Abstract

The botanical identification of *Ulluchu*, an iconic fruit frequently depicted in the art of the pre-Columbian Moche culture that flourished from A.D. 100–800 on the Peruvian north coast, has eluded scientists since its documentation in ceramics in the 1930s. Moche fine-line drawings of *Ulluchu* normally depict seed-pods or seeds floating in the air in sacrificial scenes, associated with runners and messengers or intoxicated priests. It is a grooved, comma-shaped fruit with an enlarged calyx found mainly in fine-line scenes painted on Moche ceramics. The term first appeared without linguistic explanation in the work of pioneer Moche scholar Rafael Larco Hoyle, and the identification of the plant was seen as the largest remaining challenge in current archaeobotany at the Peruvian North coast. The name *Ulluchu* seems to have been coined by Larco. According to his description, the name originated in the Virú River valley, and is supposedly of Mochica origin. However, there is no linguistic evidence that such a term indeed existed in the Mochica or Yunga language.

We conclude that *Ulluchu* can be identified as a group of species of the genus *Guarea* (Meliaceae) based on morphological characteristics. In addition, the chemical composition of the plant’s compounds supports the thesis that it was used in a sacrificial context to improve the extraction of blood from sacrificial victims. We also suggest that a ground preparation of *Guarea* seeds, when inhaled, may have been used as a hallucinogen. However, more detailed phytochemical research is needed to corroborate the latter hypothesis.

Background

*Ulluchu* is the common name assigned to a plant frequently depicted in the art of the Moche culture, which thrived on the north coast of Peru from A.D. 100 to 800. It is a grooved, comma-shaped fruit with an enlarged calyx found mainly in fine-line scenes painted on Moche ceramics. The term first appeared without linguistic explanation in the work of pioneer Moche scholar Rafael Larco Hoyle ([1] Fig. Fifty-eight: [2] Fig. Ninety-eight, Figs. One hundred and sixty-six and sixty-seven). In his 1939 publication, he reported that the peoples of the sierras and the coastal region (Viru and Moche valleys) believed that the fruit had to be picked silently to prevent it from turning bitter. He wondered if the plant symbolized the silence...
and discretion of richly attired Moche messengers, some of whom wear belts adorned with Ulluchus. In his 1938 publication, he labeled a Moche fine-line drawing of Ullu-
chus as Phaseolus sp. (a bean). Larco clearly recognized that Ulluchus had nothing whatsoever in common with "ulluco" (Ullucus tuberosus), an Andean tuber still widely cultivated and consumed in Peru nowadays.

The symbolic importance of Ulluchus in Moche iconogra-
phy was firmly established by Moche scholar Donnan McClelland [3]. Based upon a meticulous review of the UCLA Moche Archive, she showed that its distribution was non-random and that its varied usage displayed definite patterns with the greatest variability among back-
ground elements and the most frequent representation found on the belts of warriors and runners. She demon-
strated that "the leaves of the Phaseolus do not resemble the ulluchu leaf depictions" [[3]: 43]. Pepino (Solanum muricatam) and aji (Capsicum annum), which are clearly depicted in Moche art and do not resemble Ulluchus were also eliminated "since the ulluchi [sic] fruit is suspended from the plant by its smaller pointed end, whereas these two are suspended by the large end" [[3]: 437]. She also indicated that the plant had not been botanically identified, pointing out that, if it turned out to be a mythical plant, no identification would be possible.

A decade after McClelland's seminal article, S. Henry Was-
sen [4] of the Gothenburg Ethnographical Museum, elimi-
nated Persea americana Miller var. americana (a wild relative of avocado) as a candidate, and concluded that Ulluchus was Carica candicans A. Gray (a species of wild papaya). He also co-authored an article describing the enzyme papain, which can be extracted from unripe papaya, for use as a blood anti-coagulant [5]. In the latter article, the authors proposed that papain was used in the Moche sacrifice ceremony to prevent the coagulation of blood drawn from sacrificed warriors for later consump-
tion by priests.

In a paper presented at the Sibley Conference at the Univer-
sity of Texas at Austin, in November 2003, McClelland [6], in addition to updating her 1977 paper in the light of a vastly expanded Moche Archive and archaeological discov-
eries of real Ulluchus, refuted the papaya hypothesis. She also discussed the presence in the art of yellow oleander seeds (Thevetia peruviana) as legging rattles as well as espingo seeds (Nectandra sp.) which [7] had earlier suggested might have been added to corn beer for medicinal and psycho-
tropic purposes. McClelland concluded that the largest remaining challenge was the identification of Ulluchus.

In the present paper we build on the work of Donna McClelland and the archaeological excavations at Sipán in the Lambayeque Valley [8,9] and at Dos Cabezas in the Jequetepueque Valley in the 1990s [6].

Materials and methods
The primary focus of this project has been the ethnobot-
any of medicinal plants used in Northern Peru and South-
ern Ecuador, and the changes that have occurred since early colonial times. Fieldwork for the present study was conducted in Southern Ecuador from 1995–2000, and in Northern Peru from 2001–2008. In the course of the field-
work vouchers of all useful plant species sold in the mar-
kets of the region were collected after establishing prior informed consent. The specimens were registered under the collection series "RBU/PL," "ISA," "GER," "JULS," "EHCHL," "VFCHL," "TRUBH," and "TRUVANERICA," depending on the year of fieldwork and collection location. Vouchers of all specimens were deposited at the Her-
bario Truxillensis (HUT, Universidad Nacional de Trujillo), and Herbario Antenor Orrego (HAO, Universi-
dad Privada Antenor Orrego, Trujillo). In order to recog-
nize Peru's rights under the Convention on Biological Diversity, most notably with regard to the conservation of genetic resources in the framework of a study treating medicinal plants, the identification of the plant material was conducted entirely in Peru. No plant material was exported in any form whatsoever. The nomenclature of plant families, genera, and species followed the Catalogue of the Flowering Plants and Gymnosperms of Peru [10] and the Catalogue of Vascular Plants of Ecuador [11]. The nomenclature was compared to the TROPICOS database. Species were identified using the available volumes of the Flora of Peru [12], as well as [13,14] and reference material in the herbaria HUT, HAO, QCA, LOJA, and QCNE.

In addition to documenting the associated use-knowledge, plant collectors, vendors and curanderos (local heal-
ers) were interviewed about any possible knowledge of Ulluchus. Also, colonial records about useful plants of the region, which include [15-21] were searched for possible information and iconography of the plant. Photographs of all archeological specimens found, including photo-
graphs of the interior fruit structure in broken specimens, were obtained and used for direct comparison to botan-
ical vouchers and life specimens of plant candidates. Ulti-
ately, the available online collections of the Chicago Field Museum, New York Botanical Garden, and Missouri Botanical Garden were checked for possible candidates, and specimens from the Missouri Botanical Garden Her-
barium were used for final determination and imaging.

Discussion and Results
Issues surrounding the name Ulluchus
The name Ulluchus seems to have been coined by Larco [1]. According to his description, the name originated in the Virú River valley, and is supposedly of Mochica origin. However, there is no linguistic evidence that such a term indeed existed in the Mochica or Yunga language. The most comprehensive Mochica-Spanish dictionary available, compiled from the writings of Moche scholar...
E. Brüning [22], has no such term. In addition, the local population, as well as market vendors, plant collectors, and curanderos interviewed, had no knowledge of Ulluchu whatsoever, other than what they derived from Larco. Since this first publication the term has been copied by all subsequent authors [e.g. [3,4]], without any regard to its validity. It is unlikely that Brüning [22] would have missed the name when doing his research early in the 20th century, if it indeed was still being used. Brüning lists quite a few Mochica plant names, some of which are still used for the same plants today, e.g. "faik" = Acacia macracantha (faique, espino), from "fāček, fāčke" = spine.

The only language that has a somewhat similar word from which Ulluchu could be derived is Quechua: "uchu" translates to "chili, pepper," while "ullu" translates as "penis." The term "ullu uchu" is sometimes used as a name for Colomeliella ovata R. & P. (Columelliaceae), a small high-Andean plant, described as "a very thick tree; its wood is suitable for various purposes, and its leaves have febrifugal properties and are very bitter" [21]. However, this plant has no likeness whatsoever to the Moche Ulluchu. Thus we must conclude that the term Ulluchu was most likely coined by Larco [2]: 98 based on a Quechua term for a species with somewhat similar fruits that has no relation to the species used by the Moche.

**Botanical identification**

*Why is Ulluchu not Carica candicans?*

*Carica candicans* is a wild relative of papaya (*Carica papaya* L.). Although the fruits are not marketed, they are occasionally consumed by the local population, and some market vendors and healers interviewed did know the plant under its vernacular name, "mito." Larco [1,2] never mentions the plant in relation to Ulluchu. Assuming that he indeed encountered a plant with that name, it cannot have been *C. candicans*, because this species would have been named "mito."

McClelland [6] argues that Ulluchu "cannot be a papaya, which belongs to a group of plants called 'cauliflory' [i.e., stem flowery]. . . . The flowers and fruit of a cauliflory grow on the trunk of the tree and not on the limbs. . . . Ulluchus depicted in Moche art, however, hang from limbs. Papaya leaves do not resemble ullu leaves, which are triangular, ovoid, or boomerang shapes hanging from limbs. Each large palmate papaya leaf grows on a stem from the top of the tree." However, further complicating this matter, it turns out that *C. candidans* happens to be one of the few papayas that are not cauliflorous, that have triangular leaves with entire margins, and the fruits do hang from branches. Thus, judging from the iconography alone, *C. candidans* actually could be Ulluchu.

Based on recent archaeological evidence however, [6,8,9,23], it has become clear that the actual fruits found in burials do not resemble *C. candidans*. In addition, the explanation that papain, might have been extracted by the Moche from unripe papaya for use as a blood anti-coagulant [5], albeit reasonable, does not make much sense from a phytochemical perspective. Cultivated papaya (*C. papaya*) is often depicted in Moche pottery, and the species contains large amounts of papain. Why would the Moche have resorted to a rare wild species, when they could have used a cultivar with the same properties that grew on their very doorstep? Also, *C. candidans* fruits are often 10–15 cm. long, and, while this would relate to the size of some of the *Ulluchus* in the iconography, it is vastly larger than many of the fruits depicted and much larger than the fruits

![Figure 1](http://www.ethnobiomed.com/content/5/1/8)
found in burials. Finally, the anatomy of *C. candicans* simply does not correlate with the fruits encountered in burials.

**What is Ulluchu, and what was it really used for?**

Moche fine-line drawings of *Ulluchu* normally depict seed pods or seeds floating in the air in sacrificial scenes (e.g., [6] Fig. Three.14), associated with runners and messengers (e.g., [6]: Fig. Three.1) or intoxicated priests (e.g., [6]: Fig. Three.6). The *Ulluchu* fruits vary greatly in size, ranging from about 1–15 cm. They are normally comma-shaped, often with an "exaggerated round calyx" ([6]: 43) with lines on the body of the fruit (e.g., [6]: Fig. Three.4). Some illustrations show *Ulluchu* harvested by monkeys, and in such cases the fruit is mostly shown growing along the axes of the plant's leaves (e.g., [6]: Figs. Three.27 & Three.28).

Starting from this basis in 2002, we built on the work of Donna Mc Clelland and the archaeological excavations at Sipán in the Lambayeque Valley [8,9,24] and at Dos Cabezas in the Jequetepeque Valley in the 1990s [6,23]. Botanically, all these depictions resemble capsules or drupe-like fruits. It became apparent that in a biodiversity hotspot like Peru, with a flora of more than 18,000 species, a large number of plant families have fruits that vaguely resemble *Ulluchus*. Many of these families contain more than one genus with similar fruits. Examples include: (Apocynaceae: *Ambelania*; Caricaceae: *Carica*; Celastraceae: *Maytenus*; Chrysobalanaceae: *Chrysobalanus*, *Hirtella*, *Licania*; Convolvulaceae: *Dicanostyles*; Fabaceae: *Aldina*, *Alexa*, *Andira*, *Dipteryx*, *Dussia*, *Ormosia*; Guttiferae: *Tovomita*; Hippocrateaceae: *Cheiloclinum*, *Sala-

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**Figure 2**

**Line of prisoners at Huaca El Brujo.** Photo by Rainer W. Bussmann.
which may be seen as another indication of the ingestion of some substance causing this effect. From this perspective Larco’s term *Ulluchu* [2], if derived from Quechua “ullu-uchu” – “penis pepper,” would in fact make sense in describing the possible effects of the plant in question. Also, the association with sexual arousal is reinforced by mythical scenes where an *Ulluchu* tree grows out of the back of an erotic couple.

In light of the above, *Ulluchu* is a tree with opposite leaves and fruits that are drupes between 1–15 cm long possibly containing active ingredients that would elevate the blood pressure and cause erections, and psycho-active substances. The only plant family from the list above having representatives that meet all these criteria is Meliaceae, and the genus *Guarea* is the one that most closely fits the description. It includes mostly trees with pinnate leaves (which is unusual for Meliaceae), and fruits that are 3–5 valved capsules, with large, pseudo arillate seeds. The genus *Guarea* is found throughout Peru, but is mostly restricted to tropical lowland forests, with some species reaching cloud forest habitat. No species is found along the dry coast of Peru, which indicates that the material must have been widely traded in Moche times. A typical representative is *Guarea grandifolia* DC. The species has clearly pinnate leaves (Fig. 3A), and the fruits (Fig. 3C) very clearly resemble the archaeological samples depicted in Fig. 1. In addition, *Guarea* contains a large number of species with varying fruit sizes (from 1–15 cm.), calyx swelling, and grooving on the body of the fruit (Fig. 4), which all correlates with the varied *Ulluchu* imagery in Moche fineline drawings. The seeds of *Guarea* species, with a distinct white navel, very much resemble the seeds depicted in Moche fineline paintings.

Many species of *Guarea* are known by a wide variety of vernacular names, e.g., *Guarea* spec.: requia, kushimsakish; G. *glabra*: yecheñor, yechemor; G. *grandifolia*: bola requia; G. *guidonia*: atapio, latapi, latapi caspi, requia colorada, requia latapi, xoro; G. *kunthiana*: requia, paulli ruro; G. *purusana*: latapi, requia). The wood of many species is used as timber for construction. The wood, bark, and leaves contain compounds that act as abortive, emetic, purgative, and antimicrobial agents, and the bark is often sold as *Coccilliana* in expectorant preparations [12, 26-28]. The fruits and seeds contain a variety of alkaloids that are very rarely used due to their high toxicity [29]. Some of the alkaloids found, e.g. rusbyine, have a structure and effects like emetine, an alkaloid found in *Psychotria ipecacuanha* (Brot.) Stokes, which has been widely used as an emetic and expectorant. Other species of *Psychotria* are well

![Figure 3](image)

**Figure 3**

*Guarea grandifolia*. A. Mature branch. B. Flower. C. Mature fruit. D. Fruit cross section. E. Seeds. F. Branching pattern.

![Figure 4](image)

**Figure 4**

Fruits of various species of *Guarea* (*G. macrophylla* with seeds, *G. carapoides*, *G. carinata*, *G. macrophylla*, *G. purusana* with seeds, *G. guentheri* with seeds).
known as components in ayahuasca preparations due to their high content of N,N-DMT [30]. In large dosages, ipecac preparations cause high blood pressure, arrhythmia, spasms, and extension of the blood vessels. While the existing literature on Guarea seed compounds is rather fragmentary, it seems clear that a concentrated dosage of Ulluchu seeds, if ingested, would increase a prisoner's heartbeat, elevate the blood pressure, and widen blood vessels thus causing erection. All of this would make it much easier to extract sacrificial blood. Also, when inhaled by priests, the active compounds could have a mind-altering effect, which would not necessarily lead to high levels of toxicity, and could induce very rapid, short-term hallucinations.

Conclusion
We conclude that Ulluchu can be identified as a group of species of the genus Guarea (Meliaceae) based on morphological characteristics. In addition, the chemical composition of the plant's compounds supports the theses of [3,4] that it was used in a sacrificial context to improve the extraction of blood from sacrificial victims. We also suggest that a ground preparation of Guarea seeds, when inhaled, may have been used as a hallucinogen. However, more detailed phytochemical research is needed to corroborate the latter hypothesis.

Declaration of Competing interests
The authors declare that they have no competing interests.

Authors' contributions
Both authors share the contributions to fieldwork, data analysis, and compilation of this manuscript. All authors read and approved the final manuscript.

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