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Investigation of the effectiveness of mother enzyme on model organic waste material by enzyme degradation.

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B.Sc Hons

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Investigation of the effectiveness of mother enzyme on model organic waste material by enzyme degradation.

By

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Thesis submitted in partial fulfilment of the requirements for the degree of
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Declaration:

The work described in this thesis is carried out by me at the University of Sri Jayawardenepura under the supervision of Prof. Bamunuarachchi , Professor, Department of Chemistry, University of Sri Jayawardenepura, Sri Lanka and Mrs. Nilanthi Bandara , Senior Lecturer Department of Forestry and Environment Science, Faculty of Graduate Studies University of Sri Jayawardenepura, Sri Lanka

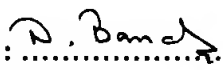
It describes the results of my own independent study except where due references has been made in the text. No part of this thesis has been submitted previously in candidature for a degree in this or any other University.

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This is to certify that this report is based on the study carried out by the candidate herself and is now approved for submission.

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Dedication

Dedicated to my loving father
And
my late mother
with all respect and love



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ABSTRACT

It is reported that at least 22 human diseases are associated with solid wastes. (Arne, Jeffery & Arber 1982). Therefore continuous disposal of solid waste and their collection creates a severe environmental and health hazard. As such, it is of utmost importance to avoid this problem before it is too late to do anything about it. In Sri Lanka the major percentage of municipal solid waste consist of organic waste. Hence one way of overcoming this problem is to increase the rate of degradation of organic material in which enzyme and micro organisms play a big role. Mother Enzyme (ME) is said to be one such mixture of enzymes and micro organisms.

Objectives of this research was to identify the constituents of the ME, to determine the effectiveness of the ME on degradation of different types of organic wastes, and to determine the effective levels of ME for different types of organic wastes.

Laboratory experiments were done at the Department of Forestry & Environmental Science, Department of Microbiology of Faculty of Medicine and the Food Science laboratory of the Department of Chemistry of the University of Sri Jayawardenepura.

Results were analyzed using Mann-Whitney U-Test and Wilcoxon's Signed Rank Test.

Macconkey agar, Nutrient agar, and Sabouraud Dextrose Agar were used to find the total number and the types of micro-organisms present in the ME. Effect of Mother enzyme on different types of organic waste were done by using Farm (cattle and poultry) waste, Kitchen wastes and Fruit industry wastes in the presence and in the absence of ME with replication. Weight reduction with time was noted down. To estimate the effect of ME on model organic waste, wheat flour, Egg Yolk and coconut oil were used. Alanine, Glucose and Acid value estimation were done to estimate the rate of degradation of the above macro molecules in the presence of and in the absence of ME. In order to find out the effective levels of ME Farm (cattle and poultry), Kitchen wastes and Fruit industry wastes were used with replication. 2g/1kg and 0.5g/1kg of mother Enzyme was given and weight reduction was noted down.

From the Microbiological analysis, *Staphylococcus aureus*, *Escherichia coli*, and *Mucor*, were found to be present in ME and the total number of cells present was $13 \times 10^1 \text{ g}^{-1}$. Since it was unexpected to find *E. coli* in Mother Enzyme we can conclude that *E. coli* has come into the sample by some kind of contamination that has occurred either in the original sample of Mother Enzyme we used as the test material or the during laboratory testing. Presence of *Mucor*, common contaminant fungi is also surprising.

From the study it was found that the break down of model organic matter - fats and proteins occur quite fast in the presence of mother enzyme. But breaking down of carbohydrates is not accelerated significantly by mother enzymes.

Increase or decrease levels of ME have no significant effect on mixed organic waste due to our consumption pattern most of organic waste generated in Sri Lanka are of carbohydrates origin. This may be the reason why there is no significant effect due to ME on different organic waste found in Sri Lanka.



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CHAPTER 01

INTRODUCTION

Proper solid waste management is essential in order to reduce environmental, social and economic problems associated with present disposal practices.

Solid waste is described as non-liquid waste material arising from domestic, trade, commercial, industrial and agricultural activities as well as waste arising from public sectors. Solid waste consists of various different materials such as food waste, discarded clothing, garden waste, construction waste, factory off cuts and process waste and packaging in the form of paper, metal, plastic, glass etc.

1.1 Significance of proper Solid waste disposal practices:

Improper disposal of solid waste is a significant health hazard. It is reported that at least 22 human diseases are associated with solid wastes (Arne, Jeffery & Arber :1982).

The two most important vectors of human disease with regard to solid waste are rats and flies. The fly is a prolific breeder and a carrier of

many diseases. Rats not only destroy property and infect by direct bites, but are also dangerous as carriers of insects, which can also act as vectors (Arne, Jeffery & Arber :1982).

1.2 Organic waste:

Organic waste is solid waste of plant and animal origin. They have high moisture content.

1.3 Disposal of Organic waste:

There are several methods to get rid of waste. In order of priority we have to reduce the generation of waste, reuse, recycle and finally dispose the remaining waste in an environmentally acceptable manner.

The amount of waste that is to be disposed can be greatly reduced by recycling. In developing countries like Sri Lanka the waste stream contains a high percentage of organic waste. The amount of the organic waste to be disposed of can be easily reduced through waste management techniques such as biogas generation and composting. In both these approaches organic material is biologically degraded in to a simpler form. In bio gas generation anaerobic microorganisms are

used to convert organic material to CH_4 , CO_2 and H_2O under anaerobic conditions. In composting aerobic microorganisms are used to convert organic material to CO_2 , H_2O and compost under aerobic conditions.

1.4 Composting:

Analysis of data in Sri Lanka reveals that the major portion of solid waste is biodegradable material and is thus suitable for composting. According to waste composition studies the general content of organic material in our waste stream is very high in organic content

Composting of organic waste can occur under both aerobic and anaerobic conditions.

In aerobic decomposition microorganisms utilize oxygen and produce more microbial cells and convert the organic matter into CO_2 and simpler compounds, which are extremely useful for the growth of plants. This is the natural means of waste removal from forests and fields by converting it to humus.

Anaerobic fermentation occurs in absence of oxygen and produces CO_2 , methane and mercaptan, which give a foul odor. Heat production during anaerobic fermentation is comparatively lower than that of

