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Ascetic or affluent? Byzantine diet at the monastic community of St. Stephen's, Jerusalem from stable carbon and nitrogen isotopes

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ABSTRACT

Stable carbon and nitrogen isotope ratios from bone collagen in skeletons from the Byzantine (5th–7th century AD) monastery of St. Stephen's in Jerusalem were examined in conjunction with a review of historical sources detailing dietary practices during this period in the Levant. Relatively low δ^{13}C ratios ($-19.0 \pm 0.5‰$, 1σ) indicate a diet consisting primarily of C_3 sources and display continuity with textual records describing monastic daily life. Conversely, human δ^{15}N values ($9.6 \pm 1.2‰$, 1σ) are enriched in ^{15}N relative to local fauna ($7.3 \pm 1.1‰$, 1σ) and point to the contribution of animal protein to the diet, an unexpected result based on both the rarity and expense of these luxury food items as well as dietary prohibitions associated with an ascetic monastic lifestyle. No sex-based differences in diet were detected for either δ^{13}C or δ^{15}N values, suggesting that men and women consumed isotopically similar foods. As the vast majority of monastic communities in the ancient Near East were located in the desert, the urban setting of St. Stephen's monastery allows for a unique glimpse into a rarely-explored facet of Byzantine life.

1. Introduction

Stable isotope analysis is a well established means of reconstructing human diet in archaeological populations (Ambrose et al., 1997; Craig et al., 2009; Katzenberg et al., 1993; Keenleyside et al., 2009; Müldner, 2007; Petroutsa and Manolis, 2010; Prowse et al., 2004; Richards et al., 2005; Schurr, 1998). Because isotopes of different elements are integrated into consumer tissues during life, these values facilitate an evaluation of different sources of dietary intake, permitting a measure of the diet consumed by an individual. Carbon isotope ratios in bone collagen enable us to distinguish between the ingestion of plants with specific photosynthetic pathways and permit a distinction between terrestrial and marine contributions to diet, while nitrogen isotope ratios delineate various trophic levels within local food webs to differentiate primary and secondary consumers.

Few isotopic analyses on skeletal collections from the Byzantine Near East have been conducted, and even fewer studies can boast an extensive textual record directly associated with human remains. Skeletal material from the large Byzantine monastic community of St. Stephen's in Jerusalem (5th–7th century AD) presents a unique opportunity to integrate biochemical and archaeological evidence with written cultural records to provide a more holistic picture of dietary intake during this period. As many Byzantine ascetics in the ancient Near East lived in isolation or in desert monasteries, St. Stephen's was exceptional in that it was located in an urban and affluent environment (Chitty, 1966; Goehring, 1993; Hirschfeld, 1993). Consequently, this study sought to examine the diet of those interred at the monastery and to evaluate the monastery's adherence to written dietary restrictions prohibiting the consumption of luxury goods, including meat and/or other forms of animal protein (Thomas and Hero, 2000).

2. Background and significance

2.1 St. Stephen's monastery

Located outside the Old City walls, just north of the Damascus Gate, St. Stephen's was an important urban religious site for pilgrims to Jerusalem (Fig. 1). Founded by Empress Eudocia, the basilica and monastery were built beginning in AD 431 and dedicated in AD 439 with the interment of the remains of Stephen, the first Christian martyr (Clark, 1982; Murphy-O'Connor, 2008; Price, 1991). However, the crypt complex in the caves below the monastery was built much earlier, dating to the Iron Age (8th–7th century BC) (Barkay et al., 1994). The complex consists of a variety of chambers, with burial benches carved from stone walls where the deceased were laid before being interred in the large repositories beneath the benches (Sheridan, 1999). These ancient burial

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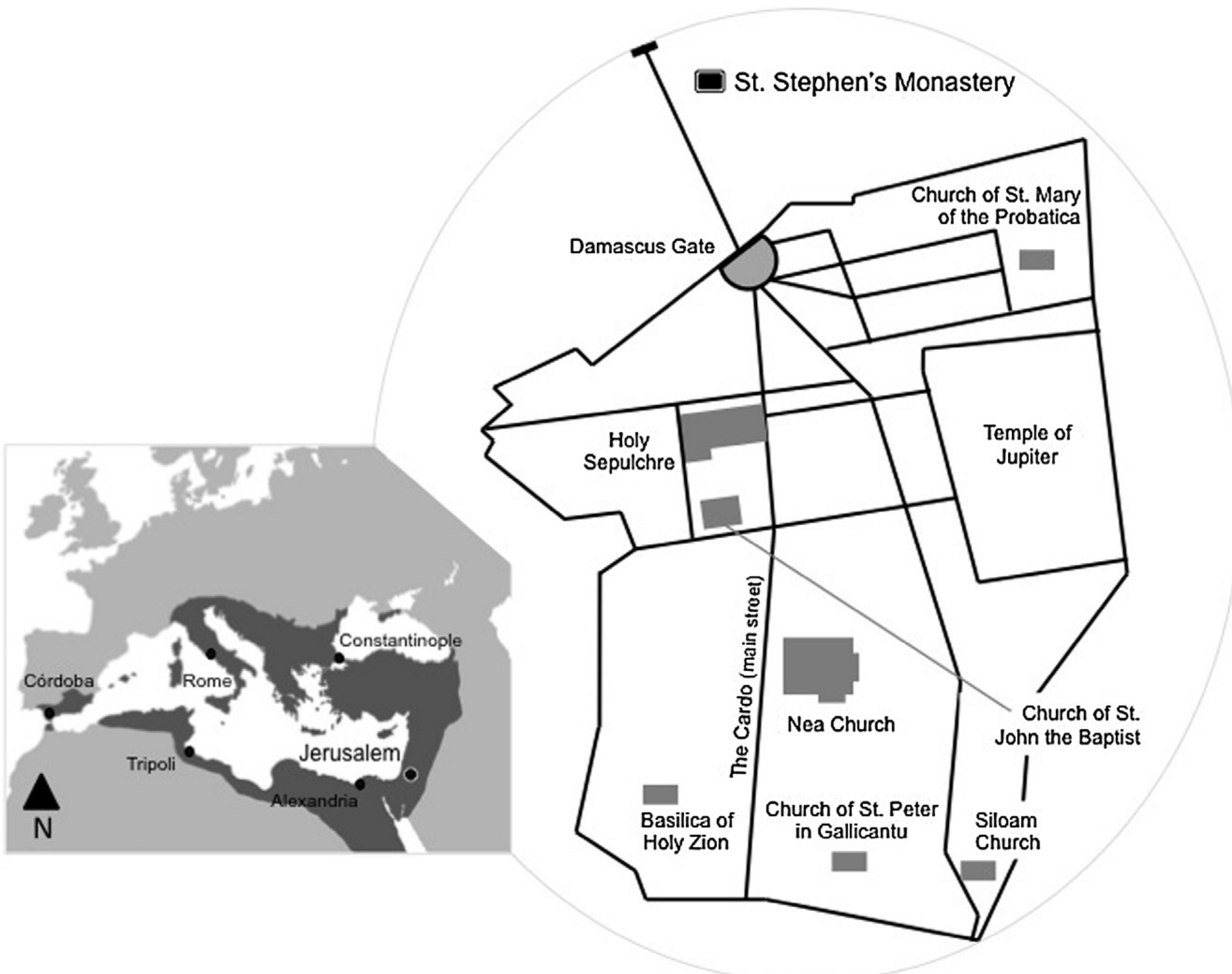

Fig. 1. Map of the major cities of the Byzantine Empire and the Old City of Jerusalem during the sixth century AD. St. Stephen's Monastery lies just outside the Old City walls.

chambers were reused in the Byzantine era by the monks of St. Stephen's, a practice not uncommon during this period (Avni, 1993). The bones in repository six date from the early 6th to mid-7th century AD based on radiocarbon dating, artifacts commingled with the bones, Greek inscriptions found in the tomb complex, and considerable architectural evidence of a large Byzantine monastic occupation at the site during a well-documented time frame (AD 431–638) (Bautch et al., 2000; Murphy-O'Connor, 2008; Sheridan, 1999).

2.2 Stable isotope biochemistry

Stable carbon and nitrogen isotope values are expressed in parts per mil (‰) using the following equation:

$$\delta = (R_{\text{sample}} - R_{\text{standard}})/R_{\text{standard}}) \times 1000$$

Stable carbon isotope ($\delta^{13}C$) values are reported relative to the Vienna Pee Dee Belemnite standard (V-PDB), while stable nitrogen isotope ($\delta^{15}N$) ratios are measured in relation to the ambient inhalable reservoir (AIR) standard (Schwarcz and Schoeninger, 1991).

Stable carbon isotope ($\delta^{13}C$) ratios enable a distinction between the consumption of different plant types. During the fixation of atmospheric CO_2 (with a $\delta^{13}C$ value of approximately −8.0‰) into their tissues, plants metabolize carbon using one of three photosynthetic pathways: C_3 (Calvin-Benson), C_4 (Hatch–Slack), and Crassulaean acid metabolism (CAM) (Lajtha and Marshall, 1994). Because CAM plants, including succulents and cacti, rarely contribute to human diet, they are not considered in the current study (Schulting, 1998).

C_3 plants display $\delta^{13}C$ values depleted in ^{13}C relative to atmospheric CO_2, ranging from approximately −35.0 to −20.0‰. The C_3 plant type dominates temperate environments and includes most fruits, vegetables, legumes, nuts, wheat, and barley (Ambrose, 1986; DeNiro, 1987; Katzenberg, 2000). Discrimination against ^{13}C in C_4 plants during carbon metabolism is not as extreme as in C_3 plants, producing $\delta^{13}C$ values between −16.0‰ and −9.0‰ (Schoeninger and Moore, 1992). An additional fractionation of approximately +5.0‰ takes place between producers (plants) and primary consumers as dietary proteins are incorporated into collagen, with little if any (+1.0‰) subsequent fractionations between primary and secondary consumers (DeNiro and Epstein, 1978). C_4 plants are well represented by tropical grasses, including maize, sorghum, millet, and sugarcane (Schwarcz and Schoeninger, 1991).

In addition to terrestrial vegetation, plants within marine ecosystems also utilize the C_3 pathway. However, unlike terrestrial plants, which obtain carbon from atmospheric CO_2, marine plants primarily derive carbon from dissolved CO_2 in the ocean (Richards and Hedges, 1999). At the base of this food web, C_3-based photosynthesis by phytoplankton brings about $\delta^{13}C$ ratios considerably heavier than those of terrestrial C_3 plants that carry upwards through all trophic positions of the marine food web. As a result, $\delta^{13}C$ ratios of marine organisms tend to range from approximately