Journal of Archaeological Science 40 (2013) 4331–4347

Contents lists available at SciVerse ScienceDirect

Journal of Archaeological Science

journal homepage: http://www.elsevier.com/locate/jas

An ethnoarchaeological study of cooking installations in rural Uzbekistan: development of a new method for identification of fuel sources

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ARTICLE INFO

Article history:
Received 15 April 2013
Received in revised form
31 May 2013
Accepted 1 June 2013

Keywords:
Cooking
Oven
Tandir
Ochock
Ash pseudomorphs
Dung spherulites
Phytoliths
Fuel
PSR

ABSTRACT

Mud constructed cooking installations such as ovens and hearths are common in modern, pre-modern and archaeological domestic contexts in West and Central Asia. Archaeological cooking installations are primarily identified using analogy of shape and size to ethnographic installations. The study presented here establishes direct evidence to the use of fire within mud constructed cooking installations, thus providing means for reducing ambiguity in identification of archaeological cooking installations. In addition, we present here a newly developed method that enables a clear-cut distinction between wood and dung ashes used as fuel materials in many modern and archaeological domestic contexts. The study is based on an ethnoarchaeological research in rural households at the Republic of Uzbekistan that was followed by geoarchaeological analyses of installation walls, wood ash, dung ash and wood and dung standards collected in the study area. Field work included ethnographic observations, interviews with informants and temperature measurements during cooking experiments. We show that changes in the clay mineral structure due to exposure to high temperatures on the interior walls of cooking installations can be detected using FTIR (Fourier Transform Infrared) spectroscopy, providing for the first time direct evidence to the use of fire within such installations. We demonstrate that the temperature recorded by clay alteration on installation walls as well as in the ashes left on installation bottoms does not correspond to baking or cooking temperatures. We also show that the newly developed method, based on the ratio of wood ash pseudomorphs to dung spherulites, separates between wood and dung ashes with very high certainty. Yet, we identify a range of values where differentiation between wood and dung ashes is uncertain, and suggest it results from intensive mixing processes. Lastly, we show that phytolith morphotype analysis is an insufficient tool, if used alone, for distinguishing wood from dung ashes in the study area. The newly developed tools for temperature estimation within mud constructed installations and for fuel origin determination contribute to better understanding of cooking-related practices, and can be applied to archaeological contexts worldwide.

1. Introduction

The manipulation of raw animal and vegetal materials into edible and nutritious food is a hallmark of human evolution (Carmody and Wrangham, 2009; Organ et al., 2011; Wollstonecroft, 2011; Wrangham, 2009). Cooking probably developed with the earliest systematic use of fire by hominins, inferred from the identification of hearths associated with burnt animal bones as early as the Lower Palaeolithic ca. 400,000 years ago (Roebroeks and Villa, 2011). Hearths can therefore be regarded as the earliest cooking installations. Mud constructed cooking installations are a much later development in human history, possibly dating as early as the PPNB culture in the southern Levant and Southeastern Anatolia, some 7000 years ago (Lyons and D'Andrea, 2003). The research presented here focuses on mud constructed cooking installations, specifically those related to west and central Asian types.

Mud constructed cooking installations in west and central Asia have been described from pre-modern times by explorers, ethnographers and ethnoarchaeologists (e.g., Avitsur, 1971; Dalman, 1964; Frankel, 2011; Kramer, 1982; McQuitty, 1984, 1993; Mulder-

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http://dx.doi.org/10.1016/j.jas.2013.06.001

Heymans, 2002; Parker, 2011; Parker and Üzel, 2007; Weinstein, 1973). These installations can be broadly separated into baking installations (dome-shaped ovens known as Tanur/Tandir, Tabun, and two-storied ovens known as Wagdiah/Arsah/Mogadeh) and frying-roasting-boiling installations (hearths of various types). The Tanur is a large (between 80 and 150 cm high and 50–80 cm in diameter) cylindrical shaped installation built from soil with a ventilation hole at its base, and a large opening at the top. It is either dug into the surface of activity (Kramer, 1982), incorporated into a mud built superstructure (Crawford, 1981) or is free standing with at least one coating layer for insulation (McQuitty, 1984). It is usually fueled with wood, dung, and/or crop processing waste located at its base while the dough for bread is placed on its inner walls.

The Tabun is a hemispherical installation shorter than the Tanur (30 cm high and about 80 cm in diameter) with a wide opening at the top from which the dough is inserted (McQuitty, 1984). Tabun shapes and sizes vary regionally (Frankel, 2011; McQuitty, 1993). In northern Jordan, for example, the Tabun has a side opening from which wood fuel and olive pulp after pressing (jift) are inserted, and a built base where the dough is laid to bake. In southern Jordan and in Israel Tabuns are laid on top of a shallowly excavated area covered by river pebbles or potsherds. These installations have no side opening, and the fuel (mostly crushed dung and crop processing waste) is piled around the installation from the outside. Fuel is kept warm constantly all year long whereas refueling (and thus more intensive burning) occurs prior to every daily use.

Ethnographic research on similar and other types of cooking installations was also carried out in other parts of the world where cooking installations were (and are) still in use. For example, Greenhouse et al. (1981) studied the botanical residues from the use of earth ovens lined with pebbles by a group of Pima Indians in the Gila River reservation. Thoms (2008) studied cook-stone features used by North American Indians, and Amouretti (1986) documented the use of a pit oven in the Sahara. Spatial distribution patterns related to the use of hearths were studied in forager societies in different parts of the world (Binford, 1998; Fisher and Strickland, 1989, 1991), while studies on the botanical remains resulting from fueling hearths with dung were conducted by Miller in Iran (Miller, 1984b) and Reddy in India (1998).

Archaeologically, hearths are prevalent in sites in west Asia since the Middle Palaeolithic while installations that somewhat resemble Tanurs and/or Tabuns in shape and size are prevalent since the Early Bronze Age (4th–3rd millenniums BC). A special hearth type, consisting of a pavement of river pebbles, is known for example from Iron Age (ca. 3200 years BP) Israel and is ethnically associated with the Philistine culture (Gur-Arieh et al., 2012 and references therein). Field identification of these archaeological installations is based on simple analogy of shape and size between ethnographic and archaeological installations, sometimes coupled with attention to presence of burnt fuel (ash) within or on archaeological installations, and somewhat also assisted by the general archaeological context (e.g., domestic context). While most of these identifications may be correct, we find that they are based on insufficient and inconclusive data. The following questions are crucial for better field identification of cooking installations:

1. Is there evidence for heat within these installations?
2. Is the associated 'ash' indeed ash?
3. Is the associated 'ash' *in situ*, or a later dumping event into an unused installation?

We could not find ethnographic documentation geared toward answering these questions. Another research question that did not receive much attention in archaeological research at historical sites in west Asia relates to the identification of the type/s of fuel that were used during operation of archaeological installations. While ethnographic studies generally showed that wood and dung are the most widely-used fuels (Kramer, 1982; McQuitty, 1993; Miller, 1982, 1984a, 1984b; Miller and Marston, 2012; Parker and Üzel, 2007; Pierce et al., 1998; Samuel, 1989; Zapata Peña et al., 2004), no study to date touched upon the proportions of such fuels within specific installations. We therefore carried out an ethno-archaeological research that was geared toward identifying physical and chemical criteria by which it could be determined whether a mud installation has been used for cooking, and toward understanding what types of fuel can be identified from ashes found within cooking installations. The ethnoarchaeological research treated the modern installations and ashes as if they were archaeological, i.e., we carried out sampling in a manner similar to sampling archaeological installations and sediments in an archaeological context, for later geoarchaeological analyses.

1.1. Research area

The ethnoarchaeological study was conducted in Uzbekistan in collaboration with the Samarkand Institute of Archaeology, Uzbek Academy of Sciences.

The Republic of Uzbekistan is located in central Asia within the Aral Sea basin. About 80% of its area is arid or semi-arid while the climate in the lowlands and mid-altitude is Mediterranean with wet winters and dry summers (Gintzburger et al., 2003). More than 60% of the population lives in rural areas, of which about 34% subsist on agro-pastoralism (Payziyeva and Paiziev, 2012). The research reported here was conducted ca. 25 km south of Samarkand, in the Karatyube Mountains area. The area is semi-arid with about 300 mm annual precipitation that carries mid-latitude steppe vegetation (Fig. 1).

The research was carried out in two villages, Sivasoy at the eastern part of the mountain ridge and Tolly at the western part of the same ridge, among two subsistence agro-pastoral families. Like other families in the research area, these families live in households that include a house for a nuclear family and separate houses for married sons and their families. Households include a courtyard where various economic and social activities are carried out daily, a garden (that carries perennial vegetables as well as fruit trees) and animal enclosures (Kandiyoti, 1999 and personal observations). In these rural areas, houses are built from mud and vegetal materials, electricity supply is scarce if existing, and although gas stoves are sometimes used, the main means of cooking, baking and heating are traditional installations. These traditional installations, locally called tandir and ochock, are built from mud and vegetal matter (most commonly straw). The tandir is a baking oven almost identical to the Turkish installation bearing the same name. The ochock is a partially enclosed hearth used for cooking, which includes roasting, frying and stewing. Cooking with the ochock is a daily task while baking takes place every two to three days. The general aridity of the environment, coupled with herd products due to the pastoral component in the economy of the society, dictates use of wood, dung and/or crop processing waste as fuel for cooking and baking activities.

2. Materials and methods

2.1. Field work

Field work was conducted for a period of two weeks during October 2011 and included ethnographic observations, interviews, experimentation with various fuel types, and sampling of sediments, raw fuel materials, ash, and installation wall parts. The study in the Sivasoy household was made possible owing to the wife of the household's owner. Additional information was obtained by