

Green synthesis of copper oxide nanoparticles using leaf
extract of *abutilon indicum* and its antimicrobial,
antioxidant, photocatalytic dye degradation activities



By:

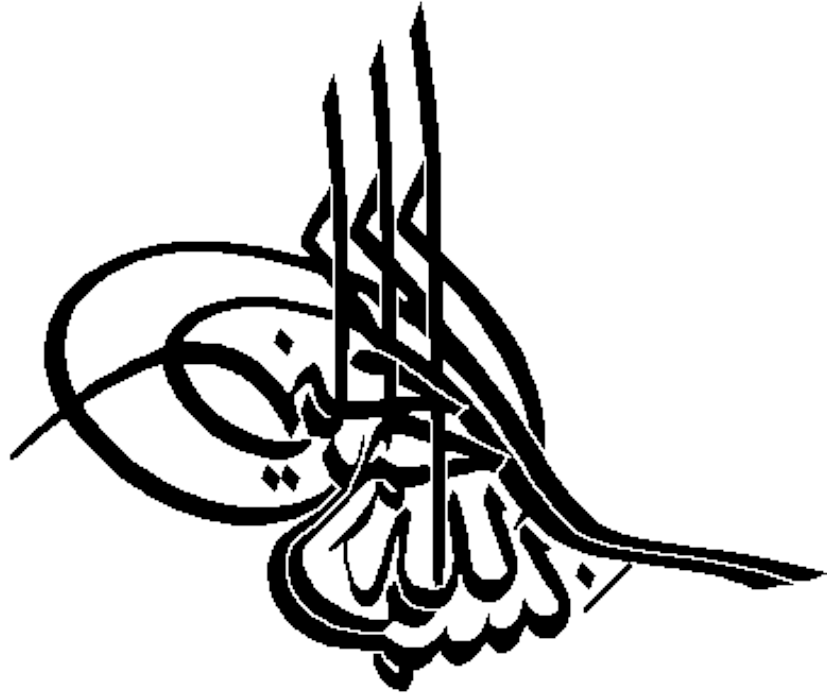
FAHEEM IJAZ

ID: 14003140054

SUPERVISOR:

DR. SAMMIA SHAHID

DEPARTMENT OF CHEMISTRY
SCHOOL OF SCIENCE
UNIVERSITY OF MANAGEMENT AND TECHNOLOGY,
LAHORE, PAKISTAN
2016



In the name of

Allah,

The most Compassionate,

The most merciful

RESEARCH COMPLETION CERTIFICATE

Certified that the research work contained in this thesis titled, “**Green Synthesis of Copper Oxide Nanoparticles Using Leaf Extract of *Abutilon indicum* and its Antimicrobial, Antioxidant, Photocatalytic Dye Degradation Activities**” has been carried out and completed by **FAHEEM IJAZ, ID: 14003140054**. The quantum and the quality of the work contained in this thesis is adequate for the award of Degree of MS/M.Phil.

Supervisor

External Examiner

Dr Sammia Shahid
Chairperson,
Department of Chemistry,
UMT, Lahore.

Dr Muhammad Azhar Iqbal
Dean
School of Science,
UMT, Lahore.

DECLARATION

I FAHEEM IJAZ S/O IJAZ AHMAD

ID: 14003140054

Session **2014-2016** hereby declare that the matter printed in the thesis titled **“Green Synthesis of Copper Oxide Nanoparticles Using Leaf Extract of *Abutilon indicum* and its Antimicrobial, Antioxidant, Photocatalytic Dye Degradation Activities”** is my own work and has not been printed, published and submitted as research work, thesis or publication in any form in any University, Research institution etc. in Pakistan or Abroad.

Dated: _____

(Faheem Ijaz)

DEDICATION

To

The perfect symbol of humanity “Hazrat Muhammad” (Peace be Upon Him), all those who are struggling for the well being of mankind, my teachers who are a symbol of guidance in my life and induced a deep love to struggle, who are a source of strength, inspiration and proud for me, my family

&

My Sweet Parents

ACKNOWLEDGEMENT

All Praises for **ALLAH ALMIGHTY**, the Most Merciful and Most compassionate, the creator of the universe, who guides us to research what is mysterious in this universe and helps in difficulties, enabled me to complete this research work successfully. I offer my humblest and sincerest words of thanks to Holy prophet **HAZRAT MUHAMMAD (PBUH)** who is forever a torch of guidance and knowledge of humanity.

It is a matter of great pleasure and honor for me to express my deep sense of gratitude to my kind and respected Supervisor, **Dr.Sammia Shahid**, Assistant Professor, Chairperson Department of Chemistry, University of Management and technology Lahore, for her esteemed Supervision, patients, motivation, incessant support and constructive criticism throughout my research.

My sincere thanks go to all the worthy teachers, especially **Dr.Khurram Shahzad Munwar, Dr. Sohail Nadeem** and **Dr. Ayesha Muhy-ud-Din**. I would also express my sincere thanks to **Muhammad Umer Zahid (SST)** for his valuable guidance and suggestion in this research work.

Last but not the least, I would like to thank my parents, brothers, sister and my wife for supporting me throughout my life and praying for my success. They continuously encouraged me during the hard time of my studies.

Faheem Ijaz

ABSTRACT

The study reports a superficial method for the green synthesis of copper oxide nanoparticles by a solution combustion method using *Abutilon indicum* water extract. The Copper oxide Nanoparticles were characterized by XRD, SEM, TEM and UV–Visible studies. XRD data indicates the formation of pure monoclinic crystallite structures of CuO Nanoparticles. SEM images showed that the particles have sponge like structure with large surface area and the average crystallite sizes were found to be 60–120 nm. These observations were confirmed by TEM analysis. Photocatalytic activity studies of CuO Nanoparticles revealed that they act as very good catalyst for the effective degradation of acid black 210 in the presence of Sunlight. The CuO Nanoparticles found to inhibit the activity of 1,1-Diphenyl-2 picrylhydrazyl (DPPH) free radicals effectively. CuO Nanoparticles exhibited significant bactericidal activity against *E.coli*, *Staphylococcus aureus*, *Klebsiell* and *Bacillus subtilis*. This research revealed a simple, ecofriendly and robust method for the synthesis of multifunctional CuO nanoparticles employing under utilized medicinal plants.

CONTENTS

THESIS SIMILARITY REPORT	i
DECLARATION	ii
RESEACH COMPLETION CERTIFICATE	iii
DEDICATION	iv
ACKNOWLEDGEMETN	v
ABRACT	vi
TABLE OF CONTENTS	vii
LIST OF FIGURE	x
LIST OF TABLE	xi
Chapter 1 Introduction	1-18
1.1 Nanoscience	1
1.2 Copper Oxide Nanoparticles	5
1.3 Green Synthesis of Nanoparticles	6
1.4 Application of Copper Oxide Nanoparticles	8
1.5 Antioxidant Activity	8
1.6 Photocatalytic Dye Degradation	9
1.7 Antimicrobial Activity	11
1.8 Characterization Techniques	12
1.8.1 X-ray diffraction (XRD)	13

1.8.2 Scanning Electron Microscopy (SEM)	14
1.8.3 Transmission Electron Microscopy (TEM)	14
1.8.4 Energy Dispersive X-Ray analysis (EDX)	15
1.8.5 Fourier Transform Infrared Spectroscopy (FTIR Spectroscopy)	15
1.8.6 Ultraviolet–Visible Spectroscopy (UV-Vis. Spectroscopy)	16
1.9 Plant Introduction	17
Chapter 2 Literature Review	18-31
Chapter 3 Methodology	32
3.1 Chemicals	32
3.2 Glassware	32
3.3 Instrument	32
3.4 Preparation of Copper Oxide Nanoparticles	33
3.4.1 Collection of Plant	33
3.4.2 Plant Extraction	33
3.4.3 Synthesis of Nanoparticles	33
3.5 Characterization Techniques	34
3.6 Photocatalytic Activity	34
3.7 Different Antioxidant Activities	35
3.7.1 DPPH Scavenging free radicals	35
3.7.2 Total Antioxidant Activity by Phosphomolybdenum	35
3.7.3 Ferric Reducing Antioxidant Power (FRAP)	36

3.7.4 Total Phenolic Content (TPC)	36
3.7.5 Ferric Thiocyanate (FTC) Assay by Linoleic Acid	37
3.8 Antimicrobial Activity	38
3.8.1 Sample Preparation	38
3.8.2 Preperation of Nutrient Broth	38
3.8.3 Preparation of Inocclum	38
3.8.4 Preparation of Nutrient Agar	39
3.8.5 Preparation of petri dishes	39
Chapter 4 Result and Discussion	40
4.1 Scanning Electron Microscope	40
4.2 Energy Dispersive X-ray	42
4.3 Dye Degradation	43
4.4 Antimicrobial activity	45
4.5 Antioxidant Activity	47
4.5.1 DPPH Free Radical Scavenging Assay	47
4.5.2 Total Phenolic Contents (TPC)	48
4.5.3 Antioxidant Activity Determination in Linoleic Acid System	49
4.5.4 Total Antioxidant activity by Phosphomolybdenate	50
4.5.5 FRAP Assay	51
Chapter 5 Conclusion	52
References	53-63

Figures	Page No.
4.1(1) SEM image of Copper Oxide Nanoparticles	40
4.1(2) SEM image of Copper Oxide Nanoparticles	41
4.1(3) SEM image of Copper Oxide Nanoparticles	41
4.2 EDX spectra of Copper Oxide nanoparticles	42
4.3 Dye Degradation from Copper Oxide nanoparticles	43
4.4 Antibacterial Activity of Copper Oxide nanoparticles	45
4.5.1 DPPH Free Radical Scavenging activity against copper oxide Nps	47
4.5.2 Total phenolic content activity of Copper Oxide Nps	48
4.5.3 Antioxidant Activity Determination in Linoleic Acid System of Copper Oxide Nps	49
4.5.4 Total Antioxidant activity by Phosphomolybdenate of Copper Oxide Nps	50
4.5.5 FRAP Antioxidant Activity of Copper Oxide Nps	51

1. Constituent Elements and their Percentage of Copper Oxide Nps	42
2. Zone Of Inhibition of Antibacterial activity of CuO Nps	45

1. Introduction

1.1 Nanoscience

During the last few decades, the interests of scientists are increasing continuously day by day in the field of science and technology at the nanometer range. Institutions of Government, some research centers of public, different type of Government and private universities and some firms have investigated these significant resources throughout the world. This technology of nano science is still at an early stage of progress. Future scientific and technological results are not easy to estimate and chase. It has been agreed the extensive scope of the pasture concerned and the possible scientific progression.