GASTRODIA - ARMELLARIA

THE ORCHID

Gastrodia (tianma) refers to the tuber of an orchid, Gastrodia elata. In recent years, virtually all orchids have been placed on the international endangered species list. This is because their natural growth is often limited to relatively rare habitats, and they are considered highly desirable as decorative flowering plants. One can continue to obtain these endangered species, but not from wild stocks; they must be cultivated. In order to purchase orchids and their products (such as tubers used for herbal medicine), it is necessary for buyers to obtain an acceptable certificate that meets the international trade criteria.

Gastrodia grew in East Asia among the mountainous regions from Yunnan in the southwest to northeast China and Korea (mostly growing above 300 meters). It was often used as a food, eaten raw or steamed. Gastrodia is desirable as a food because of its large starchy root with mild flavor; in fact, potatoes, also enjoyed for their starchy tubers (but introduced to China relatively recently), are sometimes produced as fakes for gastrodia. Gastrodia tuber is distinguished from potatoes by having a mild spicy taste and ridges on the surface that are not seen in potatoes. With China’s rapid population growth, this common plant had insufficient wild resources to meet the demand during the 20th century.

Gastrodia was listed in the ancient Shennong Bencao Jing (ca. 100 A.D.) and was later classified by Tao Hongjing as a superior herb, meaning that it could be taken for a long time to protect the health and prolong life (as well as treating illnesses). Gastrodia was originally called chijian, meaning red arrow, because of its red stem shaped like an arrow. Later it was named tianma, or heavenly hemp (ma, usually translated as hemp, refers to many plants that have fibrous stems). The herb material is sometimes referred to as tianmagen, meaning the root (or, in this case, tuber) of tianma.

SYMBIOTIC PLANT-FUNGUS

Gastrodia (tianma) is a very unusual plant. It contains no chlorophyll and has no green color in it. Lacking chlorophyll, it cannot produce its nutrients from sunlight as do most plants. Moreover, it has no roots; in the ground is a rhizome (tuber) that appears sealed shut from the soil environment. How then does it get nourishment and grow?

Gastrodia is entirely dependent on a soil fungus, Armellaria mellea, for its nutrition. This fungus can develop into the fruiting body commonly called “honey mushroom,” but exists in far greater amounts in filamentous forms. When yet another fungus (Mycena osmundicola) invades the seed of gastrodia in the soil, it produces an orchid tuber; with enough input from the Armellaria fungus, which invades this rudimentary component, the underground portion grows and then seasonally sprouts into a luxurious flowering spike. So, in a field of gastrodia, there may be numerous rhizomes unseen in the ground, with only a few sprouting to form the orchid, namely those being adequately infiltrated by Armellaria.

The Armellaria fungus doesn’t seem dependent on the orchid, but feeds on other plants, mainly trees. A portion of the mycelium forms dark-brown to black, shoe-string-like objects called rhizomorphs. They attach to the surface of tree roots, feeding off the tree’s nutrition supplies. These rhizomorphs are capable of growing outward through the soil long distances from infected tree to reach an uninfected tree. They attach themselves onto healthy root systems and begin the process of infection, colonization, and decay, eventually leading to the death of the tree. So, Armellaria is known as a serious patho-
gen for trees. The rhizomorphs that are seen on infected tree roots are the source of one of the names for the disease affecting the trees: shoe-string root rot. Also, the rhizomorphs can extend far enough from forest land to invade adjacent cultivated fields, damaging crops, especially potatoes, which have tubers similar to those of gastrodia. Armellaria does not, however, require live trees and crops, at least, not all the time, as Armellaria mycelium in the soil can live off decaying plant matter and the remains of trees.

A fascinating aspect of the orchid is that it pacifies the appetite of the fungus for trees, thus preserving the uninfected forest trees from attack where the orchid grows. The process by which it inhibits the fungus is not known, but it is expected that substances acting as fungal inhibitors, phytoalexins, are produced by the infected gastrodia rhizomes in quantities sufficient to slow the fungal spread but not damage it. And, while Armellaria destroys trees and potato crops, it doesn’t appear to cause any harm to gastrodia; to the contrary, it feeds it. While it is evident that gastrodia benefits from being parasitized by Armellaria, it is unclear what benefit Armellaria gets from gastrodia.

While Gastrodia elata, the species used in Chinese medicine, produces only tiny flowers, another variety of gastrodia (Gastrodia cunninghamii) produces the well-known decorative “black orchid”, which starts off purplish and then develops light petals forming yellow-brown flowers with dots of purplish-black. The genus Gastrodia is found in warm climates, for example, in Madagascar, tropical Asia, Oceania, Japan, and China. It consists of just 20 species, five of which are found in China, the main one being Gastrodia elata. The various gastrodia orchids grow in high humus soil in, or at the fringe of, broad leaf, coniferous, or mixed forests. The Gastrodia elata plant, when fully developed, consists merely of an underground tuber—like an elongated potato—tapering to one end and covered with brownish cork. Like those of other tubers, the tissues contain reserve food materials (mainly starch), at the expense of which it periodically produces the flowering shoot, bearing small scale leaves and yellowish-brownish flowers of the characteristic orchid type. As it ages, the stalk turns reddish, giving the plant its ancient Chinese name, chijian (red arrow). The Armillaria fungus grows over an even larger geographical area than gastrodia, tolerating colder weather. It forms its mushrooms (sporophores) only after the tree tissues in which it grows have been killed. Thus, one can see live, apparently healthy trees without mushrooms growing on them near the orchids, even though the trees may be parasitized. The tawny, white-gilled mushrooms are common on dead stumps in woodlands and hedgerows, and are collected in Europe for use as a food.

**CHINESE DESCRIPTION OF GASTRODIA AS A FUNGUS**

The discovery that tianma had to grow with a fungus was an important breakthrough achieved by Chinese researchers in Yunnan and Beijing in the 1960s, as part of an analysis of how to cultivate the plant, which had become too rare to meet the demands of herb medicine use. Li Shizhen had noted in the 16th century that: “Tianma is the root of chijian [it is said that Shennong named it chijian based on a terra-cotta color, a brownish-red], it is a parasitic body, of which
the origin is unknown, it seems to be innate (just appears, as if from nowhere), so it was called tian, (the sky; heaven). . . All the rhizomes have minute white hair-like roots packed close to each other, though they aren’t linked up together, actually all of them have ‘qi’ linking them.” These hair-like “roots” are actually the mycelium of the fungus. He also noted that “It has a root like fuling [Poria cocos, a fungus commonly used as an herb material] in the soil, without the root like fuling, the silk-shaped stem is unable to climb upward.” This showed some inkling of a connection to a fungus. Tao Hongjing (425–536 A.D.), suggested that: “Chijian is also type of zhi (fungus). Its stem is like an arrow shaft, red in color, the leaves grow on the top which do not only move in wind, but automatically wave without the blowing of wind.” Su Ching, who wrote the Tang Bencao, stated that, “According to the Baopuzi (a Taoist book by Ge Heng), there is a formula of immortality that includes duyaozhi (which means: a spontaneously waving fungus-plant). The idea that the plant waves automatically is a peculiar one, but the plant doesn’t have leaves at its top. It has small structures that are not really leaves, and do not function as leaves, since they do not need to capture sunlight. The plant may sway, however, with very little air movement, due to its top heavy nature when in flower.

**A LEGEND OF GASTRODIA MAN**

A Chinese legend tells of a gastrodia collector:

A long time ago, there was an old man living in Er Xianyan who made a living by gathering herbs, especially by gathering gastrodia—he was called ‘Gastrodia Man.’ One year, in the Spring, the collecting did not go well. The old man searched the mountain for many days but found nothing; this upset him greatly. Then, he was seized by a sudden impulse: to find a good field and grow gastrodia himself. If he could grow the gastrodia himself, he thought, he wouldn’t need to search the whole mountain, yet possibly turn up nothing, as happened this year. The old man made up his mind, and began to plant the gastrodia seeds. One year later, the gastrodia had not sprouted. He checked the field and found that all the gastrodia he put in was gone. The old man was confused and thought that the gastrodia had been stolen by someone. So, the next year, after seeding, he built a shack and watched the field all day and all night. At the time for harvesting, he figured he would get plenty of gastrodia, but when he dug up the field, he still found nothing. The old man couldn’t help but sigh and figure that gastrodia must be a plant grown only by God. What he said about gastrodia soon spread about and people everywhere said that gastrodia was a gift from God, which could not be traced back to any earthly origin (hence named tian, for its source: from heaven). Since that time, people thought that gastrodia could not be grown by human efforts, so no one tried again to grow gastrodia. This story nicely reflects the difficulty of cultivating gastrodia that has been encountered since ancient times.

**HARVESTING AND PROCESSING OF GASTRODIA IN CHINA**

Gastrodia farmers begin with small tubers harvested previously that were not suitable for use as food and medicine and plant them in ground that is prepared with fungal mycelium and wood chips. The tuber planted in the early winter (e.g., December) is appropriately harvested in the second year, also in the winter time, or in the spring of the third year; while the tuber planted in the spring is better harvested in the winter of the same year or in the spring of the next year. Before harvesting is undertaken, the nurturing fungus wood-materials are first removed, then the tubers are dug out. Both the tubers (called tianma) and the jianma (arrow gastrodia, the tuber with flowering stem) are utilized as raw materials, but any of the small white tubers and the grain-shaped tubers are kept as the seedlings for the next planting. The harvested tubers are processed promptly. After cleaning, the tubers are dumped into boiling water to be cooked according to their size. Those that weigh more than 150 grams (large tubers) are cooked for 10–15 minutes; medium tubers in the range of 100–150 grams are cooked for 7–10 minutes; and those less than 100
grams (the smallest size utilized is about 70 grams) for 5–8 minutes. These cooking times assure that the centers are softened. Then the cooked tubers are fumed with sulfur in a sulfur-fuming house for 20–30 minutes, and then dried by a gentle fire on a warm kang (a heated brick bed) at about 50–60°C. When the tubers are about 70–80% dried, they are flattened by hand, then dried further on the warm kang (at higher temperature, around 70°C) continuously until the tuber is dried completely, and then it is promptly taken off the kang to avoid scorching.

GASTRODIA IN OTHER CULTURES

Gastrodia tubers have been appreciated in many cultures outside China, especially in Australia and New Zealand. The Maori tribe had a special place for gastrodia (called huperei or perei) in their lore. According to Maori tradition the huperei was not a plant of the earth but a creature of supernatural beings and there were many superstitions relating to it. The plant was supposed to understand the Maori language, so those who went to dig the rhizomes used the substitute name maukuuku to ensure that the huperei did not hear its name and disappear, this story imitating the problem faced by "Gastrodia Man." The Woiworung tribe in Australia found the roots to be a special food. Gastrodia elata is found in Tibet, Russia, Korea, Japan, and Taiwan; in all these places it is used as food and medicine. Although it is considered an endangered species, it has a wide growing range and is increasingly cultivated, especially in China. As a food, gastrodia is commonly cooked in soups, especially with chicken or duck, where it may be joined by another unique fungal product, cordyceps, to make a rich tonic. As medicine, it is currently used mainly for treating headache, hypertension, and neurasthenia (weakness-fatigue) and was traditionally used to treat epilepsy and other convulsions.

The roots of Gastrodia sesamoides, the potato orchid, are rich in starch and very nourishing. They were highly prized by the Woiworung in Australia and Maori in New Zealand. The roots are hard to find because the plant has no green leaves. They could be found by watching where bandicoots (small marsupials) scratched for them.

ARMILLARIA AS AN ALTERNATIVE TO GASTRODIA

We now know that Gastrodia has an unusual requirement for growth and survival: it requires a fungus, Mycena osmundicola, to sprout the seeds, and it must have Armillaria mellea mushroom mycelia incorporated into the tuber in order to maintain its maturation and growth. The seeds lack a nutrient coat, thus, they require the assistance of Mycena to draw in nutrients from soil in order to germinate. The underground tubers lack the rootlets that normally gather up nutrients; they rely, instead, on the mycelia of Armillaria to do this. Once these two requirements were understood, cultivation of gastrodia became relatively easy. By the late 1980s, an adequate cultivated supply of gastrodia was developed. Still, the plant grows slowly and the demand has remained high, so it remains one of the more expensive herbs, nearly the cost of cultivated ginseng.

More importantly, the medicinal components of gastrodia were found to be mainly the metabolites of the Armillaria mushroom). In other words, if one could grow the mushroom or just culture its mycelium, the slow growing gastro-
dia tuber could be dispensed with and one could use just the mushroom material or the metabolites released into culture medium to get the desired therapeutic effects. Batch fermentation of Armellaria mycelia was easily accomplished: the mycelia grow well in a simple sugar solution with just a few basic nutrients. The mycelial material was tested in the 1970s, and, as a result of more than 25 years of continual work by many research groups, the mycelia or its culture medium is frequently used instead of cultivated gastrodia. Dozens of investigations have been undertaken to show that the chemical constituents, pharmacology, and clinical effects of Armellaria and its culture medium after growing the mycelia, are indistinguishable from that of the gastrodia tuber.

According to the research results, the main active ingredient of gastrodia is gastrodin, a simple glycoside, comprised of glucose attached to 4-hydroxybenzyl alcohol (HBA); HBA is also a component of gastrodia. Other active ingredients are the aldehyde form of HBA (4-hydroxybenzaldehyde), vanillyl alcohol, and vanillin. The content of these ingredients varies from about 0.3-1.2% of the dried tuber, with an average of about 0.8%.

The gastrodia mushroom, Armellaria (also listed as Armillariella), is known in China as tianma mihuanjun (gastrodia honey mushroom; mihuan means honey). Armellaria is considered an edible mushroom, but is not a highly desired one, so it is not much used and is difficult to find anywhere in the world as a culinary item. Cultivation of it is avoided because the mycelia is a well-known cause of root rot for many plants; it is feared that cultivating it will simply spread around the spores to cause damage in the surrounding area. Therefore, the batch culture is preferred as a means of getting this material.

The New Drug Group of the Chinese Academy of Medical Science in Beijing was the first to review and confirm the value of Armellaria fermentation liquid in comparison to gastrodia. They performed pharmacology experiments showing the same anticonvulsant activity of the two materials. They confirmed reports from other centers that Armellaria fermentation liquid could achieve effects similar to gastrodia: for example, it could alleviate dizziness symptoms caused by various pathological factors (hypertension, insufficient blood supply via the vertebral basal artery, Meniere’s syndrome, vegetative nervous functional disturbance). Since then, numerous other studies have confirmed its value. It is also effective in improving numbed limbs, insomnia, tinnitus, epilepsy, vascular headache, and post-stroke syndrome. Armellaria is more potent gram for gram than gastrodia tuber, and can be used in approximately one-half the dose of the tuber. Armellaria tablet, for example, is given orally in doses of about 3-4 grams/day.
Gastrodia 9 (available as a Seven Forests product,) is a formula for sedating internal wind and resolving phlegm obstruction. The formula uses Armellaria mushroom as a replacement for Gastrodia. It is based on traditional and modern formulas used for the treatment of spasm and pain.

Sample indications are spasms and pain, including trigeminal neuralgia, severe headaches, and Bell’s palsy. In general the formula will be combined with another formula addressing other factors. Contractile disorders are usually painful, so initial therapy may incorporate formulas for alleviating upper body pain such as Angelica 14, Cnidium 9, or Upper Palace Tablets.

Contributors to the symptom may include internal deficiencies such as deficiency of qi and blood that allows wind invasion, or deficiency of yin and blood that induces stirring of internal wind. Some excess factors play a role, such as accumulation of dampness and phlegm due to dietary excesses and/or as a result of weak digestion. Therefore Bamboo 11 may be added if phlegm accumulation is notable.

External factors are mainly cold-damp wind, though traumatic injury or surgery can also cause blockage and, in combination with other internal factors, yield the symptoms. Nourishing the blood and improving the function of the stomach/spleen may be important to attain lasting results, since wind syndromes occur primarily when the vessels are deficient in qi and blood.