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RESEARCH ARTICLE

STUDIES ON CULTIVATION AND BIOLOGICAL EFFICIENCY OF MUSHROOMS GROWN ON DIFFERENT AGRO-RESIDUES

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Abstract
The several white rot fungi are edible mushrooms and are saprophytic basidiomycetes, which have been successfully cultivated at commercial level worldwide using lignocellulose wastes as substrates for their cultivation. *Pleurotus* species is a wood digesting fungi, which was first cultivated on logs. Today it has become practice to prepare *Pleurotus* substrate from shredded wheat straw. Present paper discusses biochemical analysis and cultivation of *Pleurotus* species on soybean straw. The *Pleurotus* species was cultivated on different agro-wastes viz. soybean straw, paddy straw, wheat straw and their combination in 1:1 proportion to determine the effect of these agro waste on yield, moisture content, crude protein, total carbohydrates, fat, crude fiber, ash and minerals like Ca, P, Fe content. *Pleurotus eous* has highest percentage of protein content i.e 46% followed by *Pleurotus sajar caju* and *Pleurotus florida.* The fat content of three different species indicates that *Pleurotus florida* has highest percentage of fat content 1.9% as compared to *Pleurotus Sajar caju* (1.7%) and *Pleurotus eous* (1.2%). The crude fibers of all species are shown in table-2 *Pleurotus eous* has highest crude fiber (12%) as compared to *Pleurotus florida* (11.5%) and *Pleurotus sajar caju* (10.9%). The highest mineral concentration was found in case of *Pleurotus eous* as compare to *Pleurotus sajar caju* and *Pleurotus florida* when grown on soybean as substrate. The higher mineral content of *Pleurotus eous* makes it suitable for food supplement in diet.

Key Words: *Pleurotus,* Mushroom, Agro-residues, Nutritional value

Introduction

The bioconversion of agriculture and industrial wastes into food has attracted the world attention in recent years. There is a greater demand for the available world supplies of food and second are the prices of those foods that are increasingly steeply. The obvious ways to meet the situation are to improve the current food production yield. The mushroom cultivation is a highly efficient method of disposing of agricultural residues as well as producing nutritious food **(**Chang *et al*., 1998).

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Mushrooms are large reproductive species of edible fungi belonging to either *Ascomycotina* or *Basidiomycotina.* Mushrooms are heterotropic and depend upon the organic matter for nutrition and live saprophytically or parasitically or symbiotically on or with other organism. They can be found living on wood, leather, fur, hay, grass, paper, various straw etc (Balkrishnan and Nair, 1995; Pani and Naik, 1998**;** Yiliz, 1999**)**.

Mushrooms have been used since early ages by man as food or medicine. It is rich source of minerals (Patrabansh and Madan, 1997), antibacterial activity (Benedict and Brandy, 1972**)** and antitumourous or anticancerous activity. There is a greater demand for the available world supplies of food and second are the prices of those foods that are increasingly steeply. The obvious

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The mushroom cultivation is a highly efficient method of disposing of agricultural residues as well as producing nutritious food **(**Chang *et al*., 1998).The *Pleurotus* species also called as "Oyster mushrooms" or Dhingri now ranks second among the cultivated mushrooms in world (Chang and Miles, 1991). These studies mainly concentrated on the cultivation on wastes of forest and agricultural plants. Almost, all the available, lignocellulosic substances are likely is used as substrate for *Pleurotus sp*.

The present study deals with the cultivation of *Pleurotus sp*. on some common and abundantly available waste available for conversion in food which otherwise is left for natural degradation.

Materials and Methods

The different *Pleurotus* species viz. *Pleurotus Sajar caju* were obtained from Shri Shivaji College, Amravati; *Pleurotus florida* (Dr. Panjabrao Krishi Vidyapeth, Akola) and *Pleurotus eous* (Mahatma Phule Krishi Vidyapeth, Rahuri) and the soybean straw was collected from local agricultural field.

The substrate straw was sun dried and chopped into small bits (1-2 cm long), was soaked in water for about 18-24 hours and then boiled in water for 2 hrs and it is cooled to ambient temperature and excess of water was drained out to moisture 70 % (Zadrazil, 1978).The above prepared substrates was used for spawning with mushroom and the different substrate were taken in 1:1 ratio. The procedure adopted by Pal and Thapa (1979) and Jandaik (1976) had been followed for cultivation of *Pleurotus* species. The autoclavable (121^0C for 30 min.) polythene bags were used for above purpose.

The soybean straw was laid to height of 5-6 cm and grain spawn of each species was broadcasted on this straw layer. Like wise 5-6 layers of spawn were spread in these bags. The bags were tied up perforated with needle at regular intervals of 9 cm for gaseous exchange. The 10 g of each spawn was used for 500 g of substrate. The laboratory was kept free from contaminant by spreading the disinfectants solution with diffused light and 85% humidity.

Approximately 10 days after inoculation the mycelium growth takes place. The bags were opened and after 2-3 days site indicating the formation of fruiting bodies of mushrooms were noted. After 15-18 days the complete growth takes place. When the fruiting bodies developed the mushrooms or fruiting bodies were harvested at once and 2 and 3 flush were collected after the interval of 8 days. The cleaned mushrooms were sun dried and further preserved in polythene bags.

The total yield was determined by taking the weight of mushroom obtained after 1 st, 2 nd and 3 rd flush. The dried mushrooms were used for further biochemical analysis, which was carried out by standard procedures.

The reducing sugar was determined by DNS method, protein by Folin Lowry method, fat by ether extraction method in Soxhlet, crude fiber (Cellulose 97% and Lignin 4 - 6%) by acid and subsequent alkali treatment oxidative hydrolytic degradation of native cellulose and lignin. The residue is obtained incinerated, cooled and weight gives fiber content.

Results and Discussions

The total yield was estimated on the basis of 500 g dry substrate by measuring the fresh and dry weight. The results are presented in Table 1 indicate the total yield of *Pleurotus eous* gives the highest yield in terms of fresh wt 383.91 g and dry weight 57.92 g as compared to *Pleurotus Sajar caju* and *Pleurotus florida* and its biological efficiency was highest i.e 11.58%. The total reducing sugars in dried powder of all *Pleurotus* sp. when cultivated on soybean straw indicate that *Pleurotus eous* has highest percentage of reducing sugars 34% followed by *Pleurotus florida* and *Pleurotus sajar caju.*

The total protein content estimated in dry powder of all *Pleurotus* species cultivated on soybean straw indicate that *Pleurotus eous* has highest percentage of protein content i.e 46% followed by *Pleurotus sajar caju and Pleurotus florida.* The fat content of three different species was given in

Table 2 indicates that *Pleurotus florida* has highest percentage of fat content 1.9% as compared to *Pleurotus Sajar caju* (1.7%) and *Pleurotus eous* (1.2%).The crude fibers of all species are shown in Table 2 *Pleurotus eous* has highest crude fiber (12%) as compared to *Pleurotus florida* (11.5%) and *Pleurotus sajar caju* (10.9%).

Table 1. Total yield

No	*P. Sajarcaju* (g)		*P. florida* (g)		*P. eous* (g)	
	Fresh weight	Dry weight	Fresh weight	Dry weight	Fresh weight	Dry weight
1st flush	198.26±0.02	26.00±0.01	175.82±0.06	21.03±0.03	214.73±0.65	31.05±0.03
2 nd flush	73.97±0.21	14.17±0.42	83.37±0.34	16.53±0.46	104.01±0.78	20.15±0.23
3 rd flush	31.40±0.24	3.2±0.033	24.02±0.45	2.17±0.62	65.07±0.32	6.72±0.02
Total yield	303.63±0.01	43.37±0.021	283.21±0.01	39.73±0.01	383.81±0.24	57.92±0.01
Biological efficiency (%)	60.72	8.67	56.64	7.94	76.76	11.58

Table 2. Total Sugar, Fat, Protein and fiber contents

Total content (%)	*P. sajor caju*	*P. florida*	*P. eous*
Sugars	22	30	24
Protein	42	22	46
Fat	1.7	1.9	1.2
Crude fiber	10.9	11.5	12

The highest mineral concentration was found in case of *Pleurotus eous* is compare to Pleurotus *sajar caju* and Pleurotus *florida* when grown on soybean as substrate. The higher mineral content of *Pleurotus eous* makes it suitable for food supplement in diet (Table 3).

Table 3. Total mineral content

Minerals (g)	*P. sajor caju*	*P. florida*	*P. eous*
Ca	35.03	23.06	35.90
P	602	448	608
K	2146	2350	2620
Na	220	139	227
Mg	195	220	229
Fe	18.76	17.96	20.16
Mn	3.4	3.6	4.1
Zn	2.6	2.3	3.1

Reports on cultivation of the oyster mushroom on similar by-products have manifested variable levels of B.E. These variations are mainly related to spawn rate, fungal species used and supplement added to the substrate (Mane *et al.*, 2007). Some of the elevated B.E. of *Pleurotus sp.* on commonly

used substrates rice straw 85.5% (Mehta *et al.* 1990), leguminous plants 103.8% (Sharma and Madan 1993).

Commercial production of oyster mushrooms is largely determined by the availability and utilization of cheap materials of which agricultural lingo-cellulosic waste represents the ideal and most promising substrates for cultivation. The substrates used in this study can be considered practical and economically feasible due to their availability throughout the year at little or no cost in large quantities. Utilization of these agro-wastes for the production of oyster mushrooms could be more economically and ecologically practical.

Conclusion

Mushrooms are rich in protein but poor in fat i.e lipid and good amount of reducing sugars. In the present study, all the species of *Pleurotus, Pleurotus Sajar caju, Pleurotus florida* and *Pleurotus eous* gives better yield when cultivated on the soybean straw. The *Pleurotus eous* shows the higher biological efficiency as compared to other species.

The biochemical analysis indicates *Pleurotus eous* contain higher percentage of proteins, crude fiber and reducing sugar and lower percentage of fat when cultivated on soybean straw. Thus the present investigation recommended that *Pleurotus eous as* good supplementary diet obtained from soybean agricultural wastes.

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