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CONSTITUENTS OF SUBSTRATES IN RELATION TO SPOROPHORE YIELD OF *Pleurotus sajor-caju*

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Studies were made to find out the factors responsible for the difference in productivity of various substrates. The yield of sporophore was related positively with cellulose content and cellulose : lignin ratio and negatively with the liginin and *ortho*-dihydroxy phenolics content of the substrates.

In India, the amount of cellulosic wastes amount to Ca. 25 million tons (Ghose and Gosh, 1978) and obviously it poses problems of disposal. By the cultivation of suitable mushroom fungi these wastes can be well utilised, recycled and our environment may not be endangered of pollution (Hayes, 1979). *Pleurotus sajor-caju* (Fr.) Singer, oyster mushroom is well suited for such an exploration. The suitability of waste materials for the cultivation of *P. sajor-caju* was investigated. The results indicated that the substrates waste paper, sugarcane bagasse, hulled maize cob and rice straw were highly suitable for sporophore production (Sivaprakasam, 1980). Since there were variations in the yield potentials among the substrates used for cultivation, further studies were made to find out the factors responsible for the difference in productivity of various substrates. The results of investigation are presented in this paper.

MATERIALS AND METHODS

Correlations on the yield of sporophores obtained with the different substrates (Y) and the constituents of substrates viz., cellulose (X_1), lignin (X_2), cellulose : lignin ratio (X_3), nitrogen (X_4), phosphorus (X_5), potassium (X_6), total phenolics (X_7) and *ortho*-dihydroxy phenolics (X_8) contents were made. Cellulose was estimated following the standard procedure of Updegroff (1969). Lignin content was estimated by the method of Kimmins and Wuddah (1977). Estimations were carried out following microkjeldahl's method for total nitrogen, Vanadomolybdate method for phosphorus and flame photometric method for potassium (Jackson, 1973). Total and *ortho*-dihydroxy phenolics were estimated by the methods of Bray and Thorpe (1954) and Johnson and Schaal (1957) respectively. Simple correlations and multiple regression analyses were worked out to find out the relative contribution of each constituent.

RESULTS AND DISCUSSION

There were simple and intra-class correlations between constituents of substrates and yield of sporophore (Tables 1, 2 and 3) The yield of sporophore was correlated positively with cellulose content and cellulose: lignin ratio but negatively with the

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Table : 1 Constituents of substrates in relation to sporophore yield

Sl. No.	Substrates	Yield of sporophore (g) (Y)	Constituents of substrate (dry weight basis)							
			Cellulose % (X_1)	Lignin % (X_2)	C/L ratio (X_3)	Nitrogen % (X_4)	Phosphorus % (X_5)	Potassium % (X_6)	Total phenolics (μg/g) (X_7)	Ortho-dihidroxy phenolics (μg/g) (X_8)
1.	Waste paper	183.70	69.25 (56.32)	0.6 (4.44)	115.42 (12.69)	0.30 (3.14)	0.04 (1.14)	0.13 (2.06)	177.5	17.5
2.	Sugarcane bagasse	176.70	51.75 (46.01)	12.4 (20.60)	4.20 (2.24)	0.31 (3.19)	0.10 (1.81)	0.13 (2.07)	293.5	51.0
3.	Hulled maize cob	173.30	29.25 (32.74)	12.2 (20.43)	2.41 (1.59)	0.45 (3.84)	0.14 (2.15)	0.28 (3.03)	292.5	36.0
4.	Rice straw	163.00	37.26 (37.61)	8.5 (16.92)	4.45 (2.23)	1.00 (5.74)	0.14 (2.14)	0.63 (4.55)	318.0	70.0
5.	Sterilized spent rice straw	89.70	28.50 (32.27)	8.0 (16.40)	3.65 (1.97)	0.95 (5.59)	0.35 (3.36)	0.13 (1.98)	404.5	84.0
6.	Unsterilized spent rice straw	69.70	28.50 (32.27)	8.0 (16.40)	3.65 (1.97)	0.95 (5.59)	0.35 (3.39)	0.13 (2.07)	397.5	87.5
7.	*Delonix* flowers	67.70	23.25 (28.82)	13.6 (21.63)	1.71 (1.33)	1.50 (7.04)	0.23 (5.92)	0.53 (4.17)	395.0	375.0
8.	*Coir* waste	63.30	28.50 (32.27)	18.5 (25.47)	1.54 (1.27)	0.40 (3.60)	0.08 (1.62)	1.60 (7.27)	332.0	233.5
9.	Wood shavings	35.00	49.85 (44.92)	23.5 (29.00)	2.13 (1.55)	0.25 (2.87)	0.10 (1.81)	0.13 (2.01)	343.0	327.5
10.	*Ragi* ears	21.70	21.75 (27.79)	16.0 (23.57)	1.36 (1.18)	1.20 (6.15)	0.25 (2.87)	1.60 (7.28)	392.0	245.3

Data in parenthesis are transformed values.

Table 2. Correlation matrix of sporophore yield with constituents of substrates

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
Y (Sporophore yield)	0.567**	-0.629**	0.504*	-0.359	-0.343	-0.405	-0.348	-0.786**
X_1 (Cellulose content)		-0.435	0.712**	-0.715**	-0.464*	-0.532*	-0.702**	-0.387
X_2 (Lignin content)			-0.826**	-0.212	0.134	0.390	0.159	0.696**
X_3 (Cellulose:Lignin ratio)				-0.364	-0.309	-0.325	-0.511*	-0.443
X_4 (Nitrogen content)					0.666**	0.312	0.695**	0.277
X_5 (Phosphorus content)						0.549*	0.471*	0.393
X_6 (Potassium content)							0.344	0.413
X_7 (Total phenolics content)								0.141
X_8 (*Ortho*-dihydroxy phenolics content)								

*P = 0.05 **P = 0.01

Table 3. Regression coefficient of constituents of substrates in relation to sporophore yield

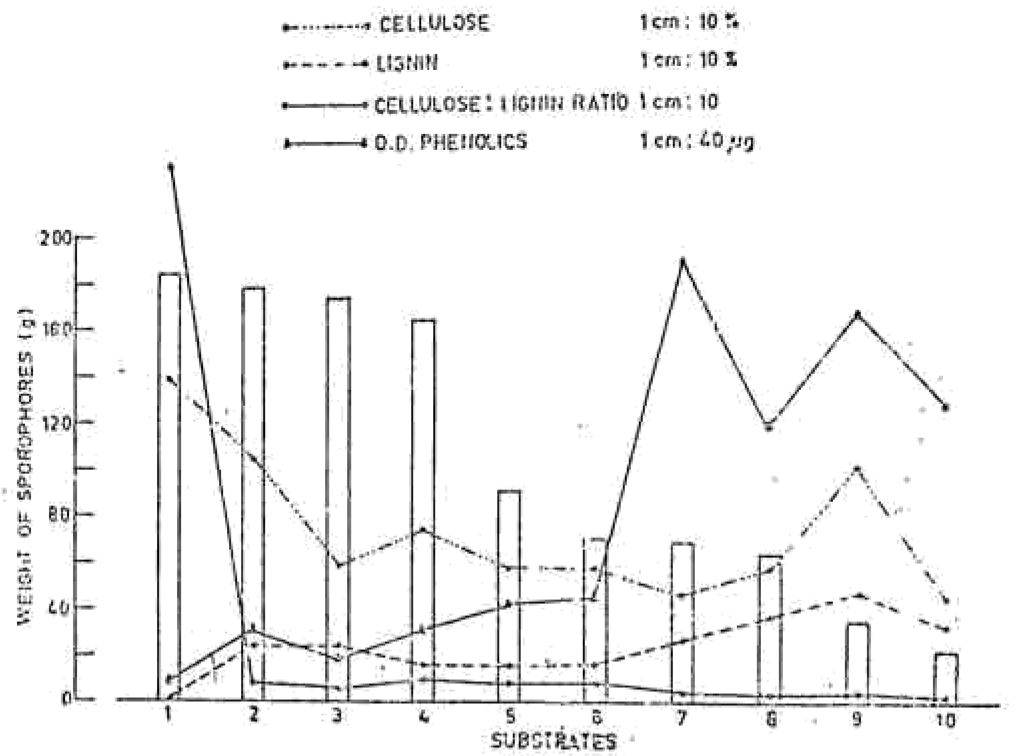
Variables	Partial regression coefficients	Standard error/t	R^2
X_1 (Cellulose content)	3.502	2.196 (1.595)	
X_2 (Lignin content)	—10.086	8.284 (—1.217)	
X_3 (Cellulose : Lignin ratio)	—18.183	13.753 (—1.322)	
X_4 (Nitrogen content)	—10.490	18.077 (—0.580)	0.759
X_5 (Phosphorus content)	5.084	8.020 (0.634)	
X_6 (Potassium content)	7.987	6.874 (1.162)	
X_7 (Total phenolics content)	—0.159	0.159 (—0.998)	
X_8 (*Ortho*-dihyroxy phenolics content)	—0.167	0.203 (—0.820)	

NS
Constant term a=303.207
Figures in parenthesis are 't' values

lignin and *ortho*-dihydroxy phenolics content (Fig. 1).

Cellulose rich organic substances have been reported to be good substrates for the cultivation of mushrooms (Waksman and Nissen, 1932; Gerrits and Muller, 1965; Quimio, 1987.)

FIG CONSTITUENTS OF SUBSTRATES IN RELATION TO SPOROPHORE YIELD



High cellulose content would result in enhanced cellulose enzyme production (Norkrans, 1967) and the enzyme production was positively correlated with the yield of sporophores (Ramasamy and Kandaswamy, 1976).

Lignin was also found to affect the activity of cellulases (Dhillon and Chahal, 1978). The substrates with high lignin and phenolics content like *coir* waste decreased the activity of cellulases (Sivaprakasam, 1980). Substrates with less lignin would favour increased enzymatic activity with higher yields of sporophores.

Lignin degradation by the mushroom fungus would result in increase of phenolics (Kirk, 1971; Feniksova *et, al.*, 1972) and polyphenol oxidases (Ander and Eriksson, 1977). Phenols are toxic to microorganisms including fungi (CruicK-shank and Perrin 1964).

As many of the substrates were rich in phenolics, Eusebio (1969) advocated the hot water extraction for removal of the toxic phenol. It is well known that phenolics interfere in the activity of various enzymes produced by fungi (Singh and Chand, 1969) as well as cellulases (Mandels and Reese, 1965). Phenolics like catechol and resorcinol reduced the activrty of cellulases (Sivaprakasam, 1980) However, the inhibition was observed more at 500 and 1000 ppm which concentration is not present in the substrates. On the other hand, even at low concentration oxidised phenolics are more inhibitory (Lyr, 1966; Hunter, 1974). That the oxidation products of phenolics like quinone and melanins interfere with the normal metabolism of microorganism has been reported by Hoffman-Ostenhof (1963).

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