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Effect of Cocoa Shell Supplementation on the Production of Two Oyster Mushrooms (*Pleurotus pulmonarius and P ostreatus*)

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Abstract

The effect of cocoa shell supplementation on the production of two oyster mushrooms, *P pulmonarius (Pp)* and *P ostreatus (Po)* was investigated in order to recommend the optimum amount of cocoa shell for growing the mushrooms in Nigeria. These were cultivated on maize cob supplemented with various ratios of cocoa shell waste to maize cob. The ratios evaluated were 0.1:1, 1:2, 1:4. 1:8, 1:116 and 1:32, assessments were based on the average yield, biological efficiency, fruit number, width of pileus , length of stipe, mycelia density, and primodia initiation. The results showed that both mushrooms recorded significantly high fruit yield (*P pulmonarius*, 101.9g and *P ostreatus*, 36.0g), biological efficiency (Pp,58.2% and Po, 20.5%), fruit number (Pp, 28 and Po, 21),width of pileus (Pp, 5.4cm and Po, 3.7cm) length of stipe (Pp, 5.2cm and Po, 4.5cm) and mycelia density (5+) at ratio 1;8 supplementation and least on 1:1. For Pp and Po, yield significantly increased from 0 - 1:2 supplementation ratio and dropped at 1:1 with Pp yielding higher than Po . These results showed that different oyster mushrooms respond differently to the amount of cocoa shell supplementation Pp necessitates a great supply of some nutrients in cocoa shell to increase the fruit yield, biological efficiency, fruit number, etc The most optimum and economic amount of cocoa shell to substrate is ratio 1:8

Keywords: Cocoa shell, oyster mushrooms (*P pulmonarius* and *P ostreatus*), supplementation

1.0 Introduction

The oyster mushrooms of the genus *Pleurotus* as a class of edible mushrooms are reputed to have a high saprophytic ability to grow on a variety of cellulosic wastes (Fasidi and Ekuere, 1993; Barbosa *et al.*, 1995; Yildiz *et al.*, 1998; Idowu, 2002). They grow on a wide array of forest and agricultural wastes and thrive on most hardwoods and wood by product (Sawdust, paper pulp sludge), cereal straws, corncobs, sugar cane bagasse, coffee residues (hull, stalks and leaves) etc. They can best serve to reduce hunger in developing nations and to improve rural economies. To this end, worldwide oyster mushroom production had surged at an accelerated rate in recent years. In 1986, *Pleurotus spp* production accounted for approximately 7% of the total world production of edible mushrooms; by 1990, production of *Pleurotus spp*. reached one million metric tones and accounted for 24% of total edible mushroom production (Chang and Miles, 1991; Hayes, 1991; Royse, 1992).

Substrates have been supplemented with organic materials such as rice bran, earthworm cast, wheat bran, grain flour, wood shaving and humus. (Grabbed, 1975; Lozvol, 1986; Poochow, 1989; Madhab *et al.*, 1989; Peng *et al.*, 2000. Incorporation of nitrogenous substances into the basic substrates does not necessary increase yields and very often substrates supplemented with higher levels of nutrient are more susceptible to competitive mould growth than non supplemented or lower level of supplementation in the production of *Pleurotus spp*. (Khandaswamy and Remaswamy, 1978; Royse and Schisler, 1987).

Cocoa shell is the crushed shell of cocoa beans (*Theobroma cacao*) which is the by product of chocolate industries. It is ground and used as animal feeds. It has soil improving capacity therefore it is used by horticulturist in Humberside Dublin for this purpose. This study was undertaken to determine the appropriate quantity/ratio of cocoa shell waste on corncob necessary to obtain optimum yield of these oyster mushrooms.

2.0 Materials and Method

The *Pleurotus spp. (P. pulmonarius and P. ostreatus)* used in this study were maintained on potato dextroses (PDA) agar for regular subculturing and stored in the refrigerator. The cocoa shell was obtained from a cocoa seeds processing mill at Ondo town, Ondo state of Nigeria.

The corncobs (CC) were shredded into pieces of 1-3 inches and mixed with cocoa shell (CS) in the following ratios; 0.1:1, 1:2, 1:4. 1:8, 1:16 and 1:32. These were moistened and composted for 3 days with the moisture content adjusted to about 65% and the pH adjusted by the addition of calcium carbonate. Portions (100g) of the processed wastes were packed in transparent polythene bags and sterilized in an autoclave at 121^0C for 30 minutes. After cooling down to room temperature, the sterilized substrates were inoculated with 10g of the spawns of the two species of *Pleorotus* (*P. pulmonariuss and P. ostreatus).* The inoculated substrates of the two mushrooms were incubated for 30days at room temperature. The spawns used for the experiment were prepared by the method described by Peng *et al*., 2000. The mycelia density was compared visually by the method of Fasidi (1995).

The biological efficiency (B.E) which is the ratio of mushroom live weight to the dry substrate weight was also evaluated.

2.1 Cropping

After incubation, the top layer (1-5cm depth) of substrate in each bag was completely removed with a sharp metal spoon. After the removal of the top layer in all the treatment bags they were capped again before moving them to the cropping house. These bags were uncapped after the appearance of pin heads or mushroom primodia.

2.2 Harvesting

Mushrooms in each bag were harvested when the caps were fully opened and flushes of mushrooms in each bag was harvested as they appear. The harvested mushrooms were then weighed for the calculation of the biological efficiency. The experiment was a completely randomized design with three replicates per treatment for each of the mushrooms used in this study.

3.0 Result and Discussion

This study deals with the production of higher mushroom fruit body yield due to supplementation of the basal substrate with cocoa shell in other to establish differences in the result of the response of two mushrooms of the same genus Pleurotus (Table 1). The average fruit body yield, biological efficiency, fruit number, width of pileus, and length of stipe of *P pulmonarius* and *P ostreatus* increased significantly in ratios 1: 8 of MC: CS; followed by ratios 1: 6, 1: 4 and least in substrates supplemented with ratio 1:1, (Table 1). The reduction in productivity with high supplementation of MC with CS may have resulted from the compactness or poor aeration of the substrate a condition which allowed for the thriving of other dormant competitive fungi, which then resulted in inadequate nutrients arising from competition within the substrate and non-availability of good surface area for the mushroom fruit body development due to this compact nature of the substrate (Stamet, 2000).

The yield, biological efficiency and all the other parameters eva[uated were higher in *P pulmonarius* than in *P. ostreatus* (Table 1 and 2) a result which indicated that different species of the genus *Pleurotus* mushrooms respond differently to the amount of CS supplement added to its media which agrees with the finding of Peng *et al.* (2000) who reported that two strains of *P. eryngii* responded differently to different levels of rice bran supplementation. This further showed that *P pulmonarius* required a greater supply of some nutrients in the cocoa shell to increase its biological efficiency and may also be due to different saprophytic ability within the genus *Pleurotus*. This agrees with the findings of some workers who reported the biological efficiency of *P. ostreatus* to range between 11-25% and P *Pulmonarius* ranging between 31-47%. (Yildiz *et al*., 1998; Ragunathan *et al.*, 1996).

In *Pleurotus sp* the primodia initiation was generally observed on 24^{th}-30^{th} (Khanna and Garcha, 1992. In this present study it was observed on the 22^{th}

Table 1: Effect of cocoa shell supplementation on the production of two species of *Pleurotus* mushrooms

	Fruit body yield (g)		Mean fruit weight (g)		Biological efficiency (%)	
Cocoa shell supplementation	***P. pulmonarius***	***P. Osreatus***	***P. pulmencrius***	***P. Osteatus***	***P. pulmonarius***	***P. Ostreatus***
0 (Control)	40.89^{c}	32.27^{b}	3.15^{c}	2.93^{a}	23.36^{8}	18.44^{b}
1.1	28.56^{g}	18.02^{g}	2.86^{c}	1.80^{b}	16.50^{g}	10.36^{e}
1.2	50.56^{i}	22.45^{e}	2.97^{c}	1.86^{b}	28.14^{d}	12.81^{d}
1.4	77.65^{b}	28.53^{d}	3.38^{c}	1.78^{b}	46.01^{b}	16.30^{c}
1.8	101.82^{a}	36.02^{a}	3.64^{c}	1.72^{b}	58.19^{a}	20.50^{a}
1.16	59.92^{c}	31.32^{c}	4.99^{a}	2.61^{a}	34.23^{c}	18.01^{b}
1.32	45.21^{e}	14.42^{e}	4.11^{b}	1.31^{c}	25.83^{e}	11.11^{e}

Note: Means followed by the same super-script letter (s) within each column are not significantly different (P<0 .01) by Ducan multiple range test

Table 2: Effect of cocoa shell supplementation on growth characteristics of ewo Pleurotus mushrooms.

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	Fruit number		Width of Pileus (cm)		Length of stipe (cm)		Mycelia Density		Primodia Initiation (days)	
Cocoa shell supplementation	***P***	***Ost***	***P***	***Ost***	***P***	***Ost***	***P***	***Ost***	***P***	***Ost***
0 (control)	13.00^{d}	11^{d}	4.58^{d}	3.74^{a}	4.25^{b}	3.76^{b}	3^{+}	4^{+}	26^{b}	24^{e}
1.1	10.00^{e}	14^{d}	3.87^{c}	2.48^{c}	3.67^{c}	2.98^{d}	2^{+}	1^{+}	30^{a}	32^{a}
1.2	50.56^{i}	22.45^{e}	2.97^{c}	1.86^{b}	4.11^{b}	3.51^{c}	4^{+}	2^{+}	24^{b}	28^{b}
1.4	77.65^{b}	28.53^{d}	3.38^{c}	1.78^{b}	4.38^{b}	3.88^{b}	5^{+}	4^{+}	22^{c}	27^{b}
1.8	101.82^{a}	36.02^{a}	3.64^{c}	1.72^{b}	5.17^{a}	4.15^{a}	5^{+}	5^{+}	22^{c}	24^{d}
1.16	59.92^{c}	31.32^{c}	4.99^{a}	2.61^{a}	4.34^{b}	3.54^{c}	4^{+}	4^{+}	25^{b}	24^{c}
1.32	45.21^{e}	14.42^{e}	4.11^{b}	1.31^{c}	4.28^{b}	3.43^{c}	3^{+}	1^{+}	25^{b}	26^{b}

day in substrate supplemented with ratios 1:8 and 1:6 but higher in the others indicating that at these levels primodia initiation days can be reduced. In *P osreatus, the primodia* were initiated on 24^{th} day on 0 (control), 1:6 and 1:8 supplementation levels with 1:1 level of supplementation initiating on 32^{nd} day indicating a delay in fruit formation as a result of high supplementation. The average fruit weight was highest in ratios 1:16 and 1:32 for Pp and least in others while it is highest in 0 (control) followed by 1:16 and least in others this could not account for increase in yield and indication that cocoa shell supplementation does not necessarily affect fruit body size which is an agronomic character.

Since the yield and biological efficiency of *P Pulmonariu* was low when grown without CS that is the control, it implies that nutrient for the development of the fruiting bodies of this mushroom species mainly come from the cocoa shell but not from the cob while cocoa shell does not influence the yield in *P. ostreatus*. The findings of Peng *et al.*, 2000 showed that two strains of *P. eryngii.* (ATCC 36047 and Holland 150) had their yield increased with increase in rice bran supplementation.

The mean fruit number, fruit weight, width of pileus, and length of stipe were significantly higher in substrates supplemented with ratio 1: 8. CC: CS in *P. pulmonarius* but least in the other treatments as evident from Table 2.

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