Faculty of Science

BIOLOGICAL TREATMENT OF PLASTIC POLYETHYLENE WASTES AND SOME HAZARDOUS ELEMENTS BY *PLEUROTUS PULMONARIUS*

Thesis

Submitted for Ph.D. Degree in Microbiology

By

Bassant Mohammed Ibrahim Hashem

B.S.c. Microbiology- Chemistry (2002)

M.Sc. in Microbiology (2009)

In Microbiology

Faculty of Science
Ain Shams University

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بسم الله الرحمن الرحيم

(سبحانك لا علم لنا الا ما علمتنا انك انت العليم الحكيم)

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Thesis Title: Biological treatment of plastic polyethylene wastes and some hazardous elements by *Pleurotus pulmonarius*

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Bassant mohammed

DEDICATION

I would like to dedicate this work to my parents and my husband for their encouragement, putting up with me and supporting me through all this work.

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Abstract

Plastic material is one of the most serious solid wastes pollution and it's accumulation in the environment is highly resistant to biodegradation. Mushrooms are being used to break down previously harmful material. On the other hand, Heavy metals are known to act as a general protoplasmic poison, Mushrooms can act as effective biosorbent of toxic metals. The main aim of this study is to grow mushroom (*Pleurotus pulmonarius*) on different plastic polyethylene wastes and liquid waste contaminated with heavy metals as a new biological technique which help environment to get off them by safe biological technique.

Pleurotus pulmonarius was grown on determined weight of different plastic polyethylene wastes namely; wet straw, non irradiated plastic, irradiated plastic, mixture of straw and non irradiated plastic and mixture of straw and irradiated plastic. The spawn of *Pleurotus pulmonarius* was irradiated by gamma irradiation at doses 0.5, 1 and 2 KGy, and inoculated on each different wastes separately to activate the growth of *Pleurotus pulmonarius* on them.

The behavior of non irradiated *Pleurotus pulmonarius* after growth was also studied by detecting the changes in enzymatic activities (cellulase, xylanase, laccase) and total protein content of mushroom. Cellulase and xylanase enzymes gave maximum value after first harvest. Although laccase activity gave maximum values after 18 days (mycelial stage), but total protein content increased remarkably with incubation period. The spawn of *P. pulmonarius* was irradiated at the does 0.5, 1 and 2 KGy, and inoculated on each different wastes separately to detect the enzymatic activities (cellulase, xylanase, laccase) and total protein content; which were increased in the various wastes by exposing the spawn of *P. pulmonarius* to gamma irradiation and detectable raises in the enzymes

activities and total protein content were recorded at dose 0.5 KGy, Any further increase in the irradiation dose was accompanied by a decrease in enzymes activities and total protein content until reach lowest value at 2 KGy.

The present study showed that the treated polymers by mushroom were more fragile, less resistant to the breaks or fragmentations when discarded in the environment and can be more susceptible to mineralization than those waste plastics without fungal treatment but infra red analysis for treated polymers don't showed any changes.

There was variation between heavy metals in the effect of their concentration in growth of *Pleurotus pulmonarius* so that Zn gave maximum growth at 50 µg\ml but *Pleurotus pulmonarius* unable to grow at the same concentration for each heavy metal Co and Ni, although it was grown at 100 µg\ml for Pb. On the other hand, *Pleurotus pulmonarius* was grown at 10 µg\ml for Co, at 15 µg\ml for Ni. These concentrations considered presublethal concentrations which mean that the maximum concentration of heavy metal after that the fungus becomes more sensitive to any increase in heavy metal concentration.

The spawn of *Pleurotus pulmonarius* exposed to different gamma irradiation doses (0.0, 0.25, 0.50, 1.0, 2.0, 2.5 kGy) to activate up taking of presublethal concentration of different element. *Pleurotus pulmonarius* gave maximum growth at 0.25 KGy then as gamma irradiation increased as growth of *Pleurotus pulmonarius* decreased until reached minimum growth at 2.5 kGy so that 0.25 KGy considered an activation dose for uptaking of presublethal concentration of each element (Zn, Co, Pb, and Ni) comparing to other doses.

Keywords: plastic polyethylene wastes,*Pleurotus pulmonarius,* cellulose, xylanase, laccase ,total protein, gamma irradiation, infra red analysis, heavy metals, presublethal concentration.

LIST OF ABBREVATION

BTEX	**benzene, toluene, ethylbenzene and xylene**
CM-ase	**CM-cellulase**
CMC	**Carboxmethyle cellulase activity**
DSC	**Differential scanning calorimetry**
F1	**Beginning of fruiting stage**
F2	**End of fruiting stage**
GSH	**Glutothionine**
MT	**Metallothionein**
NIR	**Near-infrared**
NMR	**Nuclear magnetic resonance**
PAHs	**Polycylic aromatic hydrocarbons**
PCP	**Pentachlorophenol**
PCs	**Phytochelatins**
Pr1	**Beginning of primordium stage**
Pr2	**End of primordium stage**
PUR	**Plastic Polyester Polyurethane**
SRS	**Spent rice straw**

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