Nora Nurminen, Sanna Lipkin, Anniina Kuha, Tiina Väre, Salla Marjakangas, Markku Niskanen & Juho-Antti Junno
EXPERIMENTAL MUMMIFICATION IN NORTHERN FINLAND

Nora Nurminen, Archaeology, University of Oulu, P.O. Box 1000, FI-90014 Oulun yliopisto, Finland: nora.nurminen@student.oulu.fi; Sanna Lipkin; Anniina Kuha; Tiina Väre; Salla Marjakangas; Markku Niskanen, Archaeology, University of Oulu, P.O. Box 1000, FI-90014 Oulun yliopisto, Finland; Juho-Antti Junno, Archaeology, University of Oulu, P.O. Box 1000, FI-90014 Oulun yliopisto, Finland and Medical Research Centre Oulu, Oulu University Hospital and University of Oulu, P.O. Box 5000, FI-90014 Oulun yliopisto, Finland.

CHURCH MUMMIES OF NORTHERN FINLAND

During the 17th through the 19th centuries, church burials were common among the members of elite in northern Finland. Typically, the deceased was placed in a wooden coffin either in a (family) tomb built of stone or log, or occasionally, dug directly into the sandy sub-soil. Burial could also be done by placing the coffin beneath the church floor. At least since the 17th century onwards the burial custom was also regulated. Burial depth of at least 3 cubits (about 1.5 to 1.8 metres) was a requirement, the burials were to be covered carefully and the tombs sealed after each burial. The deceased were dressed in linen or cotton robes fashioned to look like real clothing (Lipkin et al. 2015). They also wore stockings, gloves and caps. In inventoried church burials, a single coffin usually contains between seven and twenty different textiles.

The church burial custom has resulted in mummification of dozens of human remains in several churches (Joona 1997; Joona & Ojanlatva 1997; Joona et al. 1997; Kangasvuo & Pöppönen 1997; Marjomaa & Ruonakoski 1997; Paavola 1997; Tikkala 1997a; 1997b). Scientific studies of this particular mummification process are so far limited and the phenomenon is believed to have occurred naturally. Cold freeze-drying of soft tissues is considered the most likely explanation (Calamnius 1868: 201; Núñez et al. 2008). However, not all remains that were buried underneath the church floors mummified. In fact, most of the human remains consist only of complete or partial skeletons with no signs of soft tissue (Joona 1997; Joona et al. 1997; Paavola 1997; Tikkala 1997a). The exact knowledge of why or how only some of the remains have mummified is not yet available. In this study, we wanted to experiment the potential role of dry, sandy soil and fabrics on the natural mummification process during wintertime.

NATURAL MUMMIFICATION

In natural mummification, it is important to halt or at least slow down the natural decay process (Aufderheide 2003). It is known that lower temperatures will result in slower decay of the remains and thus cold climates, such as in northern Finland during the winter months, will prevent decomposition (Zimmerman & Smith 1975; Aufderheide 2003; Quigley 2006). Therefore low wintertime temperatures and low humidity are potentially some of the factors behind the mummification of church mummies of northern Finland (Calamnius 1868: 201; Núñez et al. 2008). However, other variables such as ventilation (Kaufmann 1996; Kauffmann-Doig 1998), coffin (Breuning-Madsen et al. 2003), and any fabric that is in contact with the remains (Aturaliya & Lukasewycz 1999) may have major effects on the mummification process. In addition, as sand is seen as a substance that absorbs fluids, it is possible that it would have aided the mum-

mification process. The sand found under the church floors has always been very dry and fine-grained, and could thus have major contribution on mummification.

MATERIALS AND METHODS

In this study, piglets (*Sus scrofa domestica*) were chosen as substitutes for human cadavers, as they have a similar body mass, skin structure and fat-to-muscle ratio (Schoenly et al. 1991). Therefore, pigs or piglets have been frequently and successfully used in studies on taphonomic processes (de Carvalho & Linhares 2001; Janaway et al. 2009). No piglets were harmed during this study, as they had already died during the birth or shortly after.

In order to simulate real church burial conditions (see Väre 2017; Väre et al. in press), piglets were buried into dry sand inside a cold warehouse located in Siikalatva, Northern Ostrobothnia (Fig. 1). The piglets A1 and A3 were buried in the depth of 38 cm, whereas A2 and A4 were placed on top of the sand to maximize the effects of ventilation. All these four piglets were buried in coffins. Piglet A5 was buried without any coffin or clothing directly in dry sand, approximately 30 cm beneath the ground level. The duration of the experiment was 109 days (18 February–7 June 2017).

To clarify the role of burial clothing on mummification, identical textiles made of varied types of fabrics (flax and cotton, flax of different coarseness) were laid both under and over the piglets A1 and A2. The purpose was to study the effect of different textiles in the decay process. In the church burials, the clothes were not real clothes but made of reused pieces of textiles. In this experiment, their appearance was copied and simplified. Several different fabrics were used and sewn together with seams similar to the ones in archaeological contexts. Both the textiles placed under and covering the piglets were made of two different fabrics. In the cover fabric, the two textiles and the pleats were attached with short pieces of copper thread to imitate the pins used for this purpose in the post-medieval burials. In archaeological contexts, textiles have largely preserved due to their close association with metals (Janaway 1987: 136–8), and the pins were used also to record the possible effect of metal on preservation. To test the effect of coarser fabrics, a piece of harsh flax fabric was sewn on reverse side of the cover and placed directly on piglet's skin on the sides. In addition, to imitate the wool stockings (found for example in the Köyliö church burial 4, the late 18th century; Lipkin 2016), a piece of knitted wool fabric (dyed with madder in alum mordant) was also sewn on the reverse side and placed on the piglets' feet. The fabrics were cleaned from any modern substances by washing them with slightly alkaline detergent solution and rinsing several times.

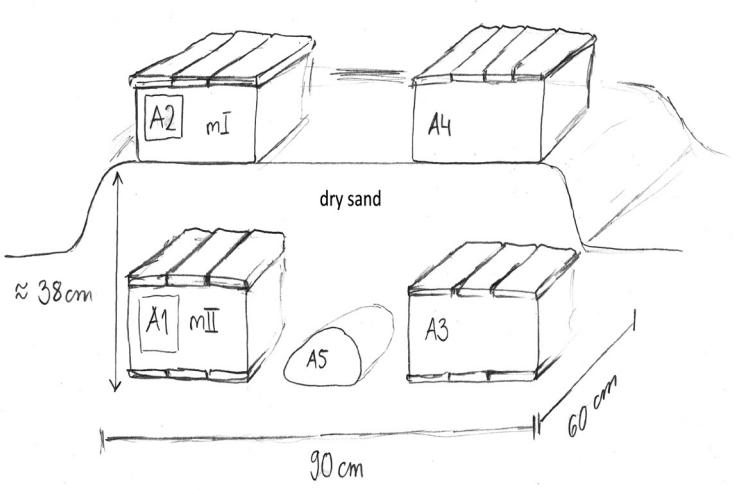


Fig. 1. General arrangements of the experiment. Illustration: A. Kuha.

Fig. 2a. Condition of piglets in the burials A2 and A4, after the experiment; 2b. Relatively well-preserved and 'fresh' piglet from the burial A1, after the experiment. Photos: S. Lipkin.

RESULTS AND DISCUSSION

When opening the coffins on the 7 June, we could visually detect only some signs of mummification. All of the piglets indicated some evidence of decay, although there was a great deal of variation (Figs. 2a&b). Most of the piglets had lost weight during the experiment (Table 1), except for A5: sand had covered the piglet completely and its complete removal was impossible due to the poor condition of the remains. It was clear that direct contact with sand was not improving the preservation.

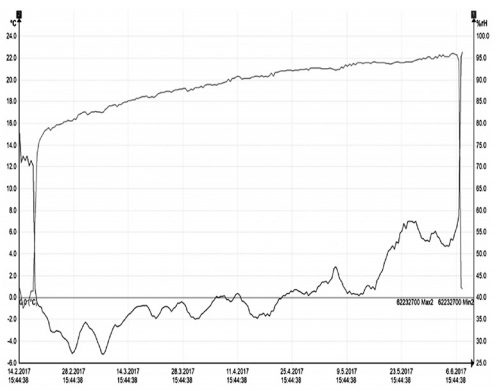
The average temperature in the A1 burial was 0.2°C, and the mean humidity 89.05%rH. In the A2 burial, the mean temperature was 0.3°C, and the mean humidity 84.63%rH. These mean values were similar with those measured from the church of Keminmaa (Väre 2017). As seen in humidity and temperature diagrams (Figs. 3a&b), the humidity was clearly more stable in the coffin buried into the sand. Also, temperature increase towards the summer was more stable in burial A1.

Stable humidity and temperature are favouring the growth of microorganisms. In our experiment, external mould was observed in all individuals. There was more mould growth on the buried piglets A1 and A3, than on A2 and A4. The latter two had interestingly remarkable variation in mould growth; A2 was covered with more mould than A4. Mould growth in the body is one of the decomposition processes, which reflect environmental factors. Best conditions for mummification were thus in burial A4, where

Burial	Weight 18 Feb (g)	Weight 7 Jun (g)	Change (%)
A1	1200	1048	-12.7
A2	1250	1108	-11.4
A3	1270	1110	-12.6
A4	1340	858	-36.0
A5	800	1072	+34.0

Table 1. Weight of the piglets prior and after the experiment.

3A



3B

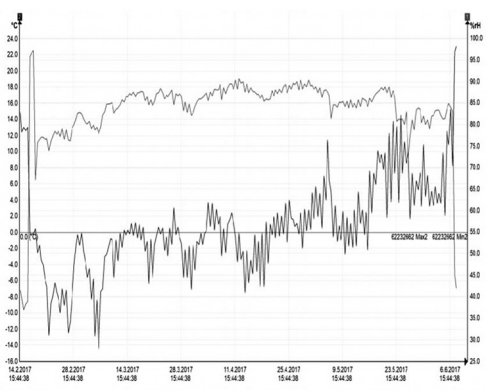


Fig. 3a. Humidity and temperature diagrams (burial A1): measurements taken 18 February–7 June 2017; 3b. Humidity and temperature diagrams (burial A2): measurements taken 18 February–7 June 2017.

temperature and humidity were not stable but ventilation was good.

In addition to external examination, an autopsy was performed on all individuals. During the autopsy, it was clearly noticed that soft tissue was still relatively fresh. In coffins with textiles, the piglets had marks of decay especially under the coarse flax fabric. Interestingly, dyed wool had had opposite effects and some drying/mummification could be detected. Keratin-based wool is resistant to acidic conditions common in Finnish conditions (Janaway et al. 2009: 158–9), and both dye stuffs, madder and alum, are favourable for preservation (Lipkin et al. in press).

CONCLUSIONS

Our experiment clearly demonstrated that mummification through freeze-drying does not occur automatically in Finnish winter. It seems that even minor details, such as textile material and ventilation may have major role in the mummification process. The data we have collected from the churches of Keminmaa, Haukipudas, and Kempele indicates that conditions in churches and under the church floors are variable. According to the present experiment, mummification is positively associated with good ventilation, dry sand and certain textile materials. However, further experiments are required in the future to understand this phenomenon better.

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