated, making it an ideal shade tree.[26] It is used extensively along streets, in parks and gardens, and sometimes indoors. Showy red and yellow flowers appear in sprays that are partly hidden by dense foliage and attract lorikeets, which may become intoxicated. Large, thick pods that each contain three to five bean-like seeds sometimes are used by children as toy boats.[26,27] The leaves and seeds may be toxic to livestock and humans,[11] but the Aborigines sometimes eat the seeds after careful preparation that involves leaching in water and roasting.[27] Castanospermine, an alkaloid derived from the seeds, has demonstrated in vitro inhibitory effects against dengue virus (which causes dengue fever) and HIV.[28,29] The tree has a strong root system that enables it to help prevent erosion along stream banks.[26] It is also a food plant for pencilled blue butterfly larvae and produces a decorative and durable timber ideal for carving.[27] The genus name derives from *castanea*, Latin for "chestnut," and *spermum*, Greek for "seed." The species name *australe* is Latin for "southern."[26]

Castanospermum australe, Black bean, Fabaceae, *The Picture of Australia.* Copper plate by Gerard Sibelius, based on Frederick Nodder's 1779 watercolor, derived from Parkinson's surviving pencil drawing made at "Endeavors River." Artwork ©2018 Editions Alecto Ltd and the Trustees of the Natural History Museum, London

complete, but some took considerably longer, depending on complexity. The "dollies" used to apply the inks were made from strong, coarse cotton, and the inks were made from boiled linseed (*Linum usitatissimum*, Linaceae) oil and pure ground pigment. Often, ten or more inks were applied to one plate. The printers used a master print, which had been marked with the proper colors for each area of the plate, as a reference when inking each plate.[1,5]

"Ever since we first embarked on the Florilegium project in 1980, it was always my ambition to publish a well-illustrated accompanying book," wrote Studholme, who helped oversee the printing process (email, March 1, 2018). "I am delighted that Thames & Hudson has now fulfilled this ambition in such style, even though it took another 38 years. But such *longueurs* do seem to be a feature of the 250-year history of Banks' Florilegium!" HG

References

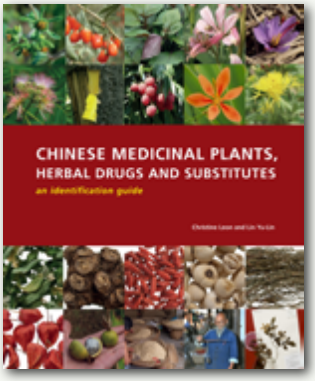
1. Gooding M, Mabberley D, Studholme J. *Joseph Banks' Florilegium: Botanical Treasures from Cook's First Voyage*. New York, NY: Thames and Hudson; 2017.
2. Horwitz T. *Blue Latitudes: Boldly Going Where Captain Cook Has Gone Before*. New York, NY: Picador; 2002.
3. Carter HB. *Sir Joseph Banks*. London: British Museum (Natural History); 1988.
4. Watkins TH. The Greening of the Empire: Sir Joseph Banks. *National Geographic*. Nov. 1996:28-53.
5. Banks' Florilegium. Alecto Historical Editions website. Available at: www.alecto-historical-editions.com/pages/about-banks-florilegium. Accessed March 4, 2018.
6. Endeavour. Captain Cook Society website. Available at: www.captaincooksociety.com/home/detail/endeavour. Accessed March 5, 2018.
7. Act I: The First Voyage. Princeton website. Available at: libweb5.princeton.edu/visual_materials/maps/websites/pacific/cook1/cook1.html. Accessed March 5, 2018.
8. Smith E. *The Life of Sir Joseph Banks*. London: John Lane Company; 1911.
9. Banks J, Hooker JD. Journal of the Right Hon. Sir Joseph Banks. London: Macmillan and Co., Ltd.; 1896.
10. Hamilton JC. Scurvy: How a Surgeon, a Mariner, and a Gentleman Solved the Greatest Medical Mystery of the Age of Sail. Captain Cook Society website. Available at: www.captaincooksociety.com/home/detail/scurvy-how-a-surgeon-a-mariner-and-a-gentleman-solved-the-greatest-medical-mystery-of-the-age-of-sail-bown-stephen-r-2003. Accessed March 21, 2018.
11. Quattrocchi U. *CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology*. Boca Raton, FL: CRC Press; 2012.
12. Lim TK. *Edible Medicinal and Non-Medicinal Plants: Volume 8, Flowers*. Dordrecht, Netherlands: Springer; 2014.
13. Jones TL, Storey AA, Matisoo-Smith EA, Ramírez-Aliaga JM, eds. *Polynesians in America: Pre-Columbian Contacts with the New World*. Lanham, MD: AltaMira Press; 2011.
14. Doucleff M. How the Sweet Potato Crossed the Pacific Way Before the Europeans Did. NPR website. Available at: www.npr.org/sections/thesalt/2013/01/22/169980441/how-the-sweet-potato-crossed-the-pacific-before-columbus. January 23, 2013. Accessed February 26, 2018.
15. *Ipomoea batatas*. Māori Plant Use website. Available at: maoriplantuse.landcareresearch.co.nz/WebForms/PeoplePlantsDetails.aspx?firstcome=firstcome&PKey=024A9344-0375-4080-B628-0F08D5CBAC94. Accessed February 26, 2018.
16. Singh YN, Blumenthal M. Kava: An Overview—Distribution, Mythology, Botany, Culture, Chemistry, and Pharmacology of the South Pacific's Most Revered Herb. *HerbalGram*. 1997;39:33.
17. *Aleurites moluccanus* (candlenut tree). CABI website. Available at: www.cabi.org/isc/datasheet/4124. Accessed March 1, 2018.
18. *Aleurites moluccanus*. Missouri Botanical Garden website. Available at: www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?taxonid=364364&isprofile=0&. Accessed March 1, 2018.
19. *Casuarina equisetifolia* (casuarina). CABI website. Available at: www.cabi.org/isc/datasheet/16718. Accessed March 14, 2018.
20. *Cordyline fruticosa* (ti plant). CABI website. Available at: www.cabi.org/isc/datasheet/11866. Accessed March 17, 2018.
21. *Cordyline fruticosa*. Missouri Botanical Garden website. Available at: www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=b585. Accessed March 17, 2018.
22. Braggins JE, Large MF, Mabberley DJ. Sexual arrangements in kohekohe (*Dysoxylum spectabile*, Meliaceae). *Telopea*. 1999;8(3):315-324.
23. *Dysoxylum spectabile*. New Zealand Plant Conservation Network website. Available at: www.nzpcn.org.nz/flora_details.aspx?ID=1825. Accessed March 17, 2018.
24. Kohekohe *Dysoxylum spectabile*. Bushmansfriend website. Available at: www.bushmansfriend.co.nz/dysoxylum-spectabile-kohekohe-xidc17756.html. Accessed March 17, 2018.
25. *Dysoxylum spectabile*. Māori Plant Use website. Available at: maoriplantuse.landcareresearch.co.nz/WebForms/PeoplePlantsDetails.aspx?firstcome=firstcome&PKey=2F50FE1A-D3FF-40D7-AC65-693B0C946607. Accessed March 17, 2018.
26. *Castanospermum australe*. Australia National Botanic Gardens website. Available at: www.anbg.gov.au/gnp/interns-2002/castanospermum-australe.html. Accessed March 18, 2018.
27. *Castanospermum australe*. Australian Tropical Rainforest Plants website. Available at: keys.trin.org.au/key-server/data/0e0f0504-0103-430d-8004-060d07080d04/media/Html/taxon/Castanospermum_australe.htm. Accessed March 18, 2018.
28. Whitby K, Pierson TC, Geiss B, et al. Castanospermine, a Potent Inhibitor of Dengue Virus Infection In Vitro and In Vivo. *J. Virol*. 2005;79(14):8698-8706. doi: 10.1128/JVI.79.14.8698-8706.2005.
29. Walker BD, Kowalski M, Goh WC, et al. Inhibition of human immunodeficiency virus syncytium formation and virus replication by castanospermine. *Proc. Natl. Acad. Sci.* 1987;84:8120-8124.
30. *Grevillea pteridifolia*. Australia National Botanic Gardens website. Available at: www.anbg.gov.au/abrs/online-resources/flora/stddisplay.xsql?pnid=45336. Accessed March 19, 2018.
31. *Grevillea pteridifolia*. Australian Native Plants Society (Australia) website. Available at: http://anpsa.org.au/g-pte.html. Accessed March 19, 2018.
32. Castillo U, Harper JK, Strobel GA, et al. Kakadumycins, novel antibiotics from *Streptomyces* sp. NRRL 30566, an endophyte of *Grevillea pteridifolia*. *FEMS Microbiology Letters*. 2003;224(2):183-190. doi: 10.1016/S0378-1097(03)00426-9.

Golden Grevillea (*Grevillea pteridifolia*, Proteaceae) – Australia Landfall – [BF Plate 277]

This small tree or large shrub, rarely a prostrate shrub, can be 14 meters (46 feet) tall and is one of more than 350 species in its genus.[1,30] Banks and Solander first came across the tree near Endeavour River.[1] It occurs in tropical northern Australia, where it grows in eucalypt woodlands, heaths, and openings just outside of rainforests. It often is found in moist locations, and tolerates a range of soil types (usually sandy).[30] The tree sets large amounts of seeds,[30,31] which contain cyanogenic compounds and may cause cyanide poisoning, but its seed-wings (sometimes called helicopters) are rich in lipids and protein that benefit ants that disperse the seeds.[1] The tree may become weedy in some climates.[30,31] It has grayish-green, divided foliage[31] that was used by European settlers to stuff pillows.[1] It produces clusters of elongated, bright orange flowers that are secund (arranged on one side only).[30,31] The nectar is important to the Aborigines, who either take it directly from the flowers or make a sweet drink by soaking the flowers in water.[31] The nectar and pollen also are favored by blossom bats.[1] A *Streptomyces*-like bacterium found in the cells of the stems of a golden grevillea specimen from the Northern Territory, Australia, yielded novel compounds, called kakadumycins, which have demonstrated strong antibacterial and antimalarial effects in cell cultures.[32] This tree is also cultivated for ornament and is the parent of many *Grevillea* hybrids now popular in horticulture.[1,30,31]

Grevillea pteridifolia, Golden grevillea, Proteaceae, *On the cultivation of the plants belonging to the natural order of Proteeae*. Copper plate by Gerard Sibelius, based on John Miller's 1773 watercolor, derived from Parkinson's pencil drawing made at "Endeavors River." Artwork ©2018 Editions Alecto Ltd and the Trustees of the Natural History Museum, London

Chinese Medicinal Plants, Herbal Drugs and Substitutes: An Identification Guide by Christine Leon and Lin Yu-Lin. Richmond, England: Kew Publishing; 2017. Hardcover, 850 pages. ISBN: 978-1-84246 387-1. $180.00.



Recipient of the **2017 ABC James A. Duke Excellence in Botanical Literature Award — Reference/Technical Category**

This book is the result of a 20-year multidisciplinary project between the United Kingdom and China that documented the botanical identity, quality, and nomenclature of Chinese medicinal plants in commercial trade. With its compilation of information and images in this book, the joint collaboration among botanists and other scientists at the Royal Botanic Gardens, Kew (RBG Kew) and the Institute of Medicinal Plant Development (IMPLAD) in Beijing has created a publication of impressive, unusual, and unsurpassed scope and depth. From 1998 to 2014, members of the collaborating teams conducted 14 joint field expeditions in 15 geographical areas of China, encompassing parts of 21 provinces and autonomous regions.

Following Mao Zedong's rapprochement with the West in the early 1970s, traditional Chinese medicine (TCM) emerged as an international model in the global development of traditional medicine systems in public health care. Notably, second to acupuncture, the most commonly used modality in TCM is the plant-based Chinese materia medica. As noted in the introduction of this massive tome:

> Ingredient accuracy and quality are central to the safety and efficacy of any medical system and Chinese herbal drug ingredients are no exception. Increasing concern, however, about the lack of rigorous quality control systems, especially in international markets, to prevent the use of unofficial substitutes and adulterants has become urgent. Confidence in the identity of these ingredients underpins many aspects of their supply.

Given that substitution and adulteration of medicinal plant materials appear to be prevalent in the global supply chain for botanical raw materials, extracts, and essential oils, there is a growing need for accurate and authoritative resources (such as the publications of the ABC-AHP-NCNPR Botanical Adulterants Prevention Program) that enable industry members, analytical and research scientists, and other stakeholders in the global medicinal plant industry and practitioner communities to determine authentic botanical ingredients.

The book covers macroscopic identification techniques for 226 Chinese herbal drugs (in both crude and processed forms) and morphological identification characteristics of their source plants. This represents about half of the official herbal drugs listed in the current (2015) edition of the *Pharmacopoeia of the People's Republic of China* (PPRC).

The book features the following:

- Reference specimens made from fresh plants (verified using herbarium voucher specimens);
- Approximately 3,000 color photos of living plants and drug materials, with annotations about key features;
- Current taxonomy and nomenclature of the included species;
- Comparative identification of official (i.e., listed in the PPRC 2015) and unofficial species of living plants and their herbal drug counterparts in international trade;
- Guidance on robustness of identifications;
- Conservation categories for all species (including a table of CITES-listed species found in the PPRC 2015); and
- Safety summaries.

Information about the official source plants of each herbal drug is organized into color-coded sections based on plant part used:

- Rhizomes, roots, tubers, and bulbs;
- Aerial parts and whole plants;
- Stems and woods;
- Leaves;
- Flowers and flower parts; and
- Fruits, seeds, and other fruit parts.

Within each of the above sections, the herbal drugs are presented in alphabetical order according to their *Pinyin* names as used in the PPRC. (Pinyin is the official Chinese spelling system used when transliterating Chinese words into the Latin alphabet.) In the case of a plant species for which more than one plant part is used as the source of an official herbal drug in the PPRC, descriptive information may be found in several sections of the book. For example, white mulberry (*Morus alba,* Moraceae) is the source of four separate herbal drugs: *sang zhi* (white mulberry twig), *sang bai pi* (white mulberry root-bark), *sang ye* (white mulberry leaf), and *sang shen* (white mulberry fruit). In this case, the same botanical description is repeated four times, and at least three of the accompanying photographs also are repeated. This is not a criticism, merely an observation.

Fortunately, it is easy to find specific ingredients in the well-conceived index, in which accepted scientific plant names are in bold black type, common English and Pinyin names are in regular (non-bold) black type, accepted (official) pharmacopeial names are in bold red type, and other pharmacopeial names are in regular red type. In all index entries, the page number on which the ingredient name first appears is in bold black type. Like all elements of this graphically rich book, the index has been carefully designed with the end user in mind.

Typically, the entries begin with a one- or two-page spread that includes descriptive information about the living source plant(s), beginning with official pharmacopeia species (sometimes more than one for a pharmacopeial ingredient), and, if applicable, unofficial substitutes. A 1.5-inch (3.80-cm) colored banner that corresponds to the color-coded section at the top of each two-page descriptive spread wraps to the margin of the left-hand page and includes the Pinyin name, the Chinese name in Chinese characters, pharmaceutical name, and drug part(s). The right-facing page features "TCM Properties and Use," and includes the plants' energetic properties, channels, actions, and indications. It is only in the upper right-hand colored banner of the plant descriptive spread that one finds any information on the herbal drug's use. No other chemical, pharmacological, or therapeutic/clinical information is included. This book is intended to describe the official source plant(s), unofficial substitutes, and descriptive details of the crude drug.

Following the source plant descriptive material is a one- or two-page spread on the "Drug Morphology" that includes different recognized forms of the crude drug (such as different cuts, slices, or processed drug descriptions), a detailed section on processing, other common names that may be applied in local or regional markets, details on safety, and commentary on unofficial substitutes, counterfeits, or adulterants. This information is often set off in bordered or shaded graphic elements and may include details on "lesser known unofficial substitutes."

An example is the treatment of the widely used root *dan shen*, sourced from *Salvia miltiorrhiza* (Lamiaceae). The four-page layout is divided into a pair of two-page layouts: one that deals with the dried plant and another that describes the herbal drug. The live plant layout includes the botanical description of the official plant as well as two unofficial substitutes: *S. bowleyana* and *S. przewalskii*. "TCM Properties and Use," on the right page for dan shen, includes the plants' energetic properties ("bitter and cool"), channels ("Heart and Liver"), actions ("invigorates Blood, dispels stasis, cools Blood, tonifies Blood, calms the shen"), and indications ("heart disease, stroke; poor circulation; menstrual conditions; irritability, insomnia, palpitations; sores and abscesses").

The two-page herbal drug layout for dried dan shen root provides a description of the official drug and the limits of the macroscopic method of identification. For example, the unofficial substitute *S. bowleyana* "cannot be reliably distinguished from the drug of the Pharmacopoeia species [i.e., *S. miltiorrhiza*] using *macroscopic* characters. Laboratory-based authentication methods [e.g., microscopy, chemical and/or genetic testing] are required and for which there is extensive literature (e.g. Kum *et al.,* 2016). [Kum KY, Booker A, Leon C, Garcia JP, Heinrich M. *Salvia miltiorrhiza* (Danshen); an NMR-metabolomic and HPTLC-based analysis of products' quality. *Planta Med.* 2016;82(S 01):S1-S381.]" A half-page section provides information on seven additional unofficial substitutes, all in the genus *Salvia*; their geographical sources; and distinguishing morphological characteristics.

Arrangement of the individual sections by Pinyin name as the primary header followed by pharmaceutical name aids in recognition of the ingredient, as the ever-changing and inconsistent universe of "accepted botanical names" is a moving target. For example, the accepted scientific name for the ingredient *wu jia pi*, which is listed in almost all TCM reference works, including the PPRC, under the scientific name *Acanthopanax gracilistylus* (Araliaceae), is listed instead under the currently accepted botanical name *Eleutherococcus nodiflorus* (Araliaceae).

The plant description under each entry is detailed and exact, yet readable and free of unnecessary technical jargon. The "Harvesting, Sourcing and Natural Range" section includes details on when the ingredient is harvested, its habitat, and general distribution in China. It also includes insightful details on specialized growing regions, cultivation, agricultural systems, and provenance-related quality. A brief section on "Conservation Status" discusses wild occurrence, endemism in China, and global status.

The text is accompanied by abundant color photography of varying degrees of quality. Most of the photography is by co-author Lin Yu-Lin, with additional contributions from co-author Christine Leon, PhD; RBG Kew staff; and former staff members. The sheer number (about 3,000) and overall excellent quality of the photographs is a feature that sets this book apart from all other TCM titles available in English. The two-page descriptive spread includes photographs of the official pharmacopeial source plant in situ and close-ups of botanical diagnostic details with captioned arrowed overlays pointing to key descriptors. Many entries include images of commercial production (both large-scale and small holder farms), drying or processing, a plant with the whole root attached, and/or the crude drug in a Chinese market. In most cases, images of the living unofficial substitute plants and their visual differences or distinctions are also included. The scope of the descriptive field photography is possible only in the context of a combined team of botanical and crude drug experts traversing remote locations on expeditions over a long time period.

The living plants represent only half of the book's photographic presentation. The other half details crude drug morphology in various forms (e.g., dried root, transversely sliced root, or longitudinally sliced root), shot on seamless backgrounds. Captioned details, numbered arrows corresponding to diagnostic descriptions in the text, and magnified visuals are extremely valuable aids for macroscopic identification. Photographs of each of these ingredients, their details, and their source plants required scientific vigilance and photographic skills in their creation. During the 16-year period of collaboration and field work from 1998 to 2014 represented in the book, more than 4,500 physical reference specimens of crude drugs were collected along with corresponding cross-referenced herbarium vouchers. These are housed in the Economic Botany Collection at RBG Kew as well as at IMPLAD in Beijing.

Before the publication of this book, one of our favorite recently published go-to books on the identification of TCM herbal drugs was the impressive *Chinese Medicinal Identifica-*

tion: An Illustrated Approach (Paradigm Publications, 2014) by Professor Zhongzhen Zhao, PhD, and Hubiao Chen, PhD, of Hong Kong Baptist University. However, as excellent as Zhao and Chen's book is, with its coverage of 428 commonly used Chinese medicinal herbs and related materials, some of its material is based on the previous edition (2010) of the PPRC, and it does not include the living source plants from which the dried herbal drugs are derived.

Chinese Medicinal Plants, Herbal Drugs and Substitutes: An Identification Guide was chosen by the American Botanical Council (ABC) as the recipient of the 2017 James A. Duke Excellence in Botanical Literature Award in the reference/technical category. Like Jim Duke's own contributions to the field of botanical research (in all its meanings), this book is an outstanding original offering born of fieldwork that combines exacting observation with a passion for perfection. This book is an extraordinary original contribution to the current knowledge of medicinal plants. HG

—Steven Foster
Author, Photographer
Eureka Springs, Arkansas

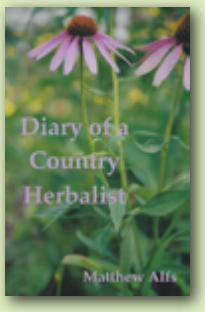
—Mark Blumenthal
Founder and Executive Director, ABC
Austin, Texas

New Book Profiles

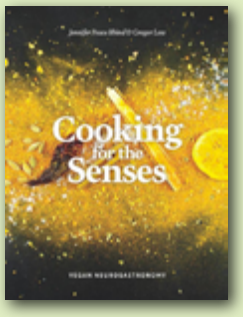
Gods, Wasps and Stranglers: The Secret History and Redemptive Future of Fig Trees by Mike Shanahan. White River Junction, VT: Chelsea Green Publishing; 2016. Hardcover, 208 pages. ISBN: 9781603587143. $22.50.

Ecologist Mike Shanahan, PhD, examines the history, mythology, ethnobotany, and ecology of the genus *Ficus* (Moraceae), which includes multiple species referred to as "stranglers" because of their habit of growing on, and often killing, host trees. The fig tree exemplifies humanity's relationship with nature, and the stories of the past may provide keys to the future: restoring rainforest, halting the loss of endangered species, and even limiting climate change. No aspect of the fig tree, from the wasps that pollinate it to the birds and mammals that feed on the fruit, is too small for Shanahan to explore in this text.

Diary of a Country Herbalist by Matthew Alfs. New Brighton, MN: Old Theology Book House; 2017. Softcover, 164 pages. ISBN: 9780961296476. $13.50.



This fictional story, set in the mid-1980s in a Midwestern homestead, is written as the diary of herbalist Sam Rogers, who details the nature around him and a life of simplicity with his schoolteacher wife. Author Matthew Alfs, RH (AHG), reveals his flair for education as he describes, through the character of Sam, native and naturalized wild medicinal plants of the Midwest, complete with Latin binomials, and the various methods that Sam uses to harvest and prepare herbs for medicinal use. The book includes a list of references, an index of the plants and health conditions referenced in the text, and blank pages for readers to make their own notes.

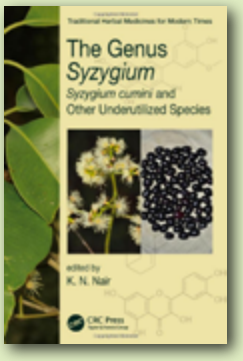


Cooking for the Senses: Vegan Neurogastronomy by Jennifer Peace Rhind and Gregor Law. Philadelphia, PA: Singing Dragon; 2018. Hardcover, 320 pages. ISBN: 9781848193000. $35.00.

An alternative way of looking at food, *Cooking for the Senses* introduces neurogastronomy and explains how understanding smell, taste, and other senses can change the experience of cooking into a more mindful, healthful activity. The authors explain the science of flavor, incorporating Jennifer Peace Rhind's aromatherapy background to elevate the art of plant-based cuisine. This text includes 100 delicious vegan recipes that reflect neurogastronomy in action, as well as a section on selected plant compounds and their roles in the maintenance of optimal health.

The Genus* Syzygium*: Syzygium cumini and Other Underutilized Species by K.N. Nair, ed. Boca Raton, FL: CRC Press; 2017. Hardcover, 270 pages. ISBN: 9781482249729. $149.95.

The economically important genus *Syzygium* (Myrtaceae) is best known for clove (*S. aromaticum*) but also contains multiple cultivated yet underused species. According to editor K.N. Nair, PhD, these species could be prospects for the global pharmaceutical and horticultural trades. This volume, the 14th in the CRC Press series *Traditional Herbal Medicines for Modern Times*, focuses largely on Java plum (*S. cumini*). The book uses a multidisciplinary approach to review the plant's phytochemical constituents, its traditional medicinal and ethnobotanical uses, and its possible applications in soil and plant health, cancer immunology, and synthesis of gold and silver nanoparticles. Further chapters explore eight other species in the genus: plants that have applications as edible fruits, medicines, spices, food colorants, and flavorings.



Edward K. Alstat 1946-2018

Edward K. Alstat, RPh, ND, died on January 26, 2018, near his home in Sandy, Oregon. He was the co-founder and owner of Eclectic Institute, a producer of innovative botanical products, and Eclectic Medical Publications (EMP), a publisher of many classic texts of the Eclectic medical movement from the mid-1850s to the 1930s.

Alstat was born in southern Illinois and treasured the time he spent as a child on his grandparents' farm. After attaining his bachelor's degree in pharmacy at the St. Louis College of Pharmacy in 1969, he moved to Lafayette, California, where he worked in all phases of pharmacy dispensing and management for multiple companies over the next eight years, while also opening a florist shop and antique store. He began his naturopathic education in Wichita, Kansas, and graduated with a bachelor's degree in human biology from Kansas Newman College (now Newman University). He then moved to Portland, Oregon, and completed his doctorate at the National College of Naturopathic Medicine (now the National University of Natural Medicine; NUNM) in 1981.

Alstat loved to play basketball with classmates and dance, and he especially enjoyed herb walks and hot springs soaks. He often expressed his hope to one day develop better-quality botanical preparations than those available during his student years. Alstat became licensed as a naturopathic doctor (ND) and registered pharmacist in Oregon and opened a private practice in Cannon Beach before becoming pharmacy director at the Portland Naturopathic Clinic (PNC), the teaching clinic of NUNM.

In 1982, PNC clinic director and naturopathic obstetrician Michael Ancharski, ND, asked Alstat to help develop a prenatal vitamin supplement. From this project, they founded Eclectic Institute and introduced their prenatal formulation as their first product, followed by a state-of-the-art multivitamin-mineral supplement. Alstat took his cue from the famous Lloyd brothers pharmacists, who were in business for 60 years in the late 19th and early 20th centuries, and his company name from the Lloyd brothers' close association with the Eclectic Medical Institute in Cincinnati.

Through the Eclectic Institute, Alstat manufactured liquid botanical extracts from fresh herbs to capture the phytochemical complexity found in the living plant. The company remained on the NUNM campus and expanded from the clinic to the space surrounding the campus gymnasium. While there, he even started an evening aerobics class in the gym. In addition to Alstat's resolving $200,000 of NUNM's unsecured debt, the Eclectic Institute provided NUNM with 10% of its gross sales while NUNM endorsed the company's products. This arrangement provided support for the company and income for the school, helping the school survive a financial crisis and the company to flourish while it supplied naturopathic physicians with quality, in-house products.

Alstat began his publishing venture in 1983 by reprinting classic Eclectic texts. He obtained the plates for reprinting the monumental *King's American Dispensatory* (1898) by H.W. Felter and John Uri Lloyd, the first and foremost of the reprints from his new EMP. This was followed in 1983 by J.M. Scudder's *Specific Diagnosis: A Study of Disease* (1874), F. Ellingwood's *American Materia Medica, Therapeutics and Pharmacognosy* (1919), and H.W. Felter's *Eclectic Materia Medica, Pharmacology and Therapeutics* (1922). In the same year, he also obtained rights from NUNM to publish this author's postgraduate research project, the *Toxicology of Botanical Medicines*, to make the information available to the naturopathic and herbal professions. During this time, Alstat organized the first Eclectic Institute weekend educational seminar at NUNM, featuring local herbal experts including the late Cascade Anderson Geller and renowned herbalist Ed Smith.

In addition to fresh herbal extracts, Alstat formulated a new type of naturopathic product line of tablets that combined dried powdered herbs with vitamins and minerals to address specific health concerns. The prototype, Opti-Biotic, was based on a conversation with the venerable naturopathic mentor William Turska, ND. When Eclectic Institute products appeared in health food stores, more combination products followed, including several formulas of the renowned John Bastyr, ND. Bringing traditions into a modern context to renew them, Alstat realized in 1988 his vision of providing fresh herbs in a form that could be easily dispensed. He became the first to use freeze-drying technology to preserve the herbs as an encapsulated powder on a commercial scale. These products became popular with physicians and the public alike, especially following publication of research at NUNM/PNC on freeze-dried nettles (*Urtica dioica*, Urticaceae) for hay fever.[1]

Along with wildcrafting, Alstat's farm was his primary source for locally grown herbs for freeze-drying and extraction. Always an advocate of organic gardening and farming, and cognizant of widespread grain sensitivities, Alstat became among the first to use organic alcohol (i.e., alcohol produced from certified organic plant sources) as a solvent for his liquid extracts, and organic grapes (*Vitis vinifera*, Vitaceae) as a source of the ethanol distillate. In 1992, the Eclectic Institute left the NUNM campus and relocated to a 90-acre farm, certified organic by Oregon Tilth, near Sandy, where a variety of commercial herbs were cultivated, including some threatened in their natural ranges, such as goldenseal (*Hydrastis canadensis*, Ranunculaceae) and *Echinacea tennesseensis* (Asteraceae), a federally listed endangered plant. In 1994, Alstat used a modern reconstruction of J.U. Lloyd's cold still to manufacture concentrated botanical liquid extracts, which reduced exposure of the extracts to heat. Lloyd's still allowed Alstat to

replicate several favorite remedies of the old Eclectic physicians like Specific Echinacea, as well as introduce a line of ethanol-free glycerite extracts including Lloyd's official Liquid Hydrastis.

Alstat continued to expand EMP and compiled research, articles, and monographs from contemporary herbalists and NDs, including Christopher Hobbs, PhD, the late Wade Boyle, ND, and this author in the first volume of *Eclectic Dispensatory of Botanical Therapeutics* in 1989, which was followed by volume two in 1995. He had acquired an almost-complete set of the original *Eclectic Medical Journal* from the Lloyd era. In 1995 and 1996, he published *EMJ Reprints* with selected articles from annual volumes representing eight separate decades. He also included special subject issues (e.g., the first compilation of J.M. Scudder's articles on organ remedies).

Over the next decade, EMP's publications of this author's books (and their revisions) — *Formulas for Healthful Living*, *Herb Contraindications and Drug Interactions*, and *Complex Herbs – Complete Medicines* — were all based on concepts that Alstat wholeheartedly supported and on formulas that he helped devise. Importantly, each text discussed issues that previous books had not addressed.

Alstat expanded his manufacturing operations to a large facility in Sandy and added another Lloyd's still and a custom laboratory. Though a strong advocate of whole herbs and unrefined complex extracts, he also developed specialty products such as liquid Lomatium Isolate (from *Lomatium dissectum*, Apiaceae) and powdered Larix arabinogalactans (from larch, *Larix* spp., Pinaceae). In 2000, he emulated another Lloyd brother, the mycologist Curtis Gates Lloyd, by teaming with renowned mycologist Paul Stamets to promote and produce freeze-dried mycelium and mushroom preparations. In addition to growing the Eclectic Institute, Alstat traveled nationally and internationally to learn from and speak to like-minded professionals.

Alstat's efforts did not go unnoticed. He was awarded the Presidential Citation from the American Association of Naturopathic Physicians (AANP) in 1996 "for outstanding leadership in providing substantial and ongoing contributions to the naturopathic medical profession, the AANP, and the naturopathic medical colleges." In 2001, he became the fifth recipient of NUNM's President's Medallion for significant contributions to the success of NUNM, the naturopathic profession, and quality health care in the United States. Alstat was inducted into the NUNM Hall of Fame in 2011 for advancing the reputation of natural medicine, but this milestone did not signify a last hurrah.

Alstat enjoyed spending as much time in his garden as possible. As a naturopathic doctor, he knew good health demanded fresh, organic food and quality water. His innovation of new products continued in 2007 when he introduced Plant Originated Wellness (POWder) products consisting of brown-glass-bottled freeze-dried powders of single plants or combinations of fruits, berries, vegetables, herbs, and spices as a convenient way to supply valuable nutrients and polyphenols to help reduce the risk of chronic degenerative diseases. In 2015, he published this author's *All American Berries*, which provided scientific evidence of the importance of these foods to good health. He also captured the water removed from freeze-dried plants as a unique source of new water manufactured in the plant through the photosynthetic process, and he never tired of proclaiming its value.

Beginning in 2012, Alstat opened the Eclectic farm to NUNM students for annual naturopathic ReVitalization Retreats. He provided several large hot tubs and teepees for their use, along with access to the meadow and cultivated fields for herb walks, hay bales for seating, and resources for mud baths, hydrotherapy, outdoor dining, camping, and more. Each year, scores of students gathered with about a dozen regional, national, and international ND elders for a weekend in September to share naturopathic philosophy, knowledge, experience, and hands-on application of nature-cure techniques. Alstat's generosity and participation helped create an atmosphere of a family reunion that celebrated the love of Mother Nature.

In a final major move in 2013, Alstat realized his dream of relocating Eclectic Institute to a private airpark in a beautiful location surrounded by the Bull Run Wildlife Preserve, about a mile from his beloved farm rimmed by the Sandy River. A revamped aircraft hangar is now the site for production and manufacturing. That same year, EMP published Laura Clavio's book *The Eclectic*, a historical account of an eccentric Midwestern doctor in the first half of the 20th century, which is representative of many alternative physicians in family practices in those days. Alstat organized a final symposium in 2016 in a large converted barn on this new property. He gathered a half-dozen authors and naturopathic doctors from across the country to discuss the Eclectic heritage, which featured the eminent Eclectic historian John Haller. To the end, Alstat did his utmost to provide opportunities to learn and experience the value and advantages of natural healing.

As Alstat's classmate, collaborator, and friend for the past 40 years, it has been my privilege to witness the transformation of health care to which Alstat made many significant contributions. He was an eclectic trailblazer, who cast light on natural means to optimize health, from the traditional to the groundbreaking. He also supported groups in the larger alterative solutions community, such as Bioneers, which advances practical changes to promote environmental health. Alstat enriched the lives of many friends, acquaintances, and co-workers through personal, professional, and business opportunities, leading them to expand the work he engendered, whether with Eclectic Institute or elsewhere. While Alstat's accomplishments were many, the love he shared with his friends and family (his wife Christine, his children Nick, Katy, Bobby, and Edwin, and his sister Karen) was more important. May he revel in that love forever. HG

—Francis Brinker, ND
Clinical Assistant Professor, Dept. of Medicine
Arizona Center for Integrative Medicine
at the University of Arizona
Tucson, Arizona

Reference

1. Mittman P. Randomized, double-blind study of freeze-dried *Urtica dioica* in the treatment of allergic rhinitis. *Planta Med.* 1990;56:44-47.

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.

American College of Healthcare Sciences: ACHS.edu is a DEAC accredited, fully online college offering Graduate and Undergraduate degrees, diplomas, and career-training certificates in holistic health and herbal medicine. ACHS is committed to exceptional online education and is recognized as an industry leader in holistic health education worldwide. Federal financial aid available to those who qualify. Educational resources available to the public include: ACHS Health and Wellness Blog, Master Lecture Webinar Series, and eBooks. For more information: visit www.achs.edu, call (800) 487-8839, or stop by the College campus located at 5005 SW Macadam Avenue, Portland OR 97239.

Other

Interns, get hands-on experience before you graduate! If you're a future pharmacist or dietitian, you can choose a rotation through ABC's internship program. You'll get a comprehensive introduction to phytomedicines, researching the medicinal, culinary, and cosmetic uses of herbs, answering ABC members' questions, working with medicinal plants in ABC's 2.5 acres of herbal gardens, and preparing herbal salves, tinctures, or meals. For more information, call 512-926-4900 x114 or email education@herbalgram.org.

Herb/Berry/Vegie farm seeking assistance with cultivation, processing, landscaping, web work, and GMP certification. Agri-Tourism startup. Work not hard but steady. Profit Sharing. Starting immediately in the Virginia Blue Ridge, Zone 7. hootinanney@yahoo.com.

Stock Photography that doesn't look like Stock: Steven Foster Group, Inc. Photography, Consulting, Publications. Specializing in medicinal and aromatic plants, along with the places they grow, our stock photo files include more than 120,000 images shot around the world for over 30 years. Contact us at our location in the heart of the Ozarks in Eureka Springs, Arkansas. Visit our website: www.stevenfoster.com or email: sfoster@stevenfoster.com.

Considering supplying herbal products in Europe? Ann Godsell Regulatory can offer consulting advice on regulatory strategy, and data requirements. Services for dossier preparation & submission also available. For more information email regulatoryinfo@anngregulatory.eu.

Tea Business Development: 60 years combined experience supporting new and existing tea ventures from start-ups to Fortune 500 companies. Original recipes, flavor and functionality enhancements, raw materials sourcing, production trouble-shooting, regulatory, scientific substantiation, and more. Former Whole Foods and Celestial Seasonings blend-masters, R&D / Q.C. Tea Bags, loose teas, RTD. Advisory services for wholesale, branded consumer products, and retail operations. Email us with your information and needs: sage@sagegroupnetworks.com.

Montana YewTip™ products, the natural Taxane source, Pacific Yew (*Taxus brevifolia*). Sustainably wildcrafted and manufactured exclusively by Bighorn Botanicals, Inc., Noxon, Montana. Capsules, tea, powder, tincture, oil, salve, lotion, soap, and lip balm. To review our products, go to www.bighornbotanicals.com. For more information, including ethnobotany, sustainable harvest protocols, safety, and biological activities, click on the "Plant Profile." Order online or call toll-free 1-888-847-1223.

Herbal Medicine Apprenticeship with Chanchal Cabrera, MSc., FNIMH, RH(AHG) four & eight week residential sessions. Gardening, Harvesting, Medicine Making plus Classes and Field Trips. HERB CAMP - Clinical Phytotherapy retreat with David Winston, RH(AHG) and Chanchal. Case studies, Materia Medica, Herb walks, Shinrin Yoku and more. 9 - 12 August 2018. Innisfree Farm and Botanic Garden, Vancouver Island. www.chanchalcabrera.com

Blue Flag

***Iris versicolor*, Iridaceae**

Photograph by Susan Bara
Captured with a Nikon COOLPIX S8200
4 mm lens, f/3.3 aperture, 1/100 sec. at ISO-100

Blue flag (*Iris versicolor*, Iridaceae) is a perennial herb native to eastern and central North America.[1] The plant produces decorative and distinctive deep blue and purple blossoms, but the rhizome is the plant part used in traditional medicine. The rhizome contains iridin, which is toxic in even small quantities but often was used by Native American tribes throughout blue flag's growing region. These tribes used the rhizome internally as an emetic and liver tonic and in poultices as a topical aid for burns, swelling, sores, and wounds.[2] HG

References

1. Plant database: *Iris versicolor*. Lady Bird Johnson Wildflower Center website. August 4, 2014. Available at: www.wildflower.org/plants/result.php?id_plant=IRVE2. Accessed April 2, 2018.
2. Moerman D. NAEB text search. Native American Ethnobotany Database website. Available at: http://naeb.brit.org/uses/search/?string=iris+versicolor. Accessed April 2, 2018.