EFFICACY OF WHEAT STRAW AND COTTON WASTE AS SUBSTRATES IN THE PRODUCTION OF EDIBLE MUSHROOMS

Musa, H., Wuyep, P. and *Ali, B.D

Department of Biological Sciences, Ahmadu Bello University, Zaria, Kaduna State, Nigeria.

**Department of Biological Sciences, Adamawa State University, Mubi, Adamawa State, Nigeria.*

Corresponding author: 08036072464

Abstract: Wheat straw and cotton waste were used as substrates and some natural additives, nitrogen and carbon sources were used as nutrient supplements to enhance mycelia growth of Pleurotus ostreatus (Florida). Sundried wheat straw substrate was cut into small pieces. The minced wheat straw and cotton waste substrates were soaked in boiled water and excess water ~~was~~ squeezed out using a clean muslin cloth. Substrates were boiled and autoclaved and spawn of Pleurotus osreatus was inoculated in a sterilized chamber and supplements were added. Wheat straw was found to be a better substrate for mycelia growth than cotton wastes. The natural additives and carbon sources resulted in better growth than the nitrogen additives on both substrates. Malted yellow maize, D – fructose and methyl cellulose can best be used as additives to promote mycelia growth of Pleurotus ostreatus

Keywords: additives, cotton waste, Pleurotus ostreatus, substrates, wheat straw.

INTRODUCTION

Mushrooms have become attractive as nutritional food and are source of pharmaceutical products prepared either as hot extracts, concentrates or in powdered form (Smith, 2002). The most important use of Mushroom is as a source of food (Ali *et al*., 2010). They are considered to be good sources of digestible proteins, carbohydrates, dietary fiber and all essential Amino acids (Barros, *et al*., 2007). Edible Mushrooms have been treated as special kinds of food since earliest times (Oei, 1996; 2005). Mushroom production is of great economic importance in all parts of Nigeria, they are used in soup making (Zoberi, 1972; 1973). They are useful in preventing diseases such as hypertension, hypercholesterolemia and cancer (Mau *et al*., 2002). It is also beneficial in forest decomposition. The forestry mushrooms are nature's most active agent in the decomposition of forest waste materials (Bahl, 1988; Kadiri *et al*., 2008). Mushrooms are fruiting structures of large fungi. The function of fruiting body is to produce spores for spawning. *Pleurotus Osteratus* (Florida) is an edible oyster Mushroom that are indigenous to hot subtropical and tropical regions that can play key roles in nutrient recycling, human nutrition and bioremediation of waste materials (Kashangura *et al*., 2006). Productions of oyster mushrooms are a saprophytic process as they obtain their nutrients by decomposing various agricultural by-products (Asami and Seto, 2004). Organic supplements are usually added to substrates to provide organic sources of nitrogen (Upadhay *et al*., 2003).

Mushroom compost is moisturize 30±2^{0}C in an incubator which was earlier sterilized with 10% formalin.

COLLECTION OF ADDITIVES

The natural additives were obtained from the university farms and some were bought from the local market. The cereals were malted before being used. This involved soaking of each cereal in distilled water for two days in a refrigerator at

*Corresponding author:
hannatudawa@yahoo.com **** Musa, H***

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15^{o}C.The soaked cereals were separately sown in glass Petri dishes filled with distilled water. These were kept in the laboratory for germination to take place after 2 -3 days. Germinated cereals were dried in an oven at 80^{0}C for 2 days. The oven dried seedlings were ground with pestle and mortar and the powder was used as additives. The substrates containing the different additives at various levels were filled into 3 boiling tubes and cover with aluminum foil. The control experiment consisted of the substrate soaked in water with no additive added. The substrates were filled into boiling tubes and covered with aluminum foil and the controls and inoculated after cooling with mycelia discs of *P. ostreatus*. The inoculated tubes were incubated at 30±2^{0}C for 5 - 10 days, and the linear mycelia extension was measured with a ruler.

Nitrogen sources were added at 1 g, 2 g and 3 g to 99 g, 98 g and 97 g of the substrates respectively. Each preparation was filled into 3 boiling tubes and the tubes were covered with aluminum foil. The control experiment consisted of the substrate that had the best mycelia growth from the natural additives and substrate that had no nitrogen sources added to them. Similarly, carbon sources were added at 1 g, 3 g and 5 g to 99 g, 97 g and 95 g of the substrate respectively. Autoclaving as above, the inoculated tubes were incubated at 30±2^{0}C for 10 – 18 days and the linear mycelia growth was measured with a ruler.

RESULTS AND DISCUSSION

Wheat straw and cotton waste were found to be good substrates for mycelia growth with wheat straw being better than cotton waste (Table 1). The summary of the result (Table 2 – 4) indicates that additives with wheat straw showed a better mycelia growth than with cotton waste, especially nitrogen additives with cotton waste that showed little or no growth except with malted yellow maize and ammonium nitrate with mycelia growth of 1.0 ± 0 at 1%, 2% and 3% additive level. The malted yellow maize showed better mycelia growth than all other additives. At 30% additive level poultry feed did not showed any mycelia growth with the used substrates. As the additive level was increase, from 10% to 30% there was a corresponding decrease in mycelia growth (Table 1).

Effect of nitrogen sources additives on the mycelia growth of *P. ostreatus*.

Wheat straw was consistently better than cotton waste in supporting mycelia growth at 1%, 2% and 3% additions (Table 3), casein 1 – Histidine and yeast extract inhibited mycelial growth at all additive levels except yeast extract that showed a slight mycelial growth at 3% (Table 3). As additive concentrations increased, mycelial growth decreased except for ammonium nitrogen that had the reverse trend (Table 3). Wheat straw mixed with nitrogen sources at 1%, 2% and 3% additive level showed better mycelial growth than the control and showed best mycelial growth with malted yellow maize, DL aspartic acid and urea than when cotton waste was mixed with these nitrogen sources at 1%, 2 % and 3% additive level.

EFFECT OF CARBON SOURCES ADDITIVES ON MYCELIAL GROWTH

At 1% 3% nd 5% wheat straw was better than cotton waste in supporting mycelial growth except for lactose and arabinose (Table 4). More so, cotton waste with arabinose was better in. supporting mycelia growth than wheat straw. As the addition level increased from 1% to 5%, mycelia growth decreased except for lactose which had the opposite trend (Table 4). Wheat straw gave a better mycelia growth than cotton waste with metry cellulose and D. fructose being better in mycehial growth than the control (Table 4).

From the findings in the study, both wheat straw and cotton waste are good for mycelia culturing and production of edible

mushroom *Pleurotus ostreatus* with wheat straw being better.

Table 1: Mean mycelia growth of *Pleurotus ostreatus* (cm) at 10 days after inoculation in Cotton waste and Wheat straw

Substrates	Mean mycelia length (cm)
Wheat straw	9.0± 0.3
Cotton waste	7.0± 0.2

Table 2: Mean mycelia growth of *Pleurotus ostreatus* (cm) at 10 days, 14 days and 18 days after inoculation in wheat straw and Cotton waste substrates supplemented with agricultural additives

Natural additives	SUBSTRATES AND ADDITIVE CONCENTRATION					
	1% addition		2% addition		3% addition	
	Wheat straw	Cotton waste	Wheat straw	Cotton waste	wheat straw	cotton waste
Cow dung	7.7±0.6	4.7±0.2	4.4±0.2	2.3±0.2	4.0±0.2	0.7±0.1
Horse dung	4.7±0.6	4.7±0.4	3.3±0.1	2.0±0.3	2.7±0.2	1.0±0.0
Poultry dung	5.3±0.2	1.0±0.0	4.8±0.4	1.0±0.0	2.3±0.0	1.5±0.2
Yam peels	4.7±0.3	5.3±0.2	4.0±0.3	2.1±0.2	1.3±0.1	1.0±0.1
Rat pellets	5.3±0.4	2.7±0.1	3.8±0.2	0.5±0.0	1.8±0.0	0.3±0.0
Poultry feed	7.8±0.6	6.7±0.3	1.1±0.0	4.3±0.2	-	-
Rice bran	7.8 ±0.2	5.7±0.2	5.7±0.4	3.2±0.2	4.4±0.1	2.3±0.3
Malted millet	7.8±0.4	5.3±0.4	4.1±0.1	3.3±0.0	1.7±0.2	1.3±0.1
Malted sorghum	7.0±0.3	6.5±0.5	6.7±0.3	3.6±0.2	6.3±0.5	1.5±0.0
Malted rice	7.3±0.3	6.3±0.4	5.0±0.5	2.3±0.0	3.0±0.2	1.8±0.2
Malted white maize						
Malted yellow maize	7.7±0.2	5.2±0.4	5.4±0.3	2.8±0.4	3.5±0.2	2.3±0.3
Sorghum chaff	8.3±0.2	5.3±0.2	4.3±0.2	2.7±0.2	3.2±0.1	2.3±0.0
Maize chaff	5.9±0.3	4.7±0.1	3.4±0.1	3.3±0.1	2.3±0.0	2.0±0.3
	7.8±0.3	5.3±0.2	4.4±0.5	2.9±0.3	3.5±0.0	1.0±0.0
Control	7.3±0.6	3.4±0.0	5.2±0.4	2.2±0.1	3.7±0.4	1.2±0.1

Key: - =No growth

Table 3: Mean mycelial growth of *Pleurotus ostreatus* (cm) at 10 days, 14 days and 18 days after inoculation in wheat straw and cotton waste substrates supplements with nitrogen sources additives

Natural additives	SUBSTRATES AND ADDITIVE CONCENTRATION					
	1% addition		2% addition		3% addition	
	Wheat straw	Cotton waste	Wheat straw	Cotton waste	wheat straw	Cotton waste
Malted yellow maize	8.7±0.6	1.3±0.1	4.2±0.4	1.0±0.0	4.0±0.0	0.5±0.0
Casein	-	-	-	-	-	-
DL-aspartic acid	8.0±0.3	-	7.8±0.3	-	7.6±0.3	-
Ammonium sulphate	4.7±0.2	-	4.6±0.2	-	3.2±0.1	-
Sodium nitrate	7.3±0.5	-	5.8±0.2	-	5.2±0.4	-
Calcium nitrate	5.7±0.3	-	5.5±0.0	-	4.5±0.2	-
Ammonium nitrate						
Potassium nitrate	4.5±0.3	1.4±0.1	5.9±0.3	0.5±0.0	6.7±0.4	-
L-Histidine						
Yeast extrat agar	2.8±0.1	-	2.5±0.1	-	2.3±0.0	-
Peptone	-	-	-	-	-	-
Urea	-	-	-	-	0.4±0.0	-
Control	1.2±0.1	-	0.5±0.0	-	0.5±0.0	-
	9.2±0.2	-	8.5±0.4	-	7.9±0.5	-
	7.8±0.0	4.7±0.4	6.8±0.2	4.2±0.2	6.8±0.5	4.2±0.3

Key: - =No growth

Table 4: Mean mycelial growth of *Pleurotus ostreatus* (cm) at 10 days, 14 days, and 18 days after inoculation in wheat straw and Cotton waste substrates supplements with carbon sources additives

Carbon Sources	SUBSTRATES AND ADDITIVE CONCENTRATION					
	1% addition		3% addition		5% addition	
	Wheat straw	Cotton waste	Wheat straw	Cotton waste	wheat straw	Cotton waste
D-glucose	7.0±0.3	5.3±0.0	6.7±0.3	4.2±0.2	6.7±0.3	4.0±0.3
Lactose	2.2±0.0	2.3±0.3	0.8±0.0	3.0±0.0	0.2±0.0	4.5±0.0
Maltose	5.7±0.2	5.5±0.2	5.4±0.3	5.0±0.3	5.2±0.4	4.0±0.1
Abrabinose	3.8±0.2	6.6±0.4	3.5±0.3	6.3±0.3	2.8±0.1	6.3±0.2
Malated yellow maize	6.0±0.5	5.6±0.1	5.8±0.1	2.8±0.1	5.5±0.5	1.5±0.0
(The best in Table 2)	9.0±0.6	2.3±0.0	7.3±0.4	2.1±0.2	7.2±0.7	2.0±0.0
Methyl cellulose	5.5±0.3	5.3±0.2	5.6±0.1	5.6±0.4	5.9±6.1	5.6±0.4
D-galactose	5.5±0.0	3.7±0.4	6.2±0.2	3.4±0.1	6.3±0.0	2.0±0.1
Sucrose	8.8±0.2	7.2±0.5	8.0±0.3	6.2±0.2	7.0±0.3	6.0±0.0
D-fructose	5.6±0.4	5.0±0.3	5.0±0.3	4.5±0.5	4.7±0.4	4.2±0.2
Starch	7.5±0.5	5.3±0.2	6.8±0.4	4.2±0.4	6.3±0.3	4.0±0.3
Control						

Conclusion

Sugars could be added to the substrates as natural and synthetic additives in order to enhance mycelial growth of *P.ostreatus* (Florida).

Recommendation

The results obtained in the study could be used in composts formulation for fruit body production of *Pleurotus ostreatus* to boost food production and to increase income generation to our economy.

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