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Scienze e Tecnologie per la Conservazione dei Beni Culturali

Study and Investigations of Archaeobotanical remains from Tutankhamun tomb

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Abstract

An immense "natural" treasure was recently recovered from the storerooms of the Archaeological Museum of Cairo. Once moved to the new seat and museum, the Grand Egyptian Museum, it was time to start studying this precious "rubbish" recovered one century ago, at the end of the archaeological excavation of the tomb of Pharaoh Tutankhamun by Howard Carter's team. The study focuses on carpological remains swiped from the surfaces of the tomb and deposited in a wooden box in 1933. The carpological remains retrieved from the box are still in excellent condition, and allowed identification at a species level. Identified remains contained fruits and seeds belonging to 24 species belonging to 14 different plant families. New Species found in all the tombs of the Eighteenth Dynasty include faba bean (*Vicia faba* L.) and onion (*Allium cepa* L.). Egyptian luffa / sponge gourd (*Luffa aegyptiaca* Mill.) is a total novelty.

In this work I started analyzing the plant remains, using only a qualitative approach. The restrictions caused by the pandemic prevented, in fact, a continuous laboratory work and the complete identification of the so far extracted macroremains.

Keywords: Tutankhamun, Plant, Identification, Macroremains, Carpology

Preface

The tomb of the young King Tutankhamun (born c. 1342 – died c. 1327 BC) of the 18th Dynasty was discovered in November 1922 in the Valley of the Kings near Luxor, Egypt, by the British archaeologist and Egyptologist Howard Carter (9 May 1874 – 2 March 1939). Carter and his team spent 10 years recording and removing 5,398 objects discovered in the tomb. They created over 15,000 documents which are now held by the Griffith Institute in Oxford. Reading about the treasures of Tutankhamun, several things may come to mind: the abundance of gold that was discovered in his tomb, the king's beautiful funerary mask, the exquisite and delicate jewelry or the shrine with the poignant statues of goddesses posed to protect the king's canopic jars.

In this research, I will look at another category, maybe not as attractive as gold, but important in history: the botanical treasures from Tutankhamun's tomb. The botanical remains discovered in the tomb do not carry the same monetary value as the golden artefacts. The value of these organic treasures lies in the knowledge they can impart to us about Tutankhamun and his time. They can provide us with clues for anything from the pharaoh's life and health to greater socio-political issues like who Ancient Egypt traded with and how the well-to-do upper classes lived. The research takes a look at several categories of botanical treasures recovered from the tomb of the pharaoh Tutankhamun. The objective of the research is to study and investigate the contents of a wooden box filled with remains that were swept from the surfaces of the tomb in 1933, currently stored in the newly constructed Grand Egyptian Museum in Cairo (Egypt). The present study concerns the archaeobotanical remains (seeds, fruits and wood) of the monumental tomb. A qualitative approach has been chosen, which would serve as a preliminary step for further studies. Other than implementation of a quantitative approach, these could concern the analysis of organic residue of ceramic vessels retrieved in the same context, allowing the reconstruction, for the first time, of a complete image of plant use in funerary practices in Ancient Egypt.

It was fortunate that Carter was the archaeologist to discover Tutankhamun, because he tried to preserve everything he discovered in the tomb. When studying ancient botanical specimens from the dry Egyptian tombs, it is possible to identify specimens without recourse to detailed anatomical examination because of the exceptional preservation. This is true for fruits, seeds, leaves, flowers and other large objects. However, some specimens have to be studied under a microscope to determine the botanical species. These include fibers, binding strips, basket material and wood.

The study aims at identifying the archaeobotanical remains from Tutankhamun's tomb as a first scientific study for this type of artifacts. Tutankhamun tomb provides an opportunity to apply modern archaeobotanical methods to investigate high-society diet and, indirectly, agricultural practice. This study presents the ideal opportunity to increase our knowledge on plants in general, and in particular on past agricultural crops. The historical documents do not provide specific details about the agricultural economy, minor agricultural crops are in fact rarely mentioned or completely unrecorded, and basic information about what crops were grown and where or how the products and /or by products of agricultural crops were used is often not recorded. As a result, archaeobotanical remains from the "wooden box" are our best form of primary evidence to address such fundamental question about ancient Egyptian agriculture.

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CHAPTER 1. State of art

1.1 Introduction

The recovery and study of plant remains from archaeological contexts, known as archaeobotany, has allowed to greatly increase the knowledge of past human-plant relationships. Although the origins of this field of research can be traced back to the 19th century, it was properly introduced in the 1960s (Fuller et al., 2014). Before then, plant remains were commonly discarded as their importance was not acknowledged. Fossilization of plant remains, and their retrieval in archaeological layers, can occur through different modalities. The peculiar environmental conditions found in Northern Africa, with very low humidity, make it possible for plant material to be found in a wide range of periods and contexts. This also allowed for the preservation of flowers and leaves comprising ornamental garlands and bouquets in Pharaonic sites (Fahmy, 1997).

The arid Egyptian climate has helped to preserve various fruits and plants in archaeological contexts, allowing them to remain intact and be recovered in modern times.

The artistic evidence from tombs, the lexicographic data from texts, the archaeobotanical and artefactual evidence from the excavation of tombs and settlements, along with data from ethnographic and ethnohistoric observations have been precious for gathering information on crop diversity, crop husbandry and the history of many species (Nicholson et al., 2000). They are useful tools to support archaeobotanical research.

Several botanists of different nationalities have studied the flora of Egypt from the eighteenth century onward. The first scientist to study the living flora of Egypt was the Swedish Petter Forsskål, in the second half of the eighteenth century, followed by the Frenchman Alire Raffenau-Delile, a botanist with the Napoleon expedition to Egypt. A German botanist, Georg Schweinfurth (who lived between 1836-1925) gathered objects of agricultural and botanical interest for the agricultural museum, which he founded in Cairo. As a matter of fact all these studies were performed before the discovery of Tutankhamun tomb (Hepper, 2009).

1.2 The pharaoh Tutankhamun

While thinking about Pharaohs, Tutankhamun (his reign c. 1336- c. 1327 BC, 18th Dynasty) immediately comes to mind (Uda et al., 2007). The discovery of his tomb by Howard Carter in 1922 remains one of the most spectacular archaeological finds, having occurred almost accidentally (Allen, 2006). The former general of Tutankhamun's, Horemheb, the last pharaoh of the 18th dynasty made sure that all references to his predecessor were destroyed, erasing him from history. Although the lack of textual evidence caused Tutankhamun to be forgotten, this omission allowed for him to be preserved for posterity, surviving the dismantling of royal tombs following the abandonment of the Valley of the Kings (Allen, 2006). Tutankhamun's tomb is famous for the presence of prestigious artifacts, including the remarkable golden funerary mask. Nonetheless, Howard Carter managed to acknowledge the potential value of less prestigious findings, including plant remains. After selecting the most interesting elements of the "botanical treasure" – flowers, a dried pomegranate and a basket of *Hyphaene thebaica* fruits (Hepper, 2009) – all the remaining plant material was swiped from the surfaces of the tomb and deposited in a wooden box (200 X 81 X 56 cm ca.). This was closed in 1933 and was stored in the Egyptian Museum in Cairo until 2017. In 2018 it was moved to the Grand Egyptian Museum.

The value of these botanical treasures lies in the knowledge they can impart regarding Tutankhamun and his time. They can provide information about funerary rituals, plant availability and plant use in Ancient Egypt. These are also correlated to greater socio-political and economic issues. The present research aims to analyze two main categories of plant remains: carpological (seeds and fruits) and xylological remains (wood).

1.2.1 A brief history of Tutankhamun life

Tutankhamun is the king whose name the whole world knows. He was born presumably at Akhetaten (modern el-Amarna) during the latter half of the reign of Akhenaten (Carter, 1972). The recent DNA analyses and MRI/CAT scanning revealed that Tutankhamun's mother was a direct sister of Akhenaten, which could explain Tutankhamun's congenital defects including his cleft palate, club foot and bone necrosis in his left foot. These scans also indicated that Tutankhamun did not die from a blow to the head, as had been believed earlier, but rather revealed that he suffered a leg fracture, which became life threatening when he simultaneously contracted malaria (Herselman, 2013). He married his half-sister from his father's marriage to Nefertiti, Ankhesenamun. Tutankhamun and Ankhesenamun had two stillborn daughters, whose mummified remains had also been discovered in his tomb (Hepper, 2009).

Howard Carter said that **"***The mystery of his life still eludes us-the shadows move but the dark is never quite dispersed***"**.

Tutankhamun was the third to last pharaoh of the Eighteenth Dynasty, reigned for a period of nine/ten years from 1336-1327 BC. He is known as "the young king" as he is believed to have risen to the throne at the young age of eight or nine. Initially called Tutankhaten, he changed his name from King Tutankhaten to Tutankhamun when he moved to the capital of god old country, restoring Thebes as a religious center. The new region had a weak infrastructure, while the priests of Amun were influential; they regained their authority before Akhenaten's reign and grew to have the upper hand in the country. Tutankhamun died young, in circa 1327 BC, aged about 18/19, without a male heir. During his reign, Tutankhamun work to rebuild the temples of God Amun not only in Thebes but also in all regions of the country. Externally Egypt hoped to gain back control with a strong King returning the Egyptian Empire's prestige. However, the king was young and had weak structure, besides the powerful influence of the priests of Amun who regained their authority before Akhenaten's reign. Since that time the priests constituted a new force which grew over time to become the upper hand in the country. A publication of March 2005, reporting the scanning of the king's mummy, indicates Tutankhamun was killed (Hawass et al., 2016).

Tutankhamun rose to fame only during the last century, when his tomb was found intact, not being subjected to robbery, which was very common for Egyptian tombs.

1.2.2 The Site of Tutankhamun's tomb

The Valley of the Kings, across the Nile from Luxor, is one of the richest archaeological sites in the world. It is here that the tomb of the king Tutankhamun was discovered. The valley hosts the necropolis of the 18^{th}-20^{th} dynasty (1550-1069 BC) pharaohs who reigned in the New Kingdom. This place was chosen due to its symbolism, as the dynastic roots of the pharaohs from the 18^{th}-20^{th} dynasties could be traced to Thebes, further south. The Valley of the Kings was, therefore, 'closer to home'. A total of 62 tombs have so far been found in the Valley of Kings. The last one to be recovered *(No. 62)* was that of Tutankhamun (Fig. 1, 2). It is called *KV 62: KV* for valley of kings in Luxor, and 62 as the 62nd tomb discovered at this site (Figures 1-3).

The discovery of the tomb of Tutankhamun in 1922 by Howard Carter, undisturbed since the king's death in 1327 BC, is celebrated as one of the greatest archeological discoveries of all time: for the first time, the wealth of Egyptian kings tombs could be seen. The discovery of this tomb still appeals to the imagination of many people, even after more than 95 years.

Figure 1 .The valley of the king, the tomb of Tutankhamun in the right foreground. Photo: H.Burton (Courtesy of the Griffith Institute, Oxford, UK).

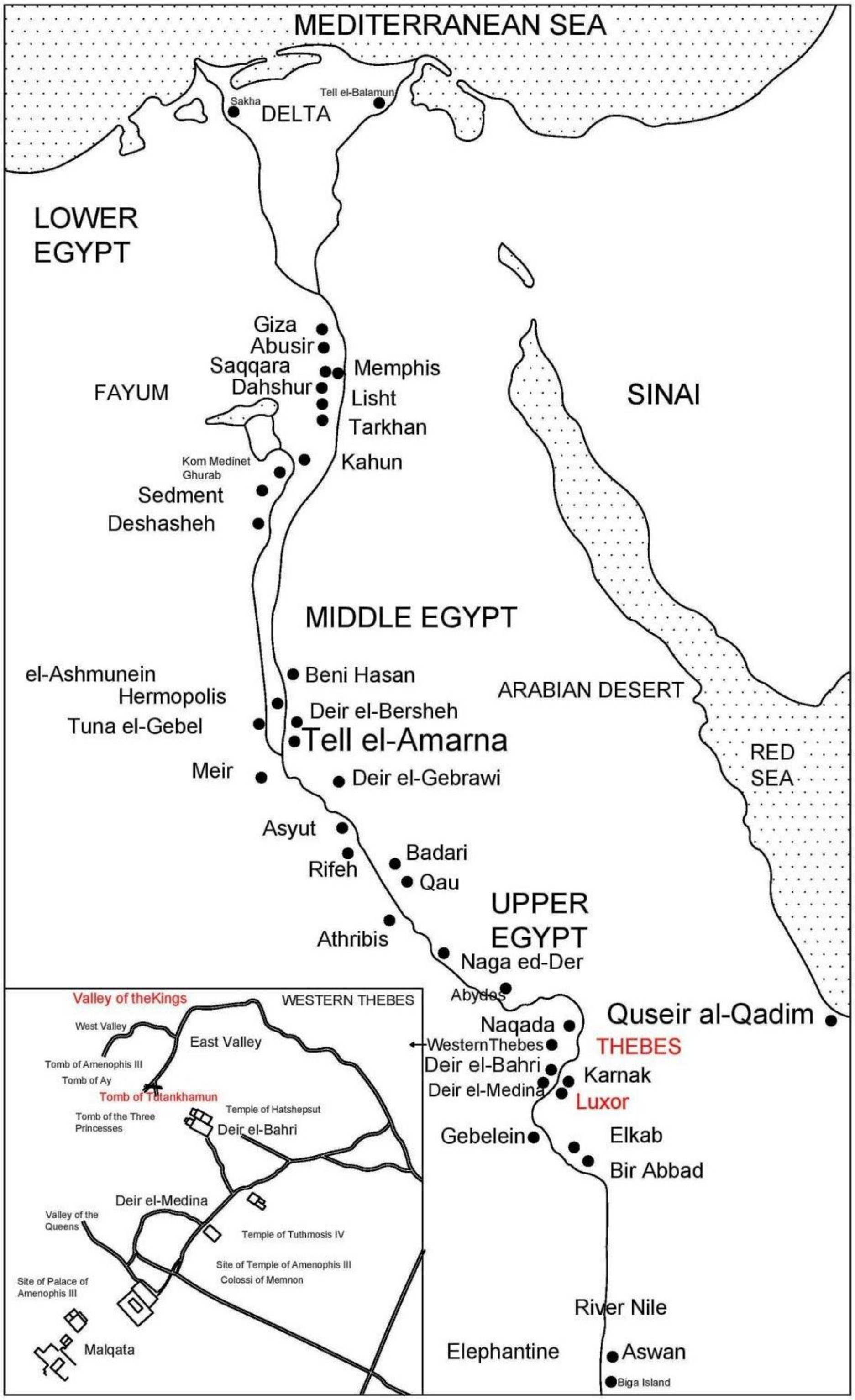

Figure 2. Map of Ancient Egypt, showing mentioned sites in the research and Tutankhamun tomb site. (Reeves and Hall, 1990 Hall, 1986, modified).

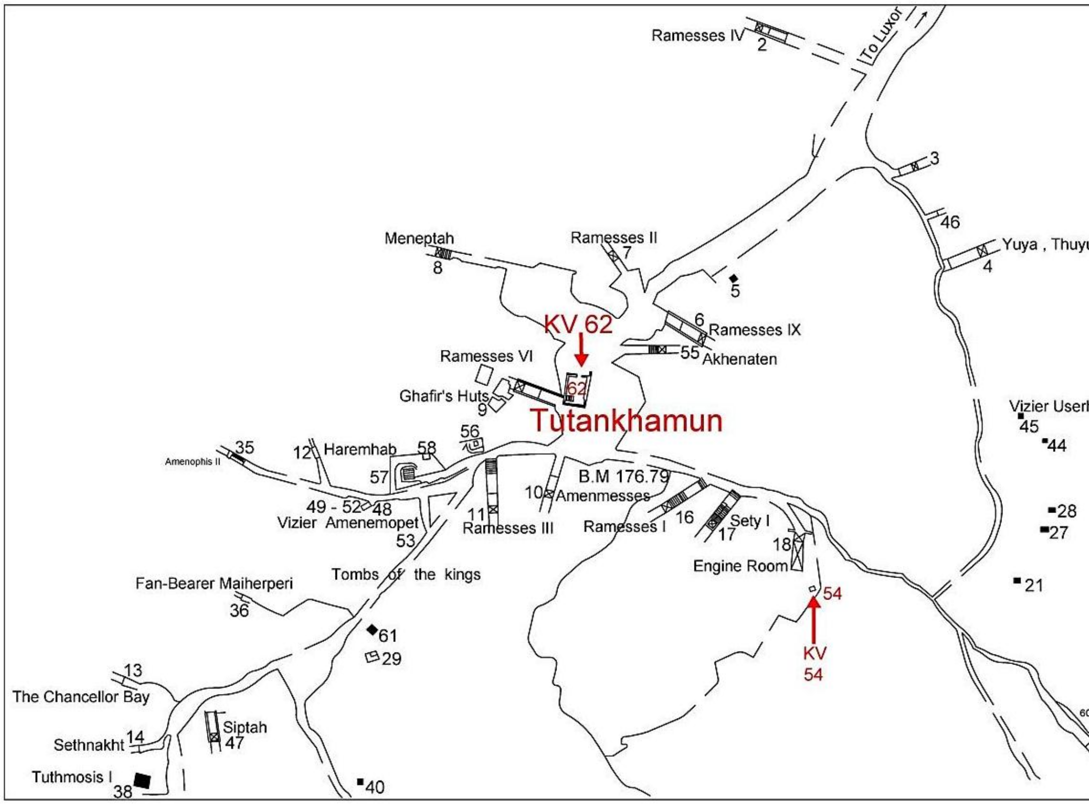

Figure 3. Map of the Valley of the Kings with the position of Tutankhamun's tomb (KV 62) and embalming cache (KV 54). Source: Herbert E. Winlock, Tutankhamun's Funeral 2010.

1.2.3 Carter's system of numbering for Tutankhamun's collection

All objects from the tomb of Tutankhamun, group of objects and all fragments have been assigned a number (1-620, 5398 objects) by Carter. Carter used a special system in numbering of objects from the tomb of king Tutankhamun. As explained abov,e that the tomb was number 62 in the Valley of the Kings and number 433 in Carter's sequence of discoveries since 1915. For subdivisions of objects within a numbered group single (a, b, c, etc.) or multiple letters (aa, bb, cc, aaa, bbb, ccc, or even more) were used. Additional subdivisions were noted by bracketed Arabic numerals. An anomaly is represented by the group of items 620 (Fig. 4) that was given 123 numbered subdivisions: 620:1 to 620:123 (Reeves, 1992).

The numbering of object started from the entrance of the tomb and is a sequence of discovery of the tomb.

The materials from the tomb such as Howard Carter notes, numbering cards, Alfred Lucas notes and Harry Burton's photographs are now available on the website of the Griffith institute and still represent the most important source of information about the collection from Tutankhamun's tomb (http://ashmolean.org/Griffith.html). Now Tutankhamun's collection is in the hands of the Grand Egyptian Museum and I will have the chance to enrich the information, adding more details to the first source.

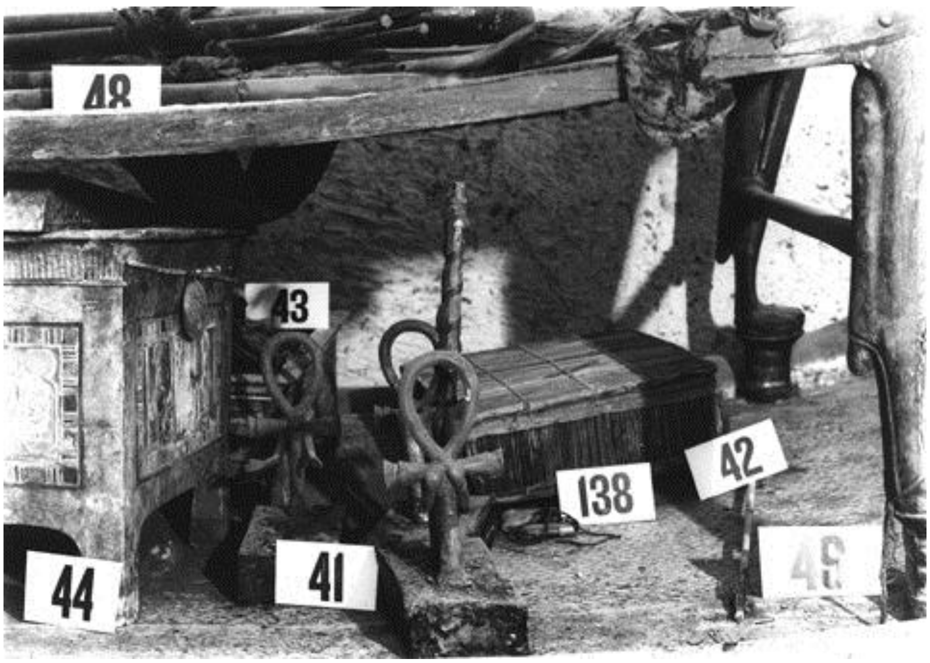

Figure 4. Numbering cards with objects from antechamber. Photo: H. Burton. (Courtesy of the Griffith Institute, Oxford, UK).

1.2.4 Design of the tomb

Tutankhamun's tomb was found to consist of four rooms: antechamber, burial chamber, annex and treasury (Figure 5). The first room was the antechamber, which was undecorated and contained about 154 card numbers, corresponding to approximately 700 objects (Reeves, 1992). This room contained the objects used for the daily life like beds, textiles and hunting materials. The burial chamber, the only decorated chamber in the tomb, was occupied by four gilded wooden shrines.

The decorations on the wall depict the king's funeral procession, and the goddess Nut was painted on the ceiling, "embracing" the sarcophagus with her wings (Reeves, 1992).

The treasury room contained over 5,000 catalogued objects, most of them funerary and ritual in nature. This room held two mummies of fetuses, that some consider to have been stillborn offsprings of the king. The annexe was used to store oils, ointments, scents, foods and wine. This was the last room to be cleared, from the end of October 1927 to the spring of 1928. It contained 280 numbering cards for objects from number 337 to 620 in Carter’s system of numbering, comprising more than 2,000 individual objects.

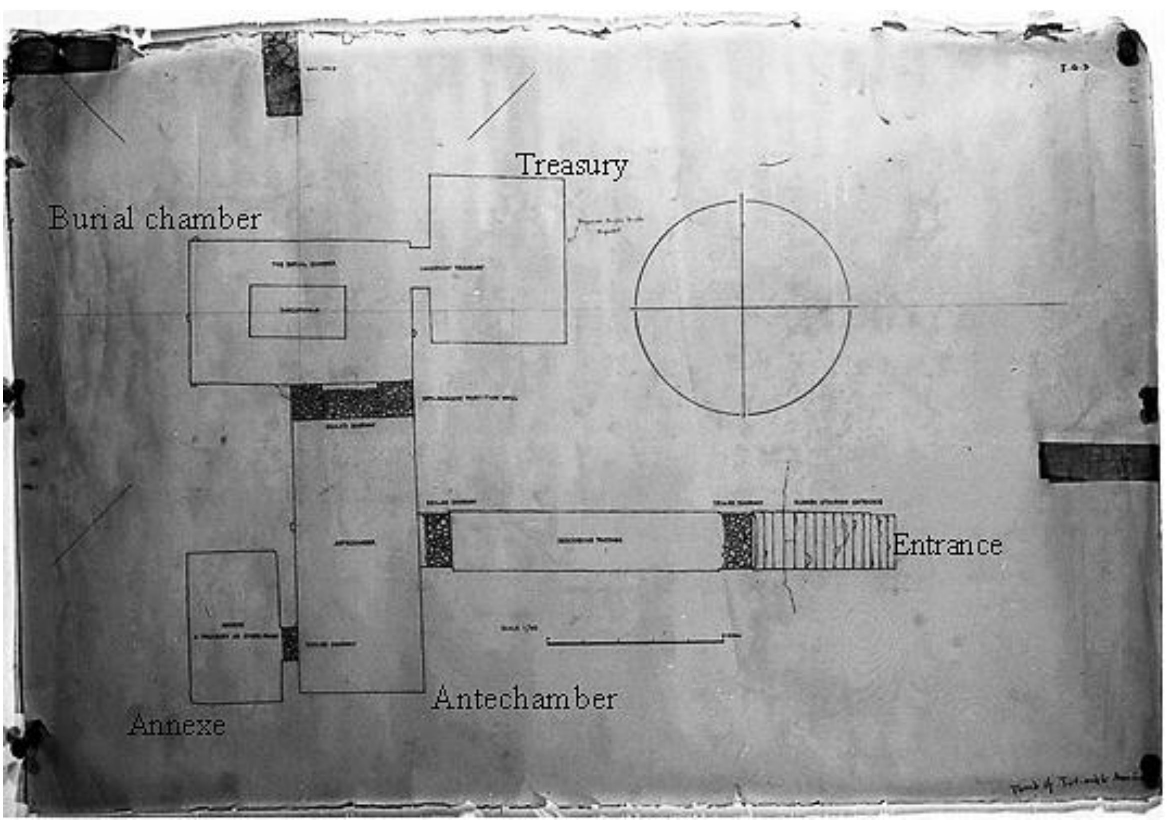

Figure 5. Plan of Tutankhamun’s tomb KV 62, 56 x 81 cm (Courtesy of the Griffith Institute, Oxford, UK).

CHAPTER 2. The archaeobotanical finds from Tutankhamun tomb

2.1 Plants in ancient Egypt

Plants were very important to the Ancient Egyptians. Plants constituted a source of food, medicine, garden elements and building materials, and had numerous other uses (Barakat et al., 2010). It is not surprising that noble and royal tombs were filled with all types of botanical elements, from floral decorations to foodstuffs. The tomb walls were usually decorated with garden scenes (Fig. 6). These botanical elements were not just included for their aesthetic attributes, but also for their symbolism, and on account of their usefulness. More than 350 plant species have been identified as remains from various Egyptian sites starting from Prehistoric period (ca. 18,000 years BP) until the Islamic age (Barakat et al., 2010). The diversity of ancient Egyptian plant materials attracted numerous botanists and other scientists of different nationalities to study the flora of Egypt from the 18th century onward. The first one of them was the Swedish Petter Forsskål, in the second half of the 18th century. He was followed by a botanist with the Napoleon expedition to Egypt, the Frenchman Alire Raffenau-Delile. A key role was played by the German botanist, Georg Schweinfurth who

Figure 6. Rectangular fishpond with ducks and lotus planted round with date palms and other fruit trees, in a fresco from the Tomb of Nebamun, Thebes, 18th Dynasty. https://www.wikiwand.com

lived from 1836 to 1925, the founder of the agricultural museum in Cairo, who gathered objects of agricultural and botanical interest for it.

2.2 Identification of plant materials from Tutankhamun tomb

Percy E. Newberry accompanied Howard Carter to deal with the botanical discoveries from Tutankhamun's tomb. Newberry was a Professor of Egyptology at the University of Liverpool from 1906-1919, a Professor of Ancient History and Archaeology at the University of Cairo from 1929-1933 and probably the first British Egyptologist to publish on plants. Some of the plant materials discovered in the tomb were identified by him and stored at the Cairo Museum. The materials that needed further analysis were sent to Kew Royal Botanical Gardens to be analyzed by the Assistant Keeper L.A. Boodle. After retirement, Prof. Newberry continued the identification of plant material from the tomb, but his work was not published due to the Depression and Second World War. Dr C.R. Metcalfe succeeded Boodle in the Kew laboratory and continued the research on ancient plants, including the materials from Tutankhamun's tomb (Hepper, 2009). Many of Boodle's identifications were published by A. Lucas in 1926.

Figure 7. Bouquet of leaves of persea tree and olive, tied to a common reed stick (photo: Grand Egyptian Museum 2020).

Figure 8. Three bouquets from Tutankhamun's tomb (photo: Grand Egyptian Museum 2015).

Tutankhamun's tomb was stocked with many materials of plant origin: from reed walking sticks to the floral garlands on the royal mummy and coffins, the gilded wooden furniture, linen clothes, bark-encrusted bows and reed arrows, perfumes, oils and even foodstuffs.

Several dried botanical specimens were discovered in the tomb, besides several bouquets of leaves of persea tree and olive, tied to a common reed stick (Fig. 7-8). Several floral tributes were also discovered in the king's coffin, on statues of deities in the tomb and in a pit outside the tomb's entrance containing the funeral feast and embalming materials. These were considered unclean and therefore could not be placed in the tomb. However, having been in contact with the royal mummy, they could not be thrown away.

They were examined by Percy Newberry in situ and could be easily identified due to their near-perfect conservation state, having remained intact after more than 3,000 years. One of the most interesting findings was a wreath around the *uraeus* on the forehead of Tutankhamun's golden mummiform coffin. The wreath was made of papyrus pith (the fibers inside the stem), olive leaves, cornflowers and waterlily petals, and Carter hypothesized that this wreath must have been placed there by the king's heartbroken widow, Ankhesenamun. Nonetheless, the most spectacular floral tribute was the floral collar found in the innermost coffin around the golden mask of Tutankhamun (Fig. 9). The collar consists of nine rows of ornaments arranged on a semi-circular sheet of papyrus pith, with colorful yellow and blue flowers interspersed with tiny blue-green faience rings, green leaves and red and yellow fruits. The collar was made up of leaves of different plants such as date palm (*Phoenix dactylifera* L.), ashwagandha (*Withania somnifera* L.), juniper berries (*Juniperus* L.), willow (*Salix mucronata* Thunb.), pomegranate (*Punica granatum* L.), blue waterlily petals (*Nymphaea caerulea* Savigny), cornflowers (*Centaurea depressa* M. Bieb.), ox-tongue (*Picris asplenioides* L.), persea tree (*Mimusops laurifolia* (Forssk.) Friis) fruits and olive (*Olea europaea* L.). Persea tree seems to have been a popular fruit in Egypt, judging from the frequency of its occurrence in tombs (Hepper, 2009). A representation of a similar collar is found in the picture of Tutankhamun and

Figure 9 .Tutankhamun's mummy covered with golden mask and floral collar. Photo: H.Burton. (Courtesy of the Griffith Institute, Oxford.UK).

Ankhesenamun on the back of his famous throne. Based on the flowers and fruits used in the collar, Newberry assumed that the king was buried sometime between middle March and the end of April.

2.3 Tree and Wood in ancient Egypt

In pharaonic times, the Nile valley supported various types of trees such as acacia, tamarisk, doum and date palms, Christ-thorn and sycomore. Other arboreal species grew in the tropical areas to the south and in Nubia, especially the luxurious ebony, which was imported from there to the pharaoh's palaces and temples (Nicholson et al., 2000).

However, the pharaohs acquired large timber and wood for special purposes from the countries northeast of Egypt, especially Lebanon where the cedar forests were regularly exploited by Egypt. Coniferous timbers such as cedar, juniper, fir, pine and cypress were the main species, but hardwoods such as box, oak and ash were imported from Asia Minor. Furthermore, the decorative silver bark of the beech tree was found in Tutankhamun's tomb (Hepper, 2009).

Several impressive pieces of woodwork were found in the tomb. The first example is the set of four shrines and the outer third coffin made of cypress wood (which was transported by sea from Edom, Turkey or Syria), gesso and gold. A. Lucas, the chemist in Howard Carter's team, studied the wooden framework of the gilded shrines and concluded that the frame was composed of cedar wood, but Boodle later identified another fragment as cypress. A number of 177 joining dowels in the shrines were composed of Christ-thorn, cedar wood, oak and acacia. Another remarkable example was the assortment of chairs in the tomb. Until now, no precise identification of all the species involved in the shrines was done, except of the well-known ones of cedar and ebony. Perhaps the most remarkable of these is the royal throne. The royal throne was covered with gold and decorated with glass, faience and stone inlay, so neither the identity nor the color of the wood has been reported. The picture at the back of the throne is full of botanical references; in addition, the queen is depicted while applying an ointment on the king. The depiction continues on both sides with the representation of huge floral bouquets composed of papyrus, lotus flowers and petals, mandrake fruits and poppy flowers.

Another beautiful category of timber objects discovered in the tomb is comprised of the ornate caskets. One of these is the casket with a remarkable lid that forms the cartouche of Tutankhamun. A reddish-brown coniferous timber, probably juniper or cypress, was used and the hieroglyphs in the cartouche are made up of ebony and ivory. Another remarkable example of woodwork was the famous chariots, found in a jumble of wheels, sawn-up axles and decaying harness. These magnificent state chariots, not found in any of the previous pharaonic tombs, were constructed of wood and covered with sheets of gold that ornamented with figures of foes of the pharaoh, animal deities and floral designs. The timber fragments were identified as elm, a plant imported from Western Asia, by Boodle. Until now is still uncertain whether the entire chariot was made of elm or a mixture of timbers.

Another example for the woodwork discovered were full-sized paddles or oars, throw-sticks and weapon-sticks, and 47 wooden bows and dozens of reed arrows, Ancient Egypt’s principal weapons. The bows were made of timber from the acacia tree and the manna or Syrian ash, the latter covered with birch bark.

2.4 Foodstuffs from Tutankhamun Tomb

The believe of Ancient Egyptian in afterlife was clear in the abundance of foodstuffs which were discovered it Tutankhamun tomb. A total of 116 baskets containing offerings of seeds and foodstuffs were recovered. The foodstuffs included fruits, nuts and seeds (watermelon, sycomore fig amongst others), doum palm fruits, persea, almonds, dates, pomegranates, grapes, Christ-thorn and whole safflower seeds which, when fresh, yielded an edible oil that could also be used medicinally. Grapes were very important for the variety of its uses, and vines were planted individually for home consumption or in vineyards, for the production of fruit in quantity and for wine.

Several vegetables, herbs and spices were also discovered in the tomb including garlic, chickpea seeds, lentil seeds, coriander seeds, juniper berries, black cumin seeds, wild thyme, dill, various mints, etc. The Ancient Egyptian civilization relied heavily on cereal cultivation, and was dependent on cereals as their staple food. It is no surprise that samples of cereals were discovered in the tomb. A sample of grains was studied at Kew in 1933 by an expert on cereals, Prof. J. Percival, who identified emmer wheat, the most important wheat in the ancient world. Loaves of bread were also deposited in Tutankhamun’s tomb. Most of them were semi-circular in shape and varied in size. Some were wrapped in rushes, perhaps used as a carrier. Nearly all of them contained fruits of Christ-thorn, so they can rather be classified as fruit loaves or cakes. Some or all of the loaves contained coriander seeds as well. Barley was also prominent in Ancient Egypt, and used in the baking of bread and the brewing of beer. Two beer strainers were discovered in the tomb, but no jars of beer were found.

A number of medicines were found in the tomb, which can be easily explained by the numerous congenital defects and a other health issues revealed by recent DNA analyses and MRI/CAT scanning on Tutankhamun's mummy (Hawass, 2010). The discovered medical materials were backed up by botanical evidence, considering that a well-stocked pharmacy was discovered in his tomb. This included a bottle of cumin oil used in ancient times for the treatment of a poor immune system. The variety of medicines retrieved in the tomb includes:

- an ointment from the Balm of Gilead shrub grown on the Dead Sea, considered a cure for many diseases;
- myrrh, castor oil, coriander oil, juniper berries, used as a diuretic and laxative;
- garlic, the central Asian plant bulbil, used as a diuretic;
- dates, used in poultices;
- other medicines, as their sweetness inhibited bacterial growth;
- fenugreek seeds, made into an ointment;
- Christ-thorn, also used as a laxative.

CHAPTER 3. Materials and Methods

3.1 The box

Archaeobotanical research depends on the successful extraction of plant remains. The samples collected from the box contain all the sweep remains from Tutankhamun's tomb. After removing all the objects from the tomb, Carter swept all the rooms and collected the remains in one box about 2 m long, 81 cm wide, and 56 cm high (Fig.10). This box was closed in 1933 and kept in the Egyptian museum in Cairo till 2017. The box was moved to the Grand Egyptian Museum in 2018. In 2019 I started to work on it and looking for archaeobotanical remains.

Figure 10. The box containing the remains from Tutankhamun's tomb KV 62, c. 200 X 81 X 56 cm (Photo: NagmEldeen 2020).

3.2 Separation and classification of box contents

The first step, needed to proceed with the analysis, is the "separation" of the archaeobotanical remains from the other remains of the box and then arrangement and classification of samples from the materials deposited in the wooden box.

3.3 Sieving and hand-picking

Initially, dry sieving was carried out for a small amount of material contained in the box, using a series of piled up sieves with decreasing mesh size (Fig. 11). Two types of sieves were used, the plastic sieve (height 8 cm, width 20.1 cm) aperture size 2 mm and Japanese sieve (mesh made of black horsehair (diameter 240 mm, height 110 mm) aperture size 1 mm. Separating the remains in different size cluster could have made hand-picking easier.

Figure 11. The sieving outside the storage using plastic and Japanese sieves. (Photo: Islam Shaheen 2020).

Sieving the box content resulted to be a challenge because we worked in the storage of Tutankhamun collection and sieving inside the storage could have produced dust, which is not allowed according to the strategy of conservation and preservation in the museum. The sieving was performed outside the storage for small amount of material from ì the box, but, according to the security rules, it is not permitted to work outside the storage. Inside the storage hand-picking was the only solution for continuing the separation of the botanical remains. Hand-picking was performed using a lamp which was on the edges of the box. The box was divided into two parts: one part containing the mixed remains, and the other for the separated remains (Fig. 12). Coarser pieces like woods, stones and plant branches were picked up first. After finishing the picking of large pieces, plastic boxes and bags were used for the "storage" of the different typologies of remains (Fig. 13), starting from larger seeds and then moving to smaller ones. Petri dishes were used for the separation of rare finds from botanical remains.

Figure 12. The box divided into two parts, the large part contain the "original material" and the second part the coarser pieces like wood pieces, stones and plant branches (photo: NagmEldeen 2020).

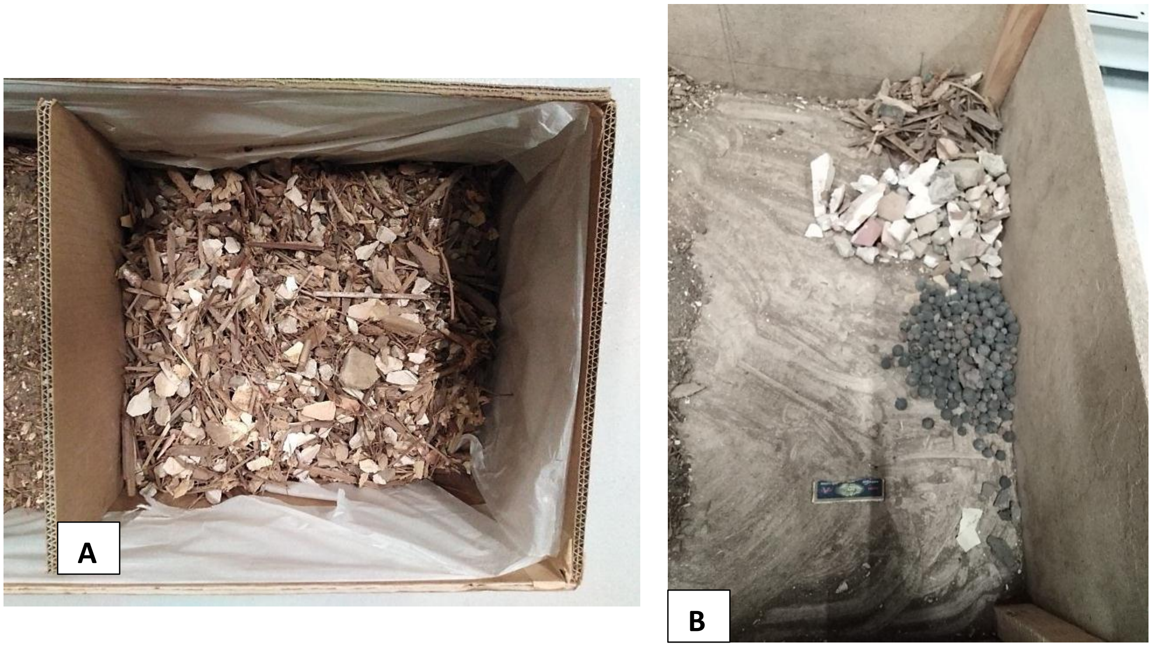

Figure 13. *(*A) The coarser pieces of woods, stones and plant branches. (B) Picking and separation of coarser remains according to typology (photo: NagmEldeen 2020).

3.4 Identification and analysis of the botanical remains

The plant remains were observed and analyzed under a Digital Microscope VHX-950F Series (Fig. 14). Images of observed materials was easily recorded on-site using an integrated high-capacity 500 GB HDD, a 1600 (H) × 1200 (V), approx. 1000 TV lines on the computer screen. Pictures have been acquired with the program VHX-950F Application Suite. The VHX-950F microscope enabled a wide range of observation from macro-scale stereoscopic imaging to the detailed analysis of a Scanning Electron Microscope (SEM). Many techniques are supported, including transmitted and polarized lighting, as well as differential interference contrast. The high-speed filing system ensures stress-free handling of a large quantity of images. Lens, magnification, lighting, and measurement data can be saved on the VHX-950F and recalled later. The VHX-950F enables a Wide magnification range from 0.1× to 5000× with a single unit.

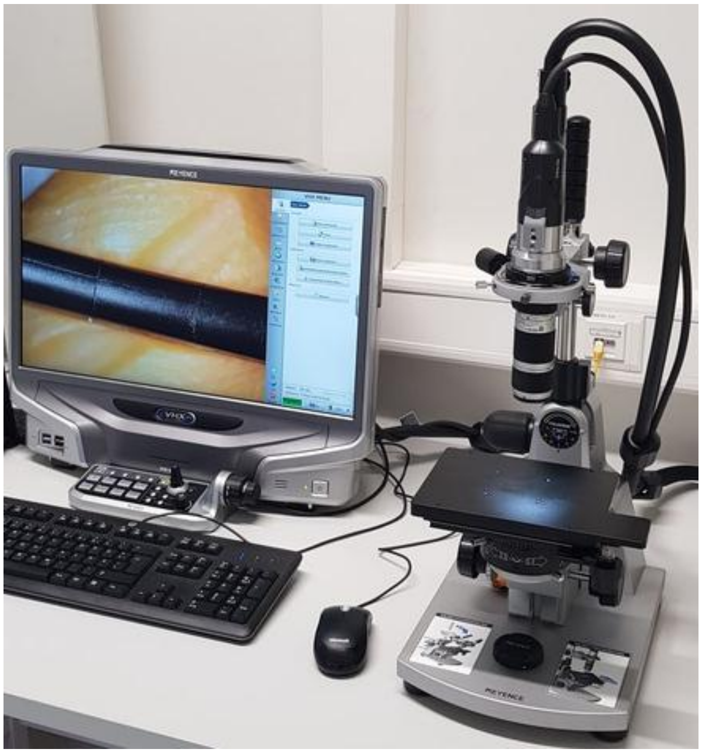

Figure 14. Digital Microscope VHX-950F Series (photo: https://www.ulman.de/).

The endocarps/remains were examined under Digital Microscope VHX-950F to determine the similarity and differences between them. Morphological identification – based on seed shape and size – was performed by comparing the samples against several atlases. These include the *Manual for the Identification of Plant Seeds and Fruits* (Cappers et al., 2013), the *Digital Atlas of Economic Plants in Archaeology* (Neef et al., 2012), the *Digital Atlas of Economic Plants* (Cappers et al., 2009), *Codex of Ancient Egyptian Plant Remains* (de Vartavan, 1997) and *Identification of cereal remains from archaeological sites* (Jacomet, 2006). A qualitative approach was chosen for the present study, therefore the remains were not counted.

CHAPTER 4. Results

This chapter provides pictures and identification of archaebotanical remains found in the swept remains from Tutankhamun's tomb.

It is possible to identify ancient Egyptian botanical remains without recourse to detailed anatomical examination thanks to the near-perfect preservation state observed in the dry Egyptian tombs. The dry atmosphere of the desert preserved in fact foodstuffs in Tutankhamun's tomb in a remarkably good state. This is true for most of the fruits and seeds that were found in the box. Some specimens have anyway been studied under a microscope to determine the species, and these include fibers, basket material and wood.

The results are presented according to the botanical family of the identified species and the list is reported in table 1. No quantitative data are provided. Plants families are arranged in alphabetic order. Photographs of the plant macro-remains, found in the tomb and especially in the box, are inedited and so presented here for the first time since the discovery of the tomb in 1922.

Scientific name	Common name
Amaryllidaceae (ex Liliaceae)	
Allium cepa L.	Onion
Allium sativum L.	Garlic
Apiaceae (Umbelliferae n.c.)	
Coriandrum sativum L.	Coriander
Arecaceae (Palmae n.c.)	
Hyphaene thebaica (L.) Mart.	Dôm Palm
Phoenix dactylifera L.	Date Palm
Asteraceae	
Carthamus tinctorius L.	Safflower
Centaurea L.	Centaury
Cucurbitaceae	
Citrullus lanatus (Thunb.) Matsum. & Nakai	Watermelon
Luffa aegyptiaca Mill.	Egyptian luffa / sponge gourd
Cupressaceae	
Juniperus L.	Juniper
Fabaceae (Leguminosae n.c.)	
Lathyrus oleraceus Lam.	Garden pea
Trigonella foenum-graecum L.	Fenugreek
Medicago arabica (L.) Huds.	
Medicago polymorpha L.	
Vicia faba L.	Faba bean and broad bean

Lythraceae	
Punica granatum L.	Pomegranate
Oleaceae	
Olea europaea L.	Olive
Poaceae (Gramineae n.c.)	
Eragrostis aegyptiaca (Willd.) Del.	
Eragrostis cilianensis (All.) Lut. ex Janchen	
Eragrostis cynosuroides Beauv.	
Hordeum vulgare L.	Barley
Triticum dicoccon (Schrank) Schübl.	Emmer wheat
Rhamnaceae	
Paliurus spina-christi (L.) Desf.	Christ's thorn
Rosaceae	
Prunus dulcis (Mill.) D.A. Webb	Almond tree
Sapotaceae	
Mimusops schimperi Hochst.	Persea tree
Vitaceae	
Vitis vinifera L.	Grape vine

Table 1. Tutankhamun tomb. List of plant taxa (this study)

Amaryllidaceae (ex Liliaceae)

Amaryllidaceae family includes onion (*Allium cepa* L.) and garlic (*Allium sativum* L.) in the subfamily Allioideae.

Allium cepa L., Onion

Several remains of Onion skins and few parts of the root (reduced stem) were found in the box (Fig. 15), but no seeds. Onion is an essential ingredient in many African foods and is mostly produced locally, with Egypt being the first producer in the continent (Kuete, 2017). Although well-developed onion bulbs are depicted in Egyptian tomb paintings, slender, the long-leafed spring onion with relatively small bulbs was also valued (Nicholson, 2000). Onion skins produce a spectrum of yellow and brown dyes (Cannon et al., 1994). The range of modern onion varieties varies enormously in size, shape, color and taste (Täckholm et al., 1954; Harrison et al., 1969; Charles, 1987; Havey, 1995).

The onion was highly valued in Egypt from at least the Old Kingdom onwards where the tending of the species in gardens is depicted (Manniche, 1989). Early linguistic records for the onion come from the Fifth-Dynasty pyramid text of Unas (ca. 2420 BC) and Pepi II (ca. 2200 BC) although these texts were probably already in use during the Third and Fourth Dynasties (Täckholm et al., 1954).

Onions are a common feature on most offering tables from the Fourth Dynasty onwards, usually with bread. Onions also appear to have been central to certain religious ceremonies. Both Pliny (XIX, I) and Juvenal (Satire XV, 9) derisively commented on the godlike status that the Egyptians bestowed on common garden vegetables, such as onions and garlic (Täckholm, 1954; Darby et al., 1977). The avoidance of eating onions in Egypt, particularly by priests, was reported by Classical authors (Ruffer 1919; Darby et al., 1977).

Figure 15. Onion (*Allium cepa* L.) skins and the root (reduced stem) (Photo: NagmEldeen 2020).

There is some evidence that onions were used in the mummification process, i.e. placed in the body cavity of mummies as early as the Thirteenth Dynasty, and certainly from the Twenty-first Dynasty onwards, the species were often used in this way, including for the mummy of Ramses II (Ruffer 1919; Täckholm et al., 1954). It has been suggested that this practice was believed to stimulate the dead to breathe again (Täckholm et al., 1954; Darby et al., 1977), although onions are represented in the artistic and textual records from the Old Kingdom onwards, the earliest archaeobotanical evidence for onions is reportedly from the aforementioned Thirteenth-Dynasty mummy (Ruffer 1919; Darby et al., 1977). Several finds occur from the Eighteenth Dynasty onwards, including those from the Eighteenth-Dynasty settlements of Deir el-Medina (Bruyère, 1937).

Allium sativum L., Garlic

Garlic skins in large quantity and a few cloves were found in the box (Fig. 16), but no seeds from the garlic were found. The earliest known references indicate that garlic formed part of the daily diet of many Egyptians (Rivlin, 2001). It was fed particularly to the working class involved in heavy labor, as in the building of the pyramids (Moyers, 1996). Archaeobotanical finds of garlic from the Pharaonic period all appear to be the cloves variety. The species have been valued for the medicinal properties of its volatile oils since at least the New Kingdom onwards. Hepper (1990) has noted that the absence of garlic seeds indicates the long cultivation and uncertain ancestry, of the species.

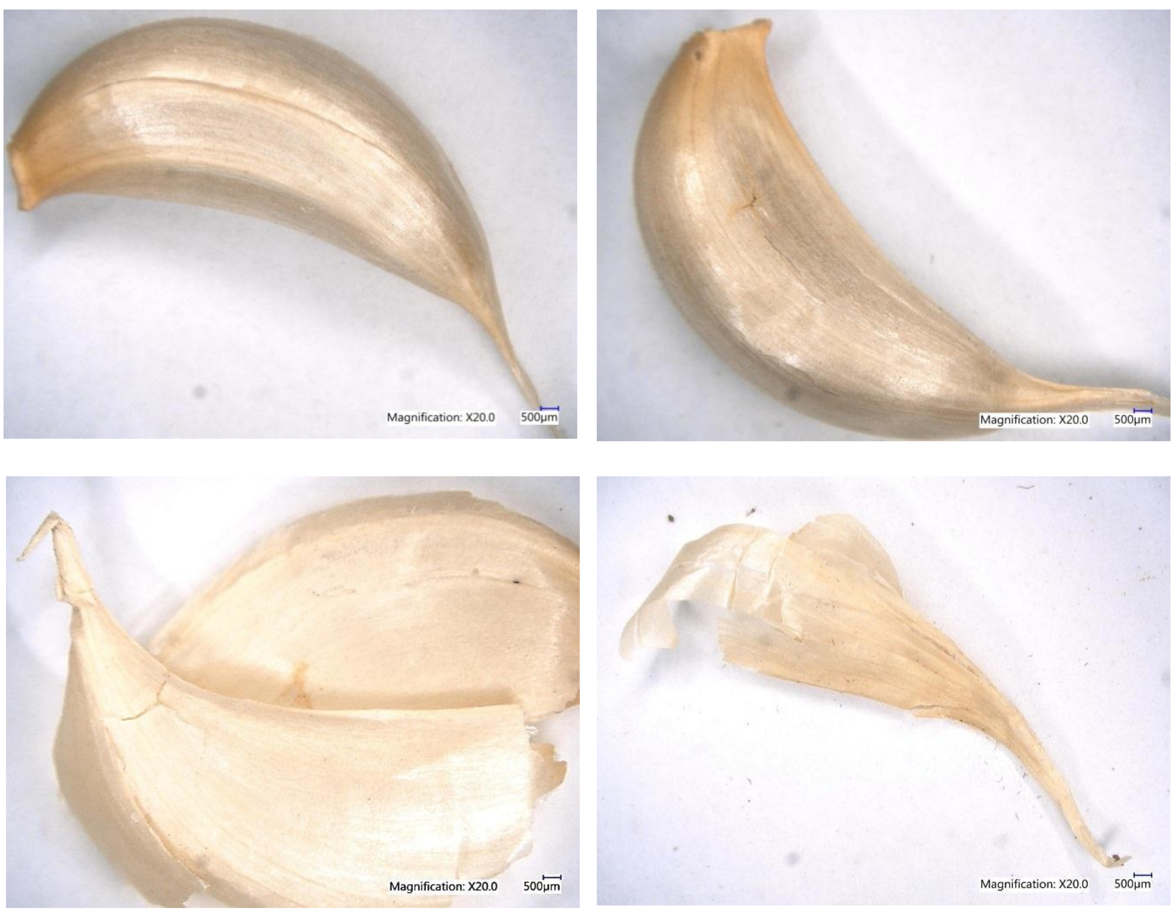

Figure 16. Garlic (*Allium sativum* L.), garlic skins and cloves (Digital Microscope VHX-950F).

The large-scale cultivation of garlic, particularly in the area of the Fayum, was introduced to Egypt by the Greeks in the third century BC and many texts of the Greco-Roman period allude to various aspects of its cultivation (Crawford, 1973). Archaeological finds of white painted, unbaked clay models of what appear to be cloves of garlic from the Predynastic sites (ca. 6000-3150 BC) of el-Mahasna, Naqada and the cemetery at Umm el Qa'ab at Abydos, are considered to be the earliest known record for garlic (Ayrton et al., 1911; Petrie, 1920; Täckholm et al., 1954).

The first archaeobotanical evidence for the species is from the Eighteenth Dynasty tomb finds at Deir el-Medina while the first textual for garlic in Egypt comes from the Twentieth Dynasty text, the Papyrus Harris (Loret, 1904; Täckholm et al., 1904). Garlic was not only placed in tombs as an offering, but was also used in the embalming process, perhaps due to its valued properties as a preservative (Hepper, 1990). Specimens of garlic have also been found on the Eighteenth Dynasty settlement site of Amarna (Renfrew, 1985).

Apiaceae (Umbelliferae n.c.)

Coriandrum sativum L., Coriander

Coriander consists of dried ripe fruits of *Coriandrum sativum* L., belonging to family Apiaceae. The picked-up fruits are still in excellent condition, although some of them have weevils (Fig. 17). Coriander fruit (a globose cremocarp composed by two mericarps) has a yellowish brown color, and sub-spherical

Figure 17. Coriander (*Coriandrum sativum* L.) fruit (Digital Microscope VHX-950F).

shape (Fig. 18). The origin of the cultivated species *Coriandrum sativum* is still not clear, and no certain information about the wild species exists (Diederichsen, 1996).

Nevertheless, several authors have named coriander as a wild plant. Linnaeus reported as long ago as 1780 that coriander also occurs as a weed in cereal fields. This species is very widely cultivated, said to be wild in Palestine, Syria, Iraq and Greece (Boodle, 1933). The fruits split easily into the mericarps and the ripe fruits often tends to shatter, which is also is a characteristic of wild plants (Diederichsen, 1996). The first records from Egypt date back to the Predynastic (de Vartavan, 1992) and backed again to appear in the Eighteenth Dynasty from Tutankhamun tomb, so it may still have been rare during Tutankhamun’s reign.

Figure 18. The subspherical cremocarp of coriander (*Coriandrum sativum* L.), it shows primary ridges, and remarkable stylopod and pedicle (Digital Microscope VHX-950F).

In his list on centers of origin of cultivated plants Vavilov (1992) mentioned Central Asia, the Near East and Abyssinia for coriander. In each of these areas, distinct forms of coriander can be found. But the discussions since Vavilov have shown that centers of variation are not necessarily centres of origin (Zeven et al., 1982). Ivanova and Stoletova (1990) speak more cautiously of centers of formation of different types of coriander and name as cradles for the distinct types: (i) India; (ii) Northern Africa; (iii) Central Asia, and (iv) Abyssinia. The geographically widespread cultivation of coriander since ancient times has resulted in a wide range of variations (Diederichsen, 1996).

Arecaceae (Palmae)

Arecaceae is a botanical family of perennial flowering plants, commonly known as palms. Those having a treelike form are colloquially called palm trees.

Hyphaene thebaica **(L.) Mart., Dôm Palm**

The Arecaceae family includes a series of edible oval fruits, amongst which doum (*Hyphaene thebaica* L. Mart.**)** and date (*Phoenix dactylifera* L. Mill.). Several fruits and seeds of these two species were found.

Doum (also spelled dom or dum) palm occurs in Nubia, Eritrea, Abyssinia, Somaliland, and is also found in extra-tropical Egypt and Arabia. This is the commonest fruit found in Egyptian tombs of all periods, and the Palm grows throughout Egypt today. The outer parts (mesocarp) of the fruit (drupe) were found (Fig. 19). Doum was first described from Thebes in Egypt, hence the epithet thebaica. A few trees remain as far north as Elat at the end of the Gulf of Aqaba. In Egypt today, the tree is found primarily in the provinces of Qena and Aswan in Upper Egypt, where it can form dense stands in valleys and depressions (Täckholm et al., 1950; Moens, 1984; FAO 1988; Hepper, 1990; Zahran et al., 1992).

Figure 19. Part of the exocarp with mesocarp of a doum (*Hyphaene thebaica* (L.) Mart.) fruit front and back view. (Digital Microscope VHX-950F).

Both wild and cultivated varieties of the dom palm occurred in the Pharaonic period (Täckholm, 1961) and archaeobotanical finds of the species are most common from Upper Egyptian sites, most likely reflecting its principal geographical distribution in antiquity. Archaeobotanical finds include dom palm fruits which have had the edible mesocarp ("the skin") removed and those intact left as tomb offerings.

The dom palm is depicted in the artistic record (Fig. 20), such as in the Eighteenth Dynasty Theban tomb of Rekhmira (TT100) and that of Ineni (TT81), who reputedly had 120 dom palms planted in his garden (Davies, 1935, 1943;

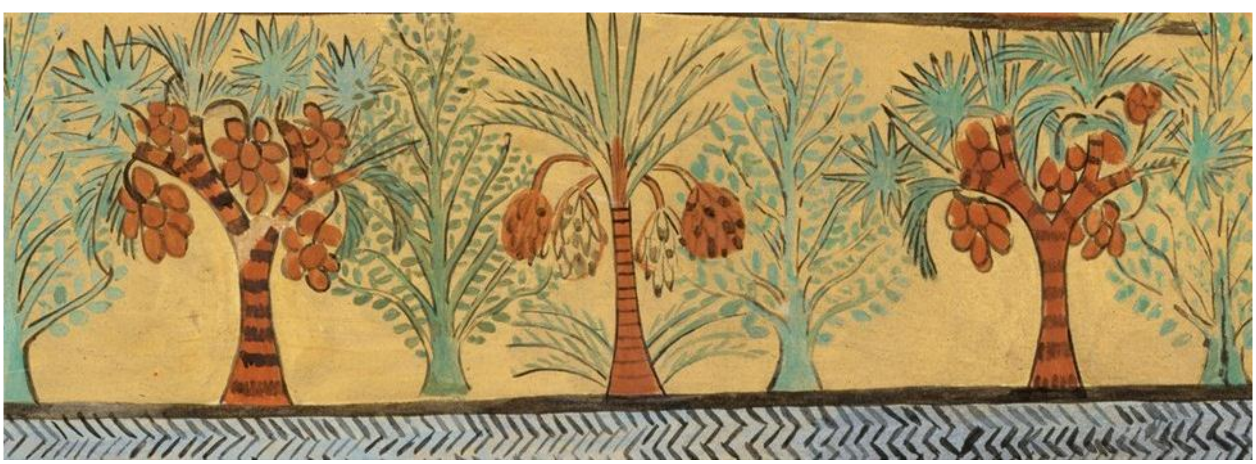

Figure 20. Date palm, dom palms and sycamore figs. Tomb of Sennedjem. Facsimile detail, Rogers Fund, 1930. (Photo: https: //imalqata.wordpress.com).

Wreszinski, 1915). The species also featured prominently in the 514 parks or sacred gardens which Rameses III donated to many temples during his reign (Täckholm et al., 1950). The textual record illustrates the importance of the dom palm as well, not only as a garden plant but as a sacred tree, known as a symbol of male strength (Täckholm et al., 1950, 1977). The dom palm is closely associated with the god of science, Thoth, who is often depicted as a baboon in Eighteenth Dynasty Theban tombs. In the tomb of Rekhmire (TT100), shown greedily collecting the dom palm fruits. The funerary texts from this tomb also record an offering of 200 dom fruit cakes to the gods.

Unlike the date, numerous dom palm fruits have been recovered from the earliest periods. The earliest remains of the fruits are from the Late palaeolithic site of Wadi Kubbaniya (ca 18,000 years BP) in Upper Egypt. Ancient finds from predynastic times onwards have included the wood, leaves, fiber, inflorescence and fruits of the species. Other finds of dom palm fruits are known from predynastic el-Badari (Brunton et al., 1928), twelfth Dynasty Kahun (Newberry, 1890), Eighteenth-Dynasty Deir el-Medina and Amarna (Bruyere, 1937; Renfrew, 1985).

***Phoenix dactylifera* L., Date Palm**

Date-stones and small parts of date-fruits are present in large quantity (Fig. 21). Several fruit caps of date palm fruit were found too (Fig. 22). The date palm occurs in the Canaries and through the Oases of the Sahara to Arabia and South West Asia, but, having been cultivated throughout the southern and eastern Mediterranean Region from remote times, native country is unknown. It was common throughout Egypt, and today is the principal palm of the country (Boodle, 1933)

Figure 21. Date-stones / seeds (pits) from furrow side and fruits (Photo: NagmEldeen 2020).

The date palm, together with the olive, grape and fig, was among the earliest cultivated fruit trees in the Old World (Zohary et al., 1975; Zohary et al., 1994). The date palm was probably domesticated in the region of the lower Mesopotamian basin, or in the oases of the southern limits of the Near Eastern arc (Zohary et al., 1975; Zohary et al., 1994). The wild date is not present in Egypt today, only cultivated and feral date palms are to be found along the Nile, its delta and in the desert oases (Täckholm et al., 1950; Boulos, 1983; Zahran et al., 1992). The date palm during the Pharaonic period was considered a symbol of femininity, just like the dom palm was a symbol of male strength. Much of the botanical evidence for date palm, prior to the middle kingdom, consisted mainly of leaves, fiber, and wood rather than date fruit.

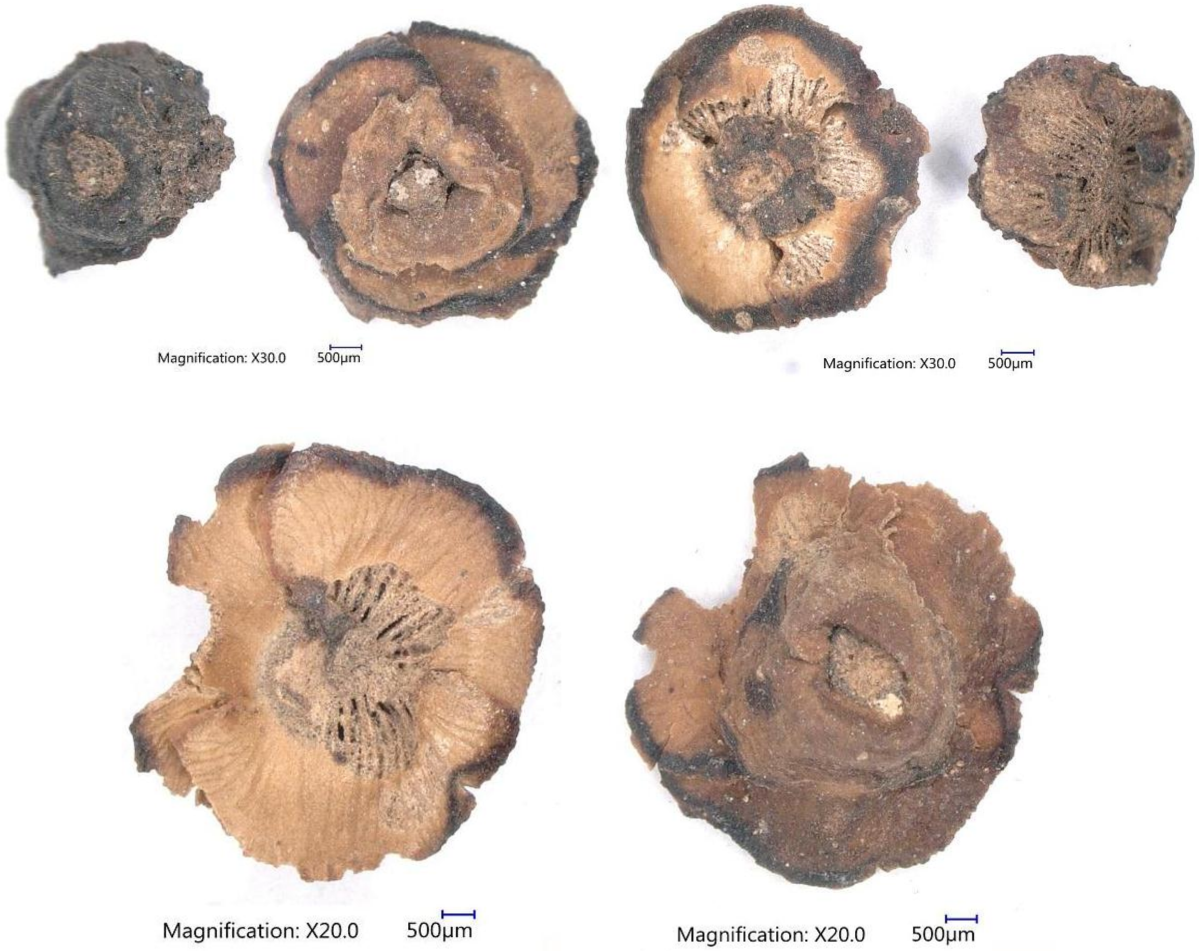

Figure 22. Fruit caps of date palm (Digital Microscope VHX-950F).

It has been argued that this is probably because artificial pollination was not practiced in Egypt until sometime during the Middle kingdom when the knowledge was introduced from Mesopotamia (Täckholm et al., 1950, 1977), the source of the earliest finds of date outside Egypt based on the archaeobotanical evidence, it has been suggested that finds of date stones prior to the Middle Kingdom are probably the result of natural wind pollination (Täckholm et al., 1950; Zohary et al., 1994). Yet, even from the Middle kingdom, finds of date stones are few in number and most are from the new kingdom and post-pharaonic periods.

Asteraceae

Carthamus tinctorius L., Safflower

Only a few seed from safflower was found (Fig. 23). It is now thought to have originated in the Near East, where relative *C. persicus* and *C. palaestinus* occur (Hepper, 2009). Safflower has a thistle-like head of yellowish-orange florets. The floret of safflower is containing a two type of color yellow dye, which dissolve easy in cold water and red dye (Carthamin acid). Researchers suggested that the safflower is a source of yellow color in ancient Egyptian textiles (Ahmed, 2019). Mummy wrappings were often dyed with this plant (Hepper, 2009).

Safflower appears first in a number of early Bronze Age (3000 BC) sites in Northern and central Syria. From there it apparently spread to Egypt, the Aegean and south-eastern Europe (Marinova et al., 2009). *Carthamus tinctorius* probably originated in Arabia (Boodle, 1933). During Twelfth Dynasty (1985-1773 BC) Egyptian textiles were dyed red, yellow and orange with safflower. The dyes were sometimes even used on mummy wrappings to give them color. It wasn’t only the flower’s dye that was used by the ancient Egyptians. Seeds from the flower have been found in temple offerings. Safflower garlands have been found sewn onto both papyrus and cloth wrapped around the mummies. Oil derived from safflower seeds was also used for medicinal purposes as a means to treat insect and scorpion bites.

During the Iron Age and the Roman and Byzantine periods, most of the evidence of *Carthamus* comes from Egypt (Marinova et al., 2009). Garlands of safflower blossoms were placed in tombs, such as the one of pharaoh Tutankhamun, with the intent of providing comfort to the deceased in afterlife. Charred safflower plants were used to make Egyptian Kohl (cosmetic eyeliner). Safflower oil was also used to light the lamps of the pharaohs (Pierce, 2018).

Figure 23. Safflower (*Carthamus tincturius* L.) seed (Digital Microscope) VHX-950F).

Cf. *Centaurea*, Centaury

Only one fruit from centaury was found in the box (Fig. 24). Judging by the frequency with which this cornflower appears in tombs, in wall paintings and as faience models for necklaces, it must have been commonly grown as a cultivated plant. It has not been reported from Egypt for many decades, and this species appears to be limited to cultivated ground in the Middle East from Turkey to Baluchistan, so it is doubtful whether it would ever have occurred naturally as a weed in Egypt, which is outside its range.

The cornflower petals were used for dying linen (Wilkinson, 1878). The cornflower is often represented on the wall paintings of gardens in the tombs, jewelry, and other decoration. Cornflower was used in the creation of fresh flower garlands that were used at the funeral banquets held for Tutankhamun (Carter, 1927), in the fourth small garland on the pedestal of the statue in front of Kha's feet (Tomashevska et al., 2019), and many others. Single cornflower amulets and amulets as part of elaborate compositions of jewelry have been identified in many sizes (Kandeler et al., 2009).

In addition to all symbolic plants, this plant became a symbol of life and fertility as well (Keimer, 1925). It was cultivated as a garden plant, portrayed, for instance, on wall friezes, and wall and floor designs in houses and palaces of the Amarna period (Kandeler et al., 2009).

Figure 24. Cornflower (cf. *Centaurea*) (Digital Microscope VHX-950F).

Cucurbitaceae

Cucurbitaceae seeds are typically flat. Seeds of this family form the main component of the remains.

Citrullus lanatus (Thunb.) Matsum. & Nakai, Watermelon

These seeds, found in a large quantity, were still in remarkably good condition as flat seeds, though some of them have (Fig. 25).

The seeds are used for their medicinal properties (Osborn, 1968; Bailey et al., 1981; Boulos, 1983; FAO, 1988; Bates et al., 1995). The studied seeds present smooth and rough surface and great variation in color, form black to dark brown and yellow to bright brown. The degree of similarity and differences among the seeds can provide an insight into other species which can be identified (Fig. 27).

Figure 25. Watermelon *(Citrullus lanatus* (Thunb.) Matsum. & Nakai) seeds Photo: NagmEldeen 2020).

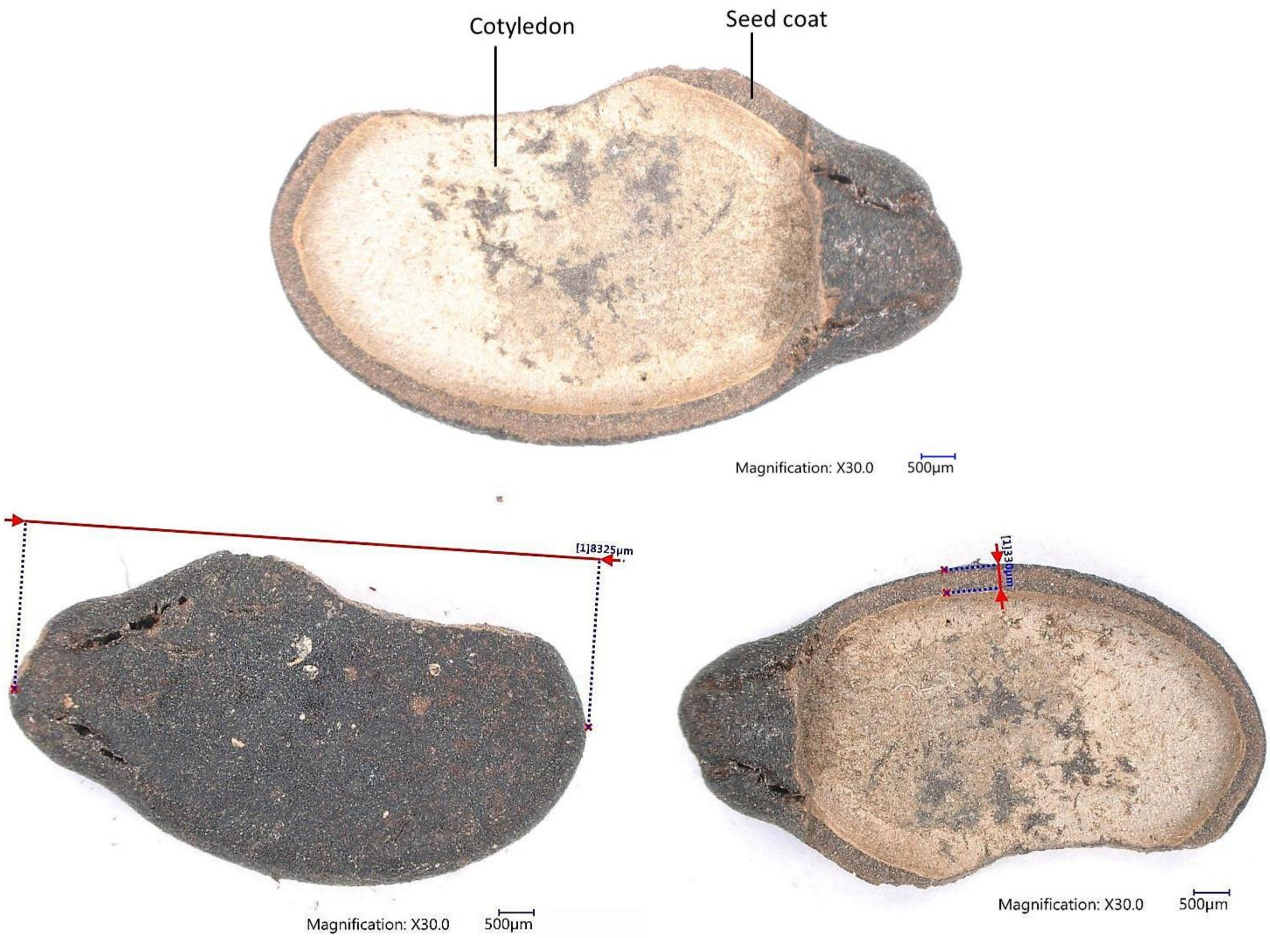

Figure 26. Watermelon (*Citrullus lanatus* (Thunb.) Matsum. & Nakai) measurement (Digital Microscope VHX-950F).

Figure 27. **Watermelon *(Citrullus lanatus* (Thunb.) Matsum. & Nakai)** seeds showing quite different colours (Digital Microscope VHX-950F).

An image of a large, striped, oblong fruit on a tray has been found in an Egyptian tomb that dates to at least 4000 years ago (Paris, 2016). De Vartavan and Asensi Amoros (1997) listed ten sites in Egypt, dating back to the pre-dynastic and dynastic eras, containing remains of watermelon (Paris, 2016). Watermelon is native of tropical and subtropical Africa (Charles, 1987, Bates et al.1995), widely cultivated in the Mediterranean Region and Sudan. Oil and tar are obtained from the seeds in Upper Egypt. Domestication of the watermelon (*Citrullus lanatus*) has alternatively been placed in South Africa, in the Nile valley, or, more recently, in West Africa, with the oldest archeological evidences coming from Libya and Egypt (Renner et al., 2019). In ancient Egypt, however, the watermelon may have been cultivated primarily for its seed (Täckholm, 1961; Germer, 1985), as is the case in many parts of Africa today (FAO, 1988). A 3500 years old leaf from an Eighteen Dynasty Pharaonic tomb revealed that Egyptians in the New Kingdom were cultivating domesticated watermelon with red-fleshed, non-bitter domesticated form (Renner et al., 2019).

***Luffa aegyptiaca* Mill., Egyptian luffa fruit**

Some seeds of *Luffa aegyptiaca* Mill., the sponge gourd, Egyptian cucumber or Vietnamese luffa, an annual species of a vine cultivated for its fruit, native to South and Southeast Asia, were picked up from the box contain (Fig. 28). *L. aegyptiaca* Mill. (syn. *L. cylindrica* (L.) Roemer) is grown mainly for the dried mature fruit flesh as a sponge, but its young fruits are edible and of an intense green color. The long, narrow fruits of smooth luffa resemble those of *Lagenaria siceraria* except in external color (Janick et al., 2007).

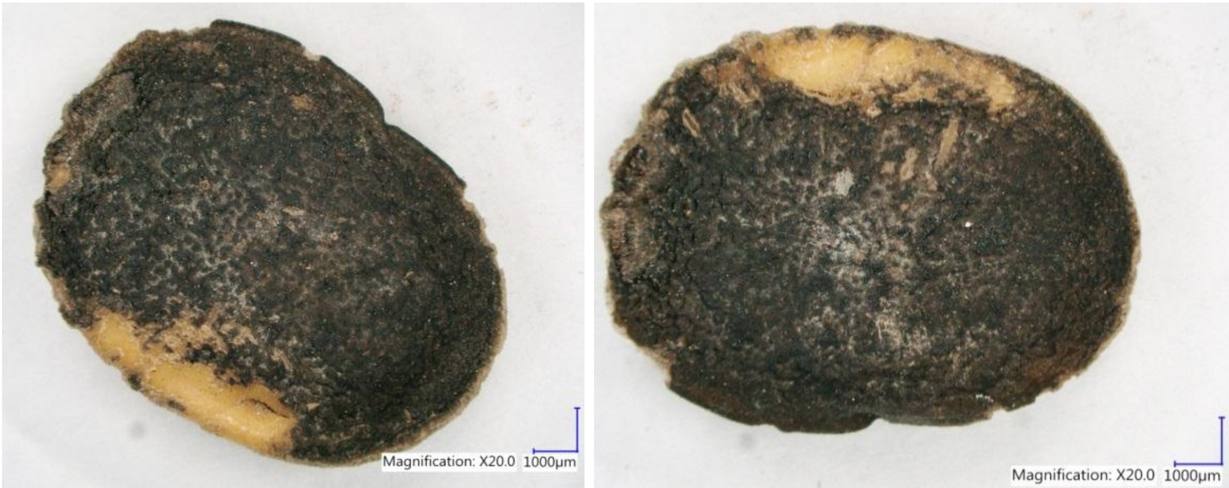

Figure 28. Egyptian luffa (*Luffa aegyptiaca* Mill.) seed (Digital Microscope VHX-950F).

Pinaceae

Juniperus L., Juniper berries

Large quantities of juniper berries were found (Fig. 29, 31). I noticed two kinds of them, different in color, black and brown. The berries are characterized by the presence of three cone seeds attached together, visible in broken berries (Fig. 30). The presence of different *Juniperus* species must be checked. Phoenician or brown-berried juniper (*J. phoenicea*) which occurs in Sinai, Jordan and around the Mediterranean is the juniper species more commonly reported in Ancient Egypt (Hepper, 2009). Lucas indicates that berries of *J. drupacea* of Lebanon were found in Tutankhamun’s tomb (Hepper, 2009).

Juniper berries are resinous and aromatic. They have found numerous uses since ancient times, especially in medicine for the treatment of headaches, asthma, indigestion and aching joints, as well as for mummification processes. Juniper oil was used for anointing the body; Juniper berries were also incorporated between the layers of linen bandages around mummies and combined with natron, which preserved the flesh. Egyptian medical texts described it as a diuretic and laxative. The Juniper berries were used also in Egyptian cosmetics and medicine (Hepper, 2009).

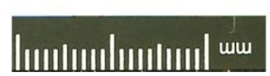

Figure 29. *Juniper berries fruit, top view (photo: NagmEldeen 2020).*

Four species of juniper berries appear to have similarity with the species found in Tutankhamun tomb and the samples found in the box. The first two are *J. phoenicea* (the Phoenician or brown-berried juniper) and *J. drupacea* (the juniper of Lebanon). Other two species are probably considered more close to the species found in the tomb, *J. oxycedrus* (the prickly juniper, widely distributed throughout the Mediterranean region, extending eastwards to Syria, Western Asia Minor, the Caucasus, Armenia, N. Persia), and *J. excelsa* (the Grecian juniper or eastern savin, native in Asia Minor, Syria, Armenia and the Caucasus) (Hepper, 2009).

Figure 17. *Juniper berries fruit and seed inside (photo: NagmEldeen 2020).*

Figure 31. *Juniper berries fruit, down view (Photo: NagmEldeen 2020).*

Fabaceae (Leguminosae *n.c.*)

Fabaceae (Leguminosae) are commonly known as the legume, pea, or bean family. It is one of the most represented families. Along with the cereals, some fruits and tropical roots, a number of Leguminosae have been a staple human food for millennia and their use is closely related to human evolution (Dimitri, 1987). If meat was not a regular item in the diet of most Egyptians, then pulses, such as lentils, peas, chickpeas, and faba beans, would have been an important and widely available source of protein for most of the population. Cereal crops were invariably accompanied by pulses during the spread of Old World agriculture and these species are found together from the Neolithic onwards throughout the Near East (Zohary et al., 1994). In Egypt, pulses are generally not found as tomb offerings, nor are they clearly depicted in tomb art, nor frequently mentioned in texts (Germer, 1985).

***Lathyrus oleraceus* Lam., Pea**

A few fruits of pea (*Lathyrus oleraceus* Lam. = *Pisum sativum* L.) (Fig. 32) were found. Foaden and Fletcher (1910) noted that peas were not a particularly popular food in Egypt at that time. Peas have a wide distribution, particularly in regions with a cool and relatively humid climate (van Zeist, 1985; Zohary et al., 1994; Davies, 1995).

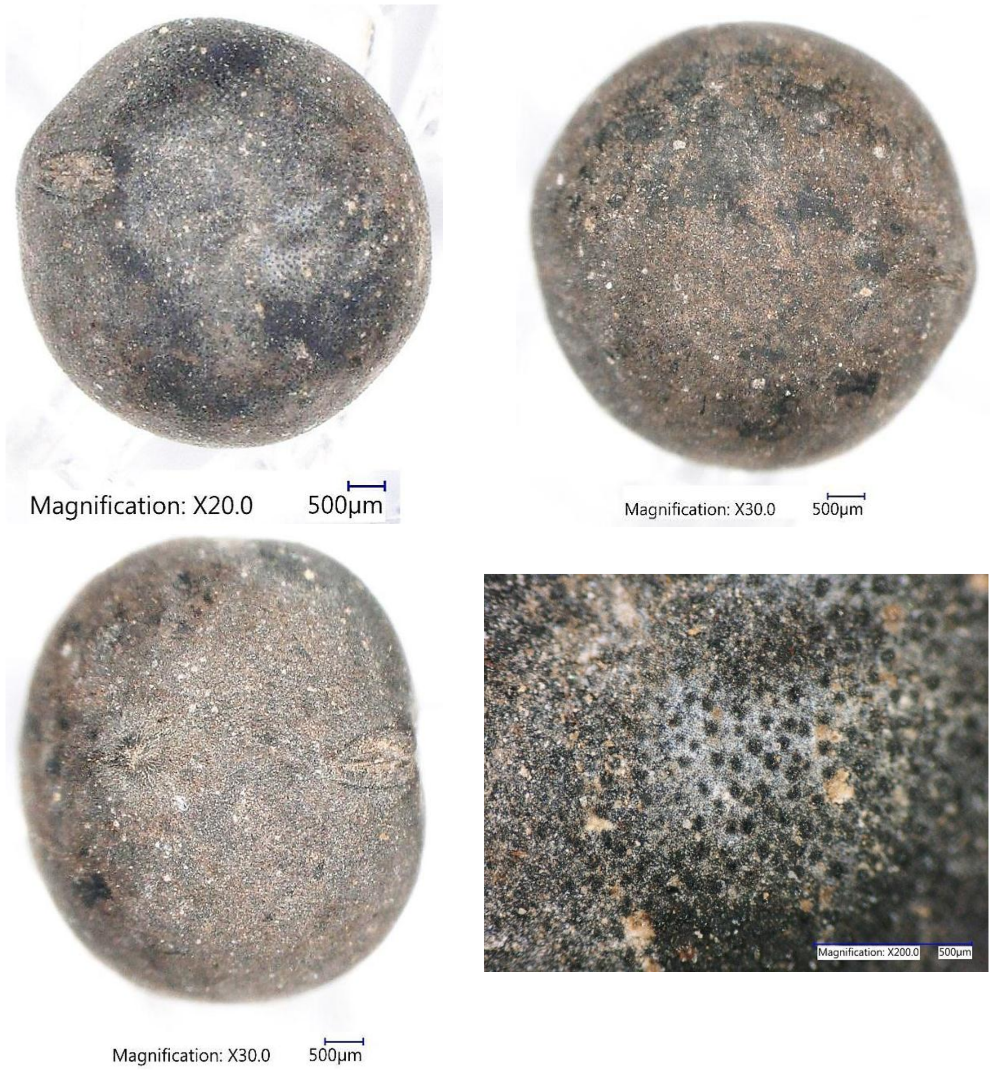

Figure 32. Pea (*Pisum sativum* L.) fruit. (*Digital Microscope VHX-950F*).

In Egypt, the earliest evidence of the species is from Merimda in the Delta, dating to c. 5000 BC (M. Hopf, unpublished data cited in Zohary et al., 1994) and from Naqada South Town in Upper Egypt dating from 3800-3400 BC (Wetterstrom, 1986) and Predynastic and early Dynastic Buto (Thanheiser, 1991) although it is not clear whether these specimens are wild or domesticated. Specimens of *P. sativum* from Predynastic el-Omari are most likely to be wild (Barakat, 1990). Other finds include those from Old kingdom Kom el-Hisn (Moens et al., 1988), Twelfth-Dynasty Kahun (Newberry, 1890), and from Second Intermediate Period

Tell el-Dab'a (Thanheiser, 1986) and Eighteenth Dynasty Amarna (Renfrew, 1985).

Vicia faba L., Faba bean

A few faba bean (*Vicia faba* L.) teguments (Fig. 33, 34) were found the box. Faba beans are one of the primary sources of food in the Nile Valley in both Egypt and the Sudan today including “ful medammes: in Egyptian colloquial, a much beloved national dish in Egypt (Täckholm, 1977, Alderman, 1993). The traditional processing of faba beans by cooking and removing the seed coat/ tegument, a processing method might also obscure their presence in the archaeobotanical record (Jones et al., Halstead 1993).

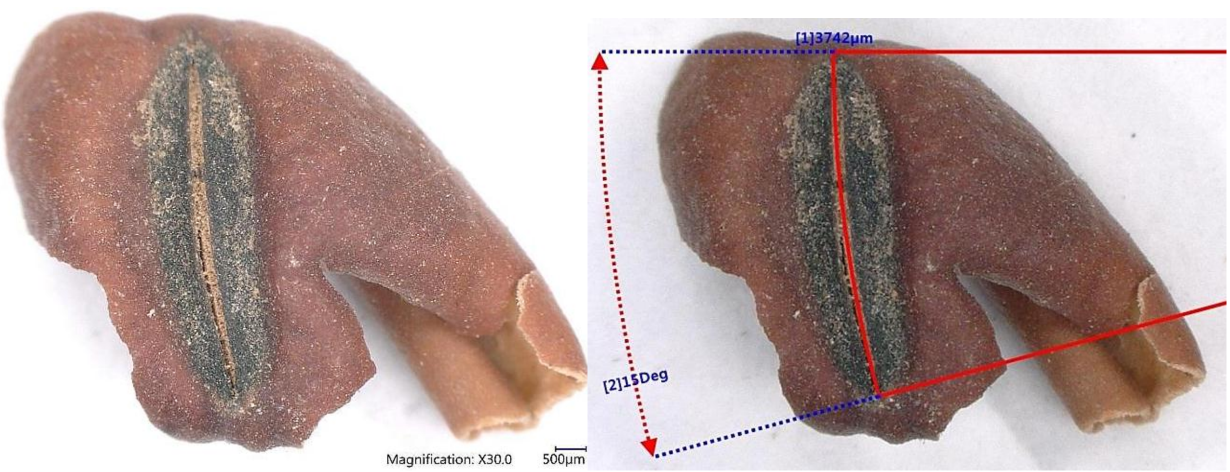

Figure 33. Faba bean (*Vicia faba* L.) tegument. (*Digital Microscope VHX-950F*).

Several classical authors have also noted that beans were a taboo or considered an unclean food in ancient Egypt, particularly by the priesthood (Ruffer, 1919, Darby et al., 1977), but exactly which species were meant remains unclear as does the connection, if any, between the taboo and fauvism. Beans were reportedly used extensively in ancient Egyptian medicine (Nunn, 1996) but again, it is difficult to determine the exact species indicated.

Figure 34. Faba bean (*Vicia faba* L.) tegument. (*Digital Microscope VHX-950F*).

The Near East is considered a center of origin for faba bean (Cubero, 1974), while China seems to be a secondary center of faba bean genetic diversity (Zong et al., 2009, 2010). Archaeobotanical finds of faba bean throughout the Near East, including Egypt, from Neolithic to Roman times are of the small-seeded variety (*Vicia faba* L. var. minor) (Täckholm, 1977; van Zeist, 1981; Harrison et al. 1985; Zohary et al. 1994). *Vicia faba* type pollen was reportedly found exclusively in six samples dating from ca. 3000 years BC at the site of Mendes in Lower Egypt, from a possible storage, processing or disposal area for the species, and suggests an earlier presence for faba bean than the archaeobotanical evidence currently indicates (Ayyad et al., 1994). Faba bean archaeobotanical specimens were also found in predynastic site of Merimda Beni Salama, the Fifth Dynasty Sahure complex at Abusir (Germer, 1985) and at Kahun, of the Twelfth Dynasty (Newberry, 1890).

Trigonella foenum-graecum L., Fenugreek

Fenugreek is an eastern Mediterranean native plant and is grown today in Egypt and other countries, such as Yemen and India, as both an animal fodder and as an herb (Foaden et al. 1910; Harrison et al. 1985; FAO, 1988). Several charred Fenugreek (*Trigonella foenum-graecum* L.) seeds, were found (Fig. 35, 36).

They are used to encourage lactation and as an ointment to heal inflammation and other ills (Meikle, 1977; Aykroyd et al., 1982; Boulos, 1981; FAO, 1988; Manniche, 1989; Hepper, 1990; Nunn, 1996). The entire plant is also used as an effective insect repellent in grain storage (FAO, 1988; Secoy et al., 1975). It has been suggested that the presence of fenugreek seeds in the tomb of Tutankhamun may have been used for this purpose (Panagiotakopulu et al., 1995). The earliest finds of fenugreek seeds are from Predynastic contexts (ca.3000 BC) (Renfrew, 1973) but they are not confirmed for the Eighteen Dynasty, in the tomb of

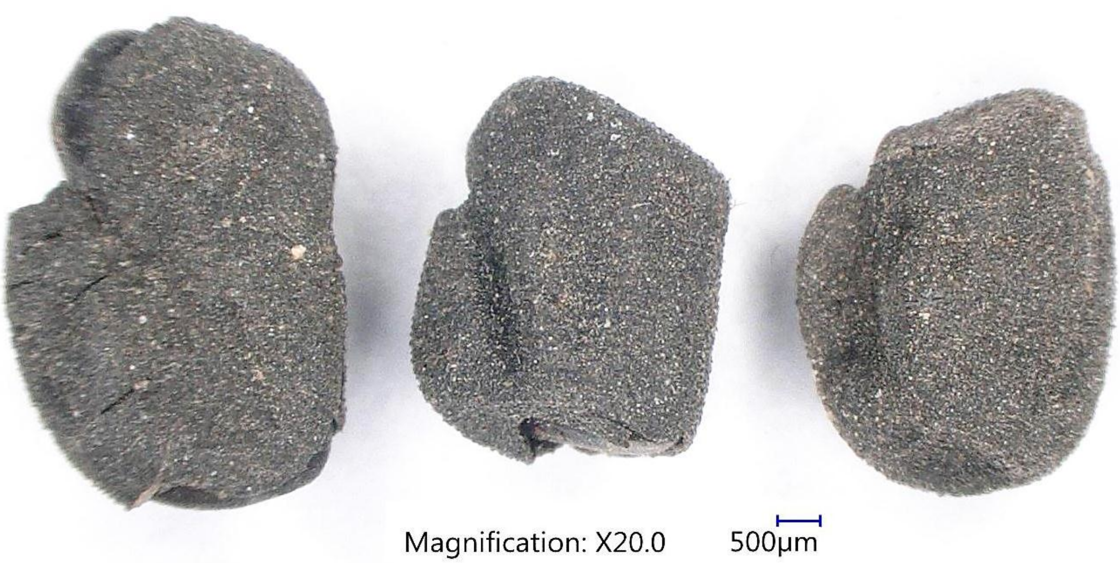

Figure 35. Fenugreek (*Trigonella foenum-graecum* L.) seed. (*Digital Microscope VHX-950F*)

Tutankhamun and the settlement of Amarna (Germer, 1989; de Vartavan, 1990; Hepper, 1990; Renfrew, 1985).

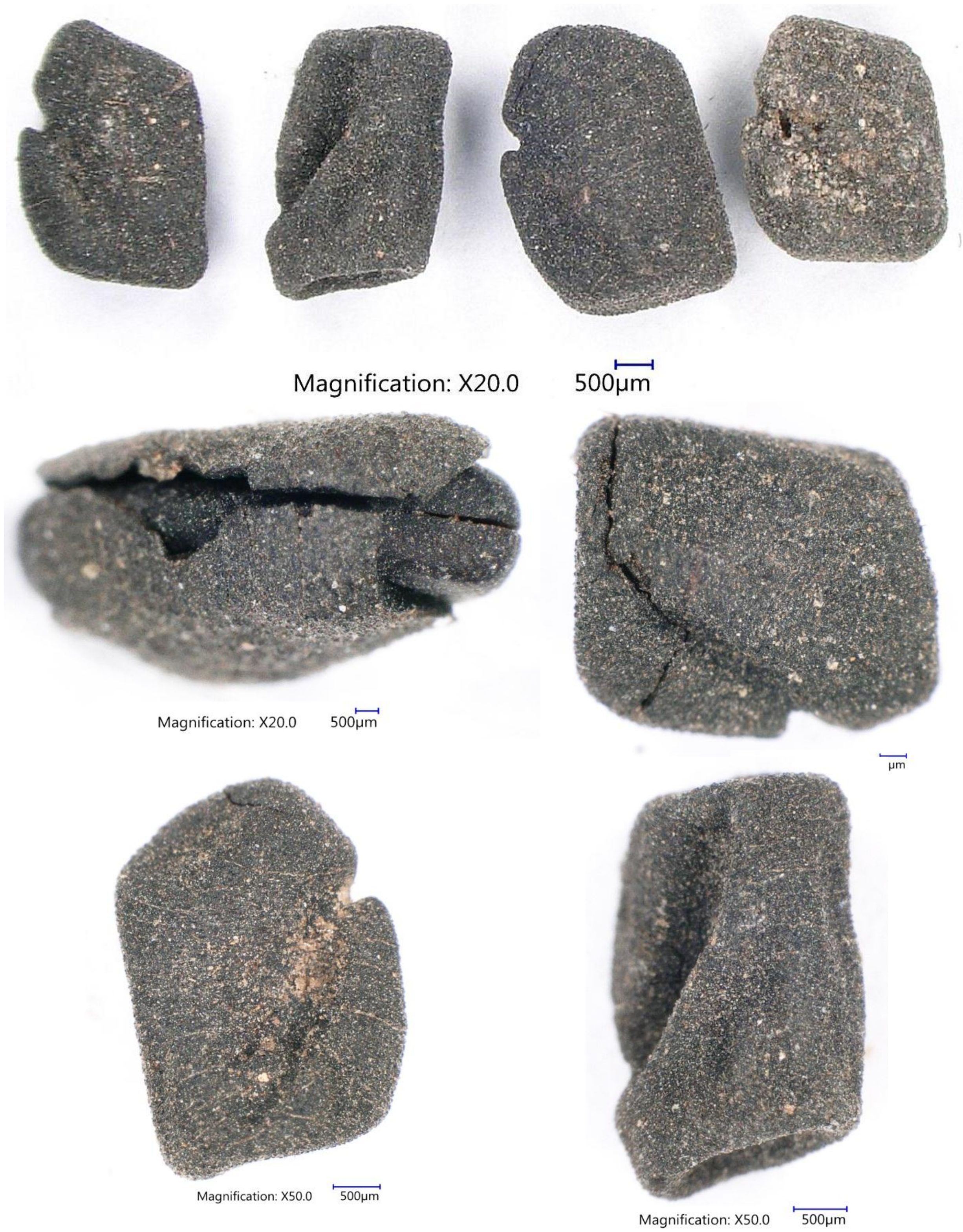

Figure 36. Fenugreek (*Trigonella foenum-graecum* L.) seed. (Digital Microscope VHX-950F).

Medicago polymorpha L. , Burclover

It is native to the Mediterranean basin but is found throughout the world. It forms a symbiotic relationship with the bacterium *Sinorhizobium medicae*, which is capable of nitrogen fixation. Common names include California burclover, toothed bur clover, toothed medick and burr medic (Heuzé et al., 2016). *Medicago polymorpha* L. was found in many ancient Egyptian dynasties, Second Dynasty in El Maasara tomb, Third Dynasty in Saqqara (Täckholm., 1940), Fifth Dynasty in Abusir (Schweinfurth, 1884) *Medicago polymorpha* L. during the Old Kingdom in Tell Ibrahim Awad site (de Roller, 1992). It was found also in Twelve and Twenty-one Dynasties (Newberry, 1890; Schweinfurth, 1886; Wetterstrom, 1984) but no mention or records for the finds in Eighteen Dynasty. Only remains of mature dried fruits were found (Fig. 37).

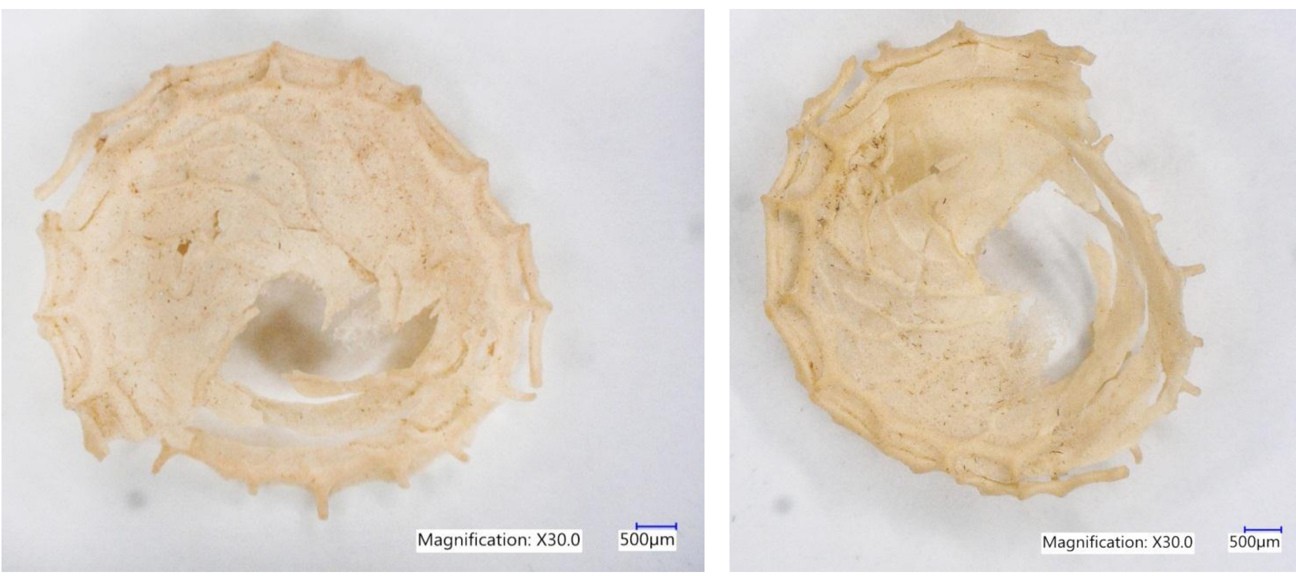

Figure 37. Remains of mature dried fruits of toothed bur clover (*Medicago polymorpha* L.) (Digital Microscope VHX-950F).

Lythraceae

Punica granatum L., Pomegranate

The pomegranate is cultivated throughout the Mediterranean region and is often sub spontaneous. It was, and still is, very common throughout Egypt. *Punica granatum* L., Pomegranate, family Lythraceae. A magnificent silver vase in the form of a pomegranate fruit (Carter No. 469), and another smaller one in ivory (Carter No. 040a) (Fig. 38) were included in Tutankhamun tomb contents. The skin of pomegranate fruit was found (Fig. 39).

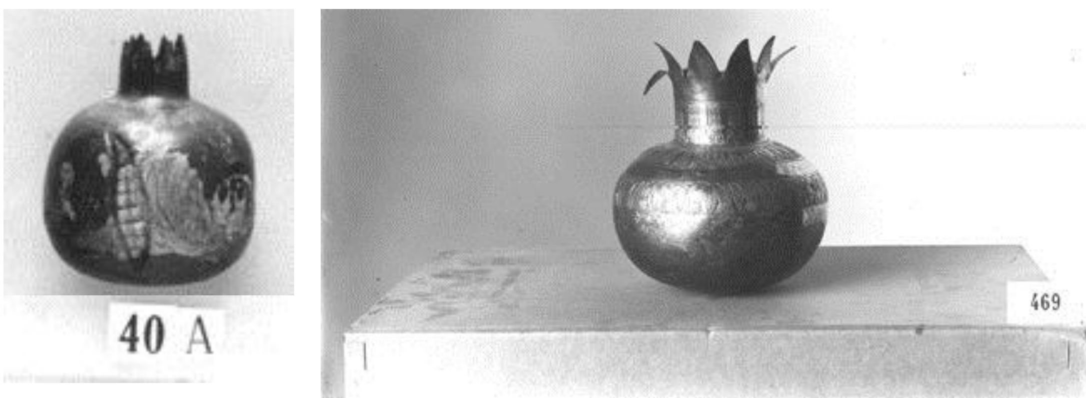

Figure 38. A pomegranate vase Carter No. 469 and smaller one of ivory pomegranate Carter No. 040a, Tutankhamun tomb. **(**Photo by H. Burton. Courtesy of the Griffith Institute, Oxford, UK).

The pomegranate was no longer a novelty in Egypt, since it had been introduced from the southern Caspian Sea region earlier in the 18th Dynasty (Tomashevska, 2019) before the time of Tutankhamun. The fresh leaves of this fruit, together with leaves of willow and lotus petals have been

Figure 39. pomegranate (*Punica granatum* L.), exocarp. (Digital Microscope VHX-950F).

included in the large flower collar that was put on the innermost coffin of Tutankhamun (Winlock, 2010). Along with the leaves, the bright red flowers of this tree were used for making collars and garlands as well.

Pomegranate when ripe the hard rind is tinged pink, yellow and purple and it has long been used for dyeing leather. The evidence for pomegranate comes from the artistic textual and archaeobotanical records from Second Intermediate period Tell el-Daba and the New Kingdom, including those from the Eighteenth Dynasty settlement of Amarna (Renfrew, 1985) as well as a single, large desiccated pomegranate from the Eighteen Dynasty tomb of Djehuty (Hepper, 1990; Zohary et al., 1994).

In the tomb of Queen Hatshepsut's butler, dates from about 1470 BC there is a large dry pomegranate together with gifts of flowers and other fruit. Pomegranates in bas-relief appear on the walls of Tuthmosis III's temple at Karnak dating from about 1450 BC, along with plants seen in Western Asia during his campaigns. As the pomegranate became more popular in Egypt its occurrence in tombs and as models increased in frequency.

Oleaceae

Olea europaea L., Olive

Endocarps of the *Olea europaea* L. were found in large quantity (Fig.40), but no whole olive fruits (drupes), epicarps (cuticular lipid layer or skin) or mesocarps (flesh or pulp) were found. The size of endocarps appears to be similar (Fig. 41). Olive trees are currently cultivated throughout the Mediterranean region. Their native country is unknown, though Syria has been suggested. It is largely grown in the Fayum (50 miles above Cairo), and along the NW coastal country adjoining the Delta. The date of the beginning of olive culture in Egypt is a subject of debate

(Serpico et al., 2000). Nonetheless, there is evidence of the consumption of olives and possibly olive oil at least since the New Kingdom. A mention of olive tree in written texts dates back to about 2500 years BC. in Ebla (Manniche, 1989).

Figure 40. *Olea europaea* L. endocarp. Front view (Photo: NagmEldeen 2020).

The earliest olive wood identifications date to the New Kingdom (Manniche, 1989). Based on the large quantity of olive stones recovered from New Kingdom archaeological contexts in Egypt, particularly in Tutankhamun's tomb and Amarna, Egypt is hypothesized to have been the setting of olive introduction. The use of olive leaves in the floral garlands placed on Tutankhamun's coffins led to speculate that they must have been cultivated locally. Classical texts mention the cultivation of olive and oil production in Egypt, albeit on a more limited scale than elsewhere in the Mediterranean.

Figure 41. Olive (*Olea europaea* L.) Endocarp (Digital Microscope VHX-950F).

The trees and the olives were imported from Syria and Greece then were later planted in the Fayum Oasis in Egypt (Manniche, 1989). The Fayum and Memphis were evidently the favored areas for cultivation, yet the trees were said to grow in other districts, notably Thebes. In modern Egypt olive trees are still the most important crop in the Siwa Oasis. However, environmental conditions in Egypt are not favorable for olive production. As a result, the date for the inception of olive culture in Egypt is unclear (Nicholson, 2000).

Poaceae (Gramineae *n.c.*)

The Poaceae, family of monocotyledonous flowering plants, is also known as grasses. It includes the cereals, bamboos and the grasses of natural grassland and species cultivated in lawns and pastures. The latter are commonly referred to collectively as grass. Poaceae is the most economically important plant family, providing staple foods from domesticated cereal crops. The family includes a series of plants, which were found in the box such as emmer wheat (*Triticum dicoccum* Schrank ex Schübl.), Barley (*Hordeum vulgare* L.), and *Eragrostis* spp.

Emmer and barley were the staple cereals of this adopted agricultural complex which, along with the herding of domesticated animals, would have originally supplemented, rather than wholly replaced, well-established hunting and gathering practices (Hassan, 1984; Wetterstrom, 1993). Thus far the earliest finds of emmer and barley in Egypt date to 5300-4000 BC from the Fayum Oasis and Merimda Beni Salama in the Delta (Caton-Thompson et al., 1952; Hassan, 1988; Wetterstrom, 1993; Zohary et al., 1993), thereby marking the beginnings of one of the most accomplished examples of plant-people interaction in history.

Emmer and barley formed an integral part of a complex administrative system of wages and taxation which played a critically important role in the development and relative stability of the economically successful Egyptian state throughout this time (Gardiner, 1947; Cerny, 1964; Janssen, 1975). The archaeobotanical record shows that emmer wheat and hulled barley have been cultivated in Egypt since at least in dung remains (Vermeeren et al., 1993), the sixth millennium BC (Caton-Thompson et al., 1934; Wetterstrom 1993; Zohary et al., 1993) and that they continued to be the two most important cereals produced until Greco-Roman times. Two vital products of emmer and barley - bread and beer - were the main staples in the Pharaonic Egyptian diet. Emmer was primarily used to make bread but also was used for beer-making while barley was most suitable for beer-making (Nicholson, 2000). Emmer (*Titicum dicoccum* (schrank) Schübl.) is a hulled wheat, which means that after the threshing process breaks up the cereal ear into spikelet, the spikelet then need to be processed further to rid them of their chaff in order to obtain a clean grain product. Like emmer, hulled barley must undergo a similar process to separate the chaff which is strongly fused to the grain.

***Titicum dicoccum* (schrank) Schübl., Emmer wheat**

The remains consists of hulled wheat spikelet (Fig. 42), spikelet with mature grains, some of the spikelet being entire, others broken and also the rachis of wheat (Fig. 43,44). Emmer wheat, *Triticum dicoccum* (Schrank) Schübl., was the only kind of wheat known to the ancient Egyptians.

Figure 42. Emmer wheat (*Triticum dicoccum* (schrank) Schübl.), husks, adaxial view. (Photo: NagmEldeen 2020).

Until the Roman period it was the main kind of wheat. In the Mediterranean region, naked wheats (*T. durum* and *T. aestivum*) are the usual crop for flour world-wide. A symbolic flail was held in Tutankhamun's golden effigy on his mummification coffin, as well as a crook; these were typical of Osiris as cultivator (flail) and shepherd (crook). Winnowing removed the edible kernel from the light scaly chaff.

Figure 43. Emmer wheat (*Triticum dicoccum* (schrank) Schübl.) husks, adaxial view, rachis adaxial and lateral view ((Digital Microscope VHX-950F).

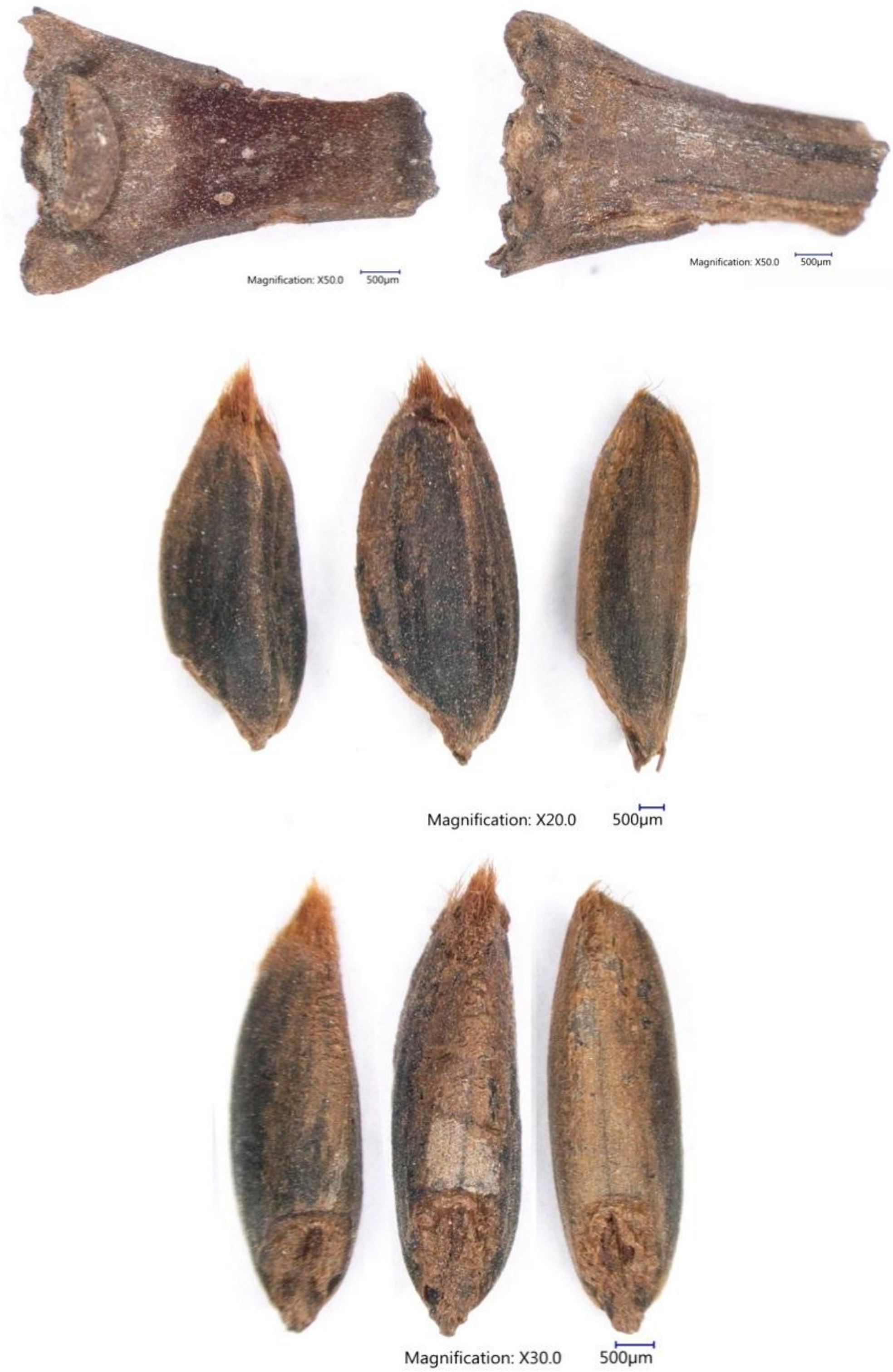

Figure 44. Hulled wheat chaff and grains. The grains show the longitudinal grooves typical of hulled wheat, emmer grain, with a blunter apex and straighter sides in all views. (Digital Microscope VHX-950F).

***Hordeum vulgare* L., Barley**

Barley was carefully cultivated and harvested for the manufacture of beer and bread. These procedures, in detail, are depicted repeatedly on tomb walls (Barakat, 2010). Several hulled barley florets were found (Fig. 44).

Figure 44. Barley *Hordeum vulgare* L., dorsal and ventral sides of seeds (Digital Microscope VHX-950F).

***Eragrostis* spp.**

Eragrostis spikelets remains were found (Fig. 45). Chloridoideae is a subfamily in Poaceae family, one of the largest subfamilies of grasses, with roughly 150 genera and 1,600 species, mainly found in arid tropical or subtropical grasslands. Eragrostideae is a tribe of grasses in subfamily Chloridoideae. It contains roughly 500 species. *Eragrostis* is a large and widespread genus of plants in the grass family, found in many countries on all inhabited continents and many islands. E*ragrostis* is the largest genus in the family Poaceae. 350 species have been described, constituting more than a quarter of the family (Van den Borre et al. 1994). At least two species of *Eragrostis* are present in ancient Egypt, *Eragrostis aegyptiaca* (Willd.) Del. and *Eragrostis cynosuroides* Beauv. The spikelet found in the box is more close to *Eragrostis cilianensis* (All.) Lut. ex Janchen.

Figure 45. *Eragrostis* spp. Spikelet's remains (Digital Microscope VHX-950F).

Rhamnaceae

Paliurus spina-christi Desf., Christ-thorn

Paliurus spina-christi Desf. (Christ-thorn) is a member of the Rhamnaceae family, also known as the buckthorn family (Nancy, 1986). Christ-thorn is common in Egypt, especially Upper Egypt, where it is known in Egyptian colloquial arabic as Nabk, which mean buckthorn. It also occurs in Sudan, dry regions of Northern Africa from Mauritania to Arabia (Nicholson et al., 2000). The majority of the Christ-thorn recovered in the tomb of Tutankhamun is comprised of fruit stones (kernel; Fig. 46). Nonetheless, few samples preserved the entire mesocarp and exocarp (dried skin, pulp) or parts of them (Fig. 47). The fruits are eaten by natives in the region of the Upper Nile, and the immature fruits are said to be medicinally useful as a laxative and febrifuge (Hepper, 2009).

Figure 46. Christ-thorn (*Paliurus spina-christi*) stones (kernel) (Photo: NagmEldeen 2020).

Christ's thorn gets its name from the sharp spines of varying length growing from the base of each leaf stalk, which were reputedly used in the making of Jesus' crown of thorns. Christ's thorn is found in Egypt and in other parts of north and east Africa, down to Tanzania, south Arabia, in the desert oases and rain fed areas of the Near East. Today the Christ's thorn tree, commonly known as sidder, is grown primarily for its shade throughout the Nile Valley but it was probably one of the original constituents of the wild flora of Egypt and continues to grow wild in Upper Egypt. The tree held religious significance for the ancient Egyptians as well. The papyrus Eber indicates that Christ's thorn fruits and leaves were used frequently in ancient Egyptian medicine for a variety of foods and the species continues to be used in folk medicine today. Fruits are used by Coptic monks in desert monasteries, with nabk fruits still comprising an ingredient in Egyptian breads (Fig. 48). The oldest archaeobotanical finds of nabk fruits are from the Predynastic sites of KH3, Naqada south town (Wettersttrom, 1986), and Hierakonpolis (Fahmy, 1995), the first Dynasty tomb of Hemaka at Saqqara (Emery et al., 1938) and from the third Dynasty tomb of Djoser at Saqqara, where 700 Christ's thorn stones were recovered (Lauer et al.,

Figure 47. *Paliurus spina-christi* outer part (dried skin,pulp) is preserved. (Digital Microscope VHX-950F).

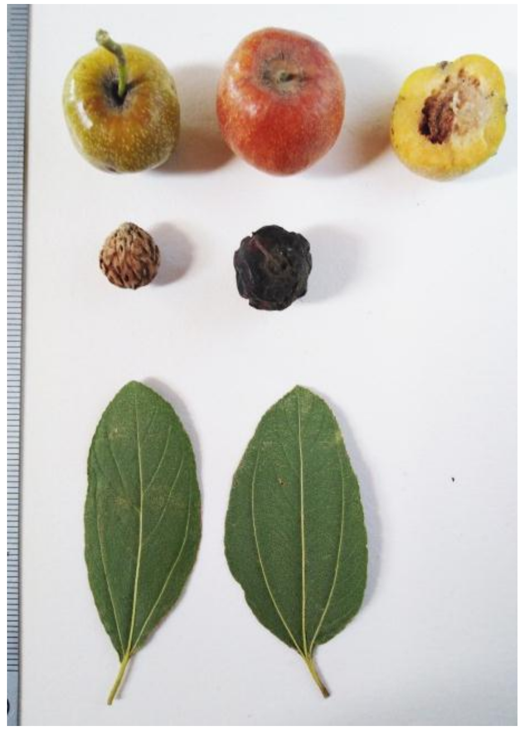

Figure 48. Modern *Paliurus spina-christi*, fruit, stone and tree leaf. (Photo: NagmEldeen 2020).

1950). Later finds are known from Twelfth Dynasty Kahun, Eighteenth to Nineteenth Dynasty Kom Rabi'a (Germer, 1989).

Rosaceae

Prunus dulcis (Mill.) D. A. Webb, Almond

Almond (*Prunus dulcis* (Mill.) D. A. Webb) is an ancient crop of southwest Asia. Selection of the sweet type marks the beginning of almond domestication. Wild almonds are bitter and eating even a relatively small number of nuts can be fatal. How man selected the sweet type remains a riddle. Also, the wild ancestor of almond has not been properly identified among the many wild almond species (Ladizinsky, 1999). Several almond (*Prunus dulcis* (Mill.) D. A. Webb) fruits were found in a good state of preservation (Fig. 49).

Figure 49. Almond (*Prunus dulcis* (Mill.) D. A. Webb) fruits. (Photo: NagmEldeen 2020).

Domesticated almonds appear in the Early Bronze Age (3000–2000 BC) in the Near East, or possibly a little earlier at the dawn of agriculture (Casas-Agustench, 2011). The earliest finds of almond in Egypt come from the Workmen's Village at Amarna (Renfrew, 1985).

The Almond is said to be wild cultivated only in Afghanistan, Turkestan, Transcaucasia, Persia and Syria. The fruits belonged to one of the hard-shelled (Fig. 50) varieties of Almond. Almond trees thrive in the Mediterranean type of climate where they grow wild in marquis vegetation among small oak trees on rocky slopes facing south, such as occur in Palestine. Shells have often been excavated from ancient sites in Western Asia, but seldom in Egypt, where the tree was unlikely to be widely cultivated. Some varieties have very bitter nuts, and these were used for the preparation of almond oil, which would have been used in

Figure 50. Almond (*Prunus dulcis* (Mill.) D. A. Webb) fruits. (Photo: NagmEldeen 2020).

cosmetics and medicine. A small piece of its hard wood was used for one of Tutankhamun's arrow (Boodle, 1933).

Nut characteristics should be considered for characterization of almond. Nut characteristics observed from the morphological characteristics of almond such as nut shape, length, width, ratio of nut length/width, thickness and weight.

Sapotaceae

Mimusops schimperi Hochst., Persea tree

The specimens of persea (*Mimusops schimperi* Hochst.) from the tomb-flora of ancient Egypt are presumed to be of cultivated origin (Friis, 1980). A few seeds of persea (*Mimusops schimperi* Hochst.) were found in the box (Fig. 51). The fruits, which contain a sweet pulp, are offered for sale in the markets of Yemen. The tree is native in Abyssinia and Eritraea (Boodle, 1933), and is not found at present time in Egypt, but the seeds have been found in graves of different epochs, and Schweinfurth (Friis, 1986)) concludes that the fruits had to be, at the time of the Middle Kingdom, everywhere in Egypt.

Figure 51. Persea (*Mimusops schimperi* Hochst.) seed front and back view. (Photo: NagmEldeen 2020).

Fruits from persa tree have been discovered in many tombs from all dynastic periods, while the branches and leaves have been found in many tombs from the New Kingdom period (Manniche, 1989) surrounding the mummy in the form of small bouquets or on garlands, such as several dried botanical bouquets of persea leaves with olive leaves, tied to a common reed stick from Tutankhamun tomb.

The persea tree was regarded as sacred in ancient Egypt, and pharaohs were often portrayed as being protected by its branches and leaves or emerging from it (Brewer, 1994). Moreover, it is thought that the cartouche resembled a persea leaf on which the god Thoth inscribed the king's name on his succession to the throne (Brewer, 1994). The persea tree remains as the tree of life and renewal dedicated to the goddess Hathor (Jacquat, 2013).

Vitaceae

***Vitis vinifera* L., Grape vine**

Vitaceae fruits are classified as berries. *Vitis* species in this family commonly known as grapes. They are spherical or ellipsoidal and contain a range between 2 and 4 oleaginous seeds each. The vine is one of the oldest cultivated fruits in Egypt. Large quantity of grape (*Vitis vinifera* L.) seeds / pips (Fig. 52), a few of grape pedicel and withered grapes are present in the box (Fig 53, 54). Grapes resembling raisins are recorded as occurring among offerings to the dead in Egyptian tombs.

Figure 52. Grape vine (*Vitis vinifera* L.) seeds/pips (photo: NagmEldeen 2020).

Figure 53. Grape (*Vitis vinifera* L.) pedicels (Digital Microscope VHX-950F).

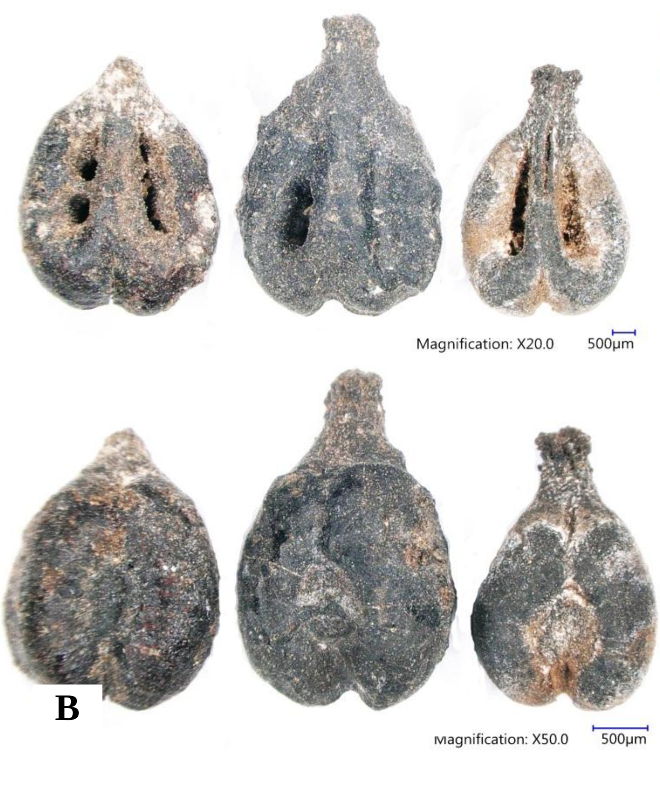

Figure 54.A&B grape vine (*Vitis vinifera* L.) seeds/pips (Digital Microscope VHX-950F).

Surplus grapes would have been sun-dried to keep as raisins. They keep for quite a long time in an edible condition but eventually they shrivel into hard grains , so it is difficult to decide whether those found in the box from Tutankhamun's tomb were placed there as dry raisins (Fig. 55) or just remains from desiccated grape. The grapes of this fruit are dark red, and the leaves are hairy on the underside (Fig. 55), which is similar to the grapes that grow today in the Fayum (Wilkinson, 1998).

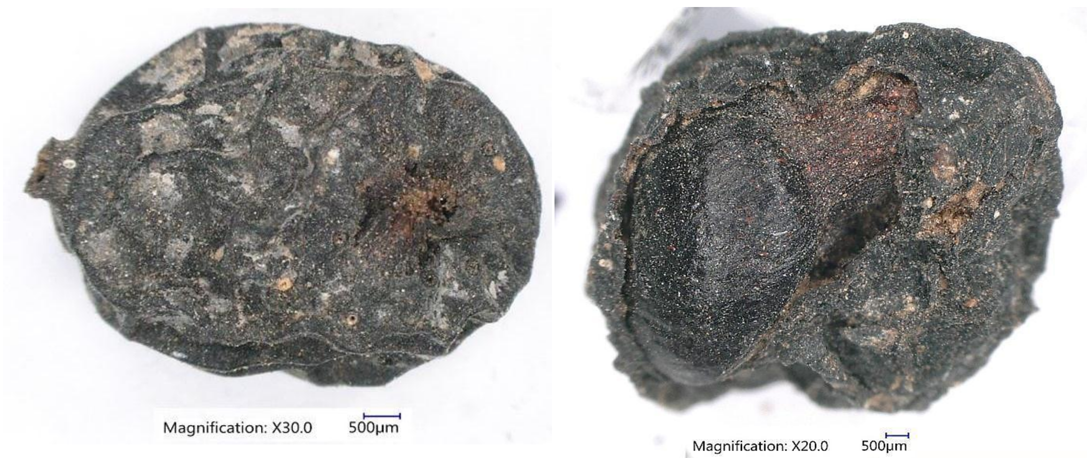

Figure 55. Grape vine (*Vitis vinifera* L.) dried or raisins with seed inside. (Digital Microscope VHX-950F).

The grapevine was stored in jars with an inscription indicating the contents and has been used to produce wine but also as an offering to the dead (Partridge, 1994). This kind of jars was found in the tomb of Tutankhamun (Wilkinson, 1998). Although it was used as a motif in all periods, it appears mainly in the floral designs of the late Eighteenth Dynasty. In this period the ceiling was often decorated with either vine leaves and grape bunch paintings or as faience grape clusters hanging on the ceiling attached to wooden beams (Petrie, 1920). According to Petrie, this is based on the idea of the plant's ability to vertically grow over the houses (Maspero, 1889).

Thirty-eight Theban Tombs contain viticulture representations, mainly as part of general agricultural scenes (Porter et al., 1964). Depictions of wine production are relatively common as well since wine was considered an essential drink for the deceased as it symbolized renewal and rebirth (Hartwig, 2004). Another pointer of the symbolic meaning of the grape is its yearly cycle. By its very nature, the plant would have had the symbolic appearance of dying and then returning to life. This particular cycle may resemble the story of Osiris, and as such, the grape became associated with the death and rebirth of Osiris and gave the grape the symbolic properties of regeneration and fertility (Frankfort, 1933,1948).

CHAPTER 5. Discussion

Different types of pulses (Fabaceae / Leguminosae) were found in the studied sample. These include pea (*Lathyrus oleraceus* Lam..), fenugreek (*Trigonella foenum-graecum* L.) and faba beans (*Vicia faba* L.). Pulses are thought to have been an important and widely available source of proteins for most of the Egyptians, particularly if meat was not a regular part of their diet. This also happens in Egypt nowadays, as everyday diets often include limited quantities of red meat (Alderman, 1993). Legumes contain trypsin inhibitors, which makes some species difficult to digest. For these reason, they need to be processed by various means before consumption, using methods such as soaking, cooking or by removing their seed coat (Aykroyd et al., 1982; Dagher, 1991; Shekib et al., 1992).

The faba bean (*Vicia faba* L.) teguments found in the box are considered to be the first such archaeobotanical finds in the Eighteen Dynasty and were not previously recorded in Tutankhamun tomb. A similar consideration can be made for onion (*Allium cepa* L.), which was not present in the previously studied archaeobotanical records from Tutankhamun's tomb.

Fabaceae (Leguminosae n.c.), are qualitatively the most represented family in the present study. These include pea (*Lathyrus oleraceus* Lam.), fenugreek (*Trigonella foenum-graecum* L.), faba beans (*Vicia faba* L.) and Burclover (*Medicago polymorpha* L.).

A wide variety of fruits were found in the box. They include Christ's thorn (*Paliurus spina-christi* (L.) Desf.), dôm palm (*Hyphaene thebaica* (L.) Mart.), date palm (*Phoenix dactylifera* L.), pomegranate (*Punica granatum* L.) and grapevine (*Vitis vinifera* L.). These species were an important element of the ancient

Egyptian diet, as humans relied on their fruit production, but were also used as offerings in funerary practices.

Based on the retrieval of numerous olive (*Olea europaea* L.) and almond (*Prunus dulcis* (Mill.) D.A. Webb) endocarps, we can assume that they were consumed as fruits or as sources for oil. It has been suggested that, because kernels of sweet almonds may have been prized as a food source, the oil may have been extracted from bitter almonds (Salunkhe et al., 1992).

Olive (*Olea europaea* L.), safflower (*Carthamus tinctorius*), pomegranate (*Punica granatum*) and cornflowers (*Centaurea* sp.) leaves and/or flowers were used in collars and floral garlands compositions found in Tutankhamun's tomb. Collars and garlands were worn for decorative purposes, which mean that they must have been cultivated under irrigation in Ancient Egypt. Since dry leaves cannot be folded, the leaves used for making garlands had to have been fresh. For this reason, it is possible to assume that they were cultivated under irrigation in Ancient Egypt. Floral collars and garlands were often intended to represent a symbol of status. Furthermore, they had a religious or protective function.

Safflower (*Carthamus tinctorius* L.) could have been used by Egyptians both as a source of yellow dye and of oil. The presence of flower heads seems to indicate that the plants were collected to be used as dyes. However, it remains uncertain whether oil was extracted from the fruit at that time or whether this practice was developed more recently (Van Zeist et al., 1992).

Egyptian archaeobotanical finds of Christ's thorn fruits are from the Predynastic sites of KH3, Naqada south town and Hierakonpolis, the first dynasty tomb of Hemaka at Saqqara and from the Third Dynasty tomb of Djoser at Saqqara. In the latter, 700 Christ's thorn stones were recovered.

Various species found amongst the analyzed remains are thought to have been used as spices. These include finds from Amaryllidaceae, namely garlic (*Allium sativum* L.), onion (*Allium cepa* L.), and Apiaceae, including coriander (*Coriandrum sativum* L.).

Additionally, some species could have been used for their medicinal properties. An example is comprised by onion (*Allium cepa* L.), whose juice has been extensively used in herbal medicine to treat coughs, colds, stomach ailments and other ills throughout antiquity (Rivlin, 2001). Garlic (*Allium sativum* L.) is also used in traditional medicine, and administered to laborers in order to improve their work capacity. Garlic was recommended for pulmonary and respiratory complaints. Its efficacy in dropsy is compatible with known cardiovascular functions (Rivlin, 2001).

The cornflower was undoubtedly important in Ancient Egypt as it held a symbolic meaning, it was depicted in wall paintings, it was included in floral collars and molded in pottery. However, the archaeobotanical finds before the Eighteen Dynasty (Tutankhamun tomb) are rare, being so far comprised only of two records from Predynastic times (El Hadidi, 1982) and from the Twelfth Dynasty (Leroy, 1992).

The purpose of fenugreek (*Trigonella foenum-graecum* L.) in Tutankhamun's tomb is not clear. Archaeobotanical records in Ancient Egypt of fenugreek only concern Predynastic times and the Eighteenth Dynasty. Burclover (*Medicago polymorpha* L.) is commonly found in records from ancient Egypt. Nonetheless, its find in the studied sediment represents the first record of this plant not only in Tutankhamun's tomb, but also for the Eighteenth Dynasty.

Archaeobotanical remains of pomegranate (*Punica granatum* L.) in Ancient Egypt ì are found in numerous contexts starting from the Middle Kingdom, becoming more common in the New Kingdom. Pomegranate found various uses in Tutankhamun's tomb, with its leaves being included in floral collars and garlands, being also depicted on wall paintings and its shape being imitated by numerous objects.

Different species of *Eragrostis* are found in Egyptian archaeobotanical records. Remains of *Eragrostis aegyptiaca* (Willd.) Del. were found in Dashshur's Pyramid from Middle Kingdom. *E. abyssinica* was found in a context from the Nineteenth Dynasty (Ramses II). *Eragrostis cynosuroides* (Retz.) P.Beauv. is a synonym of *Desmostachya bipinnata* (L.) Stapf. (Halfa grass) and was well known during ancient Egyptian times. Archaeobotanical records of *Desmostachya bipinnata* (L.) Stapf., were vast from Neolithic time to Thirteen Dynasty (de Vartavan, 1997).

Despite of remains of almond (*Prunus dulcis* (Mill.) D. A. Webb) being numerous in Tutankhamun's tomb, almond in Egypt was only found in contexts from the Eighteenth Dynasty.

The archaeobotanical remains found in the box from Tutankhamun tomb can be divided into four categories based on finds of the species in Ancient Egypt (Table 2).

Species found during ancient Egyptian dynasties	**Species appeared during the New Kingdom**	**Species found only in the New Kingdom**	**Unknown species in Egypt (not found before)**
Hyphaene thebaica (L.) Mart. Dôm Palm	*Allium cepa* L., Onion	*Trigonella foenum-graecum* L. Fenugreek	*Luffa aegyptiaca* Mill., Egyptian luffa / sponge gourd
Phoenix dactylifera L., Date Palm	*Allium sativum* L., Garlic	*Prunus dulcis* (Mill.) D.A. Webb, Almond tree	
Citrullus lanatus (Thunb.) Matsum. & Nakai,Watermelon	*Coriandrum sativum* L., Coriander		
Juniperus L., Juniper	*Carthamus tinctorius* L. Safflower		
Lathyrus oleraceus Lam., Garden pea	*Centaurea* L., Centaury		
Medicago polymorpha L.	*Olea europaea* L., Olive		
Vicia faba L., Faba bean and broad bean			
Punica granatum L., Pomegranate			
Eragrostis spp.			
Hordeum vulgare L., Barley			
Triticum dicoccon (Schrank) Schübl., Emmer wheat			
Paliurus spina-christi (L.) Desf., Christ's thorn			
Mimusops schimperi Hochst., Persea tree			
Vitis vinifera L., Grapevine			

Table 2. List of plant taxa (this study), results divided according to their finds in ancient Egyptian time

CHAPTER 6. Conclusion

The archaeobotanical study of the materials recovered from the tomb of the pharaoh Tutankhamun of the Eighteen Dynasty aimed to provide not only new elements on funerary royal equipment, but also to know more on daily life in Ancient Egypt. It is clear that the vast botanical treasure from Tutankhamun tomb is not less valuable than any of the artefacts discovered in the tomb. The value of these botanical treasures lies precisely in the knowledge we can gather from them, considering the obvious absence of textual evidence of Tutankhamun.

The exceptionally well preserved archaeobotanical materials from Tutankhamun tomb represent an idealistic case study for archaeobotanical study on Ancient Egyptian archaeobotanical materials; allow examining many issues concerning food and funerary practices. This is particularly important; as such information is limited or unavailable in other ancient Egyptian archaeological sites. The exceptional state of preservation is evidenced by the conservation of numerous diagnostic morphological features of botanical remains allowing identifying numerous taxa and performing identification at a species level of most of them.

The present study highlights the potential of analyzing desiccated plant remains, characterized by a near-perfect preservation state, is evidenced by the conservation of numerous diagnostic morphological features of botanical remains allowing identifying numerous taxa and performing identification at a species level of most of them.

The recovered archaeobotanical data from a well dated and well excavated Pharaonic period site such as Tutankhamun tomb can help to fully address detailed comparisons between sites, periods and regions. For example, a comparison can be made using the variety and large quantity of desiccated remains from the New

Kingdom (1550–1069 BC) and later especially Eighteenth Dynasty (1550 to 1295 BC), king Tutankhamun (1336–1327 BC) and the royal architect Kha and his wife Meryt (ca.1425 – 1353 BC) tomb. These raised questions including: what factors account for the increased numbers and range of species at this time, including possible luxury items, such as coriander? Could it be the development in irrigation system or the development of agrarian practices in general? Considering the various origins, are these species newly arrived into Egypt during a period characterized by the influx of new ideas, innovations and influences from elsewhere? Or is it simply the better preservation of desiccated material? Additional data from earlier Pharaonic settlements would also help to address this important question.

Similarly, how do the selection of food left as funerary offerings in tombs change through time? Moreover, how do archaeobotanical remains from funerary contexts compare with those found on settlement of the population at large? Why were some foods selected as offerings, while other were disregarder? There's the possibility that all the stones may represent fruits that were entire when placed in the tomb and vice versa. Can any pattern be selected involving regional differences in food availability, such as the preferable growing condition of the pulse crops and onions, for example, or for Lower Egypt as the primary area for the cultivation of the olive and the grape? With time, the careful sampling, recovery, analysis, quantification and interpretation of the Egyptian archaeobotanical record will gradually produce a clearer picture of fruit and vegetable distribution and use for the Pharaonic period.

The agricultural requirements of the fruits and vegetables discussed here, together with information on food related issues also need to be considered, such as the methods of food preparation and processing as noted before for faba bean (*Vicia* *faba* L.), not only for cooking but also to increase palatability or to decrease toxicity as the case in nut from almond tree (*Prunus dulcis* (Mill.) D.A. Webb), different attitudes to foods in this time and region and also the important subjects of food avoidance and food taboos as mentioned in onion (*Allium cepa* L.). Such information would greatly enrich our understanding of the uses of these species. The dessert watermelon, *Citrullus lanatus*, is native to northeastern Africa. Wild *C. lanatus* populations in Sudan, reported as bearing small, round, inferior-quality fruits, are living representatives of the wild ancestor of the sweet dessert watermelon. Ancient seeds, fruits and images of watermelons have been found in Sudan and Egypt and one image seems to depict the serving of a large, oblong, striped fruit which likely had non-bitter, tender flesh but was not sweet by modern standards.

Archaeobotanical remains of garlic are found in our samples and the Eighteenth Dynasty onwards, a Predynastic date for the presence of garlic in Egypt has been proposed due to several finds of clay models of what appear to be garlic bulbs. Other plants, which we think of as vegetables today, may not have been used as such in the Pharaonic period. During this time, the melon and the watermelon were not likely to have been the sweet fleshy varieties that we currently recognize; instead these plants probably had bitter, unpalatable fruits, which may have been grown primarily for their nutritious seeds.

Egyptian luffa fruit (*Luffa aegyptiaca* Mill.) has not been previously found in other archaeobotanical records from Ancient Egypt. The seeds found in the box are the first finds of Egyptian luffa. Its presence or absence in Ancient Egypt requires further studies.

The present highlight how the Egyptian custom of placing everyday items in tombs has increased the chances of preserving remains of plants (Manniche, 1989), allowing entire plant assemblages to remain intact for thousands of years.

Annex 1: Ancient Egyptian chronology

Paleolithic	**before 8000 BC**
Neolithic	**8000- 5000 BC**
Predynastic	**4000-3100 BC**
Maadi	4000-3100 BC
Naqada I	4000-3500 BC
Naqada II	3500-3200 BC
Naqada III	3500-3100 BC
Early Dynastic 3100 - 2686 BC	
Dynasties 0	3100-3000 BC
Dynasties 1	3000-2890 BC
Dynasties 2	2890-2686 BC
Old kingdom 2686-2181 BC Dynasties 3-6	
Dynasties 3	2686-2613 BC
Dynasties 4	2613-2494 BC
Dynasties 5	2494-2345 BC
Dynasties 6	2345-2181 BC
First Intermediate Period 2181 – 2055 BC	
Dynasties 7&8	2181-2160 BC
Dynasties 9&10	2160-2055 BC
Dynasties 11	2125-2055 BC
Middle Kingdom 2034 – 1650 BC	
Dynasties 11	2034-1985 BC
Dynasties 12	1985-1773 BC
Dynasties 13	1773-1650 BC
Second Intermediate Period 1650 – 1550	
Dynasties 13	ca. 1650 BC
Dynasties 14	1773-1650 BC
Dynasties 15	1650-1550 BC
Dynasties 16	1650-1580 BC
Dynasties 17	1580-1550 BC
New Kingdom (1550–1069 BC)	
Eighteenth Dynasty 1550 to 1295 BC	
Nebpehtire Ahmose I, Ahmosis I	1550–1525 BC
Djeserkare Amenhotep I	1525–1504 BC
Aakheperkare Thutmose I	1504–1492 BC

Aakheperenre Thutmose II	1492–1479 BC
Menkheperre Thutmose III	1479–1425 BC
Maatkare Hatshepsut	1473–1458 BC
Aakheperrure Amenhotep II	1427–1400 BC
Menkheperure Thutmose IV	1400–1390 BC
Nebmaatre Amenhotep III	1390–1352 BC
Neferkheperure-waenre Amenhotep IV/Akhenaten	1353–1336 BC
Akhenaten (dep.on date of object)	1353–1336 BC
Neferneferuaten	1338–1336 BC
Ankhkheperure Smenkhkare	1338–1336 BC
Nebkheperure Tutankhaten/Tutankhamun	1336–1327 BC
Kheperkheperure Ay	1327–1323 BC
Horemheb	1323–1295 BC

Nineteenth Dynasty 1295 to 1186 BC

Twentieth Dynasty 1186 to 1069 BC

Third Intermediate Period (1069–664 BC) Dynasties 21-25

Dynasty 21	1069-945 BC
Dynasty 22	945-715 BC
Dynasty 23	818-715 BC
Dynasty 24	727-715 BC
Dynasty 25	747-656 BC

Late Period 664 to 332 BC

Dynasties 26	664-525 BC
Dynasties 27	525-404 BC
Dynasties 28	404-399 BC
Dynasties 29	399-380 BC
Dynasties 30	380-343 BC
Dynasties 31	343-332 BC

Graeco – Roman **332 BC to 394 AD**

Ptolemies period **304 – 30 BC**

Roman Emperors **30 BC – 395 AD**

Diocletian (N.B. the Coptic calendar dates its year numbers from the accession of Diocletian) **395 AD – 305 AD**

Byzantine Period **323 AD – 642 AD**

Islamic Period **642 AD - 1517 AD**

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