(Photo taken by Roberta A. Lee in 2001)

Sweet Wood—Cinnamon and its Importance as a Spice and Medicine

Roberta Lee, MD, and Michael J. Balick, PhD

As we write this first article for *EXPLORE*, how appropriate it is to be on the small volcanic island of Pohnpei, the setting for some of the most biologically diverse forest in the world. Pohnpei's forest is rich in species endemic only to the Eastern Caroline Islands, and many of these plants are found only on Pohnpei. One such forest tree is *Cinnamomum carolinense*, the fragrant Pohnpei cinnamon locally called *madeu*. The ground bark of *madeu* has long been a traditional remedy on Pohnpei, as well as a household beverage. The inner bark of the tree is ground and mixed with boiling water, and the warm libation consumed as a tea with meals, especially in the morning, in the same way we might drink green or black tea, *Camellia sinensis*. A teaspoon or so of reddish-brown bark is boiled in a pot of water for 10 minutes, sweetened with sugar, and the liquid poured through a screen into cups. Traditionally, *madeu* is used on Pohnpei to treat backache—for therapeutic treatment, sweeteners are not usually added. The taste of the warm beverage reminds the palate of sassafras tea, and, indeed, some of the chemical compounds in *madeu* are also found in sassafras.

There are also other traditional uses for *madeu* on Pohnpei; in 1948, the anthropologist Saul Riesenberg[1] reported that the bark was mixed with a local seaside flower then pounded, and the resulting liquid used to treat excessive menstruation. It was also said to be used to treat "*Sowmwaw-n-nan-yak*" a culturally specific disease that has its origins in the mangrove forests. Along with the traditional uses came a traditional way of harvesting the once abundant trees—by stripping them of the bark, effectively girdling the trees, cutting off part of their transport system—resulting in their death. That way of wildcrafting works only if the species is in abundance, is quickly growing, and populations are managed carefully. However, the wild populations of this tree were not managed in a way that would guarantee their regeneration, and, thus, the density of this species today is but a shadow of its former abundance on Pohnpei.

We were quite lucky to be introduced to a local *madeu* harvester, Yosio Pelep, by our friend Gibson Santos, Agriculture Conservation Specialist of the Natural Resources Conservation Service/United States Department of Agriculture office on Pohnpei. For a long time, Yosio has depended on income from harvesting wild *madeu* bark to support his family. In recent years, he has become very concerned about the disappearance of the *madeu* forests on his island because of destructive

Above photo: Yosio Pelep demonstrating the old and destructive method of *madeu* harvest.

harvesting methods. Encouraged by Gibson, and our colleague William Raynor of the Pohnpei Office of The Nature Conservancy, Yosio carried out some experiments with bark harvest and discovered that if the bark was scraped off with a machete, and it did not go too deep into the tree trunk, then the bark–the source of the raw material for Pohnpei cinnamon–would grow back some months later. It could then be harvested again, with no lasting damage to the tree–but only if the bark was carefully scraped. In addition, local people have established a nursery of *madeu*, replanting thousands of seedlings in protected areas of the island where they can be harvested and provide income.

Several years ago, we climbed up the volcanic slope on which the cinnamon forest was growing, with Yosio and his family, and set up a camp at which we could live and study in the forest for a week's time. It was a grand adventure, building our local shelters made of stems and thatched with palm leaves and rigging our nylon hammocks and tents in a camp next to a fresh water supply near the top of the mountain. Each day, we would study how *madeu* was harvested using this sustainable technique, discuss with the family how they utilized it for local medicine, and sit around a campfire at night drinking *sakau* (*Piper methysticum*) with our friends Matt and Patti Long and their family, who had accompanied us on the journey in addition to Tamara Balick. We collected a wealth of data on the ethnobotany of this plant and carried out laboratory research, soon to be published, on the chemistry of *madeu* as well. Camping in a cinnamon forest was an unforgettable experience.

Like Pohnpeians, explorers have been enticed by spices such as cinnamon for thousands of years, often traveling to distant and dangerous places. Spices were used as medicines and condiments, often serving as food preservatives. Access to these spices served as a status symbol reflecting great personal wealth. In fact, the use of spices in food preparation is presumed to be as old as the craft of cooking. Cinnamon and cassia, both referred to as cinnamon, have their earliest recorded use in the first herbal written by the Emperor Shen Nung, the father of Chinese medicine (ca. 2800 BC). In this text, cassia is referred to as *kwai*, a word still used today

Yosio Pelep scraping the inner bark of the Pohnpean cinnamon tree, a sustainable method developed for wild harvest of this native species.

to describe this spice. In Egypt, cassia, cumin, anise, marjoram, and other exotic herbs were used not only in daily life but also in death as the botanical ingredients employed in mummification. Cinnamon was familiar to Phoenicians and Hebrews (1000 BC) and was known as *qinnamon*. "In Exodus 30, a section of the Old Testament, the Lord directs Moses to make a holy ointment that includes olive oil, 500 units of myrrh and of cassia, and half as much of sweet cinnamon and of calamus to anoint the sanctuary, its furnishings, and priests."[2] The use of spices such as cinnamon was introduced to Europe during the Roman invasion.[3] Pliny the Elder (first century AD) valued the equivalent of 350 grams of cinnamon (a Roman pound) at 1,000 *denarii*, equivalent to approximately 5 kilograms of silver–15 times as much as the precious metal.[4] Cinnamon reached its highest value in the 16th and 17th Centuries. Initially, cinnamon was traded and brought West via the "Silk route," an overland trail that began in China, coursed through Iran and Turkey, and eventually ended in the a part of the Roman empire now recognized as Italy. However, overland travel was dangerous and slow and monopolized by the Arabs and Venetians. Portuguese navigators and geographers, hoping to break this trade monopoly, eventually developed maritime routes that were successively dominated by the Spanish, Dutch, and English. This greatly expanded access to many spices and other exotic products from the East. The major source of cinnamon (*Cinnamomum verum*) was Ceylon (Sri Lanka). With greater access through more efficient travel came the eventual European colonization of Ceylon. This transition resulted in an expanded effort to cultivate cinnamon and made this spice much more available and inexpensive to the West. By the 16th Century, cinnamon was the one of the most popular spices used in the Western world.

There are hundreds of species of cinnamon around the world; one conservative estimate by Willis[5] was that there are approximately 250 species. Most of us are familiar with 2 species, *Cinnamomum verum* Berchthold and Presl., the true cinnamon sometimes referred to as *Cinnamomum zeylanicum* Blume or Sri Lankan cinnamon and *Cinnamomum cassia* (L.) Berchthold and Presl., the Chinese cassia or cassia bark tree. The name cinnamon by which we know these plants has its origins in the Greek root *kinnamon*–sweet wood–referring to the sweetness of the bark.

There has been confusion between cinnamon and cassia for centuries. Galen, a well known Greek physician of the second century, remarked that the finest cassia

differs so little from the lowest quality cinnamon that it could serve as a substitute as long as twice the amount is used in each recipe.[6] In Europe and Mexico, the more delicately flavored cinnamon (*Cinnamomum verum*) is used in cooking to spice up foods such as hot chocolate and in a special sauce known as *mole*, a thick savory chocolate sauce served over chicken.[7] The United States consumes approximately 6 times more cassia than cinnamon. However, in Great Britain, "cinnamon" applies only to *C. verum* and "cassia" to *C. cassia*. The U.S. Food, Drug, and Cosmetic Act of 1938 officially permitted the term "cinnamon" to be used for both *C. verum* and *C. cassia* as well as other species of cassia. Those wishing to differentiate between the 2 should note that cinnamon (*C. verum*) has a lesser bark thickness, with quills that tend to curl on each other, whereas cassia (*C. cassia*) has thicker bark and a stronger "cinnamon" taste.

Today, cinnamon and cassia are used in cosmetics and in foods and liquor as a dietary flavoring. The waste products from cinnamon and cassia production are pressed to make cinnamon oil. Cinnamon and cassia both are derived from the bark of related trees in the genus of *Cinnamomum*. The bark is loosened with a special knife and left to rot for a day. Then, the outer layer is scraped off, exposing the fine, light, inner bark. After several days of drying, the inner bark is shaped in rolls, which are called *quills* and shipped for processing.[8]

Beyond the realm of taste, the science and chemistry of cinnamon have been a source of much research over the last 30 years. Recently, cinnamon from *Cinnamomum cassia* was tested in type II diabetics mellitus (DM).[9] Type II DM is a medical condition in which the number of insulin receptors on cells decrease, making a shortage of receptors such that glucose cannot effectively be transported into the cell. As a consequence, glucose remains in the blood for long periods of time. The unused glucose becomes embedded in blood vessels and other surrounding tissues, causing damage by its presence.

In this clinical trial by Khan et al,[9] 60 patients were given 1, 3, or 6 g/day of cinnamon (*C. cassia*) or placebo for 40 days with a 20-day washout period. The participants were noted to have elevated cholesterol levels in addition to type II DM. The results of this study demonstrated that the intake of each of these doses of cinnamon reduced the mean fasting glucose by 18% to 29%, triglycerides by 23% to 29%, and cholesterol by 12% to 26%.[9] There were similar effects seen at the 3 doses tested. The researchers stated that they were not clear whether even less than 1 gram of cinnamon per day would also be beneficial.

Type II DM has been increasingly linked with elevated blood pressure and cholesterol and fasting glucose levels along with decreased high-density lipoproteins. This combination of medical conditions is now recognized as "Syndrome X." This study shows that cinnamon positively affects 2 of the 3 critical areas in which Syndrome X does its damage. Typically, under normal circumstances, at least 3 medications are needed in conjunction with diet modification and exercise to treat Syndrome X. Importantly, it appears that this spice can address many facets of a widespread and debilitating medical condition. According to the census data of 2000, approximately 47 million Americans fit the criteria of Syndrome X.[10] It will be interesting to see whether larger trials evaluating cinnamon's efficacy in lowering glucose and lipid levels will be applicable to the general population. In vitro and animal studies attempting to isolate and characterize the insulin-enhancing complexes within cinnamon have suggested that water soluble compounds known as polyphenolic compounds of catechins rather than eugenol, cinnamon, or cinnamon-like compounds were responsible for insulin-like activity.[11] Mechanisms proposed for cinnamon's activity are not completely understood but include enhancement of the insulin-signaling pathway in skeletal muscle and regulation of nitric oxide synthesis.[12]

Cinnamon's ability to act as a food preservative remains interesting and continues to be researched. Recent in vitro studies of cinnamon have shown that it is effective in inhibiting the growth of bacteria known to cause putrefaction in meat.[13] The essential oils of clove, cinnamon, pimento, and rosemary were found to be the most active for this purpose. A 1/100 dilution of these oils inhibited at least 5 of the 6 test organisms. Another study found that cinnamon killed 99.5% of the bacteria inoculated in apple juice samples over 3 days. When combined with .1% sodium benzoate, an FDA-approved food preservative, the bacteria were completely knocked out. It was noted by the researchers that the bacterial concentration was 100 times the number typically found in contaminated food.[14] In the 14th Century, a well-known and frequently used French recipe known as *camelyn* sauce was used in many meat and poultry recipes. Its ingredients included cinnamon, vinegar, salt, mace, cloves, pepper, and olive oil.[15] One could imagine that the popularity of this recipe might have been influenced by its potential to extend the life of the dish—especially in a time when refrigeration of foods was quite problematic.

A study done by Dr Christine Wu et al at the University of Illinois at Chicago found that Big Red, a chewing gum made by the Wrigley Company (Chicago, IL), suppressed mouth bacteria when it was chewed for 20 minutes. Big Red contains a variety of plant essential oils, including cinnamic aldehyde. Levels of the bacteria that were producing sulfur compounds dropped by approximately 50%. The participants were also given gum without the cinnamic aldehydes, and bacterial levels dropped by approximately 40%. However, Wu et al stated that the product did not mask foul mouth odor but eliminated the bacteria causing it. The authors also noted that this could be a temporary change.[16]

In other scientific publications, cinnamon along with other spices such as anise, ginger, mint, nutmeg, licorice, and vanilla were evaluated for their antioxidant properties against the commonly used food preservatives butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), and propyl gallate. A variety of tests were performed to prioritize which natural ingredients were most protective against oxidation. In one test, cinnamon was found to be the most effective super oxide radical scavenger or antioxidant—even stronger than BHA or BHT. Oxidation is the most common chemical reaction responsible for food degradation or spoilage.[17] The researchers suggested that the high flavonoid content of these spices was the basis for such strong antioxidant activity. For those interested in the use of more natural preservatives for foods, these findings are promising.

Antifungal effects against a number of pathogens, including *Aspegillus niger*, *Can-*

dida albicans, *Histoplasma capsulatum*, and others have been identified in the cinnamic aldehyde found in cinnamon. In one study, it was suggested that cinnamon bark oil could be considered as a potent therapy for respiratory tract infections of a fungal nature.[18] In a small, uncontrolled trial, 5 HIV-positive participants with oral candidiasis were given an oral preparation containing cinnamon for a week. Three out of 5 participants improved.[19] Finally, in a variety of in vitro and animal studies, anticancer, anti-inflammatory, and wound-healing properties of cinnamonaldehyde and eugenol isolated from cinnamon have been reported.[20, 21]

Cinnamon, once as valuable as gold, lured the Western powers of the Middle Ages to explore dangerous and unknown lands in the East. Today, cinnamon is the second most important spice sold in the United States. Aristotle once said that "In all things of nature there is something of the marvelous," and, certainly, cinnamon is a noble example of nature's wisdom.

REFERENCES

1. Riesenberg S. *The Native Polity of Pohnape.* Washington, DC: Smithsonian Institution Press, 1968.
2. Swahn JO. *The Lore of Spices: Their history, Nature and Uses Around the World.* London: Senate Publishing, LTD, 1999:125.
3. McGee H. *On Food and Cooking.* New York: Scribner, 1984:130.
4. Swahn JO. *The Lure of Spices: Their history, Nature and Uses Around the World.* London: Senate Publishing, LTD, 1999:127.
5. Willis JK. *A Dictionary of the Flowering Plants and Ferns,* 8th ed., Cambridge: Cambridge University Press:1973.
6. Rosengarten F. *The Book of Spices.* Philadelphia: Livingston Publishing, 1969.
7. Mexico: Chicken With Mole Sauce. Available at: http://www.globalgourmet.com. Accessed September 19, 2004.
8. Moldenke H, Moldenke A. *Plants of the Bible.* New York: Ronald Press Co., 1952.
9. Khan A, Safdar M, Ali Kahn MM, Khattak KN, Anderson RA. Cinnamon improves glucose and lipids of people with type 2 diabetes. *Diabetes Care.* 2003;Dec 26(12): 3215-3218.
10. Steinbaum SR. The metabolic syndrome: an emerging health epidemic in women. *Prog Cardiovasc Dis.* 2004;46:321-336.
11. Anderson R, Broadhurst CL, Polansky M, et al. Isolation and characterization of polyphenol type-a plymers from cinnamon with insulin-like biological activity. *J Agric Food Chem.* 2004;52:65-70.
12. Qin B, Nagasaki M, Ren M, et al. Cinnamon extract prevents the insulin resistance induced by a high-fructose diet. *Horm Metab Res.* 2004;36:119-25.
13. Ouattara B, Simard RE, Holley RA, et al. Antibacterial activity of selected fatty acids and essential oils against six meat spoilage organisms. *Int J Food Microbiol.* 1997;37: 155-162.
14. Ceylan E, Fung DY. Cinnamon Is a Lethal Weapon Against *E coli* 0157:H7. Presentation at the Institute of Food Technologists Annual Meeting, July 27th, 1999.
15. Scully T, ed. *Le Viandier de Taillevent. An Edition of all Extant Manuscripts.* Ottawa: University of Ottawa Press, 1988.
16. Zhu M, Carvalho RHR, Scher A, Wu CD. Short-term germ-kill effect of chewing gum containing plant essential oils. Presented at the 82nd International Association of Dental Research, Honolulu, HI, March 11, 2004; Abstract 0331.
17. Murcia MA, Egea I, Romojaro F, et al. Antioxidant evaluation in dessert spices compared with common food additives. *J Agric Food Chem.* 2004;52:1872-1881.
18. Singh HB, Srivastava M, Singh AB, et al. Cinnamon bark oil, a potent fungitoxicant against fungi causing respiratory tract mycoses. *Allergy.* 1995;50:995-999.
19. Quale JM, Landman D, Zamann MM, et al. In vitro activity of *Cinnamomum zeylanicum* against azole resistant and sensitive Candida species and a pilot study of cinnamon for oral candidiasis. *Am J Chin Med* 1996;24:103-109.
20. Ka H, Park Hj, Jung HJ, et al. Cinnamaldehyde induces apoptosis by ROS-mediated mitochondrial permeability transition in human promyelocytic leukemia HL-60 cells. *Cancer Lett* 2003;196:143-152.
21. Prasad NS, Raghavendra R, Lokesh BR, et al. Spice phenolics inhibit human PMNL 5-lipoxygenase. *Prostaglandins Leukot Essent Fatty Acids.* 2004;6:521-528.

Michael J Balick, PhD, *is Vice President and Chair of Botanical Research and Training, Philecology Curator and Director, Institute of Economic Botany, The New York Botanical Garden. An ethnobotanist, he studies the use of plants by traditional cultures.*

Roberta Lee, MD, *is Medical Director at the Continuum Center for Health and Healing at Beth Israel Medical Center, New York. She is Codirector of the Integrative Medicine Fellowship. Her research involves ethnomedicine, the study of healing systems used by traditional cultures.*