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 *Pleurotusostreatus* (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 squeezed out using a clean muslin cloth. Substrates were boiled and autoclaved and spawn of *Pleurotusosreatus* 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 *Pleurotusostreatus* *u*

Keywords: additives, cotton waste, Pleurotusostreatus, substrates, wheat straw.

INTRODUCTION

Mushrooms have become attractive as nutritional food and are source of pharmaceutical productsprepared either as hot extracts, concentrates or in powdered form (Smith, 2002). The most important use ofMushroom 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, *etal.*, 2007). EdibleMushrooms 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 *etal.*, 2002). It is also beneficial in forest decomposition. The forestrymushrooms are nature's most active agent in the decomposition of forest waste materials (Bahl, 1988; Kadiri*etal.*, 2008). Mushrooms are fruiting structures of large fungi. The function of fruiting body is to produce spores for spawning.*Pleurotusosteratus* (Florida) is an edible oysterMushroom 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*etal.*, 2003).

Mushroom compost is moisturize 30±2⁰C 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 15°C.The soaked cereals were separately

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

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 80⁰C 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±2⁰C 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 gto 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±2⁰C 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 the-e 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 *Pleurotusostreatus* with wheat straw being better.

Table 1: Mean mycelia growth of *Pleurotusostreatus* (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 *Pleurotusostreatus* (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 *Pleurotusostreatus* (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 *Pleurotusostreatus* (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 *Pleurotusostreatus* to boost food production and to increase income generation to our economy.

Acknowledgement

The authors acknowledge Prof. Kadiri, M. of the Department of Biological Sciences, University of Abeokuta, Ogun State, Nigeria for providing the spawn and putting us through in this research work.

References

Akueshi, C.O (1997). *Cultivation and utilization of mushrooms.*

College workshop on Book-keeping and Mushroom propagation, 20th February, 1997, Federal college of forestry Jos. Pp. 17.

Alofe, F.R., Odu B.E and Cilloh, H. (1998).*Mushroom, man and nature.*Edible wild mushroom in ObafemiAwolowo University Campus.*The Nigeria Fields,* 63: 3-18

Bahl, N. (1988). *Handbook on Mushroom* 2nd edition, Oxford and IBH publishing co. Pvt Ltd. New Delhi, Bombay, calcuta pp. 3-80.

Barros, L, Baptista, P., Correia, D., Casel S., OLiveira, B. and Ferreira I. (2007). Fatty acid and sugar compositions and Nutritional value of five wild edible mushrooms from North east Portugal. *Food chem.,* 105:140-145.

Chang, S.T. (1993). In: *Mushroom Biology and mushroom products* (edn). Chang S.T., Buswell, J.A and Chiu, S.W. The Chinese University Press.Hong Kong pp. 3-20.

Fasidi, I.O and Kadiri, M (1993). Effects of sporophore maturity on chemical composition of Volvorielieesculenta (mass) Singer,a Nigerian edible mushroom. *Die Nanhrung,* 37 (3), 269 – 271).

Kashangura, C., Hallsworth, J.E and Mwaska A.Y. (2006). Phenotypic diversity amongst strains of *Pleurotussajor-Caju;* Implications for cultivation in Arid environments, *Mycological Research.* Vol. 110. Issue 3, pp. 313-317.

Kadiri, M., Ahoya, N. and Machambo, J. (2004). Spawn production of *Agaricusbisporus* and *pleurotusostreatus. Biological and Environmental Science Journal for the Tropics*(BEST) 1(1): pp. 9-11.

Kadiri, M., Fasidi, I.O.,Jonathan, S.G., Adenipekun, C.O. and Kuforiji O.O (2008). *Cultivation of edible tropical Mushrooms.* Ibadan University press 1stedt. Pp. 1-21.

Kadiri, M., Kehinde, I.A and Adebgoye, O.T.H (2009).Responses of *LentinusSubnudus*Berk to varying PH and photoperiods.*Nigeria Journal of Sciences,* Vol. 42 (In press).

Kuforiji, O.O, Fasidi, I.O. and Odunta, S.A (2003).Nutritive value of *Pleurotustuber-regium.*Cultivated on different Agro-industrial waste, *Nigerian Journal of Microbiology,* Vol. 17 (1), pp. 63-67.

Musa and Aliyu (2008). Utilization of wheat straw substrate and some additives for production of edible mushroom *Pleurotusostreatus* (florida. *Biological* *and Environmental Science Journal of the Tropics* (BEST), 5 (1): 136-140.

Mau, J.L., Chang, C.N and Chen, C.C. (2002).Antioxidant properties of several medicinal mushrooms.*Journal of Agriculture and Food Chemistry*, 50:6072-6077.

Nwanze,P.L., Ahmeh, J.B and Umoh, V.J(2005). The effects of the interaction of various oil types with different culture media on biomass production of *Psathyrellaatrumbota* (Peyler).*African Journal of Biotechnology* 4:1285-1289

)ei, P. (1996). *Mushroom cultivation with special emphasis on appropriate techniques for developing countries.* Tool Publications Leiden Netherlands. Pp. 1-10.

ei, P. (2005). *Small scale mushroom cultivation.*Agrodoic 40: CTA Pub. Wageningen, the Netherlands, 86p.

latunji, D. (1998) Mushroom production turn wastes to wealth. *The Guardian* (Lagos) 13th December, 1998, pp 22-28.

thak, R., Joshi, R and Dwivedi, R (2009). Eco- friendly production of Agaricusbisporus (Lange) inbach(white button mushroom). *Natural Science* 6: 57-60.

ppe, J. (2010). Use of Agricultural waste material in the cultivation of mushrooms.*Mushroom Science* 15:15-23.

den, J. W. and Schisler, L. C. 1962.Nutrient supplementation of mushroom compost at spawning - *Mush. Sci*. 5:150-164

ıdhyay, R.C, Verma, R.N., Singh, S.K. and Yaday, M.C. (2002).Effects of organic Nitrogen supplementation on *pleurotus* species.*Mushroom Biology and Mushroom Product*. Pp. 225-232.

Zoberi, M.H. (1972). *Tropical Macrofungi.Some common species.* Macmillan press london, pp. 55-116.

Zoberi, M.H. (1973). Some edible mushrooms for Nigeria. *Nigerian field*, 38, 81-90.