



UNIVERSITI PUTRA MALAYSIA

**COMPARATIVE STUDY OF LOCALLY COMMERCIALIZED
VERMICOMPOST AND SAGO PITH WASTE VERMICOMPOST AND
EFFECTS ON MAIZE GROWTH**

ELTON TRAN PULUSAGI

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By

ELTON TRAN BIN PULUSAGI

**Thesis Submitted to the School of Graduate Studies,
Universiti Putra Malaysia, in Fulfilment of the
Requirements for the Degree of Master of Science**

August 2014

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Abstract of the Thesis Submitted to the Senate of Universiti Putra Malaysia in
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Faculty: Agriculture

The vermicompost industry in Malaysia has grown rapidly in recent years. However, there is a lack of documentation on the quality of commercially available vermicomposts; moreover, there are no guidelines for the production of quality vermicomposts. This study was carried out to characterise vermicomposts available in Selangor's local market and to determine the optimum formulation of sago pith waste mixture for vermicomposting as one of the method to convert it into value-added products. Sago pith waste (SPW) is a starchy solid waste produced during the production of sago starch. Due to high production of sago starch in Sarawak, 32,000 tonnes of sago waste (dry weight basis) is produced annually. Vermicomposting had been proven to be one of the practical methods in agricultural waste management but very little work had been reported so far on vermicomposting of sago waste.

In this study, survey had been done to access the quality of the vermicompost available in the market in Selangor by visiting the vermicompost producers and characterizing these vermicompost. From the vermicompost collected, the feedstocks mainly used were spent mushroom substrate (SMS), sawdust (SD), paddy straw (PS) and co-composted with either cow manure (CM), goat manure (GM), and/or horse manure (HM). The N, P and K content of local vermicomposts are at the range of 1.50 – 2.16%, 0.54 – 1.89%, and 0.39 – 1.73% respectively. The humic acid concentrations in the vermicompost were within 16.7 – 24%. From this study, it was observed that the chemical properties of vermicomposts varied according to the type of the initial feedstock, earthworms used and vermicomposting procedure. The nutrient contents of these vermicompost were compiled and were used to compare with SPW vermicompost produced in this study. The nutrient content ranges of these commercially available vermicompost were acceptable according to Australian Standard for compost, AS 4454.

Vermicomposting of SPW was conducted co-composted with either CM or GM at ratio 1:1, 1:2, 1:3 using *Eisenia fetida* and harvested at three different vermicomposting durations (20, 45 and 60) in randomized completely block design (RCBD). *Eisenia fetida* or the tigerworm used in this study were able to break down the fibrous sago pith waste mixture with the animal manure into finer form resembling compost. SPW vermicompost produced in this study have higher total N and humic acid content compared to vermicomposts collected from Selangor's local market, at 2.16 – 3.79% and 19.33 – 23.00% while the micronutrient contents such as Zn, Cu, Fe and Mn were at the permitted levels. Therefore, SPW vermicompost produced in this study are better compared to the commercial vermicomposts that were collected from Selangor's local market used in this study.

Maize applied with vermicomposts showed healthier growth compared to maize applied with chemical straight fertilizer which is stunted. Vermicomposts used in this study were able to buffer or improve the soil pH from 4.6 to 5.7. Maize applied with SPW vermicompost showed higher uptake for total K, Ca, and Mg compared to chemical straight fertilizer and selected commercial vermicompost. Comparing the SPW vermicomposts on the maize crop performance, SPW²+GM¹ and SPW²+CM¹ harvested at day 60 showed the better result compare to other mixtures at different harvesting period and should be used for production of SPW vermicompost.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
Sebagai memenuhi keperluan untuk ijazah Sarjana Sains

**KAJIAN PERBANDINGAN DI ANTARA VERMIKOMPOS KOMERSIL
DENGAN VERMIKOMPOS HAMPAS SAGU DAN KESANNYA KE ATAS
PERTUMBUHAN JAGUNG**

Oleh

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Industri vermikompos di Malaysia menunjukkan perkembangan yang pesat. Namun demikian, jumlah dokumentasi untuk kualiti vermikompos ini adalah kurang. Selain itu, tiada panduan dikeluarkan untuk pembuatan vermikompos tempatan yang berkualiti. Tujuan kajian ini dijalankan adalah untuk menentukan ciri kimia vermikompos yang sedia ada di Selangor dan untuk menentukan kadar campuran hampas sagu yang optimum bagi proses vermikompos sebagai satu cara untuk menghasilkan produk yang mempunyai nilai tambah. Hampas sagu (SPW) merupakan sisa buangan berkanji yang dihasilkan semasa proses penghasilan kanji-kanji sagu. Disebabkan oleh pengeluaran kanji sagu yang tinggi di Sarawak, 32,000 tan sisa buangan (berat basah) dihasilkan setiap tahun. Proses pembuatan vermikompos telah terbukti sebagai salah satu cara yang praktikal dalam pengurusan sisa buangan pertanian namun, tidak banyak laporan mengenai penghasilan vermikompos dari hampas sagu.

Dalam kajian ini, suatu kaji selidik telah dijalankan untuk menilai kualiti vermikompos yang sedia ada di Selangor dengan melawat pengeluar vermikompos serta menentukan ciri kimia vermikompos tersebut. Daripada vermikompos yang dikumpul, bahan mentah yang digunakan adalah seperti substrat cendawan terpakai (SMS), serbuk kayu (SD), jerami padi (PS) dan dicampurkan dengan sama ada dengan tinja lembu (CM), tinja kambing (GM) dan/atau tinja kuda (HM). Kandungan N, P dan K di dalam vermikompos tempatan masing-masing adalah dalam lingkungan 1.50 – 2.16%, 0.54 – 1.89%, dan 0.39 – 1.73%. Kandungan asid humik dalam vermikompos adalah dalam lingkungan 16.7 – 24%. Daripada kajian ini, dapat diperhatikan ciri-ciri kimia vermikompos berbeza mengikut bahan mentah yang digunakan, cacing tanah yang digunakan dan proses pembuatan vermikompos. Ciri-ciri kimia vermikompos yang dikumpul digunakan untuk perbandingan dengan vermikompos hampas sagu yang dihasilkan dalam ujikaji ini. Kandungan kimia ini adalah diterima pakai oleh piawaian kompos Australia, AS4454.

Pemrosesan vermikompos SPW pula dijalankan dengan campuran sama ada dengan CM atau GM pada kadar 1:1, 1:2, 1:3 dengan menggunakan *Eisenia fetida* dan dituai pada tiga tempoh pembuatan vermikompos (30, 45 dan 60 hari) dengan menggunakan reka bentuk blok rawakan lengkap (RCBD). SPW mempunyai kandungan N dan asid humik yang lebih tinggi berbanding vermikompos yang lain pada 2.16 – 3.79% dan 19.33 – 23.00% manakala kandungan mikronutrien Zn, Cu, Fe dan Mn adalah pada paras yang dibenarkan. Daripada pemerhatian tersebut, vermikompos hampas sagu adalah lebih baik dari segi kandungan nutrisi berbanding dengan vermikompo tempatan di Selangor yang digunakan dalam ujikaji ini.

Jagung yang menggunakan vermikompos menunjukkan pertumbuhan yang lebih sihat berbanding baja kimia tunggal yang menunjukkan pertumbuhan yang terbantut. Vermikompos yang digunakan dalam ujikaji ini menunjukkan yang ia berupaya untuk memperbaiki pH tanah dari 4.6 ke 5.7 Vermikompos SPW menunjukkan pengambilan nutrien K, Ca dan Mg yang lebih tinggi berbanding vermikompos yang lain dan baja kimia tunggal. Untuk perbandingan di antara vermikompos hampas sagu, SPW²+GM¹ dan SPW²+CM¹ yang dituai pada hari ke-60 adalah vermikompos hampas sagu yang terbaik dari segi kesannya terhadap pertumbuhan jagung dan patut digunakan untuk penghasilan vermikompos hampas sagu.

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LIST OF ABBREVIATIONS

C	Carbon
Ca	Calcium
CEC	Cation exchange capacity
CM	Cow manure
CMSPW	Cow manure sago pith waste
Cu	Copper
EFB	Empty fruit bunch (oil palm)
Fe	Iron
FMW	Fresh market waste
FT-IR	Fourier transform infrared
GM	Goat manure
GMSPW	Goat manure sago pith waste
Ha	Hectare
K	Potassium
Kg	Kilogram
L	Litre
Mg	Magnesium
Mn	Manganese
N	Nitrogen
SD	Saw dust
SMS	Spent mushroom substrate
SPW	Sago pith waste
T	Tonne
TN	Total Nitrogen
UPM	Universiti Putra Malaysia

CHAPTER 1

INTRODUCTION

Sago is the fourth main agriculture exports of Sarawak after oil palm, rubber and pepper. In Sarawak, the hectareage of sago plantation increased from 55,690 ha in 2001 to 59,161 ha in 2010 (Department of Agriculture Sarawak, 2010). Out of 59,161 ha of sago plantation in Sarawak, 49,330 ha are found in Mukah, 15,094 ha are owned by LCDA (Land Custody and Development Authority) (PELITA, 2012) while 44,067 ha are run by smallholders. Sago is by far the highest starch producing plant at 300 kg/tree and 25 t/ha/year (Flach, 1997). A sago mill is able to produce 25 t/day of sago starch (Bujang, 2008). In the production of sago starch, there are 2 main wastes which will be produced – sago wastewater and the sago pith waste. At the rate of 55 – 60% of sago starch extraction, at least 16 t – 20 t of sago pith waste are produced daily from a mill or at least 25,617 tonnes per year across Sarawak. Sago mills in Sarawak are mainly located at the riverbank. This is because, this location provide easy access to the river which is strategic as the availability of the water is crucial for the processing of sago starch extraction and also for the transportation of the sago log. Due to the location, it had been a practice by the mill to discharge the sago wastewater and also the sago pith waste into the river. However in recent years, these sago mills would collect the sago pith waste if there are demands from the livestock farmers and is sold at RM 20 per tonne. However this demand is not consistent, thus justify the very low price of the sago pith waste.

Vermicomposting is a process where earthworm consumed organic residue to produce compost which is also known as vermicast (Riffalda and Levi-Minzi, 1983). Vermicast is a type of soil conditioner that has a high nutrient bioavailability for plant growth. Vermicomposting is recently gaining popularity in Malaysia not only for production of vermicompost but also for the production of the earthworm. Vermicomposting had been reported to produce value added products from agricultural wastes e.g. spent mushroom substrate (Moore and Chiu 2001), olive oil mill waste (Moreno et al., 2000), toxic cassava peels (Mba, 1996), rice husk (Lim et al., 2012) etc. Thus, vermicomposting may also produce value added product from sago pith waste for sago starch industry in Sarawak and contribute towards reducing the disposal of sago pith waste into the river. Furthermore, it may be used by the local farmers to increase their income through vermicomposting and also increase the availability of vermicompost to vegetable farmers.

Vermicomposting is expanding widely in Malaysia. It had been practiced widely in the Peninsular Malaysia and had started to spread to Sarawak and Sabah. In Selangor area, a company has more than 600 vermicompost producers from Kajang, Banting, and Bangi area under a contract farming program, producing large amount of vermicompost and earthworms. These vermicompost were sold locally and exported to other countries. In the past 5 years in Peninsular Malaysia, the prices of vermicompost ranged from RM 2.5 – RM 5 per kg. Currently, there is lack of reported studies on local vericompost. Thus, the general objective of this study was to investigate the feasibility of using sago waste as a feedstock in vermicomposting.

The specific objectives of the research are as follows:

1. To determine the physical and chemical characteristics of locally produced vermicomposts.
2. To assess vermicomposting of sago pith waste with different animal manure (cow and goat) and compare their characteristics with commercially available vermicompost.
3. To determine the growth performance of maize crop applied with selected sago pith waste vermicomposts and effect on soil.



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