Science Park Journals

Vol. 3(2), pp. 034-055, May 2019
ISSN ISSN 2315-6279
DOI: 10.14412/JARNR2019.055

Available online at http://www.scienceparkjournals.org/jarnr

Journal of Agricultural Research and Natural Resources

Full Length Research Paper

Relative Performance of Oyster mushroom (*Pleurotus florida*) Cultivated on different Indigenous Wood Wastes.

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ABSTRACT: A new scheme for cultivation of Oyster mushroom (*Pleurotus florida*) with economic viability has been prepared keeping in view the agro-climatic factors for successful cultivation of the mushroom and its marketing potentials. Performance of oyster mushroom (*Pleurotus florida)* cultivated on different indigenous wood wastes was investigated in this study. Four indigenous wood wastes; *Funtumia elastica* , *Anthocleista djalonensis*, *Triplochiton scleroxylon* and *Ceiba petandra* were evaluated for their effects on growth and yield of *Pleurotus florida*. The spore emergence was first noticed in *Funtumia elastica with 32days* followed by *Anthociesta djalonensis (*35 days), *Triplochiton scleroxylon* (39 days) and *Ceiba petandra* had the longest days of 43 days. Length of stipe (cm) obtained across the substrates showed good sizable mushrooms. *Funtumia elastica* length of stipe ranged 8.10 - 9.80cm, *Anthociesta djalonensis* 7.20 - 9.20cm, *Triplochiton scleroxylon* 6.10 – 7.10cm and *Ceiba petandra* 6.50- 9.30cm. The highest yield (g) were found in *Funtumia elastica* followed by *Anthociesta djalonensis*, *Ceiba petandra* and *Triplochiton scleroxylon* with mean values of 105.50±2.55, 83.40 ± 2.07,79.00 ± 1.90 and 56.70±2.01(g) respectively. The biological efficiency (%) showed that the highest BE were found in *Funtumia elastica* followed by *Anthociesta djalonensis*, *Ceiba petandra* and *Triplochiton scleroxylon* with BE values of 86.50±2.55,72.62±2.07,69.50±1.90 and 60.35±2.01(%) respectively. Suitability of indigenous wood waste as substrates for mushroom cultivation has a special relevance to Nigeria, because sawdust are abundantly available to farmers at little or no cost thus needs to be exploited in order to reduce pollution in the country.

Keywords: *Pleurotus florida,*Substrate,Yield, Biological efficiency.

INTRODUCTION

In Nigeria, the commercial production and trade in mushroom is still at its infancy. This state can be attributed to the poor and undeveloped nature of demand for edible, local and cultivated exotic mushrooms. Lack of awareness on the required information and poor enlightenment on several possibilities and advantages of mushrooms are two of the major problems in the marketing of mushrooms locally (Hussain, 2001).
Nigeria by virtue of her population size generates several tones of agricultural, industrial, municipal and domestic wastes that overwhelms the nation's waste disposal machinery and pose an environmental pollution problem (Onuoha, 2007). However, various problems associated with the practical utilization of these materials have not been solved in order to maximize their potentials (Syed *et al,* 2003). Nigeria is richly endowed with good quality mushroom like *Pleurotus* species and *Agaricus* species. However, the cultivation of these mushrooms is still at low ebb while the technology of mushroom production and its adoption is still at research stage (Arowosoge *et al*; .2017). Presently, wild mushroom are gathered from forests and farmland for sale and are therefore not available throughout the year and when available during its season, they are usually sold at high prices. Thus, mushrooms are only available for the rich to consume. This is despite the fact that the large quantities of agricultural and forestry wastes that are produced annually in Nigeria are grossly under-utilized. About 45-50% of wood log that are processed in sawmill end up as waste (FAO,1990). Though, there is paucity of data on the quantity of sawdust generated annually (FAO, 1996). However, sawmill wood waste was estimated to be 5.72 million m^3 in year 1988 and by year 1993, it has increased to 13.87 million m^3 (FAO, 1996). The wood waste generated by the Nigerian sawmill which is usually burnt in the open air or dumped in large heaps to decompose has continue to increase with increasing number of operating sawmills, thus leading to environmental pollution (FAO, 1996). The utilization of these wastes for commercial production of mushrooms will make it available at a cheaper price throughout the year while preventing environmental pollution. Hence, this present work established performance of different indigenous wood wastes as substrates in cultivation of edible mushroom.

MATERIALS AND METHODS

Study Area: This study was carried out at the Pathology laboratory, Department of Forest conservation and Protection, Forestry Research Institute of Nigeria, Jericho, Ibadan, Oyo State, Nigeria.

Culture and spawn preparation: The pure culture of *Pleurotus florida* were prepared and transformed to spawn at Pathology laboratory of Forestry Research Institute of Nigeria, Jericho, Ibadan, Nigeria.

Substrates preparation and Cultivation

The sawdust of *Triplochiton scleroxylon* and *Ceiba petandra* was collected from sawmill in Bodija, Ibadan Oyo state. While *Funtumia elastica* and *Anthocleista djalonensis* were collected from a saw mill at Iwo, Osun State. The fresh sawdust was sun dried to remove excess moisture in it. Thereafter, the four substrates were mixed separately with 1% agricultural lime ($CaC0_3$) and 5% wheat bran to enhance the growth of the mushroom and were bagged into poly-propylene bag at 500gm per bag.

The substrates were then steam sterilized at 121°C for 2hrs in an autoclave and multi layered technique was adopted for spawning. Each bag was filled and the spawn was added at the rate of 2% of the wet weight basis of substrate. After inoculation, the bags were kept in house where the temperature and humidity were maintained around 25°C and 80-90% humidity respectively with sufficient light and ventilation for 3-4weeks. The spawn run was completed within 23 days. The polythene bags were torn-off at the tips following the spawn run and exposed to humid environment created by spraying water around the bags. Formation of fruit bodies was evident within 9-11days after opening the bags. The bags were maintained up to the harvest of the fourth flush, which was completed in 71days after spawning. A small layer of substrate was scrapped off from all the side of the beds after each harvest. Each of the four treatments was replicated five times.

Yield and Biological efficiency: Parameters such as length of stipe, height, diameter of Pileus were measured with the aid of meter rule (cm), while the total weight of the fruiting bodies harvested from all the four picking were measured as total yield of the mushroom. The biological efficiency was calculated according to the following formula (Chang *et al*,. 1981).

$$B.E.\ \% = \frac{\text{Fresh weight of mushroom}}{\text{Dry weight substrate}} \times 100$$

Data analysis

The data obtained in this study were analyzed in a completely randomized design (CRD) using analysis of variance (ANOVA) and descriptive statistics with the aid of statistical packages for social sciences (SPSS) version 16.

RESULTS AND DISCUSION

Table 1.The mean mycelia growth (%) exhibited by different substrates on weekly basis

Substrate	Week 1	Week 2	Week 3	Week 4
Funtumia elastica	39.50	75.41	100	-
Anthociesta djalonensis	35.60	68.70	100	-
Triplochiton scleroxylon	28.00	57.58	75.55	100
Ceiba petandra	22.22	51.67	73.80	100

Mean of five replicates

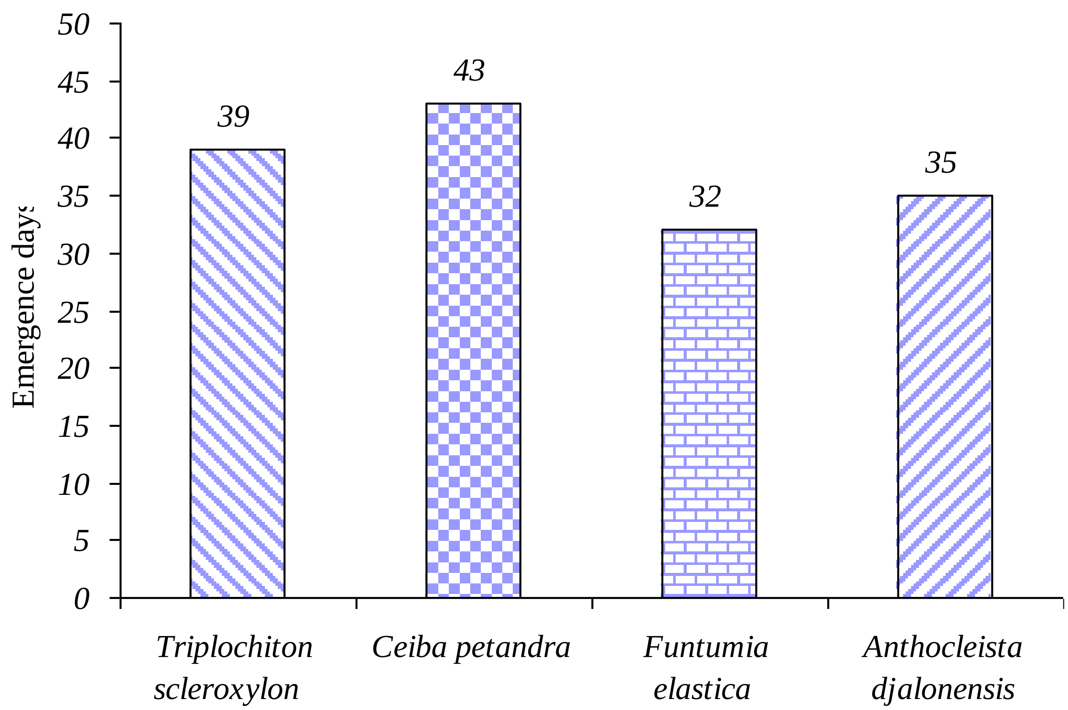

Fig 1. Days of first emergence of *Pleurotus florida* on different wood wastes

Table 2. The mean length of stipe (cm) per flush

Substrate	flush 1	flush 2	flush 3	flush 4
Funtumia elastica	9.50	9.80	8.10	9.10
Anthociesta djalonensis	7.20	9.20	8.30	7.40
Triplochiton scleroxylon	7.00	6.10	7.10	6.30
Ceiba petandra	9. 30	8.50	6.70	6.50

Mean of five replicates

Table 3 . The mean diameter of pileus (cm)

Substrate	flush 1	flush 2	flush 3	flush 4
Funtumia elastica	7.20	6.80	6.50	6.10
Anthociesta djalonensis	6.50	6.00	5.70	5.90
Triplochiton scleroxylon	5.00	5.70	5.60	5.20
Ceiba petandra	6.00	6.20	5.90	6.80

Mean of five replicates

Table 4 . The mean mushroom height (cm)

Substrate	flush 1	flush 2	flush 3	flush 4
Funtumia elastica	13.00	11.50	10.04	12.50
Anthociesta djalonensis	9.20	11.60	9.60	9.50
Triplochiton scleroxylon	10.10	9.60	10.40	8.60
Ceiba petandra	12.10	11.00	9.40	8.50

Table5.DMRT values for the yield (g) of the fruiting body of *P.florida* in different substrates

Substrate	Mean yield (g)	± Standard error	Duncan rating
Funtumia elastica	105.50	2.55	a
Anthociesta djalonensis	83.40	2.07	b
Triplochiton scleroxylon	56.70	2.01	c
Ceiba petandra	79.00	1.90	b

Mean carrying the same alphabet are not significantly different from each other ($p \leq 0.05$)

Table 6.The DMRT values for biological efficiency (BE) exhibited by different substrates

Substrate	Mean B.E (%)	± SE	Duncan rating
Funtumia elastica	87.50	2.55	a
Anthociesta djalonensis	72.62	2.07	b
Triplochiton scleroxylon	60.35	2.01	c
Ceiba petandra	69.50	1.90	b

Mean carrying the same alphabet are not significantly different from each other ($p \leq 0.05$)

Discussion

The mycelia performance (%) *P.florida* exhibited by different substrates was observed for four weeks. The result obtained (table 1) showed that sawdust from *Funtumia elastica* and *Anthociesta djalonensis* substrates reached its maximum ramification stage on third week, while *Triplochiton scleroxylon* and *Ceiba petandra* attained 100% ramification on week 4. This is an indication that *P.florida* can perform in the selected substrates. The spore emergence of *P.florida* under the four substrates (Fig 1) showed that spore emergence was first noticed in *Funtumia elastica with 32days* followed by *Anthociesta djalonensis (*35 days), *Triplochiton scleroxylon* (39 days) and *Ceiba petandra* had the longest days of 43 days (Fig 1).

The findings of this study showed that spore emergence across the four substrates compared favourably with the study of Fuwape *et al* (2014) who reported that *P. sajor-caju* took an average of 43 days for the spore to emerge on the substrate of *Gmelina arborea* sawdust. The variations in the emergence of spores as exhibited by *P.florida* across different substrates in this study could be attributed to variations in genetic make-up of the substrates used. Moreso, temperature and humidity are two vital factors in spore emergence and fruiting formation of mushroom (Nurudeen *et al*,.2013). Furthermore, the fact that *Funtumia elastica* had the first spore emergence while *Ceiba* *petandra* was the last as observed for mycelia growth could be attributed to varying density of wood wastes in terms of wood properties (Fuwape *et al*,. 2014). The fruiting bodies gotten from the substrates used were measured quantitatively using some parameters such as diameter of Pileus, length of stipe (cm) and height (cm) of the mushroom. The mushrooms were harvested up to four times across all substrates. However, mean length of stipe (cm) obtained across the substrates showed good sizable mushrooms. *Funtumia elastica* length of stipe ranged 8.10 - 9.80cm, *Anthociesta djalonensis* 7.20 -9.20cm,*Triplochiton scleroxylon* 6.10 – 7.10cm and *Ceiba petandra* 6.50- 9.30cm. The overall length of stipe encountered is an indication that the mushrooms attained a good sizeable stage that is marketable.

Consequently, the mean diameter of the Pileus and mushroom height encountered (table 3and 4) showed that values obtained were good for the mushrooms produced from the four substrates used. The mean height of mushroom obtained showed that the mushrooms produced from these indigenous substrates were relatively close in height across the four substrates. All these parameters showed that the fruit bodies obtained is an indication that these substrates supported the growth of mushrooms, hence the quantity could attract high market value as the fruit bodies are usually sizeable and this agrees with the findings of Candy (1990), Kadiri and Fasidi (1990) and Okwujiako (1992) who reported agricultural wastes as a good growth medium for *Pleurotus* spp.

The analysis of variance conducted for the yield of the fruiting body of *Pleurotus florida* in different substrates showed that there is significant difference (P<0.05) in the yield produced by different substrates. The follow up test carried out using Duncan Multiple Range Test (DMRT) to separate the mean yield (Table 5). The highest yield (g) were found in *Funtumia elastica* followed by *Anthociesta djalonensis*, *Ceiba petandra* and *Triplochiton scleroxylon* with mean values of 105.50±2.55, 83.40 ± 2.07,79.00 ± 1.90 and 56.70±2.01(g) respectively. The result obtained is an indication that all the substrates used were found suitable for mushroom cultivation. Similar findings were recorded by Ekpo *et al.,* (2008) who addressed the effect of different supplement on the yield of *Pleurotus florida* and discovered that *P.florida* performed better in substrates with higher supplements. Significant difference (p≤0.05) exists in biological efficiency thus resulted to Duncan multiple range test to separate the mean differences (Table 6). The DMRT for the biological efficiency (%) showed that the highest BE were found in

Funtumia elastica followed by *Anthociesta djalonensis*, *Ceiba petandra* and *Triplochiton scleroxylon* with BE values of 86.50±2.55,72.62±2.07,69.50±1.90 and 60.35±2.01(%) respectively.

This result is an indication that the higher the mushroom yields the higher the biological efficiency. Similar findings were reported by Mane *et al*,. (2007), Nurudeen *et al*,(2012) in their findings they reported that cultivation of oyster mushroom on similar by-products have manifested variable levels of B.E. they further explained that these variation are mainly related to spawn rate, fungal species used and supplement added to the substrate.

Conclusion and recommendations

Yield performance of oyster mushroom (*Pleurotus florida*) cultivated on different indigenous wood wastes were established in this study. The mycelia growth is independent of genetic combination of the substrates as the entire wood wastes attained 100% ramification.

Consequently, the overall length of stipe, diameter of pileus and mushroom height obtained is an indication that the mushrooms attained a good sizable stage that is marketable. The mushroom yield was reported to be significantly different ($P \leq 0.05$) across the four wood wastes. However, the overall performance of the selected wood wastes showed that all the wood wastes supported the sporophore emergence thus resulted into mushroom yield at varying levels. Commercial production of oyster mushrooms is largely determined by the availability and utilization of cheap materials of which agricultural and lingo-cellulosic wastes represents the ideal and most promising substrates for mushroom cultivation. The substrates used in this study can be considered practical and economically feasible due to their availability throughout the year at little or no cost in large quantities. Utilization of these wood wastes for the production of oyster mushrooms could be more economically and ecologically practical thus assist in reducing environmental pollution caused by high amount of lignocellulosic wastes generated.

Suitability of indigenous wood waste as substrates for mushroom cultivation has a special relevance to Nigeria, because sawdust are abundantly available to farmers at little or no cost thus needs to be exploited in order to reduce pollution in the country. The findings of this study are therefore recommended for large scale production of mushrooms using different indigenous wood wastes. Furthermore, there is need for Research Institutes, Universities and Colleges to include mushroom production in their curricular to enhance mushroom production among the populace while the technology of production should be improved.

Consequently, awareness should be intensifying on the nutritional and health benefit of mushroom in order to boost its consumption. Edible mushroom should be incorporated to diet to enhance the overall health and well being of the populace.

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