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Loche: a Unique Pre-Columbian Squash Locally Grown in North Coastal Peru

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Abstract. The loche is a high-quality landrace of *Cucurbita moschata* Duchesne grown only on the north coast of Peru and practically unknown elsewhere. Moche pottery depicting the fruits shows that it has been used for thousands of years, yet it is not a primitive landrace. The fruits today, indicated as well by the archaeological record, have some morphological diversity. Typical loche fruits are small, straight, and warted along longitudinal ridges with non-lignified rinds. They contain few to no seeds, and the fruits vary respectively in having a slightly swollen end to being tapered at both ends. The orange flesh is very high in total soluble solids and is used only in small amounts for flavoring traditional regional dishes. In the local markets, loche is sold in cut up pieces at premium prices. The entire fruit, rind included, is consumed. Propagation using shoot cuttings has been practiced for at least the past hundred years. Fruits from such plants are considered more desirable than those from direct-seeded plants. This unique crop is at risk of being displaced by industrial agriculture of export crops, but at the same time has a clear role in the revival of Peruvian gastronomy within the country and abroad.

Little is known about the highly regarded landrace of squash from the north coast of Peru called zapallo loche or just loche. The literature is sparse except for mention of it in publications about the distinct gastronomy of the region. Even there, it is usually assumed the reader knows what a loche is, and therefore no description is given. Some recipes state that if loche is not available, other orange-fleshed squashes (in most South American countries called zapallo) may be substituted. Even more confusingly, the meaning of the word “loche” has become more generalized to apply to any desirable orange-fleshed squash, especially if the seller does not have any good loches. For instance, as early as 1957, a crookneck squash with dark green, smooth rind in the central coast of Peru is called loche (Diaz, 1957). Therefore, for clarification, adjectives are sometimes applied, such as “true loche” or “black loche” when referring to the traditional genuine loche.

Loche is listed on Web sites and in other literature as either being *Cucurbita maxima* Duchesne (Soukup, 1987; Custer, 2000) or *Cucurbita moschata* Duchesne, but there is a common understanding in Peru that all loches are *C. moschata* (Diaz, 1957; Ugás *et al*, 2000). Both species are cultivated in the region. And both have been found in local archaeological sites, although *C. moschata*, along with *Cucurbita ficifolia* Bouché, is much more abundant in earlier layers back to over 5000 B.P. The traditional cultivar of *C. maxima* called ‘macre’, with fruits that can weigh up to about 80 kg, is by far the most cultivated squash in Peru.

Methods

Starting in 2003, we visited marketplaces in both northern Peru and in Lima where loches are sold. We interviewed farmers in loche fields and cooks in northern Peru. Also visited were national and regional archaeological museums that contain ceramic pieces identified as depicting the loche.

Fieldwork has begun at the Vegetable Crops Research Program of Universidad Nacional Agraria La Molina (UNALM), Lima, Peru to observe and describe the growth habit and diversity of loche under uniform field conditions, both from seed and from shoot cuttings.

Results and Discussion

Vegetative characteristics of the loche show that it belongs to the species *C. moschata*. This is based primarily on the shape of the leaves and flowers, seed morphology, and indumentation. The leaves are unlobed or with shallow lobes. The male flower hypanthium is campanulate rather than conical as in *C. maxima*. The seeds are typical of light-colored *C. moschata* seeds, with a slightly coarse margin of a shade darker color. The indument along the primary nerves on the abaxial surface of the leaf blade as well as on the petiole and on the floral bud is short to long pilose or villous and soft.

The one character that is not typical of other *C. moschata* is the shape of the pedicel attachment to the fruit. This species typically has a rounded expanded pedicel where it attaches to the fruit. In loche, the shape of the pedicel varies from typical *C. moschata* shape to not being expanded, but extending along its ridges down a couple centimeters of the fruit. This may be due to the shape of the fruit base, which is acute rather than flattened or rounded like most cultivars.

Loche plants are viny, but have smaller parts than most other *C. moschata* cultivars, including the leaves, flowers, and fruits. The fruits are up to 1.2 kg, 20 to 30 cm long and 10 cm wide, oblong to oblate and not crooknecked, but sometimes shaped like a butternut squash with a bulbous end. They start out light green but gradually turn to dark green at maturity with a glaucous waxy covering. A diagnostic character is ten loosely defined warty longitudinal ridges that are often a darker shade than the rest of the fruit and thus subtly striped. The rind is non-lignified, which is unusual for warty *Cucurbita* fruits.

The flesh is various shades of orange, but never as deeply orange-colored as some other local landraces of *C. moschata*. But the total soluble solids or sugar content was measured with a handheld refractometer to be 18° Brix, which is extremely high for any cucurbit. The flavor is excellent.

Loche is unique to the species in having naturally occurring seedless fruits. Fruits that are tapered at both ends are seedless and solid, whereas those with a bulbous end generally contain a small seed cavity with up to 20 fully developed seeds with additional undeveloped seeds (Fig. 1). The seedless fruits with their soft rinds are consumed in their entirety with no waste. However, the bulbous fruits are considered to be of higher quality.

In general, seedlessness in edible fruits is becoming more widespread and more popular. This is the trend as well with cucurbits, such as watermelon, cucumber, and some summer squash. In winter squash, except for minor exceptions, there are no seedless commercial cultivars. Some butternut cultivars have small seed cavities containing a decreased number of seeds. Commercially produced interspecific hybrids between *C. maxima* and *C. moschata* may lack seeds.

The cause of infertility in loche is not known. Our field observations show that the plants are monoecious and develop normal-looking male and female flowers with abundant pollen on the stamens. There are many more male flowers than female flowers per plant. In loche fields, an abundance of bee activity in the morning transfers pollen between male and female flowers so that stigmas are covered with pollen by midmorning. Pollination, therefore, does occur naturally of both selfs and sibs. Fruit set and productivity appear to be comparable to seed-bearing winter squash of the region. But the plants in loche fields are usually not uniform with fruits varying somewhat in size, shape, color, and wartiness, thus indicating some genetic diversity. Given this, a theory among growers that the loche is a sterile hybrid does not seem plausible, but still needs to be tested. It is not known whether the fruits are parthenocarpic or the ovules abort after fertilization.

Another unique feature of loche is that they are commercially reproduced vegetatively. Shoot tip cuttings of around 50–70 cm long are made after the fruit is harvested. These are planted and watered, and roots grow from the underground nodes where the leaves have been removed. If the dry season is particularly severe, a crop season may not only be lost, but no further cuttings will be available. Saved seeds are then sowed. But the fruit quality of this first generation is considered inferior and not generally harvested. Cuttings are made from these to produce the more desirable fruits in subsequent generations. To avoid direct seeding, loche farmers cooperate by trading cuttings. Sometimes a few irrigated “mother plants” of a region are used solely as a backup source for cuttings. The difference between direct-seeded and plants propagated asexually is being investigated at UNALM.

The practice of vegetative propagation for improving quality of the loche has been going on since at least the late 19th century, according to the notes of Enrique Brüning, a German engineer whose private archaeological collection is now housed in the Brüning Museum, Lambayeque (Schaedel, 1988). Brüning also reported that in order to encourage the growth of loche, people would burn a stone in the form of the fruits in the pile of dirt where it was planted, perhaps like an amulet.

The main pest problems in loche are pickleworm (*Diaphania* sp.) and whitefly (*Bemisia* sp). Insecticides are commonly applied. The most common diseases appear to be wilt (*Fusarium* sp., *Phytophthora* sp.) and fruit rot (*Phythium* sp). Watermelon mosaic virus (WMV) has been isolated from loche plants and its symptoms are often observed in the field. It is apparently highly susceptible to root-knot nematode (*Meloidogyne incognita*).

Because of the high value of the crop, loche fields are often kept hidden from roads. There is a problem of poachers stealing not only the fruits, but also stems for transplanting. The fields range in size from backyard gardens to a few hectares (Fig 2). Loche is cultivated almost exclusively in the lowland valleys of northern Peru in the departments of Lambayeque, Piura, and La Libertad. The climate is temperate to hot in the north with no rain except during a possible short rainy season or when El Niño occurs. Surprisingly under such arid conditions, irrigation is normally not used. The fruits are sold in local markets and in Lima. No loche is grown in nor exported to neighboring countries.

The most productive region lies around Chiclayo, the capital city of Lambayeque. In the past, this was a major trade center between the coast and the highlands and the Amazon beyond, plus settlements to the north and south. The area is rich in important pre-Inca archaeological sites where *Cucurbita* remains have been found. Unfortunately, the loche,

unlike other squashes, does not preserve well. Squash seeds, pedicels, and rind macro fragments are often found well preserved in the dry coastal archaeological sites. But the loche produces few seeds; the pedicels are weak and do not separate from the decaying fruit, and the rinds are non-lignified. Micro remains of squash rind phytoliths are abundant in these sites, but there are no phytoliths in loche rind. Re-evaluation by Andres and Nee (unpublished) since the study of Whitaker and Bird (1949) of the thousands of macro *Cucurbita* remains from Huaca Prieta, Chicama Valley, Peru, where some of the earliest such specimens have been found in South America, now housed at the American Museum of Natural History in New York, show that some of the pedicels resemble the distinct pedicels of loche.

A better source of information in the archaeological record comes from the Moche people, a pre-Inca culture who flourished in the coastal valleys of northern Peru approximately A.D. 50–800. They were highly skilled in ceramics and left a legacy in tombs of realistic life-size fruits and vegetable sculptures as well as depictions of all aspects of their daily life. While farming in the region using desert irrigation began in pre-Moche times, the Moche ceramics show they had a rich assortment of crop plants, including a few species of cucurbits comprised of a diversity of landraces. The most common squash depicted is a warty crooknecked *C. moschata*. But there are some ceramic fruits that are identical to loche. Figure 3 shows one such fruit, photographed at the Universidad Nacional de Cajamarca-Jaén, found at Batan Grande, an important archaeological site located only 40 km. northeast of Chiclayo where in the adjacent picture the fresh fruits in the main market were photographed. Therefore, the loche has an ancient origin. The warty crooknecked squashes are also found in the region today as well as other landraces depicted in the hundreds of surviving Moche ceramics.

Brüning (Schaedel, 1988) thought the loche is semi-wild, and that it is crossed with cultivated squashes to produce a more appetizing fruit. There is no known wild *Cucurbita* in the region today except for *C. ecuadorensis* H.C. Cutler & Whitaker. Furthermore, except for its relatively small size, loche does not have any primitive characteristics of a wild cucurbit. On the contrary, the following characters indicate an advanced state of domestication: reduced to no seed cavity, fruit that does not readily “slip” or abscise from the vine, no lignification of the rind, and non-bitter flesh. It is widely believed that squash was initially domesticated for the edible seeds since all wild species of *Cucurbita* have large seed cavities full of numerous seeds, with little flesh that is bitter, and hard rinds. Although this may be true in North and Central America, south of Ecuador *Cucurbita* seeds are rarely consumed and were therefore probably never an important source of food, although common in traditional medicine nowadays.

Like the loche itself, the highly-prized cuisine of northern Peru deserves to be better known elsewhere. The dishes include a rich assortment of ingredients, including a number of endemic crop plants. The loche is used in small amounts to flavor desserts, soups, and stews, most notably the traditional regional dish made with kid goat called “seco de cabrito a la norteña.” In the local markets, loche is sold in cut up pieces at premium prices; for example, April 2006 prices in supermarkets in Lima were 16.50 soles per kg versus 2.5 soles per kg for macre (*C. maxima*). Trendy “nouveau Andean cuisine” in Peru has loche as one of its landmarks and is being used as an ingredient in new dishes oriented to international palates because of its distinctive taste. For instance, in a recent gastronomic showroom in Vienna organized by the government of Peru, European chefs highlighted loche and ‘escabeche’ chili pepper (*Capsicum baccatum* var. *pendulum*) as their most remarkable discoveries.

Area under loche production appears to be decreasing, although the word itself is being misapplied to a broader range of cultivars and therefore is growing in usage. The agriculture of the region is shifting to industrial scale crop production for mostly export, primarily of rice, sugarcane, cotton, asparagus, mango, and *Capsicum* peppers.

A broader effort should be made to promote traditional dishes from northern Peru incorporating loche, thus increasing demand for it, and making it available elsewhere. Northern Peru is being regarded as a main tourist area for the near future because of major archaeological discoveries, new museums, and beach hotels, as well as an interesting endemic living culture. This can contribute to new demand for loche and other local crops. The loche is in need of study from ethnobotanical, taxonomic, and horticultural standpoints.

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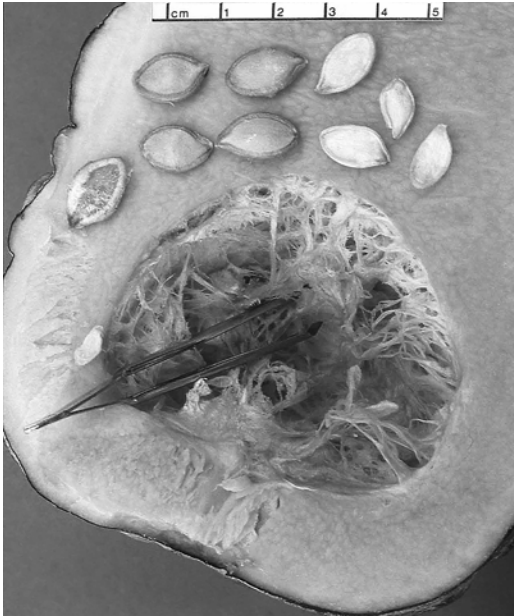


Fig. 1. Longitudinal section through a loche fruit showing the seed cavity at the apical end and the total number of seeds in the fruit, consisting in this case of four or five probably viable seeds (the darker colored seeds to the left) and four aborted seeds to the right.



Fig. 2. Rolando Santa María, expert grower from Illimo, Lambayeque, Peru, in his field of loche.

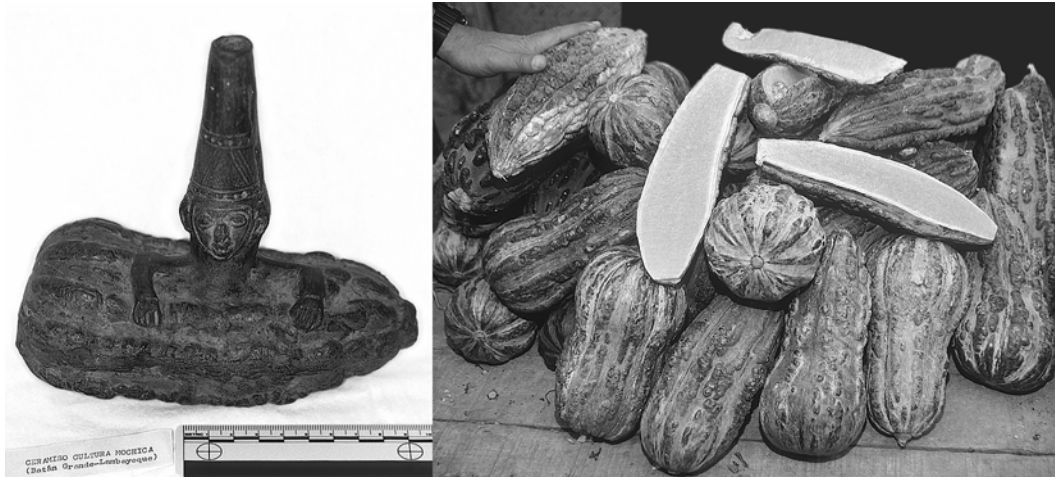


Fig. 3. Comparison between archaeological ceramic loche fruit (left) and present-day seedless and seeded fruits (right).