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Pre-columbian culinary landscapes: reconstructing elite gastronomy at Sihó, Yucatán

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ABSTRACT

In archaeological research about feeding modes of past societies, different interests and methodologies have been developed. In their search for knowledge about Mayan foods and cooking methods, scholars such as Herrera Flores and Götz [2014. "La alimentación de los antiguos mayas de la Península de Yucatán: Consideraciones sobre la identidad y la cuisine en la época prehispánica." *Estudios de Cultura Maya* 43 (43): 69–98. doi:10.1016/S0185-2574(14)70325-9] have paid attention to available resources, diet, and *cuisine*. Food is more than food intake, as it also relates to other aspects like health, identity, gender roles, worldview, memory, and emotions. For the Classic Maya site of Sihó, Yucatan, our case study, the research is oriented towards the gastronomy of the elites. Through the study of chemical residues and identification of starch granules in ceramic fragments of five types of containers namely dishes, bowls, jars, vases, and basins. This study aimed at identifying related ingredients, preparation processes and service practices, suggesting particular ways of cooking and consumption patterns. The test results were compared and supplemented with zooarchaeological evidence, iconography, historical and ethnographic records.

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Gastronomy; Sihó; starch; chemical residues; pottery; domestic group

Introduction

In contemporary archaeology, there has been an increasing interest in the role played by food in several aspects of both past and present human lives. There is a strong relationship among subsistence and health, politics, identity, gender roles, worldview, memory, sensoriality, and emotions. Different groups of people eat and cook in particular ways. According to Hastorf (2017, 5) "Food traditions are repeated ingredient combinations of meals [and] *Cuisines* are styles of cooking and preparing food, their temporal and contextual placements". Similarly, Herrera Flores and Götz (2014, 73), argue that a cuisine is the result of the way in which materials (ingredients) are selected, prepared, distributed, served and consumed.

In complex societies, food and foodways are used to mark social and economic differences. Hastorf (2017) affirms that the presentation of food may be a means to display power and ideological asymmetries, and may be used to stress inequalities, exclusion, and differentiated access to certain products. In this regard, some traditions and *cuisines* may be considered as "higher" than others, similarly to what Bourdieu (1984) calls "legitimate cultures". The concept of "legitimate cultures" refers to the best-accepted trends to perform certain practices, such as appreciation of arts or tastes, which are usually imposed by the economic or cultural elites. According to Bourdieu (1984, 2), tastes are predisposed to function as markers of class. *Haute cuisine* may be defined not only by exclusive and selected ingredients, but as Mennel (2005, 27) mentions, by a complex sequence of stages of preparation and division of labour among kitchen staff. The purpose of this chapter is to recover material evidence that helps discern particular cooking methods in two palace groups of the Classic site of Sihó, Yucatán, focusing on ingredients, preparation processes, and service practices.

Archaeological site

Sihó, Yucatán, is a Maya site located in the north-western part of the Yucatán Peninsula in México, and 30 km inland of the northest coast of Campeche (Figure 1). Archaeological research was performed two decades ago in 2001 and 2003, and most recently in 2013, 2015, and 2017. The evidence has shown a complex settlement, with a graded stratification which goes from the royal elites, who lived in central palace-type structures, to commoners who inhabited small perishable houses (Cobos et al. 2002, 2004; Fernández Souza et al. 2014, 2016). Socioeconomic differences were evidenced in architecture, pottery, and different access to material resources such as obsidian, greenstone, and food products like meat.

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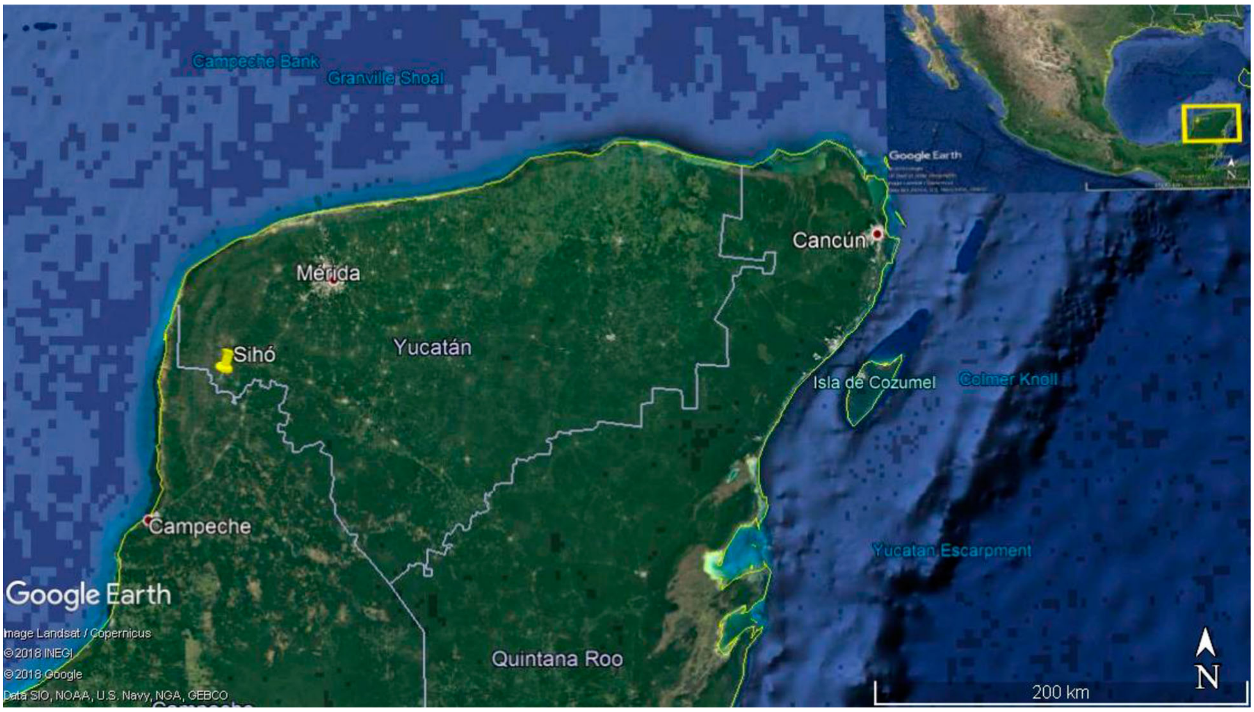

Figure 1. Location of the archaeological site of Sihó in Yucatan, Mexico (Google Earth 2018).

The chronology was established based on pottery recovered from excavations of elite groups. The site occupation started from the Middle-Late Preclassic period (c. 600/500–200/100 BC), and continued through the Early Classic (c. 250 BC–600 AC), Late Classic (c. 550/600–750/800 AC) and Terminal Classic periods (c. 800–1050/1100 AC). The main occupation occurred during the Late and Terminal Classic periods (Jiménez Álvarez 2007).

In this research, we focused on ceramic materials from the main architectural groups, located in the centre of the site and excavated in 2001 and 2003 (Figure 2). The first group, the "Central Group", is comprised of a large platform that supports on its north side the site's main pyramid, which measures 15 m high. To the west of the pyramid, sharing the platform, there is another group of structures forming a *patio* or *plazuela* type arrangement (Cobos et al. 2002; Fernández Souza 2010). These structures are 5D7 in the south, 5D2 in the west, and 5D17 in the north.

The Group 5D16 is located 200 m to the north-west of the Central Group. The structures that form the group are located on the top of a rectangular platform and form a triadic type arrangement. Structure 5D16 is located on the north side of the platform and faces an open space to the south. Structure 5D16 is the largest of this group and presents characteristics of the Maya palaces of the region. Structure 5D20 is on the east side, while Structure 5D19 is located on the west side of the platform. Structures 5D20 and 5D19 were likely auxiliary (Cobos et al. 2002, 2004; Fernández Souza 2010).

It is likely that elites of Sihó lived in the Central and 5D16 groups. Nonetheless, the groups exhibit different architectural attributes. Because of this and differences in other types of materials such as ceramics and lithics, Jimenez and colleagues (2017) suggest that the "royal elite" lived in the Central Group, while the "secondary elite" inhabited Group 5D16. We hypothesize that this stratification will also be identified in the gastronomic preferences of the inhabitants of the ancient Sihó. The Sihó elites had a complex gastronomy, which may be defined as *haute cuisine*.

Methodology

Ceramic analysis

We selected ceramic fragments from the palace-type structures of the two elite groups: 5D2, located in the Central Group, and 5D16 in the elite residential compound located outside the Centre. In order to search for preparation and service patterns, we selected five ceramic archaeological forms: tripod dishes, bowls, vases, jars, and basins (Sabloff 1975; Varela Torrecilla 1998). Additionally, we identified other specific forms like *tecomate-jars*, *incesario,* and a *molcajete*.

The ceramic forms were selected based on typological and modal analyses. The typological analysis was carried out following the type-variety system. The modal analysis followed the classification proposed by Sabloff (1975) and Varela Torrecilla (1998). Sabloff (1975, 22) described a Primary Class: plate, dish, bowl, vase, and jar. These divisions were made

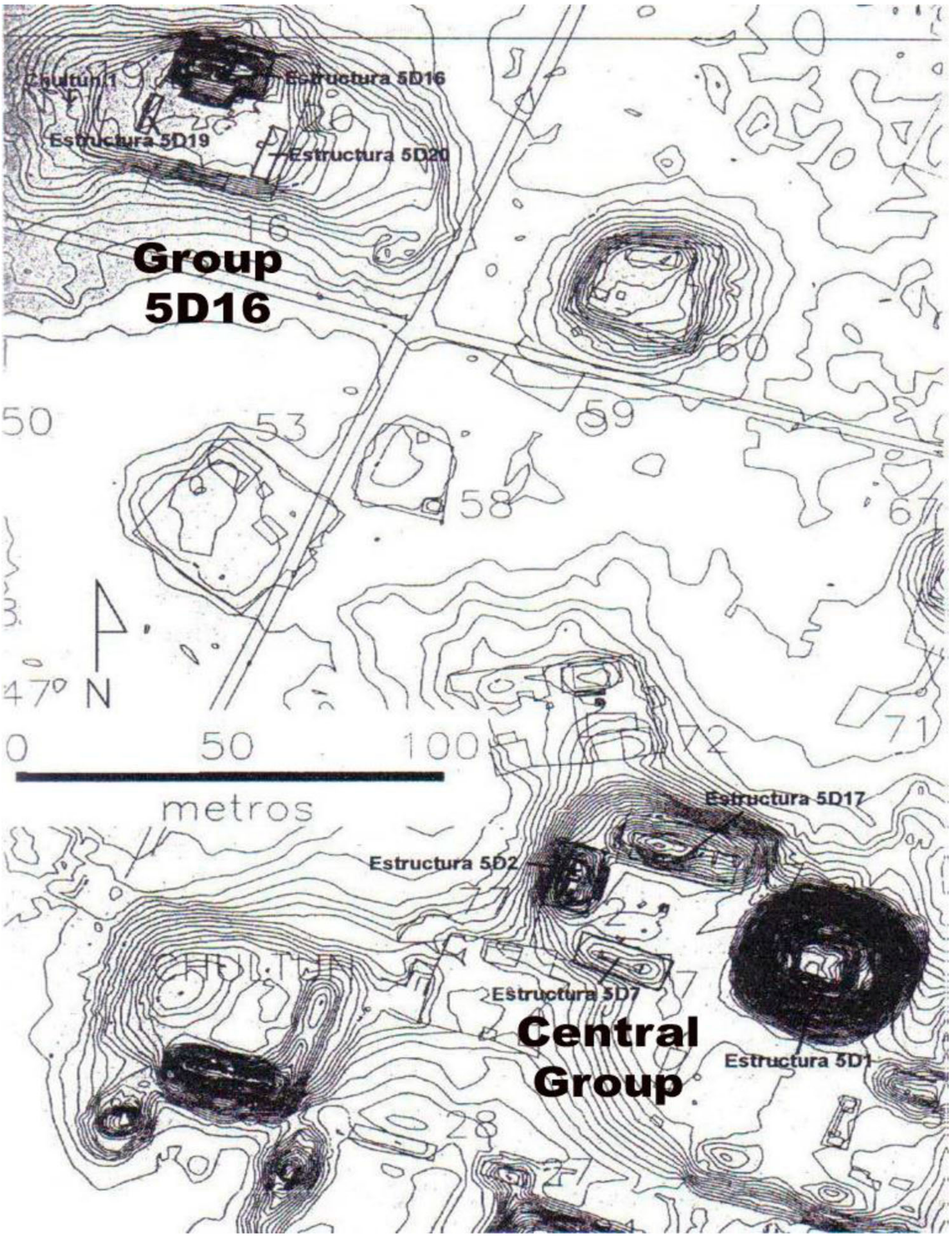

Figure 2. Location of the Central Group and Group 5D16 (taken and modified from Cobos e Inurreta 2002).

based on the form or profiles of the vessels. In addition, each form was subdivided based on its rim, lip, base, edge, appendage and lid form. Varela Torrecilla (1998, 49) adds basin, *tecomate* and *incensario* to the previous classification.

In this vein, the five ceramic forms selected were described according to the modal analysis.

- Dish, a vessel with open rim and a height between one-third and one-fifth of its diameter.
- Bowl, a vessel with open rim or slightly closed and a height no more than equal but no less than one-third of its diameter.
- Vase, an unrestricted or simple restricted vessel with a height greater than its diameter.
- Jar, a vessel with a globular body and a restricted inner neck and rim, a height greater than its maximum diameter, and with zero, one or more handles.
- Basin, a vessel with open rim or slightly closed, a height greater than or equal to its maximum diameter and with one or more handles.
- *Tecomate*, a vessel with a globular body and restricted rim, a diameter equal or less than one-fifth of its height.
- *Incensario*, a ceramic form used for burnt aromatic substances such as *copal*.
- *Molcajete* or mortar, a small ceramic form for grinding some elements for foodways (Sabloff 1975, 23; Varela Torrecilla 1998, 49, 50).

The rim diameter and height of the selected ceramic sherds were measured and each ceramic sherd profile was drawn. In order to obtain the ceramic form and type ceramic, we selected different vessel parts such as rim, base, and side. One advantage of the modal analysis is that, even in the cases in which we do not have a complete vessel, it is possible to elucidate the ceramic forms. Therefore, in our research, the modal analysis helped to select, which sherds were the best for possible chemical or botanical analyses.

In addition to the modal and typological analyses, the ceramic forms were crossed with emic terminology from classic epigraphic sources (Kettunnen and Helmke 2011; Stuart 2005; Houston, Stuart, and Taube 1989). *Lak* (dish) and *hawaante* (tripod dish) were used to serve solid food. *Jaay* (drinking bowl) and *k'ib* (drinking vase) were containers used to serve liquids (Figure 3). Fragments were ground and their powder analysed with the semi-quantitative spot tests developed by Barba Pingarrón and colleagues (Barba 2007; Barba Pingarrón, Butrón, and Pecci 2014). Starch grain analyses were carried out to recover residues of plants. Both results were compared with zooarchaeological analyses conducted by Götz (2005, 2014), in both palaces to get a wider spectrum of the elite diet and cuisine.

Spot test analysis

The test set called "spot test" was developed by colleagues from the Archaeological Prospection Laboratory of the Institute of Anthropological Investigations (UNAM) in the 1990s (Barba 2007; Barba and Ortiz 1992; Barba, Rodríguez, and Córdoba 1991, 2014). This idea has been applied with the objective of identifying activity areas in archaeological floors and soils in diverse contexts of Mesoamerica and Maya Area (Anderson, Bair, and Terry 2012; Barba 2007; Dahlin et al. 2007; Hutson and Terry 2006; Manzanilla and Barba 1990; Parnell, Terry, and Golden 2001 ; Pecci

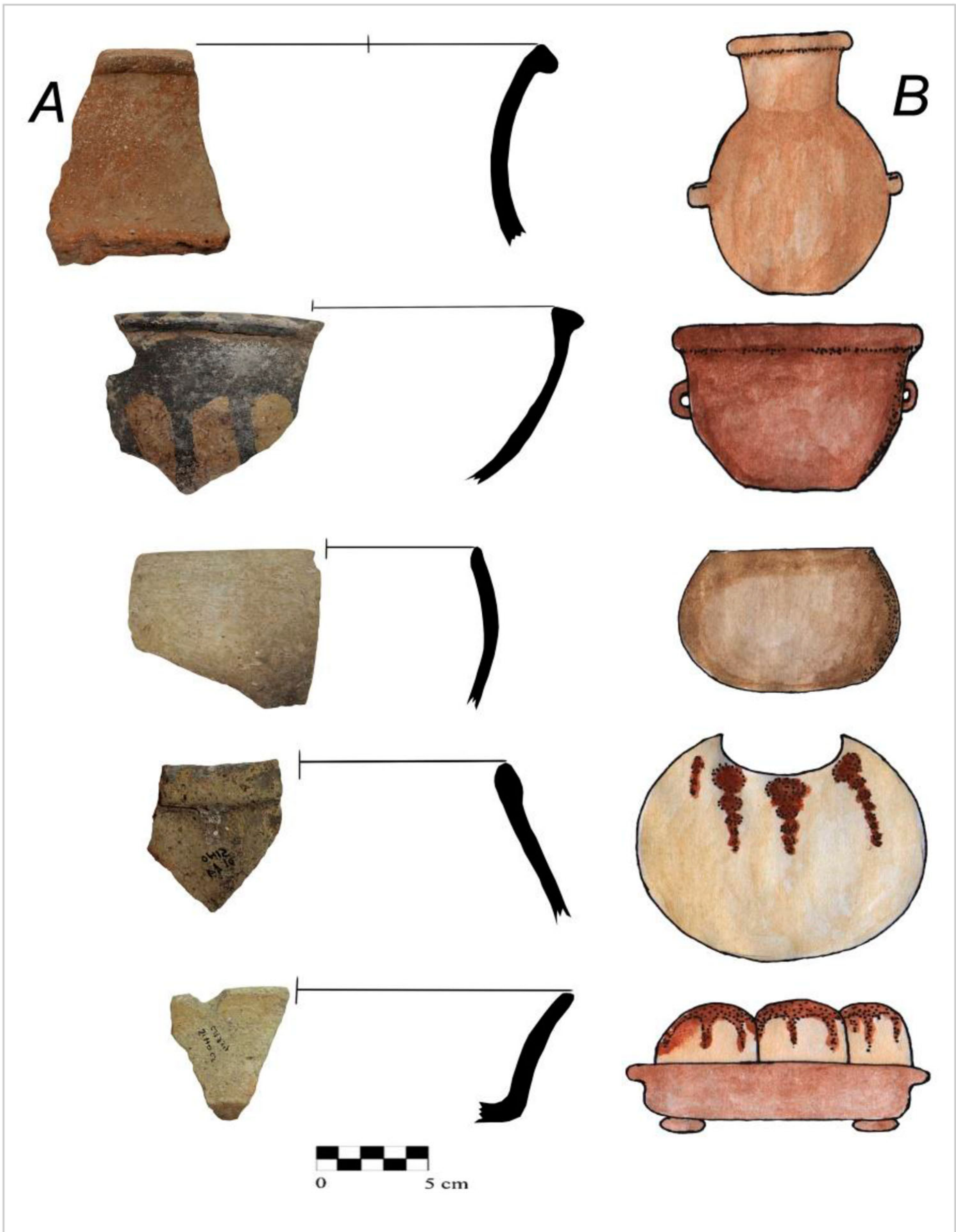

Figure 3. Column A shows the profiles of the ceramic fragments, according to the modal analysis. Column B shows ceramic containers identified in the iconography (Redrawn by L. Fernández Souza).

2000; Pecci et al. 2010; Terry et al. 2000). Nonetheless, its application in ceramics is less frequent, even though its implementation allows researchers to distinguish between the possible contents of the different vessel forms (Balam et al. 2018; Barba Pingarrón, Butrón, and Pecci 2014; Mirón Marván 2014; Palomo Carrillo, Burgos, and Dzul 2018). The tests are orientated to identify relative values in pH, phosphates, carbonates, protein residues, carbohydrates and fatty acids (Barba 2007; Barba, Rodríguez, and Córdoba 1991; Barba Pingarrón, Butrón, and Pecci 2014). Each of them has a specific methodology and indicates a range of possible contents in ceramics or possible activities in the case of soil analysis.

Specific ceramics fragments forms were previously selected and ground; their powder was analysed following previously established protocols (Barba 2007; Barba, Rodríguez, and Córdoba 1991; Barba Pingarrón, Butrón, and Pecci 2014; Pecci, Barba, and Ortiz 2017). The methodology implemented was the following: The *pH* analyses consisted of mixing uniformly the sample with distilled water in a clean container. The mixture rested one hour before taking the reading with a potentiometer OAKTON® (Barba 2007; Barba, Rodríguez, and Córdoba 1991, 2014). This type of analysis indicates the possible use of containers associated with ashes, a mode of conserving the containers, which is widely documented in Mesoamerica.

The *phosphates* test is colorimetric, and it involves the extraction of the phosphate through an acid that reacts with a molybdate to obtain a yellow phosphomolybdate. The reaction continues with ascorbic acid to form molybdenum blue compounds (Barba 2007; Barba Pingarrón, Butrón, and Pecci 2014, 205). After two minutes, the reaction is stopped with sodium citrate. Depending on the blue colour saturation and the extent of the reaction observed on a filter paper, a value between 0 and 6 is assigned. This test is associated with the processing of organic elements in the vessels and helps to discriminate between the service pieces of those that were used for cooking or storage.

The *carbonates* were determined by reacting 0.01g of the powdered sample with 1 ml of 10% hydrochloric acid in a test tube. The amount of effervescence that the reaction produces helps to establish a scale between 0 and 6, which indicates the amount of carbonates present in the sample (Barba 2007, 442). This test is associated with foods that have been processed with lime such as *nixtamal*, and foods derived from this process.

The *protein residues* test is determined by the decomposition of amino groups through an alkaline reaction, which produces ammonium gas (Barba 2007; Barba, Rodríguez, and Córdoba 1991). The test consists of placing 0.01 g of the sample in a test tube, adding 0.01 g of calcium oxide and approximately 1 ml of distilled water. In the test tube rim, two small moistened pH-indicator trips are placed and then heated approximately 1 min, until the indicator paper changes colour. The scale of quantification is from 7 to 14, 8 and above indicating the presence of residues but sometimes can reach a 10 value (Barba 2007, 443; Barba, Rodríguez, and Córdoba 1991, 2014). This indicator is associated with the presence of food of animal origin, like in broths, or the presence of blood and insects.

The last test is *fatty acids*. This test consists of placing 0.01 g of a powdered sample in a test tube and adding 2 mL of chloroform. Subsequently, the sample is heated until one-third part of the solvent evaporates, and then it is poured into a watch glass. Two compounds – ammonium hydroxide (25%) and hydrogen peroxide – are consecutively added. This creates spume in the sample. Depending on the amount of reaction, a scale of 0–3 is assigned (Barba 2007; Barba Pingarrón, Butrón, and Pecci 2014). This test is associated with oils and fats of animal or vegetable origin, and some resins.

Palaeobotanical analysis: starch identification

Starch grain analyses aim to recover plant residues that may have been processed, cooked, served, and consumed in containers. We follow the methodology proposed by Therin and Lentfer (2006, 159) and modified by Pagan (2005) and Cruz Palma (2014) among others. This methodology consists of separating the matrix in which the starches are found – in this case, the ceramic powder. Then, starches are concentrated by centrifuging the sample several times.

The following steps were applied:

1. Between 0.06 and 1.2 g of ceramic powder were placed in a vial tube.
2. We added between 0.5 and 1 ml approximately of cesium chloride (CsCl) with a density of 1.79 g/cm^3.
3. The vials were closed and shaken to form a homogenous mixture.
4. We centrifuged the mixture at 2500 revolutions per minute (rpm) for 15 min.
5. We carried the floating fraction with a sterilized pipette to new vials. It is important to mark each vial so as not to confuse the samples. All the particles up to 1.79 g/cm^3 rush down and particles with less density float; the starches are among the particles with less density.
6. In the new vials with the floating fraction, we added between 0.5 and 1 ml of distilled water, taking care of balancing them. We shake the sample and placed it in the centrifuge.
7. We centrifuged at 3200 rpm for 20 min.
8. In this step, the water has a density of 1 g/cm^3 and the starches a density of 1.5–1.79 g/cm^3, which means that starches must go down. Therefore, it

will be necessary to eliminate the greatest quantity of water without touching the mixture's bottom.

9 Repeat steps 6, 7 and 8 three more times; it is necessary to add less and less water in each step.
10 The final precipitation was taken with a micropipette and sterile points.
11 The precipitation was then placed on a slide, adding a glycerol drop with a sterile toothpick. Then, we placed a cover object, and sealed the four corners with transparent nail polish.
12 Finally, the samples were observed under a microscope.

The final samples were observed through a metallurgical microscope with polarizing light at 20× and 40× resolutions. The identification of starches was carried out following the morphological characteristics of each species. We also took some references of plants of the region such as beans, maize, yam, sweet potatoes, among others.

Results and discussion

Different ceramic forms showed different levels of chemical residues (Figures 4 and 5). In general, jars, basins, bowls, and *tecomate*s exhibited evidence of protein residues in contrast to tripod dishes, which only yielded an average of 7. The highest levels of protein residues were present in one *tecomate*, two jars, a bowl, a basin, and an exceptional tripod dish, with values of 11, 10, 9, 9, 9, respectively. Fatty acids, in general, were relatively low, but two jars, three bowls, and a tripod dish presented the highest levels (values of 3). Carbonates were higher in tripod dishes than in the other forms, except for seven bowl and three jars (Figure 4). Tripod dishes were less chemically enriched, except for the carbonates mentioned previously, perhaps as a result of containing dry meals, such as corn tamales, although five tripod dishes showed evidence of fatty acids, and two had protein residues.

Chemical residues open a discussion about probable socioeconomic differences between the elites inhabiting the Central Group and the Group 5D16 at Sihó. In our research, the average of the two groups was relatively different in some cases (Figures 6 and 7). The levels of phosphates in both groups were similar in all averages, but slightly different for jars and basins, suggesting the preparation of stews (Figures 4 and 6). The protein residues in jars and tripod dishes of Group 5D1, where perhaps the royal group lived, showed higher levels than the jars and trip dishes of Group 5D16 (Figure 7). Nevertheless, the levels of protein residues in bowls were similar. The levels for basins were lower, suggesting that they were cooking or storing some stews with high protein residues in jars and basins, but these types of vessels may have had different uses according to the preferences of each group.

The averages of fatty acids were like those of protein residues. The Central Group had higher levels than Group 5D16 in jars, bowls and similar levels in tripod dishes and basins (Figure 6). The carbonate's averages were different from those of the protein residues. The Group 5D16 had higher than the Central Group in jars but had similar levels in bowls and lower levels in basins and tripod dishes (Figure 6). If we inferred that jars and basins were used as containers for processing or storing *nixtamal* (cooking corn with lime), then it is possible that Group 5D16 had some activity associated with stews in the jars, while the Group 5D2 used the basins for the same purpose. That is stressed by the petrographic results obtained by Jiménez and colleagues (2007, 2017) in which they showed the ceramic forms with low or no calcite density, same forms that we analysed and we obtained high carbonate values, even more than ceramic forms which were described with a

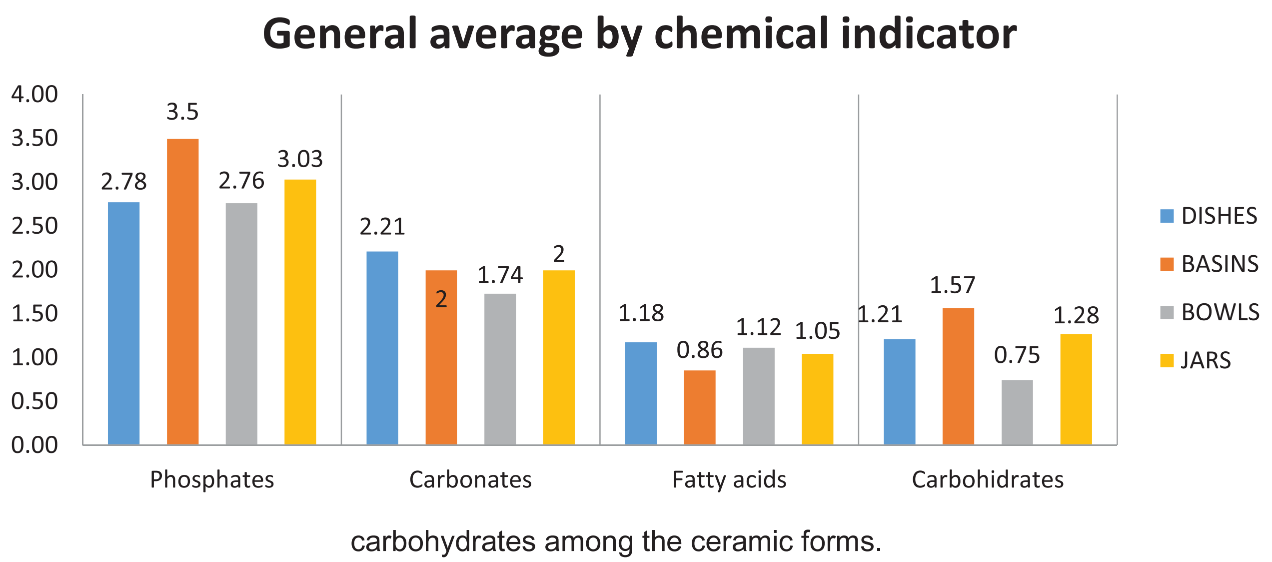

Figure 4. The graph shows the average of phosphates, carbonates, fatty acids and carbohydrates among the ceramic forms.

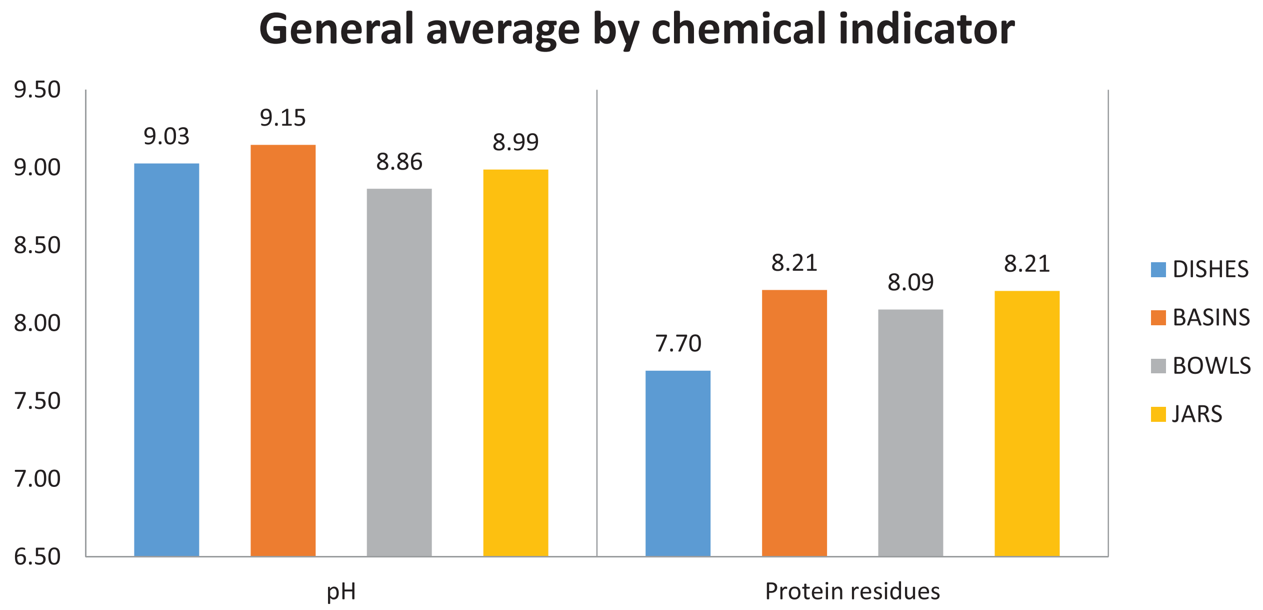

Figure 5. The graph shows the average of pH and protein residues among the ceramic forms.

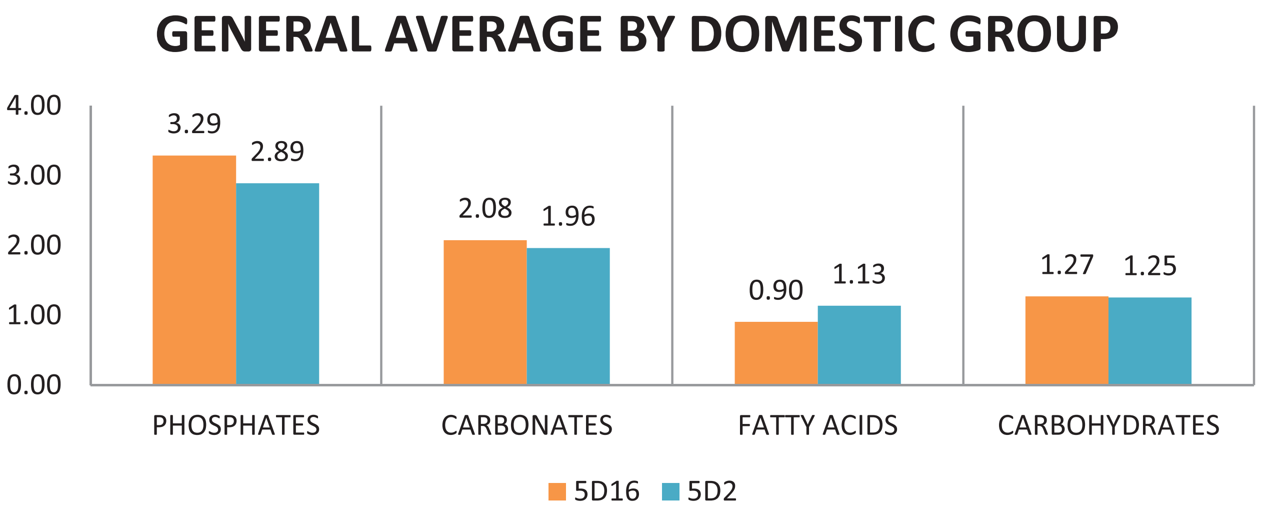

Figure 6. The graph shows the average of phosphates, carbonates, fatty acids and carbohydrates among the domestic groups.

high carbonate matrix temper. The pH was very similar in both groups and ceramic forms (Figure 7).

In the palaeobotany analyses, we obtained 50 starch grains from 15 ceramic sherds (Figure 8). The starch grains evidenced consumption of maize (*Zea mays*), two type of beans (*Phaseolus* spp.), which include probably lima beans or *ib'* in Maya *yucateco* (*Phaseolus lunatus*), sweet potato (*Ipomea batatas*), yam (*Dioscorea* sp.), manioc (*Manihot esculenta*), arrowroot (*Maranta arundinacea*), Mexican yam or *jicama* (*Pachyrhizus erosus*), *makal* (*Xanthosoma* sp.), and chili pepper (*Capsicum* sp.). We identified some starch with a shape-like type 1, probably a palm tree (Arecaceae sp.). Moreover, some starch grains presented thermal effects and other changes in their morphology, which suggests some specific ways of cooking.

In a general way, the analysis of ubiquity demonstrates the presence of each taxon from the total of the sample (Table 1). The ubiquity analysis is highly implemented in the paleoethnobotany field and it has the purpose to show the percentage of presence of each taxon in the set of samples in which the same extraction method was applied (Popper 1989, 60). The best-represented taxon was the maize with 53% of the presence in the entire sample. The higher presence of maize marks this crop as the main subsistence food in Classic times. Nevertheless, the second taxon was beans with 46% of the presence. This taxon was very interesting because we could find two possible varieties (P. *vulgaris* and P. *lunatus*), indicating to us the gastronomic preferences. Also, some of the beans starches presented morphological changes in their structure, suggesting that they were probably boiled, which was one of the most common modes of cooking this food. The third taxon with a high percentage of ubiquity was the sweet potato with 20%. At least, two

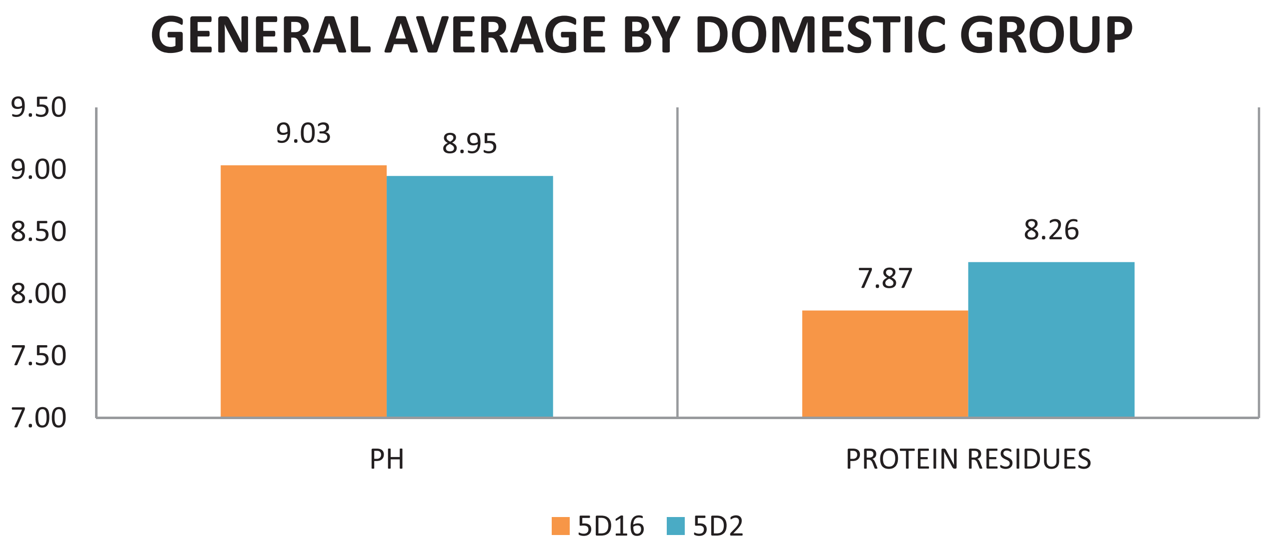

Figure 7. The graph shows the average of pH and protein residues among the domestic groups.

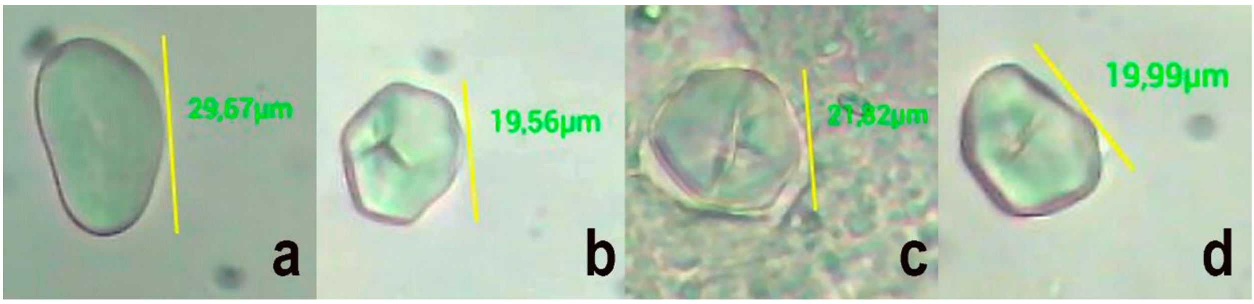

Figure 8. Some of the starches identified in the ceramic vessels. (a) Common bean (*Phaseolus vulgaris*). (b) and (c) Maize (*Zea mays*). (d) Arrowroot (*Maranta arundinacea*).

Table 1. General ubiquity of starch identification analyses.

	Sample number															
Plant taxa	4A	5	5C	6B	7A	10A	12A	17	20	21	24E	28F	31C	31F	31M	Ubiquity
Zea mays	–	1	–	1	–	–	1	2	1	–	–	2	1	–	1	53%
Phaseolus sp.	1	2	–	–	–	1		2		–	2	1*	1*	–	–	46%
Ipomea batatas	–		–	–	–	–	–	–	1	–	1			–	1	20%
Pachirhyzus erosus	–	–	–	–	–	–	–	1	–	–	–	1	–	–	–	13.33%
Manihot esculenta	–	1	–	–	–	–	–	–	–	–	–	1	–	–	–	13.33%
Arecaceae sp.		–	–	–	1			1	–	–	–	–	–	–	–	13.33%
Capsicum sp.	1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	13.33%
Xanthosoma sp.	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	6.66%
Dioscorea sp.	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	6.66%
Maranta arundinacea	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	6.66%
Not identified	–	2	1	–	–	–	5*	1	1	1	–	2		1	2*	60%
Starches with damage	–	–	–	–	–	–	3*	–	–	–	–	1*	1*	–	1*	26.66%
Number of starches in the sample	2	7	1	1	1	2	6	7	3	1	4	7	2	1	5	Total = 50
Variety of taxa in the sample	2	6	1	1	1	2	6	5	3	1	3	6	2	1	4	–

*Presence of starches with damages in its structure.

of the samples in which sweet potato starches were found were associated with maize starches, a link that we will discuss later. The next taxa represented 13.33% of the sample and included Mexican yam, manioc, chili peppers, and palm starches. This taxa was probably part of the supplement of the Sihó inhabitants' daily meals. Less representative were *makal*, yam, and arrowroot with 6.66% presence. These less common taxa were probably used as spices, but we need more evidence to assert this. There is a high percentage of taxa without identifying (60%), some of them showing different morphological characteristics, which means that these plant species were consumed in the past but not any longer.

The differences between the species consumed in both Siho groups are very interesting, and these tendencies may be indicating culinary preferences. Both groups share the maize as the basic staple, and the base of their dishes as well. Nonetheless, the percentage of maize presence in each group is different (Tables 2 and 3). In the Central Group, the presence of maize was 66%, while in Group 5D16 it was 33%. The beans had a different pattern. The higher percentage was in Group 5D16 (50%), while the Central Group yielded only 44%. These differences could indicate culinary preferences between the domestic groups, as well as different access to crops from the community. In this vein, the maize production could have been restricted by the royal elites and because of this, the "secondary elites" needed to find other resources for their food production.

The sweet potato was an interesting crop because we only identified starches in the vessels from the Central Group. The starches were found in drinking containers – a vase and a bowl – also associated with maize. This association could have been the result of containers being receptacles for corn and sweet potato *atole.* Beliaev, Davletshin, and Tokovinine (2010) and Trabanino and Guadarrama (2016) have found a similar beverage on epigraphic and palaeobotany evidence respectively, from the southern Maya lowlands. Nowadays, this beverage has been reported by Meléndez Guadarrama and López (2018, 205) in some Yucatecan and Cholan communities where this *atole* is still prepared. Thus, we can suggest that the Sihó royal elite drank a "special beverage" that included sweet potatoes.

Another difference between the groups was the less common plants or what we call "secondary crops". In the Central Group, we found the presence of some plants that complemented the dishes of the royal elites. Some of those plants could have been another carbohydrate source like the manioc, *makal*, and the arrowroot. On the other hand, it was interesting that only in Group 5D16 were palm starches found. The uses of palm in the northern lowlands are poorly documented. We know that their leaves were used for construction, but in our case, the starches were found in vessels, specifically in one *molcajete* or mortar. This points to the possibility that the palm was used to make sauces. Another palm starch was found in a basin, which was used both as storage container and one used to cook broths. Finally, yam (*Dioscorea* sp.) was only found in Group 5D16 and was probably used to replace the sweet potato to imitate the dishes from the royal elite.

Regarding the relationships between specific ceramic forms, and the starches, maize starch grains were found in ceramic forms like vases, bowls, jars, and *tecomate*-jars, which were used as liquid containers. The first two ceramic types were serving forms, suggesting the presence of corn-based beverage or *atole*. Maize starch was also reported in tripod dishes

Table 2. Ubiquity of Group 5D16.

Plant taxa	Sample number 4A	7A	10A	12A	17	21	Total starches per taxa	Ubiquity
Zea mays	–	–	–	1	2	–	3	33.33%
Phaseolus spp.	1	–	1	–	2	–	4	50%
Ipomea batatas	–	–	–	–	–	–	0	0%
Pachirhyzus erosus	–	–	–	–	1	–	1	16.66%
Manihot esculenta	–	–	–	–	–	–	0	0%
Arecaceae sp.	–	1	–	–	1	–	2	33%
Capsicum sp.	1	–	–	–	–	–	1	16.66%
Xanthosoma sp.	–	–	–	–	–	–	0	0%
Dioscorea sp.	–	–	1	–	–	–	1	16.66%
Maranta arundinacea	–	–	–	–	–	–	0	0%
Not identified	–	–	–	5	1	1	7	50%
Starches with damage	–	–	–	3	–	–	–	16.66%
Total							19	

Table 3. Ubiquity of Central Group.

Plant taxa	Sample number 5	5C	6B	20	24E	28F	31C	31M	31F	Total starches per taxa	Ubiquity
Zea mays	1	–	1	1		2	1	2	–	8	66.66%
Phaseolus spp.	2	–	–	–	2	1*	1*	–	–	6	44.44%
Ipomea batatas	–	–	–	1	1	–	–	1	–	3	33.33%
Pachirhyzus erosus	–	–	–	–	–	1	–	–	–	1	11.11%
Manihot esculenta	1	–	–	–	–	1	–	–	–	2	22.22%
Arecaceae sp.	–	–	–	–	–	–	–	–	–	0	0%
Capsicum sp.	–	–	–	–	–	–	–	1	–	1	11.11%
Xanthosoma sp.	1	–	–	–	–	–	–	–	–	1	11.11%
Dioscorea sp.	–	–	–	–	–	–	–	–	–	0	0%
Maranta arundinacea	–	–	–	–	1	–	–	–	–	1	11.11%
Not identified	2	1	–	1	–	2	–	2	1	9	66.66%
Starches with damage	–	–	–	–	–	1*	1*	1	–		33.33%
Total starches										31	

*Presence of starches with damages in its structure.

that were associated with a high presence of protein residues. Based on this evidence, we suggest that tripod dishes could have been used to serve a variety of *tamales* with meat, as Taube (1989) has reported a similar use of tripod dishes during the Classic based on epigraphic evidence in Classic.

Jars were containers for cooking or storage and some of them had maize or beans and protein residues, suggesting the preparation of stews with or without meat. The highest level of protein was found in a *tecomate*. This *tecomate* had evidence of a common bean starch grain with thermal damage. Two bowls had chili pepper (*Capsicum* sp.), maize and sweet potato. This may indicate that they were used to serve maize beverage with chili as seasoning. Another interesting starch grain was the palm. This starch grain was found in a mortar and *tecomate*-jar and could have been used as oil or for some flavour, although the levels of fatty acids were low for the mortar and relatively high in the tecomate-jar. The jars had three probable bean starch grains (*Phaseolus* spp.). One jar had a probable bean with effects in its structure, maize and protein residues with a level of 8, and a high level of fatty acids. This evidence suggests the presence of stew with meat. Another jar had higher levels of protein residues without fatty acids, two bean starch grains (*Phaseolus* spp.), maize, and arrowroot (*Maranta arundinaceae*). The evidence indicates that this jar was used for cooking some stew with protein residues from this plant.

One specific tripod dish was interesting because it had protein residues with a level of 9, one of the highest values. It was also associated with maize starches and another starch that was not identified. This tripod dish had the highest variety in starches, but we could not identify the species.

Final remarks

The comparison of starch grain analyses with previous zooarchaeological results led us to conclude that the Sihó elites consumed proteins – both from terrestrial and aquatic meat – and from plants such as different types of beans. Some ceramic forms designed to contain liquids, like jars and *tecomates*, exhibited high levels of protein residues, suggesting that they were used to serve stews and broths. The presence of corn in vases and bowls is consistent with epigraphic, historic and ethnographic information regarding the consumption of what is currently known as *atole*. Nowadays, this beverage is quite diverse and is prepared with several varieties of corn and other ingredients such as sweet potato, cocoa, chili, fruits, *achiote* and honey among others. Another interesting observation is that most of the vessels with higher taxa variability are bowls and jars, along with one tripod plate and the molcajete. Most of these ceramic forms were used to prepare or contain liquids. Iconography shows that tripod dishes were serving vessels for dry food such as *tamales* (Taube 1989). On the other hand, *molcajetes* were possibly used to prepare sauces.

The comparison of chemical and botanical results with zooarchaeological evidence from Sihó (Götz 2010, 2011), as well as with iconographic, epigraphic and historic sources from Classic and Postclassic periods in the Maya Lands, provides clues about the complex gastronomy of the elites. Maize was the most important ingredient and was used to prepare both food and beverages. *Tamales* or *waajob* were a kind of corn bread or patties mixed and stuffed with beans, meat or fish. In iconography, *tamales* frequently look covered with sauces and were recurrently served in tripod dishes (Beliaev et al. 2010; Fernández Souza 2019; García Barrios 2017; Taube 1989). Meat included venison, peccary, iguana, turkey, and other birds as well as a variety of fishes and turtles (Götz 2010, 2011, 2014). The Dresden Codex shows that meat and fish were prepared in *tamales* or directly served on a plate, suggesting a wide variety of dishes (Velázquez 2016, 2017; Fernández Souza 2019). As previously mentioned, evidence at Sihó also suggests stews or broths containing both vegetables and meat, possibly based on maize or beans. Elite beverages included combinations of corn gruels mixed and seasoned with tubers, fruits, beans, cocoa, annatto and honey. Cocoa beverages were also very appreciated as well as alcoholic beverages based on agaves, tree bark, and flowers (Beliaev et al. 2010; Chuchiak 2003; Fernández Souza et al. 2016, Fernández Souza 2019; García Barrios 2017; Tokovinine 2016). It is important to stress that dishes and drinks were beautifully presented on delicate wares, whose luxury depended on the socioeconomic and political power of their owners.

In sum, we conclude that the heterogeneity of pottery forms, residues and ingredients combinations, as well as the differences observed in cooking and serving containers is evidence of the complex, elaborate and elegant gastronomy practices of the ancient Maya elites in Sihó. This evidence not only provides enormous insight into the gastronomy of the Maya elites, but it also opens up a potentially huge door to archaeometry research.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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