Healing Plants of the Prairie

The Niobrara River Breaks in Sioux County.

By Gerry Steinauer, Botanist

On a hot July afternoon in 2010, five members of the University of Kansas (KU) Native Medicinal Plant Research Program scoured the rugged Niobrara River Breaks in Nebraska's Sioux County. They clipped and bagged the stems of silver-leaf scurf pea, prairie sagewort and other sought-after plants. In the riverbottom they dug the deep, sprawling roots of wild licorice from the sunbaked soil. In the KU medicinal chemistry lab this plant material would later be subjected to high-tech analysis in search of valuable medicinal compounds – an effort that continues a millennia-long tradition of Great Plains inhabitants seeking healing compounds from prairie plants.

Native American Healing Traditions

Prior to Euroamerican settlement, Plains Indians (and all other New World peoples) depended on native plants for medicine – knowledge of the healing powers of plants was critical to their survival. In 1932, anthropologist Ales Hrdlicka wrote in *Disease, Medicine and Surgery among the American Aborigines*: "In every tribe the older women and men knew scores of herbs … They knew poisons, emetics, cathartics, antifebriles, tonics, narcotics and hemostatics, cleansing solutions, healing gums, and powders. They had antidotes. They employed massage, pressure, scarification, cauterization, bandaging, splints, sucking, enemas, cutting, scraping and suturing."

Though most Native Americans knew commonly used plants, only highly trained medicine men and women possessed specific knowledge of the many other medicinal plants and their uses. This wisdom developed over thousands of years of trial-and-error use of plants as medicine – some healing traditions may have arrived with the original aboriginal immigrants from Asia some 13,000 years ago. The Pawnees, for example, burned the stems of yarrow and leadplant as short punks on rheumatic joints to relieve pain. Known as moxa, this practice is commonly used in Asian medicine today, which suggests it originated there.

Knowledge of medicinal plants and healing methods was passed down orally from generation to generation of Native Americans. Elders took young disciples afield, teaching them the characteristics and habitats of specific plants, the proper time of harvest, and methods of preservation, preparation and use. The lessons were precise, as many plants ingested as medicine contained toxins. Locoweeds and some milkvetches, for example, contain potentially toxic alkaloids and selenium, which could be deadly if the remedies were not properly prepared or the correct dosage used. Native Americans' knowledge of herbal medicines perhaps equaled or even surpassed that of modern man's expertise with natural drugs.

The arrival of Euroamericans on the Plains in the mid-1800s brought foreign diseases, war and displacement to reservations. As our aboriginal populations crashed and their cultures crumbled, a wealth of medicinal plant knowledge was lost. In the late 19th and early 20th centuries, ethnobotanists (those who study a people's traditional knowledge and customs of plant use) strove to document the remaining knowledge before "the death of all the old people who alone possess it."

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Nebraska ethnobotanist, Melvin R. Gilmore, pictured in 1907 with an Omaha tribe member and children at an archeological summer camp.

PHOTO BY KANSAS BIOLOGICAL SURVEY

Hillary Loring (left), Quinn Long, Kirsten Bosnak and Kelly Kindscher of the University of Kansas Native Medicinal Plant Research Program hold the excavated root of wild licorice dug from a meadow in the Niobrara River Valley in Sioux County.

Early Ethnobotany

In his classic 1919 book *Uses of Plants by the Indians of the Missouri River Region,* ethnobotanist Melvin R. Gilmore described the medicinal, food and utilitarian uses of nearly 150 native plants by the Ponca, Omaha, Pawnee, Winnebago and Sioux tribes. A Valley, Nebraska, native, Gilmore earned his doctorate in botany from the University of Nebraska in 1919 at the age of 46. For his book, an outcome of his graduate work, he interviewed native elders who had gathered and used plants when the tribes still roamed the unsettled plains, and who still remembered their "old names, uses, and symbolism."

Gilmore described how the tribes used the macerated root of purple coneflower (*Echinacea angustifolia*), a prairie wildflower found nearly statewide, as an antidote for snakebite and other venomous bites and stings. To ease toothache, a piece of macerated root was placed on the painful tooth – the root contains a novocaine-like substance that has numbing effects. Gilmore reported that a Winnebago "often used the plant to make his mouth insensible to heat, so that for show he could take a live coal into his mouth." Purple coneflower was also used in a smoke treatment for headaches in people and for distemper in horses.

A Ponca informed Gilmore that thyme-leaf spurge (*Euphorbia serpyllifolia*), a small, sprawling annual of sandy soils, "was boiled and the decoction drunk by young mothers whose flow of milk was scanty or lacking, in order to remedy that condition." This may be an example of the "belief in signs," where characteristics of a plant reveal its potential medical use – spurges have a white, latex-like sap and therefore were thought suitable for nursing mothers in need of increased milk production. Of thyme-leaf spurge, Gilmore wrote: "An Omaha informant said it was used as a remedy in case of dysentery and abdominal bloating in children. For this purpose the leaves of the plant were dried and pulverized and applied after first cross-hatching the skin with the head of a certain plant. Then the pulverized leaves were rubbed by hand on the abraded surface. It was said to cause a painful, smarting

PHOTO BY MICHAEL FORSBERG

Purple prairie coneflower growing at Spring Creek Prairie in Lancaster County. Extract from the plant was the key ingredient in Meyer's Blood Purifier, and compounds from the plant are now used in modern medicines.

sensation and to act powerfully upon the bowels through the intervening tissues and to give relief."

Of butterfly milkweed (*Asclepias tuberosa*), a now uncommon wildflower in tallgrass prairies and open woodlands in eastern Nebraska, Gilmore penned: "The root was eaten raw for bronchial and pulmonary trouble. It was also chewed and put into wounds, or pulverized when dry and blown into wounds. It was applied as a remedy for old, obstinate sores. In the Omaha tribe the ceremonials connected with the digging, preparation, consecration, and distribution [of the plant's roots for medicine] occupied four days."

Spirituality was integral to Native American healing, and medicine men and women often used ritual, song, drumming and prayer, in addition to plants, to heal. They believed the spirit healed the individual, and the plant was the vehicle through which it worked. For known conditions, such as fevers, congestion and stomach ailments, healers used specific plants for a variety of preparations. For unknown diseases, perhaps cancers, they often relied entirely on the spirit for healing. Modern science is discovering that many plants used by Indians in medicines contain medicinally active compounds, potentially explaining their healing powers. The healing power of other Native American medicinal plants remains suspect; perhaps some medicines were effective placebos.

Purple Coneflower

Unfortunately, little of the medicinal plant knowledge possessed by Native Americans was passed on to early white settlers, as most Indians had been isolated to reservations at the time of settlement, and the greatly differing spiritual views that underlay the health systems of the two groups made exchange and acceptance of native healing traditions difficult. The few plants that white settlers used to treat ailments tended to be from outside the region or were cultivated plants; they also relied heavily on non-plant remedies. Purple coneflower was one of the few Native American medicinal plants adopted for use by Plains settlers.

Purple coneflower remained little more than a folk remedy until 1871, when patent medicine salesman H.C.F. Meyer of Pawnee City included coneflower extract in a tonic called "Meyer's Blood Purifier." He boasted that his secret purifier had "cured 613 cases of rattlesnake bite in men and animals." The purifier's label professed: "This is a powerful drug as an alternative and Antiseptic in all tumorous and Syphilitic indications; old chronic wounds, such as fever sores, old ulcers, Carbuncles, Piles, eczema, wet or dry, can be cured quick and active … It will not fail in Gangrene … It relieves pain, swelling and inflammation, by local use, internal and external."

Seeking an endorsement for his purifier, Meyer sent a sample to Dr. John King, a prominent doctor in Cincinnati, and John Uri Lloyd, a professor at the Eclectic Medical Institute and co-founder of Lloyd Brothers Pharmacists, a leading drug company based in Cincinnati. To demonstrate his product's potency, Meyer offered to bring a rattlesnake to Cincinnati and have it bite him in the presence of Lloyd. Lloyd declined the invitation and dismissed Meyer, having serious doubts about the purifier's professed healing powers. King, however, later convinced Lloyd Brothers to put an *Echinacea* tincture on the market. Part of King's confidence in *Echinacea* stemmed from the fact that it was the only drug that gave his wife relief from the pain and discharge of her ovarian cancer.

In 1917, Lloyd wrote that the *Echinacea* tincture was a "therapeutic favorite with many thousand American physicians, and which is consumed in larger quantities today than any other American drug introduced during the past thirty years." Apparently the tincture was most effective when the ground root was mixed with four parts alcohol to one part water.

During the 1920s, however, the use of *Echinacea* fell into decline. This was a time of discord between doctors who favored the new lab-synthesized drugs and those who favored herbal remedies. The herbalists were losing. With World War II came the development of modern antibiotics, which was a near deathblow for the use of *Echinacea* as a medicine.

The herbal revival of the 1970s, however, brought about a rebirth of *Echinacea's* popularity, both as a botanical antibiotic and immune system stimulant. The first modern scientific research into *Echinacea's* medicinal properties began in the 1950s and continues today. Much of this research has been conducted in Germany, a country with considerable scientific interest in medicinal plants and with liberal laws concerning their use. Pale purple coneflower (*E. pallida*) and eastern purple coneflower (*E. purpurea*), species common to the south and east of Nebraska, have also been subjects of investigation.

The research indicates the *Echinaceas* have active medicinal components, including compounds with mild antibiotic activity against the disease-causing *Streptococcus* and *Staphyloccus aureus* bacteria. A pentane-extracted oil from purple and pale purple coneflower roots inhibits Walker carcinosarcoma and a type of lymphocytic leukemia. Highly active polysaccharide molecules from purple and eastern purple coneflowers stimulate the immune system, while other coneflower extracts have anti-inflammatory properties. Purple coneflower plants also contain compounds with potential as insecticides, one compound being toxic to mosquitos and house flies. Today, coneflower roots are still widely used in herbal remedies, the plants being commercially grown or harvested from prairies.

PHOTO BY QUINN LONG, KANSAS BIOLOGICAL SURVEY

The wild tomatillo, which grows nearly statewide in Nebraska prairies and disturbed sites, contains steroids with known antimicrobial, antitumor and anti-inflammatory properties.

PHOTO BY MICHAEL FORSBERG

Native Americans commonly used butterfly milkweed, a now uncommon wildflower in eastern Nebraska prairies and open woodlands, as a medicinal plant.

Modern Ethnobotany

Kelly Kindscher is one of the Great Plains' few ethnobotanists. A native of Newton, Kansas, Kindscher spent much of his childhood summers in Nebraska on his family's farm along the Republican River in Webster County. Here, in bluff prairies and wooded bottoms, Kindscher's father, a teacher by trade, taught young Kelly about native plants. He can still recall the first plant name he learned – Carolina anemone. His childhood interest in plants persisted and evolved to include ethnobotany. Kindscher later studied botany at the University of Kansas, earning a Ph.D. in 1991. For his 1992 book *Medicinal Wild Plants of the Prairie: An Ethnobotanical Guide*, Kindscher reviewed the writings of early Plains ethnobotanists and interviewed Lakota medicine men and women on the Rosebud Reservation in South Dakota who still used medicinal plants in traditional healing.

Kindscher is now a senior scientist with the Kansas Biological Survey, professor in environmental studies, as well as co-leader of the KU Native Medicinal Plant Research Program, a joint effort between KU's Department of Medicinal Chemistry and the Kansas Biological Survey. Founded in 2009, its goal is to identify medicinal compounds in Great Plains plants for use in natural remedies, foods, pharmaceuticals and veterinary products.

Since 2010, Kindscher and other program staff have undertaken plant collecting expeditions across the Great Plains from Montana to Texas, including the 2010 trip to Sioux County and excursions to the Sandhills in Thomas County and to Thurston County (where the Omaha Indian Reservation is located). Believing that plant species previously used by Native Americans are good leads for containing compounds useful in modern medicines, program leaders are choosing to concentrate their collecting and testing on those species.

> "By educating people about native plants and their uses, I hope they will learn to appreciate their values and work to conserve them."
>
> – Kelly Kindscher

All plant species produce numerous chemical compounds; the most abundant, called primary compounds, help plants grow and reproduce. Plants also produce secondary compounds, so called because they occur in minute amounts and were once thought by science to have no function. Secondary compounds, however, have recently been found to have many functions, primarily protecting plants from environmental stressors. For instance, some secondary compounds screen out damaging ultraviolet rays, others are toxic or distasteful and dissuade browsing mammals and foraging insects, while still others fight disease-causing bacteria and fungi. Because they promote plant survival, many secondary compounds are designed to affect the cells, tissues, and physiological function in competing microorganisms, plants and animals. Some exert their action in ways similar to human hormones, neurotransmitters and other compounds and thus have potential medicinal value for humans. Secondary plant compounds, or the molecules modeled after them, are the source of 25 percent of the prescription drugs used in the United States today.

Plants of the semi-arid western Plains are adapted to climatic extremes and intense grazing and therefore thought to contain more secondary compounds than plants of the wetter, eastern Plains. Western prairies, therefore, are a prime collecting area for Kindscher.

"We collect whatever plant parts the Native Americans used, whether it be the roots, stems, leaves, flowers or all parts," said Kindscher. "We also try to collect the same species from several locations, as populations may differ genetically and contain unique secondary compounds. At some locations, we also collect the same species during different seasons as growing conditions may affect the presence or quantity of potential medicinal compounds." The group harvests about 20 pounds of fresh plant material of each species at each location. Once dried, this will provide the two pounds of material needed for chemical analysis.

PHOTO BY DAVID MCKINNEY/KU MARKETING COMMUNICATIONS

In the University of Kansas High Throughput Screening Laboratory, Peter McDonald, Ph.D., uses a signal detection instrument to screen hundreds of plant extracts for antioxidant activity.

PHOTO BY HILLARY LORING, KANSAS BIOLOGICAL SURVEY

University of Kansas Native Medicinal Plant Research Program staff spread collected plant material on the floor of a Sioux County barn to begin the drying process.

At KU's medicinal chemistry lab, chemists first grind the plant material to the consistency of dried oregano, then add solvents to break down the material into a thick liquid. They use complex techniques, such as liquid-liquid partition and reverse-phase chromatography, to isolate and then identify individual compounds from the liquid. Promising compounds, such as potential antioxidants or anti-cancer agents, are further tested.

Great Plains prairie plants likely contain many medicinal compounds waiting for discovery, but is the intense effort needed to find these compounds justified? Why not just create new compounds in the lab? Though chemists can artificially synthesize millions of compounds in the lab, most do not interact well with biological systems and therefore have limited medical value. Chemists also struggle to lab-synthesize the medicinally active compounds found in plants. Morphine, for example, cannot be created in the lab and must be derived from the opium poppy. When chemists can synthesize botanical compounds, it is often in minute quantities and more expensive than procuring the compounds directly from the plants that naturally manufacture them.

A high point of the KU medicinal plant program's recent efforts includes the discovery of 14 previously unknown medicinal compounds (called withanolides) in the wild tomatillo or common ground-cherry (*Physalis longifolia*)." A member of the nightshade family, along with tomatoes and potatoes, the wild tomatillo grows nearly statewide in Nebraska prairies and disturbed sites. Withanolides are steroids with previously known antimicrobial, antitumor and anti-inflammatory properties. In tests on mice, the newly-discovered withanolides shrank, and in some cases completely dissolved, aggressive cancers without side effects or toxicity to normal cells (in high concentrations many plant compounds will kill cancer cells, but if they also kill healthy human cells they cannot be used as treatments). The Kansas group also recently discovered promising anti-cancer agents in several species of Plains milkweed.

Kindscher's goals for the medicinal plant program go beyond the practical application of new medicinal compounds. He hopes to honor the traditional knowledge of Native Americans and to conserve native plants. Over much of the Great Plains, native landscapes – and the plants they support – are fast disappearing," he said. "By educating people about native plants and their uses, I hope to encourage them to appreciate the value of these plants and work to conserve them." ■

Much of the material for this article came from Kelly Kindscher's book *Medicinal Wild Plants of the Prairie: An Ethnobotanical Guide* and other articles by Kindscher.