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A Combined Method for Museum Displaying and Storage photographic images albums of The Dome Library in South Valley University, Qena

Elsayda-Nafesa El-Shamy [(1)]
Essam H. Mohamed [(2)]

[(1)] Conservation Department, Faculty of Archaeology and Tourism Guidance, Misr University of Science and Technology, Egypt
(alsaydanafesa@hotmail.com 01015339281)

[(2)] Associate professor of Conservation of archaeological buildings, Faculty of archaeology, S.V.U
(essam.mohamed@arch.svu.edu.eg 01221240050)

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ABSTRACT

Photographic materials have complex structures that present special preservation challenges to the librarian and archivist which most commonly found in libraries and archives. Deterioration which takes place in photographs is an ongoing natural process. Deteriorated photographs may require specialized conservation and preservation treatment which the authors here concentrate on displaying and storing procedures. The Dome Library in South Valley University has a lot of photographic materials which suffer from different deterioration aspects. The authors recommend a combined method of displaying and storing of the photographic albums which can be applied later for all the other materials according to each case study with the developing project of the Dome Library digitizing in Faculty of Arts in South Valley University in Qena. Also some analytical techniques were used in the study: using Visual Assessment, Microscopic Examination, Identification of photo by X-Ray fluorescence, X- Ray diffraction analysis for determining the paper crystallinity, Fourier Transform Infrared Spectroscopy (FTIR) for determining the binder and Isolation and identification of fungi (collection of samples swabs). Finally, the authors design a method to preserve the album supported with Cradle to combine the process of storing and displaying the album in one step.

KEYWORDS

Albums; Silver; Gelatin; FTIR; Dome Library; Display; Storage

طريقة مدمجة لعرض وتخزين الصور الفوتوغرافية بمكتبة القبة – جامعة جنوب الوادي بقنا

الملخص : تحتوي مواد التصوير الفوتوغرافي على تركيبات معقدة والتى تمثل تحديات كبيرة فى عمليات الحفظ والصيانة خاصة لأمناء المكتبات وأخصائي الترميم والتي توجد بشكل شائع في المكتبات ودور المحفوظات ، ويحدث التلف في الصور الفوتوغرافية بشكل طبيعى ومستمر تزامنا مع التقادم ، وقد تتطلب الصور الفوتوغرافية المصابة بالاشكال المختلفة للتلف إلي إجراءات ترميم وصيانة متخصصة ، وعليه فقد ركز المؤلفون بالدراسة على إجراءات العرض والتخزين ، حيث وقع الإختيار على مكتبة القبة في جامعة جنوب الوادي ، والتى تحتوي على الكثير من الألبومات الفوتوغرافية التي تعاني من مظاهر التلف المختلفة ، حيث عمل المؤلفون طريقة موحدة جامعة للعرض والتخزين سوياً لألبومات الصور الفوتوغرافية والتي يمكن تطبيقها لاحقًا على جميع النماذج الأخرى وفقًا لكل حالة منهم وذلك كمقترح موصى به خلال مشروع تطوير مكتبة القبة الرقمية بكلية الآداب – جامعة جنوب الوادي بقنا .

كما تم القيام بالعديد من الفحوص والتحاليل التي استخدمت في الدراسة علي النحو التالي : التقييم البصري ، الفحص المجهري ، تفلور الأشعة السينية ، حيود الأشعة السينية ، الأشعة تحت الحمراء بالاضافة الى التعرف على الكائنات الحية الدقيقة التي أصابت الألبوم (موضوع الدراسة) ، وأخيراً صمم المؤلفون طريقة مدمجة للعرض والتخزين فى خطوة واحدة للحفاظ على ألبوم الصور .

الكلمات الدالة : الألبومات ، الفضة ، الجلاتين ، الأشعة تحت الحمراء (FTIR) ، مكتبة القبة ، العرض والتخزين .

1. INTRODUCTION

Black-and-white archaeological Photographs are found in museums, art galleries, and archives. These materials are susceptible to degradation from many sources such as environmental factors that contribute to the deterioration of photographs include: light, temperature and relative humidity; dust accumulation and insect activity; incorrect handling, atmospheric pollutants, also rough or inappropriate handling, unsuitable storage area such as poor environmental storage and display conditions and materials such using raw woods and volatile substances. Tears, losses, fading, staining, discoloration, oxidation or silver mirroring, cracks, creases, scratches, and abrasions resulted from all of these deteriorating factors which demand this study for emphasizing the importance of photographic materials preservation, exhibition, and storage procedures. High temperatures and humidity can also encourage the formation of microscopic mold spores on the image-containing layer as well as the primary and secondary paper supports. When active mold infests photographic materials, it is nearly impossible to remove it without causing damage to the image [1].

Photographic conservation is a unique and distinct subject. It is traditionally been thought like paper conservation [2-9]. While photographic conservation is a relatively young field with few treatment options, it is usually possible to extend the life of a photograph with careful handling, housekeeping, and storage habits [10].

Nearly all twentieth-century photography was in the form of silver gelatin prints. photographs have a three-layer structure: the paper support, which serves as the substrate for the subsequent layers; the baryta layer, a white opaque coating made primarily of gelatin and barium sulphate that covers the paper fibers and provides a

smooth surface to coat the gelatin; and the gelatin binder, which holds the photographic image's silver grains. The study of the physical maintenance and treatment of photographic materials is known as photography conservation and restoration [11, 12, 13, 33]. It includes both the efforts of photograph conservators, librarians, archivists, and museum curators who manage photograph collections at a range of cultural heritage institutions, as well as the actions taken to preserve personal and family photo collections. It's an umbrella phrase that encompasses both preventative preservation efforts like environmental control and conservation approaches that address particular items. Both preservation and conservation necessitate a thorough grasp of how images are taken, as well as the reasons of deterioration and how to avoid them. Conservator-restorers use this expertise to the treatment of photographic materials, preventing further deterioration and, on occasion, restoring them for aesthetic reasons [14-19].

Not only in fine art collections, but also in archives, historical societies, and family image collections, these prints can be found in huge numbers. Humidity and high temperatures are highly damaging to gelatin-silver pictures on paper. When gelatin reaches 40 degrees Celsius, it loses its fixed reticular structure and becomes a liquid. If this happens, the silver salts will be free to move around in the liquid, and the image will be lost. Biodegradation, fungus, and, in particular, silverfish, are all capable of degrading gelatin. Silver gelatin photography is a cherished delicacy for silverfish also the image's silver particles are prone to oxidation. All of those deteriorations factors led the authors to make a combined method for displaying and storing the album to preserve it for the future deterioration factors [20-24].

There was a library for the family of Muhammad Ali Pasha (1815-1953) in the Quba Palace in Cairo at the time of the Egyptian revolution on July 23, 1952. It was inherited by King Farouk (who came to power in 1936). It was then handed to schools around the governorates, with Qena Governorate receiving 406 royal family photo albums. In addition, there are certain manuscripts and documents relating to the family's trips in Europe and elsewhere, as well as around 11 thousand of the most valuable books in Arabic, German, French, and English, as well as approximately 230 musical notes for the royal hall's festivities. When Professor Muhammad Abu al-Fadl Badran became Dean of the Faculty of Arts at South Valley University in Qena (2006-2011), he set aside a huge hall for the collection of books, musical scores, and manuscripts, and classification and indexing began. When he became Secretary General of the Supreme Council of Culture, he was able to equip a room at the University of the South Valley's Faculty of Arts, to incorporate the library's collections with a donation from the German University, and the library was launched in 2016.

The choice rested on a photograph album titled "Alexandria Stadium Opening" in this library (the Dome Library at South Valley University) in the study. This research intends to shed light on a unique venue like the Library of the Dome, which houses major antiquities collections. Also, describe how to preserve a silver-gelatin photo album titled "Alexandria Stadium Opening." Visual assessment, as well as several analysis techniques such as microscopic examination using a scanning electron microscope and transmission microscope, as well as X-Ray Fluorescence, Fourier Transform Infrared Spectroscopy (FTIR), and fungus isolation and identification Finally, design and construct

a new box to preserve the album, which will be supported by Cradle, allowing the preservation and presentation of the album to be done in one step.

2. MATERIALS AND METHODS

2.1. Visual Assessment

Library of the Dome have a very important holdings of Antiquities. Most of them are albums, firstly it is should be explained the difference between photographic album and photographically illustrated book. A photographically illustrated book is a published book illustrated with real photographs. But a photographic album is a unique compilation of photographs assembled into a blank book by an individual or a group of persons. Both albums and photographically illustrated books are essentially a book or notebook with photographic attached to it. They can include printed, handwritten or no text at all [25].

POP and DOP photographic papers differ from one another. POP (printing-out paper) is a type of photographic paper that creates a visible picture by reacting to light on light-sensitive components. Warm tones, such as brown, purple, or reddish, are prevalent in POP prints. They're frequently created in the presence of a negative. DOP (developing-out paper): A photographic paper that creates a visible image by exposing a latent image created by light exposure to a chemical developer. Unless toned or faded/chemically damaged, DOP prints are cool in hue, such as blue, neutral, or black. They can be expanded from a negative or contact-printed [26].

Aside from their critical eyes, the authors utilized a digital high-resolution camera to chronicle the album's degeneration.

The author takes into account the following factors: most antique albums are too large and fragile to digitize with a

flatbed scanner. Instead, the author photographed the album with a digital camera. Using a pillow to support the open album and placing a table in front of a north-facing window for diffused natural light. Then using a tripod position the camera at an angle to the book. For a photo that isn't shaken, use a remote shutter release.

2.2. Microscopic Examination

To make a correct identification of a photographic print, it is best to make a close examination of the image surface as the normal magnifying glass is not strong enough for examining [27, 28].

Scanning electron microscope is used to get a general idea of the photo prints and explain the fibers of paper and if there is any scratches.

But transmission electron microscope (TEM) is used for examining fine details and explains the silver deterioration.

The authors used microscopic examination in the MISR university labs. using a JEOL-JXA-840A electron probe micro analyzer- Japan.

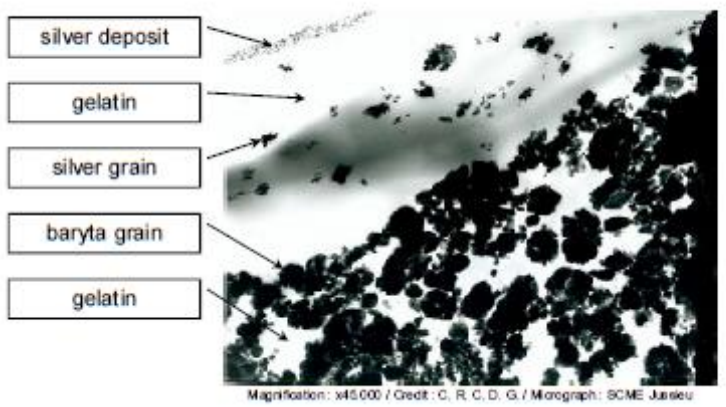

Fig.1. TEM examining of standard sample: transmission electron examining of photography baryta and image layer [29].

2.3. Identification of photo by X-Ray fluorescence (XRF)

In general, it is frequently possible to distinguish the process by which a photograph was made just by looking at it. It is the best way to understand the chemical nature of the photographs and to determine the components by knowing the elements of the structure [30]. The analysis was done in the laboratories of the National Research Center using Compact X-ray Diffract meter System PW 1840 – Analytical Equipment – Philips – Eindhoven.

2.4. X- Ray diffraction (XRD) analysis for determining the paper crystallinity

Cellulose is the most abundant biomass component of all organic materials. Both natural and man-made cellulosic products' mechanical qualities, such as strength and stiffness, are affected by cellulose crystallinity. The addition of highly crystalline cellulose to a bio composite material can improve its strength (Zhao, 2010; Rudi, 2019).

The samples were created in the laboratories of Cairo University using Compact X-ray Diffract meter System PW 1840 – Analytical Equipment – Philips – Eindhoven.

The authors calculate the cellulose crystallinity by the Equation**:** the crystallinity index (CI) calculated according to the method of Segal, *et al*. 1959, i.e. $((I_{002} - I_{18}) / I_{002})$ X100, with the diffraction intensities, I_{002} at 002 peak position ($2\Theta \approx 22.5^{\circ}$) and I_{18} at $2\Theta = 18^{\circ}$ (amorphous) (Segal, *et al*., 1954; Segal, *et al*. 1959; Lewin and Roldan, 1971).

2.5. Fourier Transform Infrared Spectroscopy (FTIR) for determining the binder

The FTIR spectrum includes the unique spectra of gelatin, cellulose, and barium sulphate [31]. Fourier transform infrared spectroscopy was used to investigate the deterioration of the photographic emulsion and paper

(FT-IR). This study was conducted using the reflectance mode of a JASCO FT/IR-6100 Spectrometer. Infrared Spectroscopy Laboratory of the National Research Center (NRC) in Cairo, Egypt, conducted the study.

2.6. Isolation and identification of fungi (collection of samples swabs)

The author collected the samples of swabs for isolation and identification of the species of fungi that affected the album. The isolation process carried out using swab technique, and then saved in closed plastic bags. The isolated species were propagated in the Microbiology Lab at MISR University for science and technology. Fungi Growth Medium For the isolation and purification of fungal spores, yeast extract media (Sigma Aldrich) was obtained 20g/L of yeast extract, 150 g/L of Sucrose, and 20 g/L of agar in distilled H_2O. Autoclave used for sterilizing the media at 121°C for 15minutes, under 1.5 Pa. (Scott, 1970; Jeszeová1 *et al,* 2018).

3. RESULTS

3.1. Visual Assessment:

3.1.1. Visual Assessment of the Dome library in south valley university in Qena

The "Dome library" is a library at Qena's South Valley University. Through a visual inspection, it became evident that the library is plagued by a number of issues that prevent the proper preservation of all of the library's conserved antiquities, resulting in various elements of deterioration. The following are the drawbacks of exhibition and storage in the library:

1- Effect of artificial light of fluorescent lamps also the absence of light filtering devices or air pollutants which cause the photo-oxidation and photo degradation processes of photographic materials, and then lead to yellowing and fading also led to weakness

and fragility of the support paper (Shin-ichi Hirashima and Akichika Itoh, 2007) showed in fig.2

Fig.2. Showing different lighting methods used in the library; A- showed the natural lighting methods of the library from the window; B- showed the use of fluorescent lamps in the lighting of the library.

2- The showcases do not contain manufactured materials that control relative humidity, such as silica gel, which affects photochemical reactions, and the air-conditioning devices used in the library do not have filters and are not suitable for maintaining the temperature and relative humidity inside the library. All of these causes contributed to the numerous deterioration types depicted in fig.3.

Fig.3. Showing storage cupboards and air-conditioning devices; A-showed that the storage cupboards do not contain temperature and relative humidity measuring devices; B- showed the air-conditioning devices have no filters.

3- Because the display cases and storage closets were made of wood (such as oak wood), emits acidic fumes, such as acetic acid fumes so these acid vapors from the wood could cause chemical reactions between the photographic materials' paper backing and the wood. In addition, there is no insect repellant in the exhibits or storage cupboards, which promotes biological deterioration (Clarke, 2007).

Fig.4. Showing the materials of display cases and storage cupboards: A- showing the materials of display cases were wood; B- showing the materials of storage cupboards were wood.

3.1.2. Visual Assessment of the applied silver-gelatin photographic album titled with "Alexandria Stadium opening"

Photograph albums are books that tell a story through their images. The archaeological photo album is in poor condition. The choice fell on "Alexandria Stadium opening", according to its size and condition. It is a silver-gelatin photo album. The dimensions for outer cover album (45.8 x 33.5 cm^2), however the inside dimensions of the papers are (43.3 x 32.5 cm^2) which bears the photographs, the album include 20 pages, also the spine of the album is 2.6 cm. the out cover of the

album was made from chamois. There is some deterioration aspects found in the album that can appear in the Visual Assessment. With the critical eye observation it is noticed that the album suffers from:

- Detachment of the leather cover from the album; (Fig.5(b))
- Breaking of the sewing thread from the album spine; (Fig.5(b))
- Breaking of canvas strings of the album spine; (Fig.5(b, c))
- Dirt in the behind cover of the album; (Fig.5(a))
- Some Looses and tears on the outside spine; (Fig.1(c))
- Oxidizing in the insides photos; (Fig.5(d, e, f))
- Discoloration, some scratches and mechanical deterioration; (Fig.5(d, e, f))
- Ingrained dirt on the surface of paper and photos; (Fig.5(d, e, f))
- Some unknown staining colors and spots; (Fig.5(d, e, f))
- Weakness and Abrading of the fiber structure of the papers of album (Fig.5 (d, e, f)).

Fig.5. Documentation of different deterioration aspects which the album suffers from as explained above.

3.2. Microscopic Examination:

Scanning electron microscope (SEM) give us the case of the fibers of paper was not clear enough also there no yellowing in the photo prints which indicates it was not albumen but it is silver gelatin (figs. A, B). Also transmission electron microscope (TEM) emphasizes the silver existence (figs. C, D). But the paper layer is thin and the paper fibers cannot be seen in the image area under a microscope. Also baryta layer looks flat, solid, and almost structure less. The baryta layer increases paper whiteness and smooths out the paper surface.

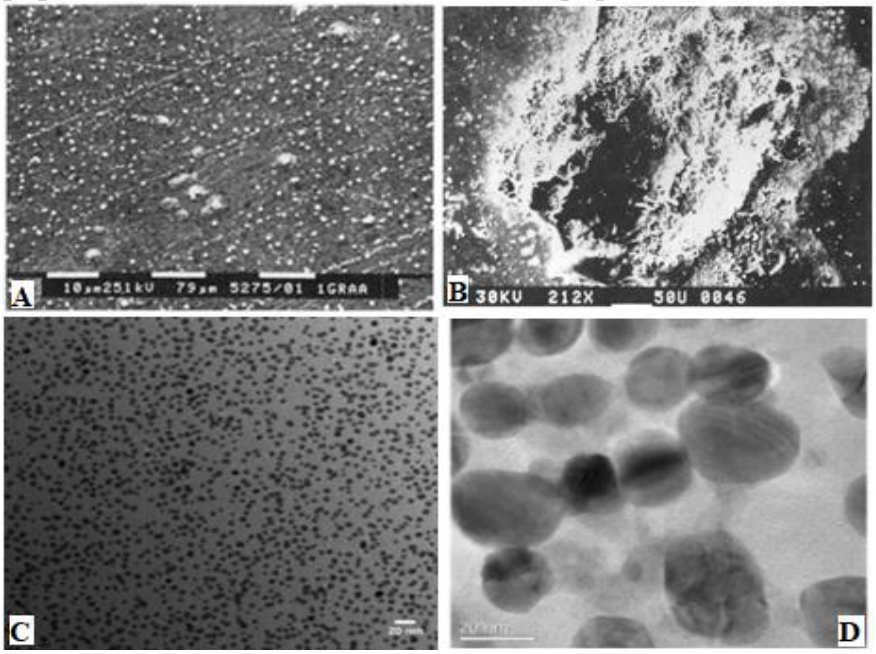

Fig.6. Scanning electron microscope (SEM) and transmission electron microscope (TEM) analysis of album samples: A, B- SEM examining of the archaeological photo sample which the fibers of paper was not clear (magnification 212X, spatial resolution 10nm); C, D- TEM examining of the archaeological photo sample which emphasizes the silver existence also baryta layer looks flat, solid, and almost structure less (magnification 20nm).

3.3. Identification of photo by X-Ray fluorescence (XRF):

Samples were analyzed by XRF analysis and the results shows that a significant decrease in the concentration of the silver element by looking at the presence of silver (Ag) in the spectrum (below), one can discern a significant difference between maximum and minimum density readings. In the XRF spectrum of silver gelatin photographs shows the presence of silver (Ag) also show the presence of a baryta layer identified by the presence of barium (Ba) and strontium (Sr) in the XRF spectrum.

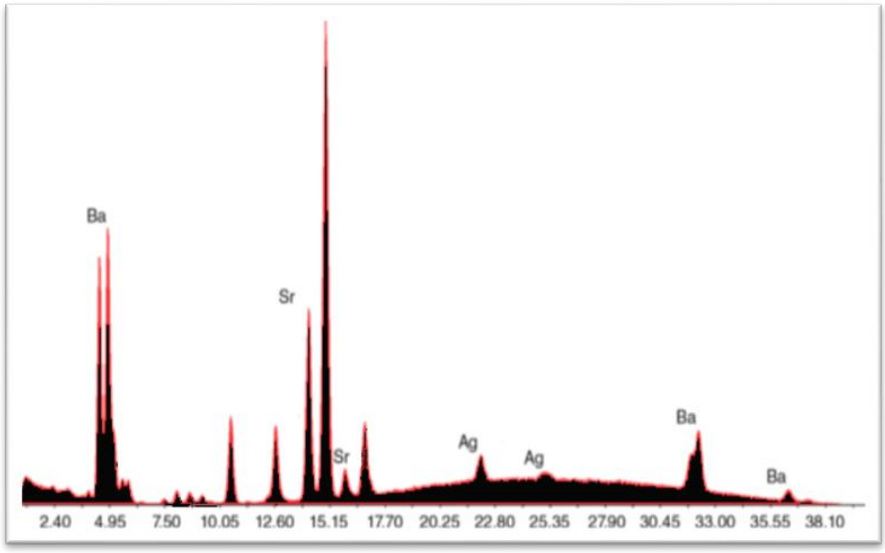

Fig.7. Identification of photo by X-Ray fluorescence (XRF) of the archaeological album photo

3.4. X-Ray diffraction analysis for determining the paper crystallinity (XRD):

Cellulose crystallinity can be calculated using the Segal method as mentioned before. The presence of crystallinity in cellulose is one of the most important characteristics contributing to its physical, chemical and Mechanical properties. Here in the X-Ray chart appear that there is high in crystallinity of cellulose.

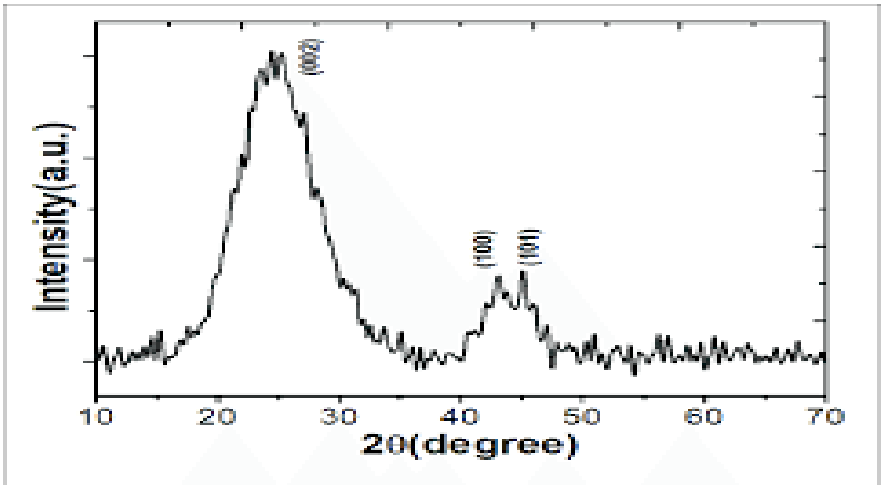

Fig.8. X- Ray diffraction analysis for determining the paper crystallinity of the archaeological album images

3.5. Fourier Transform Infrared Spectroscopy (FTIR) for determining the binder(Functional groups):

The results revealed that photographic paper and gelatin are greatly affected by oxidizing agents.

The FT-IR spectrum of PP29GF shows complete degradation of paper cellulose which was indicated by the increase in the intensity of carbonyl stretching bands at 1640.16 cm^{-1}, and the absence of the characteristic bands at 3277.43 cm^{-1}; 3071.08 cm^{-1}; 2931.27 cm^{-1}; 1233.25 cm^{-1}; 1163.83 cm^{-1}; and 1076.08 cm^{-1} (Maha, *et al*, 2012). ATR-FTIR analysis of POP silver gelatin photographs is usually a quick and highly reliable way to identify the gelatin binder of the photograph. The results show Amide I and Amide II spectral peaks that indicate the presence of proteins amide I (1600-1650 cm^{-1}), amide II (1500-1550 cm^{-1}), and amide III (≈1240 cm^{-1}). The ATR-FTIR spectrum of gelatin-based photographs shows three peaks at about 1450, 1393, and 1312 cm^{-1}. The peaks at 1450 and 1393 cm^{-1} are not the same intensity, with the peak at 1450 cm^{-1} usually being much more

intense than the peak at 1393 cm^{-1}. The peak at 1312 cm^{-1} is clearly visible for the typical concentration of gelatin.

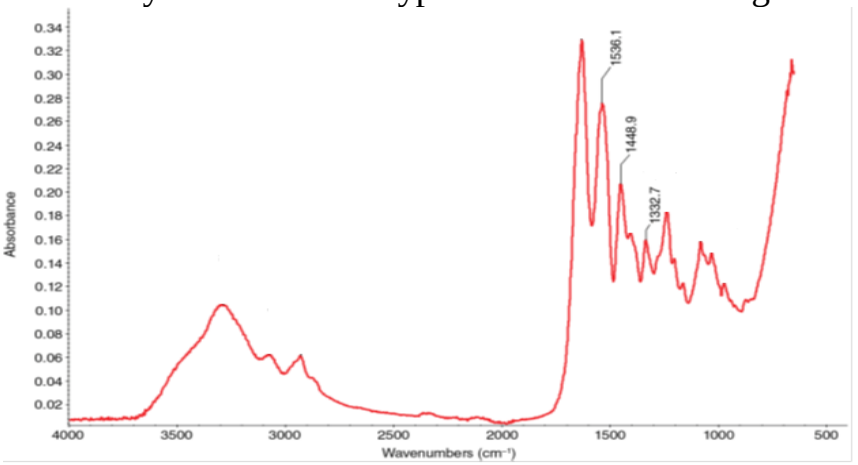

Fig.9. Fourier Transform Infrared Spectroscopy (FTIR) for determining the binder

3.6. Isolation and identification of fungi (collection of samples swabs):

In silver gelatin images, the organic components are considered potential carbon sources for the growth of microorganisms, if environmental conditions are adequate. The species identified in photographic album here are *Aspergillus niger* and *Aspergillus flavus*.

3.7. Preservation, Museum displaying and storage procedures:

The final step of Preservation and Storage was sterilization of the album to protect it from the microbiological infection in the future. Ethyl alcohol was used then the author recommended the standard degrees of relative humidity (30-50%), temperature (18-20˚C) and light (150 Lux) inside the library for long-term preservation of photographic albums [12].

Also the author to protect the photographs inside the album from abrasion suggest inserting sheets of acid-free

tissue paper or transparence paper between the album pages.

Proper storage conditions are the most effective method of ensuring the long-term preservation of gelatin silver prints. Proper storage means cool and moderately dry conditions, and appropriate storage materials. Poor-quality storage materials can also be harmful to gelatin silver photographs. Gelatin silver photographs should be stored in photographically inert enclosure materials such as 100% cotton rag or 100% alpha cellulose fibers [31]. The author also suggest anew way for preserving the albums in the library. It's new combined method for both displaying and storing methods in the same time of the photographic albums. The author recommends this method to be generalized to all other photographic albums with the same type of materials.

The author suggested making a storage box according to the appropriate measurements for the selected photographic album (taking into consideration that the measurements implemented for the box are not less than the specified measurements for the box and also not much larger than them so that the album does not move in the box, which causes damage for it) in which the photo album is saved when the box is closed. In the same time when the box is opened, there is an extra part is added under the album which is helped in displaying process. So that box is a combined new method of storage and displays the photographic albums in the same time. The author made the design of the box according to the following specifications:

- Program used: AutoCAD (Computer aided design)
- Version: 2018
- Operating system: Windows
- The Producing Company: Autodesk
- The programming language used: Auto LISP (C^{++})

Also the raw materials for the manufacture of the box are cardboard and acid free paper showed in fig.10 and 11. Also the author recommends that the contact with the albums should be completed from a digitized copy without direct contact which can be done by qualified person.

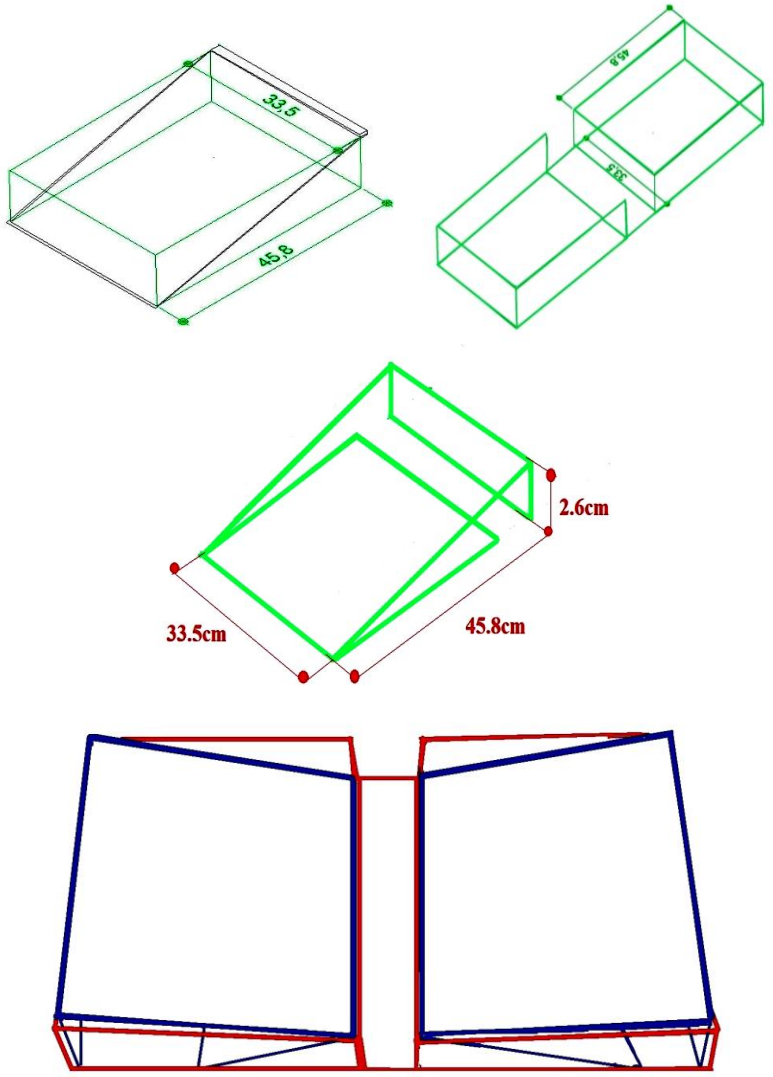

Fig.10. steps of making a storage box as a new method of storage and displays to the photographic albums in the same time using AutoCAD for the design.

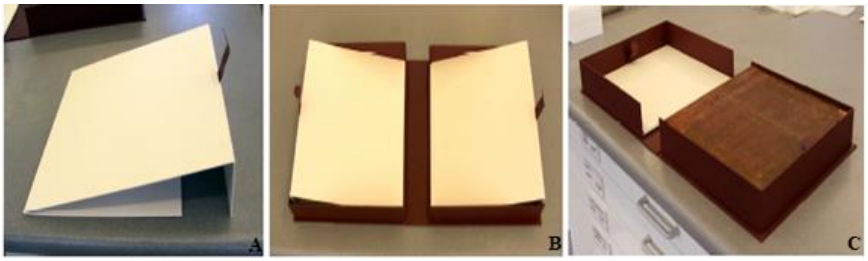

Fig.11. an imaginary image of the shape of Cradle and the box after its implementation, which is recommended to be applied to all the photographic materials (according to each case study) during the project of the library development.

4. DISCUSSION

The library titled "Dome library" located in south valley university in Qena was examined by a visual examination. As it is very important to clarify the damage aspects according to the deterioration factors found in the place which the library suffers from. The results showed the library suffers from many things that did not allow the suitable preservation of all preserved antiques in it, which led to different aspects of deterioration because of artificial light of fluorescent lamps; absence of light filtering devices; and the materials of display cases and storage cupboards were bad wood.

Also the samples examined with both SEM and TEM to emphasize the silver existence.

Modern SEMs are commonly outfitted with energy-dispersive spectrometers (EDS) to measure such X-rays. EDS is also sometimes abbreviated as EDX, EDXA, or the trade name EDAX. In SEM-EDS, one searches for and measures the intensity of characteristic X-rays at energies which correspond to elements within a specimen. But the paper layer is thin and the paper fibers cannot be seen in the image area under a microscope. Also baryta layer looks flat, solid, and almost structure

less. The baryta layer increases paper whiteness and smooths out the paper surface.

Besides X-ray diffraction images of paper samples were obtained in order to determine important nanostructural properties that may reflect macroscopic alterations in paper/cellulose properties which appeared in archaeological samples explained before in the results [32].

The results of FTIR revealed that photographic paper and gelatin are greatly affected by oxidizing agents and identify the gelatin binder of the photograph.

Finally the species identified in photographic album here are belonging to the *Aspergillus, Penicilluim, Cladosporium,* and *Trichoderma* species. Especially both *Aspergillus niger* and *Aspergillus flavus* on gelatin and the paper fibers on the album. And the authors suggested making a storage box according to the appropriate measurements for the selected photographic album.

5. CONCLUSION

These photographic images most commonly found in libraries which exposed to different factors of deterioration. The authors choose an example from the Dome Library in Faculty of Arts in South Valley University in Qena according to the developing project of the entire library. The authors concentrate on recommend new methods of displaying and storing of the photographic albums which can be used later besides some analytical techniques applied. Through a visual examination, it became clear that the Dome library suffers from effect of artificial light of fluorescent lamps also the absence of light filtering devices or air pollutants also the showcases do not contain manufactured materials that control relative humidity and the materials of display cases and storage cupboards were wood which

led to photograph albums become in poor conditions of deterioration for example a silver-gelatin photo album "Alexandria Stadium opening". By Microscopic Examination it was clear that the fibers of paper suffer from yellowing also baryta layer looks flat, solid, and almost structure less. Besides XRF results shows that a significant decrease in the concentration of the silver element but X-Ray chart appears that there is high in crystallinity of cellulose. But Amide I and Amide II spectral peaks indicate the presence of proteins with the ATR-FTIR spectrum. Also the species identified in photographic album are belonging to the *Aspergillus, Penicilluim, Cladosporium,* and *Trichoderma species.* Finally, the authors design a new method to save the album supported with Cradle to combine the process of preserving and displaying the album in one step using AutoCAD and recommends that the contact with the albums should be completed from a digitized copy without direct contact which can be done by qualified person.

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