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Yield and Proximate Composition of Oyster Mushroom (*Pleurotus Sajor - Caju*) Cultivated on Different Agricultural Wastes

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ABSTRACT

A model scheme for cultivation of Oyster mushroom (*Pleurotus sajor caju*) with commercial viability has been prepared keeping in view the agro-climatic conditions and other related aspects for successful cultivation of the mushroom and its subsequent marketing. The effect of different substrates on yield and nutritional values of *Pleurotus sajor-caju* was investigated in this study. The sawdust of *Triplochiton scleroxylon*, coconut-husk and corn-cob were used as substrates for mushroom cultivation. Each treatment was replicated five times. Each of the sample consisted of 400g weight of substrate per bag. The produce of the mushroom, mycelia growth, diameter of the pileus, length of stipe, mushroom height as well as proximate analysis of the mushroom were analyzed. The result obtained showed that protein content (%) were found to be higher in coconut-husk followed by corn-cob and sawdust with values of 40.10%, 30.12% and 29.61% respectively. The results indicated that the mean yield (g) produced from corn-cob substrates were found to be higher followed by yield produced from sawdust and coconut husk with their yield values of 108.74±7.87, 60.76±4.62 and 56.66±3.48 respectively. The biological efficiency (%) obtained is an indication that the *P.sajor-caju* utilizes the given substrates effectively. The highest B.E was found in corn-cob followed by sawdust and coconut husk with value of 85.40, 67.50 and 65.25% respectively. The length of stipe, diameter of pileus and mushroom height showed that the mushroom produced from all the substrates used were of good sizeable stage and were found to be marketable despite the differences in nutritional composition of mushroom samples. Hence, the overall nutritional values of the mushroom were good.

KEYWORDS: *P.sajor-caju*, yield, fruiting body, biological efficiency.

INTRODUCTION

Presently, sawdust is the major substrate used in mushroom cultivation in Nigeria. Due to technology advancement, the so called waste (sawdust) is now being used greatly for the production of briquette, shelf, board, office table and furniture generally (Ogunsanwo, 2001). Hence, forest fruit wastes such as pawpaw leaves, coconut husk, corn cob, which are not in high demand presently, can be a remedy for the above mentioned problems. The ongoing publicity of mushroom as a high source of protein with low cholesterol content which over ride meats and other fatty foods may soon diminish due to the multiple use of sawdust. Oyster mushroom has good nutritional potential and has wide acceptance in Nigeria markets. Mushrooms also provide vitamin and are low in fat. Evidence has also suggested that many mushroom species contain substances that may prevent or alleviate cancer, viral infections or health diseases.(NABARD, 2007).
With the upsurge in unemployment rate in developing countries, small-scale mushroom cultivation with these agriculture and forest fruit wastes could serve as a means of employment and for more income generation (Ekpo *et al*, 2008).

Furthermore, the need to create employment opportunities due to the developing countries economic situation and an alternative source of protein for the rural and urban populace, all necessitate, the need for research into the cultivation of mushrooms on a commercial scale. In order to supplement mushrooms collected from the wild, there is need to enhance its cultivation so that its benefit can be fully maximized. Mushroom offers prospects for converting lignocellulosic residues from agricultural fields and forests into protein rich biomass (Bano *et al*, 1993). Such processing of agro waste not only reduces environmental pollution but the by-products of mushroom cultivation.

Mushroom cultivation, is also a good source of manure, animal feed and soil conditioner.

MATERIALS AND METHODS

Culture preparation

The pure culture of *Pleurotus sajor-caju* was obtained from Pathology section of Forestry Research Institute of Nigeria, Jericho, Ibadan, Nigeria. The cultures were maintained on Potato dextrose agar slants at 4°C.Sub culturing were done after 15days.

Spawn preparation

Spawn was prepared in jam bottles. Whole wheat grains were soaked in cold water overnight, washed and drained of excess water. The grains were boiled in water bath for 15min.Wheat grains then packed (250g) in jam bottles and sterilized in an autoclave at 121°C for 30min. After sterilization, the bottles were inoculated with actively growing mycelium of the *Pleurotus sajor-caju* from the slants and incubated at (27 ± 2°C) for mycelia growth without any light for 10-15days until the mycelium fully covered the grains.

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Substrates preparation and Cultivation

The fresh sawdust of *Triplochiton scleroxylon* (Obeche) was collected from sawmill in Ibadan, South western Nigeria and made into heap, thoroughly watered and allowed to drain to about 65% moisture content. The sawdust was mixed with 5% wheat bran, 1% lime ($CaCo_3$) and 1% sugar respectively. The sawdust was composted for 30days being turned over at every five days interval until rancid odour disappeared and 65-70% moisture content was attained. The agro wastes, corn cob and coconut husk were collected from local farms in Ibadan and were used as substrate for mushroom cultivation.

The agro wastes (corn cob and coconut husk) were chopped to 1-2cm pieces and soaked in water over night to moisten it and excess water was drained off. Thereafter, for the three substrates (sawdust, corn cob and coconut husk), 1% $CaCo_3$ and 5% wheat bran were added into the substrates to enhance the mushroom growth. The substrates were then steam sterilized at 121^{0}C for 20min in an autoclave. The polythene bags of size 15 x 35cm were filled with sterilized substrates and multi layered technique was adopted for spawning. Each bag was filled with 400gm dry substrate 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^{0}C and 80-90 % humidity respectively with sufficient light and ventilation for 3-4weeks. The spawn run was completed within 25 days. The polythene bags were torn-off at the tips following the spawn run. Formation of fruit bodies was evident within 3-5days after opening the polythene. The bags were maintained up to the harvest of the fifth flush, which was completed in 41days after spawning. A small layer of substrate was scrapped off from all the side of the beds after each harvest. Each of the three treatments was replicated five times.

Yield and Biological efficiency

Parameters such as length of stipe, height, diameter of Pileus and total weight of the fruiting bodies harvested from all the five picking were measured as total yield of the mushroom. The biological efficiency (yield of mushroom per gm of substrate on dry wt basis) was calculated by the following formula. (Chang *et al*,1981)

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

Moisture content:

The moisture content of mushroom was also expressed in percent and calculated by the formula.

$$\text{Moisture content (\%)} = \frac{\text{weight of fresh samples} - \text{weight of dry sample}}{\text{weight of fresh sample}} \times 100$$

Nutritional Analysis:

Protein, fat, ash, crude fibre and total carbohydrate were determined with the procedure recommended by AOAC (1995).

Data analysis

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

RESULTS AND DISCUSSIONS

The proximate analysis of fruiting body of *Pleurotus sajor-caju* grown on three (3) different substrates (sawdust, corn-cob and coconut-husk) was presented in table 1. The percentage % moisture content exhibited by the fruiting body of *Pleurotus sajor-caju* shows that, highest values was obtained in mushroom grown on sawdust, followed by coconut-husk and corn-cob with values 88.30, 87.00 and 85.50 respectively.

Consequently protein content exhibited by *Pleurotus sajor-caju* grown on these substrates was found to be relatively higher. Hence the highest protein content was found in mushroom produced by coconut-husk, followed by mushroom produced by sawdust and corn-cob. With values of 40.10, 30.12 and 29.61 respectively. The higher value encountered in mushroom produced by coconut husk might be as a result of high nutritional content present in coconut-husk. This however agrees with Oso (1997) who reported that *Pleurotus sajor-caju* have high protein content.

Syred *et al,* (2003) also confirmed that protein content of mushroom is the highest among vegetables. The observation made in their fibre content are equally note worthy and stimulating as fibre content help to facilitate digestion in man. (Onuoha,2007).

The percentage fat content from the mushroom produced by the substrates is an evident that mushrooms are low in fat and cholesterol (Syred *et al*, 2003).

The ash content produced by these mushrooms was relatively low. However, the mushroom produced by sawdust exhibit higher values compared with the mushroom produced from coconut-husk and corn-cob with values of 7.42, 6.00 and 5.71 respectively. These values were similar to those obtained by Ekpo *et al.,* (2008) and Onuoha (2007). The carbohydrate content of these mushroom ranged from 65.68 to 69.22 as shown in table 1.

The proximate analysis showed a difference in the nutritional composition of mushrooms. Despite the difference in the nutritional composition of mushroom samples the overall nutritional values of the mushrooms were good.

The mycelia performance (%) *Pleurotus sajor-caju* exhibited by different substrates was observed for four weeks. The result obtained (table 2) showed that sawdust and coconut-husk substrate reached their maximum ramification stage on week 3 while corn-cob substrate attained 100% ramification on week 4. This is an indication that *Pleurotus sajor-caju* can perform in the substrates selected.

The mycelia density exhibited by substrate is an indication that *P. sajor-caju* utilizes the given substrates at different levels. This result is in accordance with the findings of Mehta and Bhandal (1998) who studied the mycelia growth of a number of species of *Pleurotus* at different temperature on Potato Dextrose Agar (PDA) medium and observed complete colonization of the petri dish at 25^0C. The analysis of variance conducted for the yield of the fruiting body of *Pleurotus sajor-caju* in different substrates showed that there is significant difference in the yield produced by different substrates ($P \leq 0.05$). The follow up test carried out using Duncan Multiple Range Test (DMRT) to separate the mean showed that mushroom produced from corn-cob substrates has the best yield (table 3) followed by mushroom produced from sawdust and coconut husk with their mean yield values of 108.74 $\pm$ 7.87 and 56.66 $\pm$ 3.48 respectively. The biological efficiency (%) obtained is an indication that the *P.sajor-caju* utilizes the given substrates effectively as this was evident in the yield obtained. The highest B.E was found in corn-cob followed by sawdust and coconut husk with value of 85.40, 67.50 and 65.25% respectively. The result obtained is an indication that corn–cob is a suitable substrate 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*. They discovered that supplements such as lime and wheat bran contributed to the high yield of mushroom and also aids sporophore emergence. Nurudeen *et al*., (2012) reported that lime ($Caco_3$) plays a vital role in mushroom cultivation by aiding the yield of the fruiting body and making substrate conducive for growth. The yield recorded in the mushroom produced from the three substrates is relatively high. This is an indication that all the three substrates supported the yield of the *P. sajor-caju*.

The fruiting bodies gotten from the substrates that support the growth of the mushroom were measured qualitatively using some parameters such as diameter of Pileus, length of stipe (cm) and height (cm) of the mushroom. The mushrooms were harvested up to five times and the mean length of the stipe (cm) per flush measured indicated that the length ranges from 5.7 to 7.2cm (table 4). However, the results obtained showed that the highest mean length of stipe was found in mushroom produced from sawdust for flush 1 and flush 2. While mushroom produced from coconut husk has the highest length of stipe for flush 3 and flush 5 (table 4). The corn-cob also possessed the higher value for the length of stipe for flush 4. However, the overall length of stipe encountered is an indication that the mushroom attained a good sizeable stage that is marketable.

Consequently, the mean diameter of the Pileus and mushroom height encountered (table 5and 6) showed that values obtained were good for the mushrooms produced from the three substrates used. The mean height of mushroom obtained showed that the mushrooms produced from the three substrates are relatively close in height (table 6). 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.

In the order of fructification, mushrooms from coconut-husk fruited first, followed by mushrooms produced from sawdust and corn-cob respectively. Coconut-husk were able to fruit first perhaps because of the richness of the nutrient which are necessary for the formation of fruit bodies as this was supported with findings of Chang and Buswel (1996) who reported nutrients and organic matter richness as factor necessary for the formation of fruit bodies.

Table1. The Proximate analysis of fruiting body of *P.sajor-caju* grown on different substrates

	Type of substrates used		
Proximate	**Corn-Cob**	**Coconut-Husk**	**Sawdust of *Triplochiton scleronxylon***
Moisture	85.5	87·00	88·30
Protein	29.61	40·10	30.12
Fat	0.77	0·90	0.53
Ash	5.71	6·00	7.42
Fibre	8.35	7.61	8·50
Carbohydrate	69.22	65.68	68.35

Mean of five replicates

Table 2. The mean mycelia growth (%) exhibited by different substrates on weekly basis

Substrate	**Week 1**	**Week 2**	**Week 3**	**Week 4**
Corn- Cob	35·00	53·40	76·30	100
Sawdust	28·20	67·50	100	
Coconut-Husk	70.3	94·50	100	

Table 3. The mean yield of the fruiting body of P.sajor-caju in different substrates

Substrate	**means (gm)**	**S.E**	**Duncan grouping**	**B.E (%)**
Corn- Cob	108.74	7.87	a	85·40
Sawdust	60.76	4.62	b	67·50
Coconut-Husk	56.66	3.48	bc	65·25

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Table 4. The mean length of stipe (cm) per flush

Substrate	flush 1	flush 2	flush 3	flush 4	flush 5
Corn- Cob	6.4	7.1	5.7	6.2	6·0
Sawdust	5.8	6.3	6.1	7.2	6.8
Coconut-Husk	6·0	6.3	6.8	7.1	7.2

Table 5. The mean diameter of pileus (cm)

Substrate	flush 1	flush 2	flush 3	flush 4	flush 5
Corn- Cob	6·0	6.4	5.3	5.1	6.2
Sawdust	6.3	6·0	5.7	7.2	6.8
Coconut-Husk	6.1	7·0	6.8	7.1	6.2

Table 6. The mean mushroom height (cm)

Substrate	flush 1	flush 2	flush 3	flush 4	flush 5
Corn- Cob	8.2	9.3	7.9	8.6	8.2
Sawdust	7.4	8.4	8.1	9·0	8.6
Coconut-Husk	8.1	8.2	8.4	9.2	9·0

CONCLUSION

Comparative study of yield and nutritional value of edible mushroom (p. sajor-caju) cultivated on different agricultural waste were established in this study. The sawdust of *Triplochiton scleroxylon*, corn-cob and coconut-husk were used as substrates in cultivating *Pleurotus sajor-caju*. The result of the proximate analysis showed a difference in the nutritional composition of mushrooms.

Despite the difference in the nutritional composition of mushroom samples, the overall nutritional values of the mushroom were good. The use of sawdust, corn-cob and coconut-husk as medium for mushroom production will assist in reducing environmental pollution caused by the high amount of agricultural and wood wastes generated. The need for job creation, improved protein supply and poverty alleviation, all provide a basis for the development of mushroom cultivation. These mushrooms should be surely incorporated into diets to play an important role in overall health and well being. The production of mushrooms is an avenue for environmental amelioration as organic wastes from wood, agriculture and food processing are used as medium for mushroom cultivation while waste generated after mushroom harvest can still serve as manure to soil.

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