

# The "Maca" (*Lepidium meyenii*), A Little Known Food Plant Of Peru

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Among the less known domesticated plants of Peru, the "maca" (*Lepidium meyenii* Walp.) occupies a special position. It was widely used during the colonial and pre-colonial periods. Vásquez de Espinoza (13), who visited Peru around 1598, and Cobo (2), from 1603-1629, give descriptions of the plant and its uses. H. Ruíz (9), of the Royal Spanish Botanical Expedition in 1777-1778, found it in cultivation close to Lake Junin and gives a short note on its utilization. However, no mention is found in Oviedo, Garcilaso and other early chroniclers. So far as is known, it does not appear represented in the ancient Peruvian pottery so rich in representations of cultivated plants.

In modern works, it is not mentioned in ethnobotanical publications such as Cook (3), Yacovleff and Herrera (15), Towle (11) and Horkheimer (6). Slight mentions are found in Vavilov (12), Bukasov (1), Hawkes (5) and Middendorf (7)<sup>2</sup>. Recently in Peru, Pulgar Vidal (8) and Chacón (4) have been interested in its medicinal properties. As maca is grown in an area that is not frequently visited by scientific travellers, and as its culture is decreasing, it is not surprising that the plant is not mentioned even in special works on the food plants of Peru.

Maca culture is concentrated in the high cordilleras of central Peru, particularly in the Departments of Pasco and Junin, between 3,500-4,000 m. At present, commercial production, for food or medicine purposes, is centered in two areas: first, the mountains surrounding Lake Junin, where macas are

sold in the market towns of Carhuamayo and Ninacaca, particularly to be sent to the Lima market; the other region is the mountainous area of Jarpa, west of Huancayo, which produces small quantities sold mainly in the Chupaca market (Fig. 1).

Macas are planted in the punas, the cold, barren extensions where sheep grazing is the dominant occupation. Here macas grow wild (14); they are the only true puna plants domesticated by man. As Cobo said, it "grows in the most inaccessible and coldest regions of the Sierra, where no other cultivated plant supplies food to man, and thus God gave the Indians of this province, this root so that they may not lack in their land a natural food."

## The Plant

The maca has the typical structure of puna plants (Fig. 2). Above the ground, there is a rosette of from twelve to twenty basal leaves, roughly elliptical in outline, formed by a flat and fleshy rhachis, with minute lobes distally arranged. The basal lobes are elliptic, entire, 4-8 mm. long and 1-1.5 mm. wide; the medium and upper lobes are deeply dissected, 8-12 mm. long. There is a continuous production of new leaves at the center of the rosette. When the outer leaves turn brown and dry, their bases form a cylindrical body, about 1 cm. high above the ground. The maca leaves are highly resistant to frost and show the typical stomata of the Cruciferae.

Below the ground, the central axis is a fleshy structure, similar in general shape to a 'Red Globe' radish but ending in a thick and strong root, with numerous lateral rootlets. The upper part of the axis is of conical shape, slightly prominent at the top at the insertion of the leaves; it measures up to 5 cm. wide and 3 cm. long, and its color varies from light purple to yellowish. About

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<sup>2</sup> Sauer, in Cultivated Plants of South and Central America in the Handbook of South American Indians, Bureau of American Ethnology Bulletin 143: 578, 1950, gives a short note on maca and a translation of Cobo's account.

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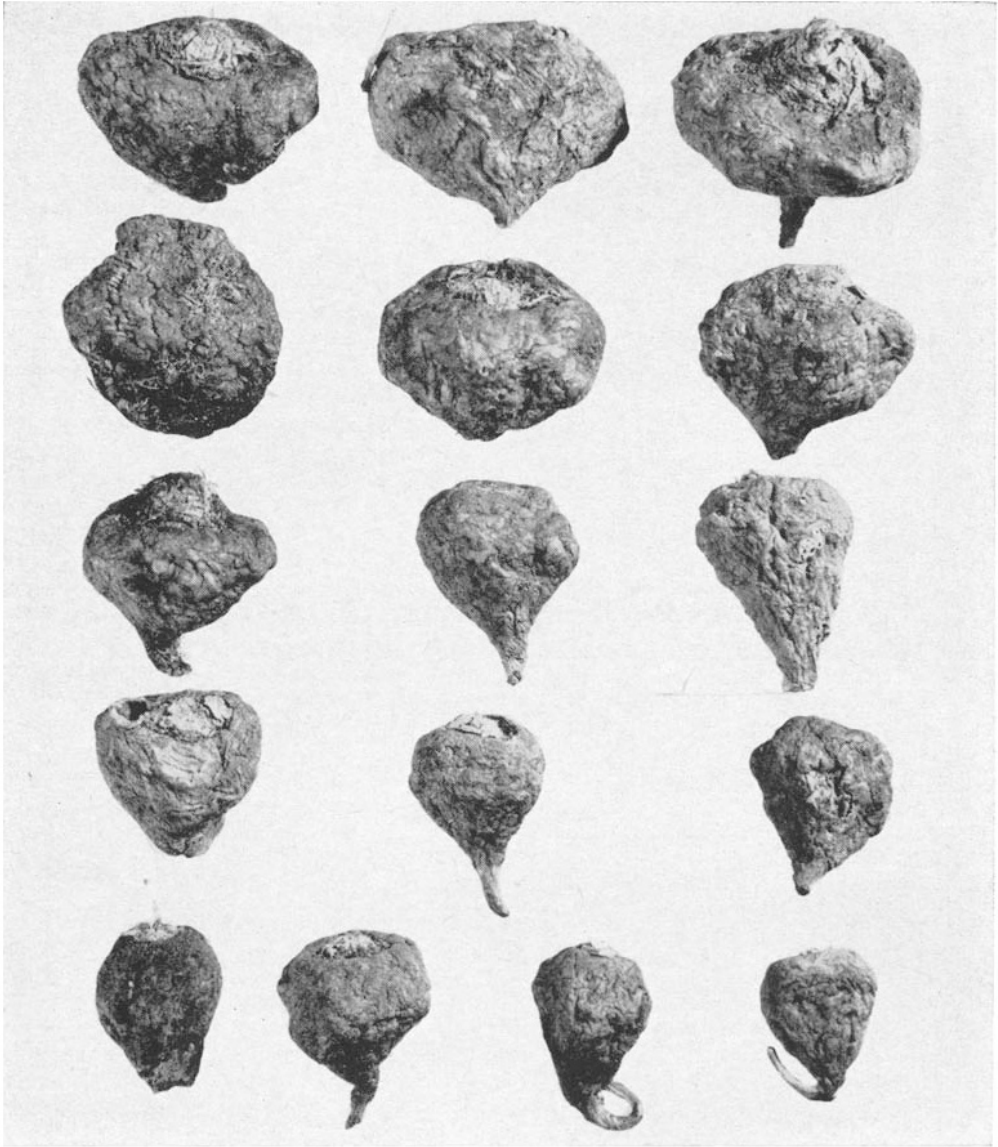


Fig. 1. Typical maca roots from the Chupaca market.

half its length, it shows two irregular areas where the feeding roots come out, alternating with smooth areas, as in the radish.

The structure of the root-hypocotyl offers some peculiarities (Fig. 3). The xylem core appears in the transversal section as an irregular star-shaped body, like that in the parsnip, in some parts penetrating deeply

into the outer tissues. The central part is formed by spiral vessels loosely arranged, surrounded by parenchyma. In the early stages, this area shows a diarch pattern, as in other species of *Lepidium* (10). From the central part there starts a radial arrangement of vessels, in single or double rows, alternating with parenchyma rays, formed



Fig. 2. Maca plant showing the rosette of leaves and the fleshy root. The maximum width of the roots measures 22 mm.

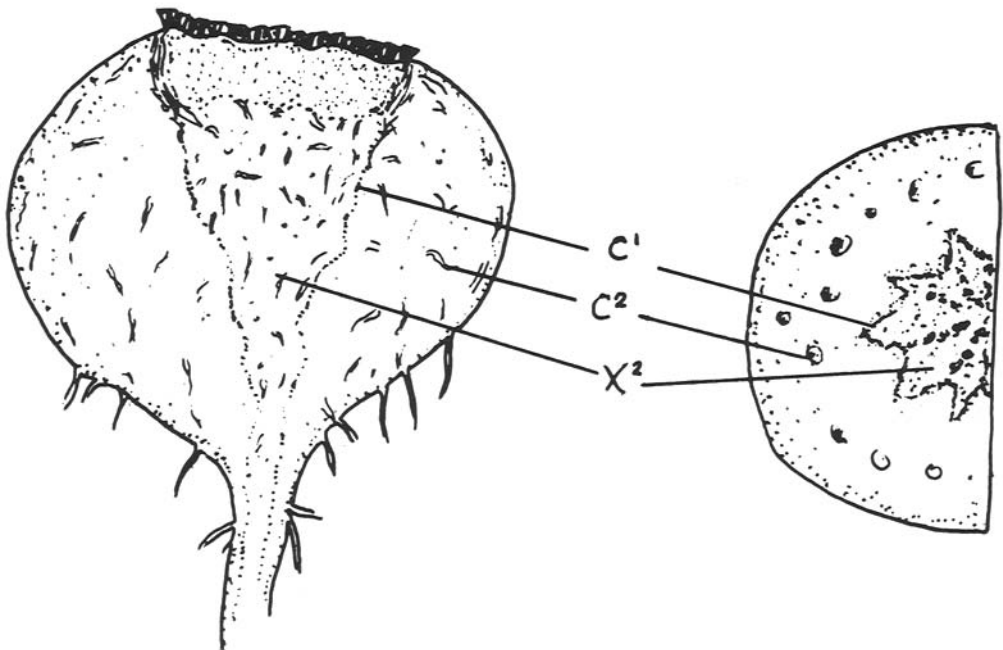


Fig. 3. Schematic view of the root. C<sup>1</sup>, main cambium; C<sup>2</sup>, secondary cambia; X<sup>2</sup>, secondary xylem.

by cells rich in starch. Outside the xylem, the cambial layers may be seen as a band of lighter color, following the contours of the central core. The most interesting characteristic of the hypocotyl-root structure is the presence, outside of the main cambium, of secondary, anomalous cambia, which occur in irregular patterns or less frequently in roughly concentric circles, often close to the external layers of the root. The tertiary xylems appear as bundles of spiral vessels surrounded by parenchyma, the latter forming in the mature root a pith of lighter color. The tertiary phloems are irregular masses of thicker cells. In young roots, it is easy to see the development of these abnormal cambia. They appear quite early and maintain their activity in the mature stage of the root. These secondary cambia in the dry, almost woody roots sold in the markets, give a marbled appearance to the cortex, often in circles formed by the darker cells of the tertiary xylem surrounding lighter piths, or in bands and lines. Often they form a roughly circular pattern, or are distributed at random. The larger part of the root is formed by parenchyma, rich in starch and sugar. Chacón (4) reports also the presence of alkaloids, fatty acids, tannins and small quantities of saponines. Towards the periphery, the parenchyma cells become larger, and empty spaces are often found. Finally, the periderm is formed by from eight to ten layers of thin walled cells, in some varieties full of anthocyanine.

In the upper section of the root-hypocotyl, the vascular bundles that run in a very irregular pattern move towards the outside and form a ring connecting to the crown of leaves. The center is occupied by a parenchymatous pith, without vessels, above the central xylem.

The floral axis is short and branched, 3-5 cm. long, with entire or crenate leaves. The whitish flowers are about 5 mm. long, on slender pedicels. The fruit is a two-celled silicula, slightly emarginated, 3.5-5 mm. long; the seeds are ovoid, 1.5-2 mm. long, smooth and reddish.

### Varieties

The Indians recognize four types, according to the color of the root: cream-yellow; half purple; purple; and black (Fig. 4).

These shades are due to the intensity of the anthocyanine in the outer layers. Because of popular preference, yellow macas are the most common in the markets. In the "half purple," the upper area is white and below the purple it is also white, similar to the distribution of red color in the common radish. In the purple, this color is found in the whole root; and in the black type, the pigment is dark purple and is likewise found on the whole root.

### Planting and Harvesting

Macas are planted in small plots on the slopes of the mountains. As usual in the Andes, the farmers divide their land in small plots, each planted to a different crop. In the puna region, where maca grows, only one other crop resists the frost and low temperatures: the "shiri" potato, used in the preparation of "chuño." The maca plots are left fallow for years. Both Cobo and Espinoza have called attention to the fact that maca is an exhaustive crop, and that, after a planting of maca, the land is left fallow for more than ten years.

Macas are planted in September-October. The soil is carefully worked, either with a common hoe or with the Indian equivalent, the "llaeta." The sods are broken off and the ground is left smooth and clean. The seed, mixed with debris, is scattered by hand, early in the morning, when there is no breeze. About one pound of seed is used for a "sharpo," a plot measuring roughly 15 x 15 m. Once the seed is scattered, one or two sheep are moved into the plot and allowed to walk around. As they walk, they press the soil and the tiny seeds are pushed a few millimeters into the soil. Indians claim that this is the only satisfactory way of planting. Although it results in the accumulation of seed in certain places, no thinning is practiced. In the punas, weed control is not a problem, and fertilizers are usually not applied.

The crop is harvested from May to July, after the frost has killed the plants. These are dug out by hand or by hoe, the leaves removed, and the roots cleaned and dried. All the roots are harvested, even those less than 1 cm. wide. They are stored and last for years (Fig. 1).

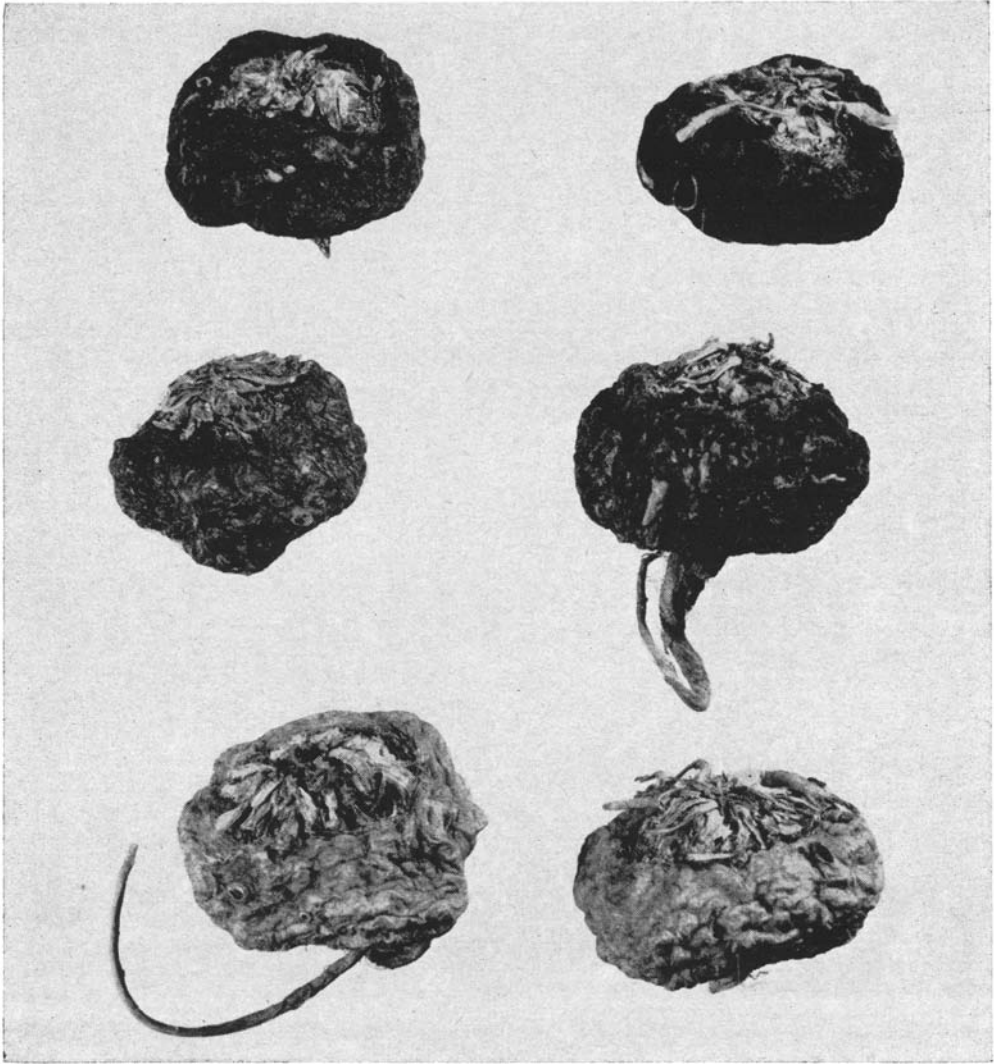


Fig. 4 Maca varieties. Top, black; middle, purple; bottom, cream yellow.

### Propagation

This is one of the most interesting aspects of maca culture. Outstanding plants are left in the field after harvesting, and once the crown of leaves is removed, they are transplanted with all the roots to a special place in the farm, where they are set out 0.5 m. apart in rows. Manure or organic matter is applied, and the plants are covered with 1-2 inches of soil. As it happens, in some Cruciferae the hypocotyl sends up new shoots,

and, in one to two months, numerous inflorescences appear above the ground. Once the seeds are set, they fall to the soil, where they are carefully collected with all sort of plant debris with which they are kept mixed for the next planting. Birds are especially fond of the tiny seeds, and women and children have to scare them away. In this form, the Indians have solved the problem of seed collecting, especially difficult in this species; it may also have accomplished some selection.

### Uses

Maca is used as a food both fresh and dry. For the first purpose, the fresh roots are cleaned and cooked, using the "pachamanca" method: a pit is opened in the ground, and the macas are placed at the bottom; then a heap of sod is burnt to provide ashes, and a layer of hot ashes is placed on the macas; alternate layers of roots and ashes fill the rest of the pit. This procedure is rather limited at present.

The dry roots are prepared by cleaning in running water as soon as they arrive from the field; then they are dried in the sun, generally on pieces of cloth. Afterwards, they are stored in bags. They may keep in good condition for years, but, after the second year, their taste deteriorates considerably. The dry macas, compared by Cobo to dry muscadines in appearance and taste, are cooked in water or milk, an operation which takes time and fuel at the puna altitude. They form a sort of porridge ("mazamorra"), sweet and aromatic, of which an outsider gets tired after a few spoonfuls, but it is a delicacy in places where only "chuño" is available. The small macas are preferred, since they are less fibrous.

Maca roots are also placed in sugar cane rum ("aguardiente"), to which they impart a special aroma.

The maca is less known to the white people as a food than for its medicinal uses. It was observed by the first Spaniards that in the Andean highlands, their domestic animals, cattle, sheep, chickens, and man himself had a reproduction rate markedly inferior than in Spain. The chronicles contain frequent references to this phenomenon and to the problems created by the lack of young animals. It is said that Indians recommended feeding maca to the animals and that the Spaniards noticed the positive effects of this food. Maca is now eaten by both Indians and white women who want to have children, with results still open to confirmation. For this purpose, macas are sold in the Indian markets, not exactly under the counter, but with a sly smile by the old women in the native medicine stalls. Laboratory tests in

rats, although they are far from being satisfactorily designed, tend to support a positive effect of maca in the increase of reproduction in this rodent (4).

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