

**DETERMINATION OF NUTRIENTS AND METALS CONTENT IN LIQUID
GENERATED FROM COMPOSTED FOOD WASTE.**

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DETERMINATION OF NUTRIENTS AND METALS CONTENT IN LIQUID
GENERATED FROM COMPOSTED FOOD WASTE.

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To my beloved family and friends.

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ABSTRACT

The increasing amount of food waste put more pressure on already municipal solid waste management systems especially in cities due to increasing of population growth and their eating habits. Composting has been recommended in order to manage waste especially for the disposal of food waste. Composting food waste is beneficial as soil amendment. This study is conducted to evaluate the nutrients ($\text{NH}_3\text{-N}$, NO_3^- and PO_4^{3-}) and metals (Fe^{2+} , Mn^{2+} and Zn^{2+}) content in liquid generated from composted food waste (fruits waste and vegetables waste). The nutrients and metals were analyzed based on the composition of bacterium and molasses. The chemical analysis of sample was carried out by using Hach spectrophotometer DR6000. The ratio of fruits waste or vegetables waste, molasses and bacterium are 1kg for fruits waste or vegetables waste, 0.5 – 3kg of molasses with 50 – 500mL bacterium. The duration of composting is eighteen weeks. The concentrations of $\text{NH}_3\text{-N}$, NO_3^- and PO_4^{3-} for composted fruits waste and vegetables waste are 200 – 1700mg/L while the metals concentrations are low which below than 30mg/L. The best ratio of composting food waste which consist of mixed fruits and vegetables waste, bacterium and molasses is 1:500:0.5 (kg:mL:kg). The result showed that the composted both fruits and vegetables wastes are potentially to be used as fertilizer for agriculture use because of high nutrient content.

ABSTRAK

Peningkatan jumlah sisa makanan telah menyebabkan tekanan ke atas pengurusan sistem sisa pepejal terutamanya di bandar-bandar kerana pertumbuhan penduduk dan tabiat makan mereka. Pengkomposan telah disyorkan untuk menguruskan sisa terutamanya bagi pelupusan sisa makanan. Pengkomposan sisa makanan bermanfaat untuk pembaikan tanah. Kajian ini dijalankan adalah untuk menilai kandungan nutrien ($\text{NH}_3\text{-N}^-$, NO_3^- dan PO_4^{3-}) dan logam (Fe^{2+} , Mn^{2+} dan Zn^{2+}) dalam cecair yang dihasilkan daripada baja kompos sisa makanan yang terdiri daripada sisa buangan buah-buahan dan sayur-sayuran. Nutrien dan logam dianalisis berdasarkan komposisi bakteria dan molases. Analisis kimia terhadap sampel telah dijalankan dengan menggunakan Hach spektrofotometer DR6000. Nisbah sisa buah-buahan atau sayur-sayuran, molases, dan bakteria adalah 1kg sisa buah-buahan atau sisa sayur-sayuran, 0.5 – 3kg molases dan 50 - 500mL bakteria. Tempoh kompos tersebut adalah selama lapan belas minggu. Kepekatan $\text{NH}_3\text{-N}$, NO_3^- dan PO_4^{3-} bagi baja kompos sisa buah-buahan dan sayur-sayuran adalah 200 - 1700mg/L manakala kepekatan logam adalah rendah iaitu kurang 30mg/L. Nisbah terbaik untuk pengkomposan sisa makanan yang terdiri daripada campuran sisa buah-buahan dan sayur-sayuran, bakteria dan molasses adalah 1:500:0.5 (kg:mL:kg). Hasil dari kajian ini menunjukkan baja kompos sisa buah-buahan dan sayur-sayuran berpotensi untuk digunakan sebagai baja untuk tujuan pertanian kerana mengandungi kandungan nutrien yang tinggi.

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LIST OF SYMBOLS AND ABBREVIATIONS

ANOVA	-	Analysis of variance
APC	-	Air Pollution Control
ATP	-	Adenosine Tri-Phosphate
C/N	-	Carbon Nitrogen ratio
CH ₄	-	Methane
CO ₂	-	Carbon Dioxide
EM	-	Effective Microorganism
Fe	-	Iron
Fe ²⁺	-	Ferric Ion
Fe ³⁺	-	Ferric Ion
H ₂ O	-	Water
HDPE	-	High-Density Polyethylene
HPO ₄ ²⁻	-	Hydrogen Phosphate
H ₂ PO ₄ ¹⁻	-	Dihydrogen Phosphate
K	-	Potassium
kg	-	Kilogram
kg/person/day	-	Kilogram per person per day
M	-	Molar
Mg/L	-	Milligram per LiTER
mL	-	miliLiter
Mn	-	Manganese
Mn ²⁺	-	Manganese Ion

MRF	-	Materials Recovery Facilities
N	-	Nitrogen
NH ₃ -N	-	Ammoniacal Nitrogen
NO ₃ ⁻ -N	-	Nitrate
O ₂	-	Oxygen
P	-	Phosphorus
PETE	-	Polyethylene Terepholates
pH	-	Hydrogen- Ion Concentration (Alkalinity)
PO ₄ ³⁻	-	Orthophosphate
ppm	-	Parts per Million
Zn	-	Zinc
Zn ²⁺	-	Zinc Ion
%	-	Percent
°C	-	Degree Celcius

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CHAPTER 1

INTRODUCTION

1.1 Background of study

Nowadays management of municipal solid waste becomes one of Malaysia's most critical environmental issues due to population growth and rapid economic development. According to Karthivale *et al.* (2004), the average amount of municipal solid waste (MSW) generated in Malaysia especially in major cities is about 0.5-0.8 kg/person/day. The amount has increased to 1.7 kg/person/day.

Fauziah *et al.* (1970) stated that household wastes are the main sources of waste followed by industrial and commercial waste. In Selangor state, the highest percentage of MSW is about 46% which consisted of putrescible waste, 15% of plastic and 14% of paper respectively.

Food waste is referred biodegradable waste which is used in the preparation and consumption of food and remaining after consumption such as kitchen and restaurant wastes. Over the years, the term was changed as vegetables trimmings, spoiled and partially eaten fruit also known as food waste. In pre 1970s, kitchen and restaurants food waste was known as "garbage fraction" that was a part of MSW (Diaz *et al.*, 1993). Shilev *et al.* (2007) stated that food waste has good potential as a raw compost agent as it contain high moisture content and low physical structure.

Composting has been recommended in order to manage waste especially for the disposal of food waste. Diaz *et al.* (1993) defined as composting is the biological decomposition under controlled conditions and sufficiently stable that consists of organic substances of plants and animal origin. According to Epstein (1997), composting is the highest form of recycling as the food waste or other waste is transform (recycled) for reuse as a composting material.

Compost is benefits to soil condition and plant growth as well as decreased the potential of erosion, run-off, and non-source pollution. The basic composting process is commonly affected by chemical and physical factors. Oxygen and moisture are the main factors affecting the decomposition of organics matter by microorganism. Other crucial factors in the composting process is temperature, pH, and nutrients especially carbon and nitrogen (Epstein, 1997)

Improper waste disposal activities give negative impacts on the environment and public health (Salim *et al.*, 1994). Government, industry, and public play an important role in order to minimize waste generation and provide a clean environment as well as reduce the environmental problems caused by the waste. Composting waste is one of the best practicing among public in order to manage waste as it has a lot advantages.

1.2 Problem Statement

Malaysia is experiencing waste management issues due to increase of population and the process of urbanization and industrialization. This situation change consumption habits and social lifestyles. According to World Urban Prospects (2014), the urban population has increased drastically from 9.068 Million in 1990 to 22.342 Million in 2014. In 2050, it is expected to reach 36 Million of population.

The increasing amounts of waste such as domestic, municipal waste, agricultural waste, and industrial wastes caused environmental and health problems.

The sources of MSW in Malaysia are different for each local authority area. It is depend on the economic standards and size of the city. In central and southern region of Malaysia, household waste is the highest percentage of waste which is 36.73 % while industrial and construction wastes recorded 28.34% and 34.93% is the waste comes from other sources (Dinie and Mashitah, 2013).

Composting is the best method in order to reduce wastes. According to Sullivan *et al.* (1998), composting food waste has high potential as a soil amendment. Cogger (2005) stated that soil and land quality can be improved by using compost soil amendment. Furthermore, compost amendment of soil can reduce runoff and create a high-value market for locally produced compost.

Current solid waste management in Malaysia is a challenge that must be planned and handled properly. So that, some initiatives should be implemented in order to handle solid waste disposal in term of effective cost, effective disposal methods and environmental friendly.

1.3 Objectives

The objectives of the study are:

- (i) To evaluate the nutrients ($\text{NH}_3\text{-N}$, NO_3^- , PO_4^{3-} ,) and metals (Fe^{2+} , Mn^{2+} , and Zn^{2+}) content generated from composted fruits waste and vegetables waste.
- (ii) To determine the effect of combination bacterium and molasses in nutrients concentration generated from composted vegetables waste.
- (iii) To determine the optimum amount of combination bacterium and molasses for generating high concentration of nutrient in composted mixed fruits and vegetables waste.

1.4 Scope of Study

This study is conducted to evaluate the nutrients and metals content in liquid generated from composted food waste. The samples of food waste used for experimental task are collected at Kip Mart Market located in Johor Bahru. The samples consist of fruits waste and vegetables waste. This location is chosen as there are a lot of wastes especially food waste throw into the rubbish bin without any proper treatment. The collected food waste will be composted around four months in a sealed container. An experimental task will be done using the DR6000 in UTM environmental laboratory of Faculty Civil Engineering. This experiment is to evaluate the nutrients and metals content ($\text{NH}_3\text{-N}$, NO_3^- , PO_4^{3-} , Fe^{2+} , Mn^{2+} , and Zn^{2+}) in the composted food waste in liquid form. The effect of combination bacterium and molasses in nutrients concentration generated from vegetables waste is also evaluated. In addition, the optimum amount of combination bacterium and molasses for generating high concentration of nutrient in composted mixed fruits and vegetables waste is also determined in this study.

1.5 Significance of Study

In general, this study is conducted to fulfill all the objectives as which are to evaluate the nutrients and metals content, and effect of combination bacterium and molasses in nutrients concentration generated from composted vegetables waste. The optimum amount of combination bacterium and molasses for generating high concentration of nutrient in composted mixed fruits and vegetables waste is also determined. By doing this research, the nutrients and metals content and also the effect of combination bacterium and molasses in nutrients concentration generated from composted vegetables waste can be determined. Besides, the optimum amount of combination bacterium and molasses for generating high concentration of nutrient in composted mixed fruits and vegetables waste will be identified. The composted food waste is used as fertilizer for the plant growth. This will provide an opportunity to recycle the food waste as a soil amendment. Thus, the composting food waste may be beneficial as fertilizer to replace the commercial fertilizer.

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