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COMPARISON OF *SALVINIA MOLESTA* AND SAWDUST AS SUBSTRATE FOR FRUIT BODY PRODUCTION OF *PLEUROTUS OSTREATUS*

WONG ANN NEE

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

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2015

DECLARATION

I hereby declare that this dissertation is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that no part of this dissertation has been previously or concurrently submitted for a degree at this or any other university.

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ABSTRACT

Cultivation of *Pleurotus ostreatus* on two different substrates, *Salvinia molesta* and sawdust was investigated. These substrates were mixed with fixed ratio of rice bran and lime. Sawdust is act as control in the experiment. The effects of substrates on mycelium development stage (MR), pinhead formation stages (PH), complete fruiting body phase (CFB), dry weight of mushroom, fresh weight of mushroom, biological efficiency, and cap diameter of the mushroom were analysed. *Salvinia molesta* was found as a good substrate in term in growth period with total mean growth period of 38.39 days, compare with sawdust with total mean growth period of 61.61 days. In term of mushroom yield, sawdust had a better yield with a higher biological efficiency, 10.32% compare with *Salvinia molesta*, 7.93%. Thus, the experiment shown *Salvinia molesta* can be a suitable substrate for cultivation of *Pleurotus ostreatus* in relative with similar environmental condition, temperature range from 25 to33 and relative humidity range from 63.5% to 84%.

ABSTRAK

Kajian tentang Penanaman Pleurotus ostreatus dalam dua bahan substrat yang berbeza, Salvinia molesta dan habuk kayu, telah dijalankan. Kedua-dua bahan mentah ini akan dicampur dengan dedak padi dan juga kapur pertanian dengan menggunakan nisbah yang telah ditetapkan. Habuk kayu adalah bertindak sebagai kawalan dalam kajian ini. Antara kajian perbandingan yang akan dijalankan dalam eksperimen ini adalah masa untuk miselium memenuhi beg substrat, masa untuk pembentukan "pinhead", masa untuk pembentukan jasad buah cendawan, berat basah dan berat kering jasad buah, kecekapan biologi dan purata diameter topi cendawan. Salvinia molesta telah didapati merupakan substrat yang bagus dari segi jumlah masa pertumbuhan dengan menunjukkan purata masa 38.39 hari, berbanding dengan habuk kayu dengan purata masa pertumbuhan sebanyak 61.61 hari. Dari segi jumlah hasilan cendawan, habuk kayu menunjukkan jumlah hasil yang lebih baik dengan kecekapan biologi, 10.32% berbanding dengan Salvinia molesta, 7.93%. Oleh itu, kajian ini mengesyorkan Salvinia molesta boleh dijadikan bahan mentah yang sesuai untuk penanaman Pleurotus ostreatus dengan syarat dalam keadaan persekitaan yang sama dengan kajian ini, iaitu suhu dalam lingkungan 25 hingga 33°C dan kelembapan relatif dalam lingkungan 63.5% hingga 84%.

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LIST OF SYMBOLS, UNITS AND ABBREVIATIONS

%	Percentage
BOD	Biochemical Oxygen Demand
°C	Degree celcius
C	Carbon
$CaCO_3$	Calcium carbonate
$CaSO_4$	Calcium Sulfate
CFB	Complete Fruiting Body
cm	Centimetre
CO_2	Carbon dioxide
CRD	Complete Randomized Design
FAO	Food and Agriculture Organization
Fe	Iron
FSA	Faculty of Sustainable Agriculture
G	Gram
K_2O	Potassium oxide
m	Meter
Mg	Magnesium
Mn	Manganese
MR	Mycelium Run
N	Nitrogen
OECD	Organization for Economic Co-operation Development
P	Phosphorus
PFPI	Partnership for Policy Integrity
P_2O_5	Phosphorus pentoxide
PVC	Polyvinyl chloride
RSM	Response Surface Methodology
SPSS	Statistical Package for the Social Sciences
US	United States
UNDP	United Nations Development Programme
USDA	United States Department of Agriculture
UMS	Universiti Malaysia Sabah
Zn	Zinc

LIST OF FORMULAE

CHAPTER 1

INTRODUCTION

1.1 Introduction

In world of mushroom production, *Pleurotus spp.* ranked fourth in year 1986 with total harvesting of 169 thousand metric tons (Chang, 1987). In year 1991, this yield had increased to 917 thousand metric tons (442%) in five years period. According to USDA 2003, during the last 25 years, worldwide mushroom production has increased over 300%, reaching approximately 2,961,493 tons in 2002. These has evidence a rapid grow of market demand on *Pleurotus* mushroom species. Some information imply that the increase in yield of *Pleurotus spp.* is closely related with the cultivation method of *Pleurotus* mushroom where it has been adopted by many people in rural areas because of their rapid mycelia growth, cheap production techniques and wide choice of species for cultivation under different climatic conditions (Quimio *et al.*, 1990). Industry expansion, in both output and diversity, is largely due to improvements in cultivation technologies and the expansion of market demand (Yamanaka, 1997).

"Oyster mushroom" is the common name of *Pleurotus spp.* that use in Europe countries and America. One of the common grown species of oyster mushroom is *Pleurotus ostreatus*. This commercial *Pleurotus* species is a wood-destroying fungus. It had been widespread in the temperate zones and able to forms fruit bodies in relatively cool temperatures in comparison with other *Pleurotus* species. The feature of this species is it need a low temperature treatment during the initial stage for primordia formation. The required treatment is called "cold shock" (MushWorld, 2004).

Pleurotus ostreatus has relatively high market value. In United States, the value of the specialty mushroom crop, oyster mushroom, reached $ 37,676,000 in 2002 to 2003 (USDA, 2003). In Malaysia, mushroom has high demand with the need on supply for 50,000 kg per day (Mohd Zaffrie *et al.*, 2013). Oyster mushroom has been highly desired in many Asian cuisines and have the reputation of being easy to cultivate (Stamets, 2000). The high value of oyster mushroom also related with its production requirements, and relatively rapid growth cycle.

Pleurotus ostreatus also beneficial due to their high nutritional value. By served as dishes, it can help to improve the health condition in human being by help in regulation of physiological functions especially in digestive tract due to its large amount of dietary fiber (Manzi *et al.*, 2001). *Pleurotus ostreatus* has good source of many nutrients contents which include protein, vitamins, fats, carbohydrates, amino acids and minerals (Chang and Buswell, 1996). Moreover, *Pleurotus ostreatus* is low in nucleic acid contents which make them an ideal food for patients suffering from diabetes, obesity and hypertension. The biochemical analysis of the mushrooms also showed the medicinal attributes in several species, such as antiviral, antibacterial, anti-parasitic, anti-tumor, anti-hypertension, anti-atherosclerosis, hepatoprotective, anti-diabetic, anti-inflammatory, and immune modulating effects (Wasser and Weis, 1999). Mushrooms also has been accepted as delicious food due to their uniqueness in color, aroma, texture and taste (Chang and Miles, 1991).

Mushroom is one of the food production that planned to be augmented to meet the increased world population. Thus, diversity methods on the mushrooms cultivation had been widely designed to meet this challenge. The cultivation of *Pleurotus ostreatus* required the preparation of the substrates. Substrate is defined as a surface on which an organism grows or is attached. According to previous study, the useful materials choices for the substrate preparation can be obtained from agricultural wastes and some species of aquatic weeds. The common agricultural wastes that had been studied as substrates for *Pleurotus* spp. are include coffee industry residues (Fan *et al.*, 2000), coffee pulp and wheat straw (Salmones *et al.*, 2005), waste paper (Baysal *et al.*, 2003). *Salvinia molesta*, which can be obtained easily from surrounding experimental area, have been choose as the substrate material. Nutritional compositions of mushroom is affected by many factors among which one of the major affecter is the composition of growth substrate (Benjamin, 1995). The major contents of the substrate that will affect the quality production of mushroom are includes fiber contents, carbon-nitrogen ratio

and mineral constituents under suitable pH condition. With above circumstances, the present study was undertaken to study the effect of *Salvinia molesta* as the substrate for the fruit body production of *Pleurotus ostreatus*.

1.2 Justification

In this study, *Salvinia molesta* using as the substrate for fruit body production *Pleurotus ostreatus* in the laboratory. The mushroom species that use in this study are belong to the genus *Pleurotus*. The mushrooms species are known to be distributed around tropical and subtropical region and oyster mushrooms are one of the most important commercial mushroom within the genus *Pleurotus*.

Through the survey conducted, the mushroom species found in the local area are mainly belong to genus *Pleurotus* are oyster mushroom (*Pleurotus ostreatus*). In order to carry out the study, consideration have been done on the mushroom availability, growing conditions, and mushroom variety according to the cultivation methods. The cultivation methods that used in this study was bag cultivation. This is the cultivation methods that suitable for *Pleurotus ostreatus* and *Pleurotus cystidiosus*. Since the availability of *Pleurotus ostreatus* is high around Sandakan area, *Pleurotus ostreatus* will be choose as the cultivate mushroom for this study.

The cultivation of *Pleurotus ostreatus* required the preparation of the substrates. Substrate is defined as a surface on which an organism grows or is attached. Previous study reveals that nutritional composition of mushroom depends on the nutrient composition of substrates. Various substrates have different effects on the growth, yield and quality of mushrooms (Ponmurugan *et al.*, 2007; Sarker *et al.*, 2008). According to previous study, the useful materials choices for the substrate preparation can be obtained from agricultural wastes (Fan *et al.*, 2000; Salmones *et al.*, 2005; Baysal *et al.*, 2003) and some species of aquatic weeds (Sarker *et al.*, 2009). For this reason, *Salvinia molesta,* have been choose as the substrate material, which had heavily infestation the lake area of Faculty of Sustainable Agriculture, University Malaysia Sabah, Sandakan (FSA-UMS, Sandakan). The existence of the aquatic plant on the lake surface has negative effect on the others lake activities. This can lead to the sustainable livelihoods of the aquatic habitat being threaten. Through showing some resource value on this biomass of prolifically growing obnoxious weed, *Salvinia molesta* will serve dual functions. One is the lake protection (ecological), and the other one is resource generation (economical).

By further study about it, *Salvinia molesta* is characterized as lignocellulosic materials which composed with polymers that difficult to be composed (Mani, 1998). Only small group of organisms, including the fungi, have the ability to degrade lignin (Loveless, 1969; David *et al.*, 1985). The decomposed of lignin contents of *Salvinia molesta* will provide the organic material in usable form, which can be absorbed by mycelium structures (Royse *et al.*, 1991). These evident has support the choices of *Salvinia molesta,* as the substrate for cultivation of *Pleurotus ostreatus*.

In this studies, the *Salvinia molesta* that collected from the lake area in FSA Sandakan will be used as the substrate for fruit body production by *Pleurotus ostreatus*. Nutritional composition of mushroom is affected by many factors among which the composition of growth substrate and the method of cultivation are of major importance (Benjamin, 1995). Various substrates have different effects on the growth, yield and quality of mushrooms (Ponmurugan *et al.*, 2007; Sarker *et al.,* 2008). The major contents of the substrate that will affect the quality production of mushroom are includes fiber contents, C:N ratio and mineral constituents under suitable pH condition.

According to the previous research that had been studied, there is no data published on the potentiality of *Salvinia molesta* as a substrate for the cultivation of oyster mushroom species *Pleurotus ostreatus*. Thus, studies on fruiting body produced by *Pleurotus ostreatus* using *Salvinia molesta* as the substrate will be purposes as one of the utilization methods on the *Salvinia molesta* usage.

1.3 Objectives

The objectives of this experiment are to examine the potentiality of *Salvinia molesta* as substrate for fruit body production by *Pleurotus ostreatus* and to utilize *Salvinia molesta* as an input resource generation in term of economical instead disposed as a wastes.

1.4 Hypothesis

H_0: There is no significant difference between *Salvinia molesta* and sawdust as the substrates for fruit body production by *Pleurotus ostreatus*.

H_a: There is a significant difference between *Salvinia molesta* and sawdust as the substrates for fruit body production by *Pleurotus ostreatus*

CHAPTER 2

LITERATURE REVIEW

2.1 *Pleurotus ostreatus*

Pleurotus ostreatus, with common name Oyster mushroom, is a type of edible mushroom. It had been widespread in the temperate zones and able to forms fruit bodies in relatively cool temperatures in comparison with other *Pleurotus* species. The special feature of this species is to need a low temperature treatment during the initial stage for primordia formation. The required treatment is called "cold shock" (MushWorld, 2004).

2.1.1 Historical Information

Oyster mushroom have been collected in the wild for many centuries, which has been use as edible mushroom. Plantation of these mushroom only began in the early 1990's. Initially, the techniques and methods that use for growing of *Pleurotus* involved tree stumps and logs as substrate (Ivors, 2003). In year 1950's, Germany, successful cultivation of oyster mushrooms on sawdust has become historic milestone for mushroom cultivation. Production of oyster mushroom in commercial scale are first started in the last 1960's using a straw based substrate (Chang and Hayes, 1978). The scale of farm in cultivation of oyster mushroom has been increasing ever since.

Compared to other edible mushrooms, species of *Pleurotus* are relatively simple to cultivate (Zadrazil, 1978). The special feature of *Pleurotus* to be able to grow on a wide range of lignocellulotic materials also make it the most adaptable genera of edible fungi to be considered produced in commercial level (Stamets, 2000). In nature, *Pleurotus spp.* exists on the wood of broadleaf trees, thus wood and wood products are common substrate for oyster mushroom cultivation (Zandrazil, 1978). Many different organic materials had been used as substrates, according to their availability in particular region.

In United States, the wheat straw is a common substrate for oyster mushroom cultivation, while in China, straw is utilized as substrate (Chang and Hayes, 1978). Other substrates used successfully include cotton waste, corn cobs. palm fronds, tea waste, and peanut shells (Cohen *et al.* 2002, Thomas *et al.*, 1998, Kalita and Mazumder, 2001, Philippoussis *et al.*, 2001).

2.1.2 Taxonomy and Morphology

Species of *Pleurotus* are wood-inhabiting ligninolytic white-rot Basidiomycetes belonging to the order Agaricales. There are 30 types of species of *Pleurotus* mushroom. *Pleurotus* have been known to grow parasitically on trees but it is classify as saprophytic fungi. The fruit bodies can be ranged in color from blue-gray, to white, to gray-brown and are mostly shell or spatula shaped, with a non-central stalk. Gills are thin, broad, dense, and vary in color from white to gray-lilac, and are often produced in large quantities, sometimes provoking allergic or irritation reaction in growers (Eger, 1978).

Culture conditions can cause to the change in color of the sporophore and gills, even within the same species. Early means of species identification required specific mating tests and isolation (Eger, 1978). In nowadays, the identification of the mushroom can be differentiate through molecular analysis and DNA sequencing allow for a more efficient, reliable, and timely.

2.1.3 Nutritional and Medicinal Value

Mushrooms characteristics as high moisture content, which in fresh can reach approximately 90% water; when dried, they contain from 5% to 20%. However conditions during growth, harvest, and post-harvest storage affect moisture content (Crisan and Sands, 1978). Oyster mushroom famous with its high nutritional value. Yang *et al.* (2001) reported crude protein content, on dry weight basis, as 23.9% in *Pleurotus ostreatus*. They contain about 60% carbohydrates (dry weight), within the ranges for other edible mushrooms (Crisan and Sands, 1978; Bano and Rajarathnam, 1988). In addition, they were reported to be low in fat (2% to 3% by dry weight), a good source of essential amino acids, and contain approximately 5% to 9 % fiber (Yang *et al.*, 2001).

Previous study indicate the substrate contributes to variation in nutrient value of fruit bodies (Crisan and Sands, 1978). Some evidence shown the mineral contents, especially P, Mg, Fe, Mn and Zn, of particular *Pleurotus* species fruit bodies increased

when grown on substrates with higher mineral content. Substrate composition has also been shown to affect fruit body flavor.

Oyster mushroom are known as have multiple medicinal properties. Mushroom can contribute in medical attributes on cardiovascular and cholesterol controlling benefits. Oyster mushroom naturally produce mevinolin (lovastatin) in portions of the fruiting bodies (Gunde-Cimerman, 1999). Mevinolin inhibits the key enzyme in cholesterol biosynthesis in the liver and reduces cholesterol absorption (Bobek *et al.*, 1998). *Pleurotus ostreatus* is known as the producer of many biologically active substances. Demonstration have been shown it have antibacterial properties (Wasser and Weis, 1999) in addition to antiviral, anti-inflamatory and immune modulation activities (Jose *et al.*, 2002). Evidence also shown it can be used as effective treatment of cancer. Gunde-Cimierman (1999) showed its effectiveness as an anticancer agent, while Gerasimenya *et al.* (2002) found it useful in decreasing the toxic effects of common cancer drugs. Cohen *et al.* (2002) provides a comprehensive list of medicinal substances found in six species of *Pleurotus*.

2.1.4 Production Overview

The life cycle of the oyster mushroom can be separated into two biological stages: the vegetative phase, consisting of mycelia expansion and maturation, and the reproductive phase of fruit-body production. An initial mycelia culture is obtained from pre-preparation of stock culture or though tissue culture. The yield mushroom cultures from these methods more predictable than those grown from spores (Royce, 2003).

Cultivation begins with propagation of mycelium on sterilized cereal grains, creating spawn. The spawn will then use to inoculate the mushroom substrate. After the substrate had been inoculated, it will then incubate in suitable area. During incubation, the formation of mycelium or spawn run will occur until it grows throughout the substrate and matures. With the suitable environmental conditions, the mature fungus will progress to the reproductive phase. Primordia will develop into harvestable mushroom.

During the reproductive phase of mushroom, some environmental conditions are required to be fulfill for mushroom to grow. The environmental conditions are included moisture, temperature, gas exchange, and light. For moisture, mushroom require extremely high humidity (90% to 100%) is recommended for optimal primordial formation. After the formation of primordia, humidity should be lowered to

85% to 90%. Ideally adjustment of the moisture contents is to be considering between the remained moisture and by evaporated moisture (Stamets, 2000). Excessive moisture can cause lack of oxygen in the substrate which will lead to the contamination. Insufficient moisture can prevent primordial from normal growing and stunt fruit body growth.

For temperature, the ideal condition for oyster mushrooms to be grow is between 10 °C and 21 °C (Stamets, 2000). Pettipher (1987) achieved successful fruiting of *Pleurotus ostreatus* with daily temperatures ranging between 8 °C and 33 °C.

For gas exchange, fungal mycelium is tolerant to carbon dioxide, thriving at 20% CO_2 levels. Oxygen is required for formation of fruit bodies. Thus, a significant decrease in ambient CO_2 level and increase in oxygen is critical for the initiation and development of primordia. A sufficient air circulation in the mushroom fruiting site is critical.

For light requirement, indirect natural light is considered ideal for the formation of *Pleurotus spp.* fruit bodies. A proper fruit body formation required moderate light. Lack or excessive of light can lead to discolored, malformed fruit bodies or the inability to fruit. Stamets (2000) recommends levels around 1,000 to 1,500 lux for commercial production.

2.1.5 Substrate Requirement

In considering the selection of types of raw material for substrate, there are two criteria should be considered. Firstly, the particular substrate material must be capable to supporting mushroom growth. Secondly, the substrate must be available locally in substantial and sustainable quantities.

Pleurotus spp. are commonly grown on a wide range of lignocellulosic materials. The substrates used in each region depend on the locally available agricultural wastes (Cohen *et al.*, 2002). The variation on the composition of substrate also play a role in vegetative and fruit-body growth. Lignin, cellulose and hemicellulose availability plays a key role in the growth of wood decaying fungi. Philippoussis *et al.* (2001) determined the cellulose: lignin ration of a substrate was positively correlated to rate of mycelia growth and mushroom yield of both *Pleurotus ostreatus* and *Pleurotus pulmonarius.* This has concluded the substrate rich in cellulose supported higher yields and resulted in more nutritious mushrooms.

Species of *Pleurotus* secrete as arsenal of enzymes specific for the digestion of lignocellulose materials, which contain in *Salvinia molesta.* The degradation of substrate is depends on the types of species of white-rot fungi used and different growth conditions (Freer and Detroy, 1982; Boyle *et al.*, 1992). According to Orth *et al.* (1993) and Kaal *et al.* (1995), specific lignin-degrading enzymes produced by *Pleurotus* spp. include lignin peroxidase, Mn peroxidase, and laccase. Cellulolytic enzymes of *Pleurotus* spp. include endoglucanase, exoglucanase, β-glucosidase (Buswell *et al.*, 1996, Tan and Wahab, 1997). Lignin, and cellulose of substrates have been shown to influence growth and fruiting of *Pleurotus.* Philippoussis *et al.* (2001) demonstrated that the cellulose:lignin ratio of the substrates was positively correlated to the mycelia growth rate and mushroom yield of both *Pleurotus ostreatus* and *Pleurotus pulmonarius.*

For the availability of substrate, *Salvinia molesta* has been find to be act as suitable substrate to be used since it is available in substantial and sustainable quantities. This aquatic weed had noticed continuously infest the lake area on FSA-UMS. Moreover, this aquatic weeds also contain lignocellulosic materials, which define suitable to be prepared as substrate culture for *Pleurotus* species.

2.2 *Salvinia molesta*

Salvinia molesta is a free-floating fresh-water fern, named after the Greek scholar Antonio Maria Salvinia (1653). It is classified as class Leptosporangiopsida, order Salviniales and family Salniniaceae. The genus is native to South America and there are about 13 species. In this experiment, the aquatic weed *Salvinia molesta* have been chosen as the materials to prepare as the substrate for cultivation of *Pleurotus ostreatus.*

2.2.1 Distribution and Description

Salvinia molesta, is native to South America. It is a small free-floating plant that grows in clusters and develops into dense, floating mats or colonies in quiet water, undisturbed by wave action. The floating leaves of giant salvinia are oblong (0.5 to 1.5 inches long) with a distinct midrib along which the leaf may fold forming a compressed chain-like appearance. The leaf hairs have a single stalk that divides into four branches that reconnect at the tip, giving the hair a cage-like or egg-beater appearance. Underwater the leaves are modified into small root-like structures. The entire plant is only about one to two inch in depth.

Salvinia molesta is a highly aggressive, competitive species. It has been evidence that it can be successfully competes with and even replaces water hyacinth and water lettuce (Kammathy, 1968). On the basis of environmental, economic and human health problems, *Salvinia molesta* ranks second behind water hyacinth on a list of the world's most noxious aquatic weeds (Barrett, 1989). It can be completely cover water surfaces and form mats up to 1 m thick (Thomas and Room 1986).

In term of characteristics, high mobility has induced the rate of reproduction of *Salvinia molesta* into a wider spaces. The mobility is facilitated by formation of aerenchyma tissue which gives stems and leaves buoyancy (Barrett, 1989). With the aid of wind and water currents to uninfected waters where they can grow and vegetative propagated. This species has a low tolerance for saline and dry environments. It does not colonize brackish or marine environments (Mitchell, 1979).

In term of habitat, common habitats are the most desired habitat, but undisturbed areas are also colonized by *Salvinia molesta*. The habitats can be varies included flood canals, rice paddies, artificial lakes, and hydroelectric facilities (Barrett, 1989). *Salvinia molesta* has invaded wetland habitats and reportedly replaced native flora.

Growth of *Salvinia molesta* is promoted by high light intensities, relatively high water temperatures, and a plentiful supply of nutrients (Mitchell and Tur, 1975). The water temperatures of 30 °C will result in rapid growth rates, and increasing the concentrations of nutrients, especially nitrogen and phosphorus (Cary and Weerts, 1983a and 1983b). This species also prefer a warm-temperate to tropical areas.

Reproduction occurs when mature plants produce buds at the stem node which develop from daughter plants. *Salvinia molesta* can double in size within four to ten days under good conditions. It is an aggressive invader species. The colonization of *Salvinia molesta* cover the surface of the water can cause the oxygen depletions and fish kills can occurs.

2.2.2 Impact of *Salvinia molesta* Infestation

Many aquatic weeds are considered as weeds as they deprive the humans of all facets of efficient use of water and cause harmful effects. Evidence has shown aquatic weed forms cause large scale depletion of water resources and harm the water quality and also bring about major impediment and losses in agricultural production and in the long term lead to deterioration in the environmental health.

Salvinia molesta is widely distributed and found abundantly in Africa, South America, Australia, India, Indonesia, Bangladesh, Burma, Sri lanka, Combodia, Mexico, New Zealand, Phillippines, Papua New Guines and Thailand. In India, there is variation in the estimates of infestation by different aquatic weeds in India (Varshney and Singh, 1976). *Salvinia molesta* forms the most predominant weed infesting the wet land area use for rice cultivation in Kerala, while water hyacinth was abundantly infesting the wastelands and neglected ponds (Thomas, 1976). In this state, *Salvinia* is a serious threat to hydroelectric projects, pisciculture, navigation and low land paddy fields. There is data shown as much as 1,900 hectares *Salvinia* covered the paddy field and currently is luxuriantly growing in almost all districts especially in Alappuzha, Kottayam, Ernakulam and Trichur. Its young saprophytes adhere to crop seedlings and grow rapidly into thick mats.

In term of human health, in Sri Lanka, it have been heavily cause the health infestation due to the habitat of *Salvinia molesta* which provide an ideal environment for the reproduction of disease-carrying organisms. *Salvinia molesta* had been act as the important plant host for Mansonia mosquitos, which serve as one of the principal vectors of rural elephantiasis (Pancho and Soerjani, 1978). Floating weeds especially water hyacinth and water fern have been reported to promote growth of all species of mosquitoes such as Aedes sp., Anopheles spp., Mansonia spp and Culex spp (Gopal, 1976). The infestation also lead to the difficulties of navigation. Roots of other species bind the mats firmly so that navigation by small boats become impossible.

In term of habitat, the infestation of *Salvinia molesta* also can causes infestation on the fish population on the lake. *Salvinia molesta* associated floating species have restricted light penetration and when resulting organic matter decomposes, it reduces oxygen for young fish. These can lead to inhibiting breeding of fish in shallow areas. Dead *Salvinia molesta* plants have been observed to fall to the bottom of the water column and to cause organic matter build-up, as well as depletion of oxygen.

2.2.3 Total Nutrient Status of *Salvinia molesta*

The nutrient composition of *Salvinia molesta* is explained for carbon, nitrogen, phosphorus and potassium. The proportion of these nutrient composition in *Salvinia molesta* had been identified will be affected after using it as substrate for cultivation of *Pleurotus ostreatus*. Percentage of nitrogen content will significantly affected by composting, used treatment and cultured mushroom as well as their interaction.

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