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The effects of different substrates on the nutritional composition of oyster mushrooms (*Pleurotus sajor-caju*)

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Abstract
Oyster mushroom were cultivated in controlled environment using different agricultural and forest waste. Experiment were conducted using six treatments *viz.* S1 (Red gram straw) S2 (Wheat Straw) S3 (Fallen leaf of Gum arabic tree + Custard apple+ Teak), S4 (Rice bran) S5, (Soybean straw) and S6, (Fallen leaf of Palash + Teak). The average yield of Mushroom produced on each bed was noted. It is observed that the dry weight of mushroom cultivated on substrate S6 (Fallen leaf of Palash + Teak) was found more followed by mushroom cultivated on treatment S1 (Red gram straw) (76gm) than the rest of the treatments. Biochemical study revealed that moisture percent was found highest in mushroom cultivated on paddy straw (35.83%) whereas lowest moisture percent was noted in mushroom grown on (S6) fallen leaf of Palash and Teak (31.68%). The crude fiber percent was found highest (18.63%) in mushroom grown on treatment S2 (Wheat straw) and was noted low (8.76%) in treatment S1 (Red gram straw) mushrooms. The ash percent was highest in mushroom grown on treatment S6 (10.66%) and lowest in mushroom obtained on treatment S5 (5.38%). The highest protein content was measured in mushroom produced on treatment S4 (12.24 mg/ml) and was found lowest for treatment S2 (10.28 mg/ml) The protein content was varied in mushroom grown on different treatment and was found in the range of (12.20 – 10.35 mg/ml). This study revealed that the oyster mushrooms grown on different straw were differ in nutritional composition although belongs to same genus.

Keywords: Palash leaf, crude fibre, leaf of teak, red gram straw

Introduction
Oyster mushroom (*Pleurotus* sp.) belonging to class Basidiomycetes and Family Agaricaceae is popularly known as 'dhingri' in India and grows naturally in the temperate and tropical forests. *Pleurotus sajor-caju* is commonly cultivated species of these mushrooms and it is also wel known for flavour and test (Zhang *et al*., 2002) [14]. They are also rich source of protein, mineral and vitamin (Caglarirmak, 2007) [2]. Mushroom normally contains 19-35% protein where as fat% is very low as compare to protein and carbohydrate (Wani, 2010) [13]. Agriculture and forest wastes can be use as a substrate for oyster mushroom cultivation. Agro-forest wastes contain lignocellulosic material which is best material for solid state fermentation of edible fungi such as *P. sajor-caju* Oyster mushroom can grow on sawdust, rice and wheat straw and other agro-waste. Observed a remarkable variation in nutritional content of oyster mushroom in different substrates (Sarker *et al.* 2007) [11].

In Maharashtra, *Pleurotus* spp. are the most commonly cultivated mushrooms. These are generally cultivated on agricultural waste materials. The potentials of using forest waste materials like fallen leaf of custard apple, gum arabic tree, teak, palash tree etc. Have not been exploited so far. These materials are available in our forests as well as in rural areas. It is against this background the present study was undertaken. In present investigation growth and nutritional composition of *Pleurotus sajor-caju* was studied using six different treatments and biochemical characteristics of oyster mushroom was assessed.

Materials & methodology
Present investigation carried out in Vasantrao Naik college of Agricultural Biotechnology, Yavatmal, Maharashtra. Spawn culture was collected from Radhakrishna Mushroom Production Center, Darda Nagar, Yavatmal.

Treatments

In present study, oyster mushroom were grown on six different substrates *viz*: wheat straw, fallen leafs of Gum arabic tree, teak and custard apple), red gram straw, soybean straw, rice straw, fallen leaf of teak and scared leaf straw, These materials are easily available and economically cheap. Accordingly substrates were catergorised using different combination and six treatments were designed as follows-

Table 1: Treatments

Sr. No	Treatments	Substrate
1	S1	Red gram straw
2	S2	Wheat Straw
3	S3	Fallen leaf of Gum arabic tree +Custard apple+ Teak
4	S4	Rice bran
5	S5	Soybean straw
6	S6	Fallen leaf of palash + teak

Sterilization

All the substrates were collected and separately autoclaved at 121ºc, 15psi for 20min. Autoclaved straw soaked in formaldehyde (100 ml/10 lit water) for 15min. After formaldehyde treatment straw again soaked in mixture of bavistin (2gm/10 lit water) for 15 min and then washed with water.

Spawning

At the time of bag filling substrate moisture content was 60-70%. 35 X 50 cm bags were used for its cultivation. Spawning was done by method of layer spawning. About 250-300 gm spawn (seeds) were used for 10-14 kg wet straw. Spawned bags were stacked on racks in neat and clean place, in closed position. Room temperature was maintained between 25-35% and humidity was maintained between 70-90% by spraying water on floor.

Cropping and harvest

After 22-23 days, all the bags were fully covered with white mycelium of *P. sajor Caju* and polythene covers were removed. The open blocks were kept on racks about 30 cm apart with gap of 60-70 cm between two shelves. Mushrooms were grown in a temperature range of 20-33 ºC. Relative humidity was maintained by spraying water twice a day on the walls and floor of the room. Relative humidity was measured by hygrometer. Humidity was maintained in room ranges between 70-90%. A light spray of water was given on blocks as soon as the small pin heads appeared. Once pinheads were 2-3 cm big a little heavier watering was done on blocks and watering of blocks was stopped to allow them to grow. Mushrooms were plucked before they shed spores to maintain quality. After 1st flush of harvest, 0.5 to 1 cm outer layer of the block was scrapped. This helped to initiate 2nd flush which appeared after 10 days. After harvesting they were dried in morning sun rays at 7-8 am. After mushrooms were fully dried they were packed into perforated polythene bags to keep them fresh.

Biochemical Analysis of cultivated mushrooms

Determination of Moisture The moisture content is determined by measuring the of a material before & after the water removed by evaporation Moisture content was determined using following formulae –

- %Moisture =initial –dried/initial *100 (Randive, 2012) [10]
- Protein content was measured by biuret method, (Burtis and Ashwood, 2006 & Randive, 2012) [10], Crude fiber was analyzed by AOAC method (2005) [1], Moisture and ash content analysed by AOAC method (2005) [1].

Results

Growth of Oyster mushroom showed varied growth on all the six selected treatments (Fig. 1). The matured fruit bodies were harvested 21-22 days after cultivation and average weight was taken from per bed harvested mushroom as depicted in table no.1 & fig 1. The results are given as follows:

Fig 1: Comparative difference between mature fruit bodies of oyster mushroom

Table 2: Average weight of dried mushroom grown on six different substrate

Sr. No	Name of the substrate			Weight of Dried Mushroom (gm)
1	S1	Red gram straw		76
2	S2	Wheat Straw		48
3	S3	Fallen leaf of Gum arabic tree + Custard apple+ Teak		65
4	S4	Rice bran		70
5	S5	Soybean straw		69
6	S6	Fallen leaf of palash + teak		94

From Table 2. It was observed that the dry weight of mushroom cultivated on substrate S6 (Fallen leaf of Palash + Teak) was found more (94 gm) followed by mushroom cultivated on treatment S1 (Red gram straw) (76gm) than the rest of the treatments. Whereas the weight of mushrooms isolated from beds with rest of the treatments showed weight range between 48 to 70gm.

Table 3: Biochemical analysis of oyster mushroom grown on different substrate

Sr. No	Oyster mushroom grown on Different substrate		Parameter			
			Moisture%	Ash%	Protein mg/ml	Crude fibre%
1	S1	Red gram straw	32.49	8.44	12.01	8.765
2	S2	Wheat straw	32.91	6.87	10.28	18.63
3	S3	Fallen leaf of Gum arabic tree + Custard apple+ Teak	32.03	8.36	10.35	14.29
4	S4	Rice bran	35.83	7.17	12.24	11.98
5	S5	Soybean straw	33.87	5.38	12.20	10.56
6	S6	Fallen leaf of palash + teak	31.68	10.66	11.74	18.32

Moisture content:
Mushroom cultivated on red gram straw (S1), Wheat straw (S2), Fallen leaf of gum arabic tree (S3), Rice bran (S4), Soybean straw (S5) and fallen leaf of palash + teak (S6) as substrate showed good growth of mushroom on its surface.

Fig 2: Moisture content in mushroom grown on six different substrate

Mushroom cultivated on Palash + Teak showed lowest moisture % (31.68%) and Mushroom grown on paddy straw (S3) showed highest moisture % (35.83%). Remaining straw showed moisture% in the range of 32.49-33.87% as depicted in table 3 & fig.2.

Ash content
Mushrooms cultivated on fallen leaf of teak and palash straw (S6) showed highest ash % (10.66%) and soybean straw (S5) mushrooms showed lowest ash % (5.38%) as given in table 3.

Crude fibre content
- Mushrooms cultivated on (S1) Red gram straw showed lowest crude fiber % (8.765) and wheat straw (S2) mushrooms showed highest (18.63%) crude fiber % given in table 3.

Protein content
The highest protein content was measured in mushroom produced on treatment S4 (12.24 mg/ml) and was found lowest for treatment S2 (10.28 mg/ml) The protein content was varied in mushroom grown on different treatment and was found in the range of 12.20 – 10.35 mg/ml (Table 3).

Discussion
In present study, mushroom cultivated on different agricultural and forest wastes. Rajini Bisaria *et al*., (1987) [9] cultivated *Pleurous sajor caju* on different agro wastes like paddy straw, wheat straw, banana leaves, maize stalk etc and they have reported variable mushroom on production. Mondal (2010) [7] reported that used wide range of plant wastes and it does not require costly processing method and enrichment material. Fallen leaf of teak, gum arabic tree and custard apple supported good mycelial growth of *P. sajor- caju.* As Guptha and Singh (2004) [5] reported Teak leaf contain Jugloan compound with antimicrobial activity but in our investigation Teak leaf along with Palash leaf showed good growth of mushroom on substrate. In biochemical analysis four parameters were evaluated viz Moisture, ash, protein and crude fibre. Patrabansh and Madan Moisture content observed between the ranges of 31.68-35.83% in the fruiting bodies of *P.sajor-caju.* Patrabansh and Madan (1997) [8] observed moisture content in the range of 31.65-33.81%. Ash content near about the range observed by Chang et.al (1981). The content of crude fibre varied from 8.76%-18.63% in the fruit bodies of P. sajor-caju cultivated on different agro-forest waste. %. Protein content were measured by Biuret test and observed between 9.28-12.24mg/ml. Randive (2012) [10] reported that in fruit bodies of oyster mushroom protein content were observed on mushroom grown on paddy straw was more compare to wheat straw similar result observed in present study. Patrabansh and Madan (1997) [8] observed variation in the range of crude fibre percentage (12.70-18.01%) in the fruit bodies of *P. sajor-caju* cultivated on different organic waste.

Conclusion
Oyster mushrooms subjected to all the six selected substrates and their combination were found varied in their nutritional composition although they are of same genus (*Pleurotus sajor-caju). Pleurotus sajor-caju* cultivated on different substrates is qualitatively rich in essential nutrient such as high protein, crude fibre, moisture percent and ash percent. The main aim of this study was to find out the economically feasible and easily available substrate for mushroom cultivation in remote areas of the country. This research concluded that for more sustainable and high productivity cheap and easy availability of substrate for cultivation of mushrooms in tribal areas like Melghat fallen leaves of teak and palash could be a better alternative.

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