What is the evidence for medicinal value of carnivorous plants?

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Introduction

Throughout history, plants have been used for medicinal purposes. Many of the modern allopathic medicines used today are either directly or indirectly derived from plants. Examples include the cardiotonic and antiarrhythmic agent digoxin (derived from the foxglove—*Digitalis purpurea*), antimalarial quinine (derived from the bark of the cinchona tree—*Cinchona officinalis*), the mydriatic (pupil dilatory) agent belladonna (derived from the nightshade *Atropa belladonna*), aspirin (derived from the bark of the willow tree—*Salix alba,* etc.), taxol (derived from the yew tree—*Taxus brevifolia*) and vincristine (derived from the periwinkle—*Catharanthus roseus* (=*Vinca rosea*)). Although carnivorous plants have been used medicinally, to date not a single compound derived from carnivorous plants has been widely-accepted in modern allopathic medicine. *Pinguicula* spp., *Dionaea muscipula*, *Drosera* spp., *Sarracenia purpurea*, and *Nepenthes* spp. are the carnivorous plants frequently touted as having therapeutic potential. We herein review the existing literature on the medical uses of these plants.

Individual Plants

The butterwort (*Pinguicula*) has been used as folk medicine in Scandinavia, where farmers have applied its leaves on open wounds of cattle (Alm 2005); it has been surmised that an antiseptic in the plant helps heal wounds and prevents superinfection (D'Amato 1998). In Norway, *Pinguicula vulgaris* is used to remove lice and to treat ringworms (Alm 2005). In Britain and Ireland, the juice from the leaves of *P. vulgaris* has also been used to treat chapped skin conditions (Allen & Hatfield 2004). In Wales, a "syrup" of *P. vulgaris* was used to induce vomiting or bowel movements. The syrup was also combined with butter to produce an ointment touted to cure "liver obstructions."

Extracts of the Venus flytrap (*Dionaea muscipula*) have been marketed as "Dionaea Tonic" and as "Carnivora" (www.800herbal.com, accessed July 2005). Dionaea Tonic is claimed by the vendors to contain a proteolytic enzyme that dissolves abnormally growing tissue. The commercial sale or production of Carnivora in the USA, which is marketed as an anticarcinogen, is prohibited by the Food and Drug Administration (FDA) (USDA 1992). Carnivora is distributed by a German physician who has sold over 100 other drugs that he claimed, without much evidence, can treat a variety of diseases including heart diseases and multiple sclerosis (USDA 1994). In addition, the drugs are seldom labeled in English despite the intent to target U.S. citizens; all

have received an automatic detention (i.e., are banned) from the FDA. The FDA has gone to great lengths to prohibit the sale of Carnivora in the U.S., including warnings to the doctor, to the German shippers of the drugs, and to promoters of these drugs.

The fact that the sticky secretions of sundews (*Drosera* spp.) do not dry out in the sun has led some to believe that the plant is effective against debilitating diseases (Millspaugh 1974). The round-leafed sundew (*Drosera rotundifolia*) has been touted to treat a number of pulmonary diseases including tuberculosis (Millspaugh 1974). As noted by the 16th century herbalist-physician John Gerarde in American Medicinal Plants: "The later physitians have thought this herbe to be a rare and singular remedie for all those that be in a consumption of the lungs" (Millspaugh 1974). Gerarde asserted that these claims were in fact based on the erroneous conclusion that because sundews are resistant to dessication, this translated to their ability to protect against consumptive diseases. Nevertheless, extracts of the plant have been used in "pulmonary ulcerations," asthma, and to "destroy warts and corns" (Millspaugh 1974). Practitioners of homeopathy have recommended sundew extracts to treat cough from asthma, tuberculosis, and other pulmonary disorders (Millspaugh 1974). In Ireland, extracts of the plant were used as a remedy for asthma and leaves boiled in milk were used for whooping cough (Allen & Hatfield 2004). Research studies indicate that *D. rotundifolia* and *D. madagascariensis* have anti-inflammatory effects (Paper *et al.* 2005). Ethanol extracts and aqueous extracts were tested using the HET-CAM assay (Hen's Egg Test—Chorioallantic Membrane; a test used to measure level of inflammation). Both extracts of *D. rotundifolia* and the ethanol extract of *D. madagascariensis* were found to inhibit inflammation.

Native Americans used the roots of *Sarracenia purpurea* to treat smallpox (Millspaugh 1974). F. H. Bignell claimed that the plant saved his brother from smallpox and left him without the usual scarring (Millspaugh 1974). Dr. John Thomas Lane was skeptical of the drug, which contains an alcohol extract of *Sarracenia* roots. He stated that he lost more than 50% of his patients using the drug (Millspaugh 1974). In reality, there is no evidence to indicate the drug is effective against smallpox. One study found that chloroform extracts of *S. flava* had antitumor activity against lymphocytic leukemia (Miles & Kokpol 1976).

Currently, an extract of *S. purpurea* is the principal ingredient in the drug Sarapin® (High Chemical, Levittown, PA). This extract is produced by distillation of the entire *S. purpurea* plant. Because Sarapin® was introduced prior to the drug laws of the 1960s, it does not have to be reviewed by the FDA unless there is a change in manufacturing, labeling, route of administration, or indications. Although its exact mechanism of action is not known, Sarapin® is claimed to have analgesic properties and to relieve neuralgic pain, sciatic pain, intercostal neuralgia, alcoholic neuritis, occipital neuritis, brachial plexus neuralgia, meralgia paresthetica, lumbar neuralgia, coccydynia, and trigeminal neuralgia (www.sarapin.com). In severe myofascial trigger pain syndrome, injection of a local anesthetic, calcium, and Sarapin® into trigger points was claimed to desensitize and deactivate rapid-firing pain fibers. Sarapin® was the main ingredient used to treat acute frontal cephalalgia (headache caused by dilated cerebral arteries) (McCalla 1995) and omohyoideus myofascial pain syndrome, a chronic pain condition in which there is tenderness of the omohyoideus muscle (a neck muscle) (Rask 1984). To determine the efficacy of Sarapin® in entrapment neuropathy of the foot, 75 patients were randomized to one of three treatment regimens (Rosen 2004). The first group was given a combination of lidocaine, Sarapin®, Vitamin B-12, and dexamethasone phosphate. The second was given lidocaine, Sarapin®, and Vitamin B-12. The third was given lidocaine, bupivocaine, and Vitamin B-12. Although the study concluded that the addition of Sarapin® relieved pain, the study was flawed because proper control conditions were not met. Another study tested the therapeutic value of Sarapin® in lower back pain (Manchikanti *et al*. 2000). In this study, a group of 180 patients was divided into three groups. The first group was treated with local anesthetic. The second group was given the addition of Sarapin® while the third was given a corticosteroid and Sarapin®. Sarapin® was found to relieve pain more than local anesthetic alone. In a study of horses, Sarapin® lacked any anesthetic efficacy in the abaxial sesamoid block model (Harkins *et al*. 1997).

Nepenthes species have several ethnocultural uses in Southeast Asia (personal communications, P. D'Amato). Medicinally, the roots of *Nepenthes* have been used to regulate menstruation and to reduce fever (D'Amato 1998). The sterile fluid of an unopened pitcher is said to relieve

asthma, to have antibacterial properties, and is used as an eyewash and antiseptic (D'Amato 1998).

Antimicrobial effects of carnivorous plants

Many modern and well established antibiotics have originally been isolated from various fungi, higher orders of bacteria, or are synthetic agents modified from the original natural compounds. To the best of our knowledge, there is no antibiotic in allopathic medicine that is derived from plants. The first manufactured antibiotic—penicillin—was isolated from the mold *Penicillium chrysogenum*, and streptomycin, the first effective drug against the causative agent of tuberculosis, was derived from the soil organism *Streptomyces*.

In certain regions of Southeast Asia, the fluid of *Nepenthes* has been used as an antiseptic. People in England, Ireland, and Scandinavia have used *P. vulgaris* extract as an antibiotic on wounds. Despite claims that carnivorous plants have antibacterial properties, apparently only one study has systematically evaluated this assertion Wu (1995, unpublished data). This unpublished and unrefereed investigation concluded that *Drosera*, *Sarracenia*, *Pinguicula*, and *Nepenthes* have efficacy against drug-resistant strains of *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Mycobacterium smegmatis*. Wu (1995, unpublished data) obtained extracts of carnivorous plants using ethanol, methanol, hexane, or water as solvents. He tested the antimicrobial activity of the carnivorous plants by exposing bacteria grown on Mueller-Hinton agar to their extract using the disk diffusion susceptibility method. He found that the extracts of *Nepenthes khasiana* exhibited exceptional antibacterial activity against many of the bacteria tested. Although plumbagin and quercetin are the two compounds said to be the active antimicrobial agents in many carnivorous plants Wu (1995, unpublished data), the concentrations of plumbagin and quercetin in *N. khasiana* did not correlate with its antibacterial effectiveness. Using mass spectroscopy and several chromatographic techniques to separate the plant extracts, a third organic compound, yet to be identified, was considered to be the antibacterial agent of *N. khasiana* Wu (1995, unpublished data).

Other studies have found *Drosera* species to have antimicrobial activities. Ferreira *et al*. (2004) investigated the antimicrobial activity of extracts of Brazilian *Drosera* (*D. communis*, *D. montana* var. *montana*, *D. brevifolia*, *D. villosa* var. *graomogolensis*, and *D. villosa* var. *villosa*) against a number of bacteria. Didry *et al*. (1998) investigated the antimicrobial properties of the tuberous sundew *D. peltata*. and found that a chloroform extract of *D. peltata* exhibited antimicrobial activity, found to be due to plumbagin.

Discussion

Claims and commercialization have been made of the medicinal properties of carnivorous plants. Nearly all are based on anecdotal case reports or testimonies. Companies that manufacture "tonics and tinctures" from carnivorous plants rely on old folk medicine and rumors of the plants' medicinal properties. In short, there are insufficient data to support claims that carnivorous plants have medicinal properties. Only by conducting rigorous, properly controlled studies, can it be definitively established whether they have any therapeutic efficacy with acceptable toxicity. If found to be ineffective, these findings will likely help in the conservation of the dwindling stands by decreasing their unwarranted harvestation. If certain compounds derived from carnivorous plants are found to be promising in *in vitro* studies, then double-blind, randomized, placebo-controlled clinical studies will ultimately be needed to determine their true medical values.

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