

MACA ROOT:

Modern Rediscovery Of An Ancient Andean Fertility Food

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INTRODUCTION

The Maca plant (*Lepidium meyenii* Walpers) has a long history of use as a food and medicine crop in the highlands of Peru. However, in 1982 the International Board for the Protection of Genetic Resources declared Maca to be in danger of extinction as a domesticated plant. Fortunately, due to recent scientific research, Maca is now beginning to flourish again and is increasing in popularity in Peru, Japan, America and Europe as an aphrodisiac and fertility-enhancing food and dietary supplement.

HISTORY

There is anthropological evidence that Maca has been cultivated in Peru as far back as 1600 BC (Anonymous 1989). Maca was considered by the Peruvian Indians as a gift from the gods along with corn and potatoes. Besides being cultivated as a food — the only crop that will flourish at the extreme altitude of the Peruvian puna — Maca was also used with hallucinogenic agents in dances and religious ceremonies (Castro de León 1990). Spanish chroniclers reported that soon after the conquest of Peru the Spanish realized their livestock were reproducing poorly in the extreme highlands (a natural phenomenon). The Indians advised the Spanish to feed their animals Maca, and when they did their livestock's fertility returned to normal. Ironically, the Spanish showed their appreciation by making the Indians pay tribute taxes in Maca roots (Anonymous 1989).

BOTANY

Maca (*Lepidium meyenii* Walpers) is an annual which belongs to the botanical family Brassicaceae (Cruciferae), and is a close relative of the turnip (*Brassica rapa* L.) and the radish (*Raphanus sativus* L.). There are approximately 175 species of *Lepidium* growing worldwide (Mummenhoff et al 1992), with *L. sativum* (AKA garden cress or pepper grass) being the most commonly known in the USA and Europe. Some authors refer to Maca as *L. peruvianum*, but no authoritative botanical organization has recognized this species name.

CULTIVATION AND HARVEST

Maca is cultivated primarily for its tuberous root which is botanically known as a hypocotyl (e.g., radish and turnip are examples of a hypocotyl). Maca plants are unusually tolerant of frost and have the unique ability to grow at the extremely high altitudes of the inhospitable puna ecosystem of Peru's central highlands (3,800 to 4,800 meters). The puna is a beautiful, but stark, ecological zone where little grows except for alpine grasses, bitter potatoes and Maca. Here the air is low in

oxygen, the sunlight is extremely intense, and the temperatures can go from balmy warm during the day to well below freezing at night. Because of extremely high winds ("phuku") the area is treeless and no plants grow taller than a few inches.

Maca planting takes place during September to December. The seeds are broadcast onto the fields and the resulting roots are harvested 6 to 8 months later. The roots are hand dug, freed of leaves, cleaned, and left to dry on tarps in the open sun. During rain and at night the drying roots are covered for protection. It takes about 2 months for the fresh roots to dry,



Maca farmers with Ed Smith in the Andes Mountains of Peru, elevation 14,500 feet.

during which time they lose 75% of their original weight. This slow drying/curing process causes the taste and aroma of the roots to transform from a radish-like pungency to a sweet butterscotch flavor. The dried roots store very well for several years with minimal loss of quality, and the seeds remain viable for 3 to 4 years (Personal communications with Peruvian Maca farmers & dealers 2001, 2003).

Maca crops can exhaust the soil, so after harvest the fields are left fallow for 5 to 10 years to replenish. Naturally occurring manure from grazing sheep, llamas and alpacas serve to fertilize the fields, although some farmers are now adding small amounts of urea to the fields to supplement nitrogen levels. Herbicides are not needed because weeds do not grow in the harsh puna environment (Personal communication with Peruvian Maca farmers 2001, 2003).

Harvest yields are approximately 11,000 kg per hectare in the Junin area, although this can vary greatly. (Personal communication with Guero, President of Asociacion de Productores de Maca 2003). The estimated total harvest in Peru in 2003 is 5,600 metric tons (Anonymous 2003a).

TRADITIONAL FOLK MEDICINE USES

The Quechua Indians of Peru's central highlands consider Maca a highly nutritious food that promotes mental acuity, and physical vitality, endurance, and stamina. It is also well known as an aphrodisiacal tonic that enhances sexual desire and performance, and is especially reputed to increase fertility in male and female humans, as well as domestic animals. Maca is often eaten by Peruvian women who want to get pregnant (Personal communications with Peruvian Maca farmers & dealers 2001, 2003).

Other traditional indications for Maca are anemia, tuberculosis, stomach cancer, memory loss, building strong bones in children, arthritis and rheumatism, respiratory ailments, and alcoholism. It is also valued by Indian women for relief of menopause symptoms. Maca is also given to schoolchildren during exams to assure good test scores (Personal communication with Peruvian Maca farmers & dealers 2001, 2003).



Maca display at the 2003 International Maca Festival in Junin, Peru.

Recently an American herb company (Pure World Botanicals) has received three U.S. Patents on Maca inventions (U.S. Patent nos. 6,552,206; 6,428,824; & 6,267,995), one as a fertility-enhancing agent. This has displeased many Peruvians who feel their traditional knowledge (i.e., intellectual property) has been stolen from them. Some of these people are now in the process of taking legal action to have this Maca patent withdrawn (Anonymous 2003b)

TRADITIONAL AND MODERN METHODS OF PREPARATION

During two Maca expeditions in the central highlands of Peru (2001, 2003) this author has personally observed many Maca products and various ways to prepare Maca foods. The following is a summary of these Maca preparations:

"Watia" is the most traditional way to prepare Maca as a food. It is prepared in a crude oven made by digging a hole in the ground and filling it with alternating layers of fresh Maca roots, and hot coals made from champas grass. The hole is then covered with soil and after an hour the roots are well roasted and ready to eat. The roots are then dug up, peeled and eaten. Workers often prepare watia for lunch when they are working in the Maca fields.

Dry Maca roots are made into a viscous, very sweet tea by boiling in water for several hours. This long boiling time is necessary because water boils at only 70° C in the high puna.

Dry Maca roots are also prepared as a gruel with milk and this is sometimes the only food eaten by shepherds in distant, isolated areas. Maca is also cooked with chuño (dried potatoes), apples, oats, quinoa or fava beans. Also, dry Maca root flour is mixed (10 to 20% Maca) into bread, cake and cookie recipes, and is also made into puddings and jams. Toasted and ground roots are used to prepare "maca coffee." Also very popular is traditional "Chica de Maca" which is a mild homemade beer made by fermenting cooked, mashed Maca roots with water. A popular modern way to prepare Maca is as a "liquado" which is the equivalent of the American smoothie. It is prepared by blending boiled Maca roots with water or milk, fruit, honey and cinnamon.

Vendors at the yearly Maca Festival in Junin display many new Maca products that are being developed for the growing international Maca market. On display are such products as Maca marmalade, Maca ice cream, distilled Maca whiskey, Maca wine, and Maca-based cosmetics (Personal observations at the Fifth International Maca Festival 2003).

Ironically, Maca capsules and tablets are now being sold in Peruvian pharmacies to modern urbanites who have rediscovered Maca and prefer these more modern, non-traditional dosage forms.

CHEMISTRY AND CONSTITUENTS

Dry Maca hypocotyls contain 59% carbohydrates, 10% proteins (including most of the essential amino acids), 8.5% fiber and 2.2% lipids (Dini et al 1994). They also contain significant levels of iodine (Anonymous 1989), which may explain the Peruvian puna's absence of the goiter often found in other remote, high-mountain regions of the world. Maca also contains a high concentration of aromatic glucosinolates – benzyl and p-methoxybenzyl glucosinolate in particular – and their derived isothiocyanates (Johns 1981). These are the same anticancer compounds found in other cruciferous vegetables like broccoli and cabbage (Wattenberg 1981). Also found in Maca are antioxidant flavanols, including catechin, epicatechin, epicatechin gallate, epigallocatechin, and epigallocatechin gallate (Sandoval 2001). Maca also contains sterols, such as campesterol, stigmasterol and beta-sitosterol (Zheng et al 2000), and alkamide compounds similar to those found in *Echinacea spp.* (Muhammada et al 2002).

Although there is much speculation about which compounds in Maca are responsible for its aphrodisiac and fertility-enhancing actions, there is no clear, conclusive evidence regarding this subject.

PHARMACOLOGICAL AND MEDICAL RESEARCH

Treatment of 9 healthy men with gelatinized Maca root (1,500 or 3,000mg per day for 4 months) resulted in "... increased seminal volume, sperm count per ejaculum, motile sperm count, and sperm motility." It is interesting to note that these improvements in sperm production and motility were not associated with increased production of the reproductive hormones, luteinizing hormone, follicle stimulating hormone, prolactin, testosterone and estradiol (Gonzales et al 2001a). Note: Gelatinized Maca root is not an extract. Instead, gelatinization is a process whereby Maca root is pre-cooked and dried in a manner similar to the manufacture of instant noodles.

A double-blind, placebo-controlled, randomized, parallel human trial on 57 healthy males (aged 21 to 56 years) who were given 1.5 to 3.0 grams per day of gelatinized Maca root (500 or 1000mg t.i.d.) demonstrated increased sexual desire, independent of changes in testosterone or estradiol levels (Gonzales et al 2002).

Healthy men administered gelatinized Maca root in sufficient aphrodisiac and fertility-enhancing doses (1,500 or 3,000mg per day) showed no increase of serum levels of luteinizing hormone, follicle stimulating hormone, prolactin, 17-alpha hydroxyprogesterone, testosterone or 17-beta estradiol. Data showed that, compared with placebo, Maca had no effect on any of the sexual hormones studied (Gonzolas et al 2003).

Oral administration of a fractionalized Maca extract enhanced the sexual function of mice, as evidenced by an increase in the number of complete intromissions and of sperm-positive females in normal mice, and a decrease in latent period of erection in male rats with erectile dysfunction (Zeng et al 2000).

Hexane, chloroform and methanol extracts of Maca administered to rats increased intromission frequency and copulatory efficacy, and decreased intromission latency and intercopulatory interval (Cicero et al 2002).

A decoction of Maca roots (boiled 30 minutes) caused an increase in testicular and epididymal weight in treated rats, and was concluded to invigorate spermatogenesis in male rats by acting on its initial, mitotic, stages (Gonzales et al 2001b).

COMMENTS

There are American herbalists and herb marketers who now claim that Maca "balances sexual hormones." However, these vague claims appear disharmonious with the research which showed no increase in serum reproductive hormone levels (including testosterone) in men given aphrodisiac and fertility-enhancing doses of Maca (Gonzolas et al 2001a, 2002, 2003).

Most of the non-extract Maca products sold in the USA and Canada are prepared from dried, uncooked Maca roots. However, many conversations with Peruvian Indians indicate that Maca is never consumed raw, and, instead, is always cooked in some way (Personal communications with Peruvian Maca farmers & dealers 2001, 2003).

This author is delighted to see Maca's traditional aphrodisiac and fertility-enhancing effects now being "proven" by modern pharmacological and medical research. It is also heartening to see the positive cultural and economic effects that the new international interest in Maca is having on the impoverished Peruvian Maca farmers and their communities. Hopefully this will continue and increase.

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Ed Smith inspecting drying Maca roots.

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