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Studies on cellulose utilization pattern of *Pleurotus florida*

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The experiment was carried out to study the cellulose utilization pattern of *Pleurotus florido* grown on paddy straw substrate, Content of cellulose remaining in the paddy straw substrate was measured after 10, 20, 30, 40 and 60 days of spawning. It was noticed that there was no significant change in the content of cellulose in the substrate till 20 days of spawning. Later there was a significant and drastic reduction in the content (mg/g) of cellulose during 30 to 60 days of spawning at different intervals of growth.

Key words : *Pleurotus florida,* rice straw, cellulose utilization

INTRODUCTION

The Indian subcontinent hosts a wide diversity of edible mushrooms. Among them the oyster mushroom, *Pleurotus* finds prominent place. It is very efficient in converting insoluble carbon sources like polysaccharides into soluble forms for its utilization and hence can be easily used for recycling of agricultural waste. Cultivation of *Pleurotus* sp. can play a vital role in uplifting the rural economy in a tribal dominated state like Jharkhand through providing small but sustainable income to the rural household. Although a lot of work has been carried out to standardize the cultivation method of *Pleurotus* throughout the world, more precise work needs to be done to characterize the growth behaviour of mushroom under Jharkhand conditions.

The mushrooms are quite versatile in utilization of carbon compounds. Concentration of carbon source is an important consideration for determining growth of any kind of mushrooms. The role of carbon for the skeletal framework of all organic compounds synthesized by the mushroom is obvious. It should be pointed out that carbon compounds utilized by the mushroom in their nutrition also provide the energy that is required for the fungus to perform in its life activities. The mushrooms, being non-photosynthetic, do not obtain their carbon from carbon dioxide in any amount, but rather from catabolic breakdown of organic compounds. Edible fungi are presently the only organisms that can effectively convert lignocellulose waste materials directly into human food or animal feed. Biological efficiency i.e., the yield of fresh mushrooms in proportion to weight of compost at spawning can reach 200% in oyster mushroom. Lignin, cellulose and hemicelluloses are all utilized in the period from inoculation to the end of cropping. The insoluble compound cellulose is broken down to soluble components by the enzymes secreted by the fungus and then these soluble molecules are taken into the fungus by absorption. Earlier work has indicated a shift from a preferential use of lignin and protein polymers during mycelial growth to the use of cellulose and hemicellulose when fruiting is initiated (Gerrit, 1969) in button mushroom. However, more information in this aspect in case of oyster mushroom (*Pleurotus florida*) would help in developing a better understanding of the interaction between growing media and oyster mushroom

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growth. This information would help in designing efficient oyster mushroom technology for maximizing the yield. Keeping this in view an experiment has been conducted to study the cellulose utilization pattern of oyster mushroom (*Pleurotus florida*) on paddy straw substrate.

MATERIALS AND METHODS

The experiment was carried out at the Mushroom Production Laboratory of Horticulture and Agro-forestry Research Programme (ICAR Research Complex for Eastern Region) Plandu, Ranchi during November, 2003 to January 2004. For determination of cellulose utilization pattern by the mushroom from the substrate at different stages of growth, paddy straw samples from spawned beds were collected (10 samples per bag) from thoroughly mixed content of bag at 10, 20, 30, 40, 50 and 60 day's interval. The content of cellulose was estimated by the following way. One gram of the ground sample was taken in the test tubes and 3 ml of acetic acid : nitric acid reagent (150 ml of 80% acetic acid mixed with 15 ml of concentrated Nitric acid) were added to it and thoroughly mixed. The tubes containing sample and acetic acid: nitric acid reagent was placed in water bath at 100°C for 1 h. Then the tubes were removed, cooled, centrifuged for 15-20 min and the supernatant was discarded. The residue was washed thoroughly by placing on filter paper in Bucchner funnel and washing with distilled water (four times). The washed residue was kept in test tube and 10 ml of 67% sulphuric acid was added and kept for 1 h. One ml of the solution was diluted to 100 ml in volumetric flask. 1 ml of diluted solution was taken in test tube and 10 ml of freshly prepared, chilled anthrone reagent (200 mg of anthrone dissolved in 100 ml of cone. H_2SO_4) was added to it and mixed thoroughly. Then the tubes were heated in boiling water bath for 10 min, cooled and the absorbance was measured in a spectrophotometer at 630 nm. The amount of cellulose present in the sample was determined from the standard graph. The experiment was laid out in Completely Randomized Design. Each treatment (interval after spawning) was replicated thrice (one bag per replication) with 10 units of 10 g sample per replication. The data were subjected to Analysis of Variance (Panse and Sukhatme, 1956).

RESULTS AND DISCUSSION

The enzymatic hydrolysis of cellulose to glucose involves the cooperative functioning of at least three enzymes, namely : an exoglucanase, endoglucanase, and β- glucosidase (Chang and Miles, 1993). The insoluble compound cellulose was broken down to soluble components by enzymes secreted by the fungus and then these soluble molecules were taken into the fungus by the process of absorptive nutrition or osmotropism. The present study was an attempt to characterize the cellulose breaking pattern of *Pleurotus florida* under paddy straw growing medium conditions. The data on the cellulose utilization pattern of *Pleurotus florida* in the

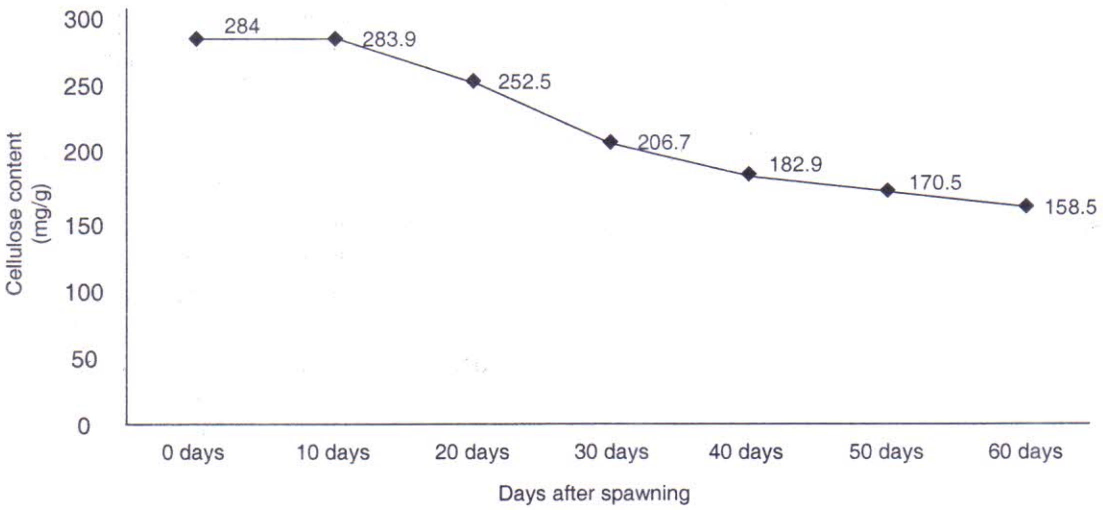

Fig. 1 : Changes in the cellulose content (mg/g) in the paddy straw substrate at different growth intervals of *Pleurotus florida*.

present experiment has been presented in Fig 1. Going through the results obtained, it can be noticed that there was no significant change in the content of cellulose in the substrate till 20 days of spawning. Later there was a significant and drastic reduction in the content of cellulose during 30 to 60 days of spawning. Here it must be noted that during the first 30 days of spawning, only the mycelial growth of the mushroom could be observed. Gerrits (1969) had reported a shift from the preferential use of lignin and protein polymers during mycelial growth to the use of cellulose and hemicellulose when fruiting is initiated in case of *Agaricus* species. The insignificant change in the cellulose content of the substrate during the mycelial growth period in the present study might be attributed to the utilization of the non-cellulosic material like lignin and proteins present in the substrate during this period. However, Xin Cheng *et al.*(1994) had reported a decline in the content of cellulose in the substrate immediately after inoculation, the rate of hemicellulose degradation being greatest during button growth, while that of cellulose was greatest after the first flush.

During the present study, the content of cellulose in the substrate decreased significantly from 30 days onwards. Here it is also noted that, the initiation of fruiting body took place about 30 days after spawning. Hence the shift from the preferential use of lignin and protein polymers during mycelial growth to the use of cellulose and hemicellulose when fruiting is initiated can be attributed to the reduction in the cellulose content during this period. Several workers have reported a direct correlation between the cellulose content and the growth of fruiting body in mushroom (Thomas *et al.*, 1998; Xin Cheng *et al.* 1994; Obodai *et al.*, 2003). However, Vane *et al.* (2001) have observed a comparatively higher rate of decrease of amorphous non-cellulosic poly-saccharides than that of crystalline cellulose in case of *P. ostreatus* on wheat straw substrate. This hinted at a differential carbohydrate utilization pattern by the oyster mushroom on different kind of media.

It is evident from the Fig.1 that 56% of the original cellulose present in the substrate was not consumed during the production of a full crop (after 60 days). Similar finding had also been reported by Royse (1992) where 44% of the original cellulose content was consumed by *Pleurotus sajor-caju* when grown on spent shitake substrate. The composition of the substrate (other than cellulosic material) might have played an important role in cellulose utilization pattern of the mushroom.

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