



Ain Shams University
Faculty of Engineering
Public Works Department

LOW CARBON TECHNOLOGIES OF AGRO-FOOD INDUSTRY

A THESIS

Submitted to the Faculty of Engineering
Ain Shams University in Partial Fulfillment
of the requirements of Ph.D. Degree in
Civil engineering

Prepared by

Eng. Osama Abd Elaziz Mohamed Abo Siada

Ass. Lecturer, Civil Engineering Department.

M. Sc Degree in Civil Engineering- Benha Faculty of Engineering-
Benha University

2011

Supervised By

Prof.Dr. Mohamed Shaaban Negm

Prof. of Sanitary & Environmental Engineering, Ain Shams University

Prof.Dr. Mohamed El-sayed Basiouny

Prof. of Sanitary and Environmental Engineering, Faculty of Engineering, Benha University

Prof. Dr. Mohamed Abd- Elaziz Fouad

Prof. of Microbiology, Faculty of Education, Ain Shams University

Dr. Sherien Ali Abdalla El- Agroudy

Ass. Prof. of Sanitary & Environmental Engineering, Ain Shams University

2018



Ain Shams University
Faculty of Engineering
Public Works Department

LOW CARBON TECHNOLOGIES OF AGRO-FOOD INDUSTRY

A Thesis For
The Ph.D. Degree in Civil Engineering
(Sanitary and environmental Engineering)
Faculty of Engineering- Ain Shams University

Prepared by
Eng. Osama Abd Elaziz Mohamed Abo Siada

Ass. Lecturer Civil Engineering Department.
M.Sc Degree in Civil Engineering- Benha Faculty of Engineering-Benha
University (2011)

EXAMINERS COMMITTEE

<u>Name</u>	<u>Signature</u>
Prof.Dr. Mostafa Abd El Monem Ashmawy	
Prof.Dr. Mohamed Shaaban Negm	
Prof. Dr. Mohamed Hassan Abd El Razik	
Dr. Sherien Ali Abdalla Elagroudy	

Date: .../.../ 2018

DEDICATION

In the Name of Allah, the Merciful, the Most Merciful

"We have no knowledge except that which you have tough us. You are indeed the knowing, the wise"

I would like first to extend all praise, thanks and appreciations to Allah, who he allowed me to prepare this thesis, hoping that it finds acceptance and success.

A special dedication to

My Mother

To my father, brother and sister

To my small family: My Wife, My Sons

(Eyad, Ahmad and Adham) and My Daughter

(Sandy)

STATEMENT

This thesis is submitted as partial fulfillment of Ph.D. degree in civil engineering, public work department, Sanitary and environmental engineering, Ain Shams University.

The author carried out the work included in this thesis, and not part of it has been submitted for a degree or qualification at any other scientific entity.

Date: -/...../ 2018

Signature: -

Name: - Osama Abd Elaziz Mohamed Abo Siada

ACKNOWLEDGMENTS

First, all praise and thanks to Allah, the GOD of all creatures for directing me the right way, and for giving me the effort to complete this work.

It is an honor to work under the supervision of eminent professors, who I appreciate their whole hearted support and immense facilities. To them, I owe more than I can record.

It is pleasure for me to acknowledge my supervisor **Prof. Dr. Mohamed Shaaban Negm**, Professor of Sanitary and Environmental Engineering, Ain Shams University, for his great effort and true encouragement.

Grateful thanks and deep appreciation to my supervisor **Prof. Dr. Mohamed El Sayed Basiouny**, Professor of Sanitary and Environmental Engineering, Faculty of Engineering, Egyptian Chinese University (ECU), for his continuous engorgement, guidance and helpful advice.

Words will never be able to express my deepest gratitude and appreciation to **Prof. Dr. Mohamed Abd -Elaziz Fouad**, Professor of Microbiology, Faculty of Education, Ain Shams University, for his continuous support, kindness, great patience and unlimited help throughout the work.

Also I like to record my great thanks to Dr. **Sherien Ali Abdalla El-Agroudy**, Associated Professor of Sanitary and Environmental Engineering, Ain Shams University, for assistance in funding research, constructive supervision, helpful advice and constant encouragement.

I would like to thank the staff of the Biological Science and Geology, Department, Faculty of Education, Ain Shams University, Especially **Dr.**

Amera Mohamed Mahmoud, for her valuable help and encouragement to finish my experimental works.

Last but not least, I would like to convey my love to *my Father, my Mother, my wife , my Sons, my daughter, my brother & my sister* for their invocation and encouragement to finish this thesis.

Researcher Data

Name:- Osama Abd Elaziz Mohamed Abo Siada
Date of birth:- 5/6/1979
Place of Birth:- Kafrelshiekh
Academic Degree:- M. Sc Degree in Civil Engineering-
Benha Faculty of Engineering
Field of specialization:- Civil Engineering
University issued the degree:- Benha University
Date of issued degree:- August- 2011
Current Job:- Ass. Lecturer, Civil Engineering
Department- Benha Faculty of
Engineering- Benha University

SUPERVISORES

Prof.Dr. Mohamed Shaaban Negm

Prof.Dr. Mohamed El Sayed Basiouny

Prof. Dr. Mohamed Abd- Elaziz Fouad

Dr. Sherien Ali Abdalla El- Agroudy

KEY WORDS

Low Carbon, Solid State Fermentation, Nutrient Enrichment; Agro–
Industrial Waste, *Trichoderma harzianum*, *Trichoderma reesei*, animal
feed

Summary

The agro-based food industry in Egypt is one of the main pillars of the improvement of the Egyptian economy, but it can be a major source of environmental pollution due to the large quantity of vegetable and fruit wastes generated. Organic wastes are often managed from agro-industries without proper planning and accompanying risks for surrounding environment.

Agricultural waste management is one of the main tasks of local governments responsible for the field of agricultural industries. The main task of researchers, engineers and technicians, is to provide policy makers and decision makers with technical options and scientific solutions for the recycling of agricultural industrial waste for reuse.

Fermentation of the solid state is one of the most important technology used to enrich the protein for the residues of the agricultural industries and is widely used with different types of safe fungus strains, which increase the nutritional value of the residues of the agricultural industries and reuse as animal feed .. This represents the economic income of food products factories and the corresponding environmental return for the disposal of waste from industrial processes.

The problem of animal feed in Egypt has increased in recent years as a result of increasing demand, inadequate production and a rise in the price of the dollar, which has affected the high prices of fodders . Therefore, alternatives should be search to increase the production of feed and its production from non-used materials such as agricultural wastes.

2. Objective of the research

a - Use of solid state fermentation technology to enrich the nutritional value of agricultural industrial waste using two different types of fungi (*Trichoderma reesei* and *Trichoderma harzianum*).

b - Improve the fermentation process of the solid waste of agricultural industries using five different types of waste (peel mango, apples, bananas, oranges and tomatoes)

C - Study the effect of changing pH and temperature on enriching the nutritional value of agricultural industrial wastes.

3. Contents of the study

The study contains six sections to add to the list of references and statement as follows:

The first chapter :

The first chapter of the study includes a basic introduction to the research project. It also clarifies the importance of the research topic, the objectives and the methods used to achieve the goal.

The second chapter :

The second second deals with the scientific concept of solid state fermentation and its importance in enriching the nutritional value of agricultural industrial wastes. It also includes the fungal strain used. It also includes different applications of the state of fermentation and solid state fermentaion reactors . It also includes a brief review of past research in this area and the results achieved.

The third chapter :

The third chapter explains the research plan used, the types of fungi used in the fermentation process, the effect of the pH change, the degree of temperature, and the incubation period on the fermentation process.

The fourth chapter :

It includes displaying the results obtained and placing them within tables and curves, and analyzing the results obtained to reach the main objective of the research. It also includes the determination the best type of waste used and the best strain of fungus , the optimum temperature pH and incubation time to reach the highest nutritional values of the wastes used.

The fifth chapter:

This chapter analyzes and comments on the results obtained from this study to determine the best type of waste used and the best type of fungus. Optimal temperature and pH are determined to reach the highest values to enrich the nutritional value of the waste used.

The sixth chapter

This chapter deal with the proposed summary and recommendations, including the following:

- Increase the percentage of protein in all agricultural industrial waste used in the study after the fermentation process using two different types of mushrooms.
- After reviewing the results of the research it is clear that the nutritional value in the residues used with the use of *Trichoderma harzianum* mushroom increases more than when using *Trichoderma reesei*.

- Tomato peel residues are the best in increasing the percentage of protein after fermentation followed by mango peel, then orange peel, peel the apples and finally bananas.
- The process of fermentation is affected by changing the surrounding conditions, mainly the temperature of fermentation and pH.

Among the recommendations proposed according to the results of this study are:

- Recommend future studies using different types of mushrooms to reach the highest possible protein values in the waste.
- The study of other factors that may affect the process of fermentation, such as the amount of waste used and the degree of moisture and change the medium growth of fungi.
- Recommend the use of this study on a large scale to establish a bioreactor within the factories and the process of fermentation for the production of animal feed directly within the factories, which has an economic return from the use of waste and environmental return for disposal.

References:

This chapter includes the references that have been used in the subject of the search arranged in alphabetical order

TABLE OF CONTENTS

Title	Page
Acknowledgments	ii
Summary	vi
Table of Contents	xi

List	of	Figures
xiii		

List	of	Tables
xi		

Abbreviations

xii

CHAPTER1: INTRODUCTION

1

1.1 General

1

1.2 Problem definition.

3

1.3 Aim and Objective of Study

3

1.4 Outlines of thesis

4

CHAPTER 2: LITERATURE REVIEW

5

2.1 Introduction

5

2.2 Protein Enrichment of Fruit and Vegetable Wastes

5

2.2.1 Fruit Industrial Wastes

5

2.2.2 Vegetable Industrial Wastes

6

2.3 Technologies Applied to Waste Reprocessing for Protein

Enrichment 6

	2.3.1 Solid Substrate Fermentation
7	2.3.2 Silage Making (Ensiling)
7	
	2.3.3 Waste Enrichment in Liquid and Slurry Processes
8	2.4 Solid-State Fermentation (SSF)
9	2.5 History and development of S.S.F
12	
2.6	Types of Microorganisms Used in SSF
16	2.7 Substrates
21	2.8 Parameters affecting in SSF Process
22	
	2.8.a Temperature and Heat Transfer
24	
	2.8.b Water activity and moisture content
25	
	2.8.c pH
25	2.9 Comparison between Submerged and Solid Substrate
	Fermentations
24	2.10 Designing and Types of SSF
30	