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Really Wild Remedies—Medicinal Plant Use by Animals

by Jennifer A. Biser

Pausing only to wipe the feverish sweat from her brow, the WaTongwe woman finishes crushing a few leaves and stems a fellow tribe member brought her from the mujonso, or "bitter leaf," tree. She soaks them in a bowl of cold water while her stomach aches with a dull pain. Closing her eyes and grimacing in anticipation of the liquid's foul taste, she holds her nose and gulps down the bitter elixir, hoping this reliable remedy will rid her of the intestinal pain that's plagued her for days.

Nearby, in Tanzania's Mahale Mountains National Park, a lethargic chimpanzee suffering from diarrhea and malaise slowly pulls a young shoot off a small tree called *Vernonia amygdalina*. She peels away the shoot's bark and leaves with her teeth, and begins chewing on the succulent pith. Swallowing the juice, she spits out most of the fibers, then continues to chew and swallow a few more stalks for half an hour.

Recovered within 24 hours, both of these females resume business as usual. They were both suffering the effects of an intestinal parasite infection. And, in case you haven't guessed, they both ate from the same tree.

Back by popular demand, the revival of herbal medicine among industrialized nations is challenging the modern pharmacological market while captivating the interest of scientists in numerous fields. Tired, perhaps, of expensive, highly synthetic drugs, we look to traditional healers in faraway places to share their time-tested therapies. The majority of the world's population, in fact, still relies on traditional medicines to some degree for their basic health care. Some scientists feel this is a valid method of finding cures for certain diseases. Others believe we should head straight for the jungle and see what leafy remedies animals are munching on. After all, isn't it possible that people learned about self-healing by watching their wild neighbors? "The probability that animals may have something to teach us about the medicinal use of plants is quite high," says primatologist Michael Huffman at the Kyoto University of Japan. Actually, the idea's hardly been ignored. In fact, an entirely new field, sometimes called "zoopharmacognosy" (zoh-oh-farm-a-cog-na-see), has evolved from the onslaught of diverse research on self-medicative behavior in animals over the past two decades. Animal behaviorists, ecologists, pharmacologists, anthropologists, geochemists, and parasitologists have all contributed to this truly multi-faceted discipline.

Huffman is one of the pioneers of zoopharmacognosy, thanks to his observations in 1987 of an animal--the chimp described earlier--attempting to heal herself. Intrigued by her speedy recovery and curious about the cause of her illness, Huffman analyzed the chimp's dung and found the intestinal parasite *Oesophagostomum stephanostomum* to be the most likely explanation for her symptoms. What's more, he found lower levels of the worm in another female chimp's excretions 20 hours after she ate the bitter pith from a *Vernonia* tree. This prompted him to collaborate with researchers in Japan, Canada, France, and the United Kingdom to find out what, if anything, the plant contained that might have killed the worms.

Huffman and his colleagues made an important discovery: They isolated an entirely new class of compounds from the pith, one of which, vernonioside B1, was found to possess antiparasitic, antitumor, and antibacterial properties. What's more, the leaves contain high levels of a well-known class of poisonous compounds found only in minute amounts in the pith. While these substances are also antiparasitic, they are likely toxic to the chimps.

medicinal plant. Interestingly, *Vernonia amygdalina* has more than 25 known medicinal uses among the peoples of sub-Saharan Africa, about half of them for intestinal and parasitic ailments. People have learned to use the pith, leaves, and roots, probably because the more toxic compounds have been selectively bred out of *Vernonia* that is cultivated in gardens.

A Leaf a Day Keeps the Worms Away

Most of us probably encounter a bitter-tasting form of medicine at some point in our lives. We seem convinced that the worse it tastes, the faster our recovery. Yet imagine swallowing whole a large leaf whose surface is covered with short, bristly hairs. Cringing at the thought? Primates usually don't when they ingest the leaves of certain members of 13 botanical families native to equatorial Africa. In 1972, Harvard University anthropologist Richard Wrangham began investigating this odd form of leaf-eating in Tanzania.

Gombe National Forest hosted this feast on foliage, where chimpanzees searched for plants of the Aspilia genus, a branch of the sunflower family. According to Wrangham, they sought the plants just after dawn. Upon locating a patch of leaves, the chimps would pick and eat them one at a time, taking much longer with them than with other leaves and fruits. Huffman, of the *Vernonia* study, says, "It's really quite interesting to see, and completely different from the same individual taking a handful of smooth leaves and chomping them all down in a few bites." Being careful not to chew, the chimps folded the leaves, rolled them around in their mouths, then finally gulped them down. Even when tasty, ripe fruits grew plentifully nearby, the chimps still sought the leaves on occasion. And what's more puzzling is the fact that the leaves were later excreted whole, completely undigested.

Why go to all this trouble to find *Aspilia* leaves? After all, they are difficult to swallow, other food is usually available, and spending the time and energy to find them does not always justify their use simply as food. For several reasons, scientists think that chimpanzees eat this plant to exploit its medicinal properties. First, chimps consume more of these leaves during the rainy season, when parasitic larvae abound and there is increased risk of infection. Second, swallowing the leaves whole rather than chewing them provides no nutritional benefit to the animals, as they pass through the animal undigested. Third, the leaves are not a regular component of the chimps' diet. Fourth, although it is not certain that healthy animals never eat the leaves, infected animals have frequently been seen swallowing *Aspilia*. And let's not forget to mention that chimps aren't the only ones to seek these leaves: Africans use them, and other parts of the *Aspilia* plant, for a wide variety of illnesses such as lumbago, sciatica, scurvy, malaria, and rheumatism.

Experts are now searching for answers to the bigger question: What is the mechanism by which leaf swallowing acts against parasites? One analysis showed *Aspilia* leaves to contain a bright red oil known as thiarubrine-A, a compound clinically proven to kill parasites, viruses, fungi, and bacteria. However, all other attempts to find thiarubrine-A in the leaves of *Aspilia,* or any other plant species swallowed, have failed. Huffman doesn't doubt that there is a medicative function behind leaf swallowing behavior. His theory about how it gets rid of worms revolves around the hairiness of the leaves. Huffman found live worms in chimp feces stuck "like Velcro" to leaf hairs and trapped within the folds. He speculates that worms may become attached to the leaves or somehow enticed into the folds during digestion, taking a "magic carpet ride" through the gastrointestinal tract, eventually to be excreted from the body. Chemicals in the plant may also decrease the ability of the parasites to adhere to the intestine, making it easier for them to be swept out by the leaves. Scientists are not yet certain just how leaf swallowing improves the health of chimpanzees, but the idea has sparked such interest in the scientific community

that answers should be just around the corner.

To date, experts have documented 30 plant species whose hairy leaves are "swallowed whole," not just by chimpanzees *(Pan troglodytes)*, but by pygmy chimps, or "bonobos" *(Pan paniscus)*, and eastern lowland gorillas *(Gorilla gorilla graueri).* These great apes, of course, share their forest pharmacy with another important primate: *Homo sapiens.* Ill human and non-human primates alike reach for the leaves of several plants in the genera *Rubia, Aneilema, Lippia*, and *Ficus*, among other roughly surfaced plants of sub-Saharan Africa. While apes swallow leaves whole and may use leaf texture to their advantage, humans do not. *Rubia cordifolia* is the antiparasitic plant Ugandans use to relieve stomach ailments. Traditionally, people of that country also rely on *Aneilema aequinoctiale* for fevers, earaches, and to stop bleeding. As Huffman did with *Aspilia,* Wrangham verified that chimpanzees swallowing whole leaves of these two plants had parasitic infections. *Lippia plicata* is ingested by Africans for more serious threats such as dysentery and malaria. And in Tanzania, *Ficus exasperata* is the preferred antidote for ulcer sufferers. Although animals and people commonly select the same species but different plant parts for medicinal use, we don't yet know that they are treating identical symptoms.

Charcoal Cures and Fruit Fix-Alls

Furry jungle inhabitants have more to contend with than just parasites and microbes. Some of the most nutritious plants they eat also contain more or less toxic substances called secondary compounds. These compounds are not required by the plant for its basic metabolism; they are considered to be a defense mechanism against hungry herbivores. Red colobus monkeys *(Procolobus pennantii kirkii)* on Zanzibar Island, Tanzania, must deal with such substances because they prefer leaves of the exotic Indian almond and mango trees. Abundant in the monkeys' habitat, these trees yield leaves high in protein. However, they're also high in secondary compounds called phenols, which interfere with the monkeys' digestion.

What could these animals eat to counteract the toxicity of the leaves while retaining their nutritional benefits? Try taking a bite out of a charcoal briquette and you'll have the answer! Between 1991 and 1996, anthropologist Thomas Struhsaker of Duke University studied the interesting feeding behavior of the Tanzanian red colobus. He observed the animals eating charcoal from charred stumps, logs, and branches, as well as from human kilns. "They really go after the charcoal," he recalls, amused. "Bigger monkeys try to take charcoal away from smaller ones. And they come down from the trees to grab pieces much bigger than they can possibly eat, carrying it off with two hands." Subsequent analysis by his colleague, University of Wyoming chemist David Cooney, showed that the study site's charcoal had a high adsorptive capacity for phenols. This means that the toxic phenols adhere to the charcoals, while proteins, important for the body's growth and repair systems, remain free for absorption by the digestive tract. Interestingly, birth rates and population densities of the red colobus are significantly higher where almond and mango trees plus charcoal are available than where charcoal is not. While charcoal eating is relatively rare, geophagy, or soil consumption, occurs widely among many primates. Clay and charcoal have large adsorptive surface areas enabling them to buffer the stomach against toxic compounds. Worldwide, people also use charcoal to inactivate lethal substances and prevent intestinal infections.

The sweet red fruits of *Aframomum angustifolium* favored by mountain gorillas *(Gorilla gorilla beringei)* in southwestern Uganda are not nearly as unpleasant to the mouth as charcoal or hairy leaves; nor do they contain toxic secondary compounds. However, according to biologist John Berry at Cornell University, this fruit's antimicrobial properties actually pose a digestive threat to the normal, healthy population of microorganisms found in the gorilla's gut. After eating fruits of this wild ginger,

antibacterial compounds in the plant can temporarily damage these microbes, in turn upsetting the gorilla's digestive system if they aren't already a regular part of the diet. Evidence shows that the gorilla's microbiota have developed resistance to the biologically active components of the plant in areas where it is commonly eaten--an adaptation

Avian Elixirs

Another animal that probably fights toxins with bacteria is the hoatzin *(Opisthocomus hoazin),* a bird native to northern South America. Hoatzins digest their food more like cows than cuckoos, their most closely related cousins. In most birds, the crop is a digestive organ used for storage and the grinding of common foods such as seeds or insects. The folivorous, or leaf-eating, hoatzin, however, uses specialized bacteria in the crop to break down hard-to-digest leafy plant material. This is reminiscent of the cow's compartmentalized stomach, where bacterial fermentation of ingested food takes place. Research indicates that the bird's gut bacteria also neutralize toxic secondary compounds found in the plants it eats. And scientists speculate that the hoatzin's microflora benefit the bird in another important way: Bacteria may take up toxins for later use against foreign microbes. Indeed, the birds harbor surprisingly few harmful bacteria or other disease-causing organisms.

Unlike the hoatzin, European starlings *(Sturnus vulgaris)* face serious pressure from pathogens and parasites. Studies by biologist Larry Clark show that by lining their nests with select fresh vegetation, these birds are protecting themselves from a myriad of possible infections. Wild carrot *(Dauscus carota),* for example, kills fowl mites in starling nests, although the precise mechanism by which this occurs is not known. The carrot contains the steroid B-sitosterol, a compound that repels mites and inhibits their egg-laying abilities. This compound is also found in leaves of the margosa tree *(Azadirachta indica)*, from which house sparrows often gather material to line their nests, and which some Native Americans employ as a tick repellent. Other chemicals in the plant may disrupt the mites' feeding behavior, or delay mite development and colonization within the nest. How starlings know to choose parasite-deterring plants like the wild carrot remains a bigger mystery.

Fur-Rubbing Frenzy

In the early 1990s, Mary Baker, an anthropologist at the University of California, Riverside, studied another possibly self-medicating behavior among white-faced capuchin monkeys *(Cebus capucinus)*. On the southeastern edge of the Nicoya Peninsula, Costa Rica, she witnessed monkeys breaking open the fruits of certain species of *Citrus* plants, and rubbing the pulp and juice into their fur. They also tore stems, leaves, and seed pods from *Clematis dioica, Piper marginatum, and Sloanea terniflorastems,* respectively. They mixed these pungent plants with saliva and vigorously rubbed them in as well. The purpose? Local inhabitants use three of the plant genera they selected--*Citrus, Clematis, and Piper*--to treat skin irritations or repel insects. Indeed, these botanicals contain secondary compounds with healing and insect-repelling characteristics. Baker also observed that fur-rubbing behavior becomes more frequent when temperatures and humidity rise during the rainy season. This may be due to the corresponding increase in the risk of bacterial or fungal infections.

Capuchin monkeys are not the only mammals that exhibit this behavior: Bears fur-rub as well. Instead of heading for the nearest cosmetic counter, they have seemingly developed their own insect-repelling facial from "genuine forest botanicals." Unpublished evidence suggests that North American brown bears *(Ursus arctos)* chew the root of *Ligusticum porteri*, or "bear root," making a paste of the plant and saliva that they rub on their faces. According to the folklore of southwestern Navajos, the bear by example gave the tribe this root from the carrot family for treating stomachaches and infections. *Ligusticum porteri* contains coumarins--fragrant organic compounds--that may repel insects when

topically applied. Interestingly, animals may also fur-rub each other to develop relationships among themselves and establish a group scent.

Reproductive Remedies

Animals may have "stumbled" upon a wealth of ways to control reproduction, and scientists believe recent discoveries are only the tip of the iceberg. According to World Wildlife Fund scientist Holly Dublin, African elephants *(Loxodonta africana)* seek a particular species of tree, possibly to induce labor. Dublin followed a pregnant elephant for more than a year in East Africa, and observed that the elephant followed a strictly uniform diet and pattern of daily behavior until near the end of gestation. At that time, the elephant walked 17 miles in one day--many more than her usual three--and ate a tree of the Boraginaceae family from leaves to trunk! Four days later she gave birth to a healthy calf. Dublin found that Kenyan women brew a tea from the leaves of this tree to induce labor. She believes this is more than just coincidence, as does University of Wisconsin anthropologist Karen Strier about her own research. Strier found that, at different times, muriqui monkeys *(Brachyteles arachnoides)* of Brazil go out of their way to eat the leaves of Apuleia leiocarpa and Platypodium elegans, and the fruit of *Enterlobium contortisiliquim* (monkey's ear). The first two plants contain isoflavanoids, which are compounds similar to estrogen. Ingesting the leaves may increase estrogen levels in the body, thereby decreasing fertility. Alternatively, eating monkey's ear may increase the monkey's chances of becoming pregnant because the plant contains a precursor to progesterone (the "pregnancy hormone") called stigmasterol.

Another fascinating finding involves the possible influence of diet on the sex of offspring among Costa Rican howler monkeys *(Alouatta palliata)*. Kenneth Glander, director of the Duke University Primate Research Center, and another zoopharmacognosy pioneer, recorded statistically improbable numbers of same-sex offspring born to howlers: One female delivered males eight out of nine times; another female delivered four out of four males; yet another had females in four births out of five. It is known that X chromosomes carry an electropositive charge while Y chromosomes carry an electronegative charge. If a charge is produced in the birth canal--perhaps by chemicals in plants eaten--the environment there would be hospitable to one or the other type of chromosomes.

Indeed, Glander found significant differences in electric potential between the monkey's cervix and the entrance to the birth canal, indicating the production of such a charge. If plants were found to be responsible for this change, it would imply that howlers may have some control over determining the sex of their young. Giving birth to males could offer a female howler a status advantage because all males are potential troop leaders. In other situations, she may best pass on her genes by producing daughters to mate with the alpha (head) male. Are howler monkeys meddling with the mechanisms of evolution? It is possible that the scenarios described above may be conferring an evolutionary advantage to particular individuals.

Self-medication in animals remains a field with endless unexplored avenues. The highly debated subject prompts questions such as "Do animals really know how to cure their own ailments?" and "How did this behavior begin?" Washington University biologist Jane Phillips-Conroy, who studied self-medication in baboons, says, "Just because a monkey eats a particular plant doesn't mean he knows it's medicinal. We need more definitive studies like those of Huffman, with actual proof that particular plants are effective against particular illnesses."

Scientists agree that understanding the process of self-medication in animals has many important implications for humans. Huffman emphasizes the tangible benefits and need for conserving the habitats in which medicinal plants flourish along with the animals that use them. "Some are interested in just finding new patentable chemical compounds [for use in human medicines], but that's only one part of it," he comments. "These animals

live in an environment where they're faced every season with the threat of reinfection by parasites. They may have found ways to control these infections without creating resistance to the chemicals or other means they use, and we have much to learn about how they do this."

Further exploration in the field of zoopharmacognosy would teach us more about behavior, botany, and medicine, all areas in which we may apply our knowledge to benefit future generations--but without wildlife or habitats, there will be little to study. According to Huffman, "With growing chemoresistance to the Western world's current arsenal of antibiotics and anthelmintics [antiparasitics], we cannot afford to let that potential source of knowledge disappear."

Go to Mother Nature's Cauldron of Cures for medicinals used today that are derived from plants.