



Nicotine in residues of smoking pipes and other artifacts of the smoking complex from an Early Ceramic period archaeological site in central Chile



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ABSTRACT

Consumption of psychoactive substances has been important in the lives of indigenous American people for several millennia. While numerous studies have reported the occurrence of smoking pipes at archaeological sites, only a few have addressed the question of the substances being smoked. The study of smoking pipes is of particular interest at the Early Ceramic period archaeological site La Granja in central Chile (500–1000 A.D.) given its ritual connotation. Analysis by gas chromatography coupled to mass spectrometry showed the presence of nicotine in a large proportion of the residues extracted from a wide variety of grinding and smoking artifacts from La Granja (total $N = 116$). Additionally, the likelihood of finding residual nicotine varied along pipe segments, decreasing from the bowl to the mouthpieces. This research has studied the cultural operative chain of the smoking complex of the Early Ceramic period of central Chile and described *Nicotiana* sp. as a plausible plant source with nicotine as the compound involved in the physiological effect, micromortars and pestles as the artifacts used in the preparation of plants for smoking and finally, the smoking pipe through which the plant compounds were incorporated into the smoker's organism.

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1. Introduction

Consumption of psychoactive substances from natural sources has been important in the lives of indigenous American people for several millennia (Dougherty, 1972; Elferink, 1983; Haberman, 1984; Schultes and Hofman, 1979; Torres, 1999; Torres and Repke, 2006; Wilbert, 1987; Winter, 2000). Tobacco (*Nicotiana* spp.), in particular, was consumed in a variety of ways by different American cultures, e.g., by smoking, chewing, snuffing, drinking or through enemas (Wilbert, 1987). The mode of consumption is usually related to the type of effect pursued, i.e., for medicinal purposes or for the achievement of particular altered states of consciousness (Wilbert, 1987). These effects are likely based on the dose-dependent effects of nicotine, e.g., in small quantities it is a stimulant and painkiller while at large doses it may produce visions, trance and catatonia (Wilbert, 1994).

Numerous studies have reported the occurrence of smoking pipes in the Americas, the earliest pipes being found in archaeological sites some of which are dated as early as the second millennium B.C. (e.g., Aguerre et al., 1973; Fernández Distel, 1980; Pérez Gollán and Gordillo, 1993, 1994; Rafferty, 2004; Winter, 2000). However, only a limited number of studies have directly addressed the question of the substance being smoked. In North America, recent analyses by gas chromatography coupled with mass spectrometry (GC/MS) have shown the presence of nicotine in pipe residues from sites dated as early as 300 B.C. (Rafferty, 2002, 2006; Rafferty et al., 2012; Tushingham et al., 2013). In South America, seeds of *Anadenanthera* sp. were found together with several smoking pipes in a preceramic site at Puna de Jujuy, northwestern Argentina (NWA), dated 2130 B.C. (Fernández Distel, 1980) and GC/MS analysis of residues in smoking pipes revealed the presence of dimethyltryptamine alkaloids, presumably from *Anadenanthera* sp., in a Formative site (ca. 40 A.D.) at Catamarca, also in NWA (Bugliani et al., 2010; Rosso and Spano, 2005–2006). The presence of nicotine was shown in plant material found in a skin pouch at the Niño Korin site near La Paz, Bolivia, dated around 500 A.D. (Bruhn et al., 1976), and archaeobotanical studies of microremains in pipe residues from the Ciénaga period of NWA (650

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B.C.–500 A.D.) revealed the presence of trichomes of *Nicotiana* sp. (Capparelli et al., 2006). Direct evidence of the consumption of nicotine, i.e., the finding of nicotine in the consumers rather than in the objects presumably used for consumption, has only recently been obtained by GC/MS analysis of the hair of prehispanic mummies from the Formative through to the Late Intermediate periods (ca. 100 B.C.–1450 A.D.) of San Pedro de Atacama in northern Chile (Echeverría and Niemeyer, 2013) and from the Inka Period (ca. 1450 A.D.) of the Peruvian coast and Argentina (Musshoff et al., 2009).

The study of smoking pipes is of particular interest at the archaeological site La Granja in central Chile (Fig. 1) due to the high number of pipe fragments found in it (790 pieces in contrast to all other sites in the region which at most have yielded a dozen fragments each); most fragments correspond to inverted T-shaped ceramic pipes with a central bowl and two opposed and open mouthpieces. The site is located in the Cachapoal valley ca. 100 km south of Santiago (34° S, 71° W), at the intersection of ancient north–south and east–west interaction trails (Planella, 1988). Archaeological excavations have shown its occupation by Llolleo groups for a long time interval during the Early Ceramic period of central Chile (500–1000 A.D.). The site contains domestic and ceremonial sectors distinguished mainly on the basis of the nature and concentration of archaeological remains. La Granja 1 and La Granja 2 (Supplementary Figs. 1 and 2) were residential sectors which included a dwelling made with large oval river stones; the materials recovered consisted mainly of grinding stones, bones of *Lama guanicoe* (Camelidae), charred remains of crops (*Zea mays*, *Chenopodium quinoa*, *Phaseolus* sp., *Lagenaria* sp.) and a large number of jug fragments with a variety of decorations. The La Granja 3 sector yielded an exceptionally high number of pipe fragments. In addition, the excavations demonstrated the existence of a system of linear north-south oriented structures made of large river stones; along them, small oven loci and areas with a superimposition of larger burns were found, as well as broken grinding stones embedded in the structure walls. At the north-east end of the system of structures, a 100–110 cm deep vertical pit was found which contained, in addition to pipe fragments, remains of camelid phalanxes, rodents, birds, fish, and sea and fresh water mussels, beads from necklaces, and scarce but selected crop remains. At the bottom of the pit, a pile of river stones was found which covered, as

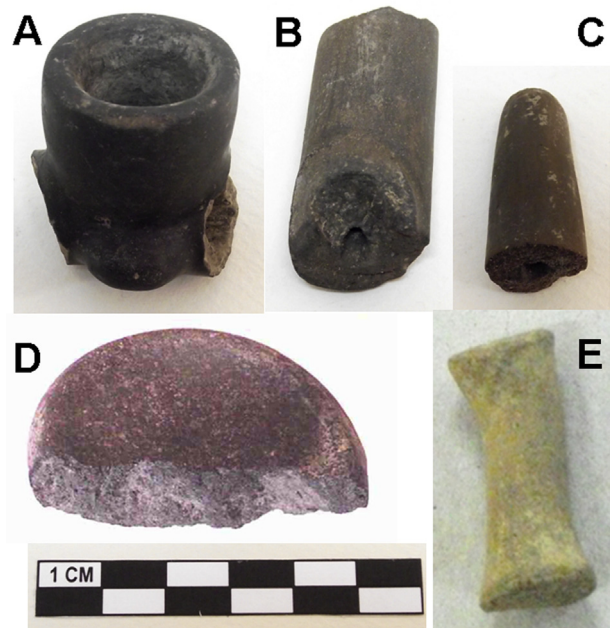


Fig. 2. Examples of artifacts of the smoking complex of Early Ceramic period of central Chile analyzed in this work: bowl (A), pipestem (B), mouthpiece (C), micromortar (D) and pestle (E).

a sort of seal, a number of intentionally buried pipe fragments. The set of elements described support La Granja 3 as a sector with a ritualistic connotation (Planella et al., 2000; Falabella et al., 2001). The wide diversity of smoking pipes found at La Granja is not inconsistent with ethnohistorical accounts of early Spanish chroniclers which describe the existence of places for social congregation of native groups around the XVI century (Valdivia, 1960 [1545]; Vivar, 1979 [1558]). The ceremonial importance of this place is supported by ethnographical studies which show that ceremonial use of smoking pipes has continued amongst natives in southern Chile (Cooper, 1949; Guevara and Oyarzún, 1912; Hilger, 1957), a region strongly linked to central Chile during the Early Ceramic period (Falabella and Planella, 1988–1989).

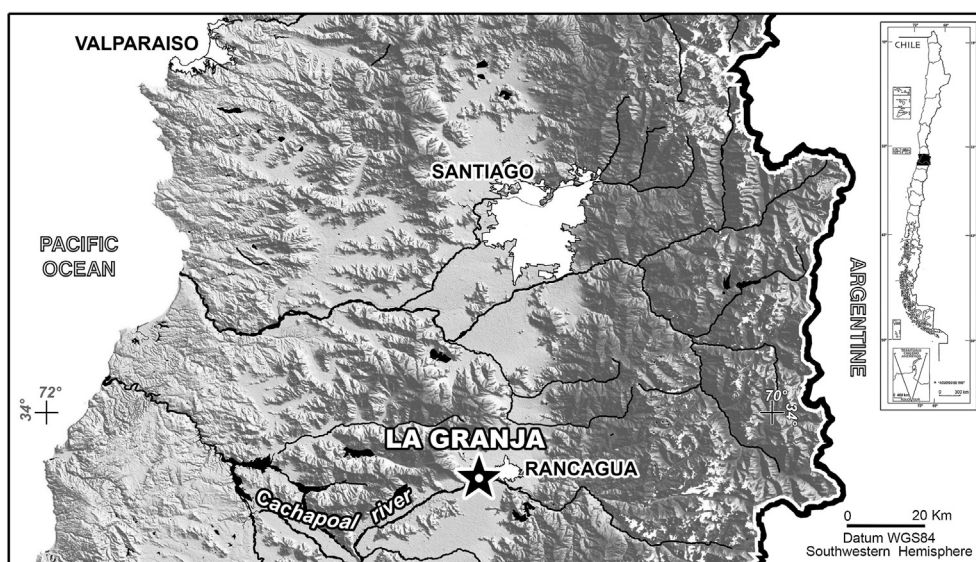


Fig. 1. Map showing the location of the La Granja archaeological site.

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