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Experimental study on evaluation of the efficiency of metallic nanoparticles and essential oil nanoemulsions in disinfection of microbial deterioration of historical parchment applying on a selected object

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THESIS

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Abstract

Parchment was used as a writing material and as a support for many forms of art works from about 200 BC until late medieval times, when it was supplanted by paper.

Biodeterioration is an important factor impairing aesthetic, functional and other properties of parchment. It takes place particularly under condition of high relative humidity that enables bacteria, actinomycetes or fungi to grow. Many chemical and physical methodologies have been applied in order to protect different art forms from microbial deterioration but most of them had some disadvantages. For instance some of them are toxic and restricted in some countries; others induce change of color or reduction of tensile properties of treated objects. So we thought to utilize nanotechnology in this side as some nanomaterials proved their effect as antimicrobial agents in several fields of life such as medicine and food industry also there are some applications in the field of conservation of historical materials in consolidation, deacidification or self-cleaning. There are also limited numbers of researches about the possibility of using these nanomaterials in disinfection of biodeteriorated museum artifacts and historical objects.

In this study disc agar diffusion method and Colony forming units (CFU) were established to estimate the ability of silver and titanium dioxide nanoparticles and lemongrass and tea tree oils in their normal and nanostate to kill and inhibit the growth of four strains of microorganisms; three fungal and one bacterial isolated from historical parchment manuscript and molecularly identified and examined for their abilities to hydrolyze collagen fibers of parchment.

The promising materials were used to treat parchment samples and examined for their impact on aesthetic, physical and chemical structure of

parchment before and after aging; mechanical properties (tensile strength & percent elongation), Fourier transform infrared spectroscopy, scanning electron microscopy and change of color of treated and aged parchment were conducted to stand on the possibility of using these materials in disinfection of historical parchment manuscripts.

Keywords

Parchment
Collagen fibers
Deterioration
Degradation
Microbial
Fungi
Actinomycetes
Disinfection
Nanoparticles
Nanoemulsions
Silver nanoparticles
Titanium dioxide nanoparticles
Essential oils nanoemulsions
Lemongrass
Tea tree
Tensile strength
Elongation
FTIR analysis
SEM micrographs
Color change
TEM
Zeta potential

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Special

Dedication

For

I dedicate this thesis on the soul of my dear mother.

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