

EVALUATION OF MUSHROOM TYPES SUITED FOR KUTTANAD THROUGH PARTICIPATORY TECHNOLOGY DEVELOPMENT

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ABSTRACT

The present study was undertaken with a view to evaluate mushroom types best suited for cultivation in Kuttanad during rainy and summer seasons based on Participatory Technology Development (PTD), nutrient analysis and consumer survey. Results confirmed that pink oyster, *Pleurotus eous* (875.5 g/bed) was significantly superior in mean yield over *Pleurotus florida* (786 g/bed) and *Pleurotus sajor-caju* (671.7g/bed). During the rainy season (July- August 2012), highest biological efficiency (87.5%) was exhibited by *Pleurotus eous* compared to *Pleurotus florida* (78.6%). Mean yield of pink oyster (790 g) was on par with milky mushroom *Calocybe indica* (800g). Nutrient analysis of different types of mushroom harvested from different types of substrate revealed that pink oyster was nutritionally better as it contained lower carbohydrate, higher protein and highest dietary fibre compared to *Pleurotus florida*, *Hypsizygus* sp. and *Pleurotus sajor-caju*. Mineral content was also optimum when compared to other mushrooms under study with a good amount of potassium (2800 ppm). In the comparative analysis of nutrients of different mushroom types grown on steam sterilized paddy straw, concentration of proximates like carbohydrate (15%) and fibre (3.4%) was maximum in pink oyster when compared to *Pleurotus florida* and *Pleurotus sajor-caju*. With regard to mineral content also, *Pleurotus eous* showed maximum concentration of magnesium (174 ppm) and zinc (16.9 ppm). In consumer survey, pink oyster ranked second in consumption (56%) and was mainly due to its less availability when compared to *Pleurotus florida*. Based on the PTD trials, nutrient analysis and consumer survey, pink oyster- *Pleurotus eous* can be recommended for cultivation in Kuttanad region of Kerala for both rainy and summer seasons. *Pleurotus florida* also can be recommended for rainy season and *Pleurotus eous* and *Calocybe indica* for summer season of Kuttanad.

Keywords: Kuttanad, nutrient analysis, proximate, minerals.

INTRODUCTION

Kuttanad is a special agro ecological zone representing the water logged lands spread over 69 panchayaths of Alappuzha, Kottayam and Pathanamthitta districts of Kerala state. Large area of this land is below, at, or just above mean sea level. Climate is tropical humid monsoon type with a mean annual temperature of 27.6 °C and rainfall 2746 mm. Humidity in general is very high. Wet lands of Kuttanad, the rice bowl of Kerala stretch over an area of 35,500 ha where rice is cultivated. Total production of rice vary from 1.6 lakh tons to 1.75 lakh tons and straw from 2.25 lakh tons to 2.5 lakh tons. Usually this large quantity of straw is left in the field for incorporation in the soil. A viable alternative for Kuttanad farmers for recycling of agro waste into protein rich food is mushroom cultivation. Hence, the present study was undertaken with a view to evaluate mushroom types best suited for cultivation in Kuttanad during rainy and summer seasons based on Participatory Technology Development (PTD), nutrient analysis and consumer survey, since no previous work has been conducted so far in this regard.

MATERIALS AND METHODS

Identification of Mushroom Types Suited For Kuttanadu

Mushroom varieties used for PTD Trials were shown in Plate 1



1. *Pleurotus florida* (white oyster)

2. *P. eous* (pink oyster)

3. *Hypsizygus* sp (blue oyster)



4. *P. sajor-caju* (Grey oyster)



5. *Calocybe indica*

Plate 1. Mushroom varieties used
Identified by Dr. D. Geetha , Professor, College of Agriculture, Vellayani

Rainy Season: Ten farmers from Alappuzha and Pathanamthitta districts who were engaged in mushroom cultivation for over two years were selected based on the recommendation of the Agricultural officer of the concerned Krishi Bhavan. Varieties used are given in Plate 1. The experiment was laid out in Complete Randomised Design with three treatments and six replications under natural conditions. 10 beds were used for each variety. Chemically sterilized paddy straw was used. Weight of each mushroom bed was fixed as 1 kg of dry substrate. They were prepared as per the standard procedure of multilayered spawn running technique. Mushroom beds were kept in a mushroom shed of length 6m and breadth 4m. Polythene bags were removed after completion of spawn running stage. Observations on yield, number of days for spawn running, days for first harvest, interval between first and second harvest, cropping period, mean maximum temperature and relative humidity of the shed were recorded. Data was tabulated, statistically analysed and inferences were made.

Summer Season: The experiment was laid out in Completely Randomised Design in 10 locations with five treatments and six replications under natural conditions. Trial was also conducted at research station. Observations recorded were same as above. Data was tabulated, analysed statistically and inferences were made.

Nutrient Analysis

Nutritional analysis of mushrooms grown on chemically sterilized paddy straw and also from different substrates like paddy straw, rubber wood saw dust, banana pseudostem waste were conducted at the Quality Control Lab of Central Institute of Fisheries technology, Kochi on payment basis. AOAC methods were followed . Proximates like carbohydrate, fat, protein, fibre and mineral like sodium, potassium, calcium, magnesium, iron, molybdenum, selenium and zinc were analyzed.

Consumer Survey

A consumer survey was conducted with a sample size of 100 among the mushroom farmers of Kottayam and Alappuzha districts of Kuttanad for assessing the preference in terms of consumption. Beneficiaries were selected from the consumers of mushroom farmers who were members of Mushroom Club, RRS, Moncompu.

RESULTS AND DISCUSSION

PTD trials: The Rainy Season (June-July, 2012)

Data on yield and biological efficiency of mushrooms under study i.e. *P. florida*, *P. eous* and *P. sajor-caju* are given in Table 1. From table 1, it was observed that pink oyster *P. eous* gave the highest mean yield of 875.50g/ bed and was significantly superior over *P. florida* and *P. sajor-caju*. The same result was also obtained with biological efficiency *P. eous* ranked first (80.5%).

Table 1. Yield and biological efficiency of mushrooms

Sl.No	Mushroom	Yield (gm)	Biological efficiency (%)
1	<i>Pleurotus florida</i>	786	78.6
2	<i>Pleurotus eous</i>	875.50	87.5
3	<i>Pleurotus sajor-caju</i>	671.33	67.1
	CD value	79.01	7.9

Mushroom shed characters: Mean Maximum Temperature of the shed inside 24±2 °C,
Mean Relative Humidity: 90%

With regard to the period for completion of spawn running, *P. eous* took the least time i.e. 10 days after bed preparation followed by *P. florida* with 10 days as evidenced from Table 2. Pink oyster took the least time for attaining first harvest also ie 12 days after bed preparation. Time interval between first and second harvest was the least for *P. eous* (6 days) followed by *P. florida* i.e. 7 days. From the results of the PTD trial, pink oyster can be recommended for rainy season cultivation in Kuttanad.

Table 2. Other observations of PTD trial

Sl. No.	Varieties	No. of days for spawn running	Days for 1 st harvest	Interval between 1 st and 2 nd harvest (days)	Interval between 2 nd and 3 rd harvest (days)	Cropping period days
1	<i>Pleurotus florida</i>	16	19	8	6	47
2	<i>Pleurotus eous</i>	10	12	6	7	46
3.	<i>Pleurotus sajor-caju</i>	20	25	10	8	43

* Spawn used: First generation

For Summer Season

Data from farmer's field were not satisfactory due to many factors that impaired successful cultivation like high temperature, low quality of irrigation water (due to high acidity and salinity) and severe attack of rats. For summer season statistical

Table 3. Yield data of mushroom

Sl. No	Name of Mushroom	Mean Yield (gms)	Biological Efficiency (%)
1	<i>Pleurotus florida</i>	570	57
2	<i>P. eous</i>	730	73
3	<i>Calocybe indica</i>	800	80
4	<i>Hypsizygus sp.</i>	632	63.2
5	<i>P. sajor-caju</i>	610	61
	CD value	50.21	6.8

Mushroom shed characters: Mean maximum temperature inside: 34±2 °C
 Mean relative humidity: 68%

Table 4. Other observations of PTD trial

Sl.	Varieties	No. of days for spawn running	Days for 1 st harvest	Interval between 1 st and 2 nd harvest (days)	Interval between 2 nd and 3 rd harvest (days)	Cropping period days
1	<i>Pleurotus florida</i>	22	25	12	12	55
2	<i>Pleurotus eous</i>	15	17	6	9	39
3.	<i>Calocybe indica</i>	27	33	10	15	58
4	<i>Hypsizygus sp.</i>	21	25	11	13	49
5	<i>Pleurotus sajor-caju</i>	22	26	13	8	47

analysis of data from Rice Research Station showed that yield of Pink oyster, *P. eous* (790g/bed) was on par with milky mushroom - *Calocybe indica* (800g/bed).

Time taken to complete spawn running stage was enhanced during summer and lowest period was observed in pink oyster i.e. 15 days. It was maximum for milky mushroom (*Calocybe indica*) i.e. 27 days. The same trend was observed with number of days for first harvest. Interval between first and second harvest was the least for pink oyster.

Nutrient Analysis

(a) Mushrooms from chemically sterilized paddy straw

Results of Table 5 showed that nutrient status of mushrooms harvested from the same substrate i.e. paddy straw varied with mushroom types. With respect to proximate, milky mushroom had the highest concentration of carbohydrate (3.32g/100g). Lowest content of fat i.e. 0.09 per cent was noticed in *Hypsizygus sp.* pH of mushrooms ranged between 5.2 and 5.8.

Table 5. Relative concentration of nutritional factors of mushroom types cultivated in Kuttanad

Sl. No	Parameter(g)	Type of Mushroom				
		<i>P. florida</i>	<i>P. eous</i>	<i>Calocybe indica</i>	<i>Hypsizygus sp.</i>	<i>P. sajor-caju</i>
1.	Carbohydrate	3.17	2.59	3.32	2.61	2.59
2.	Protein	3.03	2.72	2.10	2.76	2.96
3.	Fat	0.09	0.21	0.26	0.04	0.54
4.	Fibre	1.5	2.9	1.86	1.79	0.52
	pH	5.52	5.5	5.75	5.60	5.23

*Substrate : Chemically sterilized paddy straw

Relative concentration of minerals are presented in Table 6. *P. sajor-caju* contained the highest concentration of all minerals under study i.e. sodium, potassium, calcium, magnesium, iron, molybdenum, selenium and zinc. Selenium, the antioxidant mineral was present only in *P. sajor-caju*. All mushroom varieties were found to be a good source of potassium (1840-3300 ppm). The K content was higher in comparison with Sodium, which is an advantage from the nutritional point of view. The crude fat content was even less than one per cent as similar to report of Khanna and Garcha [1]. Mushrooms grown in the present study were observed to be almost fat free especially when grown on paddy straw and therefore can be consumed safely in fresh state by patients suffering from diabetes and atherosclerosis.

Table 6. Relative concentration of minerals in mushroom types cultivated in Kuttanad

SL.No	Parameter (ppm)	Type of mushroom (chemically sterilized mushroom bed)				
		<i>P. florida</i>	<i>P. eous</i>	<i>Calocybe indica</i>	<i>Hypsizygyus sp.</i>	<i>P. sajor-caju</i>
1	Na ⁺	100	40	100	50	100
2	K ⁺	1840	2800	3200	2500	3300
3	Calcium	9.03	1.67	4.30	1.31	118
4	Magnesium	141.46	65.62	60.14	59.43	191.1
5	Iron	10.19	10.91	4.73	12.95	75.26
6	Molybdenum	BDL	BDL	BDL	BDL	BDL
7	Selenium	BDL	BDL	BDL	BDL	0.871
8	Zinc	5.85	9.2	0.91	5.05	29.27

*BDL- Below detective level

Mushroom from beds of different substrates

From Table 7, it was confirmed that in general proximates were higher in quantity in *P. florida* and *P. eous* harvested from rubber wood sawdust. pH of all varieties ranged between 5 and 6. Banana waste showed the lowest content of carbohydrate and fat.

Table 7. Relative concentration of nutritional factors in fruit bodies of *P. florida* and *P. eous* upon cultivation on variable substrates

SL.No	Parameter	Type of mushroom						
		<i>P. florida</i>		<i>P. eous</i>		<i>Hypsizygyus sp.</i>		
		Paddy straw	Saw dust	Banana waste	Paddy straw	Sawdust	Paddy straw	Saw dust
1.	Carbohydrate	3.17	7.59	1.83	2.59	2.59	2.61	1.87
2.	Protein	3.03	5.46	4.65	2.72	2.8	2.76	2.47
3.	Fat	0.09	0.46	0.19	0.21	3.3	0.04	0.13
4.	Fibre	1.5	1.69	0.54	3.11	0.99	1.79	0.72
	*pH	5.52	5.43	5.32	5.5	5.18	5.6	5.28

For minerals, all mushroom varieties from rubber sawdust gave the highest content. Selenium, the prominent antioxidant mineral was present in all the mushroom types harvested from saw dust beds only. So rubber wood sawdust can be considered as a better substrate for getting mushrooms of higher nutrient value. Crude fibre contents varied between mushroom between substrates. It was noted that highest fibre content was seen in *P.eous* when grown on paddy straw. Mushrooms from sawdust that recorded highest content and hence pink oyster grown in rubber wood saw dust can be recommended to meet dietary fibre need of patients suffering from stomach and internal disorder. Beelman *et al.* [3]

described that nutritive composition of the mushroom varied with species, strain, type of substrates on which it was grown, the maturity of the fruiting body, the methods of analysis and the environmental conditions on which it was grown.

Table 8. Relative concentration of minerals in mushroom types cultivated in Kuttanad

Sl.No	Parameter	Type of mushroom						
		<i>P. florida</i>			<i>P. eous</i>		<i>Hypsizygus sp.</i>	
		Paddy straw	Saw dust	Banana waste	Paddy straw	Sawdust	Paddy straw	Saw dust
1.	Sodium	100	250	100	40	70	50	60
2.	Potassium	1800	3050	5800	2800	800	59.43	2200
3.	Calcium	9.03	67.07	*0.01	1.08	0.005	12.95	233.8
4.	Magnesium	141.46	196.45	259.3	65.62	203.2	BDL	272
5.	Iron	10.19	41.89	37.24	10.23	146.3	BDL	70.39
6.	Molybdenum	BDL	BDL	2.02	BDL	BDL	5.05	BDL
7.	Selenium	BDL	7.07	BDL	BDL	0.28	0.005	9.84
8.	Zinc	5.85	15.39	10.44	11.95	59.95	0.25	31.95
	pH			5.33	5.5			

Studies by Verma *et al.* [2] reflected mushroom contains significant amounts of magnesium, calcium, phosphorous and iron. Proximate compositional variations were apparent among all mushroom types under study grown on variable substrates and may be affected by certain intrinsic physiological and biochemical variabilities induced by the usage of variable substrates for cultivation. In general, mushrooms are established good source of proteins [1].

Consumer Survey: Survey was conducted among consumers from Kuttanad (Alappuzha and Kottayam districts) with a view to identify the most preferred mushroom varieties and other consumption details. Results were interpreted based on percentage data. Friends formed the major source of motivation for consuming mushroom (Table 9).

Table 9. Motivation for consuming mushroom

Sl.No	Source of motivation	Frequency (n=100)	Rank
1	Friends	48	1
2	Media	31	2
3	Classes	21	3

All the respondents were aware of the nutritional and medicinal properties of mushroom. *P. florida* ranked first in mushroom consumption based on availability. Pink mushroom was consumed by 56 per cent of the respondents while milky mushroom was used by 20 per cent. Trainings formed the major source of inspiration (37 per cent) for getting information about medicinal value of mushroom (Table 10). 90 per cent of the consumers bought mushrooms directly from farmers (Table 11).

Table 10. Source of Information about Medicinal value of mushroom

Sl.No	Source of motivation	Frequency (n=100)	Rank
1	Training	39	1
2	Other sources	35	2
3	Media	19	3
4	Books	16	

Table 11. Source of purchase of mushroom

SI. No	Source of motivation	Frequency (n=100)	Rank
1	Direct purchase	90	1
2	Home delivery	8	2
3	Vegetable shop	2	3
4	Super market	0	4

Among the consumers 92 per cent purchased 200g mushroom at a time. Sale price of mushroom was Rs. 200/kg for 91 per cent of the respondents. From Table 12 it was found that 69 per cent of the consumers were continuously using mushrooms for the past one year.

Table 12. Period of utilisation of mushroom

SI. No	Source of motivation	Frequency (n=100)	Rank
1	1 year	69	1
2	6 months	23	2
3	2 years	8	3

With regard to the dishes prepared all the consumers used mushroom in the form of ‘‘Thorán’’. (Table 12) 93 per cent of the consumers were not aware of the use of mushroom as ‘‘snacks’’. With regard to the recipes 100 per cent of the consumers used mushroom in the form of ‘‘Thorán’’. For 100 samples mushroom was consumed by all family members.

Table 13. Type of mushroom dishes prepared

SI. No	Source of motivation	Frequency (n=100)	Rank
1	Thorán	100 %	1
2	Theeyal	61 %	2
3	Soup	30 %	3
4	Fried	7 %	4
5	Other curry	5 %	5

Considering the health benefits after mushroom consumption, reduction in body weight was observed by 52 per cent of the respondents while in 28 per cent of the samples increased digestion was reported. Reduction in cholesterol level was experienced by 79 per cent while lowering of blood pressure was noticed in one per cent of the samples (Table 14).

Table 14. Benefits of consumption

SI. No	Source of motivation	Frequency (n=100)	Rank
1	Weight reduced	52 %	1
2	Improved digestion	28 %	2
3	Indigestion problems	20 %	3
4	No specific effect	20%	4
5	Weight increased	0	5
6	Headache	0	5

CONCLUSION

The present study identified pink mushroom i.e. *Pleurotus eous* as the most suited mushroom variety for cultivation during rainy season in Kuttanadu region of Kerala state with an average yield of 875.5g/bed. With regard to the period for completion of spawn running, it took the least time i.e. 10 days after bed preparation followed by *P. florida* with 10 days. Nutrient status of mushrooms harvested from the same substrate i.e. paddy straw varied with mushroom types. With respect to proximate, milky mushroom had the highest concentration of carbohydrate. Highest amount of protein was noticed in *P. florida*. Lowest content of fat i.e. 0.09% was noticed in *Hypsiygyus* sp. It was confirmed that in general, proximates were higher in quantity in *P. florida* and *P. eous* harvested from rubber wood sawdust. pH of all varieties ranged between 5 and 6. Banana waste showed the lowest content of carbohydrate and fat. Selenium, the prominent antioxidant mineral was present in all the mushroom types harvested from saw dust beds only. So rubber wood sawdust can be considered as a better substrate for getting mushrooms of higher nutrient value. Results of consumer survey showed that friends formed the major source of motivation for consuming mushroom. *P. florida* ranked first in mushroom consumption based on availability. Trainings formed the major source of inspiration for getting information about medicinal value of mushroom. Sale price of mushroom was ₹200/kg for 91 per cent of the respondents. 90 per cent of the consumers bought mushroom directly from the farmers. With regard to the recipes 100 per cent of the consumers used mushroom in the form of 'Thorani'. For 100 samples mushroom was consumed by all family members. The results of the present study will pave the way for increasing domestic cultivation of mushroom and enhancing the consumption as a protein food source in Kuttanad region.

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