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Ethnobotany of Purple Coneflower (*Echinacea angustifolia*, Asteraceae) and Other *Echinacea* Species¹

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The purple coneflower, *Echinacea angustifolia*, was the most widely used medicinal plant of the Plains Indians. It was used for a variety of ailments, including toothache, coughs, colds, sore throats, snakebite, and as a painkiller. H. C. F. Meyer used it as a patent medicine in the 1870s and introduced it to the medical profession. Recent scientific research (mostly German) on *Echinacea* species has shown that they possess immunostimulatory activity. Increased cultivation of *E. purpurea* and *E. angustifolia* may be needed to meet the increased demand for its roots and to alleviate the effects of overharvesting of wild stands.

La etnobotánica de la *Echinacea angustifolia* (Asteraceae) y los otros *Echinacea* especies. *Echinacea angustifolia* fué la planta medicinal más usada de los indios de la pradera norteamericana. Se usó para curar una variedad de enfermedades, incluso el dolor de muelas, el dolor de garganta, la mordedura de serpiente, y como un quita dolores. H. C. F. Meyer la usó como una medicina patentada en los años 1870 y se la introdujo a la profesión de medicina. Recientes investigaciones científicas (la mayoría en Alemania) sobre las especies de *Echinacea* han demostrado que éstas posean un efecto estimulante en el sistema de inmunidad. Es posible que sea necesario más y más cultivo de *E. purpurea* y *E. angustifolia* para satisfacer la demanda creciente de las raíces y para mitigar los efectos de la recolección de las poblaciones silvestres.

The purple coneflower, *Echinacea angustifolia*, has a large number of common names reflecting its use and appearance. These names, given in the approximate order from most to least common, are: purple coneflower, echinacea, snakeroot, Kansas snakeroot, black sampson, narrow-leaved purple coneflower, scurvy root, Indian head, comb flower, niggerhead, black susans, and hedgehog. These last five names refer to the seed head, which is round, black, and spiny. Due to the shape of its seedhead, the 18th century German botanist Conrad Moench named the genus *Echinacea*. This name, from the Greek "echinos" (hedgehog), refers to the spiny, rounded seedhead, similar to a hedgehog or sea urchin. The species name *angustifolia* means narrow leaved. In some of the older literature, the names *Rudbeckia* and *Brauneria* were used for this genus instead of *Echinacea*.

DESCRIPTION

Echinacea angustifolia is a perennial with one to several stems 1–6 dm tall, with stiff bristly hairs. Leaves are alternate, oblong to lance-shaped, 5–30 cm long, with three to five nerves running down the length of the blade. Flower heads are at the end of branches and evident from June to July. Ray flowers are spreading, 2–4 cm long, 5–8 mm wide, and light pink to purple. *Echinacea pallida* is similar,

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although it is stouter and taller, to 10 dm tall, and has longer (4–9 cm), narrower ray flowers that droop. *Echinacea purpurea* has a distinctive appearance, with larger ovate leaves. For a treatment of all *Echinacea* species, see McGregor (1968).

Echinacea angustifolia is found on dry upland prairies that are often rocky. Its distribution is primarily in the Great Plains: east of the Rocky Mountains from Texas to Montana and Saskatchewan, to eastern Oklahoma, western Iowa and western Minnesota. *Echinacea pallida* occurs on rocky open sites from northeast Texas to southwest Wisconsin (mostly on prairies east of the range of *E. angustifolia*). *Echinacea purpurea* is found in rocky open woods and prairies eastward from northeast Texas, Missouri, and Michigan (Great Plains Flora Association 1986).

INDIAN NAMES

The numerous Indian names tell of the importance and uses of the plant. The Omaha and Ponca name for the purple coneflower is *mika-hi* (comb plant)—the seed head was sometimes used to comb their hair (Gilmore 1977). They also call it *inshtogahte-hi*, referring to the use of the plant as an eyewash (*inshta*, eye). The Pawnee name is *ksapitahako* (hand, to whirl), referring “to its use by children in play when they take two stalks of it and whirl one round the other, the two stalks touching by the two heads” (Gilmore 1977). They also call it *saparidu hahts* (mushroom medicine) because its seed head is similar in shape to a mushroom (Gilmore 1977). When found growing in the hills, the Lakota (Sioux) name is *ica'hpe hu* (something used to knock something down) (Rogers 1980). When growing in lower places, it is called *on'glakcapi* (something to comb the hair with).

INDIAN USE

The ethnobotanist Melvin Gilmore reported in 1917 that the macerated root of the purple coneflower was “used as an antidote for snake bite and other venomous bites and stings and poisonous conditions” by all the Indians of the Upper Missouri River region (Gilmore 1977). In addition, these Indians and others used the purple coneflower “for more ailments than any other plant” (Gilmore 1913a).

The Dakota (Sioux) used the freshly scraped root as a remedy for hydrophobia (rabies), snakebite, and situations where a wound had putrefied (Smith 1928). The Dakota applied the root (probably ground up) to areas of inflammation to relieve the sensation of burning by its “feeling of coolness” (Gilmore 1913b). The Lakota (Sioux) used the root and green fruit as a painkilling remedy for toothaches, tonsillitis, bellyache, pain in the bowels, or when one was thirsty or perspiring (Munson 1981; Rogers 1980). On a visit to the Rosebud Reservation in South Dakota during summer 1987, I learned that the purple coneflower is still widely harvested by the Lakota for a variety of medicinal uses.

The Omaha recognized two kinds of purple coneflower: *nuga* (male—being larger and having other masculine characteristics), and *miga* (female—being smaller and a more efficient medicine) (Gilmore 1913a). The Omaha used it for sore eyes, and medicine men applied the macerated root as a local anesthetic to deaden sensation so that they could remove pieces of meat from a boiling pot without flinching to show their ability to perform supernatural feats (Gilmore 1913a). A Winnebago medicine man also used it to make his mouth insensible to heat so

that he could take a live coal into his mouth to demonstrate his power (Gilmore 1977). Both of these feats helped to create confidence in the man's ability to heal.

The Kiowa have used the purple coneflower root as a cough medicine since ancient times; and in the 1930s, they still used the dried seedhead as a comb and brush (Vestal and Schultes 1939). The Kiowa and the Cheyenne (Grinnell 1962) treated colds and sore throats by chewing a piece of the unground purple coneflower root and letting the saliva run down the throat.

The Cheyenne also used the purple coneflower as a remedy for sore mouth and gums (Grinnell 1962). They made a tea from the leaves and roots. This liquid was also rubbed on a sore neck to relieve pain. Toothache, caused by a hollow tooth, was relieved by letting this liquid come in contact with the tooth (Grinnell 1962). The root was chewed to stimulate the flow of saliva, which was especially useful for sun dance participants as a thirst preventative (Hart 1981). The Cheyenne also drank a purple coneflower tea for rheumatism, arthritis, mumps, and measles. A purple coneflower salve was made for external use in treating these ailments. When the roots were mixed with blazing star (*Mentzelia laevicaulis*) and boiled, the resultant tea was drunk for smallpox. When purple coneflower roots were mixed with puffball spores (*Lycoperdon*) and skunk oil, they were used in the treatment of boils (Hart 1981).

Other tribes who lived in the Prairie Bioregion (the Great Plains and the Tall-grass Prairie region to the east) and used the native purple coneflower were the Crow, Hidatsa, Comanche, and Pawnee. The Crow chewed the root for colds and drank a tea prepared from the root for colic (Hart 1976). Hidatsa warriors were known to chew small pieces of the root as a stimulant when traveling all night (Nickel 1974). The Comanche used the root for treating sore throat and toothache (Carlson and Jones 1939). The Pawnee also used the root medicinally (Gilmore 1977); roots excavated from one of their earth lodge villages (the Hill site, located near Guide Rock, Nebraska, and occupied around 1800) were identified by Melvin Gilmore at the University of Michigan Ethnobotanical Laboratory (Wedel 1936).

Outside the Great Plains, the Fox used it (probably *E. pallida*, rather than *E. angustifolia*) as part of a medicinal cure for stomach cramps, along with the roots of wild-ginger (*Asarum canadense*), flowering spurge (*Euphorbia corollata*), and beebalm (*Monarda punctata*) (Smith 1928). Also, an Indian from Mexico who served as a translator for Melvin Gilmore when he was interviewing the Oglala Dakota on the Pine Ridge Reservation in South Dakota in 1912 told that the purple coneflower was used by his people for snake bites (Gilmore 1913b). The native distribution of purple coneflower does not extend into Mexico. Its use in Mexico may indicate a history of trade for this root between tribes of the southern portion of the Prairie Bioregion and Mexico. Also several tribes, such as the Apache, Kickapoo, and Potawatomi, retreated into Mexico in the 19th century and may have taken it. Or it may be a reference to the use of *Iostephane heterophylla*, a closely related species found in Mexico.

ANGLO FOLK USE

While used extensively by Indians as a medicine, the purple coneflower was not quickly adopted by white physicians. These physicians already had a wide array of American woodland, European, and exotic medicinal plants for their use.

The relationship to the native peoples was for the most part antagonistic and hostile and not conducive to the exchange of information concerning medicinal plant substances. Consequently, medicinal plants of the prairie were never widely studied. The purple coneflower was the only native prairie plant popularized as a medicine, and this did not happen quickly.

Dr. Ferdinand V. Hayden was one of the first physicians to mention the use of *E. angustifolia*. In his 1859 "Botany Report to the Secretary of War" on the Upper Missouri River region, he stated that the root (incorrectly identified as *E. purpurea*) was found abundantly throughout the country and was pungent and used very effectively by the traders and Indians for the cure of rattlesnake bite (Hayden 1859).

The taste of purple coneflower root is unique. Curtis Gates Lloyd of Lloyd Brothers Pharmacy Inc. described the taste of *E. angustifolia*: "Upon chewing the root of prime echinacea, a sweetish taste becomes first apparent, which on prolonged chewing is followed by an acrid, tingling sensation that remains long upon the tongue" (Lloyd 1917).

Dr. J. S. Leachman of Sharon, Oklahoma, in a 1914 issue of the *Gleaner*, reported the uses of the purple coneflower root by the early settlers in Oklahoma: "Old settlers all believe firmly in the virtues of Echinacea root, and use it as an aid in nearly every kind of sickness. If a cow or a horse does not eat well, the people administer Echinacea, cut up and put in the feed. I have noticed that puny stock treated in this manner soon begin to thrive" (Lloyd 1917).

MEDICAL HISTORY

H. C. F. Meyer of Pawnee City, Nebraska, discovered the usefulness of the purple coneflower, *E. angustifolia*, in 1871, probably learning about its medicinal qualities from Indians or early settlers (Lloyd 1904). Meyer was a patent medicine salesman, and he marketed purple coneflower tincture as part of a secret remedy called "Meyer's Blood Purifier" (Foster 1985). Meyer sent samples of his medicine and the unknown western root to Dr. John King and John Uri Lloyd, both of Cincinnati, for identification and endorsement. He hoped that this would make his product known to more people and would increase his patent medicine sales.

Dr. John King was a prominent medical practitioner and author of the 1852 *American eclectic dispensatory*. John Uri Lloyd was a pharmacist and founder of Lloyd Brothers Pharmacists, Inc., a manufacturing firm specializing in American medicinal plants (Foster 1985). King was unwilling to endorse a secret formula that did not even list its ingredients on the label. Lloyd informed Meyer that he would need the whole plant for identification and that his company could only introduce a new drug under its botanical name.

Meyer sent the whole dried plant to Lloyd; it was identified by Curtis Gates Lloyd as *E. angustifolia* (Lloyd 1917). Meyer made exaggerated claims for his medicine. After its identification he made a new label for his patent medicine (Lloyd 1917):

ECHINACEA ANGUSTEFOLIA [sic]

This is a powerful drug as an alterative 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; also Erysipelas. It will not fail in Gangrene. In fever it is a

specific; typhoid can be adverted in two to three days; also in Malaria, Malignant, Remittent and Mountain fever it is a specific. It relieves pain, swelling and inflammation, by local use, internal and external. It has not and will not fail to cure Diphtheria quick. It cures bites from the bee to the rattlesnake, it is a Specific. Has been tested in more than fifty cases of mad dog bites in human and in every case it prevented hydrophobia. It has cured hydrophobia. It is perfectly harmless, internal and external. Dose.—One half to one fluid-drachm 3 or 4 times a day. Manufactured by H. C. F. Meyer, M.D.

Patent

Pawnee City, Neb., U. S. A.

Meyer additionally claimed that "in 613 cases of rattlesnake bites with men and animals, prompt cures have been made" (Meyer 1887). Lloyd wrote that Meyer offered to "come to Cincinnati and in the presence of a committee selected by ourselves, allow a rattlesnake of our selection to bite him wherever we might prefer the wound to be inflicted, proposing then to antidote the poison by means of Echinacea only. This offer (or rather, challenge) we declined" (Lloyd 1917).

Dr. King introduced *E. angustifolia* to the medical profession while stating that Meyer "entertains a very exalted idea of his discovery, which certainly merits a careful investigation by our practitioners . . . and should it be found to contain only one-half the virtues he attributes to it, it will form an important addition to our *materia medica*" (Meyer 1887). Dr. King did have confidence in the drug, owing in part to it being the only substance that would give his wife relief from her "virulent cancer" (Lloyd 1917).

Lloyd was skeptical of Meyer's claims and hesitant to introduce the drug. It was not until several years afterward that King convinced the Lloyd brothers to put an echinacea tincture on the market for its therapeutic value. At this time they were also receiving considerable demands for the tincture by physicians. This demand increased greatly. Lloyd claimed in 1917 that it is a "therapeutic favorite with many thousand American physicians, and which is consumed in larger quantities to-day than any other American drug introduced during the past thirty years" (Lloyd 1917). It was determined that the best results occurred when the tincture of the ground root was made with a menstruum of four volumes alcohol to one volume water (Beringer 1911). The best roots were believed to come from "the prairie lands of Kansas and Nebraska" (Felter 1898).

Interest in the purple coneflower as a native medicinal plant resulted in Boyce and Kirkland isolating the volatile oil in purple coneflower roots in the pharmacy laboratory at the University of Kansas in 1898 (Woods 1930). The oil had the odor and taste of the echinacea drug introduced by the Lloyd brothers 11 yr previously.

Many doctors and researchers reported their successful use of the tincture of purple coneflower in treatment of various disorders. Professor H. W. Felter called echinacea "A corrector of the depravation [sic] of the body fluids" (Felter 1898). Not all doctors were convinced of its effectiveness. The Council on Pharmacy and Chemistry, composed of the college educated, "Regular" or traditional physicians, associated Meyer's claims with the college educated Eclectic Physicians (such as King, Lloyd, and Professor Felter). They reprinted Meyer's label and reported in the 1909 *Journal of the American Medical Association* (Council on Pharmacy and Chemistry 1909):

It is worth noticing—although it is not surprising—that these far-reaching claims have been made on no better basis than that of clinical trials by unknown men who have not otherwise achieved any general reputation as acute, discriminating and reliable observers . . . In view of

the lack of scientific scrutiny of the claims made for it, echinacea is deemed unworthy of further consideration until more reliable evidence is presented in its favor.

A study in 1915 found no physiologically-active substances in purple coneflower (Heyl and Hart 1915). In 1920 no evidence was found for it affecting botulism, anthrax, rattlesnake venom, tetanus, septicemia, tuberculosis, or trypanosomiasis (Couch and Giltner 1920). Conclusions from this last experiment, however, were refuted (Beal 1921), and the evidence suggested some benefit of its use on a clinical basis. The purple coneflower, specifically *E. angustifolia*, was used by some pharmacists and it received a quasi-endorsement when it was listed in the National Formulary from 1916 to 1950.

RECENT SCIENTIFIC RESEARCH

Recent scientific research has not justified the extravagant claims of the value of purple coneflower by Meyer, but it has shown the plant to have active medicinal constituents. Much of the research done on the purple coneflower has been done in Germany, where there is greater scientific interest in medicinal plants because more liberal laws govern their commercial availability and use (Tyler 1986). These experiments have not been conducted exclusively on *E. angustifolia*, but also on the similar and closely related *E. pallida* and *E. purpurea*. The first pharmaceutical company's research to attribute physiological activity to the purple coneflower was conducted by the Sandoz Co. and published in Germany in 1950 (Stoll et al. 1950). They found the root to possess a mild antibiotic activity against *Streptococcus* and *Staphylococcus aureus*.

In 1971, a pentane-extracted oil from the root of *E. angustifolia* and *E. pallida* was found to be inhibitory to Walker carcinosarcoma 256 and P-388 lymphocytic leukemia (Voaden and Jacobson 1972). Italian investigators have found the wound healing effects to be attributable to echinacin B (Bonadeo et al. 1971; Tyler 1981). Echinacin B is a polysaccharide that temporarily increases hyaluronic acid. This acid, found in the substance between the cells and connective tissue, acts as a binding and protective agent, increasing connective tissue forming cells called fibroblasts, thus resulting in beneficial wound healing affects.

A purple coneflower product available in Germany in 1978, containing the juice of the fresh aerial parts of *E. purpurea*, was found to make mouse cells 50–80% resistant to influenza, herpes, and vesicular stomatitis viruses (Wacker and Hilbig 1978). Perhaps the most important finding for the genus, so far, is the discovery of large, highly active polysaccharide molecules in both *E. angustifolia* and *E. purpurea* that possess immunostimulating properties (Wagner and Proksch 1985; Wagner et al. 1985). As suggested in a recent review, the substances are effective in the following manner (Moring 1984):

Echinacea stimulates the immune system by binding to carbohydrate receptors on the cell surfaces of T-lymphocytes which in turn induces their nonspecific transformation, production of interferon, and the secretion of other lymphokines. These lymphocytes trigger the activation of phagocytic macrophages and natural killer cells which are responsible for the destruction of bacteria and tumor cells respectively. T-lymphocyte transformation also results in the increase of cytotoxic killing by these cells which search out and destroy virus infected cells. The antiviral activity of Echinacea preparation appears to be directly related to the release of interferon by

T-cells and other undifferentiated parenchymal cells (i.e. fibroblasts). The interferons bind to cell surfaces and stimulate the synthesis of intracellular proteins that block the transcription of viral RNA, and in effect prevent viral infection.

Stimulation of the immune system appears to be highly influenced by dose level. Recent pharmacological studies (Wagner and Proksch 1985; Wagner et al. 1985) indicate that a 10 mg/kg daily dose of the polysaccharide over a 10-d period is effective as an immunostimulant. However, increases in the daily dosage beyond this value resulted in "markedly decreased pharmacological activity" (Wagner and Proksch 1985).

Other research has shown that purple coneflower possesses anti-inflammatory activity and has therapeutic use in urology, gynecology, internal medicine, and dermatology (Harnischfeger and Stolze 1980, as cited in Moring 1984; Wagner and Proksch 1985). In addition, echinacea contains chemical compounds that are highly insecticidal. One compound is toxic to mosquitoes and house flies; another substance, echinolone, disrupts insect development (Hartzell 1947; Jacobson 1954; Voaden and Jacobson 1972). Research is being done in the Horticulture Department of South Dakota State University to identify *Echinacea* germplasm containing the highest level of echinolone to be used as an insecticide on the state's sunflower crop (Foster 1985).

HARVESTING AND CULTIVATION

The purple coneflower has been the most widely and extensively harvested medicinal plant of the Prairie Bioregion by both Indians and whites. Previously there was confusion over which species was being harvested, especially between *E. angustifolia* and *E. pallida*, and sometimes the identification of the prairie species, *E. angustifolia*, has even been confused with the eastern species, *E. purpurea*. This confusion may have resulted in some of the early variation in experimental results.

Recently, German researchers have discovered that imports from the United States of *E. purpurea* have been adulterated with prairie dock (*Parthenium integrifolium*). These results have cast some question on the reliability of previous German research. *Parthenium integrifolium* is commonly called prairie dock, wild quinine, and Missouri snakeroot; this last name might be confused with Kansas snakeroot by herb diggers and buyers. However, both the aboveground portion of the plant and the root of prairie dock can be distinguished from *Echinacea* species. Prairie dock roots were probably harvested as an available and less expensive substitute because they are larger and, when ground, look similar to *Echinacea*. Other adulterants that have been found in *Echinacea* include: eryngo (*Eryngium aquaticum*), round-head lespedeza (*Lespedeza capitata*), sunflower (*Helianthus annuus*), and other substances (Lloyd 1917). Until recently, there has been little quality control of *Echinacea* by herb companies. The incident with *Parthenium* is helping to change this. Rudolph Bauer and others in the Pharmacy Department at the University of Munich have developed a chemical test that identifies the chemical fingerprint of each *Echinacea* species and can tell if a sample has been adulterated (Bauer et al. 1987).

The harvesting pressure on wild stands of purple coneflower has been intense

during times of its greatest popularity. L. E. Sayre of the University of Kansas Pharmacy Department reported in 1897 that "Students during the late summer and early fall months find in it a little profit at twenty-five cents a pound" (Sayre 1897). In 1902 he reported that over 200,000 pounds of the dried root, worth over \$100,000 (with the price rising to 50 cents per pound), were harvested in Kansas (mostly in the northwestern part of the state) (Sayre 1903).

Considering that it takes about eight to ten (or more) dried roots to equal one pound, about 2 million roots were harvested in that year; one can only wonder what effect that had on the current population and distribution of the plant. In 1902 Sayre wrote to Rodney True, who directed the investigations of drug and medical plants at the Department of Agriculture in Washington D.C., "asking that something be done by the government for the protection of this weed against extermination" (Sayre 1903). True suggested that it be cultivated commercially. Apparently the demand for purple coneflower root waned before the purple coneflower was close to extinction and before any cultivation occurred in the region. The plant must be fairly resilient as it is still locally common in some locations.

The demand for the purple coneflower roots for medicinal use seems to have a cycle as unpredictable as the drought cycles in the region. Ronald McGregor of the University of Kansas Botany Department reported that, in 1965, with a sudden research demand for *Echinacea* root, over 25,000 pounds of dried root were harvested that year (McGregor 1968). At that time, *E. pallida* was the species most desired although *E. angustifolia* was acceptable.

Interest in purple coneflower roots again declined, but has risen lately. Steven Foster reported that because of excessive harvesting, purple coneflowers are decreasing along Missouri roadsides (Foster 1985). Due to concern over their demise, it was made illegal in 1987 to harvest the three *Echinacea* species found in Missouri—*E. pallida*, *E. purpurea*, and *E. paradoxa*—on state parkland, highways, state forest lands, and wildlife areas (Berman 1987).

Due to continued German interest, concern for proper identification and loss of wild stands, there is again renewed interest in cultivating the purple coneflower. When it is grown from seed, 3–4 yr are needed for roots to reach harvestable size (Foster 1985). To increase the speed and frequency of seed germination, seeds need to be stratified for 2–4 mo. Seeds should not be planted deeply. Seedlings have little vigor and need to be carefully tended (weeded and watered) for successful establishment. The purple coneflower can also be propagated by crown division.

Yields for cultivated, 3-yr-old *E. purpurea* roots, grown at Trout Lake, Washington, were 1200 pounds per acre (Foster 1985). Yields are unavailable for *E. angustifolia*, but probably would be smaller because of the smaller stature of the plant. Apparently there is no commercial production of purple coneflower within its native range.

The purple coneflower can also be grown for its ornamental value, especially for its showy flowers. There are numerous cultivars of *E. purpurea*, with 'The King' and 'Sombrero' available in the U.S. and a larger number available in Germany (McGregor 1968). The ornamental possibilities of *Echinacea* have not been fully explored. According to McGregor (1968):

Evidence indicated the best possibility for obtaining a new valued cultivar is in the hybrids between *Echinacea purpurea* L. and *E. angustifolia* DC. var. *angustifolia*. These hybrids form

a rather compact, rounded bushy plant about 2 feet in diameter. It is well adapted to grow in full sunlight, tolerates a variety of soil conditions, and has a long flowering period. It is winter hardy and drought resistant, at least in Kansas.

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