

**A Review of the Chemicals Used in Mummification During the
Process of Mummification**

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ABSTRACT

The potential of ancient Egyptians to keep the human body through embalming has no longer only involved people on account of that antiquity, however, additionally has constantly raised the query of how this wonderful chemical substance and ritual system was nearly accomplished. Here we integrate archaeological, philological, and natural residue analysis, dropping new light on the exercise and economic system of embalming in ancient Egypt. This review presents an awareness of the usages of mummification materials which includes Natron salt, Coniferous resin, Mastic, Beeswax, Bitumen, Cassia, onions Lichens, and gums Arabic in historic Egypt to decide their effectiveness in the maintenance of the frame. For every cloth, the chemical method, the history, and the function in the upkeep of the body are offered. It is shown that natron salt turned into the most crucial material to desiccate a corpse and that the vegetable substances referred to above have anti-bacterial houses that included the frame from microbial attack

Keywords: Beeswax, Bitumen, Lichens, Mummification, Natron salt, Vegetable materials

INTRODUCTION

Mummification was practiced in ancient Egypt for more than 3000 years, emerging from initial observations of bodies that had been naturally preserved in the hot desert

sand^{1,2}. Ancient Egyptian civilization believed in a human life existence that continued after the death of a person, but this individual immortality was considered to be dependent in part on the preservation of the human body in as lifelike a form as

possible. Their religious concepts demanding the afterlife made it essential to chemically preserve the body as a place for the 'soul' to return to again in life. This natural belief came from observations that the dry sand without bacteria in the desert acted to preserve buried bodies. An example of the importance of the preservation of the body is seen in the invocation from the ancient Egyptian mortuary texts referred to as the "Book of the Dead": 'My body is everlasting, it will not perish and it will not decay for ages'.

What is mummy?

The word "Mummy" refers to the dead body of a person or an animal that has not decayed due to specific natural or artificial conditions. The word itself is derived from the Persian/ Arabic word *mummiya*, meaning "tar" or "bitumen". When the Arabs encountered the Egyptian mummies in the seventh century CE they thought they were covered in tar. Although the Egyptians did occasionally use tar in the mummification process, most mummies

were coated in dark resin, which gave the skin a black color. Ancient Egyptian civilization was distinguished by a clearly defined belief in a human existence that continued after death. Their religious concepts concerning the afterlife made it necessary to preserve the body as a place for the "soul" to return³. This belief came from observations that the dry sand of the desert acted to preserve buried bodies. Research to date shows that Egyptian mummification was carried out in Old Kingdoms (2649-2152 BC), declining during the late Ptolemaic (c.200-30BC) and stopped altogether when Islam was introduced in the 7th century AD⁴.

The mummification process involved stripping the body of its internal organs- except the heart because it is considered a center of intelligence and feelings and the man would need it in the afterlife and drying the body using natron, a naturally occurring salt containing sodium carbonate, sodium bicarbonate, sodium chloride, and sodium sulfide.

Generally speaking, the dried body would have been stuffed with a linen cloth and bags of various substances, including natron, resin-soaked bandages, and sawdust. Finally, the incision was closed and the corpse was wrapped then they put the mummy inside the sarcophagus together with his belongings (jewelry, amulets, canopic jars, etc.)



Fig-1: The Process of Mummification

In the beginning, the mummies were placed inside the sarcophagus in a pyramid but later they started to bury the pharaohs in the Valley of the Kings, under the ground, because the thieves (robbers) came into the pyramids to steal the pharaoh's belongings⁵. The mummification balms were based on relatively cheap and readily available animal fat and plant oils with

more expensive perfumes, wood oils, spices, and resins or pitches added for their special symbolics. The plants and animal oils are not only hydrophobic but also polymerized to produce a network capable of protecting fragile tissues from microbial attack. Modern chemical analysis tells us that the protective wood pitches, resins, and oils would have contained some disinfected phenolic compounds and molecules good at inhibiting microbial and fungal growth called terpenes. These terpenes are related to a family of molecules based on isoprene unit (2-methyl-1, 3-butadiene)⁶.



Figure 2: Guardians of various organs during mummification

Resin from coniferous trees such as pine, cedar, or fir holds a particular appeal for

mummy scientists. Conifers are not indigenous to Egypt and their resins were probably imported from the eastern Mediterranean or the ancient Near East, which corresponds roughly to today's Middle East.

It can be said that most authors have agreed on the description of three methods of mummification, but they differed among themselves in the description of the material used. Some describe the mummification material depending on the description of old references and this may be due to a lack of analysis tools some authors describe these materials depending on analysis and investigation. Most of the analysis has occurred from the end of the 12th century to the present day and archaeologists have long found unknown materials used with mummies. This may be due to (1) most have analyzed wrapped mummies; (2) most resinous materials have been used on bandages; (3) from the conservation point of view, difficult to remove bandages to look for other

materials used in mummification (because this led to the deterioration of mummies).

How was this decided?

The nature of the various resins and oils was viable to decide due to the unique nature of the chemical signature they left behind on the strips of the bandages. With the use of a microscopical sample of the former which they liquefied, scientists have been capable of warming each pattern reporting the time every substance took to vaporize. This supplied a unique signature which was run in a mass spectrometer to determine the identity and the nature of the substance located inside the bandages.

Phenols, guaiacols, naphthalene's, monoterpenes, sesquiterpenoids, oxidized terpenoids, and triterpenoids have been recognized; through this intergrading, the materials used in mummification could be determined. those compounds additionally have antibacterial and antifungal consequences and additionally save you from deterioration because of insects. This examines targets to focus on the

mummification sorts and to discuss the materials utilized in the mummification process history, chemical composition, and their effectiveness within the maintenance of the body.

Materials used

Chemicals used to embalm Egyptian mummies 2500 years ago had been found, such as botanical resins and materials originating from southeast Asia, consistent with the observation in nature.

Natron

The primary use of time 'natron' seems to be in the glazing of quartz and steatite. The word in Egyptian hieroglyphics "ntry" is maximum likely derived from the root "ntr", indicating its association with spiritual and funerary rituals⁷. Natron is a white, crystalline, hygroscopic, and herbal material mined at Wadi Natron in the Nile Delta and an important compound for the mummification technique in ancient Egypt. It was used inside the removal of water from tissues, before their remedy with resins, and prevented or restarted the

biological deterioration and putrefaction of the body thru fungal and bacterial attacks.

Desiccation with natron has been diagnosed as the 7th degree in a thirteen-stage technique used all through mummification. during the dehydration system, the body becomes covered with natron. This had the effect of casting off any closing frame liquid and consequently making sure in opposition to any similar putrefaction (% , 11980). a few authors argue that this system lasted for 40 days (percent,1980) and some argue that it lasted 70 days (Sandison, 1963). Abdel Maksoud stated that Sandison (1986) proved that the mummification technique did no longer take forty days. Entire dehydration of the body could have taken 28 days or less, as this system depended on one or extra of the following elements:

1. The circumstance of the body previous to natron treatment, due to the fact a frame, which has already all started to exhibit signs and symptoms of purification can also

take a long term to reap a suitable dry circumstance.

2. The composition of the salt aggregate makes up the nation. A high pleasant of salt, specifically sodium carbonate, and bicarbonate, might produce first-class nice consequences.
3. The reuse of natron salt for multiple bodies, the result after the primary use will go to pot.
4. The quantity of natron used needs to be 10 times greater than the body volume.
5. It became observed that the proper remedy depends on the climate situation.

Coniferous resin

The big use of plant oils shows that the embalmers were aware of the unique properties of unsaturated oils that let them 'dry', or instead, polymerize spontaneously. This polymerization might have produced fantastically cross-linked aliphatic networks, which would have stabilized

otherwise fragile tissues or textile wrapping towards degradation by using generating a physicochemical barrier that impedes the sports of microorganisms⁷.

According to arguments presented using a few scientists, the resin used on the human frame at the end of the mummification procedure was derived from coniferous trees, especially cedar, juniper, and pine timber. The 3oxidation merchandise of abietic acid found inside the mummy resin suggests that a true conifer resin becomes used as the base for the embalming fluid.



Figure 3: Coniferous Resin

A few analytical techniques have significantly accelerated the accuracy of the identity of historic natural substances together with oils or resins and at some point, of all the methods which have been achieved, the coniferous oils can be divided into the following:

1) Pine oil: - It comes from the pine tree (family; Pinaceae) which reaches a height of over forty feet and has evergreen leaves, a straight trunk, an abnormal crown, and bark this is scaly and cracked. Medicinally useful components are collected in summer.

2) Cedar wooden oil; for heaps of year it 70-a hundred feet to have stimulated men with thoughts of strength and solidary. The timber is fragrant, insect-repellent, quite durable, and rot-resistant. It became first utilized in coffins and noticeably esteemed by the Egyptians for lots of forms of timber paintings and very plenty so for coffin making. Sawdust made from cedar changed into also used as a body packing for mummies.

3) Juniper; A shrub or a small tree (circle of relatives; Cupressaceae), approximately 10 toes in peak. The bluish-inexperienced leaves are narrow, leathery very satisfactory. The fruit is a false berry shaped by the bracts surrounding the flower. The medicinally useful elements

are collected within the summer time and autumn.

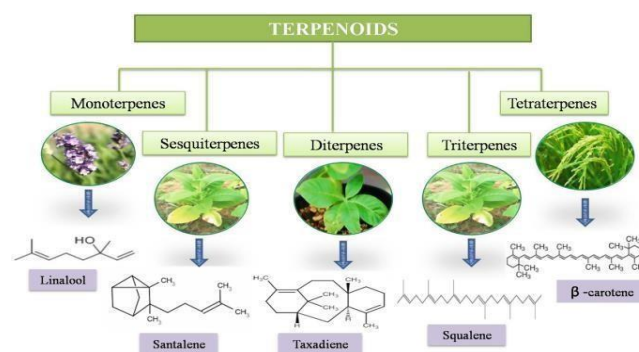


Fig-4 Structural formulas of the terpenoids, the important components of crucial oils Mastic

It's miles a yellowish, semitransparent, natural resin that is exuded from cuttings made on the trunk of mastic bushes. These bushes belong to the Anacardiaceae's own family, which is traditionally cultivated in the south of Chios, a Greek island within the Aegean Sea. Mastic oil is produced by the steam distillation of mastic and the fabric stays underneath the tree for many days and coagulates through the local environmental situations. The coagulated product is then accrued and referred to as mastic gum. The Egyptians used mastic in embalming and spiritual capacities. It probably had religious importance even if used for embalming.

Myrrh

Myrrh is an oleo-gum resin, freely discharged from herbal tissues or from incisions made to acquire this product. It flows as a pale yellow, bitter, odorous gum.

Myrrh is observed as a powder or as granular pieces of many. Myrrh oil exudates are obtained from the timber of Commipora species of

Burserance circle of relatives. those oils are occasionally used as flavoring agents.

Myrrh incorporates resin myelin (23-40%), unstable oil myrrh (2-eight %), and gum (40-60%).

Myrrh, any in historical Egyptian, changed into fragrant gum, basically resin in form of small yellow-purple lumps. Myrrh became imported from Somalia and southern Arabia, and it was usually used at some point in the new nation to stuff and massage on and into mummies. It became by and large valued for the perfume that it imparted to the corpse.

Beeswax

Beeswax is a kind of wax from the honeycomb of honeybees. It's far yellow, brown, or white bleached stable. The regular color of beeswax varies from sunglasses to yellow, orange, pink, and brown. The color of beeswax adjusts with age, regularly example virgin wax is white but darkens swiftly as it a while, regularly turning nearly black. It has a faint honey odor. It consists of a large part of myristyl palmitate, cerotic acid and esters, and some excessive carbon paraffin. Beeswax is lipid in nature. It has saturated hydrocarbons, acids or hydroxyl-acids, alcohols, and pigments, mostly from pollen and propolis, in addition to minute lines of the brood. Beeswax became utilized for some functions in historic Egypt. For an instance, it became regularly used to version figures and become also hired inside the mummification procedure.

Gum Arabic

Gum Arabic is a certainly occurring exudate amassed from acacia Senegal trees and, to a lesser quantity, from Acacia seyal

trees⁸. it is one of the oldest imported commercial gums. it's miles an excessive molecular weight macromolecule that can without problems be dissolved and dispersed in the water below appropriate conditions. about 70% of the world's production of gum Arabic is in Sudan, the relaxation is in the French-speaking international locations of West Africa, Gum Arabic is used within the manufacturing of food, prescription drugs, and cosmetics; it has additionally visible use in medication.

Heena

Heena turned into used within the new kingdoms. a number of its compounds (lawsone, 2-hydroxy-1,4 naphthoquinone) have antibacterial effects⁹.

Lichens

Lichens became used within the NEW state. a number of its compounds (usnic acid, sphaerophorin, pannarin, and paraconic acid) have antibacterial and antifungal results. Usnic acid enantiomers

triggered good-sized antifeedant hobby and toxicity toward larvae.

Cassia

It was used around 2600 BC. some of the critical oil compounds (cinnamaldehyde, linalool, eugenol, and 1,8 cineol) have antimicrobial, antiseptic, and antifungal effects in addition to a major outcome in opposition to insects¹⁰.

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Table 1: Scientific data of mummification materials

S.No.	Scientific name	Common name	Major constituents	Essential oils	Biological activity
1	Pinus sp.	Pine	Monoterpenes, isopimand acid, abietic dehydroabietic acid	B-thujene, α -pinene, β -pinene, bornyl acetate, myrcene, limonene, and α -terpineol.	It has antibacterial effects against gram-positive bacteria and gram-negative bacteria in addition to antifungal effects.
2	Cedrus libani A. Rich subsp. Atlantica	Cedar	Essential oils, monoterpenes, sesquiterpenes, Atlanta	Limonene, myrcene, α -pinene, β pinene, camphene,	Cedar oil is used in pet care merchandise to repel fleas and ticks.
3	Juniperus communis L.	Juniper	Resin, pinene, borneol, inositol, terpinene, limonene.	α -pinene, β -myrcene, limonene, terpinolene, β pinene, α -terpineol.	Vital oil had been stated to own sturdy antimicrobial properties
4	Pistacia lentisus var. Chia	Mastic Gum	Triterpenes of the oleanane, euphane, and lupine type, α tocopherol, polyphenols.	A-pinene, β pinene, β myrcene, camphene, α terpineol	It is used as an antiseptic, infection, and antimicrobial material.
5	Commip-hora ssp.	Myrrh	Gum, acidic polysaccharides, resin	Heerabolene, eugenol, furanosesquiterpenes, α pinene, dipentene.	It is used to kill and repel tick pests, also used for its antiseptic houses.
6	Cinnamomum	Cassia	Camphor, camphene, dipentene, limonene, pinene, monoterpenoids	A-pinene, camphene, camphor, α -terpinol, β -myrcene	Antibacterial, antiseptic, and fungicide.
7	Allium cepa L.	Onion	Riboflavin, betacarotene, ascorbic acid, sterols	Dipropyl disulfide, methylation, cyclophilin, dihydro alliin	Including antimicrobial and antioxidant
8	Peltigera canina L.	Lichens	Usnic acid, thamnolic, nostolide 1nad2		Used against infections, antibacterial and antifungal
9	Lawsonia inermis L.	Henna	Mannite, tannic acid, mucilage gallic acid, and 2hydroxynaphthoquinone		It is used as an antibacterial material.