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COMPARATIVE YIELD ASSESSMENT OF OYSTER MUSHROOM (*Pleurotus ostreatus*) GROWN ON DIFFERENT SUBSTRATES

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ABSTRACT

This study was conducted to examine the performance of oyster mushroom (*Pleurotus ostreatus*) grown on different substrates in relation to mycelia development, spore emergence, growth and yield. The experiment consists of six treatments viz: Sawdust, Coconut-husk, Maize-cob, Maize-cob + Sawdust, Coconut-husk + Maize-cob and Sawdust + Coconut-husk. Each substrate was moistened and left over-night. Thereafter, 1 % CaCO3 and 5 % wheat bran were added into 600g of each substrate. 200 g of each of the substrate was put into polythene bags of size 15 x 35 cm and replicated three times. The substrates were steam sterilized at 121 ºC for 20 minutes in an autoclave. Sterilized substrates were inoculated with pleurotus spawn and then air-tight sealed. The substrates were kept in the dark room at 25 ºC to ramify. The ramified substrates were spread out in a plastic bowl and watered daily for mushroom to sprout. Number of days for complete ramification of mycelium and appearance of pinhead were computed. Length of stipe, diameter of the pileus and height of mushroom were measured in centimetres using meter rule and the mean calculated. Number of fruiting bodies were counted and the yield determined on a weighing balance. Data obtained were analysed using ANOVA (at p = 0.05). The result revealed that sawdust has the least mean ramification and spore emergence period of 21.33 and 25.33 days, respectively. The result also revealed that mushroom grown on sawdust had the highest mean height values and yield on fresh weight basis of 7.22 ± 1.54cm and 16.67 ±1.20g respectively. The study recommends sawdust for commercial production of oyster mushroom.

Keywords: Oyster mushroom; Yield; Substrates; Spawn; Ekiti State

INTRODUCTION

Mushrooms are classified as non-timber forest products (NTFPs), because they are found in the forest both on forest ground and on dead forest trees. They refer only to the fruiting body of macro-fungi (Chang and Miles, 1992). Mushrooms are the fleshy and edible fruit bodies of several species of macro-fungi. Edible mushrooms are highly nutritious and can be compared with eggs, milk and meat (Oei, 2003). Agricultural residues are the major source of lignocellulosic materials used as substrate for production of edible fungi such as Oyster mushroom (*Pleurotus species*). Oyster mushroom convert high

percentage of the lignocellulosic materials which cause environmental pollution to more useable and profitable fruiting bodies called mushroom (Ekpo *et al*., 2008).

Pleurotus species is the third most popularly grown mushroom and commercially very important edible mushrooms, found all over the world. (Pinkal and Ratna, 2013). The most important step in the cultivation of mushroom is pasteurization process which eliminates the development of moulds on raw material during spawn run. *Pleurotus* species can tolerate temperature up to 30^0C although it fruits faster and produces larger mushroom at 25^0C (Pinkal and Ratna, 2013). *Pleurotus ostreatus* is an edible species, commonly known as the oyster mushroom (Hestbjerg *et al.*, 2003). *P. ostreatus* is an efficient lignin- degrading mushroom and can grow well on different types of lignocellulosic material (Palmieri et al., 2001).

Mushroom cultivation involves some technological elements, which are in consonance with those exhibited by our common agricultural crop plants. For example, there is a vegetative growth phase, when the mycelia grow profusely; and a reproductive growth phase, when the umbrella-like body that we call mushroom emerge (Martinez et al., 2001). *P. ostreatus* demands few environmental controls and their fruiting bodies are not often attacked by diseases and pests. They can be cultivated in a simple and cheap way. All this makes *P. ostreatus* cultivation an excellent alternative for production of mushrooms when compared to other mushrooms (Sanchez, 2010).

Mushroom can be processed in many ways to extend their shelf life. Drying reduces bulk quantity, thus facilitating transportation, handling and storage. It helps the food product keep its natural colour, and kills off organisms that can cause food spoilage (Ashok *et al*., 2013). In addition, drying can help to save money in several ways (Nagy *et al*., 2011). Dehydrated mushrooms are used as an important ingredient in several food formulations including instant soups, pasta salads, snack seasonings, stuffing, casseroles, and meat and rice dishes (Nachiket *et al.*, 2007). Several published clinical studies have reported that mushrooms dietary supplementation may increase innate immunity and exhibit beneficial effects on human health (Dayong et al., 2007). Mushrooms dietary supplementation analysis found that mushroom consumption was associated with better diet quality, improved nutrition and therapies for the treatment of many disease in the body (Novaes *et al*., 2007; Niedzielski *et al*., 2014).

In Nigeria, indigenous mushrooms are still been gathered from farmland and forests floor during the raining season for sale and for household consumption. Mushrooms are therefore not available throughout the year and when available during its season, they are usually sold at high prices (Arowosoge *et al*., 2017). Hence to ensure regular supply of mushroom, there is the need for identification of substrates that will effectively produce mushrooms of high-quality yield.

MATERIALS AND METHODS

Materials

The materials used for this study are: Pleurotus spawn, Sawdust (SD), Coconut husk (CH), Maize-cob (MC), wheat bran, lime (CaCO3), methylated spirit, cotton wool, black and transparent polythene bags, clean basins, water, ruler, inoculating stick, spirit lamp, rubber band and mushroom house (dark room). Others include; weighing balance, oven, micro-Kjeldahl apparatus, Soxhlet apparatus, muffle furnace, test tubes, mortar and pestle, filter

paper, measuring cylinders and weighing balance. Agro-waste substrates (coconut husk and maize-cob) were sourced locally in the village.

Methods

Substrate preparation, pasteurization, inoculation and ramification were carried out following the procedures used by Nurudeen *et al*. (2014). The experiment was divided into six substrate treatments viz: Sawdust (SD), Coconut-husk (CH), Maize-cob (MC), Maize-cob + Sawdust (MS), Coconut-husk + Maize-cob (CM) and Sawdust + Coconut-husk (SC). Each substrate was chopped to fine particles, well moistened and left over-night. Thereafter, 1 % CaCO3 and 5 % wheat bran were added into 600g of each substrate. 200 g of each of the substrates were put into transparent polythene bags of size 15 x 35 cm and replicated three times. The substrates were steam sterilized at 121 ºC for 20 minutes in an autoclave. Pleurotus spawn was added at the rate of 2 % into the sterilized substrates and then air-tight sealed. After inoculation, the bags were kept in the dark room at 25ºC for the spawn to ramify.

The ramified substrates were brought out and spread in a bowl in the laboratory. The substrates were kept moist for mushroom to sprout. Time taken for the completion of growth of mycelium on substrates, and appearance of pinhead were recorded. Length of stipe, diameter of pileus (or cap) and height of mushroom were measured in centimetres using meter rule. Number of fruiting bodies were counted for each treatment and weighed immediately after harvest using weigh balance to determine the fresh weight. After recording the weight, the fruit-bodies were oven-dried at 80^0C for 24 hours to determine the dry weight. Mean weight for each treatment were computed and recorded.

Data Analysis

Data obtained on growth and yield were subjected to analysis of variance (ANOVA) at $p = 0.05$, to determine differences in mean, while the mean were separated using Duncan Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Mycelium Growth Performance of *Pleurotus oestreatus* on Different Substrates

The result of mycelia growth (i.e spawn ramification) of *P. oestreatus* on different substrates in Figure 1, shows that sawdust has the least mean ramification period of 21.33 days. This was followed by sawdust + coconut-husk (23.33 days) while maize-cob took the longest time (46.33 days) to fully ramify. The result obtained in this study is in contrast to that of Girmay *et al.* (2016) who grew oyster mushroom on different substrates involving sawdust cotton seed, wheat straw, and paper waste in which the longest mean no of days (19.67) for total colonization was recorded for sawdust. The mycelia performance with 100% colonization by *Pleurotus ostreatus* on sawdust substrate within 3 weeks in this study suggests that it is a high-quality substrate probably with high nutritional contents compared to other substrates used (Oie, 2003).

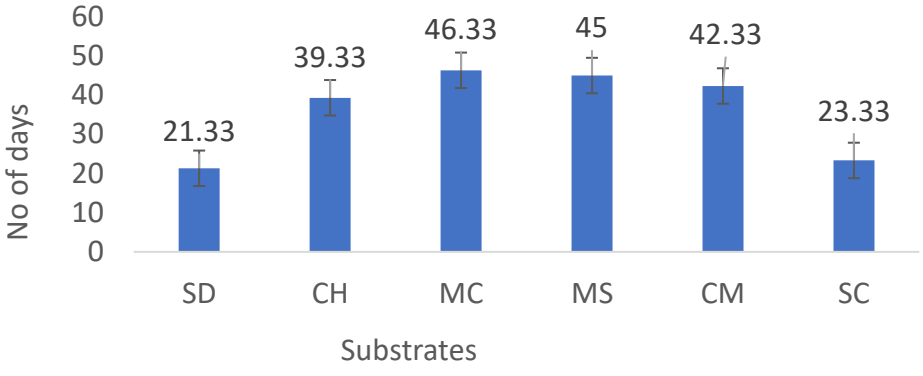

Fig 1: Mean no of days for full ramification

Key: SD- Sawdust, CH: Coconut-Husk, MC: Maize-cob, MS: Maize-cob + Sawdust, CM: Coconut-Husk + Maize-cob, **SC:** Sawdust + Coconut-Husk.

Spore Emergence of *Pleurotus oestreatus*

Spore emergence (appearance of pinhead) of *Pleurotus oestreatus* as shown in Figure 2, was first observed on sawdust substrate (25.33 days), this was followed by sawdust + coconut-husk (26.67 days) while maize-cob took the longest time (66.33 days) for pinhead appearance. The observed variations in the emergence of spores as exhibited by *P. oestreatus* in this study followed the same trend as mycelia colonization across the different substrates. This observation could be attributed to mineral content and genetic makeup of the substrates which dictates degradation of polysaccharide compounds associated with the fruiting stage. (Curvetto *et al*., 2002; Nurudeen *et al.*, 2013).

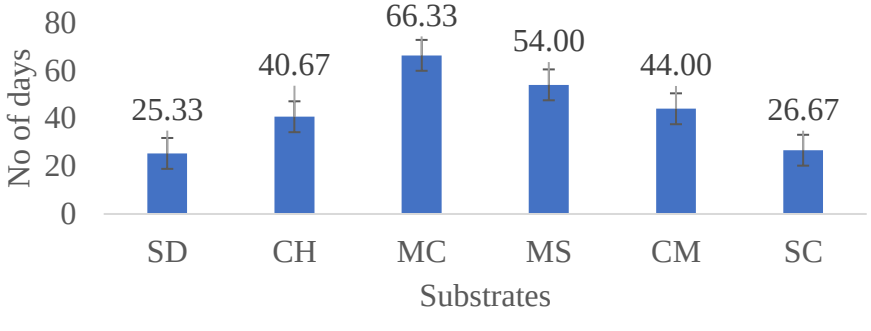

Fig 2: Days of first fruit emergence

Key: SD- Sawdust, CH: Coconut-Husk, MC: Maize-cob, MS: Maize-cob + Sawdust, CM: Coconut-Husk + Maize-cob, **SC:** Sawdust + Coconut-Husk

Table 1: Growth values of *Pleurotus oestreatus* (cm)

Substrates	SD	CH	MC	MS	CM	SC
Length of stipe	3.58 ±0.08^{a}	2.16±0.63^{bc}	3.28±0.14^{ab}	3.50±0.63^{ab}	2.52±0.39^{bc}	1.30 ±0.13^{c}
Diameter of pileus	5.51±0.32^{ab}	3.41 ±0.54^{b}	3.86 ±0.69^{b}	7.22 ±1.54^{a}	4.80±0.17^{ab}	3.73 ±0.47^{b}
Height of mushroom	4.43 ±0.70^{a}	3.02 0.67^{ab}	3.95 ±0.31^{a}	4.21 ±0.27^{a}	4.15 ±0.31^{a}	2.01 ±0.18^{b}

Means in the same row followed by the same letter (s) are not significantly different at $p \leq 0.05$
Key: SD- Sawdust, CH: Coconut-Husk, MC: Maize-cob, MS: Maize-cob + Sawdust, CM: Coconut-Husk + Maize-cob, SC: Sawdust + Coconut-Husk.

Yield of *Pleurotus oestreatus*

The results on mean yield of *P. oestreatus* as shown in Table 2 revealed that sawdust substrate had significantly highest yield on fresh weight basis (16.67 ±1.20g). However, on dry weight bases, mushroom yield for all treatments were not significantly different. Results on number of fruiting bodies showed that coconut-husk substrate had the highest mean value of 6.67 ±0.33, followed by maize-cob (5.33 ±0.67), while the least number of fruiting bodies was obtained for maize-cob + sawdust substrate (2.00 ±0.58). The observed higher fresh weight of mushroom obtained for sawdust, coconut-husk + maize-cob, maize-cob and maize-cob + sawdust substrates is an indication that the substrates could be used for commercial production of *P. oestreatus*. Meanwhile, the lowest yield obtained for sawdust + coconut-husk could probably be attributed to low nutritional composition of the substrate. This assertion further corroborates the report of Ogundele *et al.* (2017) which observed that yield of *P. oestreatus* grown on sawdust is a function of nutritional composition of the substrate.

Table 2: Yield of Pleurotus oestreatus (g)

Substrates	SD	CH	MC	MS	CM	SC
Fresh weight	16.67±1.20a	5.33±0.33c	13.00±1.53b	12.67±0.82b	13.33±0.33b	2.00 ±1.00d
Dry weight	1.33 ±0.33a	1.00 ±0.58a	1.33 ±0.33a	1.00 ±0.58a	1.00 ±0.58a	1.33 ±0.33a
No of fruiting bodies	5.00 ±0.57ab	6.67 ±0.33a	5.33 ±0.67a	2.00 ±0.58c	4.33±0.33abc	2.67±1.45bc

Mean in the same row followed by the same letter(s) are not significantly different at $p \leq 0.05$
Key: SD- Sawdust, CH: Coconut-Husk, MC: Maize-cob, MS: Maize-cob + Sawdust, CM: Coconut-Husk + Maize-cob, SC: Sawdust + Coconut-Husk.

CONCLUSION

Yield assessment of oyster mushroom (*Pleurotus oestreatus*) cultivated on different agricultural and wood wastes were established in this study. The result revealed that sawdust substrate had the best overall performance in terms of mycelia growth and appearance of pinhead, mushroom growth and yield. While the Sawdust + Coconut-Husk had the least overall performance in all the parameter assessed. Consequent upon the results from this study it is recommended that sawdust would be the ideal substrate for commercial production of oyster mushroom. This would help in reducing environmental pollution that could have resulted from the wastes generated from sawmills and other wood processing industries.

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