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Yield and Nutritional contents of three *Pleurotus* species grown on *Melaina arborea* sawdust

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ABSTRACT: This study compares the yield and nutritional value of *Pleurotus florida, Pleurotus plumonarius* and *Pleurotus sajor-caju* grown on *Melaina arborea* sawdust. Exactly 100g of sawdust obtained from *M. arborea* was weighed into screwed capped bottles and inoculated with 10g spawn each of *P. florida*, *P. plumonarius* and *P. sajor-caju* and incubated at 30+2^{0}C for 6 weeks. The fresh weight, dry weight, biological, efficiency, productivity and proximate composition of the fruiting bodies of the tested fungi spp were determined. The results showed that fructification was initiated 5 days after spawn running of *P. plumonarius* and *P. sajor-caju* while fructification was not recorded in *P. florida*. There were significant differences in the fresh weight (yield), biological efficiency and productivity among the spp. It was observed that the *P. plumonarius* had highest fresh weight (13.1g), dry weight (1.0g) biological efficiency (13.1%) and productivity (1.3%). However, *P. sajor-caju* presents good contents of protein, minerals but low fat content.

Keywords: *Pleurotus florida, Pleurotus plumonarius*, *Pleurotus sajor-caju, Melaina arborea,* Nutritional composition

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INTRODUCTION

Mushroom is a spore bearing, achlorophyllous fruiting body whose body is divided into cap or pileus, stipe and hyphae. It is a macrofungi that belongs to the phylum basidiomycota (Diez and Alvarez, 2001). Mushroom could either be edible or non-edible; the edible mushroom can be consumed by human for the nutritional properties and added to food to have pleasant flavour and aroma (Oei, 2003). Edible mushroom has high protein content, moisture content, fibre content, carbohydrate and low fat content; it is also rich in vitamins and minerals (Manzi et al., 1999). Mushrooms represent one of the world's greatest untapped resources of nutritious food. Cultivation of saprophytic edible mushrooms may be the only currently economical biotechnology for lignocellulose organic waste recycling that combines the production of protein rich food with the reduction of environmental pollution (Obodai *et al*., 2003).Cultivation of mushroom can be viewed as an effective means to extract bio resource left behind in agro-industrial solid residues and simultaneously as a sound environmental protection strategy (Adejoye and Fasidi, 2009). Furthermore, the use of these residues in bio-processes may be one of the solutions to bioconversion of inedible biomass residues into nutritious protein rich food in the form of edible mushroom (Chiu *et al.,* 2000).

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Mushroom contains many essential amino acids; white button mushrooms are example that contains more protein than kidney beans. As a group, mushroom also contain some unsaturated fatty acids, provide several of the B vitamins and Vitamin D, some even contain significant Vitamin C as well as the minerals, potassium, phosphorus, calcium and magnesium (Park, 2001). *Pleurotus*: *P. sajor-caju, P. plumonarius, P. florida* mushroom are common edible mushroom which belong to the class Agaricales and survive well in moist condition. The objective of this work is to compare the yield and nutritional value of three *Pleurotus* species (*P. florida, P. plumonarius* and *P. sajor-caju)* on *M. arborea* sawdust

MATERIALS AND METHODS

Collection of samples

The fungi used for this study were three *Pleurotus* species which were obtained from the culture collection of the Federal Institute of Industrial Research (FIIRO), Oshodi, Lagos.The substrate used for this study was sun dried wood waste (sawdust) of *M. arborea*. This substrate was collected from Ejinrin road Plank Market, Ijebu-Ode, Ogun State, Nigeria.

Preparation of Substrates

Eighty (80) grams sawdust of *M. arborea* was weighed into uniformed sized screwed cap bottles. Moisture content of the substrate was adjusted to 60% with distilled water. The samples were sterilized for 15 min at 121^{o}C and 151bs/ pressure, allowed to cool to ambient temperature and spawned with 10g of the pure culture of the mushroom *P. florida, P. plumonarius* and *P. sajor-caju*. The screw capped bottles were subsequently placed into a spawn running room at 30± 2^{o}C under dark conditions. After six weeks of spawn running, the screw capped bottles were placed in a growth chamber and exposed for fructification at 15± 2^{o}C and 80-90% relative humidity. Evaluation of the mycelia growth was carried out according to the method of Ahmed *et al*., (2009). Biological efficiency and the productivity of the substrates were calculated according to the method of Mercelo *et al*, (2001).

$$\text{Biological efficiency (B. E)} \frac{\text{Mushroom fresh weight}}{\text{Compost initial dry weight}} x\ 100$$

$$\text{Productivity (P)} \frac{\text{Mushroom dry weight}}{\text{Compost initial dry weight}} x\ 100$$

Chemical composition of the mushroom biomass

Proximate composition of fruit-bodies was determined according to A.O.A.C (1995), and ash content obtained by oven drying for 3 h at 550 °C in the muffle furnace. Total N was determined by the Kjeldahl method, and crude protein obtained using conversion factor (N x 6.25). Crude fat was analyzed using a Soxhlet extractor, and carbohydrates estimated by the phenol-sulphuric acid method (Dubios *et al*., 1956) and Ca, Mg, K and Fe were determined using atomic absorption spectrophotometry, P by colometry, Na by flame photometry

Analysis of data

Data were obtained in each treatment in triplicate. Data collected were subjected to analysis of variance (ANOVA) using general linear model option (SAS Institute). Test of significance were determined by Duncan's multiple range test at 0.05% level of probability.

RESULTS AND DISCUSSION

Table 1 showed the trends in mycelia growth of *P. florida, P. plumonarius* and *P. sajor-caju* cultured on *M. arborea* for six weeks. It was observed that *P. florida* had the highest mycelia length at the 1st week while highest mycelia length was observed at the 3rd week for *P.sajor-caju*. There was full ramification of the sawdust by the fungi spp from week four to week six. There was a significant difference in the yield of *P. plumonarius* and *P. sajor-caju*, however, *P. florida* produced no fruit bodies. *P. plumonarius* had mean fresh weight of 8.7g while *P. sajor-caju* had a mean fresh weight of 6.0g and the dry weight of *P. plumonarius* was also higher than that of *P. sajor-caju*. The biological efficiency and productivity of *P. plumonarius* were 8.70 and 0.97% while that of *P.sajor-caju* was 3.0 and 0.34% respectively (Table 2). *M. arborea* (wood waste) has been confirmed as a good substrate for *Pleurotus* cultivation and this is because oyster mushroom requires much carbon (cellulose, hemicellulose and lignin) which is richly available in the wood waste (Cha *et al*., 1997). A range of 12 to 14 days has been reported as time period of spawn running for various *Pleurotus* species on composted or non composted substrates (Baysal *et al*., 2003; Royse *et al.,* 2004; Tisdale *et al*., 2006 and Mane *et al*., 2007). The result from this study agrees with the previous reported spawn running period. The pinhead for two *Pleurotus* species (*P.sajor-caju* and *P. plumonarius)* was formed 5 days after the spawn running and fruiting appeared 2-6 days after the pinhead formation. Baysal *et al*., (2003) and Royse *et al.,* (2004), reported 2-4 weeks as fruiting period. Higher flushes were obtained in *P. sajor-caju* (3) while 2 were obtained in *P. plumonarius.* Philippoussis *et al*. (2001) reported a cropping cycle in the range of 20-52 days for 2-3 numbers of flushes on different composted and non composted substrates for *Pleurotus* species. Fruit bodies were larger in *P. plumonarius* but smaller in *P. sajor-caju,* this may be due to the stage of harvest. *P. plumonarius* was harvested when the mushroom caps were open like flower. The results obtained on mushroom size were consistent with earlier report that there are several sources of variation for mushroom size which include the type of substrate, spawn rate, type of mushroom species as well as their strain (Royse *et al*. 2004). The experiment was terminated at the third flush. Msandete and Cuff (2007) observed that 93 to 97% of total fresh weight was obtained from the 1st to the 3rd flush and this was attributed to the quantity of mushroom harvested which was directly proportional to the nutrient depletion from the substrate. The biological efficiency was calculated against the mean fresh weight of the

Table 1: Mycelia growth of *P. pulmonarius, P. florida and P sajor-caju* on *M. arborea*

Isolates	Mycelia length (cm)					
	1	2	3	4	5	6
P. florida	1.56^{c} ±0.02	4.13^{b} ±0.044	4.90^{a} ±1.04	6.0^{a} ±0.06	6.0^{a} ±0.35	6.0^{a} ±0.46
P.pulmonarius	1.50^{b} ± 0.01	5.03^{b} ±0.009	5.03^{a} ±0.03	6.0^{a} ±0.46	6.0^{a} ±0.10	6.0^{a} ±0.17
P. sajor-caju	1.40^{a} ± 0.01	1.40^{a} ±0.05	5.37^{a} ±0.21	6.0^{a} ±0.83	6.0^{a} ±0.81	6.0^{a} ±0.15

* = Means of three replicate ± standard error. Values followed by the same letter(s) along each vertical column are not significantly different by Duncan's multiple range test ($P<0.05$).

Table 2: Yield of *P.pulmonarius, P.florida* and *P.sajor-caju* on *M. arborea*

Isolates	Fresh weight (g)	Dry weight (g)	Cap length (cm)	Stalk length (cm)	Biological efficiency (%)	Productivity (%)
P. florida	NG	NG	NG	NG	NG	NG
P.pulmonarius	$8.70^{a} \pm 0.35$	$0.90^{b} \pm 0.05$	$3.83^{a} \pm 0.05$	$5.00^{a} \pm 0.29$	$8.70^{b} \pm 0.12$	$0.97^{a} \pm 0.08$
P. sajor-caju	$6.0^{a} \pm 0.53$	$0.340^{a} \pm 0.02$	$4.51^{a} \pm 0.40$	$4.51^{a} \pm 0.07$	$3.0^{a} \pm 0.12$	$0.34^{a} \pm 0.02$

* = Means of three replicate ± standard error. Values followed by the same letter(s) along each vertical column are not significantly different by Duncan's multiple range test ($P<0.05$).

Key
NG No growth

fruiting body and compost initial dry weight. The biological efficiency of *P. plumonarius* (8.7%) was higher than that of *P.sajor-caju* (3.0%) and the percentage biological efficiency agreed with range of 3.4 and 20.17% and 2.5 and 13.5% obtained by Philippoussis *et al*, (2001) and Pani and Das (1998). This is not unexpected as other researcher has observed significant differences in mushroom species or strain grown on the same substrate (Obadai and Vowotor, 2002). Table 3 showed that there were no significant differences in the nutritional contents of the three *Pleurotus* species cultivated on *M. arborea*. *P. florida* had the highest crude fat, crude fibre and lowest crude protein, *P.sajor-caju* contained the highest crude protein, while *P. plumonarius* and *P.sajor-caju* have similar percentage dry matter. Protein contents (26.84-27.87%) were in close agreement with the results obtained by Adejumo and Awosanya, (2005) who reported a range of 22.8- 36.8% for four edible mushrooms species and Ali *et al*., (2007) for *P. ostreatus* grown on sawdust. The fat content is higher than what was obtained in previous studies (4.48% by Ogundana and Fagade, 1981) and (1.7-4.6% by Oei, 2003). The discrepancy may be due to the type of substrate used. The percentage fiber agrees with that reported by Yithzak *et al*., (2009) which ranges between 11.7 and 17.0% and the ash content was slightly higher (12.20-12.36%) than (6.1-9.3%) obtained by Oei, 2003. *P. pulmonarius* was observed to contain the highest mineral elements for K (0.603 mg/100g), Ca (0.213 mg/100g, Mg (0.300 mg/100g and P (0.383 mg/100g) and *P.sajor-caju* with the highest N (0.320 mg/100g) and Fe (0.118 mg/

Table 3: Proximate composition of *P. florida, P. plumonarius and P.sajor-caju* on *M. arborea*

Isolates	Crude Protein	Crude fat	Crude Fiber	Ash	Dry Matter
	(%)				
P. florida	26.84 ± 0.023^{a}	11.97 ± 0.080^{a}	13.88 ± 0.035^{b}	12.22 ± 0.15^{a}	67.86 ± 24.34^{a}
P. pulmonarius	27.63 ± 0.277^{b}	11.83 ± 0.381^{a}	13.74 ± 0.064^{b}	12.36 ± 0.017^{a}	92.29 ± 0.092^{a}
P. sajor-caju	27.87 ± 0.035^{b}	11.66 ± 0.09^{a}	13.27 ± 0.035^{a}	12.20 ± 0.06^{a}	92.29 ± 0.058^{a}

* = Means of three replicate ± standard error. Values followed by the same letter(s) along each vertical column are not significantly different by Duncan's multiple range test ($P<0.05$).

100g) while *P. florida* was observed to have the lowest percentage of these mineral elements except for Fe which was lowest in *P. plumonarius* (0.110 mg/100g). (Table 4). The results obtained in this study compares favourably with the report of Adejumo and Awosanya, (2005) who reported that mushrooms are rich in mineral contents.

Table 4: Mineral content of *P. florida, P. plumonarius* and *P. sajor-caju* grown on *M. arborea*

Isolates	N	K	Ca	Mg	P	Fe
	Mg/100g					
P. florida	$0.128^{b} \pm 0.02$	$0.588^{a} \pm 0.03$	$0.193^{a} \pm 0.01$	$0.257^{a} \pm 0.03$	$0.360^{a} \pm 0.03$	$0.114^{a} \pm 0.01$
P. pulmonarius	$1.300^{b} \pm 0.02$	$0.603^{c} \pm 0.01$	$0.213^{c} \pm 0.02$	$0.300^{a} \pm 0.02$	$0.383^{a} \pm 0.10$	$0.110^{a} \pm 0.02$
P. sajor-caju	$0.320^{a} \pm 0.01$	$0.596^{b} \pm 0.02$	$0.205^{b} \pm 0.02$	$0.294^{a} \pm 0.01$	$0.377^{a} \pm 0.04$	$0.118^{a} \pm 0.04$

* = Means of three replicate ± standard error. Values followed by the same letter(s) along each vertical column are not significantly different by Duncan's multiple range test ($P<0.05$).

RECOMMENDATIONS

The results of this study showed that *P.sajor-caju* has protein content while *P. plumonarius* is the best in mineral composition when cultivated on *M. arborea*. Thus *P.sajor-caju* and *P. plumonarius* can be chosen for cultivation on *M. arborea*

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