Maca, *Lepidium meyenii* Walpers, *L. peruvianum*

The earth's highest altitude food crop, with an exceptionally high food and medicine value

“Exploitation of natural resources is the name of the game in Peru [currently]. If it can be caught, cut down, drilled or dug, it will be. Entire mountains are coming down for the mining industry, and the forests of the Amazon have been cut back hundreds of miles. Wildlife is disappearing, and the coastal waters of Peru are being fished heavily. Sustainable business of any kind helps, in at least some small way, to mitigate widespread devastation.” - Chris Kilham, *Ode Magazine*

Common Names:
Maca, Peruvian Ginseng, Mace, Maca-maca, Chichara, Ayak, Ayuk, pepper grass, pepperweed  
*Spanish (Peru)*: Mace, Maino  
*Quechua*: Maca-maca, Ayak, Ayuk, Chichara, Ayak willku

Plant Family:
Brassicaceae (Cruciferae), Mustard (Cabbage) family  
Genus *Lepidium* related to pepper grass

Etymology:
Maca is the common name in the Peruvian highlands and originates from the Quechua language. The genus name *lepidium* derives the Greek *lepis* (meaning scale) and understood to be a reference to the heavy root. The species *L. meyenii* was described by Gerhard Walpers in 1843 (and the reason for walpers often being added to the botanical name). “It has been suggested that the cultivated maca of today is not *L. meyenii* but a newer species *L. peruvianum* Chacón, based on specimens collected since 1960 […] and comparative studies of botanical characteristics.” While most maca today still referred to as *L. meyenii name*, many botanists believe most are *L. peruvianum*, but there is no formal agreement.

Parts Used:
Tuberous taproot botanically referred to as the Hypocotyl (as are radishes and turnips).

Botany & Cultivation:
Maca is the world’s highest altitude food plant growing above tree line between 12,500-14,500 feet above sea level. It is a “biennial cruciferous plant with a radish-like tuberous taproot up to 8 cm varying in color from red, purple, black, yellow, and cream. It displays a low-growing basal rosette of 12-20 dissected leaves, diminutive white raceme inflorescence (typical of cruciferous plants), and dehiscent fruits. Wild maca is found in the highlands of Peru, Bolivia, and Argentina, but cultivated maca is primarily limited to the highlands of central Peru… The diminutive aboveground stature of the plant makes a crop of maca nearly invisible to the untrained eye.” (Balick & Lee, 2002; NRC, 1989)

There are at least 8 ecotypes (local varieties) of *Lepidium meyenii* that are differentiated according to coloring and hypocotyl and generally referred to as yellow, red or black maca. The color differences may be due to levels of anthocyanins (Leon, 1964) Analysis of ecotypes showed black maca is higher in soluble sugars, riboflavin, and iron, red maca is higher in protein and potassium (though red maca is experience to be somewhat sweeter than other varieties), and yellow maca has intermediate values (Wang et al., 2007). Concentrations of macaene, macamide s, glucosinolates beta-sitosterol, campesterol were also found to be associated with color type (Clement, 2010).
In addition to its particular adaption to high altitudes and low oxygen, Maca’s native environment is cool, with extreme temperature fluctuations, high winds, full high altitude sun (intense UV radiation) and well-drained, alkaline soils. Maca seeds are sown at the beginning of the rainy season (September-November) as either the sole crop or combined with strips of bitter potato (the only other cultivated staple of the highlands). Indigenous Peruvians find this combination protects the potato from insect attack, as maca contains repellent volatile substances. They broadcast seeds on lands without preparation or fertilization other than occasional manure dressing. Indigenous Peruvians also observe that maca depletes the land in its absorption of soil nutrients and grow it on a rotational basis.

Traditional cultivation is integrated with animal husbandry. The seeds are buried using branches or are left to be trod on by sheep “and at harvest time, the leaves may also be used as fodder for livestock.” (NRC, 1989).

The biennial tuber is harvested in the first year of growth (in 6-8 months). But to obtain seeds they select out of the harvest the biggest and most ripened maca hypocotyls to transplant in a special seedbed fertilized with manure. Particular care is taken to ensure best conditions such as adequate humidity for the vigorous development of the plants, which produce seeds within six to seven months after transplanting.

Little is known about cultivation of maca outside its native habitat, though in early 2000’s Chinese entrepreneurs illegally smuggled seeds and live roots to cultivate it in Chinese Yunnan Province Mountains. The altitude is not as high and reports are that a number of chemical inputs: pesticides, herbicides, and commercial fertilizers, are needed, as the maca is not adapted to the new environment. Early report comparing the two places maca is grown indicate that Chinese maca does not have all the constituents and properties of Peruvian maca.

**Harvest & Sustainable Sourcing:**

Maca hand dug harvest of the first year hypocotyls begins in May or June. They are cleaned and left outside direct sunlight for about until they are dry. Old sources describe a 4-6 day drying time but Ed Smith observed a 2 month drying time during which roots are covered with tarps over night and when raining. When completely dry maca is stored in a cool, dark place until they are eaten. Roots dried in this way are long lasting and can be stored for up to seven years.

When the Spanish arrived in 1533, the little plants was virtually unknown to the larger world except for interested botanists and remained on the verge of extinction for centuries. In 1982 the International Board for the Protection of Genetic Resources formally declared Maca to be in danger of extinction. In 1994 less than 50 hectares were devoted to the commercial cultivation of maca. Yet because of rising international interest and demand, by 1999 over 1200 hectares were under cultivation. Since then, cultivation has increased further and offers highland Quechua Indians a livelihood in their traditional homelands.

Peru now considers maca a national treasure and natural genetic heritage product. In 2003, the Peruvian Minister of Justice seeking to protect its heritage issued a regulation officially banning the export of unprocessed raw maca. The government of Peru followed formally registering a Maca Junín-Pasco Appellation of Origin with the World Intellectual Property Organization (WIPO) in 2014.

This international designation is significant, as Chinese businesses by smuggling fresh roots out of Peru are growing maca “under biopiracy conditions” and selling it in the international market, upending maca quality and livelihood of the Andean Indians. Additionally concerns about chromium
toxicity of the Yunnan Province along with Genetic modification (GMO) has led to an international outcry to prevent the current methods of Chinese cultivation of maca.

Sign petition to Peruvian government to further protect maca [https://www.themacateam.com/save-peruvian-maca](https://www.themacateam.com/save-peruvian-maca)

In sourcing maca, seek to ensure that the maca is grown in traditional ways in the Peruvian highlands. Two companies that support traditional maca production and buy directly from Peruvian Indians that I am aware of are: [www.TheMacaTeam.com](http://www.TheMacaTeam.com) and [www.Herbpharm.com](http://www.Herbpharm.com)

**Medicine Preparation:**

Food, powder, capsule, tincture

The powder in turn is available Raw or Gelatinized.

*Raw Maca* is not heated above 100º F, preserving enzymes and nutrients at peak levels. This is the best choice for most people.

*Gelatinized Maca* is heated to a high temperature to remove starch content, making it easier to digest for those who are sensitive to starch and experience gas or indigestion. (This preparation is best for those on SCD or GAPS diets) Gelatinized the maca is more concentrated, and cooking neutralizes possible goitergens (Brassicaceae family plants have glucosinolates which have anticancer benefits but are also goitergens which can be a concern if consumed raw in large amounts without other balancing factors in the diet.) The disadvantage is that the heat destroys the enzymes and alters some of the important nutrients. **There is no animal gelatin in Gelatinized Maca, it is a term referring to the consistency when cooked to remove the starch.**

**Major Constituents:**

*Note: amounts when listed are based on daily dose of 2 tsp (8.4 grams) of dried Maca powder*

**Carbohydrates:** 159% coming from maca's cellulose and lignin, are polyholosides.

**Proteins:** between 10 -14% (including most (19) of the essential amino acids such as serine, arginine, phenylalanine, valine, isoleucine, leucine and lysine)

**Fiber:** 8.5%

**Lipids:** 2.2% (higher than other roots, of which linoleic acid, palmitic acid & oleic acid are the primary fatty acids)

**Minerals** (high levels): calcium (258 mg), iron (15.4 mg), potassium (2050. mg), selenium, magnesium, manganese and zinc, copper and iodine (.052 mg).

The iodine content in maca has been both praised and feared. It provides the Quechua Indians with a much-needed source of iodine “which maybe [the reason for] the absence of the goiter often found in other remote, high-mountain regions of the world.” And is valued for its thyroid nourishing effects. But too much iodine can be a problem for hyperthyroid conditions and Hashimotos. The iodine content in maca is actually relatively low (10 g, or 2 tsp, of Maca powder contains .052 mg of iodine or 35% of the RDA) though it is slightly higher in the darker varieties. The iodine is also balanced by maca’s selenium content. High iodine supplementation without selenium in the system can be a concern for those with Hashimotos. In all it appears the iodine content is balanced enough to be beneficial for most thyroid conditions.

**Vitamins:** Vitamin B1 (0.20 mg) Vitamin B2 (0.35 mg) Vitamin C (2.50 mg)

**Aromatic Glucosinolates** (high concentration): “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).”

**Antioxidant Flavanols:** including catechin, epicatechin, epicatechin gallate, epigallocatechin, and epigallocatechin gallate (Sandovala 2001).

**Sterols** (rich): including sitosterol, campestrol, ergosterol, brassicasterol, ergostadienol and beta-sitosterol

**Macamides and Macaenae:** novel compounds and newly discovered by Dr. Qun Yi Zheng and team in the 1990’s. “The compounds occur in very small quantities, but their effect appears to be is significant. Experiments with animals show these two groups of compounds to be very powerful sex and energy enhancers.” (Kilham www.medicinehunter.com/macas-inner-secrets#sthash.dhulSQr.dpuf) These compounds are unique to maca and are used as marker compounds to distinguish maca from other species in the genus (Chain et al., 2014).

**Alkamides compounds:** similar to those found in *Echinacea* spp. (Muhammada et al 2002). *Alkaloids & Tannins*
Macca has been the predominant vegetable staple for the peoples of South American Andean highlands, where little grows beyond grasses, bitter potatoes and macca. Though it grows only in a very small and isolated area of the world, there is anthropological evidence that Macca has been cultivated for at least 3,600 years. “Wild macca plants as food was found in the midden of Panaulauca Cave, a human rock shelter inhabited between 7700 BC to 1200 AD (Pearsall, 1989). By 1200 BC, macca roots became more abundant in archaeological records, and also began to approach the size of modern cultivars, indicating that humans had begun cultivating macca (Pearsall, 1989). This coincided with the domestication of camels, and it’s speculated that llama herding may have favored macca domestication by providing disturbed habitats in which macca would thrive (Pearsall, 1989).”

“Macca was considered by the Peruvian Indians as a gift from the gods along with corn and potatoes. Besides being cultivated as a food … Macca 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 Macca, 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 Macca roots.” (Ed Smith) Early accounts of Spanish travelers in 1562 and 1572 reported that macca roots, were used for barter “since the time of the Incas, as there was no other crop on their lands.”

It helps the native Peruvians thrive in a very harsh, low oxygen environment. The Incas and their descendants ascribe many health benefits to eating macca such as increased strength and endurance. Inca warriors ate macca to prepare for battle. The rural community and its doctors are firmly convinced that eating macca enables infertile couples have children. (And historically, as was mentioned above, macca was also given to infertile animals)

“Until recently, macca was relatively unknown outside of its native area of the Peruvian highlands. Even in other areas of Peru, macca was not well known, and in 1980 traditional cultivation practices were dwindling nearly to extinction, with a mere 15 hectares of macca under cultivation (Hermann and Bernet, 2009). This began to change in the 80’s due to several factors that brought macca to the attention of a wider audience. Ethnobotanists began to study highland root crop cultivation in the 80’s (Balick and Lee, 2002)” “They rekindled interest in macca through nutritional analyses of what was designated as "the lost crops of the Andes." The publication of a book by that name introduced macca to the world.” “A local entrepreneur in Junin, Timotea Cordoba, began making a macca-containing beverage available to truck drivers and travelers between Lima and Huanaco (Hermann and Bernet, 2009). Postcards from happy customers, attributing restored marriages or long-awaited children to the magical macca were displayed in Cordoba’s shop and helped to feed macca’s growing popularity.”

“Word of macca’s properties soon spread to the city of Lima, bringing macca into wider Peruvian markets. Macca has increasingly been incorporated into a wide variety of packaged foods in Peru, such as cereal, bread, candy, and beverages. Further promotion brought macca to international markets, where it became known especially for its purported sexual benefits, despite the fact that there is little human research to support the claims. The international market for macca has subsequently grown exponentially; it has been likened to the explosion of the tulip market in Holland in the 1660’s, in which fortunes were made and lost overnight, and is also bringing a concomitant increase in crimes surrounding macca harvest and sales (Schultz, 2014). In China, it’s believed that black macca is superior to the cream-colored roots, and this sells for as much as $143/kilo (Schultz, 2014).”

“Touted by news media and businesses as a superfood, macca’s popularity has exploded in the past decade…Macca is now commonplace in health food stores, smoothie shops, and major retail chains. According to HerbalGram’s 2013 Herb Market Report, macca was among the year’s 30 best-selling herbs in the mainstream multi-outlet channel, exhibiting a remarkable 150% increase in sales from the previous year.”

www.EarthFlower.org  1 Union Square W. #309 NY, NY 10003  claudia@EarthFlower.org  917-723-2309
**Maca as Medicine - Outline of Herbal Uses & Indications**

**Taste:** Bitter, Sweet, slightly spicy

**Energetics Qualites:** Warm & Moist   (Bold - ruled by Leo)

**Actions:**
Adaptogen, Rasayana, Nutritive tonic, Aphrodisiac, Nutritive, Spermatogenic, Anabolic, Anti-fatigue, Yin tonic,

**Doses:**
Dosage recommendations vary, because maca is traditionally used as a food staple and not a supplement. General suggested usage of maca powder is 1,500 - 5,000 mg and also 2 teaspoons (5.6 – 8.4 grams)

**Specific Indications:**

Ø **Adaptogenic food** generally found to improve vitality and energy, balance body systems, and buffers the body from stress. “It has been a major observation in botanical medicine that the plants that grow in the harshest environments have the most potent medicinal qualities. The plants develop potent phytochemicals in order to protect themselves and adapt to the environment. By eating these plants many protective and medicinal benefits are transferred to humans.”

Ø **Fatigue (chronic fatigue):** improves stamina and energy

Ø **Athletic performance:** increases stamina, strength and endurance, and builds muscle and aids in the adjustment to high altitudes. Inca warriors ate maca to prepare for battle. Maca is a natural “anabolic” containing compounds that are helpful in building muscle fiber when the muscles are exercised.

Ø **Low Libido, including SSRI-induced sexual dysfunction:** enhances the libido both men and women, particularly low libido due to stress, along with overall energy, stamina and endurance. Both ancient and folk traditions regard maca a highly potent sexual stimulant, (also used for erectile dysfunction) It is somewhat of an enigma, as many human studies on maca show beneficial subjective effects without measurable changes in circulating hormone levels. While there is little agreement about aphrodisiac actions within maca, a few recent studies have uncovered possible aphrodisiac constituents in maca, such as ‘P-methoxybensilisothiocyanate’ a chemical that is aphrodisiac. Chemical analysis shows the presence of biologically active aromatics which have unique aphrodisiac properties. Also Macamides and Macaenes are also novel compounds that demonstrate very powerful sex and energy enhancement in animal studies.

**A few Lepidium meyenii Libido Studies**

Gonzales et al. (2002) conducted a randomized, double-blind, placebo-controlled trial in healthy men, and found that maca caused a significant increase in self-perception of sexual desire, but did not affect serum hormone levels.

Zenico et al. (2009) likewise found in clinical trials that men with erectile dysfunction experienced a significant subjective improvement in sexual and general well-being after treatment with maca.

A clinical trial conducted in women experiencing antidepressant-induced sexual dysfunction found that maca could help alleviate SSRI-induced sexual dysfunction and have a beneficial effect upon libido, particularly in post-menopausal women (Dording et al., 2015; Dording et al., 2008).

“Maca boosts sex drive like crazy. And if there’s any side effect, some people just have to stop taking it because they get so sexually stimulated... Kind of makes you feel a little like a superhero.”

– Chris Kilham, Good Morning America interview February 2011

Ø **Infertility:** increases fertility in both men as well as women (and animals) The fertility powers of maca are prized by couples in the Peruvian highlands, where it has been used for these purposes for more than 3,000 years. Men and women who fail to conceive a child eat maca on a regular basis until conception occurs. In 1961, Dr. Gloria Chacon de Popovici, a biologist in Lima, Peru, published studies of her research scientifically demonstrated the increased fertility in animals using maca. While maca is traditionally eaten during pregnancy in the highlands, it is recommended that women only take it between menses and ovulation and discontinue during pregnancy. (See cautions below)

www.EarthFlower.org  1 Union Square W. #309 NY, NY 10003  claudia@EarthFlower.org  917-723-2309
Low Sperm count: One of the known specific actions of maca is to increase the quality and quantity of sperm without altering hormone levels in the blood. It improves the quality and quantity of semen, increases sperm production and sperm motility in men as well as optimizing erectile function and reducing enlarged prostate. In China, black maca is regarded as a potent elixir for vitality and some animal studies do point to black maca’s particular effectiveness for spermatogenesis as well as for memory and cognition (Gonzales et al., 2006; Rubio et al., 2007), though the differences in medicinal properties between ecotypes is still debated. (Schultz, 2014).

Enlarged prostate prostatic hyperplasia: Only the red maca has been shown reduce prostate size. Animal studies of red maca show benefits for prostatic hyperplasia not observed in other ecotypes of maca, which may be linked to its polyphenol content (Gonzales et al., 2005).

Menopausal symptoms: Aids in alleviating many menopausal symptoms and also PMS symptoms. In postmenopausal women, maca was found to lower sexual dysfunction and have a beneficial effect upon indices of anxiety and depression, without affecting circulating hormone levels (Brooks et al., 2008) Maca does not contain phytoestrogens, but acts as a general hormonal adaptogen. “Maca operates differently than other natural interventions for menopause, promoting optimal function of the hypothalamic-pituitary-adrenal (HPA) axis that governs hormone levels in the body. It is also found to a significant increase in beneficial high-density lipoprotein (HDL) in supplemented women—but not in study controls. Most importantly, from the women’s own experiences, maca significantly reduced both the frequency and severity of individual menopausal symptoms, particularly hot flashes and night sweats.” Dr. Hugo Malaspina, of Lima, Peru has been using maca in his practice for more than fifteen years, and commonly recommends maca to women experiencing premenstrual discomfort or menopausal symptoms. and commented that “Maca regulates the organs of internal secretion, such as the pituitary, the adrenal glands, the pancreas, etc. I have had perhaps two hundred female patients whose perimenopausal and menopausal symptoms are alleviated by taking maca.”

Hormonal imbalances: Clinical and folk experience of maca points to a normalizing action in relation to what is described as hormonal imbalances (such as menopausal symptoms, PMS and endocrine disorders). However, many studies of maca consumption have not found any particular hormonal increase or decrease except a few studies that showed it increases progesterone while estrogen and other hormones remain the same. Its action is not well understood. For hormonal imbalances, red maca is recommended for women and black maca for men.

Bone Density & Osteoporosis: In Peru maca is traditionally given to children to build strong bones and it appears it has the same action for elders. A study “Prevention of estrogen-deficient bone loss was observed in ovariectomized rats orally administered 240 mg/kg of an ethanol extract of maca daily for 28 weeks but not in animals administered 96 mg/kg (Zhang et al. 2006). Red maca is thought to be the most beneficial for developing bone density. Dr. Aguila Calderon, former Dean of the Faculty of Human Medicine at the National University of Federico Villarreal in Lima, comments, “Maca has a lot of easily absorbable calcium in it, plus magnesium, and a fair amount of silica which we are finding very useful in treating the decalcification of bones in children and adults”.

Depression: imparts a feeling of general well being and elevated spirit along with decreased stress and anxiety. “In a study on the effects of maca for sexual dysfunction induced by selective serotonin reuptake inhibitors (SSRI), patients who were stable on an SSRI (patients were taking escitalopram, citalopram, sertraline, venlafaxine, uoxetine, paroxetine, duloxetine, or uvoxamine) were orally administered 1.5 or 3 g of maca daily for 12 weeks. No adverse effects of maca, including effects on SSRI efficacy, were reported, and patients in the high dose group had a modest improvement in depression (Dording et al. 2008). A few psychiatrist recommends maca to those who take Prozac. That anti-depressant often sends libido plummeting, and he finds that maca brings it back. It takes many years to inculcate a plant medicine into a large number of medical practices, but
with maca this process is happening. In fact, a study on people who have experienced diminished sex drive due to taking antidepressants showed that taking maca can rebuild lost libido. Another recent study in post-menopausal women found that treatment with maca reduced symptoms of depression and diastolic blood pressure, but did not have an effect on circulating hormone levels (Stojanovska, 2015).

- **Brain function - memory and cognition:** Promotes mental clarity and focus. In Peru, it is given to children because it is believed to support cognitive performance and build strong bones red maca is sometime recommended for mental focus

- **Thyroid function:** Maca is formally recognized to “Support the Thyroid” under section 6 of the DSHEA (Dietary Supplemental Health and Education Act.) Yellow maca is generally used for thyroid support. The darker varieties contain higher amounts of iodine, which may not be good for some thyroid problems. (See ‘Major Constituents’ mineral and iodine content above) Maca may help thyroid issues by nourishing and balancing hypothalamus function, which in turn controls the thyroid’s function and the other endocrine glands: pituitary, adrenals, ovaries, testes, and pancreas.

- **High triglycerides:** “In hereditary hyper-triglyceridemic rats, a strain used as a model for insulin resistance, improvement in glucose tolerance was observed after administration of a diet containing 1% maca daily for 2 weeks (Vecera et al. 2007). Maca “helps the body to utilize glucose for energy rather than process it for fat storage.”

- **Skin:** Protects the skin exposure to Ultraviolet radiation. Red maca is recommended for acne.

- **Blood:** Anemia – balances iron levels; Lower high blood pressure, raise low blood pressure

**Contraindications & Cautions:**

**Avoid or use with caution during Pregnancy and Lactation:** In Peru, Maca is a staple and nourishing food consumed in the diet of men, women, children, infants, elderly, infirm and also by pregnant and lactating women.

Yet as a modern food supplement it is recommended to discontinue use in pregnancy and use with caution during lactation. Speculation is that its normalizing effect of hormones is not desired during pregnancy nor lactation. Clinical case observance has noted that milk production goes down during maca supplementation and back up when discontinued. The Botanical Safety Handbook comments, “While this review did not identify any concerns for use [during pregnancy or] while nursing, safety has not been conclusively established.

**Maca as Food & Drink**

Maca is one of the few medicinal plants that is actually a major staple in the diet. Chris Kilham comments “In the Andes, people typically eat about half a pound of maca daily.” It’s in the mustard family, which also contains numerous and valued vegetables such as turnips, kale, chard and cabbage. The tuberous roots have a tangy, sweet taste and an aroma similar to that of butterscotch.

As roots are traditionally dried after harvest, allowing them to be stored for prolonged periods, the fresh roots are considered a special treat called "Watia". It is prepared in panchamancas 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 and is baked or roasted in ashes (in the same manner as sweet potatoes). Workers often prepare watia for lunch when they are working in the Maca fields.

The dried and often roasted roots are used in numerous ways in the Andean highland cuisine.
It is boiled in water or milk to make a porridge called mazamorra. Maca is cooked with chuño (dried potatoes),
www.EarthFlower.org  1 Union Square W. #309 NY, NY 10003  claudia@EarthFlower.org  917 -723-2309
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 made into puddings and jams. The traditional drying and roasted before use, makes maca more digestible, and may also enhance the levels of some bioactive constituents, especially macamides (Esparza et al., 2015 & Gonzales, 2011).

Dry Maca roots are made into a viscous, sweet tea by boiling in water for several hours. (The long boiling time is necessary in high altitudes) Maca is also used to make a fermented beverage, known as chichi de maca,

Maca is popular in modern Peruvian cuisine in sodas puddings and jams and as an addition to "liquados" which are preparations of blended milk fruits and honey throughout Latin America and may be the inspiration of the modern American “smoothie”. It is prepared by blending boiled Maca roots with water or milk, fruit, honey and cinnamon.

As a cousin of common garden cress (Lepidium sativum), the leaves of maca may also be used as food with a taste similar to watercress, but this is less common in traditional use as they often leave the leaves as fodder for their animals.

More recently the process of gelatinization has been adopted post-harvest for commercial maca root; this is an extrusion process, which breaks down the starch molecules, making the product more water-soluble and possibly better absorbed.

**RECIPIES forthcoming! (Refer to class notes and demos)**

**Notes**

a. In female mice provided with a maca extract (5 g maca in 100 ml water) as the sole source of drinking water for 30 days (estimated intake not listed), increases in progesterone and testosterone levels were observed, but with no changes in levels of 17β-estradiol. After mating, no differences in the rate of embryo implantation were observed (Oshima et al. 2003).

b. No adverse effects on implantation or on fetal develop-ment were observed in mice orally administered 1 g/kg of a freeze-dried aqueous extract of maca on days 1 to 4 of pregnancy (D’Arrigo et al. 2004).

c. No adverse effects on fetal development or offspring growth were observed in mice fed diets containing 30% maca daily throughout pregnancy and lactation. The litter size was larger in treated animals than in controls (Kuo et al. 2003).

d. No adverse effects on pregnancy or fetal development have been observed in animal studies with daily doses up to 1 g/kg (D’Arrigo et al. 2004; Kuo et al. 2003; Oshima et al. 2003; Ruiz-Luna et al. 2005).

e. *Lepidium meyenii* animal pharmacological studies: No changes in serum levels of testosterone or estradiol were observed in male rats orally administered 2 g/kg of red, yellow, or black ecotypes of maca daily for 7 days. Red maca, but neither yellow nor black maca, significantly reduced the ventral prostate size in treated animals (Gonzales et al. 2005).

f. In male rats orally administered 2 g/kg of red maca daily for 42 days with or without intramuscular injections of testosterone enanthate on days 1 and 7, maca prevented the prostate weight increase induced by testosterone treatment (Gonzales et al. 2005).

g. In male rats orally administered 48 or 96 mg/kg of maca daily for 7, 14, or 21 days, no changes in serum testosterone levels were observed. An increase in sperm count was observed after 7 d ays, while the sperm count was reduced at 14 and 21 days (Gonzales et al. 2003b).

h. In rats orally administered 0.01 to 5 g/kg of maca daily for 7 d ays, seminal vesicle weight was reduced at the 0.01 and 0.10 g/kg doses. Maca increased the length of stages VII– VIII of the seminiferous tubules in a dose-response fashion,
with highest response at 1.0 g/kg. Cauda epididymal sperm count, sperm motility, and serum estradiol level were not affected at any of the doses studied (Chung et al. 2005).

Sources: [more citations forthcoming]
2. Ed Smith, Maca Root: Modern Rediscovery Of An Ancient Andean Fertility Food; The Journal Of The American Herbalists Guild, January 2004
3. Chris Kilham, Macas Inner Secrets: www.medicinehunter.com/
5. Americam herbal products association’s botanical Safety Handbook (pg 544)
6. Jennifer Szymaszek for the New new york times, Medicine hunter in Peru,
11. An increase in litter size was observed in mice orally administered 1 g/kg of a freeze-dried aqueous extract of maca daily 15 days prior to mating, throughout gestation, and for 21 days after birth. No adverse effects on fetal or pup development were observed (Ruiz-Luna et al. 2005).
12. Maca monograph, HANE (Herbal Academy of New England)