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Human intestinal parasites from a Mamluk Period cesspool in the Christian quarter of Jerusalem: Potential indicators of long distance travel in the 15th century AD

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ABSTRACT

The aim of this research is to determine which parasites were present in a mediaeval latrine from the old city of Jerusalem. This latrine contains fragments of pottery from the Middle East and also from Italy, suggesting links of some kind with Europe. Excavation identified two separate entry chutes emptying in a shared cesspool. Radiocarbon dating and pottery analysis is compatible with a date of use in the late fifteenth century and early sixteenth century. Twelve coprolites (preserved stool) and mixed cesspool sediment were analysed with light microscopy and enzyme-linked immunosorbent assay (ELISA). Six species of intestinal parasites were identified. These were the helminths *Ascaris lumbricoides* (roundworm), *Trichuris trichiura* (whipworm), *Taenia sp.* (beef/pork/asiatic tapeworm) *Diphyllobothrium sp.* (fish tapeworm), and two protozoa that can cause dysentery (*Entamoeba histolytica* and *Giardia duodenalis*). While roundworm and whipworm were found in every sample, the other parasite species were present in only one or two samples each, suggesting that only a minority of those using the latrine were infected with those species. The role of Jerusalem as a site for long distance trade, migration or pilgrimage is considered when interpreting the Italian pottery and the parasites present, especially *E. histolytica* and *Diphyllobothrium sp.*

1. Introduction

Jerusalem has long been known as a crossroads between Europe, Africa and Asia due to its geographic location. Like many cities in the Middle East, in the mediaeval period its population was comprised of people of different religious beliefs including Muslims, Christians and Jews (Little, 1989; Badr, 2005; Braude and Lewis, 1982). The cultural and religious complexity of the local population of the city has resulted in the differing attitudes to diet and food hygiene noted in these three religions. However, its role as a city holy in Judaism, Christianity and Islam made it a destination for so many more travellers. As well as the merchants who came to trade, pilgrims travelled long distances to pray at sites that they held precious in their traditions (Janin, 2002; Prescott, 1954). This complex mixture of religions and cultures coupled with the presence of long distance travellers makes Jerusalem an ideal site for research into health in the past, and in particular how past infectious diseases may have been spread by those travellers.

The aim of this study is to analyse samples from the contents of a mediaeval cesspool from the Christian quarter of the old city of Jerusalem, in order to determine if intestinal parasites were present. This will allow us not only to better understand the health of those who lived in the Christian quarter of the city at that time, but also to look for signs of infectious diseases that were not endemic to the Jerusalem region. This should highlight the presence of long distance travellers who had taken their parasites with them as they journeyed to Jerusalem.

2. Materials

In 1996 rescue excavations were carried out in the courtyard of the Spanish School (Colegio del Pilar) in the Christian quarter of Jerusalem. This lies a short distance to the north of the Church of the Holy Sepulchre (Fig. 1). Three small test pits were opened, in one of which a stone-built cesspit was discovered and partly

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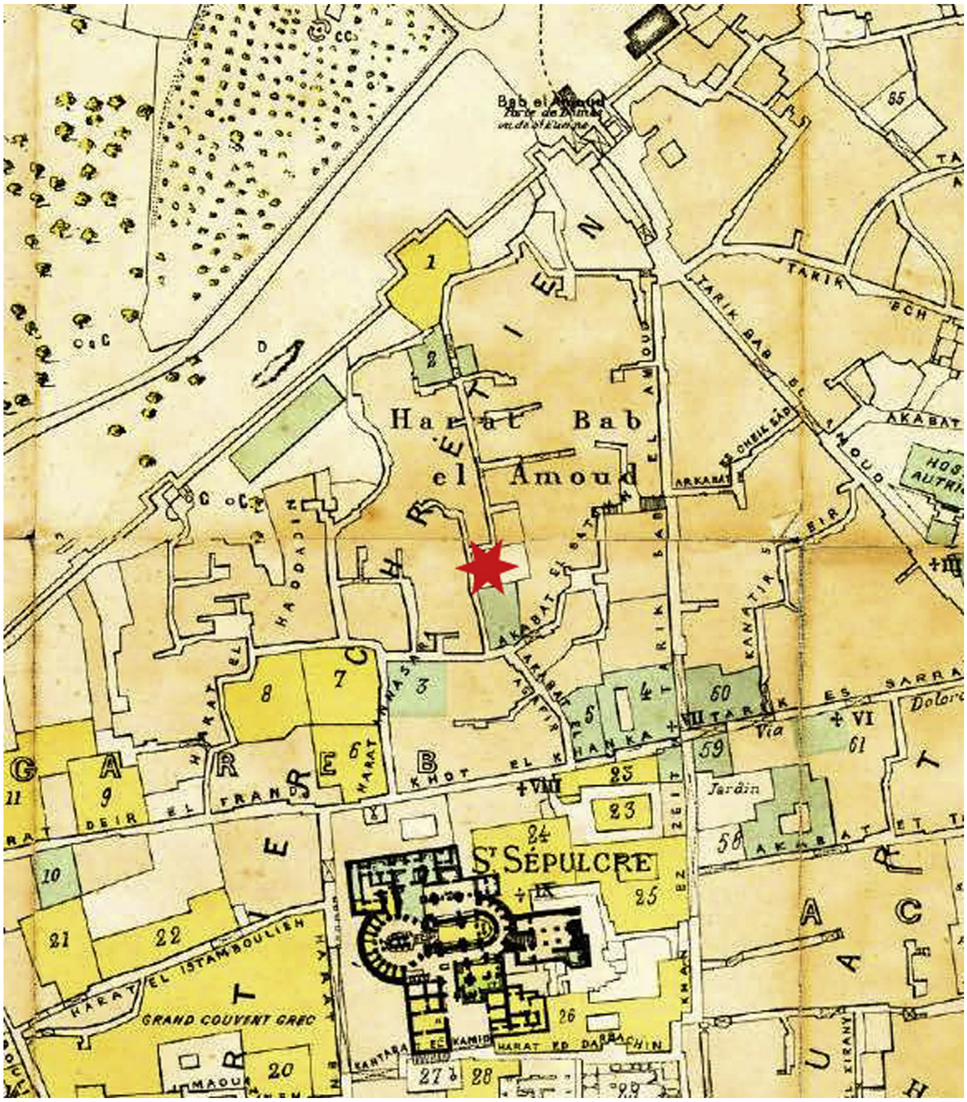

Fig. 1. Map of old city of Jerusalem, with site of the excavation marked by a star. Reproduced courtesy of the École Biblique de Jérusalem.

excavated. The cesspit had a vaulted roof, stone-built walls, an earth floor and two entry chutes on opposing sides (Fig. 2). As it was only partly excavated the full dimensions are unknown, but its height was noted to be about 2.5 m to the top of the vault and width estimated at about 2.40 m. A fragment of charcoal from the cesspool sediment (level 8) was sent for AMS radiocarbon dating at the Oxford Radiocarbon Accelerator Unit (ORAU), UK and the calibrated date indicated the tree dated from 1304–1413 AD with 95% probability (Fig. 3). This falls within the Mamluk Period (1250–1516 AD). The pottery recovered within the cesspool suggested the use of the cesspit in the later 1400s. Since, wood is often stored or used in different ways before eventually being burnt and forming charcoal, these results together would be compatible with use of the cesspool during the second half of the fifteenth century and early sixteenth century. At this time, Jerusalem was under the jurisdiction of the viceroy of Damascus (Little, 1989). Pottery in the cesspool includes both local ware and imports from northern Italy (Fig. 4), and the function as a cesspit is supported by the presence of numerous chamber pots.

3. Methods

Sediment from level 8 of the cesspool was sieved and 12 lightly mineralised coprolites (pieces of stool) were identified. Further sediment was also stored. These samples recently underwent analysis for evidence for ancient parasites. 0.2 g subsamples of each sample were weighed and taken for disaggregation using one of two techniques, namely 0.5% trisodium phosphate and distilled water (Anastasiou and Mitchell, 2013). This allowed a comparison of whether any extra species were identified using either technique. After 1 h, the samples had been fully disaggregated. This suspension was passed through a column of sequential microsieves with mesh size of 300, 160 and 20 μm. Most parasite eggs have dimensions of 25–150 μm so will be trapped on the 20 μm sieve (Bouchet et al., 1999, 2003). After washing the sediment from the 20 μm sieve the suspension was centrifuged to concentrate the sediment, excess water removed, and glycerol added prior to mounting on slides to ensure a clear view of any parasite eggs present. In order to identify the parasite remains the slides were examined using digital light microscopy. Egg counts per gram of soil can be determined using a number of methods (Reinhard et al., 1986), but we determined them by counting the number of eggs in the entire 0.2 g sample and multiplying the eggs present by five. This has the advantage of avoiding the need for lycopodium spores, and also avoids the potential bias of taking an aliquot of disaggregated fluid to represent the larger original sample when the eggs may not be uniformly distributed throughout the disaggregation fluid. Parasite eggs were identified based upon their shape, size, colour and special