



Ain shams University
Faculty of women for Arts, Science and Education

Biodegradation of synthetic textile dyes in waste water by some yeasts

A Thesis

Submitted to the Department of Botany, Faculty of Women for Arts, Science and Education, Ain Shams University In partial fulfillment for the award of the Degree of Master of Science (Microbiology)

By

Doaa Saber Abdel Maksoud El faramawy
B.Sc. Microbiology and Chemistry (2010)

Under Supervision

Prof. Hoda Hassan Abo Ghalia
Prof.of Microbiology, Botany Department,
Faculty of Women for Arts, Science and
Education,
Ain Shams University

Prof. Sanaa Mohamed Ashour
Prof.of Microbiology, Botany Department,
Faculty of Women for Arts, Science and
Education,
Ain shams university

To

Botany Department
Faculty of Women for Arts, Science and Education,
Ain Shams University

2017

M.Sc. Thesis

Name: Doaa Saber Abdel Maksoud El faramawy

Title: Biodegradation of synthetic textile dyes in wastewater by some yeasts

Scientific Degree: M.Sc. in Science (Microbiology)

Department: Botany

Faculty Name: Faculty of Women for Arts, Science and Education

University: Ain Shams University

***This thesis has not been previously submitted for any degree
at this or any other university***

Signature

Doaa Saber Abdel Maksoud El faramawy

Supervisors

Prof. Hoda Hassan Abo Ghalia

Prof. of Microbiology, Botany Department,
Faculty of Women for Arts, Science and
Education, Ain Shams University.

Prof. Sanaa Mohamed Ashour

Prof. of Microbiology, Botany Department,
Faculty of Women for Arts, Science and
Education, Ain Shams University.

Approval Sheet

Name: **Doaa Saber Abdel Maksoud El faramawy**

Title: **Biodegradation of synthetic textile dyes in wastewater by some yeasts**

Approved by

Signature

Prof. Hoda Hassan Abo Ghalia.....

Prof. of Microbiology, Botany Department, Faculty of Women for Arts, Science and Education, Ain Shams University.

Prof. Sanaa Mohamed Ashour.....

Prof. of Microbiology, Botany Department, Faculty of Women for Arts, Science and Education, Ain Shams University.



Acknowledgement

Acknowledgement

First of all, thanks are due to **Allah** to **WHOM** I relate any success in my life.

I would also like to express my sincere appreciation and gratitude to **Prof. Sanaa Mohamed Ashour**, Professor of Microbiology, Botany Department, Faculty of Women for Arts, Science and Education, Ain Shams University for her unlimited and devoted efforts, valuable constructive ideas, her continuous guides and supervision during the work and data collection.

My special thanks and deep appreciation to **Prof. Hoda Hassan Abo Ghalia**, Professor of Microbiology, Botany Department, Faculty of Women for Arts, Science and Education, Ain Shams University for her unlimited and devoted efforts, valuable constructive ideas, her continuous guides and supervision during the work and data collection.

I also would like to express my thanks and appreciation to **Dr. Ahmed khalafalla**, Professor assistant of Ecology, Botany Department, Faculty of Women for Arts, Science and Education, Ain Shams University for his help in working the statistical analysis.

Words fail to express my greatest appreciation to all my professors and colleagues of Botany Department, Faculty of Women for Arts, Science and Education, Ain Shams University.

Lastly but not least, words won't be enough to describe my deep appreciation, thanks and supreme gratitude to all family especially **my dear mother**, who had unfailingly supported me at all times and had never lost their patience with me. My words stand short of my supreme gratitude and thanks to my brothers and my sisters for their continuous support and encouragement.

Most of all, I owe my warmest thanks to **my husband**, I greatly indebted to him for moral help, his share and pushing me and my lovely children **Mohab and Nour**, the time spent on this thesis has time taken away from them.

List of Contents

<u>Contents</u>	Pages
Abstract.....	X
Introduction.....	XIV
Plan of the work.....	
Review of literature.....	1
1-Characteristics of textile wastewater.....	1
2-Dyes used in textile industry.....	6
A. Azo dyes.....	9
B. Anthraquinone dyes.....	11
C. Triphenylmethane dyes.....	13
3-Impacts of dyes to the environment and human's health...	15
4-Treatment of textile wastewater containing dye.....	18
4.1. Physical methods.....	19
4.2. Chemical methods.....	22
4.3. Biological methods.....	25
4.3.1. Microbial biosorption.....	26
4.3.2. Biodegradation.....	27
5-Factors affecting dye biodegradation in textile wastewater.....	31
6-Enzymes used in dye decolorization.....	33
6.1.Laccases.....	34
6.2.Peroxidases.....	36
6.3.Tyrosinases.....	39

7-Phytotoxicity and microbial toxicity of dyes.....	39
Material and Methods.....	41
1-Samples collection and preservation.....	41
2-Dye stuff and chemicals.....	41
3-Culture media.....	42
4-Isolation, purification and maintenance of yeasts.....	43
5-Screening of isolates for textile dye degradation	44
6-Identification of dye-degrading yeasts.....	45
7-Optimization of environmental parameters that affect the decolorization process.....	49
8-Enzyme activity.....	54
9-Extraction and analysis of products obtained after dye decolorization.....	55
10-Phytotoxicity study.....	55
11-Statistical analysis.....	56
Results and discussion.....	57
General discussion.....	167
Conclusion and Recommendation.....	176
Summary.....	178
References.....	184
Arabic summary.....	
Arabic abstract	

List of Tables

Table	Title	Pages
(1)	Major types of pollutants in textile wastewater, their origin and relevance impact in biological treatment	3,4,5
(2)	Characteristic features of dyes used in the textile industry	7,8
(3)	Screening of dye degrading yeasts grown on broth and solid decolorization media supplemented with methyl red, reactive brilliant blue (100 mg / l) and /or malachite green dyes (10 mg / l) at 25° C of incubation for 24 h	58,59
(4)	Morphological characteristics of the selected yeast isolates	61
(5a)	Physiological characteristics of the selected yeast isolates under aerobic conditions	62,63
(5b)	Physiological characteristics of the selected yeast isolates under anaerobic conditions	64
(6)	The substrate assimilation and identification of the selected yeast isolates by Integral system plus	65
(7)	Effect of incubation temperature on the decolorization of methyl red dye by the selected yeast strains	70
(8)	Effect of incubation temperature on the decolorization of reactive brilliant blue dye by the selected yeast strains	72
(9)	Effect of incubation temperature on the decolorization of malachite green dye by the selected yeast strains	74
(10)	Effect of incubation time on the decolorization of methyl red dye by the selected yeast strains at the optimum temperatures	77
(11)	Effect of incubation time on the decolorization of reactive brilliant blue dye by the selected yeast strains at the optimum temperatures	79
(12)	Effect of incubation time on the decolorization of malachite green dye by the selected yeast strains at the optimum temperatures	81
(13)	Effect of pH value on decolorization rate of methyl red dye by the selected yeast strains at the optimum temperature and time of incubation	85

(14)	Effect of pH value on decolorization rate of reactive brilliant blue dye by the selected yeast strains at the optimum temperature and time of incubation	87
(15)	Effect of pH value on decolorization rate of malachite green dye by the selected yeast strains at the optimum temperature and time of incubation	89
(16)	Effect of aerobic and anaerobic conditions of incubation on the decolorization of methyl red dye by the selected yeast strains at the optimum temperature, time of incubation and pH value	94
(17)	Effect of aerobic and anaerobic conditions of incubation on the decolorization of reactive brilliant blue dye by the selected yeast strains at the optimum temperature, time of incubation and pH value	96
(18)	Effect of aerobic and anaerobic conditions of incubation on the decolorization of malachite green dye by the selected yeast strains at the optimum temperature, time of incubation and pH value	98
(19)	Effect of inoculum concentrations of yeast suspension on the decolorization of methyl red dye by the selected yeast strains	101
(20)	Effect of inoculum concentrations of yeast suspension on the decolorization of reactive brilliant blue dye by the selected yeast strains	103
(21)	Effect of inoculum concentrations of yeast suspension on the decolorization of malachite green dye by theselected yeast strains	105
(22)	Effect of concentration of the yeast cell suspension on the decolorization of methyl red dye by the selected yeast strains	109
(23)	Effect of concentration of the yeast cell suspension on the decolorization of reactive brilliant blue dye by the selected yeast strains	111
(24)	Effect of concentration of the yeast cell suspension on the decolorization of malachite green dye by the selected yeast strains	113

(25)	Effect of dye concentration on the decolorization of methyl red dye by the selected yeast strains	117
(26)	Effect of dye concentration on the decolorization of reactive brilliant blue dye by the selected yeast strains	119
(27)	Effect of dye concentration on decolorization of malachite green dye by the selected yeast strains	121
(28)	Effect of carbon source of the medium on decolorization of methyl red dye by the selected yeast strains	125
(29)	Effect of carbon source of the medium on decolorization of reactive brilliant blue dye by the selected yeast strains	127
(30)	Effect of carbon source of the medium on decolorization of malachite green dye by the selected yeast strains	129
(31)	Effect of nitrogen source of the medium on decolorization of methyl red dye by the selected yeast strains	133
(32)	Effect of nitrogen source of the medium on decolorization of reactive brilliant blue dye by the selected yeast strains	135
(33)	Effect of nitrogen source of the medium on decolorization of malachite green dye by the selected yeast strains	137
(34)	Effect of the different types of the media on decolorization of methyl red dye by the selected yeast strains	140
(35)	Effect of the different types of the media on decolorization of reactive brilliant blue dye by the selected yeast strains	142
(36)	Effect of the different types of the media on decolorization of malachite green dye by the selected yeast strains	144
(37)	Activities of laccase, tyrosinase and lignin peroxidase in control cells of selected yeast strains and cells obtained after decolorization in plain distilled water of methyl red dye	149

(38)	Activities of laccase, tyrosinase and lignin peroxidase in control cells of selected yeast strains and cells obtained after decolorization in plain distilled water of reactive brilliant blue dye	150
(39)	Activities of laccase, tyrosinase and lignin peroxidase in control cells of selected yeast strains and cells obtained after decolorization in plain distilled water with 5% glucose of malachite green dye	151
(40)	Effect of untreated textile industry effluent, untreated mixture of methyl red, reactive brilliant blue and malachite green dyes and metabolites after decolorization by the mixture of the potent yeast strains on percentage germination, plumule and radical lengths of <i>Sorghum versicolor</i> and <i>Phaseolus vulgaris</i>	163
(41)	Effect of methyl red dye (10 mg / l) before and after its decolorization by the potent two yeast strains on the percentage germination, plumule and radical lengths for <i>Sorghum versicolor</i> and <i>Phaseolus vulgaris</i>	164
(42)	Effect of reactive brilliant blue dye (10 mg / l) before and after its decolorization by the potent two yeast strains on percentage germination, plumule and radical lengths for <i>Sorghum versicolor</i> and <i>Phaseolus vulgaris</i>	165
(43)	Effect of malachite green dye (1 mg / l) before and after its decolorization by the potent two yeast strains on the percentage germination, plumule and radical lengths for <i>Sorghum versicolor</i> and <i>Phaseolus vulgaris</i>	166