
THE CONCLUSIVE EVIDENCE OF EXISTENCE COTTON PLANT IN ANCIENT EGYPT AND USED IT IN MUMMIFICATION PROCESS CASE STUDY FROM ROMAN PERIOD



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Abstract

Many researchers assumed that ancient Egypt has no ideas about the cotton plant. Although, the evidences of using cotton were very limited, some ancient texts mentioned the cotton since the 4th century BC, Ptolemaic period onwards. As a raw material for cloths industry. In one of the antiquities robbery crimes, two mummies were confiscated, the ministry of tourism and antiquities informed to examine both of them. One of these mummies were carrying a layer of fiber between the wrappings and the body. The author used two different techniques to identify and dating this fiber; microscopic examination and C14 dating.² The analysis confirmed that it is cotton and dates back to Roman period between c. 36 ± 1893 Bp. Additionally, using different techniques to examine mummification materials. The study will focus on the importance of using different techniques to confirm the analysis results, in both identifying the fibers and different materials, which used during the mummification process itself. The study will contribute to provide more information about the variety of ancient Egyptian techniques during the mummification process in Roman period, Moreover, the paper will shed light about Egyptian cotton history.

Keywords: Cotton- Mummification- C-14 osteological Analysis- Mummy

مُلخَص البَحْث

الدليل القاطع على وجود نبات القطن في مصر القديمة واستخدامه في عملية التحنيط: دراسة حالة من العصر الروماني.

افترض العديد من الباحثين ان مصر القديمة لم تعرف نبات القطن، الا ان بعض المصادر القديمة ذكرت ادلة على وجود القطن منذ القرن الرابع ق.م، وانه استخدم في صناعة الاقمشة منذ العصر البطلمي وما بعده،

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² C 14 radiocarbon analysis was at IFAO (Laboratoire de Datation par le Radiocarbone)

لكن للأسف لم يكن لدينا الأدلة الكافية لتأكيد هذه الفرضية. في إحدى قضايا سرقات الاثار تمت مصادرة موميائين بواسطة الشرطة وأبلغت وزارة الاثار لفحص المضبوطات وتحديد انها قطع اثرية من عدمه. تم فحص الموميائين وكانت احدهما تحمل طبقة من الياف نباتية وضعت فوق الجسد وأسفل اللفائف الكتانية. قام المؤلف باستخدام أكثر من طريقة لتعرف الألياف منها الفحص الميكروسكوبي المتعدد (باستخدام ميكروسكوب مجسم وميكروسكوب اليكتروني ماسح) وبواسطة التحليل الطيفي بجهاز الاشعة تحت الحمراء وجميعها اثبتت انها الياف نبات القطن. كما تم تأريخ هذه الاليف بواسطة الكربون المشع (كربون ١٤) بمعامل المعهد الفرنسي للدراسات الشرقية حيث أوّرخت بداية العصر الروماني ١٨٩٣ ± ٣٦ Bp ، كما تم تحليل مواد التحنيط التي كانت عالقة بهذه الاليف. تركز الدراسة على أهمية استخدام العديد من التقنيات المعملية لتأكيد تعريف الياف نبات القطن وكذلك تعريف المواد الأخرى التي استخدمت في عملية التحنيط. كما تساهم الدراسة في توفير مزيد من المعلومات حول تنوع التقنيات والمواد المستخدمة في عملية التحنيط في العصر الروماني. علاوة على ذلك ستلقي الورقة الضوء على تاريخ القطن في مصر.

الكلمات الدالة: القطن في مصر القديمة -المواد المستخدمة في التحنيط- - كربون ١٤ - مومياء

1- Introduction

The anthropological examination of skeletons and mummies reveals as a rule many detailed information about the interred person and its individual life.³ Sometimes it is even possible to create a paleobiography or an osteobiography.⁴ The mummy was confiscated by the police authority; therefore, the provenance was unknown. In 2006, the author informed to examined two mummies confiscated by the police Authority. The face and the end of legs of one of the mummies were unwrapped by the robbers, which allowed to visual examination. The mummy was in a good preservation state and has an extensive layer of plant fiber between the bandages and the body.

2- Material and Methods

The paper focus on one mummy, which was carefully cleaned dry with a soft brush, the visual examination was by using a magnifying glass. This was followed by the anthropological examination, in which the sex and age.⁵ The mummification techniques examination was based on Aufderheide (2003).⁶ Several methods are available for the characterization of the structural, physical and chemical properties of fibres such as heating; burning and solubility, were tested.⁷ Various methods are used for fiber identification like microscopic method. End use property characterization methods often involve use laboratory techniques which adapted to simulate actual conditions of average wear on the fibres as Infrared Spectroscopy Analysis. Fiber's examination by

³ Larsen (1997)

⁴ Mihanovic, et al. (2017)

⁵ Buikstra & Ubelaker (1994); Bass (2005); Brothwell (1981)

⁶ Aufderheide, (2003)

⁷ (<http://www.definetextile.com/2013/04/identification-of-cotton-fiber.html>)



using the stereoscopic microscope; C14 radiocarbon dating; advanced Physical tests for a cotton sample; Microbial tests Definition and study of materials used in embalming process by using SEM with EDAX unit and FTIR machine. (All photographs were taken by the author).

3- Results and discussion

According to the osteological analysis of the skull features, the mummy belonged to a middle adult male based on Buikstra and Ubelaker (1994).⁸ On the top of head there are black hairs and remains of a beard which contains a trace of white hair. The arms and hands are extended laterally beside the body. The mummy's length is 180 cm, and the width from one shoulder to the other is 38 cm. The mummy is wrapped with linen bandages except the face and the end of legs. Above the last layer of linen, there is a woven netting made of ropes and suspended to its parts of the soil. Unusual layer of plant fiber used between wrappings and the body. Therefore, the author took a sample for analysis by nondestructive methods.



Fig. (1) The mummy and the Cotton fibres appear in the upper part.

⁸ Buikstra & Ubelaker, (1994)

3.1 Fiber's examination

The fiber sample was examined by using the stereoscopic microscope, sample shown a structure is represents the cotton fibres.

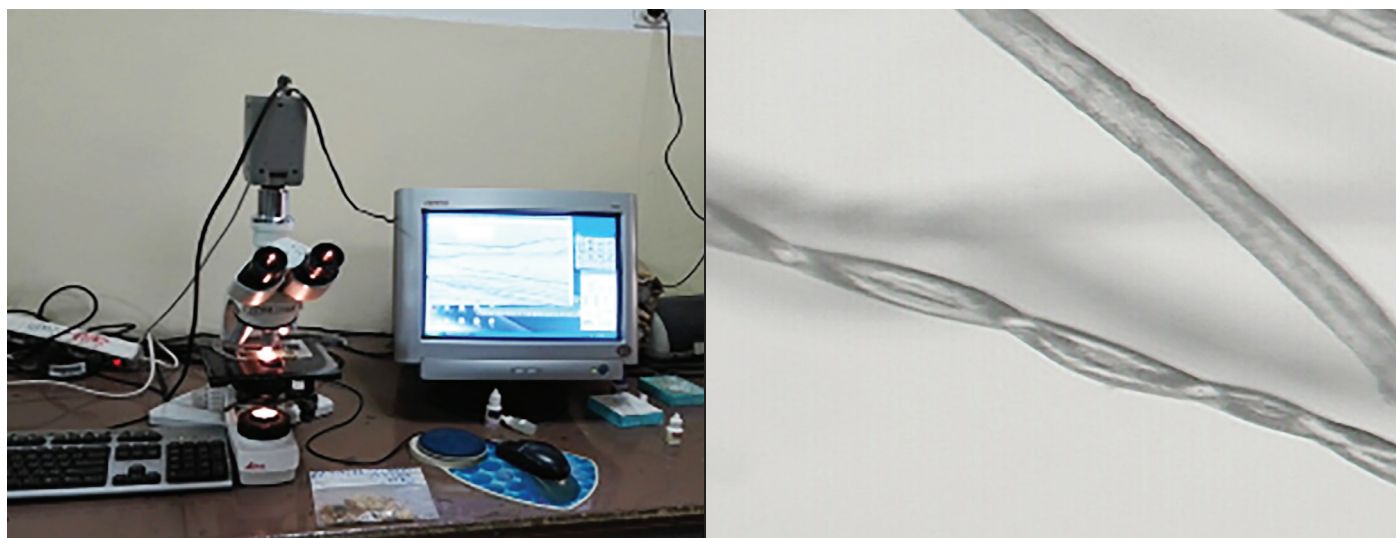


Fig. (2) Examination of the fibres by using stereo microscope, magnification 100X.

Under a microscope a cotton fiber looks like a twisted ribbon or a collapsed and twisted tube (Fig. 2). These twists are called convolutions: there are about 60 convolutions per centimeter. The convolutions give cotton an uneven fiber surface, which increases inter-fiber friction and enables fine cotton yarns of adequate strength to be spun.⁹

Scanning electron microscope appearance some other materials attached with cotton fibres.

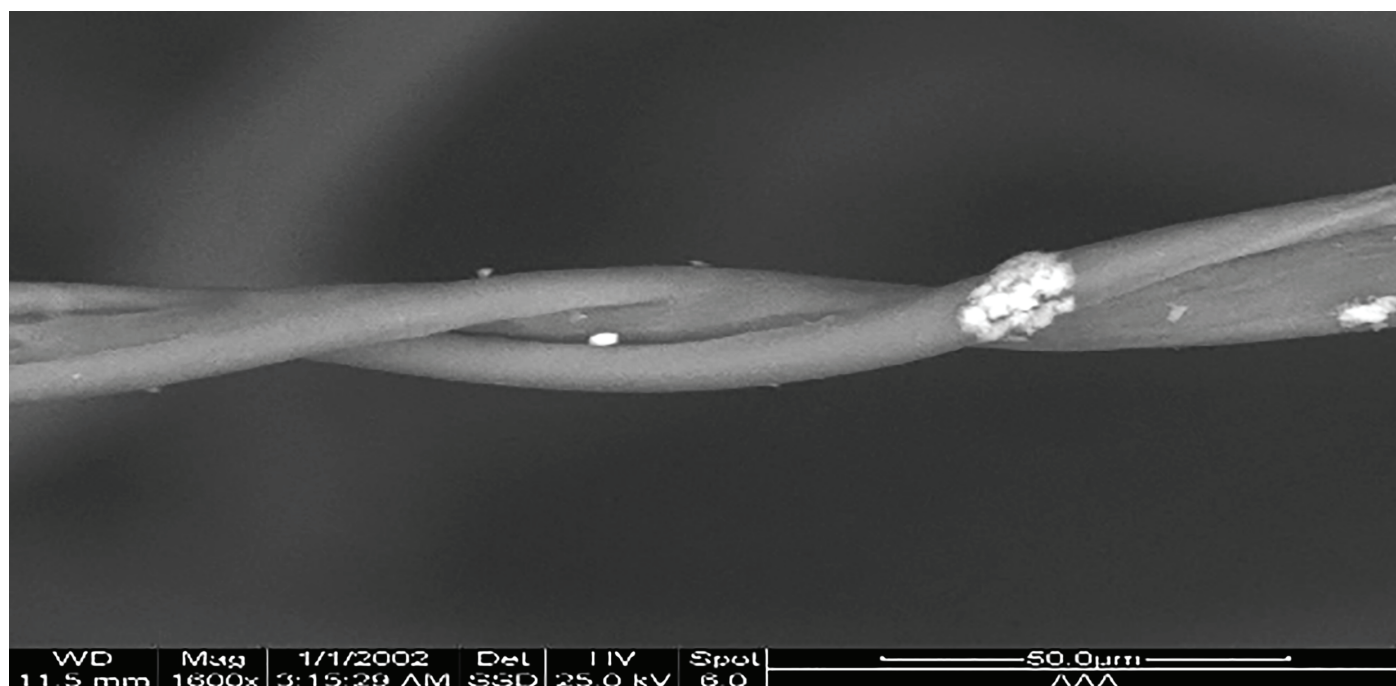


Fig. (3) Examination of the fibres by using scanning electron microscope, magnification 1600X

⁹ (<https://www.sciencedirect.com/topics/materials-science/cotton-fiber>).

Cotton fiber can also identify by modern technique as infrared ray, spectroscopic technique for the characterization of cellulosic (plant) fibres. For each of the species of fiber, the ratios fell within characteristic ranges.¹⁰ This sample was analysed by (IR machine, Bruker, model Vertex 70 with ATR unit), and compared the results with a standard cotton sample from the library of the machine. The spectra of sample displaying the similarities in absorption bands with the stander cotton curve.

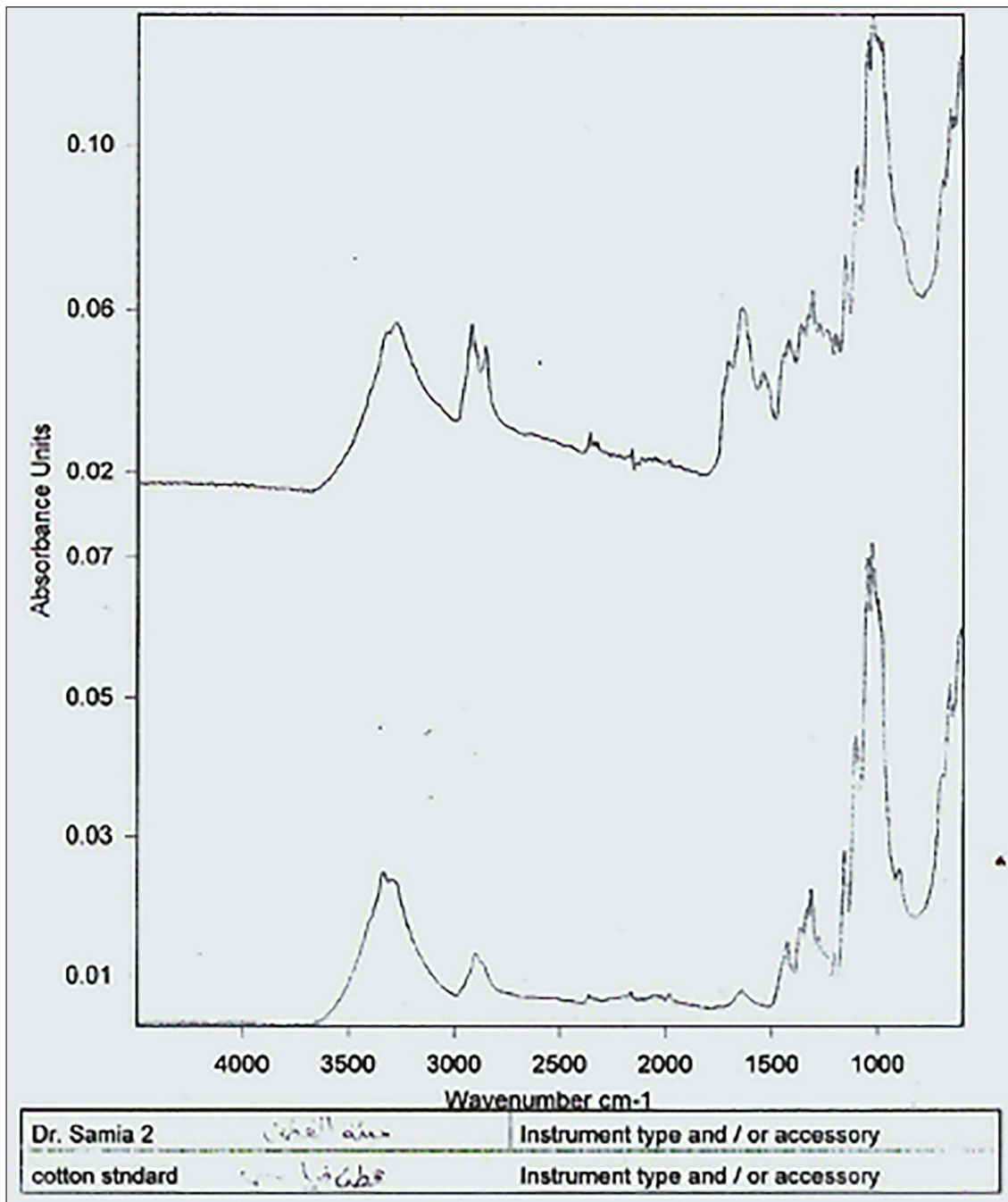


Fig. (4) -FTIR spectra of samples displaying the similarities in absorption bands.

¹⁰ Garside & Wyeth, (2013)

3.2 C14 radiocarbon dating

The mummy was dated by scientific method, C14 Radiocarbon dating was done for the cotton fiber. The radiocarbon dating was done by the French Institute (IFAO) radioactive carbon Lab. C14 dating results was 36 ± 1822 BP. The radiocarbon dating was done under the rolls by the French Institute (IFAO) (radioactive carbon Lab.) It should be noted that the date mentioned is until 1950, it is meaning that, the sample dates back to the first/second centuries AD, representing the beginning of the Roman time. While these dates consistent with some historians and researchers, but it remains the first time to find cotton fibres used under the linen bandages on the body of a mummy.

3.3 Physical and chemical tests for fibres sample

Our sample fiber color creamy white to yellowish white.

-Heating and burning tests results: The sample of fiber was excellent resistance to degradation by heat. When the fiber ignited not shrink from the flame but burn with a yellow flame. It continues to burn when the flame is removed and smell odor like burning paper. There is a little grey ash residue after combustion. This test is clearly determined it is cotton fiber.

Solubility test: -The sample of fiber had high resistance to normal cleaning solvents and to alkalis, but attacked by hot dilute acids and cold concentrated acids because it disintegrates. This also characteristics of cotton fiber.

3.4 Advance tests of physical properties: -

These tests were carried out at the Cotton Research Institute in Giza after the approval of the permanent Committee of the Egyptian Antiquities. The results of the maturity tests reflect the moderation of the maturity of this fiber. However, the diameter measurement showed that it is rough and short fibres and the measurement of mechanical properties is not possible due to the dryness and deterioration of fibres.

Single hair tests

For this cotton fiber sample, the possibility of one hair measurement was very low, while it was observed that the consistency of the fiber was moderate and the hair is one unit with a bit of roughness. The difference in precision between the hair and the fiber bundle is due to the deterioration of most hairs. The difficulty of measuring the characteristics of the hair was due to the poor preservation and the difficulty to find the appropriate number of hairs for proper measurements. Due to the delicate nature of the fiber, being easy to crack, the seeds are heavily planted, and fiber wrapped with them, the feasibility of obtaining a measurement was challenging. The current readings of the length of fiber and hair length make it unsuitable for spinning. However, we have taken into account the age of the sample. Moreover, the poor environmental conditions have been subjected to excessive drought and significant climatic changes, causing fiber

properties to deteriorate. Therefore, we assumed that the length of the fiber and the hair length was more significant than the values present in the readings.¹¹

3.5 Microbial tests

Microbiological tests on the fibres were carried out in the microbiology laboratory at the Research and Conservation Center. The results showed that there was no microbial injury on the fibres. Furthermore, the non-degradation of cellulose fiber supports this result. Therefore, we believe that the absence of microbial activity related to the mummification materials and the cotton fibres directly contacts the mummy, which led to its preservation.

3.6 Definition and study of materials used in embalming process

The sample was examined by scanning electron microscopy, where the images showed the presence of white and other brown spots above the fiber. These two spots were analyzed by the EDAX unit connected to the scanning electron microscope. The results as shown in the image and detailed in the below analysis curves. The white color spot analysis results indicated carbonate, bicarbonate, sulfate, chloride sodium, and some impurities, elements of the natron salt expected in this case. These results confirm the absence of microbial growth on the cotton fiber due to contact with mummification materials. However, the second spot of analysis (brown spot) showed the presence of an organic compound; to get analyzed, we utilized an infra-red device.

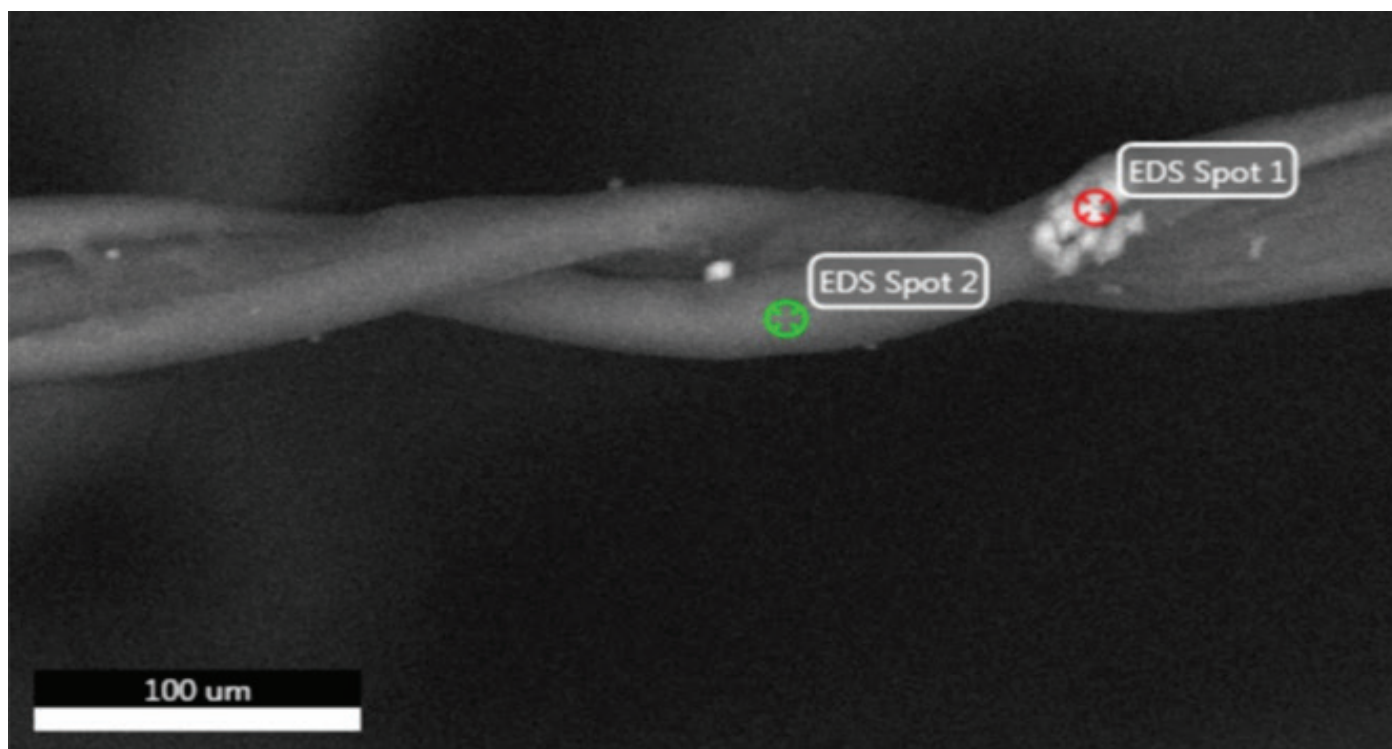


Fig. 5 (upper) SEM image show white spot (one) and brown spot (two).

^[11] Arafa et al., (2018)

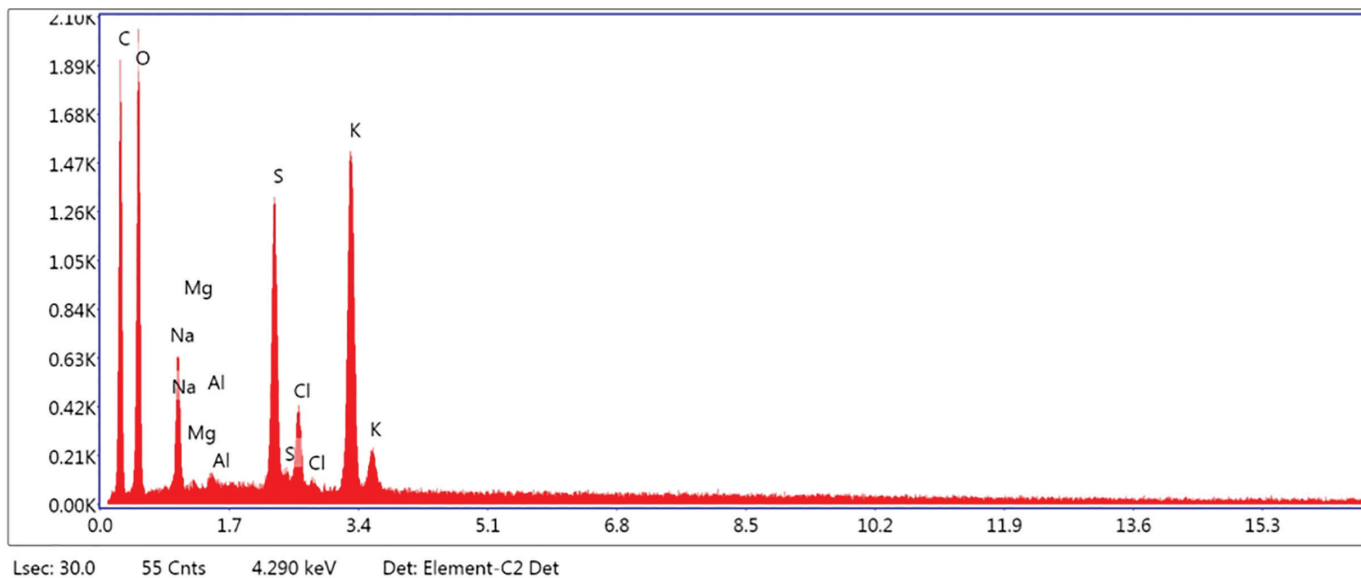


Fig.5 (lower)The carve analysis of spot one by EDAX unit

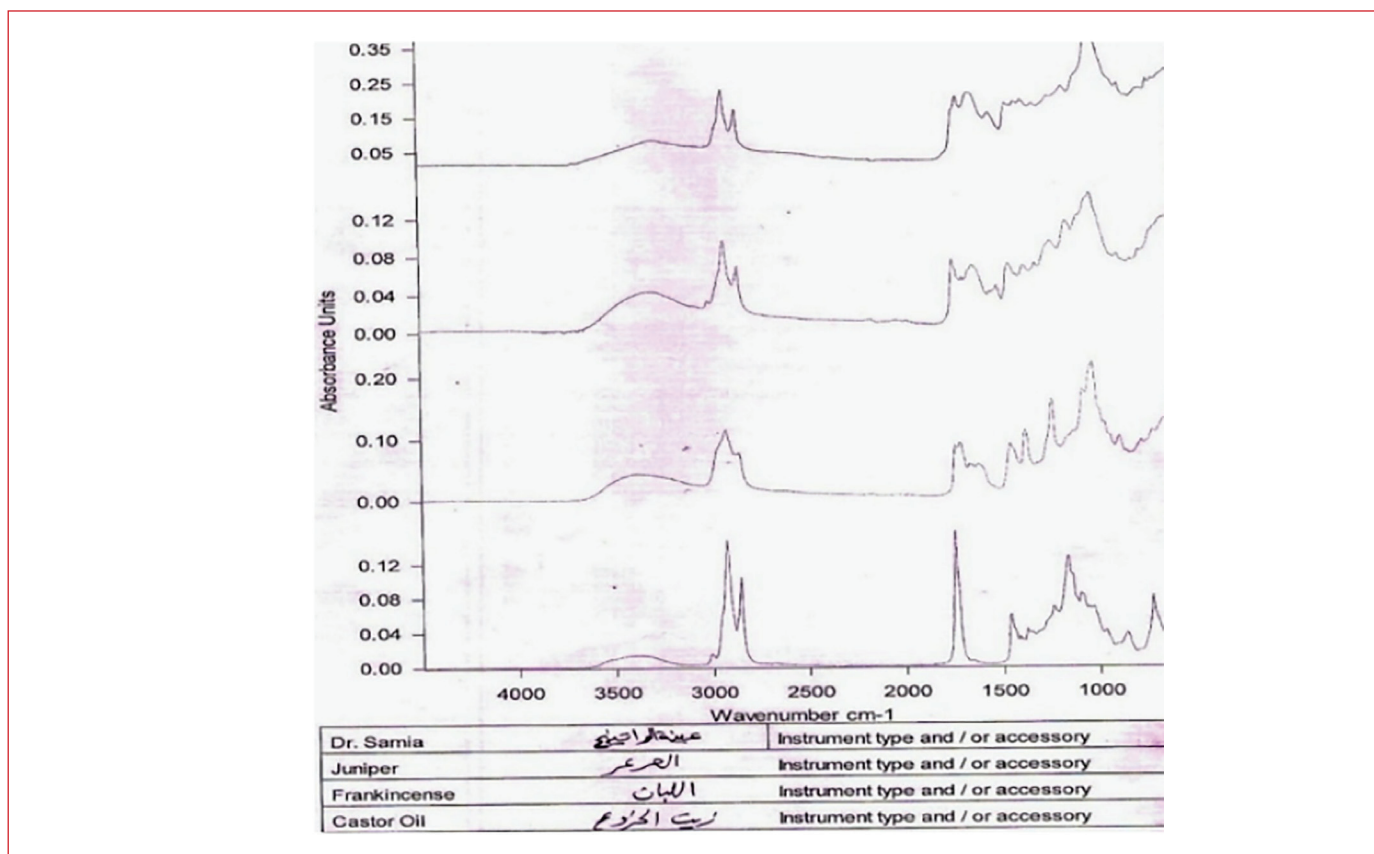


Fig. (6) The spectrum analysis curves of the sample show that the material consists of several components: juniper, frankincense and castor oil.

The FTIR- (IR) revealed that they used mixture of material consisting of several components commonly found in mummification process in the Late period and Ptolemaic period i.e., the Egyptian mummy in Philadelphia University Museum (PUM II).¹²

¹² Cockburn et al., (1983)

Maksoud and El-Amin provide the most comprehensive list of the materials encountered in Egyptian mummies; the most widely used were: natron, coniferous and non-coniferous resin, juniper, mastic, myrrh, cassia, and beeswax.¹³ The quality and quantity of materials used during the embalming process varied among individuals and was potentially influenced by social status and wealth during certain periods. The second spot analysis provided more insights into the continued use of resins and oils since the New Kingdom. Actually, in the tombs of the kings, i.e., in the tomb of Tutankhamun, they were found a quantity of juniper. Moreover, several juniper fruits were found in the Deir el Bahari cache return to the 20th dynasty It might have been that the oil extracted from juniper seeds was used in mummification and over the body of the deceased.¹⁴



Fig.(-7A) juniper trees



(-7B) juniper fruits

3.6.1 Junipers are coniferous plants in the genus *Juniperus* of the cypress family Cupressaceae. Depending on taxonomic viewpoint, between 50 and 67 species of junipers are widely distributed throughout the Northern Hemisphere, from the Arctic, south to tropical Africa, from Ziarat, Pakistan, east to eastern Tibet in the Old World, and in the mountains of Central America. The highest-known juniper forest occurs at an altitude of 16,000 ft (4,900 m) in southeastern Tibet and the northern Himalayas, creating one of the highest tree-lines on earth.¹⁵ The juniper tree is perennial and evergreen plants. Juniper contains on volatile oils and anoline and sugary and resinous and chromatic materials up to 80 compounds and materials separated materials gave the impact for bacteria, especially pulmonary tuberculosis, juniper is used in many popular

¹³ Maksoud & El-Amin, (2011)

¹⁴ Klales, (2014).; Lucas (1991); Nazir (1970) in Arabic

¹⁵ Hampe & Petit, (2010)

medicine recipes for anti-bacterial and antiseptic. Juniper oil is stated to possess a wide range of pharmacological activities. It has diuretic, antiseptic, carminative, stomachic and antirheumatic properties and has been traditionally used for cystitis, fatulence, and colic. Moreover, it has been applied topically for rheumatic pains in joints or muscles and modern proved the antibacterial and antifungal activity of juniper berry oil and its selected components.¹⁶

3.6.2 Castor oil



Fig. (-8A) Castor bean in disturbed area



(-8B) Ricinus communis, seed

Castor oil was also detected in FTIR analysis of brown spot, castor oil come from seeds of the ricinus communis plant, which is native to tropical areas of Africa and Asia. The castor oil plant grows wild in Egypt at the present day and, since the seeds have been found in graves as early as Badarian period (4500BC) The plant possibly is indigenous in country. Herodotus, Diodorus, Strabo and Pliny all mention the use in Egypt of castor oil for burning in lamps. Herodotus states that the seeds, were either bruised and pressed, or roasted and boiled, in order to obtain the oil, which is strong smell. Strabo state that the oil was used by the poorer people and laborers, both man and women, for anointing the body. Pliny says that in Egypt the oil was the extracted without employing either fire or water, the seed being first sprinkled with salt and them passed. The costar oil plant figured largely in the pharmacopeia of ancient Egypt and the oil plant barriers and roots are frequently mentioned in the medical papyri.

Castor oil was used in medicine to soften the intestines and massage and treat tumors and pimples.¹⁷ Castor oil is thought to have anti-inflammatory, antimicrobial, moisturizing, and some other useful properties mentioned in prescription No. (251) Ebers papyrus.¹⁸

¹⁶ Filipowicz, et al., (2003).

¹⁷ Lucas(1991) in Arabic; (Ghaliongui,1987), https://www.newworldencyclopedia.org/entry/Castor_oil_plant

¹⁸ Nazir, (1970).in Arabic.

3.6.3 The frankincense / al lubn

Origin of the Name: The Arabs called the milky sap of the frankincense tree al lubn, from the word for milk. Origin and Habitat Frankincense trees are found in Oman, Somalia, Ethiopia, Yemen, the southern Arabian, Peninsula and India. The desert of the Dhofar region in southern Oman is the source of *Boswellia sacra*, sacred frankincense. The *Boswellia serrata*, Indian frankincense, is widely distributed and abundant in the dry, hilly parts of India. The trees on the Somali coast grow out of polished marble rocks without soil; the purer the marble the stronger the tree. The *Boswellia papyrifera* grows primarily in Ethiopia and Sudan.¹⁹



Fig.(-9A) Flowers and branches of the Boswellia sacra Tree



Fig. (-9B) Al lubn

Botany and Morphology of Frankincense: Frankincense is the hardened oleo gum resin exudates (a mixture of volatile oil, gum, and resin) from different species of *Boswellia*. It is a translucent, brittle, whitish-yellow substance, in roundish, club-shaped, pear-shaped, or irregular tears, and usually covered by a whitish substance produced by the pieces rubbing against each other. The purer varieties are almost colorless, whitish, or with a greenish tinge, and easily flammable. It has a sub-acrid, terebinthinate, bitter, and aromatic taste. It melts with difficulty, becomes soft and adhesive by chewing, and forms an incomplete white emulsion when rubbed up with water. When burned, frankincense produces a brilliant flame and diffuses an agreeable aroma.²⁰ In the ancient manuscript, they mention that the incense was brought to Egypt by the Negro tribes. On the trip of Queen Hatshepsut to Punt land, and in the eighteen dynasties, it was mentioned that she brought trees in Jars to cultivating them in the temple garden. The archaeologist Brestid called them (Merrh), while Naveel identified the same trees as Frankincense.²¹

¹⁹ TUCKER,(1986).

²⁰ <https://pdfs.semanticscholar.org/3454/440f1160482da4a10bde3cecea0dde67a753.pdf>

²¹ Lucas, (1991). in Arabic

The Ancient Egyptians in the mummification process cleansed body cavities with frankincense and natron. Modern experimental research in Persian medicine, it is used for diabetes.²² In modern clinical research found that the gum resins of *Boswellia serrata* (a traditional ayurvedic medicine) and of other *Boswellia* species have experienced increasing popularity in Western countries. *serrata* gum resin extract for the treatment of a variety of inflammatory diseases like inflammatory bowel disease, rheumatoid arthritis, osteoarthritis and asthma.²³ In my opinion in this period, it seems that they used several antimicrobial agents such as juniper and castor oil; besides Frankincense, was an excellent aromatic resin, to make a single mixture placed over the body to protect against decomposition.

4. A brief history of the Egyptian cotton

Our knowledge about cotton cultivation in Egypt dates back to a later time, Mohammed Aly (1805), but this information has been proven incorrect from the research presented herein. Therefore, we have searched in historical references about the history of cotton farming in Egypt, where we found references to confirm the existence of cotton in Egypt before the era of Mohammad Aly (1805). Historian Herodotus visited Egypt in the 5th Century BC. He mentioned that the pharaoh Amasis or Ahmose II 526-570 BC, the 26th Dynasty, had gifted two shirts, one to the Sami (Spartans) and the other to the temple of Lendis. Those shirts were made of linen and were adorned with pictures of many animals made by cotton fibres, and each thread in the shirt was worthy of admiration.²⁴ Beleni, who lived in Egypt in the first century AD, also mentioned a tree growing in Upper Egypt called *Gossypium*; the Egyptians made from its textile, called it "Xylina", which is unmatched in its whiteness and softness.²⁵ Therefore, the description of the tree or plant prescribed is probably *Gossypium Arboreum*, local in the warm African lands and is in its wild state in Sennar, Sudan.²⁶

Likewise, Beshtali found remnants of textiles, baskets, ropes and relics in the excavations of the Coptic Antiquity Society in the monastery of Anba (Voipamun) in the desert of Taiba in 1947; they examined the textiles which some of them made of cotton. It dates back to the early fourth century BC.²⁷

Besides, Ahmed Bak Kamal believes that the Egyptian name of cotton is "tot", and the oldest cotton fabrics were found in the Nubian country of the Roman era 30 BC - 640 AD. Also, cotton textiles of this era were found in the town of Marwa in Sudan. Rosellini says that the cotton seeds were found in a pottery pot in one of the tombs in Taiba and are kept in a museum in Italy; he thought it belonged to a *Gossypium Arboreum*.²⁸ The

²² Mehrzadi et al., (2018)

²³ Abdel-Tawab. et al., (2011).

²⁴ Nazir, (1970). in Arabic

²⁵ Salem, (2000). in Arabic

²⁶ Khattab, (1983). in Arabic

²⁷ Nazir, (1970). in Arabic

²⁸ Griffith & Crowfoot (1934); Kamal, (2000). in Arabic

archeologist F. Petri believed that cotton was cultivated in the Greco-Roman era and was spread in the Roman period 30 BC-640 AD. Even though cotton was cultivated in ancient Egypt, linen was highly used in clothes, which might be due to a limited area cultivated by cotton. Cotton cultivation was not widespread and not widely used in textiles until the Islamic era.²⁹ Based on the references discussed above, the Egyptians might have known the cotton, although the name for cotton in the ancient Egyptian language has not been identified to date. However, we know a kind of cotton cultivar in Egypt called Aashmuny and the plant tongue (*Gosibum Barbadens*). We also know that Akhmim was known as Ashmoun and was famous by manufacture textiles; maybe this kind was one of the cotton kinds cultivated in ancient Egypt.³⁰

El-Ktab, et.al. (1959) focused in a historian that has mentioned that cotton clothing was common in the Ptolemaic period (30-332 BC).³¹ He stated that cotton clothes recoded in the Rosetta stone, while the cotton was mentioned as part of the narrated story of Queen Cleopatra "She did not find a gift better than the shirt she had made by herself with her maids from cotton threads in three days to give it to Julius Caesar in Rome". Egypt was famous in the Roman era for the cultivation of cotton and its trade and industry. However, the spread of injustice at the end of their era and the insecurity caused the disappearance of cotton cultivation and manufacturing. Also, textile was found in Aniba, south of Egypt, from the fourth century BC. the researchers thought it is made from flax, but it was found that it was made of cotton.

Cotton was known to the Arabs before the conquest of Egypt and expanded farming in Egypt after the Arab conquest until that in the eighth century was a large cotton store in their capital. It is written in a Manuscript of Ibn al-Muqaffa', the bishop of Al-Aashmonin in Egypt (dated to the thirteenth century), in which he describes the fire that took place in Al-Fustat. When the revolution of the people of Khurasan happened against Marwan the second (the last ruler of Bani Umayya), he fled to Egypt, and they followed him. However, he ordered burning Al-Fustat; the fire starts from the south part of the city, starting from the cotton stores. Some Egyptian and Arab writers wrote about the cultivation and manufacture of cottons in Egypt, such as Al-Sharif Muhammad ibn Muhammad Al-Idrisi, the Sicilian, and the famous geographer of the 12th Century; Ibn Osman Nabulsi Safadi al-Shafi'i; Ibn al-Bitar; Ibn al-Muqaffa. Likewise, David Antoine, who lived in Cairo in the late sixteenth century, said that cotton is a plant grown in the month of Baramwda (April) and comes out on a leg branching and wicking apple shape and showing off the cotton hair. In Egypt, the plant takes off every year, not as in Iraq; this is left until it becomes a tree.

When Napoleon conquered Egypt in 1798, he ordered a group of scientists who accompanied the campaign to study plants in Egypt. As a result, the French botanist

²⁹ Petri, (1975).in Arabic

³⁰ Kamal, (2000). in Arabic

³¹ El-Ktab, et.al. (1959). in Arabic

Mr Dalail has written, the cotton in Egypt is *Gossypium Arboreum* species, and the *Gossypium Herbaceum* species is cultivated in the North Delta in Samannoud and Mahala. Another crop species was recorded as *G. Frutescens*; it is Asian cotton grown in Taiba in Luxor and *G. Vitifolium*, cotton with broad leaves similar to grape leaves planted in orchards for decoration as was cultivated on a small scale for exploitation. The last species entered Egypt after 1700 by caravans coming from the Sudan and Ethiopia, and it was called Al-baldy; it was a stinking and short-staple and used in the cheap fabrics industry. The renaissance of cotton cultivation started in Egypt when the engineer Louis Al-Alexis Gumel (a French engineer summoned by the Egyptian government to regulate the textile industry in Egypt in 1820) found cotton bushes for decoration in the garden of Mohammed Bey El-Aroufly in Boulaq. The engineer admired the length and durability of this plant's hair. So, he tries to increase this species. He successes in proliferating, the product was for sale at an attractive price at that time, then began to cultivate cotton gradually spread and replaced the old species and this cause the renaissance of cotton cultivation in Egypt.³²

5. Cotton and mummies in ancient Egypt

Eastwood (2003) wrote that although ancient Egypt is known for producing linen cloth, in Egypt, excavated textiles made from sheep's wool, goat hair and palm fiber are also known. Cotton not in general use in Egypt until the first century AD; cotton identification on a mummy has been discounted. The mummy in question (Philadelphia University Museum: PUM II) was shipped to America in raw cotton.³³

More information about PUM II was sought, but only two articles were published in two books.³⁴ Thus, not all the information was accessible; however, a summary was put together from what was available. In 1971 Wayne State University, Medical school started studying Egyptian mummies; the aim was to study mummies disease and ancient culture. In 1973 the Philadelphia University Museum (PUM II) mummy was a second case study from the same museum. The mummy sent to study without her cartonnage and coffin. This mummy brought from Egypt as a souvenir in the nineteen-century by travelers and was left in the basement. The provenance of this mummy was unknown, and by archeological evidence was dated to the Greco-Roman period.³⁵

To study the mummy, they removed the linen strips. The outer wrapping of PUM II consisted of broad, finely woven strips of linen; these were removed and placed in a box for further study.³⁶ The mummy was radiocarbon dated using linen from the wrapping; the date obtained was 170BC70± years (Ptolemaic period)³⁷ Ave Cockburn asked the

³² El-Ktab et al., (1959). in Arabic

³³ Eastwood, (2003)

³⁴ Cockburn A. & et al., (1983); Cockburn, (1986).

³⁵ Cockburn, (1986)

³⁶ Cockburn, (1986)

³⁷ Cockburn et al. (1983).



textile conservator to examine the strips of linen removed from PUMII, as experienced excavated that cotton fibres attached by linen strips, of course, it was a great surprise. They did not believe this tiny ball of cotton was original. They belonged to this mummy and, the identification of cotton on a mummy has been discounted because the cotton was not commonly used in Egypt at that time, and the mummy was shipped to America in raw cotton used as a backing material in the 19th century.

After several years, Cockburn feels this piece of unfinished business should be resolved. She enlisted the help of Mary Ballard, the textile conservator at the Detroit Institute of Art and Elizabeth Coughlin from the Ethnobotany Museum at Harvard, who has examined the cotton in her laboratory. Coughlin commented that macerated papyrus could be observed in the sample and some pieces of myrrh, not in a solution that might have been sprinkled over it. She realized that the banding agent was a part of the cartonnage and pointed out a small area of reddish pigment: this ties in which the colors used to decorate the cartonnage. Another fiber expert has examined the ball briefly under a light microscope, then commented on the suitable type of fiber and left that. Inspector Eve Cockburn believed that the other part of the small cotton ball still in cartonnage; she asked the curator in PUM to help her to examine the cartonnage. However, the cartonnage was stored in another place, he went with her, and they examined the cartonnage together. He said, "the cartonnage itself with the other half of the cotton ball as you see in the two sides, you can even see the sheen of the cotton, as well as its association with cartonnage". Eve Cockburn, with Mrs M. Greeves in Shirley Institute in Didsbury, examined the little cotton ball. She expressed great surprise for the absence of biological degradation, the fact that she attributed the results to the way the cotton ball had been closely wrapped in linen. She thought that one speck was part of the seed coat.³⁸

In my opinion, after 33 years of the last publication on PUMII, the small ball of the cotton sample must be reexamined again using more advanced scientific techniques. The new discovery reported here of the cotton fibres above the mummy and under the linen bandages; no doubt it belongs to mummy. Moreover, the cotton fibres with seeds impeded in it indicating row cotton and the amount of fiber as a thick layer are undoubtedly evidence. Lastly, this expert opinion is through my experience as a conservator of mummies for more than thirty years. Moreover, through my work in the center of research and conservation of antiquities labs, we identified the fibres and the materials in contact with fibres used in mummification. Furthermore, we conducted microbiological tests in our labs.

³⁸ Cockburn, (1986)



Future studies

Genetic study of the cotton sample

Much research has been carried out to look into the history of cotton growing in Egypt, done by Egyptian and international researchers interested in the wild breeds that are still growing in the Egyptian land. For example, Wafa Amer (1999) studied the genetics of some old species³⁹ and Momtaz & Amer, 1998 tried to examine the relation of some wild species to modern species being farmed in Egypt.⁴⁰ In addition, Palmer et al.2012 studied the seeds that were excavated in Qasr Abrim site (Egyptian Nubia).⁴¹ This site is located 40 km northern Abu Simbel and 70 km northern the Egyptian-Sudanese border. This site is currently immersed under the waters of Lake Nasser after the High Dam. These seeds were of a type of cotton. The sample was dated 1600 years ago; the genetic research on these seeds proved that *Gossypium herbaceum* seeds were closely related to the African species. This discovery refutes the view that cotton was brought to Egypt from India during the reign of Alexander the Great) 332B.C).⁴²

These results also confirm what French campaign scientists wrote (1798) that the *Gossypium Herbaceum* was one of the four cotton species cultivated in Egypt.⁴³ We hope that future genomic studies of the ancient cotton fiber that contains seeds may answer some of the debatable questions. Our study aimed to know if this type of cotton was wild or cultivated and to any contemporary species is nearest. The results of this research are just the start of a series of further research and are not finished yet.

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³⁹ Amer, (1999)

⁴⁰ Momtaz & Amer, (1998)

⁴¹ Palmer et al., (2012)

⁴² <https://doi.org/10.1093/molbev/mss070>.

⁴³ El-Katab et al., (1959).in Arabic

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