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## An ethnoarchaeological study of livestock dung fuels from cooking installations in northern Tunisia

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## ABSTRACT

Livestock dung is a valuable material in many rural communities worldwide. In our research area, the site of Althiburos and its surroundings, now el Médéina, in northwestern Tunisia, dung is the main source of fuel for domestic purposes, primarily the processing and cooking of foods. Ovicaprine dung is daily used in traditional mud *tannur* type ovens, namely *tabouna*. The archaeological record shows that mud constructed cooking installations were common during the first millennium BC. Previous studies of phytoliths and dung spherulites at Numidian Althiburos suggested the use of vegetal and fecal matter for fuel purposes. We present here the results of the continuation study based on the comparison between archaeological results (a selection of cooking installations, six hearths and two mud ovens) and those obtained from the ethnographic study of dung fuel materials from the site area. The present study builds up on ethnographic observations and informal interviews (dung collection, management, storage, waste disposal and cooking and baking activities), temperature measurements within the burning fuel, as well as modern material sampling (fresh dung, burned pellets, dung ashes and fuel trash paths) which was followed by integrated studies of phytoliths and calcitic microfossil analyses (dung spherulites and wood ash pseudomorphs) for comparative purposes. The results obtained provided direct evidence regarding the type of fuel sources: dung, wood and a mixing of dung and vegetal matter (wood and agricultural by-products). Dung was used as source of fuel material across time (from the Early Numidian occupation phase, 10th–9th century BC, to the last centuries BC) and space (in different excavation areas and type of installations). Such integrated studies demonstrate the value of combining different microarchaeological techniques and the use of ethnoarchaeological material from site areas.

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### 1. Introduction

It is well known that livestock dung is a valuable source of fuel in many rural communities across the world (Miller, 1984; Anderson and Ertug-Yaras, 1998; Reddy, 1998; Sillar, 2000). Among traditional societies dung is an important secondary product that can be used in varied range of ways (i.e. fertilizer either in its organic form or after being burned, building material, container making, etc.), in addition to fuel for domestic uses. The use of dung as fuel has been commonly related to situations of deforestation, in areas where the

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woody vegetation is sparse or not available (Bottema, 1984; Miller, 1984; Anderson and Ertug-Yaras, 1998). However, ethnographic studies on fuel selection show how it may relate not only to availability and economic factors (i.e. cost, efficiency and redundancy, as this material may be needed for other main purposes such as manure), but also by other cultural choices or social values (i.e. taboo on using specific materials) (Shahack-Gross et al., 2004; Picornell et al., 2011). Ethnographic research in the Moroccan Rif, an area in western Maghreb where Mediterranean woodlands are still abundant, illustrates that despite wood has traditionally been the main source of fuel for domestic purposes, the use of dung cakes (primarily mixed cow and goat dung) is linked to the firing of pottery (Zapata et al., 2003). In this later example the use of dung cakes responds to technical reasons related to their burning properties (slower and more regular than wood), and shows a limited consumption, as only a partial amount of the household dung production is used for firing and most of the production is devoted to other main purposes, such as manure and tempering.

In our research area, the site of Althiburos and its surroundings, located in a small fluvial valley on the northern edge of the Ksour massif, in northwestern Tunisia (Fig. 1), livestock dung is the main source of fuel for domestic use, primarily the processing and cooking of foods, in addition to ceramic production. The area, where firewood is sparse, is particularly interesting because the present-day rural communities use ovicaprine dung as the main fuel source, including daily cooking and baking in mud cylindrical *tannur* type ovens, locally called *tabouna* (Portillo and Albert, 2011).

A variety of archaeological domestic cooking installations from all time periods have been studied in the Mediterranean region. Many studies have focused mainly in prehistoric and protohistoric ovens and hearths, based on macroscopic descriptions and analogies to ethnographic parallels. A number of recent studies have explored such fire installations using microarchaeological techniques (Weiner, 2010 and references therein), thus emphasizing on the identification of the mineralogical signatures of heating associated to the installations, and taking into account formation and degradation processes that are critical for interpreting the archaeological record (Albert et al., 2000, 2003; Albert and Cabanes, 2007; Berna et al., 2007; Gur-Arieh et al., 2012, 2014). Possible

depositional route-ways and taphonomic histories for such firing contexts may relate to fuels used, foods accidentally burnt during preparation and cooking, as well as materials accidentally or deliberately discarded into the fire (i.e. destroying infested seeds) (Van der Veen, 2007; Matthews, 2010). In addition, secondary depositional pathways and re-use for storage or trash may introduce burnt and un-burnt materials that are unrelated to the original function of the installations (i.e. fill deposits, inclusion of building materials).

Mud constructed cooking installations are also common in Numidian archaeological contexts belonging to the first millennium BC (Belarte, 2011; Ramon and Maraoui, 2011). In previous studies at Numidian Althiburos we have addressed plant and dung exploitation, including food processing activities, through the combined use of opal phytoliths— microscopic bodies composed of pure silica present in the tissues of many vegetal species (Piperno, 1988, 2006; Pearsall, 1989) and dung spherulites— calcitic particles that form in animal guts and can be found in dung (Brochier et al., 1992; Canti, 1997, 1998, 1999). Livestock dung assemblages have been examined through such microfossils in varied contexts belonging to different occupational phases of the site (covering most of the 1st millennium BC), including room floors and midden deposits, but also in combustion structures such as hearths and ovens (Portillo and Albert, 2011, 2016; Portillo et al., 2012). The aim of this previous research was to evaluate the potential use of plant and dung microfossils, in integration with other bioarchaeological evidence from faunal and charred plant macro-remains, for delineating domestic activities being carried out at the site, including food processing and grazing and foddering of herds. The presence of phytolith-rich layers in association with large amounts of fecal spherulites in certain areas of the site suggested that plants were deposited onsite as livestock dung or dung-products. Thus, such microfossil associations in combustion structures suggested the use of plant and dung material for fuel purposes. Additionally, we carried out a pilot ethnoarchaeological study in order to better understand the manner in which both vegetal and dung microfossils were embedded in the archeological assemblages and, more widely, their role in site formation processes (Portillo et al., 2012). For this purpose, the research included the study of selected

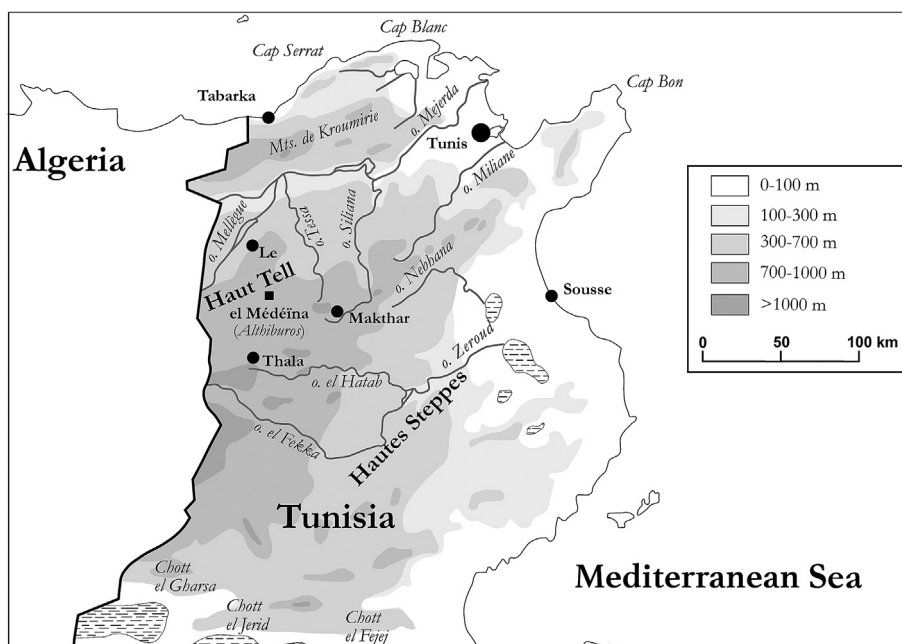


Fig. 1. Map showing the general location of Althiburos, in northern Tunisia.

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