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Quantitative changes of lignocellulosic components in paddy straw during cultivation of *Volvariella volvacea*

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Volvariella volvacea was found to be poor coloniser of substrate and could utilize complex carbon sources such as hemicellulose, cellulose from straw substrate but not lignin during spawn run and cropping. Utilization of cellulose and hemicellulose increased gradually during spawn run and cropping as well. The fungus lacks the ligninolytic enzyme system. Because of less efficient hydrolytic enzyme system, productivity of *V. volvacea* in the paddy straw was found to be low.

Key words : Lignocellulosic component, paddy straw, *Volvariella volvacea*

INTRODUCTION

Paddy straw is the major lignocellulosic agricultural waste used for cultivation of *Volvariella volvacea* in India. The major components utilized by mushroom fungi from this substrate are complex carbon sources such as cellulose, hemicellulose and lignin. An analysis of the degradation of these carbon sources and production of laccase and cellulase by *V. volvacea* at different stages of spawn run and fructification and their correlation with the productivity were considered necessary to study the utilization of major carbon sources in the substrate.

MATERIALS AND METHODS

The substrate paddy straw was inoculated by *Volvariella volvacea* and the samples of colonised substrate were taken at different stages of spawn run and cropping. The percentage of lignin was determined following the method of Effland (1977) and hemicellulose and cellulose according to method of Sengupta *et al.* (1958).

For determination of mycelium content of colonised substrate, at first the mushroom fungus was grown in liquid medium and the chitin content of the mycelia was determined by the method of Ride and Drysdale (1972). The fungus was found to have 1.70 % glucosamine on dry weight basis. Chitin content of the colonised substrate was also determined following the above method. As the chitin content of the mycelium of *Volvariella volvacea* was known it was possible to determinee the amount of mycelium present in 100 g colonised substrate from its total chitin content.

The cellulase and laccase activity in the colonised substrate were assayed according to Mandel *et al.* (1974) and Sandhu *et al.* (1983).

RESULTS

The utilization of lignin, cellulose and hemicellulose of the substrate by *V. volvacea* at different stages of spawn run and cropping was studied.

Table 1 : Utilization of lignin, cellulose and hemicellulose in the substrate at different stages of spawn run and cropping by *V. volvacea* (g per 100 g dry substrate)

Complex carbon sources	Stages of spawn run and cropping (Day)			
	1-4	5-8	9-11	12 days to 1st flush (15)
Lignin	0.00	0.00	0.00	0.00
Cellulose	0.21	2.23	5.08	4.72
Hemicellulose	0.55	2.18	6.2	6.52

Data are average of five separate determinations

The results in Table 1 showed that in case of *Volvariella volvacea* there was no lignin utilization throughout the stages of spawn run, pin formation and cropping. But utilization of cellulose and hemicellulose was gradual during spawn run phase and cropping.

The activities of laccase and cellulase by *V. volvacea* at different stages of spawn run and cropping were also studied.

In case of *V. volvacea* (Table 2) the activity of cellulase increased upto 11 day during spawn run phase, then it started declining. There was no laccase activity at any stage of spawn run and cropping.

Table 2 : Activities* of laccase and cellulase by *V. volvacea* at different stages of spawn run and cropping.

	Stages of spawn run and cropping (Day)				
Enzyme	0	3	6	9	15
Laccase	0.00	0.00	0.00	0.00	0.00
Cellulase	0.00	0.16	0.17	0.19	0.05

* Activities expressed as unit in relative terms of absorbence at 520 nm.

compounds which can be readily assimilated.

Volvariella volvacca was found to utilize cellulose and hemicellulose throughout spawn run and cropping phases, but was unable to utilize lignin at any stage because of its inability to produce laccase. Similar results were reported by Bushwell *et al.* (1993) in two strains of *V. volvacea* studied by them. Consequently for *V. volvacea* rice straw which is relatively rich in lignin (24 %) besides containing cellulose (35.5 %) and hemicellulose (24.2 %) (Rajarathanam *et al.*, 1997) is not a suitable substrate for growth and colonisation.

It was also found that content of colonized mycelium in the substrate and yeild at the end of first flush in case of *V. volvacea* could be directly correlated with their capacity for utilization of the substrate components (lignin, cellulose and hemicellulose) based on their capacity to produce hydrolytic enzymes (cellulase and laccase). *V. volvacca* was found to be poor coloniser of substrate because of less efficient hydrolytic enzyme system, the production of fruit bodies per unit quantity of substrate was also less.

Table 3 : Comparative utilization of subsrate component, hydrolytic enzyme activity, colonisation of substrate and yield of *V. volvacea* at the end of first flush.

Mushroom fungus	Utilization of substrate component (g per 100 g of dry substrate)			Hydrolytic enzyme activities		Colonisation of substrate	Yield (g per kg)
	Lignin	Cellulose	Hemicellulose	Laccase	Cellulase		
V. volvacea	0.00	4.72	6.52	0.00	0.05	5.91	147

Comparative utilization of substrate component, production of hydrolytic enzymes, colonisation of substrate and yield of *V. volvacea* at the end of first flush were studied.

From the comparative study of the utilization of substrate components, production of hydrolytic enzymes, colonisation of substrate and yield of *V. volvacea* (Table 3) it is apparent that due to the absence of the enzyme laccase this fungus could not utilize lignin so the rate of colonization at the end of first flush was also poor.

DISCUSSION

The major lignocellulosic components of paddy straw are cellulose, hemicellulose and lignin. The growth and cropping of an individual mushroom fungus on a particular lignocellulosic substrate depend on the ability of the mushroom fungus to utilize the major components which depends on ability of the fungus to synthesize hydrolytic enzymes necessary to degrade these complex compounds to low molecular weight simple

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