Exploring the culinary uses of Santa María and Belén painted vessels from the Late Intermediate Period in Catamarca, Argentina

Irene Lantosa a,⁎, Valeria Palamarczuk b, Martín Orgaz c, Norma Ratto b, Marta Maiera a

a Universidad de Buenos Aires, Consejo Nacional de Investigaciones Científicas y Técnicas, Unidad de Microanalítica y Métodos Físicos aplicados a la Química Orgánica (UMYMFOR), Facultad de Ciencias Exactas y Naturales, Intendente Güiraldes 2160, C1428EGA Ciudad Autónoma de Buenos Aires, Argentina

b Universidad de Buenos Aires, Instituto de las Culturas (IDECU) UBA-CONICET, Facultad de Filosofía y Letras, Museo Etnográfico J B Ambrosetti. Moreno 350, C1051AAH Ciudad Autónoma de Buenos Aires, Argentina

c Universidad Nacional de Catamarca, Escuela de Arqueología, Avenida Belgrano 300, Campus Universitario, K4700 San Fernando del Valle de Catamarca, Provincia de Catamarca, Argentina

⁎ Corresponding author at: Intendente Güiraldes 2160, C1428EGA Ciudad Autónoma de Buenos Aires, Argentina.
E-mail address: irenelantos@qo.fcen.uba.ar (I. Lantos).

1. Introduction

The Late Intermediate period (10th–15th centuries AD) in northwest Argentina was characterized by an increasingly complex social organization, demographic growth, political conflicts, and overall change in the mode of living (Tarragó, 2000). Evidence of this shift in lifestyle can be observed in architectural patterns, agricultural installations, and in new regional styles of ceramics, metals, textiles and rock art. In particular, two ceramic styles were dominant during the Late Intermediate period in some valleys of the province of Catamarca, Argentina: (a) the Santa María style in the Calchaquí and Yocavil valleys and nearby areas, and (b) the Belén style in the Hualfín, Abaucán and Andalgalá valleys (Bennett et al., 1948; González, 1950, 1977). These styles continued to coexist with Inca styles during the late 15th and 16th centuries AD when NW Argentina was incorporated into the empire (Calderari and Williams, 1991; González and Tarragó, 2005).

Santa María and Belén ceramic assemblages, despite their diversity, can be categorized in two main morphologies: vessels sometimes called “urns” (tinajas or urnas) and bowls (pucos) (Baldini and Sprovieri, 2014; Palamarczuk, 2014; Puente and Quiroga, 2007). Vessels and bowls are usually associated with funerary practices (Amuedo, 2015; Marchegiani et al., 2009; Nastri, 2003). In many cases vessels were used as urns to hold human remains (usually young children) and bowls were used as lids. Vessels containing human remains have been found both in cemeteries and within domestic areas. Although the association of vessels to mortuary practices is well established, we believe it has been skewed by many studies using collections from late 19th and early 20th century expeditions, which targeted the recovery of funerary material remains (Podgorny, 2004; Ramundo, 2007). Recent studies have reported the recovery of Santa María and Belén vessel style fragments within the household floors and dump areas and with no link to funerary use. As a result, there is a growing consensus among archaeologists that vessels played important roles in daily life activities in domestic contexts (Greco et al., 2012; Iucci, 2016; Nastri, 1999; Orgaz et al., 2007; Palamarczuk, 2008; Piñeiro, 1996; Rivolta and Salazar, 2006; Roldán and Funes, 1995;
Sempé, 1984; Sempé 1976; Sjodin, 2001; Williams, 2003; Wynveldt and Iucci, 2009; Wynveldt, 2008).

In spite of this, we often continue to refer colloquially to these vessels, beyond their context of recovery, under the name of “Santa María urns” or “Belén urns”, as these nomenclatures refer to well-known specific morphologies, emblematic in the archaeology of the Argentine Northwest (Primera Convención Nacional de Antropología, 1966). The label “urn” which has been used in the past, and continues being used today as a professional archaism, contributes to the persistent, possibly unconscious perception of Santa María and Belén vessels as funerary containers. It is relevant to point out that the vessels found in domestic contexts have the same morphological and decorative characteristics as those used as funerary urns.

Following Rice (1996), the “use” of a vessel refers to the specific way in which it serves a particular purpose. From an archaeological perspective specific uses can be inferred from the physical and morphological properties of the vessels, the presence of marks, wear patterns, impregnated materials, and from information on the finding context (Skibo, 1992).

Use-wear evidence is scarce and often ambiguous in Santa María and Belén vessels recovered from domestic and mortuary contexts. Although there is some extraordinary evidence that vessels or recycled large vessel neck fragments were used for processing or cooking (Amuedo, 2012; Greco et al., 2012; Tarragó et al., 1999), in most cases there is no evidence of soot or wear patterns resulting from exposure to heat. In addition, Santa María and Belén vessel morphologies are especially well suited for storage, given their large capacity, heaviness that inhibits transport, thick walls, robust bases, wide necks, everted lips designed to cover the mouth with textiles or animal hide (Orgaz, 2014). Palamarczuk (2002) has also proposed that vessels may have been used for water storage, given the high porosity of the pastes and wide neck that allows easy access to the content, possibly aided by bowls or ladles.

Although morphological and use-alteration analyses provide important information on potential vessel use, direct evidence of use can be obtained by organic residue chemical analyses (Skibo, 1992). Organic residues resulting from culinary activities such as preparation, storage, transport and service of foods and beverages can be well preserved in the porous matrices of ceramic containers (Copley et al., 2005). Absorbed lipid residues are complex mixtures formed by the container’s multiple uses during its life history (Evershed, 2008). Residues can be the unintentional result of culinary activities, or they can be the result of intentional coating of inner surfaces in order to seal pores and avoid evapo-transpiration of liquids (Deboer, 1974; Henrickson and McDonald, 1983; Schiffer, 1990; Skibo, 1992). Both types of residues may form palimpsests that can be difficult to interpret. The characterization of lipid residues has been successfully achieved by gas chromatography–mass spectrometry (GC–MS) (Colombini and Modugno, 2009; Evershed, 2008).

In this paper we explored the use of vessels (tinajas) from non-funerary contexts in three case studies selected from the valley area of Catamarca province, in Northwest Argentina (Fig. 1). The aim of this preliminary study was to explore organic residues preserved in ceramic matrices of vessels as potential indicators of culinary uses. All three case studies shared the fact of having been found in domestic floors and of showing no clear use-wear patterns that could signal culinary use, beyond the context of recovery. As a consequence, residue analysis was imperative to obtain evidence of their potential use as containers. This study is, to the best of our knowledge, the first to carry out organic residue analysis on non-funerary Santa María and Belén vessels.

2. Case studies of non-funerary vessels from Catamarca, Argentina

The first case study is from the site Fuerte Quemado-Intihuatana in the northern section of Yocavil valley, at an altitude of 1900 m.a.s.l. (Fig. 1). The Yocavil valley is part of the Calchaquí valley system that is defined by the Sierra del Cajón mountainous chain to the West and the Calchaqui and Aconquija ranges to the East. The Santa María river runs along the valley North to South, and on each margin there are numerous alluvial cones from tributary streams that run into the main drainage system (Ruiz Huidobro, 1972). The site is defined by a group of buildings covering a total area of three square kilometers, and divided into six sectors. Sectors I, II, III, V, and VI were built during the Late Intermediate period (11th to 15th centuries AD), while sector IV was built during the Inca period (15th and 16th centuries AD) (Kriscautzky, 1999). The sample we selected for the case study was recovered during excavations in the 1970s and 1980s in Enclosure R-51 of Sector V (Fig. 2a). It is a spacious elliptic building made from well finished stone walls, and it has no direct access in or out. A functional study of the architectural features and ceramic assemblage suggested that this space, also occupied during the Inca expansion, was used for private commercial practices within a local elite residence (Orgaz, 2014). The selected vessel (V1) is Santa María style, carefully decorated in a bicolor design (black paint on cream-white slip). The recovered portion of the vessel is from the neck area, and it shows a geometrical serpent-like design which probably was part of the lateral panel (Fig. 3a). This container has no evidence of soot in its outer surface, and it has some marks of wear in the inner surface.

The second case study is from El Colorado, a locality in the southern section of the Yocavil valley that covers approximately 60 ha, where the evidence of occupations are distributed between the piedmont and the alluvial plain of Santa María river (Fig. 1). The site was inhabited during a long period of time by small-scale agropastoralist groups from the Early period to the present. A small cluster of buildings located in the North Sector is composed by structures with Late period architecture (Palamarczuk, 2016). Within this cluster is Detection 2, a residential place composed of a minimum of seven enclosures. An intramural excavation in an extended area was carried out in one of them (E3; Fig. 2b), recording a sequence of occupations of the structure that reach to Early Colonial times1. Fragments of a Santa María tricolor style vessel (black and red paint on cream-white slip) fractured in situ were found at a depth of 70 cm from the current surface lying on the initial occupation floor of E3, near a hearth. A sample of charcoal was dated using AMS obtaining a result of 624 ± 20 yr BP (YU-4564). The vessel (V2) fragments belong to the body, neck and lip, and they have no evidence of soot or other marks on their surfaces (Fig. 3b).

The third case study is from Mishma 7 site which is located in the Fiambalá valley (Sempé, 1984) (Fig. 1). The site has two large groups of buildings made up from various enclosures and surrounded by a perimeter wall. The site has a total surface area of 200 m². Investigations were carried out during the 1970s (Sempé, 1984) and 1990s when the occupation was dated between 1405 and 1573 AD2 (Ratto, 2013). Ceramologic studies showed the coexistence of Late Intermediate and Inca material culture (Orgaz et al., 2007). The sample selected for this case was found in Structure A, a rectangular enclosure measuring 9.5 m length and 4 m width, lying on a floor at 60 cm below surface level (Fig. 2c). The archaeological context of this floor included hearths, burnt animal bones, plant remains and ceramic fine ware (Inca, Belén, Abaucán and Sanagasta styles) as well as ordinary cooking ware. Structure A was the only enclosure at the site where Inca style ceramics were recovered. Sempé (1984, 1976) believed that Structure A was used for storage of food and other organic materials. The sample included in this study is a fragment that belongs to the body of a Belén style small vessel (V3), with bicolor decoration (black paint on red slip) (Fig. 3c). It has no evidence of soot.

3. Materials and methods

Lipid extraction was carried out on archaeological samples V1, V2, and V3. In addition, reference samples of typical plant and animal food resources rich in lipids from pre-Hispanic Catamarca valleys were studied for comparative purposes.
Powder of the references dry samples (R1 maize kernels, R2 mesquite pods, R3 chañar fruits, R4 beans) was obtained by grinding with a coffee mill. The llama fat (R5) was frozen and ground using a porcelain mortar and pestle. Samples weighing five to ten grams were taken from the archaeological vessel fragments (Fig. 3a, b, and c) and were rinsed on both surfaces with chloroform:methanol (2:1; vol/vol). Then they were broken into small fragments with a hammer and ground in a porcelain mortar and pestle. Sediment control samples were available for El Colorado and Mishma 7 samples, and were treated identically to ceramic samples. Lipids were extracted with chloroform:methanol (2:1; vol/vol) (Folch et al., 1957). All solvents were of chromatographic quality and pre-distilled before use. Each sample was placed in an ultrasonic bath for 15 min (twice) and filtered; a few drops of distilled water were added, the organic phase containing the total lipid extract (TLE) was separated after centrifugation for 3 min (twice), evaporated under a soft nitrogen stream, weighed and then transferred to a 2 ml glass vial and stored at −18 °C. An aliquot of the TLE was saponified with 1 ml of 4% potassium hydroxide in an ethanolic aqueous solution (2:1, vol/vol), at 60 °C for 2 h (Colombini et al., 2003). After cooling at room temperature, the neutral fraction was prepared by addition of 20 ml of N,O-bis (trimethylsilyl) trifluoroacetamide (BTSFA) with 1% trimethylchlorosilane (TMCS) (Supelco) and heating at 60 °C for 20 min. After cooling, the TMS derivatives were dried under a soft stream of nitrogen, n-hexane was added and the solution stored at 4 °C. Samples were analyzed within 24 h of derivatization. Procedure blanks for lipid extraction, saponification, methylation, and TMS derivatization were prepared and analyzed.

Chemical characterization of FAME by GC–MS was performed with a Shimadzu GCMS–QP5050A (Kyoto, Japan). The system was equipped with a Zebron ZB5 capillary column (Phenomenex, 5% phenyl-95% dimethylpolysiloxane, 30 m length, 0.25 mm i.d., 0.25 μm film thickness). Helium was used as carrier gas (0.9 ml/min continuous flow rate) and manual injection was in split mode at a temperature of 250 °C. After an initial temperature at 110 °C, the column was heated to 280 °C at 10 °C/min followed by an isothermal period of 45 min. The MS was operated in the electron impact mode at 70 eV with a source temperature of 280 °C. Compound identifications were carried out by comparing retention times of FAME standards and mass spectrometric fragmentation patterns. The relative abundances of individual FAME to total FAME in lipid extracts were calculated from total ion chromatogram (TIC) peak areas.

Chemical characterization of TMS derivatives of neutral lipids was carried out in a Shimadzu GCMS–QP5050A (Kyoto, Japan). The system was equipped with an Ultra 2 capillary column (Agilent, 5% phenylmethylpolysiloxane, 50 m length, 0.20 mm i.d., 0.11 μm film thickness).
impact mode at 70 eV with a source temperature of 280 °C. Compound
mal period of 30 min. In both cases, the MS was operated in the electron
25 min, and then heated to 290 °C at 8 °C/min, followed by and isother-
perature of 250 °C. The initial temperature was 240 °C, the column was
rate of 1 ml/min. The injection was manual and in split mode at a tem-
10 °C/min followed by an isothermal period of 25 min, and then heated to 270 °C at 10 °C/min followed by an isothermal period of 25 min, and then heated to 290 °C at 8 °C/min, followed by and isother-
ental period of 30 min. In both cases, the MS was operated in the electron
impact mode at 70 eV with a source temperature of 280 °C. Compound
identifications were carried out by comparing retention times of sterol standards and mass spectrometric fragmentation patterns.

4. Results

Results from chemical analyses showed that the three archaeological vessels (V1, V2, and V3) had organic residues resulting from contact with foods and/or drinks (Table 1). The lipid concentration per gram of ceramic matrix varied from 86.7 μg/g in sample V1, 100.9 μg/g in sample V2, and 190 μg/g in sample V3. These lipid concentrations were well above the limit required for organic residue analysis (Evershed, 2008). The high concentrations and fatty acid diversity (see Table 1) also suggested the endogenous nature of lipids, given that sediment control samples yielded very low lipid concentrations (10.0 to 17.0 μg/g) and poor fatty acid profiles with low intensity peaks for miristic, palmitic, oleic, and stearic acids\(^3\), which are typical of sediments without anthropic modifications (Bull et al., 2000, 1998). In addition, migration of soil lipids into ceramic samples is highly improbable due to semiarid conditions and no soil formation in the region.

The gas chromatograms from the archaeological vessels showed a series of methyl esters of carboxylic acids in the C\(_{12}\)–C\(_{24}\) range (Table 1). The most abundant saturated fatty acids (FA) include capric (C\(_{10:0}\)), lauric (C\(_{12:0}\)), myristic (C\(_{14:0}\)), palmitic (C\(_{16:0}\)), and stearic (C\(_{18:0}\)) acids, maximizing at C\(_{16}\) and C\(_{18}\). Unsaturated fatty acids were palmitoleic (C\(_{16:1}\)) and oleic (C\(_{18:1}\)) acids. Sterols (cholesterol and sitosterol) were found in two of the three vessels (V1 and V2). Palmitic to stearic ratio was calculated as an indicator of animal or plant origin of lipids (Eerkens, 2005).

The fatty acid profile of sample V1 (Santa María bicolor vessel from Fuerte Quemado-Inthiutana) showed high abundance of palmitic acid (C\(_{16:0}\)), followed in concentration by stearic (C\(_{18:0}\)), oleic (C\(_{18:1}\)), myristic (C\(_{14:0}\)), and pentadecanoic (C\(_{15:0}\)) acids. The palmitic to stearic acids ratio (C\(_{16:0}\)/C\(_{18:0}\)) was 1.4 which could indicate that the origin of the lipids is animal, supported by the presence of myristic and pentadecanoic acids (Evershed et al., 2002). The fatty acid profile is comparable to that of llama fat (R5), which also has a low palmitic to stearic ratio (2.0), and both myristic and pentadecanoic acids in similar abundances to sample V1. The animal origin of the lipid residues is also supported by the presence of cholesterol in the neutral compound fraction (Chizzolini et al., 1999).

Sample V2 (Santa María tricolor vessel from El Colorado) has a more complex fatty acid profile that indicates a mixture of animal and plant lipids (Fig. 4). The most abundant fatty acids are stearic (C\(_{18:0}\)) and palmitic (C\(_{16:0}\)) acids. The palmitic to stearic ratio (C\(_{16:0}\)/C\(_{18:0}\)) was 0.9 which is similar to animal lipid ratios, although the lauric to miristic ratio (C\(_{12:0}\)/C\(_{14:0}\)) was 0.09 which borderline between plant an animal lipids (Eerkens, 2005). Other fatty acids such as myristic acid (C\(_{14:0}\)), and odd-chain pentadecanoic (C\(_{15:0}\)) and margaric (C\(_{17:0}\)) acids also point towards animal lipids. Small amounts of branched iso and anteiso carboxylic acids (12-methyl-tridecanoic, 12-methyl-tetradecanoic, 13-methyl-tetradecanoic, 14-methyl-pentadecanoic, 15-methyl-hexadecanoic, and 14-methyl-hexadecanoic) were also found, which in combination with the odd-numbered fatty acids, suggest the presence of ruminant animal fat (Martínez Marín et al., 2010; Spangenberg et al., 2006). South American camels are the most probable sources (Lantos et al., 2015; Vázquez et al., 2008). Odd-chain and branched fatty acids were also found in the llama reference sample (R5). Eicosanoic (C\(_{20:0}\)), docosanoic (C\(_{22:0}\)), tetracosanoic (C\(_{24:0}\)), and hexacosanoic (C\(_{26:0}\)) acids were found in sample V2, indicating presence of plant lipids. This is also supported by di-carboxylic acids (hexanodioic, octanodioic, nonanodioic, decanodioic, undecanodioic, and dodecanodioic acids). These di-carboxylic acids are oxidation byproducts of longer mono and polysaturated fatty acids, which can be indicators of degraded plant lipids. Further evidence of the complex mixture is the presence of an animal sterol (cholesterol) (Chizzolini et al., 1999) and a plant sterol (sitosterol) (Hartmann, 1998). Sitosterol

Helium was used as carrier gas at a continuous flow rate of 0.9 ml/min. The injection was manual and in split mode at a temperature of 250 °C. The initial temperature was 100 °C, the column was heated to 240 °C at 10 °C/min followed by an isothermal period of 25 min, and then heated to 280 °C at 4 °C/min, followed by and isothermal period of 30 min. Alternately, Zebron ZB5 capillary column (Phenomenex, 5% phenyl-95% dimethylpolysiloxane, 30 m length, 0.25 mm i.d., 0.25 μm film thickness) was used. Helium was used as carrier gas at a continuous flow rate of 1 ml/min. The injection was manual and in split mode at a temperature of 250 °C. The initial temperature was 240 °C, the column was then heated to 270 °C at 10 °C/min followed by an isothermal period of 25 min, and then heated to 290 °C at 8 °C/min, followed by and isother-
ental period of 30 min. In both cases, the MS was operated in the electron
impact mode at 70 eV with a source temperature of 280 °C. Compound

Fig. 2. Archaeological sites (from north to south): (a) Fuerte Quemado-Inthiutana, Yocavil valley, Catamarca, Argentina (b) El Colorado, Yocavil valley, Catamarca, Argentina; (c) Mishma 7, Fiambalá valley, Catamarca, Argentina.
was found in three of the four plant reference samples (R1 maize, R2 mesquite and R3 chañar) (Table 1).

The fatty acid profile of sample V3 (Belén bicolour vessel from Mishma 7) showed high abundance of palmitic acid (C16:0), followed by myristic (C14:0), stearic (C18:0), palmitoleic (C16:1), oleic (C18:1), lauric (C12:0), and pentadecanoic (C15:0) acids. The palmitic to stearic acids ratio (C16:0/C18:0) was 4.0 which is high and possibly indicates some plant lipid contribution, as it is similar to some of the plant reference samples

---

Table 1

<table>
<thead>
<tr>
<th>Sample code</th>
<th>V1</th>
<th>V2</th>
<th>V3</th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
<th>R4</th>
<th>R5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Bicolor Santa María vessel, Fuerte Quemado-Intihuatana, Yocavil valley</td>
<td>Tricolor Santa María vessel, El Colorado, Yocavil valley</td>
<td>Bicolor Belén vessel, Mishma 7, Fiambalá valley</td>
<td>Maize (Zea mays L., Dentado blanco)</td>
<td>Mesquite (Prosopis nigra Griseb.)</td>
<td>Chañar (Geoffroea decorticans Gill. Ex Hook &amp; Arn.; Burkart)</td>
<td>Beans (Phaseolus vulgaris L.)</td>
<td>Llama (Lama glama L.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lipid conc. (μg/g)</th>
<th>V1</th>
<th>V2</th>
<th>V3</th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
<th>R4</th>
<th>R5</th>
</tr>
</thead>
<tbody>
<tr>
<td>C12:0</td>
<td>0.4</td>
<td>0.2</td>
<td>5.3</td>
<td>0.6</td>
<td>6.5</td>
<td>1.4</td>
<td>4.8</td>
<td>33.0</td>
</tr>
<tr>
<td>C13:0</td>
<td>4.3</td>
<td>2.3</td>
<td>16.8</td>
<td>7.3</td>
<td>15.0</td>
<td>33.0</td>
<td>16.8</td>
<td></td>
</tr>
<tr>
<td>C14:0</td>
<td>1.4</td>
<td>0.9</td>
<td>9.5</td>
<td>27.3</td>
<td>46.3</td>
<td>40.3</td>
<td>33.4</td>
<td>33.0</td>
</tr>
<tr>
<td>C15:0</td>
<td>19.5</td>
<td>25.7</td>
<td>44.0</td>
<td>28.5</td>
<td>10.6</td>
<td>1.5</td>
<td>10.4</td>
<td>42.5</td>
</tr>
<tr>
<td>C16:0</td>
<td>26.5</td>
<td>5.2</td>
<td>38.1</td>
<td>7.7</td>
<td>31.3</td>
<td>1.3</td>
<td>1.5</td>
<td>16.8</td>
</tr>
<tr>
<td>C17:0</td>
<td>2.6</td>
<td>5.6</td>
<td>30.7</td>
<td>31.3</td>
<td>8.6</td>
<td>31.3</td>
<td>1.3</td>
<td>1.5</td>
</tr>
<tr>
<td>C18:0</td>
<td>4.3</td>
<td>0.9</td>
<td>6.0</td>
<td>11.0</td>
<td>7.7</td>
<td>3.1</td>
<td>1.3</td>
<td>1.5</td>
</tr>
<tr>
<td>C18:1</td>
<td>1.4</td>
<td>0.9</td>
<td>4.0</td>
<td>5.3</td>
<td>6.0</td>
<td>4.8</td>
<td>10.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Other fatty acids</td>
<td>12Me-13:0 (0.3); 13Me-14:0 (1.3); 12Me-14:0 (1.0); 14Me-15:0 (1.4); 14Me-16:0 (0.4); 13Me-16:0 (1.8); hexanodioic acid (0.4); heptanodioic acid (0.3); octanodioic acid (0.6); nonanodioic acid (1.5); decanodioic acid (0.1); other unidentified FA (19.1)</td>
<td>Cholesterol, sitosterol, stigmasterol, sitostanol, sitostanol/stigmasterol</td>
<td>Cholesterol, sitosterol, stigmasterol, sitosterol, sitostanol/stigmasterol</td>
<td>Cholesterol, sitosterol, stigmasterol, sitostanol/stigmasterol</td>
<td>Cholesterol, sitosterol, stigmasterol, sitostanol/stigmasterol</td>
<td>Cholesterol, sitosterol, stigmasterol, sitostanol/stigmasterol</td>
<td>Cholesterol, sitosterol, stigmasterol, sitostanol/stigmasterol</td>
<td>Cholesterol, sitosterol, stigmasterol, sitostanol/stigmasterol</td>
</tr>
</tbody>
</table>

---

Fig. 3. Vessel samples: (a) Santa María bicolour vessel, Sector V, Fuerte Quemado-Intihuatana, Yocavil valley; (b) Santa María tricolor vessel, El Colorado, Yocavil valley; (c) Belén bicolour vessel, Mishma 7, Fiambalá valley.
The lauric to miristic ratio (C12:0/C14:0) was 0.3, which is a further indication of plant lipids (Eerkens, 2005). No sterols were detected in the neutral fraction analysis.

5. Discussion

The results from this exploratory study are consistent with the culinary uses of the vessels. The residues recovered from El Colorado vessel (V2) were the most complex mixture of lipids, as well as the best preserved. In this case, biomarkers of plant and animal lipids were detected as well as their degradation products. The third container from Mishma 7 (V3) also showed evidence of animal lipids, although the fatty acid ratios indicated possible mixtures with plant lipids.

The domestic contexts in which the three ceramics were found, together with the lack of soot or wear from heat exposure, point towards their use as containers for storage or service. The fact that all three vessels had biomarkers of animal lipids—in one case identified as camelid fat—could suggest the use of fat or marrow to seal their inner surfaces in order to make them optimal for liquid storage (Miyano et al., 2017). Liquids may have varied from water to fermented or non-fermented drinks. The container from El Colorado is especially interesting because there are clear signs that the substance that was stored included resources of plant origin, possibly a drink made from local plants. A less likely alternative hypothesis could be the use of vessels as short term storage containers to serve stews made from animal and plant products.

The profuse decorations and themes depicted in Santa María and Belén vessels are evidence that these containers were designed to be seen and to communicate relevant social messages (Basile and Ratto, 2011; Palamarczuk, 2014). The fact that they were used for culinary purposes does not yet clarify the problem of their role as everyday tableware or in commensalism practices. More contextual evidence will be needed to shed light on this issue.

Although this exploratory study included a small sample size, the results obtained from organic chemical analyses suggest that vessels in domestic contexts may have been used as part of the culinary equipment, potentially for storage of liquids or stews. Given that organic residues are complex palimpsests, further analyses on a larger sample are needed in order to determine the origin of the organic residues recovered from the ceramic matrixes.

Nevertheless, these results provide insight into the potential uses of vessels that, until very recently in Argentine archaeology, were deemed as exclusive for funerary purposes.

6. Conclusion

In this study lipid organic residues were recovered and analyzed by organic chemistry techniques in order to explore potential culinary uses of Santa María and Belén vessels from the Late Intermediate Period in Catamarca, Argentina. The results of this study indicated that all vessels effectively were used for culinary purposes, potentially for storage of liquids or stews. Although the study is preliminary, strong evidence was obtained that contradicts the traditional view of vessels as exclusively funerary "urns" in Argentine archaeology. This exploratory study has provided sufficient evidence to warrant a broad study of organic residues in Santa María and Belén vessels in the future.

Notes

1. Evidence was also recorded in strata inferior to the foundations of E3 that indicate occupations prior to their construction, the oldest ones corresponding to formative moments.

2. Radiocarbon AMS dating was carried out duplicates of the same charcoal sample, which resulted in the following radiocarbon dates: 514 ± 35 yr BP (AA69979, 1405–1435 cal. 1 sigma) and 297 ± 26 yr BP (MTC15592, 1522–1573 cal. 1 sigma).

3. The fatty acid relative abundances from the control sediment sample from Los Colorados were: 11.2% miristic acid (C14:0), 55.84% palmitic acid (C16:0), and 32.95% stearic acid (C18:0). The fatty acid relative abundances from the control sediment sample from Mishma 7 were: 62.7% palmitic acid (C16:0), 25.7% stearic acid (C18:0), and 11.6% oleic acid (C18:1).


