CHARACTERIZATION OF MICROORGANISMS ISOLATED FROM DIFFERENT ARCHAEOLOGICAL MATERIALS AND EFFECT OF ENVIRONMENTAL FACTORS ON THEIR BIOLOGICAL ACTIVITIES

By

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B.Sc. (Biochemistry and Nutrition), Ain Shams University, 2000.

M.Sc. Agric. Sc. (Agricultural Microbiology), Ain Shams University, 2012

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ABSTRACT

Fatma Mahrous Faheim El-Wekeel: Characterization of Microorganisms Isolated from Different Archaeological Materials and Effect of Environmental Factors on their Biological Activities. Unpublished Ph.D. Thesis, Department of Agricultural Microbiology, Faculty of Agriculture, Ain Shams University, 2016.

Microbial deterioration of Archaeological objects was studied in various historical places of Egypt and methods for treatment were suggested. Seventy samples were taken from different Archaeological materials from nine locations in Greater Cairo area, by swabbing contaminated spots. Sampling locations were: Egyptian Textile Museum, Third Pyramid Egyptian Museum, Cheops Boat museum, Amri Tomb, Nefer Baw Betah Tomb, El-Kady Abdel-Baset Mosque, The Royal Carriages Museum (Boulak) and The Royal Carriages Museum (Cairo Citadel) . Environmental conditions (temperature, pH and relative humidity) inside sampling locations were recorded during the four seasons for one year. Sampling resulted in 258, 42 and 6 colonies of fungi, bacteria and actinomycetes, respectively. Identification of fungal colonies revealed that they represent 31 species belong to 14 genera, namely *Aspergillus, Penicillium, Acremonium, Fusarium, Stemphylum, Rhizopus, Cladosporium, Botrytrichum, Pacillomyces, Trichoderma, Cheatomum, Botrytis, Alternaria and Mortierella*. Bacterial colonies represent two species of the genus *Bacillus* and actinomycetes colonies were two species of *Streptomyces* and one species of *Saccharopolyspora.*

Biological activities of the obtained isolates were studied by determining production of cellulase, protease, lipase and amylase by the obtained isolates using the cup plate technique. esults showed that the most potent isolate for cellulytic activity was *Aspergillus flavus*, for proteolytic activity was *Asp. candidus*, and for both amylolytic and lipolytic activities was *Fusarium poae***.**

Effects of environmental conditions (pH, incubation temperature and incubation period) on enzymes production by the selected isolates were studeid. The highest yields of all enzymes (cellulase, protease, lipase and amylase were achieved (after 7 days at 30**°C** and pH 5).

The minimal inhibitory concentration (MIC) of the three microcides; which were dichloroxylenol, penta-chlorophenol and p-chloro-meta-cresol were determined against all microbial isolates using the disk diffusion technique.

The MICs dichloroxylenol, penta-cholorophenol and p-chloro-m-cresol that inhibit all tested microbial isolates were 1000ppm, 900ppm and 2500ppm, respectively.

To determine the effect of microbial infection of physical, morphological and chemical properties of the studied materials, new pieces of linen textile, pine wood, Racta paper, leather and limestone specimen were infected with the corresponding isolated microorganisms and incubated for 2 months at ambient temperature and 60-70% humidity.

Examination of physical properties of the infected pieces showed black and red spots occurred on the infected pieces of paper and wood, loss of strength and elongation and beige, dark and brown spots on the textile piece and change in color from yellow to dark and brown on leather. On limestone, black spots occurred, without change in shape, specific gravity decreased from 1.77 to 1.43, water absorption increased from 5.31 to 7.23 and texture changed from smooth to slight roughens.

Morphological properties of the infected pieces were determined using Binocular dissecting stereomicroscopy at low magnification (8-36 X) and Scanning Electron Microscope (SEM) combined with energy dispersive analysis of X-ray (EDAX) unite. Results revealed fungal infiltration and mat of filamentous fungal threads on all tested specimen.

Chemical properties were determined by FTIR (Fourier Transform Infra-Red) apparatus. Results showed changes in concentrations of carbon and aluminum, and some ions like Na, Si, S and Cl appeared after infection in wood specimen.

Infected textile, wood, paper, leather and limestone pieces were treated with dichloroxylenol at 1000ppm, penta-chlorophenol at 900ppm and -chloro-m-cresol at 2500ppm and results also showed that all used microcides at their best concentrations were sufficient to completely prevent the growth of all microbial isolates for 6 months.

Keywords: Archaeological materials, Microbial deterioration of artifacts, environmental conditions, Enzymes activity, microbiocides, deteriorating factors.

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Dedication

To the soul of My Father and Mother

To my family and true friends

To everybody who helped me in this work

With Admiration, Appreciation and Respect

Finally

I'm really grateful to my husband for his continuous supporting and encouragements

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