Effect of Interaction of Various Nitrogenous and Ligno-cellulosic Amendments on Biomass Production of Pleurotus Florida

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Abstract

Pleurotus florida, commonly known as oyster mushroom, grows easily on various agricultural wastes, having high content of protein which contains essential amino acids. This study was carried out to determine the optimal parameters for the production of *P. florida* in lateritic zone of West Bengal State in India under uncontrolled environmental condition. Among all the nitrogenous supplementation, saw dust showed maximum bio-efficiency followed by rice bran. Among the interaction study of various oil types, maximum yield on coconut oil followed by sunflower oil amendment was obtained.

1. Introduction

Pleurotus florida, commonly known as oyster mushroom, belongs to the class Basidiomycetes and order Agaricales. They are distinguished by their characteristic umbrella like fruiting bodies, from which they derived the name mushroom. Mushrooms are used as alternative food for decades because of its contents. Mushroom is a good source of protein (nearly 25-50%), also contains fat (2-5%), sugar (17-47%), mycocellulose (7-38%), minerals (8-12%) and vitamins such as D, C, B_1, B_5, B_6, niacin and riboflavin (Adebayo et al., 2007; Miles and Chang, 1986). Mushroom is not only the source of all these food nutrients it also has medicinal values. *P. florida* is widely used as antioxidant and antitumour (Jose and Janardhanan, 2000; Smith et al., 2002). It has been reported that oyster mushroom can grow on several agro-industrial waste materials. Poppe (2004) reported that *P. florida* grows on rice straw, wheat straw, mustard haulms, cotton wastes, sugarcane bagasse, banana pseudo-stem and leaves, waste news paper, barley straw, cardamom pulp, cinnamon leaves, etc. The variation in the production rate and in the pileus size is due to the nutrient status of the substrates used for the cultivation of mushroom. Different workers reported that supplementation of different nitrogenous supplements give better yield response in the production bed. Rice bran, wheat bran and different oil rich supplement like soybean meal, cotton seed meal, etc. were used by different scientists for the same purpose (Upadhyay et al., 2002). Nwanze et al. (2004) works on various aspects of increasing the carpophore size by the addition of different lipid sources in spawn grain and culture medium. The effect of various grains, culture media, oil types and rates on carpophore production of *Psathyrella atroumbonata* was studied by Nwanze et al. (2005). In the present study six different nitrogenous amendments and four different ligno-cellulosic supplements were evaluated for yield response of *P. florida* with an analysis of optimal dose.

2. Materials and Methods

2.1. Production of inoculum

The inoculum was prepared in petri dishes on potato dextrose agar media and the cultures were maintained in test tubes on the same medium. Malt extract medium was also used for the longer preservation purpose (Jonathan et al., 2009).

2.2. Production of spawn

Whole wheat grain was cooked for 15 minutes, drained off extra water and cooled. After cooling, gypsum ($CaSO_4.2H_2O$)

and lime ($CaCO_3.7H_2O$) was mixed thoroughly in 4:1 ration in relation to the grain weight. The grains were then transferred into 12x18 cm clear polypropylene bags @ 150-200 g bag^{-1} and autoclaved for 2 h at 121^{o}C. After sterilization, bags were inoculated with pure cultures of *P. florida* and kept in a dark place at 22-24^{o}C for 2 weeks for complete mycelial growth.

2.3. Preparation of solid substrate with supplementation

Rice straw were cut into nearly 1.5 inches size and washed thoroughly with plain water. Then all the substrates were treated by soaking into solution of bavistin (50 ppm) and formalin (500 ppm) for 16-18 h (Jain and Vyas, 2002). After soaking, the substrates were spread over a clean inclined plain for draining off excess water and filled in the perforated polypropylene bags @ 500 g dry substrates when the moisture content was about 70-80% (Iqbal et al., 2005). As nitrogenous supplement rice (*Oryza sativa*) bran, sawdust, mustard cake (de-oiled seed cake of *Brassica nigr*), linseed cake (de-oiled seed cake of *Linum usitatissimum*), Bengal gram (*Cicer arietinum*) flour and corn (*Zea mays*) flour were used. All the materials were sterilized by soaking separately in 100 ppm carbendazim solution for 16 h (Upadhyay et al., 2002). The rate of addition of supplement was 2 and 5% (dry weight). Coconut (*Cocos nucifera*) oil, sunflower (*Helianthus annuus*) oil, soybean (*Glycine max*) oil and palm (*Elaeis guineensis*) oil were four lingo-cellulosic supplements used @ 0.005, 0.01, 0.015 and 0.02 ml g^{-1}. Ligno-cellulosic supplements were sterilized by autoclaving at 121^{o}C for 10 minutes. All the sterilized supplements were thoroughly mixed with straw substrate at the time of spawning. Those bags were inoculated with mature spawn and kept in the dark place at 22-24^{o}C for complete spawn run. After completion of total spawn run when primordia formation were started the bags were removed to facilitate the growth of the fruiting bodies. As soon as the fruiting bodies were developed and attained their full size, they were cut just above the surface of the substrates.

3. Results and Discussion

3.1. Effect of nitrogenous supplementation

Commercial production of oyster mushroom started very late as compared to *Agaricus bisporus* or button mushroom in world history. Agricultural residues when used as the substrates gave all the nutrients to the fungal biomass. Cellulose, hemicellulose and lignin were the source of carbon to the oyster mushroom. Nitrogen of the cereal straw was released by the action of fungal enzymes (Adejoye et al., 2006; Upadhyay et al., 2002). By the supplementation of nitrogenous materials in the substrates the absorption of nitrogen rich nutrient was easy for the fungal biomass. In the button mushroom cultivation this practice was very common and reported for many years. Present study showed that among all the nitrogenous amendments, sawdust gave maximum yield, 21% more bio-efficiency, followed by rice bran supplementation with 19% more bio-efficiency than controlled substrate (Table 1). Bengal gram flour and green seed cake gave nearly same bio-efficiency of the unsupplemented bag.

3.2. Effect of ligno-cellulosic supplementation

Bio-efficiency of *P. florida* after supplementation of ligno-cellulosic amendments at different rates is shown in Table 2.

Among all the supplements coconut oil showed maximum efficacy (5% more) followed by sunflower oil (3% more). Palm oil supplementation gave negative effect on the bio-efficiency only 0.01 ml g^{-1} supplementation rate showed the same result as of unsupplemented bag or control. Among all the different rates of oil supplementation 0.1 ml g^{-1} supplementation rate was optimum for the production purpose. Above result can be explained by the sterol content of the ligno-cellulosic materials (Nwanze et al., 2005). The main constituent of oil is triglyceride. The saturated fatty acid content in coconut oil is maximum than other three oils. The unsaturated and saturated fatty acid ratio is 0.1 for coconut oil which is minimum among all four.

Table 1: Evaluation of nitrogenous supplementation

Nitrogen supplement	Total yield increase (%) from 2 kg of substrate		Increase (+) / decrease (-) in bio-efficiency (%)		Average weight of sporophores (g)		Number of days taken for complete spawn run
Supplementation rate	2%	5%	2%	5%	2%	5%	
Sawdust	16.6	17.3	+ 20	+ 21	9.8	9.9	23
Rice bran	15	16	+ 18	+ 19	9.9	9.7	24
Bengal gram flour	4.5	6.5	+ 5	+ 8	8.5	8.7	27
Corn flour	7.5	6.2	+ 9	+ 9	8.8	9.1	24
Mustard cake	10.8	12.7	+ 13	+ 15	7.8	7.5	27
Linseed cake	4.16	6.7	+ 5	+ 8	7.2	7.5	28
Control	1,880 g 2 kg-1 substrate		94%		8.1		28

Table 2: Evaluation of lingo-cellulosic supplementation				
A	B	C	D	E
Coconut oil 0.005	- 3.2	- 4	6.6	28
Coconut oil 0.01	+ 3.7	+ 8.6	7.2	28
Coconut oil 0.015	- 4.8	- 6	6.3	30
Coconut oil 0.02	- 8.3	- 11.6	6	32
Sunflower oil 0.005	- 3.7	- 4.8	6.3	29
Sunflower oil 0.01	+ 2.4	+ 3	7	27
Sunflower oil 0.015	- 5.6	- 7	6.1	29
Sunflower oil 0.02	- 9.6	- 12	5.8	29
Soybean oil 0.005	- 6.4	- 8	6.1	30
Soybean oil 0.01	+ 1.2	+ 1.6	6.9	29
Soybean oil 0.015	- 7	- 9.2	6	33
Soybean oil 0.02	- 1`0.8	- 14.6	5.5	35
Palm oil 0.005	- 5.3	- 7.4	6.1	30
Palm oil 0.01	Same as control		6.8	28
Palm oil 0.015	- 8.06	- 10	5.9	32
Palm oil 0.02	- 10.3	- 13.2	5.5	32
Control	1,880 g 2 kg^{-1} substrate	94%	8.1	28

A= Ligno-cellulosic supplementation rate (ml g^{-1}),B=Total yield increase (+) / decrease (-) from 2 kg of substrate (%), C=Increase (+) / decrease (-) in bio-efficiency (%), D= Average weight of sporophore (g), E= Number of days taken to complete spawn run

4. Conclusion

Supplementation of nitrogenous and ligno-cellulosic amendments gave better yield of *P. florida* in lateritic zone of West Bengal. The higher yield gave better economy to the farmer. Cultivation of oyster mushroom using sawdust and coconut oil is a better option due to higher yield and economy to the farmer. It also serves as alternate source of protein at lower rate and has positive effect against protein hunger, vitamin deficiency and malnutrition.

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