UNIVERSITI PUTRA MALAYSIA

EFFECTS OF DIFFERENT EMPTY FRUIT BUNCH (EFB) COMPOSTING PERIODS ON THE PRODUCTIVITY OF VOLVARIELLA VOLVACEA

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BY

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A project report submitted to Faculty of Agriculture, Universiti Putra Malaysia, in fulfillment of the requirement of PRT 4999 (Final Year Project) for the award of the degree of Bachelor of Agricultural Science

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This project report entitled **Effects of Different Empty Fruit Bunch (EFB) Composting Periods on The Productivity of *Volvariella volvacea*** is prepared by **Noratika Binti Abd Rauf** and submitted to the Faculty of Agriculture in fulfillment of the requirement of PRT 4999 (Final Year Project) for the award of the degree of Bachelor of Agricultural Science.

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ABSTRACT

Volvariella volvacea, also known as the paddy straw mushroom, belongs to the family Pluteaceae. It was first cultivated in China as early as 1822. Referred as a 'warm mushroom' because of its ability to grow at high temperature, it is also a fast-growing mushroom compared to other mushrooms. *Volvariella volvacea* was proven suitable to be cultivated using empty fruit bunch (EFB) of oil palm compared to paddy straw as a cultivation substrate. In previous research, there is only one study of improving the yield quantity of *Volvariella volvacea* by using various cultivation substrates; paddy straw, cotton waste, banana leaves, sawdust and EFB. With the same purpose of improving yield production, this study focuses on determining the most suitable number of days of composting EFB to be used in the cultivation of *Volvariella volvacea*. Previously, the common number of days of composting EFB used by mushroom growers is nine days, but there are no studies that prove nine is the best number of days for composting EFB. In this study, three replicates of each different number of days of composting EFB were conducted. The composting plots were arranged using Randomized Complete Block Design (RCBD) and were conducted under favorable conditions for the cultivation of mushrooms cultivation. Six, nine and twelve day of composting EFB were selected to determine the validity of this research, which was conducted in outdoor cultivation for practical purposes in achieving the main objectives of this study. Both yield production and biological efficiency (BE%) of *Volvariella volvacea* are used as an indicator in this study and for determining the most suitable days of composting EFB that can be used. The values of the yield production and biological efficiency are collected and processed using t-test. The results show that twelve day of composting EFB give the highest yield production and biological efficiency but it shows no significant difference in both result indicator among the different composting periods of EFB substrate for *Volvariella volvacea* cultivation. The studies findings reveal an opportunity for commercial of *Volvariella volvacea* mushroom especially in saving time of composting EFB as the cultivation substrate.

ABSTRAK

Volvariella volvacea atau dikenali sebagai cendawan jerami padi berasal daripada famili Pluteaceae, dan ia mula ditanam di China pada awal tahun 1822. Dikatakan sebagai 'cendawan hangat' oleh kerana keupayaannya untuk tumbuh pada suhu yang tinggi dan ia merupakan cendawan yang paling cepat-tumbuh berbanding cendawan-cendawan yang lain. *Volvariella volvacea* terbukti sesuai untuk ditanam dengan menggunakan buah tandan kosong (BTK) daripada kelapa sawit berbanding jerami padi sendiri sebagai substrat tanaman. Dalam kajian sebelum ini, hanya ada kajian yang membuktikan peningkatan kuantiti hasil *Volvariella volvacea* dengan menggunakan pelbagai substrat tanaman; jerami padi, biji kekabu, pelepah daun pisang, habuk kayu dan termasuklah BTK. Dengan tujuan yang sama untuk meningkatkan kuantiti hasil pengeluaran, tetapi dalam kajian ini ia menentukan hari yang paling sesuai dalam pengkomposan BTK untuk digunakan dalam penanaman *Volvariella volvacea* dimana sebelum ini hari pengkomposan BTK yang digunakan adalah sembilan hari tetapi tidak ada kajian membuktikannya ia adalah terbaik untuk penanaman cendawan ini. Tiga replikasi untuk setiap hari yang berbeza dalam pengkomposan BTK dan akan ditanam dan disusun menggunakan Rawak Reka Bentuk Blok Lengkap (RCBD) dalam keadaan yang menyokong pertumbuhan cendawan. Enam, sembilan dan dua belas hari pengkomposan BTK telah dipilih untuk menentukan kesahihan kajian ini, dimana ia dijalankan secara kaedah penanaman luaran untuk tujuan praktikal dalam mencapai objektif utama kajian ini. Kedua-dua hasil pengeluaran dan keupayaan biologi (BE%) daripada *Volvariella volvacea* akan digunakan sebagai petunjuk dalam kajian ini dan seterusnya dalam menentukan hari yang paling sesuai untuk pengkomposan BTK boleh digunakan. Nilai-nilai hasil pengeluaran dan keupayaan biologi akan dikira dan diproses menggunakan 't-test'. Daripada keputusan tersebut, dua belas hari pengkomposan BTK memberikan hasil pengeluaran dan keupayaan biologi yang tinggi tetapi ia menunjukkan tiada perbezaan yang signifikan yang sesuai dipilih menjadi hari pengkomposan BTK terbaik dalam hasil penanaman *Volvariella volvacea*. Kajian ini dapat membuka peluang dalam pengkomersialan cendawan *Volvariella volvacea* terutamanya membantu dalam menjimatkan masa dalam pengkomposan BTK sebagai substrat tanaman.

CHAPTER 1

INTRODUCTION

1.1 Paddy Straw Mushrooms

Volvariella volvacea also known as paddy straw mushroom or the Chinese mushrooms originated in China and was first cultivated in the year of 1822 (Chang, 1977). This mushroom belongs to the family Pluteaceae (Kotl. &Pouz), class of the Basidiomycetes (Singer, 1961). It was one of the easiest mushrooms to be cultivated and grows wild on the ground, in the gap of rice straw and also in the gap of palm oil fiber. It grows well at relatively high temperatures between 28°c to 35°c (Chang, 1978). Paddy straw mushroom has high nutrient content such as protein and contains anti-cholesterol, eritadenin an effective antibiotic to prevent anemia. *V. volvacea* shows properties of being anti-tumor, immunosuppressant and immunomodulatory (Kishida et al., 1998).

This mushroom accounts for about 5-6% of the total world production of cultivated mushrooms and is sixth in the global production of cultivated mushrooms (Buswell and Chen 2005). However, the cultivation of *V. volvacea* is still new in Malaysia, unlike the oyster mushroom that has been grown commercially throughout Malaysia.

1.2 Agricultural Residues Problems in Malaysia

Palm oil is an important Malaysian commodity crop and Malaysia is the world's largest producer and exporter of palm oil, accounting for 11% of the world's oil and fats production. In

year 2015, 5.64 million hectares of land in Malaysia are under oil palm cultivation, an increase 4.6% recorded from the previous year. In 2015, crude palm oil (CPO) production recorded 19.96 million tons, while the fresh fruit bunch (FFB) yield for 2015 was 18.48 tons per hectare (MPOB, 2015). FFB is process to extract the palm and kernel oil which 20% from FFB (Lorestani, 2006) is the empty fruit bunch (EFB). The industry generates an estimate of 20.8 million tons of EFB in the year 2015 not included other waste such as palm kernel shell (PKS), palm pressed fibers (PPF) and palm oil mill effluents (POME), palm fronds and oil palm trunks from the plantation.

Agricultural residues are a big issue and there is concern that such residue will cause an environmental pollution problem because of overflowing and improper waste management. In Malaysian's palm oil industry, open burning of agricultural residues is prohibited by the government. With the large amount of palm oil residues and the lack of land space, there is consensus that the reuse and recycling of the empty fruit bunch (EFB) to produce other beneficial products from plantations is a good and necessary solution to the environmental pollution problem.

Other than palm oil residues, other waste from any agricultural plantation such as paddy straw, wood sawdust, sugarcane bagasse as well as livestock production waste such as manure can be adaptively reused. All agricultural residues are very rich in nutrients that are needed by plants. These residues can be recycled or reused by other plant production in good and low cost ways. These residues and by-products, as proved by Wang (1999), can be recovered and upgraded to a higher value and become useful products through chemical and biological process in order to solve the issue surrounding the overflowing of agricultural residues.

1.3 Mushroom Cultivation as a Good Potential to Solve Agricultural Residue Problems

Mushroom cultivation as good potential in mitigating the problem of overflowing agricultural residues in Malaysia. Edible mushroom cultivation on agricultural residues, especially residues from palm oil plantations, is an option with potential because the EFB is seen as a good alternative for waste conversion. Other than as a planting medium, palm oil residues also can be used as organic fertilizers (Aisueni & Omoti, 1999) which enables nutrients to return to the land. EFBs can also help to prevent soil erosion and control weed populations. The

preparation of composting materials for mushroom cultivation need some resources and takes time. Therefore, farmers are seeking a new alternative to cut costs by using other agricultural residues as a plant bed, which is helping by increasing bio-efficiency as demonstrated by Royse (2010), and improving mushroom yield. Oyster mushroom cultivation was proven to help manage the agricultural residues that otherwise have become problematic for disposal (Das & Mukherjee 2007; Loss et al., 2009). This combination of the mushrooms grower industry and the palm oil industry represents an economic potential (Stoknes et al., 2008) and soon can be applied more broadly in Malaysia's agriculture industry.

Volvareilla volvacea is one of the mushrooms that are getting noticed by farmers in Malaysia because the mushroom is fast growing, easy to cultivate and has a short crop cycle that is completed within 4-5 weeks. Ahlawat & Kumar (2005) stated it can be grown on uncomposted substrate quickly and easily; this includes substrates such as on paddy straw and cotton waste or other cellulosic organic waste materials.

A variety of waste materials have been used for cultivation of the paddy straw mushroom, which include: paddy straw (Chang, 1965), water hyacinth (Cheng & Mok, 1971), oil palm bunch (Naidu, 1971), oil palm pericarp waste (Graham & Yong, 1974; Yong & Graham, 1973), banana leaves & saw dust (Chua & Hu, 1973), cotton waste (Chang, 1974, Hu et al., 1973 & Yau & Chang, 1972) and, sugarcane bagasse (Hu et al., 1973, 1976 & 1976).

Because Malaysia is one of the biggest producers in terms of palm oil plantations and produces very large volumes palm oil products, its residues can be used as a good conversion for other agriculture activities. With continuously increasing production of large quantities of EFB by a plantation each year, residues can be used as a source of cultivation substrate for mushroom production because they are available all-year at low cost and the residues contain nutrients needed in mushrooms growth. One of the best mushrooms to be cultivated in Malaysia using palm oil residues is *V. volvacea*. With nutrients supplied by palm oil residues and the reduced reliance on petrochemical fertilizers, EFB substrates may help in paddy straw mushroom cultivation by enabling high yield production, higher biological efficiency and improving the nutrients of the mushrooms itself.

In previous research, EFB was proven to promote a high yield rather than cultivation on paddy straw itself (Naidu, 1971). There is yet to be a study that demonstrates the best EFB composting period in terms of affecting yield production. In this study, the relationship between composting period and yield production of *V. volvacea* is measured along with biological efficiency (BE %) so that the use of EFB compost can be practically adopted by mushroom growers in their cultivation practices.

1.4 Objectives of Study

i. To investigate the relationship of empty fruit bunch (EFB) composting period and the yield production of *Volvariella volvacea.*

ii. To select the best empty fruit bunch (EFB) composting period in giving high yield production and high biological efficiency of *Volvariella volvacea*.

CHAPTER 2

LITERATURE REVIEW

2.1 *Volvariella volvacea*

Volvariella volvacea is a species of edible mushroom that has been cultivated throughout Asian countries but are now gaining popularity worldwide. In the beginning, *V. volvacea* was cultivated in China by Buddhist and was served to the royal family as one of their royal foods. Baker (1934) and Chang (1974) stated that around 1932, *V. volvacea* was introduced to other Asian countries including the Philippines, Malaysia and the South Asian countries. *V. volvacea* grows well between 28 and 35°C (Chang, 1978). Ahlawat et al. (2008) and Shaffer (1957) stated that it is widely grows in tropical, subtropical and temperate regions by using agricultural wastes as growth substrates. *V. volvacea* is very easily and quickly grows in the subtropical climate with high annual rainfall and is very suitable to be cultivated in Malaysia.

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