

Study of the Antifungal Effects of Copper-based Pigments and Synthesized Nanomaterial on Mural Painting-deteriorated Fungi in the Egyptian Museum in Tahrir

Dr. Seham Ramadan

Conservation Department, Faculty of Archaeology, Fayoum University, Egypt.

srm03@fayoum.edu.eg

Prof. Gamal Mahgoub

Conservation Department, Faculty of Archaeology, Fayoum University, Egypt.

Prof. Mohamed S. Abdel-Aziz

Microbial Chemistry Departments, National Research Centre, Dokki, Giza, Egypt.

Dr. Austin Nevin

Institute for Photonics and Nanotechnologies, National research council, Milan, Italy.

Dr. Abdelrazek Elnaggar

*Conservation Department, Faculty of Archaeology, Fayoum University, Egypt.

*Faculty of International Business and Humanities (FIBH, Egypt-Japan University of Science and Technology (E-JUST), Alexandria, Egypt

Abstract

Seven fungal strains, namely: *Aspergillus terreus*, *A. clavatus*, *A. niger*, *A. humicola*, *A. sydowii*, *Paecilomyces variotii* and *Fusarium oxysporum* were isolated from Stelae dates back to the 19th Dynasty of the New Kingdom of the reign of King Sity in ancient Egypt, respectively. The isolated fungi were identified by studying their macro and micro-morphology. Furthermore, nanogel, nanolime and nanosilver were tested to study their ability to inhibit the fungal growth of the isolated fungi. The potent fungus, *A. terreus*, which showed best result in nanosilver biosynthesis *Aspergillus clavatus* (25mm) > *Aspergillus niger* (24mm) > *Aspergillus sydowii* (22mm) > *Paecilomyces variotii* (20mm) and *Fusarium oxysporum* (20mm) > *Aspergillus terreus* (14mm) > *Aspergillus humicola* (12mm), was further identified by the molecular technique (18S rRNA). Nanosilver. On the other hand, nanolime followed nanosilver in its antifungal effect against isolated fungal strains and its activities followed the order: *Aspergillus niger* (22mm). Different nanomaterials (nanogel, nanolime and nanosilver) were prepared either chemically followed by nanogel exhibited the highest antifungal activities against the isolated fungi whereas nanolime exhibited weak antifungal activity. The effect of archaeological pigments (Malachite, Azurite, Egyptian green and blue) on the isolated fungi as antifungal agents was also investigated. It has been found that Azurite and malachite showed a considerable effect more than the Egyptian green and Egyptian blue. The hydrolysis of animal glue, binding material, was also studied by cultivating the isolated fungi in broth medium containing animal glue as nitrogen source and the proteolytic activity of their culture filtrate has been assayed.

Key Words: Stelae, Pigment, Fungi, Nanomaterials, Animal glue.