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File: ■ Maca (*Lepidium meyenii*)
■ Ethnobiology
■ Ethnopharmacology

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RE: Review of Maca – a Promising Adaptogen

Gonzales GF. Ethnobiology and ethnopharmacology of *Lepidium meyenii* (maca), a plant from the Peruvian highlands. *Evid Based Complement Alternat Med*. 2012;2012:193496. doi:10.1155/2012/193496.

Maca (*Lepidium meyenii*) grows in Peru at elevations over 4000 m. It is used traditionally as food and to enhance fertility in humans and animals. While there are related species in Europe and North America, maca's habitat of intense cold, very intense sunlight, and strong winds is unique. Cultivated in the Andes for 1500-2000 years, consumption worldwide has risen dramatically since 2000 as maca's reputed benefits have become widely known.

The plant part used is the hypocotyl, maca's underground nutrient storage organ. A fresh hypocotyl-root axis is about 10-14 cm long and 3-5 cm wide, shrinking as it dries. Like many plants, maca from different producers (or different seasons, microclimates, etc.) may vary significantly in chemical content. Dried maca has about 10.2% protein, 59.0% carbohydrates, 2.2% lipids, and 8.5% fiber. It is high in iron and calcium and has copper, zinc, and potassium. Hypocotyls vary in color; 13 colors are known. Different colors indicate levels of unique secondary metabolites, e.g., macaridine, macaene, macamides, and maca alkaloids. Sterol and glucosinolate levels also vary with color.

Maca is boiled in water or extracted in alcohol before consuming. One report of (1R,3S)-1-methyl-1,2,3,4-tetrahydro-β-carboline-3-carboxylic acid (MTCA) in maca suggested that it could be toxic, leading to a consumer alert from the French Agency for Sanitary Security (AFSSAPS). However, MTCA occurs in many foods in higher concentrations than in maca and has not resulted in reports of toxicity. Maca is consumed from childhood in the Andes, usually as juice made with several mixed colors of hypocotyls.

Maca's effects on male and female reproductive capacity have been examined in vivo and in human studies. While some found increased sexual behavior of male rodents with maca administration, others did not. Maca increased sperm count and motility in normal rats and those with several induced pathologies. Black maca, and to a lesser extent yellow, were the most effective colors studied; red maca was ineffective. In bulls, maca

increased sperm quantity and quality. Healthy, human males who used maca for four months had increased seminal volume, sperm count, and sperm motility. A systematic review found four randomized clinical trials (RCTs) assessing maca and human sexual function. Two found significant positive effects, one in healthy, menopausal women and one in healthy, adult men. A third, of healthy cyclists (gender unspecified), reported no effects; however, data from the study show significantly improved self-rated desire compared to baseline and to placebo. In a study not included in the systematic review because no placebo effect was assessed, patients with selective serotonin reuptake inhibitor-induced sexual dysfunction had significant improvement in libido with maca. Another RCT assessed maca in mild erectile dysfunction and found significant benefits in subjective perceptions of well-being. An unpublished study in the author's laboratory found no effect on erection. In female rodents and women, maca did not affect serum estradiol levels. An in vitro assay found no proliferative effect on MCF-7 cells. In mice and trout, maca improved embryo quality. The author's laboratory observed the most improved mouse embryo quality with red maca. In guinea pigs and mice, the number of offspring rose with maca. Red and black maca were protective of bone architecture in ovariectomized rats, without estrogenic effects on uterine weight.

Gonzales reports for the first time a beneficial effect of maca in benign prostatic hyperplasia (BPH). Red maca was more effective than yellow or black in preventing prostatic hyperplasia (PH) induced by testosterone enanthate (TE) in rodents. Different amounts of benzylglucosinolates in red maca extracts produced dose-dependent effects on prostate weight, suggesting that these compounds are responsible for the effect. Polyphenols in red maca may also contribute. Red maca also reduced zinc levels in TE-induced PH, but not seminal vesicle weight. Finasteride, BPH standard treatment, reduces prostate and seminal vesicle weights but not zinc levels. Adding red maca might be beneficial. Maca's mechanism of action is not known. Red maca did not affect serum hormone levels in rodents or human males.

Although no traditional descriptions have been found of maca's mental effects, children are given maca in Peru to improve school performance. Black maca improved memory and learning in memory-impaired mice; red and yellow maca did not. Maca reduced depression and anxiety scores and was an energizer in healthy men, compared with placebo. One RCT assessed effects of maca, alone or with other supplements, in metabolic syndrome; results are not detailed. Another found that gelatinized maca reduced systolic and diastolic blood pressure in healthy men after 12 weeks. In another RCT, maca with cat's claw (*Uncaria tomentosa*) was compared with glucosamine sulfate in 95 patients with osteoarthritis. Both treatments significantly improved symptoms.

In a study of the health status of adults 35-75 years old in the Peruvian central Andes, those who used maca were compared with non-users. About 80% used maca; 85% of them for nutrition. Maca was associated with higher health status scores, fewer fractured bones, lower signs of chronic mountain sickness, lower body mass index, and lower systolic blood pressure. Liver and kidney function, lipid profiles, and glycemic function of users did not differ from non-users.

—Mariann Garner-Wizard

Referenced article can be found at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3184420/pdf/ECAM2012-193496.pdf.