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Late Holocene plant use in the Sierras Pampeanas of Argentina: Evidence from phytoliths and starch grains

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ABSTRACT

Archaeobotanical studies carried out in the southern Sierras Pampeanas of Argentina (San Luis Province) are reported, which add new information about the presence of cultigens in the area during the late Holocene and the variety of wild species used in this period. The presence of starch grains of *Zea mays* (corn), *Cucurbita* sp. (squash), undifferentiated tubers, and *Phaseolus* sp. (beans), as well as phytoliths of Panicoideae, Chloridoideae, Arundinoideae, Bambuseae, Cyperaceae, Asteraceae, Arecaceae and woody dicotiledons are documented from analyses on knapped tools. The obtained data allow discussing the diversity of the resources utilized and the importance of cultigens in prehispanic times in a context that is currently considered the southern limit of prehispanic food production economies.

1. Introduction

Ever since the archaeological research of González (1952, 1960), the Sierras Pampeanas of Argentina have been considered an archaeological region with its own characteristics, distinguishable from the northwest of Argentina and from other areas. In this context, even today it is proposed that the historical trajectories of local groups are related (Berberián et al., 2013; Laguens and Bonnín, 2009). However, there is a lack of balance regarding archaeological data between the two main sectors of the Sierras Pampeanas, namely Sierras de Córdoba and Sierras de San Luis (Cattaneo et al., 2013; Heider and Curtoni, 2016).

Sierras de Cordoba has been the focus of a profuse research on domestic and wild vegetables, their importance on human diet and intensification processes, among other issues (Berberián and Roldán, 2001; López and Recalde, 2016; Medina and Pastor, 2006; Medina et al., 2016, 2017; Pastor, 2007). The lines of evidence used have been varied: colonial documents from the 16th century that report an agricultural system based on maize, beans, quinoa, squash and peanuts (Berberián, 1987; Medina et al., 2009; Piana de Cuestas, 1992; among others), complemented with the collection of locust bean (*Prosopis* spp.) and chañar (*Geoffroea decorticans*) (i.e. Castro Olañeta, 2006; Pastor, 2007). Additionally, bioarchaeological studies with stable isotopes and osteo-dental paleopathological research have indicated the existence of a diet rich in carbohydrates and C4 plants (i.e. Bordach et al., 1991; Fabra et al., 2006). These developments, together with the sharp increase in regional work, the development of micro-botanical analyses and new radiocarbon dates, have produced significant advances. Lately, open-air residential-agricultural archaeological sites (traditionally considered sedentary) have been rethought in terms of their dynamics of occupation, chronology and articulation with productive spaces, as well as the role they played in the context of socio-political processes in the region (Medina et al., 2016).

In the mountain portion of San Luis, however, the evidence for prehispanic use of vegetable resources during the late Holocene is almost exclusively indirect, and was obtained in the late twentieth century (Heider and Curtoni, 2016). Wild resources are hardly mentioned in the literature and agriculture has traditionally been considered as a possibility based on the identification of residential bases in potentially cultivable land, the presence of milling instruments (mortars and conanas), lithic axes and ceramic pots, and the identification of small open-air archaeological sites that have been interpreted as crop fields (Gambier, 1998).

The earliest evidence for the processing and consumption of maize in the Sierras Pampeanas of Argentina dates back to the final Holocene, approximately 2500 years BP (Pastor et al., 2012). In terms of

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agricultural practices, archaeological discoveries of cultivated plants, including pumpkin (*Cucurbita* sp.), quinoa (*Chenopodium quinoa*), beans (*Phaseolus vulgaris* and *Phaseolus lunatus*) and maize, became more abundant only after 1100 years BP. However, maize and crops in general were not a main subsistence resource (Pastor and López, 2011). Recent research has shown the high incidence of wild plants in the subsistence of late societies, with cultigens occupying a secondary role in the diet (López, 2015; Medina et al., 2011; Medina et al., 2016; among others).

This paper reports the results of an archaeobotanical study on knapped artifacts obtained from the excavation of the Alero Dupuy and La Vertiente sites, located at the Sierras de San Luis (San Luis province). Their significance is discussed within the framework of the subsistence strategies of the human groups that inhabited central Argentina in the late Holocene. Specifically, based on the archaeobotanical evidence, we discuss the used taxa and their importance in economic terms. The approach is novel in two respects: on the one hand, the application of archaeobotanical methodologies to knapped artifacts has been scarce in Argentina (Álvarez et al., 2009; Escola et al., 2013); on the other hand, the studied area has no research history related to the discussion on the southern boundaries of pre-Hispanic food production and the currently proposed models (Gil et al., 2014; Heider and López, 2016; Medina et al., 2016, 2017; among many others).

2. Study cases and their paleo-environmental context

The materials analyzed (knapped tools) were recovered from excavations of two archaeological sites (Alero Dupuy and La Vertiente) located in the central-north area of the San Luis province (Fig. 1). The geomorphological context corresponds to the southern foothills of Sierras de San Luis, with outcrops of igneous and metamorphic rocks of the Palaeozoic basement. Due to its location, the area comprises an ecotone between the phytogeographic provinces of the Chaco (Serrano district and dry Chaco district) and the Espinal (Caldén district and Algarrobo district) (Soriano et al., 1992). The former is characterized by the predominance of *Schinopsis haenkeana*, with less presence of species such as *Lithraea ternifolia*, *Fagara coco*, *Celtis chichape*, *Acacia caven*, *Aspidosperma quebracho-blanco*, *Schinus areira*, *Prosopis torquata*, *Jodina rhombifolia*, *Ruprechtia apetala*, *Acacia visco* and *Chorisia insignis*. Among the grasses, the most important genera are *Stipa* and *Fastuca*. In the Espinal, however, the genus *Prosopis* predominates, species such as *Prosopis nigra*, *Prosopis alba*, *Celtis spinosa*, *Prosopis caldenia*, and *Geoffroea decorticans* are common and the more frequent grasses are *Trichloris crinita*, *Elionurus muticus*, *Schizachyrium consanguineum*, *Setaria mendocina*, *Setaria globulifera*, *Stipa gynerioides*, *Stipa tenuissima*, *Stipa tennis*, *Poa lanuginosa* and *Poa ligularis* (Cabrera, 1971).

Paleoclimatic studies are well developed in the San Luis province. In a macro-regional context, this area occupies part of the South American Arid Diagonal. Two climate groups -Pampean and Patagonic- can be distinguished on the sides of this Diagonal (Piovano et al., 2009). During the middle Holocene this mountain range presented humid conditions (Chiesa et al., 1997). At approximately 3500 BP, there was a reduction in rainfall, and since then, conditions similar to the current ones have been observed. However, the studies by Strasser et al. (2010) show locally wetter conditions in the highland pampas than in the piedmont during the final Holocene.

The two sites where the analyzed material was recovered are contrasting in several ways. Alero Dupuy is a rock shelter located in a sector of xerophilous forest, close to the Pantanillo Stream (a tributary to the Quinto River), at 1154 MASL. After the excavation, two radiocarbon dates were obtained: the first one corresponds to times of Hispanic-Indigenous contact (from coal fragments recovered in the combustion structure dated to 560–280 calBP [LP 2878]), and the second belongs to the middle Holocene, dated to Cal 5570–5010 calBP (taken on a guanaco bone fragment with cut marks [AA 105423]), which places the first occupations of the rock shelter towards the middle Holocene. Alero Dupuy has been described as a multi-activity site with long-term and semi-permanent occupations (Curtoni et al. 2017).

La Vertiente is an open-air site, used for specific activities and located in a small high pampa on the side of the River Conlara, at 1157 MASL. In the lower part of the excavation, a guanaco bone fragment with cut marks was dated to 4900–4540 calBP[1] (AA107246) (Curtoni et al., 2016), also placing initial occupation in the middle Holocene. Occupation during the late Holocene has been proposed from indirect evidence, namely, the presence of ceramics on surface and at the initial levels of the excavation (Curtoni et al., 2016). An additional difference between the two sites is the amount of archaeological material recovered, with half as much evidence as collected in Alero Dupuy (Curtoni et al., 2016). Finally, considering the archaeological evidence recovered in the sites, it has been estimated that hunting of small and medium-sized animals was the main component of subsistence, combined with gathering of wild resources and the exploitation of domestic ones (Curtoni et al. 2016, 2017).

3. Materials and methods

The materials selected for analysis were, in all cases, quartz knapped artifacts (n = 9) (Table 1; Fig. 2). The selection took into account both the stratigraphic position in the excavation and macroscopic analysis once the pieces were clean.

Due to the overall sample size of the sites (144 and 30 artifacts formatted for Alero Dupuy and La Vertiente, respectively), the set from Alero Dupuy was twice as large as that from La Vertiente. The technotypological analysis was based on the concepts proposed by Aschero (1975–1983) and Aschero and Hocsman (2004). Since there are no functional studies on these raw materials for the region, the primary functions were determined following Hocsman (2006), who postulates that the morphology of the formatted artifacts provides tools to define what would potentially be the best possible use, within the framework of a limited range of actions.

An adaptation of the protocols of Dickau (2005) and Loaiza (personal communication 2016) was used for the recovery of the microremains. The first step was a soft wash of the artifacts with deionized water and a toothbrush to remove sediment and allow their description. Following Kealhofer et al. (1999), it was assumed that different methods of sampling provide different types of information, that is, the analysis of the soil around the artifacts produce data concerning the context, and the “artifact sample” obtained directly from the artifacts using sonication provide direct evidence for its use. To avoid contamination, the artifacts were washed with deionized water applied with pressure and using a different toothbrush for each. Subsequently, each instrument was sonicated in deionized water for 5-minute cycles. The liquid containing the residues was concentrated by centrifugation cycles of 15 min at 2500 rpm, eliminating as much water as possible. For the separation of the starch grains, a solution of Zinc Bromide ($ZnBr_2$) with a density of 1,79 g/cm^3 was added to each sample, following the protocol of Dickau (2005). After the extraction of the starch grains the materials with densities greater than 1,79 g/cm^3 (remaining at the bottom of the test tube) were washed by adding deionized water and centrifuging at 2500 rpm for 15 min, then decanting until the layer created by the zinc bromide solution was not visible. This material was used for the extraction of phytoliths. In the particular case of the samples obtained from knapped instruments, deflocculating and sieving of the sediment were omitted, on account of the small amount of phytoliths obtained. The carbonates were removed using hydrochloric acid (HCl) and nitric acid (HNO_3) was added in a hot water bath for the removal of organic matter. After each acid bath the samples were

[1] The dates of both sites were calibrated using CalPal 2016.2 software and the INTCAL 2013 calibration curve.