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Full Length Research Paper

Effect of substrate supplementation with wheat bran, NPK and urea on *Psathyrella atroumbonata* Pegler sporophore yield

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Three agricultural by-products (oil palm fruit fibre, banana leaves and sawdust) were supplemented with wheat bran, NPK fertilizer and urea at 5 - 20% (w/w) for wheat bran and 0.1, 0.5, 1.0 and 2% (w/w) for NPK and Urea. The supplemented substrates were used to cultivate *Psathyrella atroumbonata.* There was sporophore formation in all the substrates supplemented with NPK except at 1% and 2% in oil palm fruit fibre and 2% in banana leaves. The highest yield was on sawdust supplemented with wheat bran at 5%. Urea as supplement did not support sporophore formation in all the substrates except in sawdust but with low yield at 0.5%.

Key words: Suplementation, wheat bran, NPK, urea, sporophore *Psathyrella atroumbonata*.

INTRODUCTION

Mushroom consumption and utilization predate civilization. Early men must have recognized mushrooms because of their peculiar nature in springing out of almost anywhere. The use of mushroom as food and delicacies are now gaining popularity in the human diet. Their importance in medicine is now highly recognized. They are known to be rich in proteins, sugars, lipids, amino acids, glycogen, vitamins and mineral elements (Isikhuemhen et al., 1999; Chang, 1996) . They also have potential medicinal benefits (Chang and Miles, 1989; Liu et al., 1993; Lin, 1995; San, 1996).

Psathyrella atroumbonata is a well known edible mushroom usually growing in the wild and has not been commercially cultivated. In Africa, especially in West African sub-region, mushroom cultivation is still at a pioneering stage and the African indigenous technology for mushroom production is very rudimentary and many people usually collect and eat wild edible mushrooms (Okuoya and Ajerio, 1988; Isikhuemhen and Okhoya, 1995, 1996). *P. atroumbonata* grows in many parts of tropical Africa, especially West African sub-region where it is part of the local people's food. The mushroom is a lignicolous fungus commonly found growing in small clumps on or around dead rotten trees or on dead roots of wood that is at the last phase of decomposition. It has a well defined stipe which is whitish and about 5 – 9 cm long. The pileus is about 1.5 to 5 cm in diameter, light brown, conical or bell shaped and brittle. The spores are pale brown in colour. The mushroom is similar to *Coprinus* in appearance but does not undergo auto-digestion as does *Coprinus*.

In *P. atroumbonata*, there is generally low yield achieved when grown or cultivated on synthetic substrates. To improve the mean fruit yield, supplementation is necessary. This study was undertaken to investigate the use of three agricultural by-products for the cultivation of *P. atroumbonata* under different levels of wheat bran, NPK fertilizer and urea supplementation.

MATERIALS AND METHODS

Pure culture of *P. atroumbonata* was obtained from tissue cultures made from mushrooms collected in the wild around dead decaying roots of *Gmelina arborea* wood in Kogi State of Nigeria. The pure cultures were kept in refrigerator at 5 C till when needed. Oil palm fruit fibres (OPFF) were collected from an oil mill near Uselu market, Benin City. The sawdust was collected from local saw mill at Uwasota area in Benin City, Nigeria. Banana leaves were collec-

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Table 1. Effect of NPK supplementation of three agricultural wastes on sporophore yield of *Psathyrella atroumbonata*.

Substrate	NPK (%)	Sporophore appearance (days)[a]	Yield (g)[b]
OPFF	0	120	58.06 ± 0.12
	0.1	94	62.04 ± 0.06
	0.5	93	66.38 ± 0.16
	1.0	-	-
	2.0	-	-
Banana Leaves	0	104	56.21 ± 0.41
	0.1	107	57.52 ± 0.37
	0.5	110	51.22 ± 0.23
	1.0	102	45.38 ± 0.18
	2.0	-	-
Sawdust	0	103	60.10 ± 0.12
	0.1	101	61.70 ± 0.13
	0.5	104	52.82 ± 0.19
	1.0	103	50.17 ± 0.13
	2.0	104	42.31 ± 0.18

[a]Number of days before sporophore appearance. [b]Fresh weight after three flushes.
- = No yield recorded.

ted from private farms in Abraka, Delta State, Nigeria. The substrates, except sawdust were chopped into pieces of about 2 cm in length and were soaked in tap water and heaped for 7 days to ferment and with turning every two days (Quinmio et al., 1990). The fermented substrates were mixed with 1% $CaCO_3$ and 1% sugar on oven-dry weight basis. The moisture content of the fermented substrates was adjusted to 75% with addition of sterile water.

The supplements used were wheat bran, urea and commercial fertilizer (NPK 15:15:15). Supplementation with wheat bran was done at 4 levels (5:10:15 and 20%) of dry weight while 0% was used as control. For urea and NPK, 4 levels of supplements were also used (0.1:0.5:1 and 2%) of dry weight and 0% was also used as control. The NPK and urea were first dissolved in water and mixed thoroughly with the substrates. After mixing the supplements with the substrates thoroughly, five hundred gram (500 g) oven dry weight equivalent of prepared substrates were loaded into cellophane bags measuring 15 x 30 cm each. A polyvinyl chloride pipe (PVCneck) measuring 5 cm wide and 3 cm long was passed through the top of the bag. Thereafter, the mouth of the bags was plugged with cotton wool and covered with foil paper. Three replicate bags were prepared for each substrate. The bags were then loaded into a steamer and steamed for four hours at the temperature of about 70 C. They were allowed to cool down to ambient temperature before they were inoculated at 5% level of spawing (w/w). Inoculated bags were kept on a clean bench in the laboratory at 28 + 2 C and average relative humidity of 90%. After complete colonization of substrates by the mushroom mycelium, the bags were opened for fruiting. This was followed by periodic watering of bags every other day with 150 ml of sterile water per day to avoid dryness. Fresh mushroom yield and other parameters were recorded after three flushes.

RESULTS AND DISCUSSION

The most stimulatory supplement in all the substrates was NPK. There was sporophore formation in all the substrates supplemented with NPK at all levels except at 1% and 2% in oil palm fruit fibres (OPFF) and 2% in banana leaves (Table 1). The highest yield with NPK supplementation was at 0.5% in OPFF while the least yield was in sawdust at 2%. Sporophore did not form in OPFF and banana leaves supplemented with wheat bran at all levels of supplementation (Table 2). The best stimulatory concentration of wheat bran in sawdust was 5% while 20% gave the least stimulatory effect. Urea as supplement did not support sporophore formation in all the substrates tested except in sawdust at 0.1% and 0.5% but with low yield (Table 3). The most stimulatory concentration of urea was 0.1% in sawdust while there was no sporophore formation at 1% and 2% in sawdust. The second flushes were generally the highest in all the treatments including the control. Contaminants such as *Aspergillus, Rhizopus, Penicillium* and *Neurospora* were encountered during the experiment.

Supplementation or inclusion of additive during mushroom cultivation is to enhance the yield of mushrooms. Supplements or additives usually change the decomposi-tion rate and also the sequence of decomposition of substrates components (Zadrazil, 1993). Supplementa-tion of substrates with different levels of carbonates and nitrogen-based additives has been shown to enhance mushroom production (Royse et al., 1991; Fasidi and Kadiri, 1993; Zadrazil, 1993; Isikhuemhen et al., 1999, Royse, 1996) . Royse et al. (1990) have reported formulas incorporating grains as a significant ingredient in mush-room substrates. They reported that grains are widely used in the United States as substrate supplements for

Table 2. Effect of wheat bran supplementation of three agricultural wastes on sporophore yield of Psathyrella atroumbonata.

Substrate	Wheat bran (%)	Sporophore appearance (days)[a]	Yield (g)[b]
OPFF	0	-	-
	5	-	-
	10	-	-
	15	-	-
	20	-	-
Banana leaves	0	-	-
	5	-	-
	10	-	-
	15	-	-
	20	-	-
Sawdust	0	104	60.52 ± 0.42
	5	106	69.05 ± 0.42
	10	103	66.07 ± 0.12
	15	103	56.55 ± 0.06
	20	106	40.78 ± 0.09

OPFF: Oil palm fruit fibres.
[a]Number of days before sporophore appearance. [b]Fresh weight after three flushes.
- = No yield recorded.

Table 3. Effect of urea supplementation of three agricultural wastes on sporophore yield of *Psathyrella atroumbonata*

Substrate	Urea (%)	Sporophore appearance (days)[a]	Yield (g)[b]
OPFF	0	-	-
	0.1	-	-
	0.5	-	-
	1.0	-	-
	2.0	-	-
Banana Leaves	0	-	-
	0.1	-	-
	0.5	-	-
	1.0	-	-
	2.0	-	-
Sawdust	0	104	60.52 ± 0.21
	0.1	102	41.32 ± 0.11
	0.5	106	34.63 ± 0.14
	1.0	-	-
	2.0	-	-

OPFF: Oil palm fruit fibres.
[a]Number of days before sporophore appearance. [b]Fresh weight after three flushes.
- = No yield recorded.

commercial cultivation of mushrooms. In this study, all substrates and levels of supplementation showed variable sporophore yields. The best mycelial development and sporophore yield was observed on sawdust supplemented with wheat bran at 5%. The best sporophore yield with NPK supplementation was on OPFF at 0.5%. It seems that NPK at 0.5% level is the optimum for external supply of nitrogen, phosphorous and potassium as highest sporphore yield were produced at this level. The results observed in this study is similar to that of Fasidi and Kadiri (1993) who reported that rice bran and cassava peels as additives stimulates both mycelial extension and sporophore yield of *Lentinus subnudus* on various agricultural wastes tested.

Royse and Schisler (1986) reported a high production rate when wheat bran was used as supplement to shiitake mushroom substrates. Han et al. (1981) working on the growth of *Lentinus edodes* found that nutrient supplementation of sawdust with wheat bran, soya bean cake, sesame cake and peanut cake increase the mycelial growth with optimum concentration at 5%. The observed stimulatory effect of wheat bran may be due to carbohydrates, amino acids and mineral elements present in wheat bran (Fasidi and Kadiri, 1993). The lowest yield was observed on sawdust supplemented with urea at 0.5%. This low yield may be due to carbon to nitrogen imbalance in the sawdust (Stamets, 2000).

The report has shown that yield of *P. atroumbonata* on some agro industrial wastes can be enhanced using supplements such as wheat bran and nitrogen, phosphorous and potassium fertilizers.

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