

The Use of Local Nigerian Substrates for the Production of *Pleurotus ostreatus* var. *florida* Eger. Sporophores

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ABSTRACT

Andropogon, *Panicum*, *Pennisetum* and *Oryza* straws used in this study all supported the fructification of *Pleurotus ostreatus* var. *florida*. Among these local Nigerian substrates, *Andropogon* straw supported a significantly higher fruit-body yield and fresh weight than all other straws. *Panicum* straw yielded the lightest and shortest fruit-bodies. *Pennisetum* straw resulted in the widest and longest pileus.

Keywords: *Andropogon* straw, fruit-bodies, *Oryza* straw, *Panicum* straw, *Pennisetum* straw

INTRODUCTION

In Nigeria lignocellulosic wastes are of limited use. An efficient and economic way of upgrading these plant wastes into high-value protein is by using them in the culture of edible mushrooms. In mushroom cultivation, lignocellulosic wastes are turned into edible biomass by solid-state fermentation (Oei 1991; Okwujiako 1992).

Trials were carried out to determine the best local agricultural waste that best supports the production of mushrooms. Fasidi and Ekuere (1993) also investigated the production of sclerotia of *Pleurotus tuber-regium* using banana leaves, corn cob, cotton wastes and rice straw. Cotton waste resulted in the highest yield. Similarly, Okwujiako and Smith (1999) reported that wheat straw has a potential of being utilized for commercial production of sclerotia of *P. tuber-regium*, recording a yield of 24.2% sclerotia. Okhuoya and Okogbo (1991), grew *P. tuber-regium* on cassava peelings, corn straw, oil palm fruit fibre, rice straw, yam peelings and wild grass (*Pennisetum* sp.). Kadiri and Arzai (2005) showed that *Lentinus subnudus* Berk could be cultivated on wood logs of tropical trees. In another study, Fasidi (1996) reported that cotton waste, cassava peels and rice straw supported the fructification of *Volvariella esculenta*, while sawdust and cotton waste did not. According to that study, fructification was initiated 13 days after spawning on cotton waste and rice straw. Cotton waste gave the highest yield amongst the wastes investigated. Rangunathan *et al.* (1996) cultivated three species of *Pleurotus* mushrooms on various agro-residues, namely paddy straw, maize stover, sugarcane bagasse, coconut coir pith and mixture of these wastes. They reported that maximum yield was obtained when *P. sajor-caju* was cultivated on paddy straw, while *P. platypus* and *P. citrinopileatus* produced maximum yield on coir pith and sugarcane bagasse, respectively. In another work, Yildiz *et al.* (1998) studied the response of *P. ostreatus* to sorghum straw, peanut straw, soybean straw and wheat straw, and reported the highest yield of sporophores on peanut straw (24.8%), followed by soybean straw (21.9%), finally by sorghum straw (11.4%).

The present study is therefore aimed at investigating the usefulness of the different substrates employed, in the cultivation of *P. ostreatus* var. *florida* in Abia State of Nigeria.

MATERIALS AND METHODS

Inoculum

The inoculum of *P. ostreatus* var. *florida* used for this investigation was provided by Dr. I. A. Okwujiako. This was maintained on corn meal yeast agar prepared as follows: the dry components of 20 g of agar powder, 10 g cornmeal powder, 5 g of malt extract broth and 2 g of yeast extract were mixed together in a 1 L Erlenmeyer flask containing about 20 ml of distilled water. The mixture was stirred thoroughly and made up to mark by adding about 980 ml of distilled water. The mixture was dispensed into two 250 ml conical flasks which were then stoppered with cotton wool and autoclaved.

Agro-wastes

The agro-wastes used included: *Andropogon gayanus*, *Panicum*, and *Pennisetum* straws were cut from bushes around Orji Uzor Kalu Housing Estate Ehimiri, Umuahia, while local dwarf *Oryza* and *Zea* straws were obtained from the Federal Cereal Research Institute Amakama. The straws were sun-dried for one week, and kept in the mushroom house until used.

Spawn production

The *Sorghum bicolor* and millet (*Pennisetum polystachum*) (green type) grains used for spawning were purchased from Umuahia Main Market in Abia State, Nigeria. Spawn production, which is essentially a process of bulking up the mycelial culture on granular substrate, was carried out following the method of Stamets (1993). The grains were thoroughly washed to remove chaff and then soaked overnight in clean tap water in plastic buckets. The soaking was done to enable them to absorb water and soften. About 0.5 g and 0.13 g of gypsum (CaSO_4) and chalk limestone (CaCO_3), respectively were added to 100 g of each grain type. The gypsum was meant to prevent clumping of the grains while the CaCO_3 increases the pH. The grains were then distributed into about 300 ml capacity heat-resistant sample bottles, filled to 2/3 level. The bottles of grains were capped and autoclaved at 1.02 kg/cm² for 1 hr each day for 3 consecutive days to ensure complete elimination of both spores and vegetative parts of contaminants. After cooling, the grains were aseptically inoculated each with two 0.6 cm (diameter) mycelial discs from young cultures of

P. ostreatus var. *florida* showing greatest vigour in a bench inoculation chamber and incubated at $28 \pm 2^\circ\text{C}$ until fully developed. The fully developed spawn bottles were stored in a refrigerator to stop further mycelial growth.

Substrate preparation

The locally available substrates namely *Andropogon* gayanus straw, *Panicum maximum* straw, *Pennisetum purpureum* straw, corn straw, and *Oryza sativa* straw were evaluated for cultivation of *P. ostreatus* var. *florida*. The straw substrates were chopped into about 10 cm average lengths and separately steeped overnight in clean water (Sharma 2003). The substrates were filled separately (in four replicates) into uniformly perforated transparent 5-L plastic buckets and allowed to drain excess water. The buckets, each containing about 1 kg of substrate, were pasteurized for 2 h at 80°C in a gas-heated drum.

Spawn running (inoculation of substrates)

After cooling, the substrates were inoculated with grain spawn at 30 g per bucket, by gently pressing the spawn between the fingers and placing them on layers of the substrate. The buckets were covered and placed in wooden rocks in the cropping room. No casing was done.

Preparation of the cropping rooms

Prior to the incubation of the spawn-run substrates, the cropping room floor was scrubbed with water and detergent, the walls were got rid of cobwebs and disinfected. The room was well lit and ventilated by opening the window panes. This equally maintained the day time temperature at 18° to 32°C and reduced the carbon dioxide concentration of the rooms. The cropping room was constantly flooded with clean tap water to maintain high humidity required for good vegetative growth of the mushroom.

Induction of fruit body formation

Ten days after spawn-running, by which time the substrates had been thoroughly ramified by mycelium of *P. ostreatus* var. *florida*, the bucket covers were removed to further improve aeration, while humidity was reduced by reduction in flooding of the cropping room floor, until mushroom initials appeared which subsequently grew into mature mushroom fruit-bodies. The mushrooms were harvested at maturity when the pileus was fully expanded. Three flushes of fruits were harvested from the straws as they grew through the holes on the plastic buckets. The harvested fruit bodies of *P. ostreatus* var. *florida* from the various substrates, were counted, weighed to obtain the fresh weight, after which measurements were made of the pileus and stipe for their sizes (Fasidi 1996).

Statistics

The values obtained were statistically analyzed using Analysis of Variance (ANOVA) and the means were separated using the Least Significant Difference (LSD) at 0.05 level of significance. Each treatment was replicated three times.

RESULTS AND DISCUSSION

Agricultural wastes and the fruit-body yield

The *Andropogon* straw, *Penicum* straw, *Pennisetum* straw and *Oryza* straw used in the investigation, all supported the fructification of *P. ostreatus* var. *florida* (Fig. 1). Among the substrates, *Andropogon* straw supported a significantly higher fruit body yield (27.25) than *Oryza* (14.75), *Pennisetum* (11.75) and *Panicum* (2.50) straws ($P < 0.05$). The result further supports the fact that *Pleurotus* species as a class of edible mushroom, have a high saprophytic ability and are capable of growing on a variety of cellulosic wastes (Garcha *et al.* 1984; Klibansky *et al.* 1987; Laboride 1987; Yildiz *et al.* 1998), causing the bioconversion of the cellulosic wastes into edible biomass (Thambidurai *et al.* 2006). How-

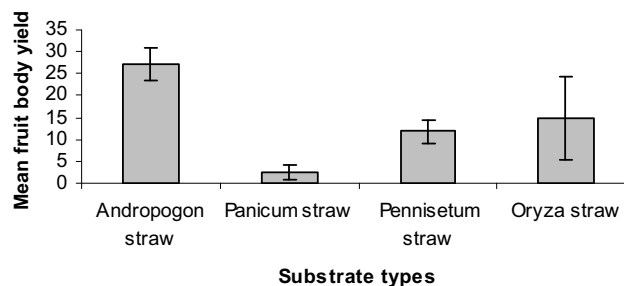


Fig. 1 The effects of different agricultural wastes on the mean fruit body yield of *P. Ostreatus* var. *florida*.

Table 1 The effects of different substrates on the fresh weight (g) of fruit bodies of *P. ostreatus* var. *florida*.

Substrate type	Mean fresh weight
<i>Andropogon</i> straw	56.65 ± 16.00 a
<i>Panicum</i> straw	4.21 ± 4.90 c
<i>Pennisetum</i> straw	27.62 ± 16.73 b
<i>Oryza</i> Straw	20.60 ± 18.00 b

Means (\pm SD) having the same subscript letter(s) are not significantly different ($P > 0.05, 0.01$) by LSD.

ever, the present results indicate that *Andropogon gayanus* straw can be a good material for cultivation of *P. ostreatus* var. *florida*. This again shows that although these mushrooms are voracious in their ability to utilize cellulosic wastes, there is some level of specificity in the choice of the wastes. For instance, Sharma (2003) reported that in general the species of *Pleurotus* preferred to grow on the substrates namely paddy straw, wheat straw, mustard straw; maize stalks, and sugarcane bagasses, but *P. djamor*, the pink oyster mushroom did not do well on sorghum stalks and sugarcane leaves. According to Sharma (2003), the reason of the poor performance of *P. djamor* on the substrates, may be due to non-suitability of constituents of these substrates to pink Oyster mushroom. Similarly, *P. ostreatus* var. *florida* may have found the constituents of *Andropogon* straw more suitable than the constituents of the other substrates.

Agricultural wastes and the fresh weight (g) of fruit-bodies

Table 1 represents the mean fresh weight of *P. ostreatus* var. *florida* fruit bodies as influenced by different substrates. *Andropogon* straw yielded significantly the heaviest fruit bodies of 56.65 g ($P > 0.01$), while *Pennisetum* straw (27.62 g) *Panicum* straw yielded the highest (4.21 g). The trend of fresh weight of the fruit-bodies followed that of the number of fruit-bodies obtained from the different substrates.

Agricultural wastes on the average pileus (cap) diameter and stipe (stalk) length

The result of the influence of the different agro-wastes on the sizes of the pileus and stipe of the fruit bodies of the mushroom is presented in Tables 2 and 3. *Pennisetum* straw significantly increased the pileus size (diameter) (4.78 cm) followed by *Andropogon* straw (4.17 cm) and *Oryza* straw (3.59 cm). *Penicum* straw rather caused a reduction of the pileus size (1.92 cm). Similarly *Pennisetum* straw increased the stipe size of the mushroom, producing stipes that are 2.68 cm long. The mean stipe length of the fruit-bodies produced on *Oryza* straw and *Andropogon* straws (2.30 cm and 2.25 cm respectively), are not significantly shorter than those of the *Pennisetum* straw. Conversely, the pileus of the fruit bodies produced on *Panicum* straw are significantly shorter (1.05 cm) than those of the others substrates. The present result showed a slight deviation from the results of the influence of the agro-wastes on the fruit body yield and fruit-body fresh weight.

Table 2 The effects of different Agricultural Wastes of pileus size of the fruit bodies of *P. ostreatus* var *florida*.

Substrate type	Mean pileus size
<i>Andropogon</i> straw	4.17 ± 0.65 b
<i>Panicum</i> straw	1.92 ± 2.23 c
<i>Pennisetum</i> straw	4.78 ± 1.06 a
<i>Oryza</i> Straw	3.59 ± 1.48 b

Means (± SD) having the same subscript letter(s) are not significantly different ($P > 0.05$, 0.01) by LSD.

Table 3 The effects of different Agricultural Wastes of on the stipe size (cm) of *P. ostreatus* var *florida* fruit bodies.

Substrate type	Mean stipe size
<i>Andropogon</i> straw	2.25 ± 0.52 a
<i>Panicum</i> straw	1.05 ± 1.22 b
<i>Pennisetum</i> straw	2.68 ± 6.22 a
<i>Oryza</i> Straw	2.30 ± 0.44 a

Means having the same subscript letter(s) are not significantly different ($P > 0.05$, 0.01) by LSD.

Pennisetum and *Oryza* straws and its poor performance on *Panicum* straw have remained consistent. However, *Andropogon* straw appears to perform better than all the other substrates used on account of the fruit body yield and fresh weight. This result prompted the selection of *Andropogon* straw for further investigation with organic amendments.

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