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ASSESSING THE GROWTH OF MUSHROOM USING SAWDUST AND CASSAVA PEEL AS SUBSTRATE

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ABSTRACT----------

The experiment was conducted to compare the growth of mushroom (Pleurotus ostreatus) using different substrates. The substrates that were used to grow the mushroom includes; a mixture of sawdust (5kg) + wheat bran + $CaCO_3$, a mixture of sawdust(5kg) + bio fertilizer + $CaCO_3$, a mixture of cassava peel (5kg) + wheat bran + $CaCO_3$ and a mixture of cassava peel (5kg) +bio fertilizer + $CaCO_3$. The experiment were carried out using Completely Randomized Design (CRD) of four treatments and twenty replicates (5 replicates per treatment). The results of the indoor mushroom cultivation experiment showed that, for the first flush, the mean fresh weight varied from 60g for mixture of sawdust and wheat bran to 30g for mixture of sawdust and biofertilizer. For the second flush, the mean fresh weight varied from 48g for mixture of sawdust and wheat bran to 21g for mixture of sawdust and bio fertilizer while the dry weight for the first flush ranged from 7g for the mixture of sawdust and wheat bran to 3g for the mixture of sawdust and bio fertilizer. For the second flush, the mean dried weight ranged from 4g for the mixture of sawdust and wheat bran to 1g for the mixture of sawdust and bio fertilizer. The colour of mushroom fruits for the mixture of sawdust and wheat bran was light yellow while the colour of mushroom fruits for the mixture of sawdust and bio fertilizer was white colour. The mixture of cassava peel and wheat bran did not support the growth of mushroom while the mixture of cassava peel and bio fertilizer did not produce Pleurotus ostreatus rather a different species of mushroom. Considering all the treatments investigated, the mixture of sawdust and wheat bran substrates is recommended as the best and fastest medium for the indoor cultivation of Pleurotus ostreatus.

KEYWORDS: *Growth, Mushroom, Pleurotus Ostreatus, Sawdust, Cassava Peel, Wheat Bran*----------

1. INTRODUCTION

Fungi have a worldwide distribution, and grow in a wide range of habitats, including deserts. Must fungi grow in terrestrial environments, but several species occur only in aquatic habitats. Fungi along with bacteria are the primary decomposers of organic matter in most of all terrestrial ecosystem worldwide. Fungi are distinct group of organisms which include species with fruiting bodies that are large and visible (macrofungi).

Mushroom is the fleshy, spore-bearing fruiting body of a fungus typically produced above the ground on soil or on its food source. They are placed in a kingdom of their own under the kingdom fungi apart from plants and animals. The macrofungi fruiting bodies are large enough that they can be seen with the naked eye and to be picked up by hand. Unlike green plants, mushroom are heterotrophs, and without chlorophyll, they cannot generate nutrients by photosynthesis, but instead obtain their nutrients from metabolizing non-living organic matter. Most mushroom species are either under the phylum Basidiomycota or Ascomycota, the two phyla are under the kingdom Fungi. (Cho, 2004).

Mushroom generally has a stem (Stipe), a cap (Pileus), and gills (Lamillae) on the underside of the cap. They are propagated by spores. Under conducive environment, spores germinated into hyphae (collectively, mycelia). Mycelia are filamentous and generally unseen with the naked eyes. Germinated hyphae form primary mycelia, and then secondary mycelia through plasmogamy (hyphae fusion). They accumulate nutrients from the substrate in which they grow and colonise the substrate. When stimulated by climatic factors such as temperature, humidity, etc. the mycelia colony forms pins under certain conditions that grow into fruit bodies. Pins are used to refer to young fruit bodies. Pins differentiate into a pileus(cap) and stipe (stem) forming fruit bodies. Spores are produced in the gills under the cap. The spores are released by the fruit bodies in order to produce the next generation (Oei, 2003).
Mushroom life cycle is divided into two phases: vegetative and reproductive growth. The vegetative growth indicates linear growth of fungal mycelium breaking down complex substrate components into simpler molecules and absorbing them as nutrients. The mycelia cease vegetative growth and begin to produce fruit bodies which are called

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"mushroom". When temperature is low, humidity high, oxygen tension high and light intensity high. This phase is the reproductive growth phase. By repeating these growing stages, mushroom cultivation can be said to be practice of obtaining fruit bodies (Cho, 2004).

Mushroom can be grouped into three basic ecological classes: Saprophytic, Mycorrhizal and Parasitic. Saprophytes which decompose organic matters like wood, leaves and straws in nature are most commonly grown mushroom. Mycorrhizal mushrooms form a commonly dependent beneficial relationship with the roots of host plants, ranging from grasses to trees. Ectomycorrhizal are used to refer to the mycelia of these mycorrhizal mushrooms because they form an exterior sheath covering the roots of plants. Endomycorrhizal are those that invade the interior rot cells of host plants. The two organisms benefit from this association. The resident mushroom mycelium raises the plant's capability to absorb nutrients, essential elements and nitrogenous compounds (Chen, 2005).

Edible mushrooms are the fungi which possess big fruiting bodies and can be culinary, medicinal or both. There are 600 species of edible mushrooms which can be culinary, medicinal or both. There are 600 species of edible mushroom which can be culinary and medicinal. Chinese scientists have researched into more than 40 types of edible mushrooms since 1960. Example: *Coriolus versicolor, Armillariella mellea, Ganoderma lucidum, Cordyceps sinensis, Lentinus edodes, Hericium einaceus* (Chen, 2005).

Oyster mushrooms are low calorie and exhibit low fat and sodium contents. Because of low lipid concentration and sugars, the most evaluated elements are Cd, Hg and Pb (Deepalakshmi and Mirunalini, 2014). In basidiomycete fungi, extracellular laccases are constitutively produced in small amounts and the lignocellulolytic enzymes are affected by many typical fermentation factors, such as medium composition, P^H, temperature, aeration rate, etc. (Ahmed *et al*., 2013).

2.0 MATERIALS AND METHODS

2.1 Study Environment

This study was conducted at the mushroom unit, University of Port Harcourt Demonstration farm, Choba campus.

2.2 Selection of Species

Pleurotus ostreatus were selected for this study due to the fact that it is easily accessible and particularly common in the South East of Nigeria, where the mushroom are commonly used in soup preparation. The two substrate selected are; Sawdust and Cassava peel. They were selected because they are readily and locally available.

2.3 Collection of Specimen

The spawn used in this study were sourced from the University of Port Harcourt demonstration farm, Choba campus. The fresh mixed sawdust were sourced from the timber shed at Aluu in Port Harcourt, Rivers state while the Cassava peel were sourced from a farm at Aluu in Port Harcourt, Rivers state.

Plate 1: Unground Cassava peel

Plate 2; Grind Cassava peel

Plate 3: Sawdust

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2.4 Experimental layout

The experiment was designed using Completely Randomized Design (CRD), four(4) treatments for the experiment and each treatment were replicated five(5) times.

2.5 Materials; Mushroom substrate bags, wheat bran, biofertilizer, lime($CaCO_3$), water, sawdust, cassava peel.

2.6 Treatment application

Treatments were applied in the following order;

* Sawdust + wheat bran + $CaCO_3$ + water (5 replicates)
* Sawdust + bio fertilizer + $CaCO_3$ + water (5 replicates)
* Cassava peel + wheat bran + $CaCO_3$ +water (5 replicates)
* Cassava peel + bio fertilizer + $CaCO_3$ + water (5 replicates)

2.7 Method

Mushroom were grown by the following process;

2.7.1 Tissue Culture

This gives the primary source of spawn production.

Step in tissue culture;

A medium called potato dextrose agar solution were prepared using 200g of irish potatoes which was boiled. The water from the irish potatoes was filtered in a beaker, 20g of Glucose D and 20g of Agar powder added and stirred homogenously. Medium was turned into a conical flask; cotton wool was used to close the opening, using a foil and a rubber band and sterilized for 15-20minutes in a pressure pot then poured into a petri dish while hot. Matured mushroom fruits were harvested and dissected to get the internal tissues using surgical blade. Thereafter internal tissue were placed into an airtight petri dish, within 3-4days, it spread and turn white.

2.7.2 Grain Sterilization

Guinea corn were washed and parboiled in a pressure pot till it is soft, then sieve and air dried. The dried grains were transferred into a bottle, mouth of the bottle were covered with paper and tied with rubber band, the guinea corn inside a bottle were sterilized for 1hr 30minutes and allowed to cool. Mycelia from the petri dish were cut and put inside the bottles, it spread and turned white. Also, multiplication of spawn took place by cutting mycelia from the bottles into new sterilized guinea corn bottles.

2.7.3 Substrate Preparation

The substrate is the medium where fruiting bodies grow. Since 5 treatments were used, a total of 20 bags were prepared.

5kg of sawdust + 100g of wheat bran + 5g of lime($CaCO_3$) + 1litre of water were added and mixed together and they were bag with thick nylon, 1kg per bag which gave rise to 5 bags. Second mixing was; 5kg of sawdust + 5g of lime($CaCO_3$) + 50ml of bio fertilizer in 1litre of water were mixed together and bag with thick nylon, 1kg per bag which gave rise to 5 bags. The third mixing was; 5kg of Cassava peel + 100g of wheat bran + 5g of lime($CaCO_3$) + 1litre of water were mixed together and bag with thick nylon, 1kg per bag which gave rise to 5 bags. The fourth mixing was; 5kg of Cassava peel + 5g of lime($CaCO_3$) + 50ml of bio fertilizer in 1litre of water were mixed together and bag with thick nylon, 1kg per bag which gave rise to 5 bags. After bagging, the substrates were perforated, covered with cotton wool and rubber band were used to tie the nylon. Here; the substrate bags were filled into drums and sterilized for 4hours to kill all contaminants, after which the bags were transferred to the laboratory for inoculation.

Inoculation of substrate bags is a process where spawn (mushroom seeds were introduced from the spawn bottles into the sterilized substrate bags. This activity was done in an inoculation room before which 20ml of methylated spirit were added with 100ml water were used in cleaning of hands, substrate bags and inoculation materials. Laboratory coat and hair net were used to avoid contamination. After inoculation, the substrate bags were transferred into the incubation room where they stayed for four weeks under the temperature range of 26^0C – 29^0C. Here; they passed through the process of 'ramification'; a process whereby the mycelium covers the substrate bags and after four weeks, they are ready to fruit, and then transferred to the fruiting room.

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2.7.4 Data collection

Substrate bags when fully colonized with mycelia, were transferred to the fruiting room and opened to initiate fruiting, through sprinkling of water on the bags. After 5days, it started fruiting and harvesting were done by hand-twisting, weighed with electronic digital balance and dried with solar drier under the sun for 1day. Data were collected and recorded from the replicates and the means of each set of data calculated. The data collected included the following;

* Height of stipe; This were measured in centimeters using meter rule from the base to the tip of the pileus.
* Diameter of pileus; This were measured in centimeters using meter rule from one edge of the pileus to the other edge.
* Fresh weight; The fruit bodies were weighed immediately after harvest using electronic digital balance.
* Dry weight; After recording the fresh weight, the fruit bodies were dried and weighed again.

RESULTS AND DISCUSSION

All the treatments did not support the growth of *P. ostreatus.* The results of the experiment are presented below;

3.1 Growth of *Pleurotus ostreatus* on Cassava peel.

Cassava peel + wheat bran + $CaCO_3$ were colonized by mycelia within 4weeks after cultivation, but did not produce any fruit.

Cassava peel + bio fertilizer + $CaCO_3$ undergo colonization process and started germinating within 5weeks after cultivation, but did not produce *Pleurotus ostreatus*, instead, another specie of mushroom germinated from the substrate.

3.2 Growth of *Pleurotus ostreatus* on Sawdust.

Sawdust + wheat bran + $CaCO_3$ started producing *Pleurotus ostreatus* on the 5th week after cultivation. The effect of different substrates of stipe height, pileus diameter, fresh weight and dried weight of *P. ostreatus*. Sawdust + wheat bran has the highest mean stipe height (5.3cm), the widest mean pileus diameter (4.2cm), the highest mean fresh weight (60g) and the highest mean dry weight (7g). Furthermore, the fruit colour was light yellow.

Sawdust + bio fertilizer + $CaCO_3$ started producing *Pleurotus ostreatus* on the 5th week after cultivation. The effect of different substrates of stipe height, stipe, pileus diameter, fresh weight and dry weight of *P. ostreatu*. Sawdust + bio fertilizer had the least mean stipe height (4.0cm), the least mean pileus diameter (3.5cm), the least mean fresh weight (30g) and the least mean dry weight (3g). Furthermore, the fruit colour was white

Table 1: First flush of *P. ostreatus* on Sawdust Substrate

First flush	Sawdust + Wheat bran + $CaCO_3$	Sawdust + Bio fertilizer + $CaCO_3$
Average stipe height	5.3cm	4.0cm
Average pileus diameter	4.2cm	3.5cm
Fresh weight	60g	30g
Dry Weight	7g	3g

Table 2: Second flush of *P. ostreatus* on sawdust substrate

First flush	Sawdust + Wheat bran + $CaCO_3$	Sawdust + Bio fertilizer + $CaCO_3$
Average stipe height	4.5cm	3.2cm
Average pileus diameter	3.4cm	2.2cm
Fresh weight	48g	21g
Dry Weight	4g	1g

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Plate 4: Growth of different Species of mushroom on cassava peel + bio fertilizer

Plate 5: Growth of *P.ostreatus* on sawdust + bio fertilizer

Plate 5: Growth of *P.ostreatus* on sawdust + wheat bran

DISCUSSION

The variation in mycelia growth with substrates could be due to their differences in nutrient composition (Shah *et al.,* 2004), This might also depend on the size of the substrate in the polythene bag. This results agrees with the findings of Akinmusire (2011) who recorded an average of 22-32days on complete mycelia colonization on different agro waste and reported that it took between 21-50days for complete mycelium run on different substrates.

The results obtained in the experiment revealed that the mixture of sawdust and wheat bran produced mushroom with the highest fresh and dry weights, Sawdust is referred to as excellent substrate for mushroom growth but the higher yield of mushrooms with sawdust and wheat bran compared to sawdust and bio fertilizer can be attributed to several factors, such as;

(a) Nutrient composition: wheat bran is rich in nitrogen, which is an essential nutrient for mushroom growth, while bio fertilizers may contain nutrients their composition might not be as well-suited or balanced for the specific needs of the mushroom mycelium.

(b) Carbon-to-Nitrogen Ratio: Mushroom require a balanced carbon-to-nitrogen ratio. Wheat bran helps to achieve this balance in the substrate, promoting better mycelia colonization and fruiting.

(c) Substrate structure: Sawdust provides a suitable physical structure for mycelium growth, and wheat bran compliments it. The texture and composition of sawdust, when combined with wheat bran, create environment that supports the development of a robust mycelia network.

4.0 CONCLUSION

The mushroom *Pleurotus ostreatus* has a rapid and higher yield on the sawdust substrate with wheat bran as supplement. The full mycelia colonization, which was attained at different times by each substrate suggest that complete ramification of any substrate by mycelia of mushrooms is substrate dependent. The variations observed in the colonization of mushroom mycelia could be attributed to differences in bio-chemical composition, such as lignin, cellulose, starch, and other essential plant components. Hence, sawdust + wheat bran and sawdust + bio fertilizer supports the growth of *Pleurotus ostreatus* while cassava peel + wheat bran and cassava peel + bio fertilizer does not support the growth of *Pleurotus ostreatus*.

Considering all the parameters investigated, sawdust substrate is recommended as the best substrate for indoor production of *Pleurotus ostreatus*.

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