Textile Conservation Techniques in the Museums of Egypt: A Review

[1*]Yogitha Gunupuru, [1*]Divya Krupa, [2]Saroj Yadav and [3]Neelam M. Rose
[1]Research Scholar, [2]Associate Professor and [3] Professor and Head of the Department
[1,2,3] Department of Apparel and Textile Science, I.C. College of Community Science,
CCS Haryana Agricultural University, Hisar, India
Corresponding Author: gyogitha2000@gmail.com, krupadivya440@gmail.com

Abstract

This article reviews conventional and advanced methods for textile conservation across the museums of Egypt. The rich and long history of textile production of Egypt is now facing hindrances due to conventional techniques and declining environmental conditions. This paper examines the transition from conventional methods of textile analysis and preservation to sophisticated scientific procedures using SEM, FTIR, and EDS. Examples from the Egyptian Museum, the Islamic Art Museum, and the Egyptian Textile Museum illustrate how these methods aid in the recovery of ancient textile treasures. The article emphasizes the necessity of employing a multidisciplinary approach and how advances in nanotechnology, biotechnology, and machine learning in the future could promote sustainable conservation efforts. Such initiatives promote the preservation of the priceless cultural assets.

Key words: Textile conservation, restoration, cultural heritage, museum textile storage, historical textiles

Introduction

From ancient times, Egypt's textile sector has gained international recognition. During the Dynastic Era in ancient Egypt, textiles were important to civilization. From ancient times, Egypt's textile sector has gained international recognition. The predominant fabric was linen, which was made in three primary categories, included royal linen, which was used exclusively in palaces. There is evidence of the advanced nature of textile manufacture in both surviving pieces and funeral art. Flax was cultivated, processed, and spun laboriously to manufacture linen threads of superior quality. Over time, weaving processes changed, involving men as well as women in various phases of the manufacturing process.

Throughout history, the textile sector has experienced significant growth thanks to the abundance of raw materials, which can be found locally, imported, or cultivated in fields. The manufacturing sector and its workshops employed a wide array of craftsmen in addition to weavers who were highly skilled in the art of weaving. Egyptian weavers made the textile industry flourish in a number of industrial hubs, including the Delta towns, Cairo, and Upper Egypt, where it is still functioning today. During the Islamic period the museums of Egypt, Arab, and foreign countries, as well as private collections, include a large number of remnants of textiles manufactured in Egypt and the surrounding areas over the years. particularly during the Islamic period (Mohamed, 2022).

Numerous factors negatively impact archaeological textiles in Egyptian museums, which might involve fluctuating relative humidity (RH), temperature changes, light and air pollution effects, unconventional methods of storing and displaying the textiles, outdated or inadequate restoration techniques, and expired adhesives like Arabic gum, animal glue, and starch (Lemberg, 1998). The combined effects of these substances deteriorate and worsen the dyes and fibres, making the fibres harder, causing separation and loss of fragments, staining, and dust accumulation (Harby, 2002). Oxidation, moisture, heat, radiation, microbial invasion, and mechanical strains are among the natural causes of textile deterioration (Vinita, 2018). Cellulosic textile deterioration results in a breakdown of the molecular configuration, which impairs the material's strength, appearance, and durability. It also causes discolouration and fading (Tera and Shady, 1993). In order to preserve historical textiles for future generations, it is necessary to strike a balance between safeguarding the evidence and improving the long-term conservation of the materials (Timar-Balazsy and Eastop, 1998).

Textiles play a crucial role in preserving a society's cultural legacy, showcasing its social, artistic, and technological advancements. Historical fabrics provide valuable insights into daily life i.e., trade and economic systems of ancient civilizations. Their preservation enables archaeologists and historians to study ancient techniques, materials and advances in conservation. It not only enhances conservation

science and technology but also contribute to broader preservation of cultural heritage by applying innovative materials and techniques. This paper aims to present techniques for preserving and restoring historic Egyptian textiles. It highlights to recent advancements in analytical and conservation techniques and also provides an overview of the history, current state, and prospects of textile conservation.

The Evolution of Textile Conservation – Past, Present, and Future

Textile conservation has likely been practiced for as long as humans have utilized textiles. However, it is undeniable that traditional textile conservation practices were quite distinct from the recognized and established existing scientific guidelines. The science of textile conservation had its origins in the early 1900s (Barlow, 2016). Initially, most of the conservation work was done empirically, generally by curators and collectors adopting techniques derived from traditional crafts and practical expertise rather than scientific principles. The initial techniques included stitching and repairing, often using suboptimal materials caused the fabrics to deteriorate further. Chemical treatments were frequently applied to protect fibres from mold and insects. However, due to limited knowledge of how chemicals interact over time, these treatments often resulted in long-term damage (Timár-Balázsy and Eastop, 1998).

Textile conservation is an advanced field that integrates technology, science, and artistic vision worldwide. In order to get a microscopic description of the composition and state of textiles, present conservators employ a variety of sophisticated analytical methods, including Fourier-transform Infrared Spectroscopy (FTIR), Energy-Dispersive X-ray Spectroscopy (EDS), and Scanning Electron Microscopy (SEM). By identifying fibres, dyes, and products of decay, these approaches enable the development of more effective conservation measures (Kamel *et al*., 2014).

The most effective methods focus on minimal intervention and reversibility, ensuring that any preservation process can be reversed without causing further damage. Mild solvents and micro-vacuuming are few preferred non-invasive cleaning techniques. Detailed records of the textile's state and the conservation process have become accessible due to the incorporation of digital documentation, which completely transformed the area and may be extremely helpful for future study and treatment (Quye and Lennard, 2015). Textile conservation is a multidisciplinary field that encompasses several scientific disciplines, including physics, biology, chemistry, applied arts, humanities, and history. Keeping up with advancements in all these areas is crucial for effectively preserving textile artifacts. Currently, there are significant advancements in each of these fields of study (Ahmed, 2012).

The future of textile conservation lies in the continuous advancement of technology and the interdisciplinary approach that combines chemistry, material science, and digital technologies. Innovations in nanotechnology and biotechnology promise to bring new materials and methods that can protect and preserve textiles more effectively. For instance, the development of nanofibers and bio-based polymers offers new solutions for reinforcing weakened fabrics without altering their appearance or texture (Karimnejad *et al*., 2017). Another promising area is the use of 3D scanning and printing technologies to create precise replicas of fragile textiles for study and display, reducing the need for handling original artifacts. Additionally, machine learning and artificial intelligence can assist in predictive maintenance by analyzing environmental data and wear patterns to foresee and mitigate potential damage before it occurs (Zhang and Gao, 2020).

Conservation Techniques and Analytical Methods used in Egyptian Museums

Identification of fibres, dyes, and adhesives in textiles requires the use of a variety of analytical methods, including SEM, UV analysis, FTIR, and XR-D. Reactivation consolidation, needlework, and the use of polymers for reinforcement are a few such restoration techniques. Advanced techniques like laser cleaning and reversible procedures to replace damaged portions. Below are the techniques used by the Egyptian museums for preserving and conserving textiles.

1. **Visual Analysis**: Textiles are visually examined to assess their condition, identity, visible signs of degradation, soiling or damage. This preliminary evaluation provides insights into the object's condition and guides further analysis (Abdel-Kareem *et al*., 2008).

2. **pH Testing**: To ascertain the textile object's degree of acidity, surface pH testing is carried out. Assessing the object's overall stability and preservation prerequisites, as well as the possible consequences of acidic deterioration (Abdel-Kareem *et al*., 2008).
3. **Microscopy**: The fibres, surface morphology, and structural features of the textile can be examined at the microscopic level using methods such as optical microscopy and SEM (Scanning Electron Microscope) to evaluate the degree of deterioration and damage. (Abdel-Kareem *et al*., 2008).
4. **Scanning Electron Microscopy** (FEI-QUMTA 200SEM) The fibres can be examined in detail using the SEM to assess damage levels and design appropriate restoration techniques (Amin and Rashed, 2013).

Fig. 1. New Approach for Conservation of a Silk Fabric in the Islamic Art Museum, Cairo (Harby *et al*., 2011)

Fig. 2 Conservation of a Rare Painted Ancient Egyptian Textile Object from the Egyptian Museum in Cairo showing before and after conservation (Abdel-Kareem *et al*., 2008).

Fig. 3 Preservation and Restoration of a Piece of a Textile at the Egyptian Textile Museum showing before and after conservation (Amin and Rashed, 2013)

5. **SEM morphological examination**: This method uses a scanning electron microscope for examining the surface of the fabric at the microscopic level. The quality of the fibres, any damage, and the existence of dust and adhesive particles were all determined with its assistance. (Harby *et al*., 2011)
6. **Infrared Spectroscopy**: Fourier Transform Infrared Spectroscopy (IR) examines the textile's constituents' chemical structure i.e., fibre structure, pigments, and other materials utilized in the fabrication of the piece can be identified with the use of this analytical technique (Abdel-Kareem *et al*., 2008).
7. **X-ray diffraction analysis**: Examines fabric and determines the kinds of particles and mordants that are present. This method also reveals information about fabric's composition and any other components that could be present. (Harby *et al*., 2011)
8. **Fourier Transform infrared spectral analysis (FTIR)**: The textile samples were analyzed using FTIR to determine the presence of organic stains and dyes. The sorts of dyes employed in the cloth were identified by the researchers by comparing the spectra of the samples with those of recognized dyes. (Harby *et al*., 2011)
9. **UV analysis**: The Perkin Elmer Lambda 900 is used to identify the components in the artifact such as adhesives and dyes to guide the restoration procedure (Amin and Rashed, 2013).
10. **Dye stability testing**: This tests how well dyes perform in textile resists wetting agents. The stability was assessed by immersing cotton

warps in cleaning solutions placed against dyed areas to check for colour bleeding or fading (Harby *et al.*, 2011).

11. **Wetting Process**: To address brittle and dry edges, controlled wetting processes using alcohol and water are employed. This restores moisture and makes artifact stable enough for future conservation steps (Amin and Rashed, 2013).
12. **Mechanical cleaning**: Loose dust and grime present on the surface of fabric can be cleaned using fine brushes and vacuum cleaners. This method ensures that any stray particles that weren't affixed to the cloth can be carefully eliminated without causing any damage. (Harby *et al*., 2011)
13. **Wet cleaning technique**: Remove dirt and debris by allowing water and mild detergents to penetrate the fibres. Several wash cycles with gentle agitation were used followed by rinsing to remove contaminants without damaging the fabric or dyes (Harby *et al*., 2011).
14. **Drying procedure**: To make sure the fabric dried without deforming, various drying methods are used, such as air drying and employing a Japanese tissue sandwich. In order to preserve the fabric's integrity and avoid damage, proper drying techniques are essential. (Harby *et al*., 2011)
15. **Elimination of the traditional restoration error**: The traditional method of using wet cardboard to dissolve adhesive often leaves residual materials behind. To address this, poultices made from acid free paper were applied to effectively breakdown the paste and completely remove any glue and cardboard preventing long term damage (Harby *et al*., 2011).
16. **Textile Support**: To keep the warp and weft directions consistent, plain Weave fabric can be used after cleaning and is later stretched on a wooden frame. (Amin and Rashed, 2013)
17. **Fixation**: Using needlework, the artefact can momentarily be affixed to the textile support using cotton thread and thin needles. Tacking and couching stitches were used with silk thread and fine needles to fix the writing portion of the artefact for long-term support ensuring long term stability and protection (Amin and Rashed, 2013).
18. **Reinforcement**: To extend the durability of the fabric, a protective layer of Lascaux can be applied to reinforce the silk screen support by using an acetone poultice to help reactivate the adhesive and protects from damaging factors like dust and UV radiation (Abdel-Kareem *et al*., 2008).
19. **Surface consolidation**: In order to prevent additional damage, surface consolidation entails stabilizing brittle or damaged textile sections. This might entail using adhesives or consolidates to reinforce weak spots in the cloth and bind loose threads or fibres. (Harby *et al*., 2011)
20. **Stitching and patching**: These methods are frequently employed to fix holes, rips, and other damages in antique fabrics. Expert textile conservators smoothly restore damaged sections while preserving the original piece's integrity by using compatible materials and specialized sewing techniques. (Harby *et al*., 2011)
21. **Final support process**: The tapestry was preserved and displayed in the museum setting for long-term conservation by appropriately supporting and framing it using a metallic frame for exhibition and securing the fabric to a fresh linen support. (Harby *et al*., 2011)
22. **Museum Display**: For displaying the artifact, a foam frame had been used. The artifact was hung for display after a piece of foam was cut and positioned below the cloth support. In addition to successfully showcasing the artifact, this protective display technique offered support and defence against additional harm while it was on display. (Amin and Rashed, 2013)
23. **Display**: The ancient silk fabric was displayed in a case with a brand-new steel frame support system that the researcher had created for the Islamic Art Museum in Cairo. New linen cloth stretched on the metal frame served as backing for the textile. (Harby *et al*., 2011)

24. **Storage**: The historical silk fabric in Cairo's Islamic Art Museum was kept under glass that was secured to a plywood framework backed with cotton fabric, an anchoring support, and glass having a plastic sticker affixed to the edges. (Harby *et al*., 2011)

Conclusion

Egyptian historical textile conservation is a complex process that blends traditional artistry with advanced scientific methods. Given the rich textile legacy of ancient Egypt, physical and biological analyses using advanced conservation techniques are essential for determining the state of textiles and developing suitable restoration plans. As conservators work to stabilize and conserve these artifacts, these techniques offer deep understanding into the fibre composition, structural integrity, and degree of microbial infection. Furthermore, the significance of textiles in terms of history and culture emphasizes how crucial it is to preserve them. Perspectives about the everyday activities, commerce, and creative expressions of ancient cultures can be gained from preserved textiles. In order to raise public awareness and foster an appreciation of cultural heritage, they help improve museum exhibits and fund educational programs. The necessity for continuous assistance in this area is further highlighted by the financial advantages of conservation, especially through tourism. Continued technological development and multidisciplinary cooperation are key to the future of textile conservation. Advances in digital recordkeeping, biotechnology, and nanotechnology hold forth the potential of less intrusive and more efficient conservation techniques. Conservators can better preserve Egypt's textile legacy for next generations by fusing traditional knowledge with contemporary technological advancements.

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