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LUO HAN GUO

Sweet Fruit Used as Sugar Substitute and Medicinal Herb

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Luo Han Guo (*luohanguo*) refers to the fruit of *Siraitia grosvenori*, formerly called *Momordica grosvenori*, a member of the Cucurbitaceae (1). The fruit is well-known for its sweet taste; this plant family (Gourd family) has other members that contain remarkable sweet components, including additional species of the genus *Siraitia* (e.g., *S. siamensis*, *S. silomaradjae*, *S. sikkimensis*, *S. africana*, *S. borneensis*, and *S. taiwaniana* 2) and the popular herb *jiaogulan* (*Gynostemma pentaphyllum*). The latter herb, which has both sweet and bitter tasting triterpene glycosides in its leaves, is now sold worldwide as a tea and made into an extract for use in numerous health-care products (3). *Luohanguo* has been used as a medicinal herb for treating cough and sore throat (4) and is popularly considered, in southern China, to be a longevity aid (5). These are the same uses as listed for *jiaogulan*. *Luohanguo* has more recently been developed into a non-caloric sweetener to compete with other herbal sweeteners such as stevioside from the unrelated *Stevia* leaf. (6).

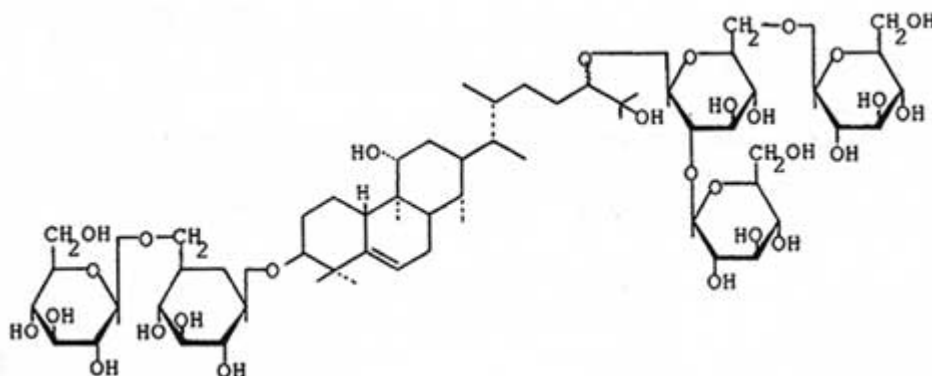


Luohanguo is primarily grown in southern China, mainly in Guangxi Province, with most of the product from the mountains of Guilin. The steep mountains provide shade and they are frequently surrounded by mists that further protect against excessive sun, yet the temperature in this southern province is warm. The wild plant is rare, thus *luohanguo* has been cultivated in the region for many years. There are descriptions of its cultivation in the area dating back to 1813 (5). Guilin now has a 4,000-acre *luohanguo* growing area that produces 10,000 pieces of fruit annually (7). Most of these fields are in Yongfu and Lingui Counties, which are recognized in China as sites having an unusually high number of residents living to an age 100 years or more (8, 9), which some attribute to the consumption of *luohanguo*, as well as the pristine environment. However, the local residents mainly proclaim the benefits of tranquil lifestyle, simple diet, and regular exercise.

Longjiang Town (Dragon River) of Yongfu County was named "Home of Chinese *luohanguo* Fruits." Several factories have been established in this region to produce *luohanguo* extracts and finished products, the oldest being the Yongfu Pharmaceuticals Factory. A carefully prepared visual presentation of *luohanguo* cultivation and its environs is offered by the Dragon River Company, a New York based international company that set-up manufacturing in the town of [Dragon River](#).



Luohanguo is collected as a round green fruit that turns brown upon drying. The sweet taste of *luohanguo* comes primarily from mogrosides, a group of terpene glycosides, present at the level of about 1% of the fleshy part of the fruit (10). Both the fresh and dried fruits are extracted to yield a powder that is 80% or more mogrosides. The mogrosides have been numbered, 1-5, and the main component is called mogroside-5, previously known as esgoside (see chemical structure diagram below). Other, similar compounds from *luohanguo* have been labeled siamenoside and neomogroside. The mixed mogrosides are estimated to be about 300 times as sweet as sugar by weight, so that the 80% extracts are nearly 250 times sweeter than sugar; pure mogrosides 4 and 5 may be 400 times as sweet as sugar by weight.



A process for making a useful sweetener from *luohanguo* was patented in 1995 by Procter and Gamble Company (2). As described in the patent application, the fruit itself, though sweet, has too many additional flavors that would make it unsuitable for widespread use as a sweetener, so P&G developed a method for processing it to eliminate the undesired flavors. The fruit is seldom used fresh anyway, due to the problems of storing it; further, the raw fruit has unattractive flavors and a tendency to easily form off-flavors by fermentation; also, its pectin eventually gels. So, it is common to dry the fruits for any further use, and this is how they appear in Chinese herb shops. The fruits are slowly dried in ovens; the drying process preserves the fruit and removes most of the objectionable flavor of the fresh fruit, which is associated with volatile components. Unfortunately, the drying also causes the formation of bitter, astringent flavors. These flavors limit the use of the dried fruits and dried fruit extracts to the preparation of dilute teas and soups and products to which sugar, honey, and the like are added. In the P&G process, the fresh fruit is picked before ripening and allowed to complete its ripening during storage so that processing begins with the just-ripe fruit. The peel and seeds are then removed, and the mashed fruit becomes the basis of a concentrated fruit juice or puree that can be used in food manufacturing. Further processing involves using solvents to remove volatile and off-flavor components. Numerous sugar substitutes derived from *luohanguo* by similar processes that isolate the sweet compounds are now readily available for manufacturing and for kitchen use.

HISTORY AND TRADITION

During the Tang Dynasty, Guilin was a major Buddhist



retreat area with many temples. The fruit (*guo*, a term used mainly for gourd-like fruits) is named after the *luohan*, which are advanced Buddhist practitioners (see classic painting of some *luohan*, left; in India, they are called arhats) The story told in China is that knowledge of this fruit first emerged from monks who were using it during the 13th Century. Due to its limited natural growing area (mainly mountain sides in Guangxi and Guangdong; to a much lesser extent, in Guizhou, Hunan, Jiangxi, and Hainan Island), and difficulty in cultivating it successfully, this fruit did not enter the general herb tradition of China, which depended on more abundant products. So, it is not mentioned in the traditional herb guides (10).

The herb became more prominent during the 20th century. One early English-language report on it is an unpublished manuscript written in 1938 by Professor G.W. Groff and Hoh Hin Cheung (11). The fruits were reported to be frequently used as the main ingredient in cooling drinks (that is, drinks consumed to counteract hot weather, fever, or disorders described in the tradition as warm or hot in nature). The juice of fresh fruits was known to be very sweet. Groff and Hoh noted that the "*luohan* fruit of commerce, when cooked with pork or steeped with tea, provides a common Chinese household remedy for colds and congestion of the lungs." They confirmed through interviews that the fruit had only become extensively used in China in recent history. Still, it appears that the development of distinct cultivars, and extensive knowledge of its growth, pollination, and climatic requirements implies a fairly long history of cultivation activity by at least a limited group of people.

The herb had been brought to the U.S. early in the 20th century. Groff mentions that during a 1917 visit to the U.S. Department of Agriculture, botanist Frederick Coville showed him *aluohan* fruit obtained from a local Chinese store in Washington, DC.. Seeds from *luohan* fruits purchased in a San Francisco Chinese store were included in the original botanical description of the species in 1941.

The beginning of research into the sweet component of *luohanguo* is attributed to C.H. Lee, who published an English report in 1975 (12), and to Tsunematsu Takemoto working in Japan in the early 1980s (he later turned his attention to studying *jiaogulan* (3). Development of *luohanguo* products in China has grown steadily since that time, particularly with the more recent development of highly concentrated extracts for use as sweeteners.

Probably the best depiction of *luohanguo* medicinal use in southern China during the 20th century is that given by Dai and Liu in their book **Fruit as Medicine** (4), originally published in Chinese in 1982, then published in English in 1986. Here is their description:

Dried fruit may be bought in the city markets. The outer surface of the dried fruit is round and smooth, dusty yellow-brown or dusty green-brown. It is covered with fine, soft hair. The fruit is covered by a hard but thin shell. Inside is a partly dry, flexible substance containing the juice, as well as a large number of seeds. The skin, juicy part, and seeds all have a good sweet flavor. Its nature is cool, and it has no poison. The fruit helps relieve sunstroke, moistens the lungs, eliminates phlegm, stops cough, and promotes bowel movements.

Applications:

1. Heat stroke with thirst: Take one fruit, break it open and stir into boiled water. Drink the liquid in place of tea.
2. Acute or chronic throat inflammation; aphonia. Take half a fruit and 3-5 seeds of *sterculia*. Cover with water and simmer, then swallow very slowly.
3. Chronic cough. Take 1 piece of fruit, cover with water, simmer, and drink the liquid. Do this twice each day.
4. Constipation in the aged. Take 2 pieces of fruit, obtain the juicy part and the seed (put the shell aside for other uses), break apart, cover with water, and simmer. Drink before going to bed.

5. Diabetes. Take an appropriate measure of the fruit and crush it or simmer it into a thick juice and add to food being prepared, using it as a substitute for sugar.



There are several commercial preparations of *luohanguo*. One of the common ones is *Luo Han Guo Chong Ji* (*chongji* is an instant extract granule or dissolving block of extract; the product is shown here, made at the Youngfu Pharmaceutical Factory in Yongfu County of Guilin). It is widely distributed in China, Hong Kong, and via Chinese shops in the West.

Numerous other products are now made with *luohanguo*, alone or, more commonly, with other herbs. Below are some samples of such products in tea form.



The box pictured on the left is one of several products of the Guilin Gexianweng Pharmaceutical Company. This one is *Luohanguo* with ginkgo for cough; another features *luohanguo* with chrysanthemum for heat stroke and headache, and another combines *luohanguo* with asparagus root, oldenlandia, scutellaria, and pearl, as a detoxicant blend. The middle package is a product of the Shantou Great Impression Group, and is made with *luohanguo*, chrysanthemum, and oroxylum extracts added to green tea leaves. The box to the right is by Life Rising, an American company founded by a Chinese immigrant TCM doctor, Guo Zhengang. The *luohanguo* is combined with black tea (with or without licorice root) to make the products.

Recent work on *luohanguo* includes investigation of the antioxidant activity of the mogrosides (13) and their potential use as cancer prevention compounds (14). This suggested effect is based on the understanding that antioxidants can produce significant reversal or suppression of the early stage of cancer development, which has been an area of particular interest for tea drinking (15). Further, *luohanguo* and its sweetening component are often mentioned in relation to diabetes and obesity, because it can substitute for caloric sugars normally consumed in the diet.

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January 2004