STUDIES ON USE OF COTTON WASTE SUBSTRATE AND SOME ADDITIVES FOR THE PRODUCTION OF EDIBLE MUSHROOM *Pleurotus ostreatus* (FLORIDA)

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Abstract: Utilization of cotton waste substrate with some nitrogen, carbon and agricultural additives for the production of an edible mushroom *Pleurotus ostreatus* (Florida) was carried out in Bayero University, Kano, Nigeria. Substrates were soaked in boiled water for one hour and the excess water was squeezed out with the help of a clean muslin cloth. The cotton waste substrate was filled into boiling tubes and autoclaved at 103 kpa. *P. ostreatus* was inoculated into the tubes. The mycelia growth length was measured as from 5 to 18 days after inoculation. The summary of the result indicated that Urea of nitrogen source additive was the best supplement that promoted the mycelia growth of *P. ostreatus* followed by methyl cellulose of carbon source. Yeast extract agar, Casein and Poultry feed additives completely inhibited the mycelia growth of the mushroom. Malted yellow maize, malted sorghum, DL-aspartic acid, D-fructose and methyl cellulose could be used as supplement since they promote mycelia growth of *P. ostreatus*. The results suggest the usefulness of cotton waste substrate for production of mushroom.

Keywords: *Pleurotus ostreatus*, additives, mycelia growth, cotton waste

Introduction

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). Mushrooms have become attractive as nutritional food and are source of pharmaceutical development and medicinal purposes (Smith, 2002; Barros *et al*., 2007). Mushrooms are useful in preventing diseases such as hypertension, hypercholesterolemia and cancer (Mau *et al.*, 2002). Edible Mushrooms have been treated as special kinds of food since earliest times (Oei, 1996). The forestry mushrooms are nature's most active agent in the disposal of forest waste materials (Bahl, 1988; Kadiri *et al.*, 2008). Mushrooms are used in making soup to replace melon in Okra or vegetable soup (Zoberi, 1972, 1973).

Mushrooms are decomposing agricultural by-products (Asami and Seto, 2004). Organic supplements are usually added to substrates to provide organic sources of nitrogen (Upadhay *et al*., 2003). Oyster mushrooms have been preferred by most mushroom growers all over the world because of its flexible temperatures and environmental requirements. It is also said to have more cultivated known species than the other mushroom (Kuforiji *et al*., 2003). Commonly cultivated types of oyster mushroom are *Pleurotus ostreatus*, *Pleurotus sapidus*, *Pleurotus ergi* and *Pleurotus pulmonarius* (Chang, 1993).

Mushrooms have been cultivated on large scale in the United Kingdom, Holland, France, United States, China and Japan (Chang, 1993). Mushroom cultivation in the last decades has extended to some African countries. Akueshi (1997) reported that, in Nigeria there are efforts by the federal Government to popularize the production of mushrooms for revenue earning and with utilization of substrates and food supplements, it is hoped that with time individuals, households and entrepreneurs will embark on the production of Mushroom for exportation from Nigeria to other countries.

Cultures of edible Mushroom and spawn production have been introduced in some research institutes such as the Federal Institute of Industrial Research, Oshodi, Lagos and Federal college of Forestry Jos, Nigeria. Mushrooms can grow wild but pure culture scan only be possible through scientific methods (Olatunji, 1998). The best mushroom production is obtained by inoculating the fungus from pure culture that is isolated from artificial agar medium by means of an aseptic withdrawal of fruiting body fragment placed directly on the agar medium (Kadiri, *et al*., 2009; Musa and Aliyu, 2008).The culture obtained in this way is used as a spawn which is inoculated on the mushroom compost of cellulolytic material which vary from straw of maize, rice, cotton waste and saw dust (Kadiri *et al.*, 2004).

Nutrient supplements such as glucose, peptone, sucrose, rice bran, maize chaff and spent grain are added to substrates to provide organic sources of nitrogen for formation of fruiting bodies in mushroom (Upadhay *et al.*, 2003). Attempt in this study was made to investigate the effects of adding some additives on cotton waste for the growth of an edible mushroom *Pleurous ostreatus* (florida).

Materials and Methods

Collection of substrates

Cotton wastes substrates were collected and treated without any additive and were filled into boiling tubes in triplicates up to 10 cm height each and were autoclaved at 103 kpa for 15 minutes. The autoclaved boiling tubes were inoculated with mycelia discs obtained from culture of *P. ostreatus* using sterilized 5 mm cork borer and a sterilized inoculating needle. The inoculated boiling tubes were incubated in an incubator at 30+ 2^0C 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 of the university. The cereals were malted before being used. This involved soaking of 200 g of each cereal in 250 ml of distilled water for two days in a refrigerator at 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 3 days. Germinated cereals were oven dried at 80^0C for 2 days after which they were powdered with pestle and mortar and the powder was used as additives to the substrates at 10, 20 and 30% additive levels to 90, 80, and 70 g of substrates, respectively. These were filled into 3 boiling tubes and cover with aluminium foil. The control experiment was cotton waste substrate with no additive. All the boiling tubes were autoclaved at 103 pa pressure for 15 min and after cooling inoculation were done using 5 mm mycelia discs of *P.*

ostreatus. The inoculated boiling tubes were incubated at 30 + 2^0C for 10 days, and the linear mycelia extension was measured (Musa *et al*., 2015).

In the case of additives from nitrogen sources, 1, 2 and 3 g was added to 99, 98 and 97 g, of the substrates, respectively. Each preparation was filled into 3 boiling tubes and the boiling tubes were covered with aluminium 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, additives from carbon sources, 1, 3 and 5 g were added to 99, 97 and 95 g of the substrate, respectively. Autoclaving was done as above, the inoculated tubes were incubated at 30+2^0C for 18 days and the linear mycelia growth was measured.

Results and Discussion

Cotton waste was found to be good substrates for mycelia growth (Table 1). The summary of the result (Table 3) indicates that nitrogen additives with cotton waste showed no growth except with malted yellow maize and Ammonium nitrate with mycelia growth of 1.0 ± 0 at 1, 2 and 3% additive levels. 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 2)

Table 1: Mean mycelia growth (cm) ± S.E. of *Pleurotus ostreatus* (Florida) in Cotton waste at 10 days after inoculation

Substrates	Mean mycelia (Growth) length
Cotton waste	7. ± 0.2

Table 2: Mean mycelia growth (cm) ± S.E. of *Pleurotus ostreatus* florida in Cotton waste substrates mixed with agricultural sources as additives at 10 days, 14 days and 18 days after inoculation

Natural additives	Substrates and additive concentration		
	10% addition Cotton waste	20% addition Cotton waste	30% addition Cotton waste
Cow dung	4.7±0.2	2.3±0.2	0.7±0.1
Horse dung	4.7±0.4	2.0±0.3	1.0±0.0
Poultry dung	1.0±0.0	1.0±0.0	1.5±0.2
Yam peels	5.3±0.2	2.1±0.2	1.0±0.1
Rat pellets	5.3±0.4	0.5±0.0	0.3±0.0
Poultry feed	5.7±0.2	4.3±0.2	No growth
Rice bran	5.3±0.4	3.2±0.2	2.3±0.3
Malted millet	6.5±0.5	3.3±0.0	1.3±0.1
Malted sorghum	6.3±0.4	3.6±0.2	1.5±0.0
Malted rice	5.2±0.4	2.3±0.0	1.8±0.2
Malted white maize	5.3±0.2	2.8±0.4	2.3±0.3
Malted yellow maize	4.7±0.1	3.3±0.1	2.3±0.0
Sorghum chaff	5.3±0.2	2.9±0.3	2.0±0.3
Maize chaff			
Control	3.4±0.0	2.2±0.1	1.2±0.1

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

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

Table 3: Mean mycelia growth (cm) ± S.E. of *pleurotus ostreatus* florida in cotton waste substrates mixed with nitrogen sources as additives at 10 days, 14 days and 18 days after inoculation

Natural additives	Substrates and additive concentration		
	1% addition Cotton waste	3% addition Cotton waste	5% addition Cotton waste
Malted yellow maize	1.3±0.1	1.0±0.0	0.5±0.0
Casein	No growth	No growth	No growth
DL-aspartic acid	No growth	No growth	No growth
Ammonium sulphate	No growth	No growth	No growth
Sodium nitrate	No growth	No growth	No growth
Ammonium nitrate	No growth	No growth	No growth
Potassium nitrate	1.4±0.1	0.5±0.0	No growth
L-Histidine	No growth	No growth	No growth
Yeast extract agar	No growth	No growth	No growth
Peptone	Not growth	No growth	No growth
Urea	No growth	No growth	No growth
Control	No growth	No growth	No growth
	4.7±0.4	4.2±0.2	4.2±0.3

Table 4: Mean mycelia growth (cm) ± S.E. of *Pleurotusostreatus* (Florida) in Cotton waste substrates mixed with carbon sources as additives at 10 days, 14 days, and 18 days after inoculation

Carbon Sources	Substrates and additive concentration		
	1% addition Cotton waste	3% addition Cotton waste	5% addition Cotton waste
D-glucose	5.3±0.0	4.2±0.2	4.0±0.3
Lactose	2.3±0.3	3.0±0.0	4.5±0.0
Maltose	5.5±0.2	5.0±0.3	4.0±0.1
Abrabinose	6.6±0.4	6.3±0.3	6.3±0.2
Mlated yellow maize (The best in Table 2)	5.6±0.1	2.8±0.1	1.5±0.0
Methyl cellulose	2.3±0.0	2.1±0.2	2.0±0.0
D-galactose	5.3±0.2	5.6±0.4	5.6±0.4
Sucrose	3.7±0.4	3.4±0.1	2.0±0.1
D-fructose	7.2±0.5	6.2±0.2	6.0±0.0
Starch	5.0±0.3	4.5±0.5	4.2±0.2
Control	**5.3±0.2**	**4.2±0.4**	**4.0±0.3**

Effect of carbon sources as additives on mycelia growth of Pleurotus ostreatus

At 1% 3% and 5% cotton waste supported mycelia growth with arabinose except for lactose (Table 4). As the addition level increased from 1% to 5%, mycelia growth decreased except for lactose which had the opposite trend (Table 4).

Conclusion

Sugars could be added to the substrates as natural and synthetic additives in order to enhance mycelia 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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Conflict of Interest

The authors declare that there is no conflict of interest related to this study.

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