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Ancient Egyptian hair gel: new insight into ancient Egyptian mummification procedures through chemical analysis

N.C. McCreesh [a,*], A.P. Gize [b], A.R. David [a]

[a] KNH Centre for Biomedical Egyptology, Stopford Building, Oxford Road, Manchester, M13 9PT, UK
[b] SEAES, Williamson Building, Oxford Road, Manchester, M13 9PL, UK

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ABSTRACT

Artificial mummification in ancient Egypt involved the application of chemicals to the body mostly for the purpose of preservation; others were applied for ritual aspects. Unguents were used also in everyday toilette. Here we report a type of material which was applied specifically to the hair, a fatty material used as a 'hair gel'. Personal appearance was important to the ancient Egyptians so much so that in cases where the hair was styled the embalming process was adapted to preserve the hair style. This further ensured that the deceased's individuality was retained in death, as it had been in life, and emphasises the importance of the hair in ancient Egyptian society.

1. Introduction

Our understanding of the mummification process in ancient Egypt has advanced dramatically as a result of detailed organic analyses (Connan and Dessort, 1989, Colombini et al., 2000; Buckley and Evershed, 2001). The aim of the embalming process was to render the body of the deceased as it had been in life. In death however the human body changes and it partially loses its' identity, for example the face becomes sunken. Many attempts were made in ancient times to restore the face to how it had been in life yet these were not always effective (for example subcutaneous packing could lead to the face bursting, Elliot Smith, 1912). The hair however is the one remaining part of the human body which does not change morphologically.

The question arises if any part of the standard embalming process was tailored for individual needs. In this communication we show that individuality was retained in the hair, which in some cases received a different embalming process to the rest of the body. Consequently analytical studies of ancient Egyptian mummies need to recognise that different procedures were applied to different parts of the body and that they could be tailored to fit individual cases.

2. Materials & methods

Previous studies on mummified remains have used biomarkers to determine the materials used in embalming which have been shown to include oils, resin, beeswax and bitumen. None of these studies have focussed on one specific area of the body. This investigation has focused solely on ancient Egyptian hair using microscopy (light and environmental scanning electron) and chemical analysis (gas chromatography-mass spectrometry).

Fifteen hair samples (DA001, DA003, DA004, DA008, DA010, DA012, DA105, DA115, DA117, DA123, DA124, DA125, DA130, DA131, DA132, referred to by original autopsy number, Aufderheide et al., 2004), were taken from a group of mummies from the Kellis 1 cemetery, Dakhleh Oasis, Egypt, all of late Ptolemaic-Roman period date. The samples were taken from a selection of naturally and artificially mummified bodies, both male and female and of varying ages from approximately 4–58 years old. Plus three samples from individual mummies not from the Dakhleh Oasis group – 7477 female, 30–50 years from 22nd dynasty, Rosemount Museum, Colorado, USA; Unprovenanced male detached head, late New Kingdom- early Late Period, Cyfarthfa Castle Museum, UK; Takabuti female, approx.30 years old, 25th dynasty, Ulster Museum, Ireland.

* Corresponding author. Tel.: +44 161 275 2647; fax: +44 7967798126.
E-mail addresses: natalie.mccreesh@manchester.ac.uk (N.C. McCreesh), andy.gize@manchester.ac.uk (A.P. Gize), rosalie.david@manchester.ac.uk (A.R. David).

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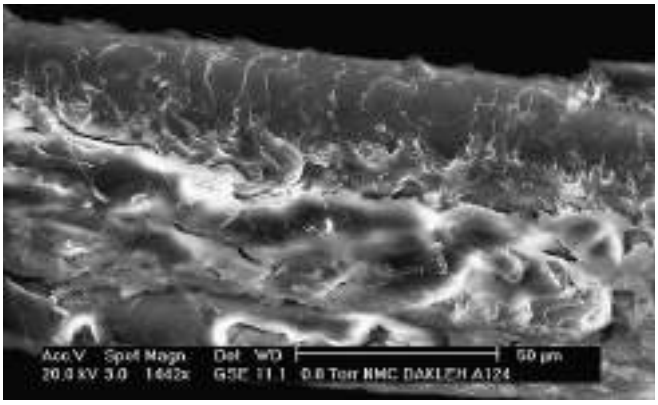

Fig. 1. Coated hair strand, DA124, male, aged 50–55 years.

2.1. GC–MS method

Samples were extracted with solvent dichloromethane. The sample was introduced into the injection port of the gas chromatograph: model Carlo Erba GC8000. The volatile pyrolysis products were released into a stream of helium as the carrier gas, and cryofocused with liquid nitrogen (for 2 min) before being taken into the gas chromatograph column where separation of the individual components was effected. GC inlet set at 300 °C, initial GC temperature 40 °C for 1 min, temperature ramp 4 °C per min, final temperature 300 °C for 20 min, sample interfaced through 300 °C transfer line to the mass spectrometer: model Fisons 800, full scan MDB (full scan *m*/*z* 40–500, no solvent delay, scan time 0.9 s, interscan 0.1 s, run time 100 min).

3. Results

Microscopy was used to determine if the hair was coated (Fig. 1). In the Dakhleh samples 9 were found to have some form of coating, 3 were indeterminate due to poor condition of the sample and three appeared to have no coating (McCreesh et al., 2011). All except one mummy (DA001) had a fat-like coating to the hair; the mummy Takabuti also had a fat-like coating on the hair. The Cyfarthfa Castle mummy and Aset Beka had coating on the hair, but this was of a harder, resin-like material.

In 14/15 hair samples from the Dakhleh group analysed by GC–MS the only ubiquitous compounds were free fatty acids (14:0, 16:0, 18:0) and their methyl esters (Fig. 2.). 18-methyleicosanoic acid is a diagnostic biomarker of hair lipids. Koch et al. (1982) developed a protocol to separate lipids on hair surface, and lipids internal to hair. In our analyses there was no evidence for this specific biomarker, indicating the lipids probably did not come from the body. In addition, microscopy shows clear evidence of a coating applied to the hair (Fig.1; David, 2008).

In some samples trace amounts of the biomarkers typically reported from mummies were detected (e.g., n-alkanes, regular steranes and pentacyclic hopane-type triterpanes). Although compositionally distinct the hair of some mummies indicates that the embalming material used on the torso and bandages may have splashed carelessly onto the hair (e.g DA123).

Maurer et al. (2001) also analysed mummies from the Dakhleh Oasis. Their samples were taken from the thorax and cranial cavity. Comparing their results and this study, it is evident that different materials were used for different areas of the body. The hair samples from the Dakhleh Oasis were not coated with resin/bitumen based embalming materials, but were coated with a fat based substance.

In addition Aset Beka and the Cyfarthfa Castle head, whose heads had been completely shaven, resulted in no difference being

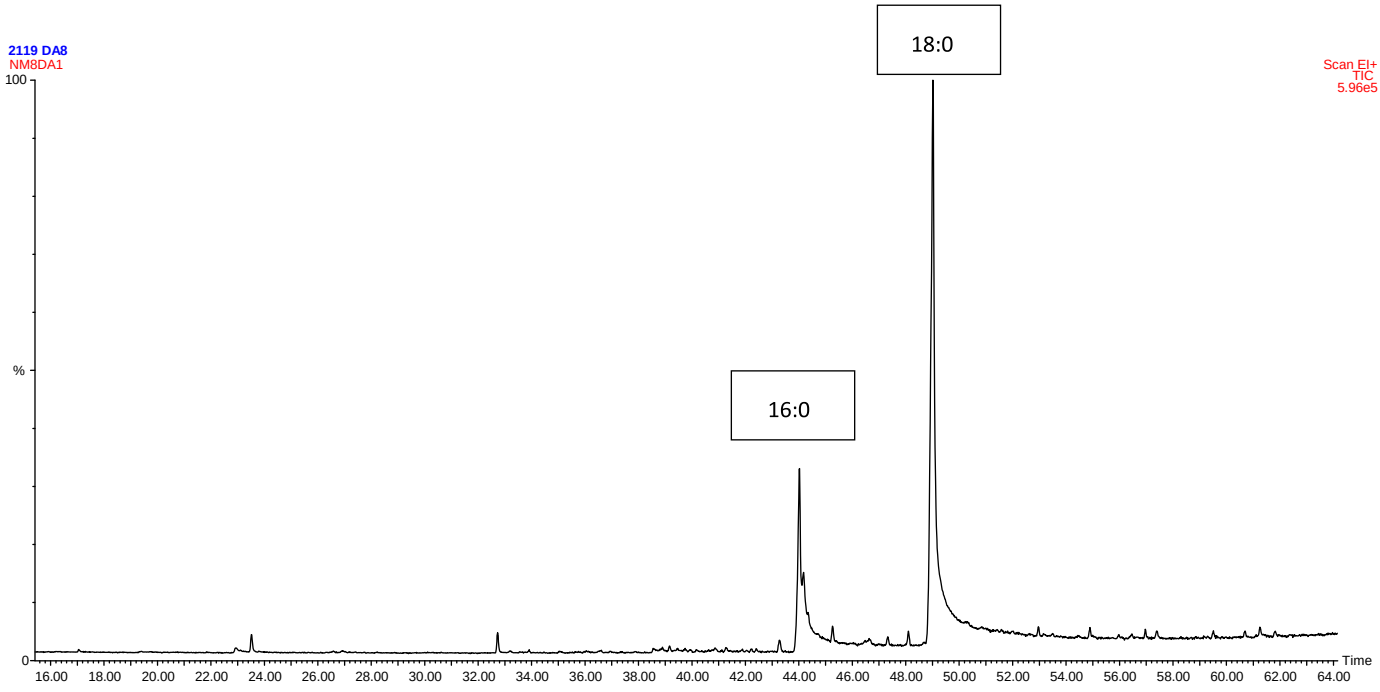

Fig. 2. Typical TIC of mummy hair extract, DA008, showing the typical predominance of 16:0 and 18:0 carboxylic acids.

observed between the embalming material on the head and the bandages.

4. Conclusion

In the case of the Dakhleh mummies and Takabuti it is evident that a fatty substance was used to coat the hair. This is interpreted as a product that was used in life to style the hair, similar to a modern day 'hair gel' or fixative. The term 'hair gel' is used as a modern analogy and does not presume chemical composition. Microscopy and macroscopic examination denotes the obvious artificial styling of the hair, often in curls. Applying the fatty substance would have aided in the hair style staying set in place.

It is inferred that the hair had to have been protected from the embalming stages of mummification for it to be in such a condition. In some of the Dakhleh mummies artificial mummification was not used, the bodies spontaneously mummified, therefore it is reasonable to presume that their hair was found styled as it had been during life.

In the other mummies the bodies had undergone artificial mummification, which would have included two key stages: steeping the body in natron for desiccation, after the salt had been cleaned off, the body was then treated with the embalming material which worked as a preservative due to the anaerobic, hydrophobic and antibacterial properties.

From the results it is argued here that in the case of the deceased having long hair these stages of the mummification were altered to preserve the hair style. In the cases of the deceased having no hair (Aset Beka, Cyfarthfa Castle) due to shaving, then it was not seen as a necessity to treat the hair differently to the rest of the body. The results indicate that the same or very similar resinous materials used to embalm the body were used on the head and hair, likely in one stage of the mummification process. This resulted in the hair being fully coated in resin from root to tip, as the material had been applied over the entire head.

In cases where the deceased had hair long enough for it to be styled (i.e. not shaved) then the stages of embalming must have been altered. As no evidence of natron salts were observed in any of the hair samples, this suggests that the hair was covered and protected from this stage of the procedure. Alternatively the hair would have had to have been thoroughly washed and restyled after this stage. When the rest of the body was coated with the resinous materials the hair definitely was protected. To coat the hair in this manner would have destroyed the hair style, leaving the hair flat and matted to the head.

In summary it has been shown in this study that biomarker analysis of ancient Egyptian mummy hair yields analyses different to those from the body and wrappings. It is clear that although the body was mummified following generalised procedures the hair was treated independently in some cases. The individuality of the deceased was maintained in some part by their hair style.

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