Corn, Colanders, and Cooking: Early Maize Processing in the Maya Lowlands and Its Implications

David Cheetham

Introduction

One of the least-explored areas in the analysis of prehistoric ceramics is how pottery vessels were actually used; that is, the particular purpose they served (Rice 1996:139). Such insights are often thwarted or ignored in classification schemes tailored primarily to deduce temporal frameworks and patterns of ceramic interaction, and most type-variety studies of prehistoric Maya pottery are no exception. Treating pots as tools designed to meet a specific need (Braun 1983) provides valuable insight into prehistoric behavior well beyond what is achievable through typological analysis alone.

My intent in this study is to demonstrate the value of the “pots as tools” perspective by examining the utilitarian vessels used by the earliest fully sedentary Maya villagers (ca. 1000–800 BC) to prepare lime-pretreated maize, or nixtamal, most likely for tamales or other gruel-based foods.¹ I begin by outlining the technology and implements required to make nixtamal, the nutritional advantages of preparing maize in this manner, and ethnographic examples of its application. I then summarize available data concerning the productivity of early maize in the Maya Lowlands in order to generate probable crop sizes and corresponding caloric values for the period in question. The volume of ceramic vessels used to process maize in two separate areas of the lowlands, the Belize Valley and central Petén, are presented and linked with estimated household supplies of maize. I conclude that the amount of maize required to make nixtamal at this early date necessitated a multi-household effort in both areas, and that consumer groups in the central Petén were probably larger than in the Belize Valley. The cooperative nature of maize processing indicates extended household social organization from the outset of village life in the Maya

¹ All dates in this chapter are presented in uncalibrated radiocarbon years BC.
Lowlands and hints that during the preceding Late Preceramic period consumer groups were organized in a similar manner.

**Making Nixtamal: Motivation, Materials, and Methods**

The practice of boiling maize in lime water was the cornerstone of ancient cuisine in Mesoamerica. Called *nixtamalli* by the Aztecs (Hispanicized nixtamal), lime-pretreated maize is still made throughout Central America. Why has this curious culinary technique endured? There are two benefits to processing maize with lime. First, it effectively removes the tough outer shell (pericarp) of the kernel, which certainly makes maize more palatable. Second, it provides a major nutritional advantage over untreated maize by improving the accessibility of niacin (vitamin B) and six amino acids (protein) and supplying an excellent source of calcium to the diet (Bressani and Scrimshaw 1958; Bressani et al. 1958; Katz et al. 1974). Both factors surely contributed to the method’s longevity, but I suspect the removal of stubborn shells was the impetus for the diffusion of lime processing.

The lime required to make nixtamal is obtainable from three sources: hardwood, marine and freshwater shells, or limestone. In rare cases, where shells are used, they are cooked on a fire for several hours, then transferred to containers and sprinkled with water to induce slaking. The end result is a fine caustic powder. This practice was common among Lacandon Maya families in the tropical lowlands of eastern Chiapas, who, in a typical production episode, would make about 25 gallons of lime, enough for 9–12 months of nixtamal (Baer and Merrifield 1971:152–153; Nations 1979). In earlier times the Lacandon also used mahogany bark, which yields strong lye when burned (Tozzer 1907:51). In cases where limestone is used, chunks of this soft stone are placed on a hot fire for several days. After removal the stones are slaked by adding a small amount of water, again yielding a caustic powder. This powder is stored dry, or more water is added to form pieces for storage. In the highlands of Chiapas, chunks of slaked limestone are stored underground near households to maintain alkaline strength until needed (Vogt 1969:57; see also Pennington 1969:101–102).

The raw material used to make lye in most of the Maya Lowlands during Prehispanic times was certainly limestone. This karst region has a virtually infinite supply of limestone and, in the Belize Valley and adjacent central Petén areas, it yields some of the “best lye for steeping shelled maize” (Thompson 1965:355). In fact, the limestone in this area is of such high quality that small-scale lime making for nixtamal and other purposes (e.g. mortar) is still very common (e.g. MacKinnon and May 1990:200). Exactly where slaked lime to make nixtamal would have been stored in prehistoric times is unknown, though the enigmatic subterranean storage chambers (*chultunob*) frequently encountered near household patio groups may have been used for this purpose.

Other uses for slaked lime include mixing it with tobacco to make *pilco*, a stimulant that was chewed (Redfield and Villa Rojas 1939:111; Thompson 1970:112),
for tanning skins (La Barre 1948:130), for temper in pottery (Hughes-Hallett 1972), and possibly for medicinal purposes. The Chorti Maya mixed slaked lime with water and coated stored maize with this paste to prevent infestations of weevils and other pests (Wisdom 1940:108). They also boiled lime with plants to produce dyes and added lime to finished dyes to lighten their color (Wisdom 1940:101). All of these applications, and likely many others, were probably common in the Maya Lowlands during Prehispanic times. Of course, enormous quantities of lime were also consumed in the form of plaster to cover masonry buildings, plazas, and other architectural features.

The Lacandon Maya provide one of the most thoroughly documented cases of nixtamal-making. As early as the 1890s, there are eyewitness accounts that maize was boiled and soaked overnight in lime to remove the outer shells, after which the nixtamal was rinsed and milled (Maler 1901:31; Tozzer 1907:51). By the late 1960s, five-gallon metal tins had replaced ceramic cooking vessels (Baer and Merrifield 1971:145–149, 161), but the basic cooking process had not changed.

The five-gallon tin is ... put on the fire ... in the afternoon ... filled about half full of water ... about a cup of lime [is added]. When the water and lime begin to boil, the tin is removed from the fire ... corn is ladded in with a gourd ... the tin is filled [with corn] to within an inch of the rim ... stirred ... [and] placed back on the fire to cook until the shell begins to separate from the inner kernel. [The] tin is removed from the fire ... [and] the corn is covered ... until morning ... [when the] woman removes ... the shells ... from ... the top of the water. She then ... ladles [the corn] into a basket ... and takes it to the river to wash. (Baer and Merrifield 1971:186, emphasis mine)

Photographs make it clear that during the 1960s nixtamal was also rinsed near domestic structures (see Baer and Merrifield 1971:189).

In anticipation of the modeling presented later in this study, it is important to underscore the fact that in the Lacandon case cooking vessels were filled to, or near to, capacity. In fact, every detailed account of nixtamal preparation I am aware of uses a roughly 1:1 ratio of water and maize. With minor variations, accounts like the Lacandon case cited above occur in the ethnographic and ethnohistoric of several Maya regions, including the highlands of Chiapas and Guatemala (Vogt 1969:57, Fig. 21), the Yucatan Peninsula or northern Maya Lowlands (Gann 1918:21; Smyth 1989:118; Tozzer 1907:51), and east-central Guatemala (Wisdom 1940:88). This method of making nixtamal also was closely replicated in northern Mexico (Bennett and Zingg 1935:33; Pennington 1963:78–79, 1983:281, Fig. 3), and lime-soaked maize was common in the American Southwest (Crown and Wills 1995:178; Russell 1908:73; Stevenson 1915:74, 76; cf. Woodbury and Zubrow 1979:47) and as far north as the western Great Lakes region of Minnesota, Wisconsin, and western Ontario (Densmore 1928:319).

After maize is boiled in an alkaline solution, it must be rinsed in clean water. The tool of choice in most documented cases is a ceramic colander, perforated gourd, or basket, but nixtamal can also be rinsed in jars. Although some scholars (e.g. Arnold 1985:17; Skibo and Blinman 1999:172–173) claim that perishable strainers would not be used because lye causes deterioration, ethnographic examples suggest otherwise. In the Maya area, for example, reed baskets were used in
the Guatemalan Highlands (Ricketson 1937:253), and in lowland Chiapas both baskets and gourds were common as recently as the 1960s (Baer and Merrifield 1971:148–149, 161, 185). At about the same time, baskets were being used by some northern Mexican peoples (Pennington 1969:101–102).

The best account of modern ceramic colanders in the Maya area is provided by Reina and Hill (1978), who aptly conclude that presence of these vessels throughout the Guatemalan Highlands is the result of a traditional diet and specific way of preparing maize (Reina and Hill 1978:209). Indeed, the occasional mention of colanders and their function by earlier investigators (Blom and LaFarge 1926:332, 338–339, 345; Ricketson 1937:253) confirm the longevity of nixtamal preparation in the region. Most modern specimens are unslipped medium-size jars with handles and numerous perforations throughout the base and lower body walls (Fig. 1), although hemispherical bowls with perforated bases are also made (Reina and Hill 1978:Pls. 108–111). The Lacandon Maya used ceramic colanders at the turn of the last century (Maler 1901:31; Tozzer 1907:51) and presumably up to the point when metal containers were introduced.

Simply transferring nixtamal to a pot of clean water for rinsing is the least recorded procedure in the ethnographic literature (but see note 7 and Vogt 1969:57 for a rare instance in highland Chiapas). Of course, this method would leave no telltale sign in the archaeological record. I suspect that in archaeological cases where nixtamal was likely made and colanders are lacking (e.g. Classic Maya) jar rinsing was common or strainers were made of perishable materials.

Finally, no summary of nixtamal-making in Mesoamerica would be complete without a brief mention of the intended food. In antiquity, as in modern times, this invariably was tortillas or tamales, although a nutritious drink (atole) or gruel (pozole) can also be made. In the case of tortillas and tamales, the nixtamal is milled when moist and water added to achieve the desired consistency. At this point the paste or dough is called masa. For tortillas, pieces of masa are pressed into thin, flat cakes and toasted on a flat ceramic or steel griddle (comal). Tamales are elongated

![Modern pichanchas (colanders) of the Guatemalan Highlands](http://example.com/fig1.jpg)
or round pieces of masa that are thicker than tortillas and usually wrapped around an interior filling of vegetal matter, meat, beans, or any combination of these items. The whole is then wrapped in wet corn leaves or husks (in modern times banana leaves are often used), and many tamales are boiled or steamed in a ceramic jar or suitable modern container. The origin of these foods is a mystery, but tortilla making is usually detectable in the archaeological record by the presence of flat ceramic griddles (e.g. Grove 2000:141). The lowland Maya did not make tortillas during the Preclassic or Classic periods, although tamales are depicted on Classic period polychrome pots and other objects (Taube 1989). As we shall see, current evidence suggests that tamales were enjoyed at a much earlier date.

**Early Maize in the Maya Lowlands: History and Estimated Productivity**

Pollen extracted from deep cores below several lakes in northern Belize and the central Petén (Figs. 2 and 3) indicates that maize debuted in the Maya Lowlands about 3000 BC, some 20 centuries before pottery. The pollen record also points to deforestation and repeated burning during this lengthy preceramic era, conditions
attributable to frequent swidden field preparation (slash-and-burn or milpa) and hence a significant time commitment to land – clearing, planting, weeding, and reaping. The necessity of tending milpas coupled with unfettered access to the numerous terrestrial and aquatic food sources in this tropical setting raises the possibility that many, if not most, preceramic groups were sedentary in particular sites for years at a time.

The proposed link between Preceramic period swidden labor requirements and a pattern of semi-permanent residency needs clarification. A milpa cut from primary tropical forest, although yielding relatively large harvests, requires about five times as much effort to clear as an identical size plot in secondary growth (Nations and Nigh 1980:8). Appreciating this fact, one would be inclined to repeatedly

Fig. 3 Locations and dates of early forest disturbance and maize cultivation in the Maya Lowlands (see Fig. 2 for locations)

<table>
<thead>
<tr>
<th>location</th>
<th>initial forest clearing</th>
<th>maize introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Belize</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cob Swamp</td>
<td>2500 B.C.</td>
<td>3400-3000 B.C.</td>
</tr>
<tr>
<td>Cobweb Swamp</td>
<td>2500-2400 B.C.</td>
<td>2500 B.C.</td>
</tr>
<tr>
<td>Laguna de Cocos</td>
<td>3000 B.C.</td>
<td>2000-1500 B.C.</td>
</tr>
<tr>
<td>Petén, Guatemala</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lake Petén-Itza</td>
<td>3600 B.C.</td>
<td></td>
</tr>
<tr>
<td>Lake Petenxil</td>
<td>n/a (savanna)</td>
<td>2000 B.C.</td>
</tr>
<tr>
<td>Lake Quexil</td>
<td>1500 B.C.</td>
<td>3000 B.C.†</td>
</tr>
<tr>
<td>Lake Sacnab</td>
<td>1800-1500 B.C.</td>
<td>3000 B.C.†</td>
</tr>
</tbody>
</table>

†Pohl et al. (1996:362-363).
‖Islebe et al. (1996:265, 269).
¶Cowgill and Hutchinson (1966:122); Tsukada (1966).
‖Deevey (1978); Deevey et al. (1979:298).
*Deevey et al. (1979:298).
†Crop unspecified (reported by Deevey et al. [1979:302] as “agricultural disturbance”).

Clearing land with stone tools, which requires about twice the labor input as steel machetes and axes (see Hester 1952), may also have discouraged the unnecessary clearing of primary forest. However, large trees also can be killed by “girdling” the trunk – removing an encircling strip of bark and wood – thus inducing defoliation and allowing sunlight to reach the ground. This strategy, which is greatly aided with the use of fire, has the potential to reduce the requisite labor to clear primary forest (see Piperno and Pearsall 1998:180), although to what extent is unknown in the absence of quantified ethnographic data.
cultivate nearby, previously felled primary forest (mature fallow lands) before resorting to increasingly distant stands of virgin forest, especially when population pressure is minimal. For example, before the 1970s, the isolated Lacandon Maya of eastern Chiapas, Mexico, had virtually unlimited access to primary forest, yet routinely cut milpas in secondary growth near their communities (Nations and Nigh 1980). This labor-saving strategy was so common that on occasions when communities did relocate, previously abandoned villages were chosen to ensure access to mature stands of secondary growth (Baer and Merrifield 1971; Tozzer 1907:38). Although we currently lack the settlement pattern data necessary to demonstrate this or any other residency pattern for the Preclassic period, I believe the Lacandon strategy is fitting, at least for groups that occupied choice lands near lakes or rivers, faced little or no population pressure (i.e. no land shortage), and had abundant resources at their disposal. At the very least, the lengthy pollen record of forest clearing, burning, and maize cultivation in the Maya Lowlands suggests a level of sedentism and social organization exceeding that of band level societies (see Clark and Cheetham 2002).

Unfortunately, pollen is no help in identifying the ultimate origin of early maize in this region. Nevertheless, local hybridization is doubtful since the wild progenitor of maize, teosinte, does not grow naturally below about 900 m in elevation (see Kempton and Popenoe 1937), an altitude exceeding most of the Maya Lowlands. Genetic data indicate that domesticated maize originated in the central Río Balsas drainage region of Guerrero, Mexico, as a result of mutations in annual teosinte (Zea mays ssp. parviglumis) (Matsuoka et al. 2002; see also Benz 1999; Doebley 1990; Piperno and Pearsall 1998; Smith 1995). Based on direct AMS dating, maize was domesticated no later than 3500 BC, and spread throughout most of Middle America during the ensuing millennium (Blake 2006; Freitas et al. 2003). Given the time lag involved, Zea mays probably arrived in the Maya Lowlands already domesticated, the seeds either carried by immigrants from an adjacent region or obtained through exchange by indigenous groups.

It is not until the advent of permanent villages and ceramic technology, however, that carbonized maize fragments appear in the archaeological record. Several small cupule fragments were found on and below Cunil phase (ca. 1000–800 BC) architecture at Cahal Pech (Lawlor et al. 1995), but size prevents an assessment of overall cob morphology. A larger sample of small cob fragments and kernels is reported from slightly later Swasey phase deposits at Cuello (Miksicek 1991:71–73; Miksicek et al. 1981), together with a 14C date of 770 ± 130 BC from maize kernels found in the initial occupation level (1A) above the paleosol (Hammond et al. 1991:Table 1). Metric measurements (Table 1) indicate that a “typical” intact cob would have had about 12 rows of kernels, a rachis (stem) width of 0.6–0.9 cm, and a complete width in excess of about 2.2 cm. Miksicek and his colleagues (1981:58) note similarities with several maize types from South America and Mesoamerica, to which I would

---

3The fibrous cup-like depression or socket from which a maize kernel grows and becomes imbedded.
add that many measurements are consistent with roughly coeval (1150–1000 BC) maize impressions in mud at the Pacific Coast site of Salinas La Blanca, Guatemala, attributed to the Nal-Tel–Chapalote race originally of the central Mexican Highlands (Mangelsdorf 1967:Table 14; see also Mangelsdorf et al. 1964:174, Mangelsdorf et al. 1967:188–189). Of course, exact classification of early maize in the Maya Lowlands must await a more robust data set, particularly whole cobs.

In spite of this drawback, it is possible to provide a rough estimate of the productivity of maize in this area ca. 1000 BC (Table 2) using diachronic cob length data for the Tehuacán Valley (Kirkby 1973:Fig. 48a; also see Mangelsdorf et al. 1964) and crop yield/cob size correlation data for the Valley of Oaxaca (Kirkby 1973:Fig. 48b). While admittedly imperfect when applied to a region as distant and climatically different as the Maya Lowlands, these data suggest that a typical cob was 6.5-cm long, a size compatible with the metric measurements of the Cuello fragments. Considering that modern first-year milpas in the Maya Lowlands average 878 kg of shelled maize per hectare (Cowgill 1962:276–277), the estimated

### Table 1 Summary metric data for Swasey phase (ca. 850–750 BC) maize remains from Cuello, Belize (after Miksicek et al. 1981:Table 1; Miksicek 1991:Table 4.3)

<table>
<thead>
<tr>
<th>Cultural/stratigraphic phase</th>
<th>No. of frags</th>
<th>Mean No. of rows</th>
<th>Mean rachis dia. (mm)</th>
<th>Percentage of Cuello maize types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swasey IIb–c</td>
<td>10</td>
<td>11.6</td>
<td>6.3</td>
<td>SW I 73, SW II 9, SW III 18</td>
</tr>
<tr>
<td>Swasey IIa</td>
<td>22</td>
<td>12.5</td>
<td>7.8</td>
<td>SW I 14, SW II 77, SW III 9</td>
</tr>
<tr>
<td>Swasey I</td>
<td>10</td>
<td>13.5</td>
<td>7.8</td>
<td>SW I 70, SW II 30, SW III 0</td>
</tr>
<tr>
<td>Swasey 0 (paleosol)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

### Table 2 Estimated morphology and productivity of maize in the Maya Lowlands, 1000–800 BC

<table>
<thead>
<tr>
<th>Cob length (cm)</th>
<th>Lower limit</th>
<th>Average</th>
<th>Upper limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0</td>
<td>6.5</td>
<td>8.0</td>
<td></td>
</tr>
</tbody>
</table>

| Average number of rows (kernels) | 12 | 12 | 12 |
| Average kernel width (mm) | 5 | 5 | 5 |
| Average kernel length (mm) | 5.3 | 7.0 | 5.3 |
| Average kernel thickness (mm) | 4.0 | 5.3 | 5.0 |
| Number of kernels per cob | 120 | 156 | 192 |
| Yield per hectare (kg dried seed) | 170 | 330 | 500 |

*After Kirkby (1973:Fig. 48)*
average yield of 330 kg of dried seed per hectare seems appropriate; both ancient yield and cob size estimates are slightly less than one-third of modern counterparts. Of course, this assumes that the number of ears per plant remained relatively stable for some 3,000 years.\(^4\)

What does this tell us about modern and ancient patterns of consumption? On the basis of interview data, Cowgill (1962:277; see also Reina 1967:14) estimates that the average modern (ca. 1959) Maya family (5 people, 1 dog) in the Petén Lakes area consumes 1,730 kg of shelled maize per year, or 770 g per day per person. However, where actual daily intake of maize is carefully measured (Stuart 1990) a much lower average of 370 g is reported. This more realistic level of consumption provides 1,350 calories per person per day, about 61\% of recommended caloric intake (Stuart 1990:136, 139). To meet this demand, a family of six requires 812 kg of shelled maize per annum. Spoilage, infestations, seed for the subsequent crop, and animal feed increase this figure to at least 1,000 kg, requiring about 1.1 ha of arable land.

To reach this level of consumption between 1000 BC and 800 BC, a similar size family would need to harvest maize from slightly more than three hectares. Given the small size of maize cobs, however, there would have been little incentive to do so; the return per unit of labor was small, other protein-rich foods were plentiful, and competition for those foods was surely minimal. I suspect that, on average, maize comprised about 20\% of daily caloric intake at this time, levels requiring a manageable 1.0 ha of milpa land per residential unit (Table 3). This consumption

<table>
<thead>
<tr>
<th>Cultivated milpa land (ha)</th>
<th>0.25</th>
<th>0.50</th>
<th>0.75</th>
<th>1.0</th>
<th>1.25</th>
<th>1.5</th>
<th>1.75</th>
<th>2.0</th>
<th>2.25</th>
<th>2.50</th>
<th>2.75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated yield (kg of dried seed)</td>
<td>83</td>
<td>165</td>
<td>248</td>
<td>330</td>
<td>413</td>
<td>495</td>
<td>578</td>
<td>660</td>
<td>743</td>
<td>825</td>
<td>908</td>
</tr>
<tr>
<td>Net yield (estimated kg–20%)</td>
<td>66</td>
<td>132</td>
<td>198</td>
<td>264</td>
<td>330</td>
<td>396</td>
<td>462</td>
<td>528</td>
<td>594</td>
<td>660</td>
<td>726</td>
</tr>
<tr>
<td>Daily grams of maize per person(^a)</td>
<td>30</td>
<td>60</td>
<td>90</td>
<td>120</td>
<td>151</td>
<td>181</td>
<td>211</td>
<td>241</td>
<td>271</td>
<td>301</td>
<td>331</td>
</tr>
<tr>
<td>Daily caloric value per person(^b)</td>
<td>108</td>
<td>217</td>
<td>325</td>
<td>433</td>
<td>545</td>
<td>653</td>
<td>762</td>
<td>870</td>
<td>978</td>
<td>1087</td>
<td>1195</td>
</tr>
<tr>
<td>Percentage of required daily calories(^c)</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>29</td>
<td>34</td>
<td>39</td>
<td>44</td>
<td>49</td>
<td>54</td>
</tr>
</tbody>
</table>

\(^a\)Based on net yield and a residential unit of six people

\(^b\)Based on 3.61 calories per gram of dry seed (10.6\% moisture content; see Stuart 1990:137–138)

\(^c\)Based on intake of 2,216 calories (see Stuart 1990:136)

\(^4\)Although various preserved portions of prehistoric maize plants are reported for the central Mexican Highlands (see Mangelsdorf et al. 1967:184–187, 190–194), the number of ears per plant through time is unknown.
rate, which ostensibly relegates maize to a supplementary food standing, is supported by the low maize (C₄ plant) values obtained from isotopic analyses of late Middle Preclassic period human bone collagen (Powis et al. 1999:372–373; Tykot et al. 1996) and the likelihood that consumption did not radically change during the intervening 300–500 years. In short, the estimated net annual yield of about 264 kg from 1.0 ha of milpa land would be large enough to provide a reliable food source for the average household, but not its main source of caloric intake.

While the proposed consumption rate for the period 1000–800 BC is low relative to later periods of Maya prehistory (see Schwarcz 2006; Tykot et al. 1996:Figs. 1 and 2), it is not insignificant. If maize was regularly eaten in small amounts, for example, it may have been prepared as gruel or included in soups or stews. If eaten every few days it may have constituted a large portion of main dishes, for instance, tamales. Such patterns of consumption, singly or in combination, would yield the “low” isotopic values noted for slightly later skeletal material. Because maize was probably used to its full potential at this time and during the preceding 20 centuries, strict comparison with the relatively high consumption rates of much later periods, especially the Classic and Postclassic, would be somewhat misleading. Dependency on this crop increased through time relative to yield and cob size, dwindling natural food sources, and rising population. By Classic period times, if not slightly earlier, these factors had coalesced and the era of maize dependency had begun.

Maize Processing and the Cunil Horizon

During the two centuries spanning 1000–800 BC, particularly the latter half, the long-lived tradition of semi-permanent residency in the Maya Lowlands was replaced or abandoned in favor of permanent village life (Fig. 4). The industrious founders of these new settlements leveled hilltops to make way for plazas and durable lime-plastered building platforms, produced the region’s first ceramic vessels and artifacts, and engaged in long-distance interaction with neighboring Mesoamerican cultures to obtain exotic objects, raw materials, and knowledge. The precise cause or causes of this fundamental shift is unknown, but it is clear that over the course of a few decades the region had entered the Mesoamerican fold.

Who were these people and what, if any, was their connection to the inhabitants of the Preclassic period? The earliest pottery provides persuasive evidence that they were indigenous to the region. The overall uniqueness of ceramic vessel traits (e.g. form, slip, surface treatment), for example, excludes derivative scenarios involving immigration from one or more bordering regions (Cheetham 1998:27–28; cf. Andrews et al. 1990). And some of the most salient traits of the initial ceramic assemblages (e.g. slip color preferences and frequencies) persisted well after 800 BC, an era of indisputable Maya occupation. Cultural continuity is also indicated by the persistent styling of other artifact classes, such as baked clay human and animal figurines (Cheetham 2007). If I am correct in asserting that the first permanent villages in this region were founded by indigenous Maya people, then the forest clearing
Corn, Colanders, and Cooking

and maize cultivation of the preceding era is probably attributable to them as well (see also Clark and Cheetham 2002; Iceland 1997).

The most remarkable aspect of the earliest Maya pottery is the similarity of collections across the region (Fig. 5). Generic and odd ritual and serving vessel forms are ubiquitous, particularly dull slips dominate, and slip color frequencies correspond to within a few percentage points or less. The manner, content, and frequency of additional decoration are equally similar. Four percent of sherds (predominantly from serving vessels) in all quantified collections, for instance, received fine-line incisions after they were slipped and fired. Etched decoration of this sort varies in complexity from simple rim-encircling lines to abstract Olmec style and indigenous supernatural creatures of mythological or religious nature. The consistency and distribution of these traits indicate frequent inter-village contact, a common ceramic technology and religious substrate, and, I suspect, a single Maya language or series of mutually intelligible dialects. On the basis of these data, I have argued that the region’s first widespread horizon style occurred from roughly 1000–800 bc (Cheetham 2005). Dubbed the Cunil horizon after the ceramic complex of the same name from the site of Cahal Pech, Belize (Cheetham and Awe 1996, n.d.), this era witnessed a unified pattern of material culture much like that of the subsequent Mamom horizon.

Fig. 4 Uncalibrated Early and Middle Formative period chronological sequences for select sites in the Maya Lowlands
at Cahal Pech (Awe 1992; Cheetham 1995, 1996; Healy et al. 2004). At the nearby site of Xunantunich, a sheet midden below the largest temple pyramid yielded a pure sample of Cunil sherds (Strelow and LeCount 2001), and Cunil and slightly later material occur together above bedrock at Barton Ramie, Pacbitun, Blackman Eddy, and several peripheral sites at Cahal Pech (personal observations of collections, 1994–1995, 2000). In the Petén District of Guatemala, Eb ceramic complex sherds (the local manifestation of the Cunil horizon) occur in several middens at Tikal (Culbert n.d.; Cheetham et al. 2003; Laporte and Fialko 1993), above bedrock at Uaxactún, and at several sites near Lakes Yaxha-Sacnab (personal observations of collections, 1999–2000). In the Pasión drainage area, the Xe and Réal Xe ceramic complexes at the sites of Altar de Sacrificios (Adams 1971) and Seibal (Willey 1970) are also part of the Cunil horizon. A notable exception to this pattern is the Swasey ceramic complex of northern Belize, touted as the oldest pottery in the region for over two decades (Hammond et al. 1979; Kosakowsky and Pring 1998; Pring 1979). Examination of this material by the author and Donald Forsyth

Fig. 5 Reconstruction of Cunil horizon pottery vessels from Cahal Pech, Belize (top), and Tikal, Guatemala. Drawings by Ayax Moreno, courtesy of the New World Archaeological Foundation
revealed a few Cunil horizon ties, but traits typical of the subsequent Mamom horizon (e.g. waxy slips, composite silhouette forms) were found to be common, indicating that the Swasey phase began no earlier than late Cunil times (see Clark and Cheetham 2002:Appendix 3[4]).

The most noteworthy indicator of maize preparation during the Cunil horizon is the colander. These distinctive vessels (Fig. 6) were an integral part of the utilitarian pottery repertoire at sites in the Belize Valley, central Petén, and the intervening zone. Perforated sherds are lacking in ceramic assemblages from the Pasión (Xe, Réal Xe) and northern Belize (Swasey) areas, hinting that colander use was limited to this east–west Belize–Petén corridor. All known sherds are from small to medium size hemispherical bowls with a rounded base. Rims are direct, and closely spaced

Fig. 6 Colander rim and base sherds from the central Petén and Belize Valley (whole vessels 2x graphic scale)

The lack of colanders in northern Belize is not surprising. Swasey material dates to late Cunil horizon times and by 800 BC colander production ceased in all areas. However, their absence in the Pasión area is odd given the considerable ties between serving vessels in this area, the central Petén, and Belize Valley. Either colanders were used and simply not found during excavations, or other methods of rinsing corn were prevalent in the area.
holes (average diameter four millimeters) were poked through vessel bases from the exterior when the clay was wet. Most specimens have coarsely smoothed, soot-free unslipped surfaces that are commonly pitted, and some specimens have traces of white residue—presumably lime—on the interior surface. Central Petén potters often applied a dull red slip to the rim exterior, but on most specimens it is very eroded.

The culinary counterparts of colanders are relatively large unslipped jars and *tecomates* (neckless jars), both of which were used for cooking and storage (see Fig. 5). These globular vessels occur in all Cunil horizon ceramic complexes, but my descriptions are limited to areas where colanders are present. In the Belize Valley, the majority of these vessels are medium to medium-coarse tempered, with unslipped brown or black–brown surfaces burnished to a slip-like consistency on the upper shoulder and neck. Jars generally have rounded bottoms, short vertical necks, and wide vertical strap-handles. Most tecomates were finished in a similar manner, although the rims are usually thickened. As is evident from the dimensions presented in Table 4, the orifice of most of these vessels is too small to allow a colander to be inserted, indicating that maize was removed by some other means, such as a ladle. Ethnographic analogy suggests that wooden stands may have been used to support the colander for initial draining (Fig. 7), the nixtamal then carried to a clean water source and thoroughly rinsed.6 Early Maya jar and tecomate

---

**Table 4** Descriptive statistics for early Maya (1000–800 BC) cooking vessels used to produce nixtamal

<table>
<thead>
<tr>
<th></th>
<th>Central Petén</th>
<th>Belize Valley</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rim diameter</strong> (range)</td>
<td>Colander: 22–30 cm</td>
<td>Jar: 16–47 cm</td>
</tr>
<tr>
<td><strong>Rim diameter</strong> (mean)</td>
<td>24.5 cm</td>
<td>27 cm</td>
</tr>
<tr>
<td>**Capacity (liters)**a</td>
<td>3.3</td>
<td>42.5 (37 cm dia.)</td>
</tr>
<tr>
<td><strong>capacity ±20%</strong> (min. to max.)</td>
<td>–</td>
<td>34–51</td>
</tr>
<tr>
<td><strong>1/2 min. to max. capacity</strong></td>
<td>–</td>
<td>17–25.5</td>
</tr>
<tr>
<td><strong>kg maize requiredb</strong></td>
<td>12.8–19.1</td>
<td>15.7–23.5</td>
</tr>
</tbody>
</table>

--

6 Jar and tecomate estimates based on partially intact vessels (Central Petén), vessel wall curvature and complete height (base to neck/shoulder junction), and “summed cylinders” capacity calculation (see Rice 1987:221–222)

6 Based on 1/2 min. to max capacity values (1 L = 0.75 kg dry maize)

---

6 James Stuart (letter to author, January 10, 2002), who has made extensive observations of Nahua nixtamal production in Veracruz, states that rinsing in a stream or other moving body of water is preferred, since the frequent replenishment of clean water while the nixtamal is rubbed and kneaded is the most effective means of removing the lime and pericarp pieces. Where access to such a water source is inconvenient, water is periodically brought in and the nixtamal washed in buckets.
capacities range from about 21–37 L. In the central Petén these vessels are larger, with capacities in the 34–63 L range. Temper is medium-coarse, and the light brown to gray–brown unslipped surfaces are dull. Jars typically have medium–tall outcurved necks and a narrow flat base, whereas most tecomates have thickened rims like their counterparts in the Belize Valley. Handles are rare, the few examples being narrow and loop-shaped.

Using cooking vessel capacities, and assuming a 1:1 ratio of water to maize, it is possible to estimate the quantity of grain needed to produce a batch of nixtamal during the Cunil horizon (see Table 4). With these data in hand, and using the earlier estimate of 1.0 ha for milpas, the amount of maize available to one or more households (i.e. pooled) can be charted in daily increments and compared with the maize requirements per batch of nixtamal (Fig. 8). When all lines of data are

**Fig. 7** Reconstruction scene of a Cunil Maya mother and daughter rinsing lime from maize in the center of the Cahal Pech village about 850 BC (note wooden colander stand and the gourd dipper in the woman’s left hand). Drawing by Ayax Moreno, courtesy of the New World Archaeological Foundation
presented in this manner, independent household production and consumption seems very unlikely. A batch of nixtamal in the Belize Valley, for example, would require at least 11 days of a household’s maize reserves. In the central Petén, it would take an 18 day supply. On a more basic level, it is inconceivable that a household of six individuals could consume this much maize in isolation (1.3 kg/4,764 cal. per person in the Belize Valley, 2.2 kg/7,797 cal. in the Petén), and any leftovers would quickly spoil in the tropical climate. In short, cooking vessels size, estimated available maize supply, spoilage, and overall efficiency suggest that the production and consumption of nixtamal-based foods were cooperative events involving two or more households, with cooking duties rotating between them.

With further scrutiny of Fig. 8 it is possible to estimate how frequent these events were and the number of households involved. My interpretations are based on approximately two-thirds of calories from maize on days nixtamal was made (i.e. with per annum [average daily] caloric intake remaining at 20%). This amount is in keeping with (1) the modern daily maize intake introduced earlier; (2) the premise that nixtamal would not be eaten alone, but milled and consumed with other foods (e.g. in the form of tamales), and (3) the likelihood that leftover nixtamal or milled dough (masa) would rapidly spoil if not consumed within a 24-h period. With these limitations in mind, an interesting pattern emerges.

Fig. 8 Cumulative maize supply and caloric value for one to five households plotted against required maize for cooking vessels in the Belize Valley and central Petén (based on annual 1 ha milpa per household and 6.5 cm cobs)
Based on one harvest a year, a two household consumer group in the Belize Valley would have the estimated minimum amount of maize for a batch of nixtamal (8.1 kg) every 5.6 days. On average, this would provide 109% of the day’s caloric intake per person, an amount in excess of a typical day’s caloric intake that would leave little or no room for supplementary foods. When the consumer group is expanded to three households, the time interval drops to 3.7 days, at which point about 73% of the day’s caloric intake would come from maize. At this level of pooling, maize could be eaten regularly with other foods and spoilage would not be a factor. Larger consumer groups, although possible, seem unlikely given diminishing returns. A four household group, for instance, would have the requisite maize for a batch of nixtamal about a day earlier (2.8 days) than a three household group, but the caloric value per person drops to 55%. With five households pooling maize, the disadvantages are more pronounced (2.2 days, 44%).

Given relatively large cooking vessels, the central Petén Maya required considerably more seed (158–169%) to prepare a batch of nixtamal than their Belize Valley neighbors. A two household consumer group, for example, would need 8.9 days of supply to meet the estimated minimum vessel requirement (12.8 kg). This amount of maize, however, would vastly exceed the group’s needs (174% of caloric intake per person). A three household consumer group – the suggested optimal grouping for the Belize Valley – would require 5.9 days of pooled maize reserves, but still exceed per person caloric intake (115%) and leave no room for additional foods. The most efficient consumer group size would appear to be four to five households. Under these conditions, collective maize reserves would be available every 4.4–3.6 days, and would provide 86–70% of caloric needs. At this level of pooling, caloric intakes and time intervals approximate those of the three household consumer group proposed for the Belize Valley.

Conclusions

Ceramic colanders produced during the first two centuries of fully sedentary village life in the Belize Valley and central Petén areas of the Maya Lowlands were used to wash maize after the outer shells (pericarp) were removed in an alkaline solution of boiling water and lime. This interpretation is supported by occasional traces of white substance on colander interiors, the lack of soot on these vessels, and analogous ethnographic examples of the containers and procedures used to make nixtamal. Of subsequent preparation I am less sure, but the presence of grinding implements suggests that nixtamal was milled into masa dough, and the absence of flat ceramic griddles (comales) eliminates tortillas as the end product. Steaming or baking seems most likely, in which case the food would have been tamales. If true, this basic food of the Classic period Maya (see Taube 1989) originated at least 1,300 years earlier.

Considering their relatively late shift to fully sedentary village life and pottery making – some 500–600 years after neighboring regions – it is curious that the
lowland Maya provide the earliest tangible evidence of nixtamal technology in Mesoamerica and beyond. A single colander is reported for the 1000–800 BC era in the distant Valley of Mexico (Niederberger 1976:Pl. 41[13]), but contemporary and earlier cultures in regions surrounding the Maya Lowlands did not make these vessels. As one of the many unique ceramic traits defining the Cunil horizon, colanders are thus a good indicator that the founders of Maya villages were not immigrants, but indigenous peoples who embraced ceramic technology and fashioned their pots according to local practical and stylistic demands. In a more fundamental sense, a causal relationship between agricultural pursuits and ceramics is unlikely (see Brown 1989:205) given centuries of maize cultivation before the introduction of pottery. Rather, the production of pottery was probably the inevitable by-product of permanent village life and heightened contact with distant cultures that already had vigorous ceramic traditions.

Like colanders, the lime pre-treatment of maize may have been a Maya initiative, but it is entirely possible that the general practice was adopted from neighboring cultures that used some means other than ceramic colanders to rinse maize. In any case, the fact that colanders were made from the outset of fully sedentary village life in the Maya Lowlands suggests that the practice of soaking dry maize in caustic water – with or without boiling – began sometime during the preceding Preceramic period. If so, ceramic colanders may have replaced or supplemented perforated wooden or gourd prototypes.

When cooking vessel sizes, estimated maize yields, and caloric intake data are considered together, independent nixtamal processing and consumption by individual Maya households during the Cunil horizon is not a viable interpretation. Even when filled to 80% of average capacity, as I have modeled their handling in this chapter, cooking vessels simply yielded too much maize for individual families. Spoilage and the sporadic preparation intervals dictated by limited maize supplies further reduce the prospect of single family production and consumer groups. Apparently, extended households (i.e. multi-building residential clusters) were the norm and, based on area-specific cooking pot sizes, I suspect these fundamental social units were slightly larger in central Petén villages like Tikal and Uaxactún (four to five residences) than in Belize Valley villages like Cahal Pech and Xunantunich (three residences). The important point is that cooking vessel sizes in this case are a mute indicator of basic consumer group size, not the relative consumption of maize or large-scale consumption events, such as feasts. Potential links between culinary implements and basic consumer group size should be a launching pad for studies of consumptive behavior and social organization, especially where data on residential composition are scarce or lacking.

Mixe-Zoquean speaking groups of the greater Isthmian area to the west (Chiapas, southern Veracruz, and eastern Oaxaca) are a possible source of inspiration for this tradition. The reconstructed Mixe-Zoquean vocabulary includes a word for nixtamal (pici) and numerous other maize-related loan words (Campbell and Kaufman 1976:85, 87) that diffused to distant regions of Mesoamerica, including the Maya Lowlands, most likely during the final two centuries of the second millennium BC.
Very little is known about the physical arrangement of residential structures during the Cunil horizon, but what we do know supports the idea of extended household consumer groups. For example, two closely spaced residential building platforms dated to about 850 BC were found below the southeast corner of the central plaza at Cahal Pech (Cheetham 1995). Because excavations failed to expose much of the adjoining area, it is possible that one or more additional residential buildings once stood in close proximity. In general, the frequency of Cunil phase structures below the central plaza at Cahal Pech indicate a village of tightly clustered household units (Cheetham 1996). Architectural data of this sort are currently unknown in the central Petén, though two enormous and closely spaced Eb phase middens at Tikal (Laporte and Fialko 1993:Fig. 6b–c) suggest several households in the immediate area. The clustering of three or more Swasey phase residential structures at Cuello (Hammond et al. 1991:Figs. 3.2–3.4) is a very strong candidate for an extended household consumer group.

In a particularly relevant study, Mills (1999) argues that increasing cooking vessel size in the Four Corners area of the American Southwest ca. AD 1100–1300 reflects larger consumer groups rather than greater per capita maize consumption. In support of this persuasive argument, Mills notes a shift toward larger extended households evidenced by increasingly agglomerated residential architecture. A comparable increase in cooking vessel size is lacking in the Belize Valley and central Petén for the Cunil horizon, suggesting that early Maya extended household size remained steady in both areas during this roughly 200-year period.

Given the apparent link between cooking vessels and consumer group size, it would be interesting to know if, and to what extent, the capacity of cooking pots made after 800 BC departed from Cunil horizon norms. Detailed analyses of Middle and Late Preclassic period vessels will, of course, be required to determine this, but having handled a great deal of this material it is my impression that capacities did not change, at least not appreciably. If this proves true, extended household consumer groups of Cunil horizon times persisted as maize yields steadily increased relative to cob size. Increasing supplies would have gradually reduced the interval between preparations, thus allowing maize to be eaten more frequently even though batch size (i.e. vessel size) remained about constant. Interestingly, increased maize consumption during the Middle and Late Preclassic periods is indicated by isotopic studies of human bone collagen (e.g. Powis et al. 1999), and groups of three to five residential structures are characteristic of these and all subsequent periods (Ashmore 1981:Figs. 3.2–3.3; Powis 1996). The fundamental unit of lowland Maya social organization, it would appear, was in place from the outset of settled village life.

Perhaps the most puzzling aspect of early Maya maize processing is the cessation of colander production at the end of the Cunil horizon. It is tempting to suggest that nixtamal-making was discontinued along with colanders about 800 BC, but it is unlikely that the practical – and possibly nutritional – benefits of boiling maize with lime would be ignored once known. It is more likely that the rinsing procedure itself changed. New and perhaps more efficient methods to remove lime from boiled maize may have included rinsing and draining in the same cooking pot, transferring boiled corn to a pot of clean water, or rinsing with perishable containers like perforated
gourds or baskets. Whatever transpired, it is clear that the Cunil horizon practice of extended-household maize preparation and consumption was an enduring legacy.

Acknowledgments I thank Martin Biskowski, Oralia Cabrera, John Clark, George Cowgill, John Hodgson, Terry Powis, Ian Robertson, Arleyn Simon, John Staller, Barbara Stark, and James Stuart for their constructive comments. Travel funds to examine ceramic collections were provided by the New World Archaeological Foundation (John Clark, Director). Other people who made this work possible include Jaime Awe, Pat Culbert, Vilma Fialko, Paul Healy, John Hodgson, Juan Pedro Laporte, Lisa LeCount, Richard Leventhal, and the late Gordon Willey. Nora López Olivares, former director of Prehispanic and Colonial Monuments of the Institute of Sports, Anthropology, and History (IDAEH) in Guatemala City, allowed me to study pottery from Uaxactun and Altar de Sacrificios; Gloria Polizzotti Greis and the directors of the Peabody Museum at Harvard University granted access to pottery from Seibal, Uaxactun, Altar de Sacrificios, and Barton Ramie; and Norman Hammond and Laura Kosakowsky provided access to Cuello pottery at Boston University. Special thanks are due to Arleyn Simon, who provided sound advice and support during our many discussions about pots and corn.

References


Blom, F. F. and LaFarge, O. (1926). Tribes and Temples: A Record of the Expedition to Middle America Conducted by the Tulane University of Louisiana in 1925. Middle American Research Institute, Publication No. 1. Tulane University, New OrI


