

**CORN HUSK AS POTENTIAL SUBSTRATE FOR *Pleurotus florida*
CULTIVATION**

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**DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF BACHELORS OF
AGRICULTURE SCIENCE WITH HONOURS**

**PERPUSTAKAAN
UNIVERSITI MALAYSIA SABAH**

**HORTICULTURE AND LANDSCAPING PROGRAMME
FACULTY OF SUSTAINABLE AGRICULTURE
UNIVERSITI MALAYSIA SABAH
2018**



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JUDUL: SEKAM JAHUNH SEBAGAI SUBSTRAT BERPOTENSI UNTUK PENANAMAN
CENDAWAN *Pleurotus florida*.

IJAZAH: IJAZAH SARJANA MUDA SAINS PERTANIAN DENGAN KEPUJIAN
PROGRAM HORTIKULTUR DAN LANDSKAPE

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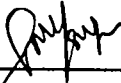
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ACKNOWLEDGMENTS

This dissertation would not have been possible without the guidance and the help of several individuals who in one way or another contributed and extended their valuable assistance in the preparation and completion of this study.

My utmost gratitude to my supervisors, Prof. Madya. Dr. Markus Atong and Dr. Mohd Rakib Mohd Rashid who had supported me throughout my study with their guidance and sharing of knowledge and experience for the completion of this research work.

A deepest appreciation dedicate to Mr. Mattunjan, the staff of field administrative, who have great experience in mushroom cultivation for his guidance for the proper procedure for mushroom cultivation.

I would like to whole-hearted appreciation to the final year project coordinators, Miss Shahida Mohd. Sharif and Miss Izyan Ayuni binti Mohamad Selamat for coordinating the progress of final year project. Besides, my sincere gratitude for all of my friends, seniors and the laboratory assistants for their support and guidance and most importantly for contributing their unselfish time in helping me to carry out my research works.

Last but not least, I would like to express my heartfelt gratitude to my family for their unconditional love, understanding and moral support during the research work.



ABSTRACT

Corn husk was used as the alternative materials to replace sawdust in this study for commercial production of *Pleurotus florida* as the source of sawdust are getting limited. The objective of this study was to evaluate the growth and development and yield of white oyster mushroom (*Pleurotus florida*) using corn husk as substrate. Completely Randomised Design (CRD) was used in this study with total seven treatments. Substrate ratio with 100% sawdust was used as the control in the study. Mixture of 75% sawdust and 25% corn husk (T2), 67% sawdust and 33% corn husk (T3), 50% sawdust and 50% corn husk (T4), 33% sawdust and 67% corn husk (T5), 25% sawdust and 75% corn husk (T6) and 100% corn husk (T7) treatments with five replicates each were conducted. Results were analyzed by Statistical Analysis System (SAS), using one-way ANOVA procedure to test the significant difference at 5% significant level. Significance difference ($p < 0.05$) were found in the mycelium running rate, duration of complete mycelium run, the time required for primordial initiation and duration from inoculation until harvest of first flush for the growth and development. While for the yield production, significance difference were found in the number of fruiting body, the number of effective fruiting body, fresh weight, dry weight and biological efficiency. However, there was no significant difference in time required for formation of fruiting body form primordial among the treatments in the growth and development. Diameter of cap, length of stem and moisture content also found no significant difference in the yield production. From this study, T3 (0.55 ± 0.01 cm day⁻¹), T4 (0.50 ± 0.03 cm day⁻¹), T5 (0.51 ± 0.03 cm day⁻¹) and T6 (0.50 ± 0.03 cm day⁻¹) had the higher mycelium running rate than T1 but the shortest duration of complete mycelium run were found in T1 (33.20 ± 0.49 days). The shortest time required for primordial formation of first flush was found in T7 (1.40 ± 0.24 days). Furthermore, T7 (38.60 ± 0.24 days) and T4 (38.60 ± 0.24 days) had the shortest time required for the inoculation until first harvest. For the yield production, T7 had the highest number of effective fruiting body produced (17.8 ± 1.28) and treatments with cornhusk mixture T7 (28.40 ± 3.08), T6 (20.20 ± 3.96), T5 (23.00 ± 1.93), T4 (22.00 ± 3.99) and T3 (26.00 ± 2.78) were found to have similar number of fruiting body produced. Highest fresh weight was harvested from T7 (108.90 ± 10.48 g) and T3 (95.05 ± 9.07 g) while the highest dry weight was obtained by T7 (7.14 ± 0.60 g) as well. For the biological efficiency, T7 has the highest biological efficiency ($51.37 \pm 4.95\%$) compared to other treatments. All the parameter measured were obtained for two flushes that produced along the period of cultivation. The findings suggested that there is potential to use corn husk as substrate for *P. florida* cultivation, as substitute to the use of sawdust in current commercial practice.

SEKAM JAGUNG SEBAGAI SUBSTRAT BERPONTENSI UNTUK PENANAMAN CENDAWAN *Pleurotus florida*

ABSTRAK

Sekam jagung telah dicadangkan sebagai bahan alternatif untuk menggantikan habuk kayu dalam pengeluaran komersial *P. florida* sebab sumber habuk kayu yang semakin terhad. Objektif kajian ini adalah untuk menilai pertumbuhan dan hasil Cendawan Tiram Putih (*Pleurotus florida*) dengan menggunakan sekam jagung sebagai substrat. Rekabentuk rawak lengkap (CRD) telah digunakan dalam kajian ini dengan tujuh rawatan. Nisbah substrat dengan 100% habuk kayu telah digunakan sebagai kawalan kajian. Campuran 75% habuk kayu dan 25% sekam jagung (T2), 67% habuk kayu dan 33% sekam jagung (T3), 50% habuk kayu dan 50% sekam jagung (T4), 33% habuk kayu dan 67% sekam jagung (T5), 25% habuk kayu dan 75% sekam jagung (T6) dan 100% rawatan sekam jagung (T7) telah digunakan dengan lima replikasi setiap rawatan. Data telah dianalisis menggunakan Statistical Analysis System (SAS), dengan One-way ANOVA untuk menguji perbezaan bererti pada aras keertian 5%. Perbezaan bererti ($p < 0.05$) didapati dalam kadar pertumbuhan miselium, jangka masa untuk kelengkapan miselium, jangka masa untuk perbentukan primordial, jangka masa dari inokulasi hingga menuaian pertama untuk pertumbuhan. Bagi pengeluaran hasil, perbezaan bererti didapati dalam jumlah buah, bilangan jasad buah, berat segar, berat kering dan kecekapan biologi. Walau bagaimanapun, tiada perbezaan bererti dalam jangka masa pembentukan buah selepas primordial di antara rawatan dalam pertumbuhan cendawan. Diameter topi, panjang batang dan kelembapan juga mendapati tiada perbezaan yang bererti dalam pengeluaran hasil. Dari kajian ini, T3 ($0.55 \pm 0.01 \text{ cm day}^{-1}$), T4 ($0.50 \pm 0.03 \text{ cm day}^{-1}$), T5 ($0.51 \pm 0.03 \text{ cm day}^{-1}$) and T6 ($0.50 \pm 0.03 \text{ cm day}^{-1}$) mempunyai kadar mycelium yang lebih tinggi daripada T1 tetapi jangka pelengkapan miselium paling pendek didapati pada T1 (33.20 ± 0.49 hari). Tempoh tersingkat untuk pembentukan primordial didapati pada T7 (1.40 ± 0.24 hari). T7 (38.60 ± 0.24 days) and T4 (38.60 ± 0.24 days) juga mempunyai masa tersingkat untuk inokulasi sehingga penuaian pertama. Bagi pengeluaran hasil, T7 mempunyai bilangan jasad buah yang tertinggi (17.8 ± 1.28) dan campuran sekan jagung T7 (28.40 ± 3.08), T6 (20.20 ± 3.96), T5 (23.00 ± 1.93), T4 (22.00 ± 3.99) dan T3 (26.00 ± 2.78) telah didapati tiada perbezaan bererti dalam bilangan. Berat segar tertinggi dituai dari T7 ($108.90 \pm 10.48 \text{ g}$) dan T3 ($95.05 \pm 9.07 \text{ g}$) serta berat kering tertinggi diperolehi oleh T7 ($7.14 \pm 0.60 \text{ g}$) juga. T7 mempunyai kecekapan biologi tertinggi ($51.37 \pm 4.95\%$) berbanding dengan rawatan lain. Semua parameter yang diukur diperolehi dari dua sirip yang dihasilkan sepanjang tempoh penanaman. Penemuan ini mencadangkan bahawa terdapat potensi untuk menggunakan sekam jagung sebagai substrat untuk penanaman *P. florida*, sebagai pengganti penggunaan habuk kayu dalam amalan komersial semasa.

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LIST OF SYMBOLS, UNITS AND ABBREVIATIONS

%	Percent
$(\text{NH}_4)_2\text{SO}_4$	Ammonium sulphate
°	Degree
°C	Degree celcius
ANOVA	Analysis of Variance
BE	Biological efficiency
BHA	Butyl hydroxy anisole
BHT	Butyl hydroxy toluene
CaCO_3	Calcium carbonate
CaSO_4	Calcium sulphate
$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$	Calcium sulphate dehydrate
cm	Centimeter
CO_2	Carbon dioxide
CRD	Completely Randomised Design
FSA	Faculty of Sustainable Agriculture
g	Gram
gm/kg	Gram/kilogram
H_a	Alternate hypothesis
HCl	Hydrochloric acid
H_o	Null hypothesis
hrs	Hours
LSD	Least significant difference
m/L	Milligram per meter
MgSO_4	Magnesium sulphate
min	Minutes
ml	Millilitre
mm	Millimeter
NaOH	Calcium hydroxide
NGO	Non-Government Organization
PDA	Potato dextrose agar
psi	Pound-force per square inch
PVC	Polyvinyl chloride
SAS	Statistical Analysis Software
UMS	Universiti Malaysia Sabah
USDA	United States Department of Agriculture

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CHAPTER 1

INTRODUCTION

1.1 Background

Mushrooms are fleshy macro fungi which produces spore-bearing fruiting body of typically produced either epigeous (above ground) on soil or hypogenous (underground) (Chang and Miles, 2004). Mushrooms have similar cell structure as plant do but they do not manufacture their own food as they do not contain chlorophyll like green plants. Therefore, they feed themselves by digesting other organic matter just like animals.

According to Stamets and Chilton (1983), mushrooms are known as the vegetarian's meat as their nutritional value especially proteins, vitamins, and minerals are rich. Mushroom contains all the nine essential amino acids requires for human body thus the protein content in mushroom are intermedia between that of animals and vegetables (Singh and Singh, 2005). Mushrooms are consumed and appreciated for their flavor, economic and ecological values and medicinal properties for many years, therefore they had been cultivated widely (Aguilar-Rivera and De Jesús-Merales, 2010). Mushroom is an attractive crop to cultivate because of their ability to grown on agricultural wastes as its saprophytic nature ability. Thus, the cost of production is reduced as the substrate materials can be obtained at low prices or even for free. Besides, conservation of the environment can be done by recycling wastes at the same time.

Eighty-five percent production of the world's edible mushroom are accounted by the five main genera such as *Agaricus*, *Pleurotus*, *Lentinula*, *Auricularia* and *Flammulina*. *Agaricus* leading the as the major production with about 30% of production and followed by *Pleurotus* which constitutes about 27% of the world's output. Seventeen percent of the production was contributed by *Lentinula* while the remains 11% was responsible by the other two genera, *Auricularia* and *Flammulina* (Royse, 2014). Adebayo and Martinez-



Carrera (2014) stated that the production oyster mushroom (*Pleurotus* spp.) are in the third place among the world production after the white button mushroom (*Agaricus Bisporus*) and shiitake mushroom (*Lentinula edodes*). From the statistics stated above, we can clearly acknowledge the production of *Pleurotus* species had grown at a rapid rate as it had become as the second major production of world's edible mushroom which had led over the *Lentinula* species.

Oyster mushroom (*Pleurotus* spp.) is the most commonly cultivated mushroom in Malaysia as it has the ability to grow at a wide range of temperatures and utilizing various lignocellulose substrates (Khan *et al.*, 2012). Genus *Pleurotus* belongs to family Tricholomataceae and has about 40 well-recognized species (Ahmed *et al.*, 2009). Oyster mushrooms are able to degrade lignin efficient therefore they can grow well on different types of lignocellulosic materials. According to Mat-Amin *et al.* (2014), there are eight out of seventeen mushroom varieties cultivated commercially in Malaysia as their adaptability to be grown with the Malaysia climate. They are abalone (*P. cytidiosus*), rice straw (*Volvariella* sp.), Telinga kera (*Auricularia polytricha*), grey oyster (*P. sajor-caju*), white oyster (*P. florida*), red oyster (*P. flabellatus*), ganoderma (*Ganoderma applanatum*) and shiitake (*Lentinusedones*). White oyster mushroom (*P. florida*) belongs to the family Basidiomycetes. Basidiomycetes plays an important role in nature by recycling carbohydrate through lignin degradation which is achieved through lignolytic enzymes such as laccase, ligninase, peroxidase, and Magnesium peroxidase (Twumasi *et al.*, 2011).

As the awareness of consumers towards health increased due to the promotion by government agencies and non-governmental organization (NGO)s whereby they are very concerning its many benefits, the demand for mushroom is increasing in line (Mat-Amin *et al.*, 2014). A solution to increase the production of the mushroom in commercial mushroom cultivation search and practice the use of agriculture waste as alternative substrate medium. These alternative substrate materials should be bio-degradable and it would be better from the agricultural wastes. Besides, these materials will help in the waste management of agricultural by-products and therefore reduce the waste produce by utilizing them. Mondal *et al.* (2010) stated that rice straw, rice husk, corn straw, sawdust, cotton stalk and banana leaves are agriculture wastes that are normally used as substrate medium for mushroom cultivation.

In Malaysia, 1.4 million tons of agricultural waste is disposed into landfills annually (Agamuthu *et al.*, 2009). Some of the by-products are used as animal feed and for other small scale applications such as planting media. As many of the agricultural by-products contain substantial amounts of cellulose, especially in fibrous form, these agricultural waste can be utilized as the potential materials for crop or horticulture cultivation. Thus, it helps to minimize the production cost and conserve the environmental towards sustainable agriculture practices. Maize as the major production of cash crop in Malaysia whereby they achieved about 63 metric tons in 2015 and was about 27% of the total production (USDA, 2016). Although the corn production in Malaysia are still under development, but it had reduces the potential growth of corn import (USDA, 2016). The agricultural waste produced by the corn production are corn stalk, corn cob, corn husk and corn silk. Corn husks are the outer covering of an ear of corn as a protection layer to the fruit. It also plays an important role in photosynthesis whereby they utilize CO₂ to make sugars using the C4 photosynthetic pathway, in which carbon assimilation is essentially split into two distinct cycles within the leaf (Pengelly *et al.*, 2011). Corn husk normally used in the presentation of a dish, but are not edible and should be discarded after use. Therefore, corn husk has the potential to be the alternative substrate for mushroom cultivation.

1.2 Justification of Study

The commercial production of mushrooms for the Malaysia local and export markets was about 1,000 tons per year (Mat-Amin *et al.*, 2014). For the commercial mushroom production, sawdust and rice husk have been used for the most as substrate media (Saidu *et al.*, 2011). However, forest protection has become the main issue for public in the society for many years. Besides, the cultivation of mushroom that required softwood sawdust rather than hard wood as the decompose ability of mushroom are limited. Softwood sawdust like mango and cashew are known to be more suitable than hardwood sawdust (Pathmashini *et al.* 2008). Therefore the supplying of sawdust as planting substrate of mushroom will be limited and the problem of shortage of sawdust is reduced in long term mushroom cultivation (Shah *et al.*, 2004). In addition, sawdust can be toxic to mushroom especially the dust from the black walnut tree. The sawdust supplied by sawmills might come from several types of tree and it might include black walnut tree that contained toxic substance, Juglone (Strugstad and Despotovski, 2012).

Corn husk is chosen in this study as an agricultural waste that used to produce white oyster mushroom (*Pleurotus florida*) because the corn husk are been produced abundantly and the uses of corn husk are still under discover. Besides, corn husk contains cellulose, hemicellulose, and lignin that act as the carbohydrate sources for the fungi when they decompose the plant materials (Chitra and Vasanthakumari, 2012). Therefore, corn husk has the potential as substrate for mushroom cultivation. This will be a both sides benefited situation as the problems of the waste produced by commercial agriculture cultivation are reduced and the production of mushroom in Malaysia are improving at the same time. By studying to produce white oyster mushroom using corn husk as potential substrate, we will be able to look forward to the greater benefits of corn husk.

1.3 Objectives

- a) To evaluate the growth and development of white oyster mushroom (*Pleurotus florida*) using different rates of corn husk as substrate.
- b) To evaluate the yield of white oyster mushroom (*Pleurotus florida*) using different rates of corn husk substrate.

1.4 Hypothesis

- a) H_{01} : There is no significant difference of mushroom growth using cornhusk substrate compared to sawdust substrate.
 H_{a1} : There is a significant difference of mushroom growth using cornhusk substrate compared to sawdust substrate.
- b) H_{02} : There is no significant difference of mushroom yield using cornhusk substrate compared to sawdust substrate.
 H_{a2} : There is a significant difference of mushroom yield using cornhusk substrate compared to sawdust substrate.

CHAPTER 2

LITERATURE REVIEW

2.1 Mushroom

Mushrooms used to be classified into the Kingdom Plantae, but now belongs to the Kingdom Fungi which draw a clear line from animals or plants due to their unique characteristics. A mushroom is defined as 'a macrofungus with a distinctive fruiting body which can be either epigeous or hypogeous. The macrofungi have large fruiting body that can be seen with the naked eye and to be picked up by hand' (Chang and Miles, 1992). Mushroom refers to the fruiting body is under the class Agaricomycetes, class of fungi in the division of Basidiomycota, that have a stem (stipe), a cap (pileus), and gills (lamellae) on the underside of the cap (Figure 2.1).

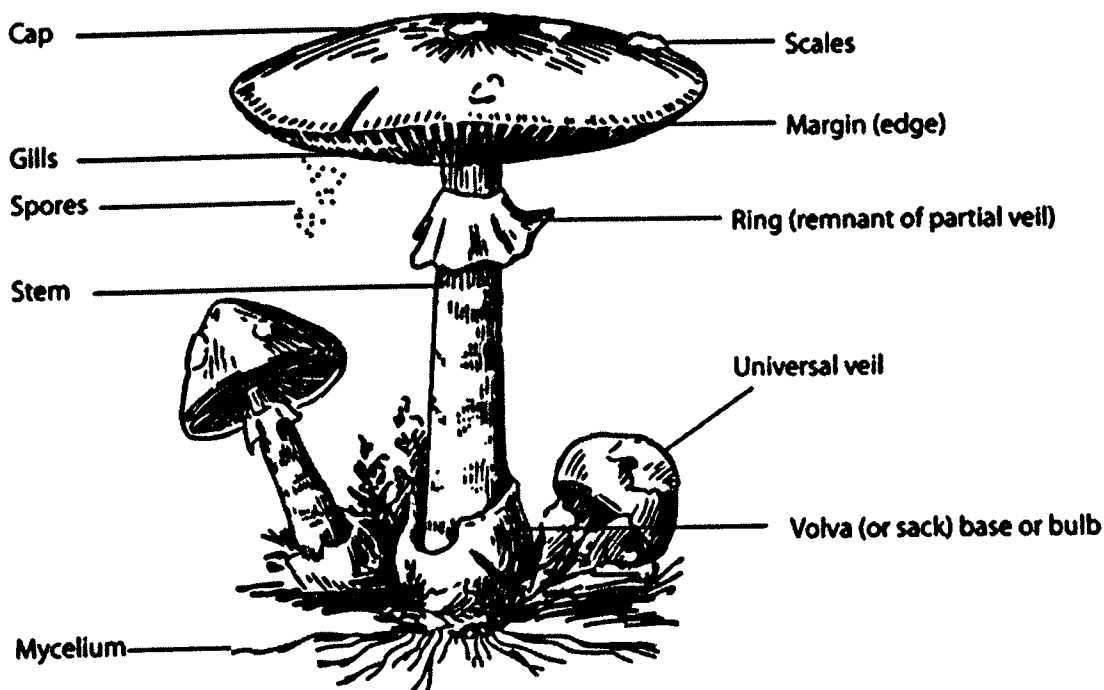


Figure 2.1
Source:

Features of a typical bolete fruiting body drawn by Sam J. Norris.
Bessette *et al.* (2000)



Mushrooms are heterotrophs that use organic energy sources, and normally produce by other living organisms as secondary or tertiary producers. Mushroom depends on the preformed food for their nutrition because mushroom cannot generate nutrients by photosynthesis due to the lacking of chlorophyll. Therefore, they accumulate nutrients from the substrate by secreting digestive enzymes, colonize and decompose the materials (Singh and Singh, 2005) and it turns out that high protein, carbohydrate, multivitamins, minerals and rich source of folic acid which are good for the health are found in mushroom fruiting body. Scientific studies confirm that vitamins and minerals in mushrooms are suitable for nutraceutical, pharmaceutical and cosmetic products (Abdel-Aziz *et al.*, 2015). Edible mushrooms are being consumed for their nutritional, medicinal and recreational activities or for religious purposes.

Mushrooms are classified into three categories which are saprophytes, parasites or mycorrhizae based in their tropic pattern. The most commonly grown mushrooms are saprophytes which are the decomposers in an ecosystem that growing on organic matters such as wood, leaves, and straw in nature (Imtiaj and Rahman, 2008). Primary decomposers such as oyster mushroom and enokitake, have lignocellulosic enzymes that can decompose the raw materials. On the other hand, secondary decomposers like button mushroom or straw mushroom required bacteria or other fungi for substrate degradation.

Mushrooms required carbon, nitrogen and inorganic compounds as its nutritional sources and carbon sources such as cellulose, hemicellulose, and lignin are their main nutrients. Therefore, sawdust, paddy straw, rice husk, corn cob, corn stalk and date-palm leaves can be used as mushroom substrates (Kholoud *et al.*, 2014). Different mushroom species will demand different amount of nutritional sources. Oyster mushroom and shiitake required less nitrogen and carbon as nutritional source (Hoa *et al.*, 2015).

Most organic carbon in the environment occurs as carbohydrates bound into the major components of plant tissues (Issac, 1997). However those carbohydrates are bound in different forms with different relative amounts and present in complex forms. In general terms, plant tissues are made up from cellulose (polymer of D-glucose), hemicelluloses (xylans and mannans), lignin (polymers of phenylpropane), other polysaccharides and glycoproteins. Cellulases which break down cellulose, fibrous part

of woody plants which is the most abundant organic matters on earth (Stamets and Chilton, 1983) and lignases which break down lignin, the block like structure which the cellulose encases can be found in mushroom. Fungi produced cellulase enzymes in response to the presence of cellobiose (disaccharide) which initially acts as an inducer although the higher levels of cellobiose might cause the repression of cellulase enzyme activity (Amore *et al.*, 2013). The degradation of lignin component is not easily done by microbial enzyme due to the large amount of lignin laid down in cell walls of woody and thickened plant materials provide mechanical strength and resistance to plant tissues. Therefore, fungi are less easily to break down lignin as they are recalcitrant to degradation (Ruiz-Dueñas and Martínez, 2009).

2.1.1 Fruiting Body Formation

Fungi producing millions and millions of spores by multiplying processes. Spore germinate and branch to form a mycelium when the spore settled in a suitable environment. Mycelium is defined as a network of fungal cells threaded together to form long, forking chains, creating a complex fabric of cells that pull its nutritional resources together to begin the construction of a mushroom (Stamets and Chilton, 1983). When two sexually compatible mycelia meet, they may fuse to form secondary mycelium, which is capable of forming fruiting body, mushroom. Overall, the mycelial colony will forms pins under certain conditions such as shaded area after fully colonized the substrate and grows to fruiting body when stimulated by temperature, humidity and other environmental factors (Oei, 2005).

2.2 *Pleurotus* species

In the family of Pleurotaceae, species of the genus *Pleurotus* are second most important commercial mushroom. *Pleurotus* is very popular in the countries of South-East Asia as they are easy to grow in wild range of temperate and tropical climate as wild mushrooms of this genus distributes worldwide (Boa, 2004). Hoa *et al.* (2015) stated that *Pleurotus* species need a short growth time and their fruiting body are not often attacked by diseases and pests compares to other edible mushrooms. Several species also known for their ability to grow well at relatively high temperature such *Pleurotus eryngii* (King oyster mushroom), *Pleurotus citrinopileatus* (Golden oyster mushroom), *Pleurotus djamar* (Pink oyster mushroom), *Pleurotus ostreatus* (Tree oyster mushroom), *Pleurotus*

cystidiosus (abalone oyster mushroom), *Pleurotus sajor-caju* (Grey oyster mushroom) and *Pleurotus florida* (white oyster mushroom) (Kong, 2004).

Pleurotus species is composed of 90% water and 10% dry matter. It contains high potassium to sodium ratio, which makes mushrooms an ideal food for patients suffering from hypertension and heart diseases (Hoa *et al.*, 2015). It is commonly consumed as human diet and for medical purposes. *Pleurotus* species helps in blood regulation, anti-thrombotic, lowers blood pressure, lipid concentrations and glucose levels, anti-inflammatory, anti-viral, anti-bacterial and anti-toxic; inhibits tumor growth and antioxidant (Valverde *et al.*, 2015).

Pleurotus species are characterized by the rapidity of the mycelial growth and high saprophytic colonization activity on cellulosic substrates (Thakur and Singh, 2014). They are well known for the most efficient in the degradation of lignocellulose substrates among all types of white rot for their ability to directly break down cellulose and lignin bearing materials without composting (Hatakka and Hammel, 2010). Sharma *et al.* (2013) stated that *Pleurotus* species are efficient lignin degraders, which can grow on different agricultural wastes with broad adaptability to varied agro-climatic conditions. Therefore, oyster mushroom cultivation plays an important role in managing organic wastes which have become problematic for disposal (Das and Mukherjee, 2006).

2.3 White Oyster Mushroom (*Pleurotus florida*)

2.3.1 Morphology

According to Staments and Chilton (1983), *Pleurotus* comes from the Greek "pleuro", meaning formed laterally or in a sideways position, and referring to the lateral position of the stem relative to the cap. While the epithet *Florida* refers to the location where the mushroom was first discovered. *Pleurotus florida* was isolated in the United States of America in the subtropical Florida by Block (Singh and Singh, 2012; Block *et al.*, 1958).

This species is similar in appearance to *Pleurotus ostreatus* and was considered as a subspecies of *P. ostreatus* but is somewhat smaller when compared to *P. ostreatus*. According to Chang and Miles (2004), *P. florida* has a tongue shaped cap, maturing to a shell shaped form, approximately 50-100mm in diameter and 10-50mm in stem. Some

modern mycologists are inclined to regard it as another species with different colour and different temperature requirements. According to Stamets and Chilton (1983), the flesh is normally thin and white (Figure 2.2). The margin is even and occasionally wavy. The gills are white, decurrently and broadly space. The stem is attached in an off-centred fashion and is short at first and absent in age. Its spores are whitish to lilac grey in mass.



Figure 2.2 *Pleurotus florida*

Pleurotus florida is widespread in temperate, subtropical and tropical zones. According to Kong (2004), *P. florida* can be harvest in warmer temperature as it's fruiting temperature range is wider than other *Pleurotus* species, it does not require fruiting induction (cold shock) and the hight in only 10 days compared 20 days for *P. ostreatus* (Stamets and Chilton, 1983). The moisture content of *P. florida* is approximately 91% and it can tolerate to high Carbon Dioxide (CO₂) level. Besides, it can produce abundant crops within a short time flame (total of approximately 63 days from spawn run to cropping), gives higher yield than *P. ostreatus* and is the highest productivity among the *Pleurotus* species (Kong, 2004).

2.3.2 Medicinal Advantages

White oyster mushroom (*Pleurotus florida*) is an edible mushroom that gained popularity lately due to its nutritional values and ease of cultivation. Mushroom is known as

vegetarian's meat as they act as an excellent source of minerals and their protein level is intermediate between the protein of vegetables and animals. This mushroom also contains 20 free amino acids, aspartic acid, glutamic acid, serine, glycine, alanine, praline, cysteine, valine, methionine, phenylalanine, isoleucine, leucine, lysine, histidine, threonine, asparagines, glutamine, arginine, tyrosine, and tryptophan (Sun *et al.*, 2017). According to Iqbal *et al.* (2016), *P. florida* produces metabolites of medicinal and pharmacological interest, such as antimicrobials, immunostimulants, antioxidants and antitumourals. According to Djajanegara and Harosyo (2008), oyster mushroom is an excellent source of natural antioxidant as they are rich in antioxidant. Due to the latest findings that indicated the harmful effect of the commonly used synthetic antioxidants such as BHA (Butyl Hydroxy Anisole) and BHT (Butyl Hydroxy Toluene) which are correlated to the damage of liver, the demand for natural antioxidant sources by food industries (Djajanegara and Harsoyo, 2008). However, there is low natural resources of antioxidant content. Therefore, white oyster mushroom strain that produces higher amount of antioxidant will be beneficial to fulfil the food industry demand.

Pleurotus florida has the properties of antioxidant and antitumor activities which helps in preventing and inhibiting formation of growth of tumors (Ogundele *et al.*, 2014). Therefore the nutrient contents of edible mushroom often being analyzed for further studies as the data derived will be served as useful basic to define the nutritional value. Table 2.1 shows the nutrient content of 100 g of fresh *P. florida* mushroom and dried *P. florida* mushroom by Alam *et al.* (2008).

Table 2.1 Nutrient contents of 100 g of fresh and dried *P. florida* mushroom

Nutrient contents	Fresh (g)	Dried (g)
Protein	2.5-2.7	19.0-22.0
Lipid	0.5-0.6	4.0-4.6
Fiber	2.9-3.1	22.0-24.6
Carbohydrate	5.0-5.6	40.0-45.0
Ash	1.1-1.2	8.6-9.5

Source: Alam *et al.* (2008)

Factors such as the differences among strains, the composition of growth substrate, the method of cultivation, stage of harvesting, specific portion of the fruiting body used for analysis can affect the nutritional composition of edible mushroom (Alam *et al.*, 2008). Moreover, biological factors such as species of mushrooms, morphological part of fruiting body, developmental stages and age of mycelium, biochemical



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