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Research Article

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Comparative Study of Fruiting Body Production of some Oyster Mushroom in Two Different Temperatures

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Abstract

Oyster mushroom (*Pleurotus spp*.) are widely cultivated throughout the world for nutritional as well as for medicinal purposes. To see the effect of temperature on yield, efficiency and protein content of different oyster mushroom, eight oyster mushroom i.e. *Pleurotus ostreatus, P. florida, P. sajorcaju, P. eryngii. P. pulmonarius, P. citrinopileatus*, *P. flabellatus and P. fossulatus* were taken. 10% spawn of respective mushroom strains were inoculated in overnight wetted non-sterilized rice straw and kept in two different temperatures (18°C and 25°C). In 18°C all the species produced fruiting bodies whereas in 25°C, all the tested species except *P. fossulatus* could produce the fruiting bodies. Considering the time as a main factor in fruiting, a new parameter Biological efficiency day^{-1} (BED) is introduced to better understand the fruiting efficiency in respect to time. It was found that beyond second flushes fruiting was not commercially sustainable. In lower temperature (18˚C) *P. florida* (ITCC 3308) showed the highest BED value whereas *P. pulmonarius* showed the highest BED value in higher temperature (25˚C). The protein content of the fruiting bodies varied significantly from species to species though temperature has no such effect. The fruiting life varied from 4-7 days in all the tested mushrooms except *P. fossulatus* which was much longer (>25 days). In present experimental condition *P. fossulatus* showed the most temperature sensitivity, *P. pulmonarius* showed the least temperature sensitivity whereas all the other species showed moderate temperature sensitivity.

Keywords

Biological efficiency (BE); Biological efficiency day^{-1} (BED); Fruiting body; Oyster mushroom; *Pleurotus* sp

Introduction

After Yeast fermentation, mushroom production has been considered as the second most esteemed commercial microbial technology [1]. Cultivation of mushroom does not require sophisticated instruments or fertile soil, they can grow inside the room on various agroresidues [2]. Due to the capacity to grow on a variety of substrates, mushrooms were considered to manage organic wastes which unless are problematic for disposal [3]. A large number of mushrooms are considered not only for food but also for medicinal purposes. Mushroom also produces a large number of lignocellulosic enzymes both intracellularly and extracellularly which have immense roles to play not only in producer organisms but applicable in different industrial and biotechnological purposes [4,5].During the last few decade oyster mushroom production accelerates very much [6]. Currently *Pleurotus spp*. positioned second after *Agaricus* among the cultivated mushrooms [7]. They are very much popular to people around the globe for its taste and easy cultivation methods in a wide range of temperature [8]. The members of the genus *Pleurotus* not only present the delicious dishes but also produce a large no of nutriceuticals, pharmaceuticals and cosmeceuticals [9].

The oyster mushroom *Pleurotus spp.* has been regarded as edible mushroom for many years [6]. About twenty different species of oyster mushroom are cultivated throughout the world. The production of different mushroom varies from batch to batch depending upon the different cultural conditions. The present paper deals with eight species of *Pleurotus* and give a comparative account of their yield, BED (Biological efficiency day^{-1}) and other parameters in two different temperature.

Materials and Methods

Mushroom species and culture media

The mycelial strain of *P. florida* (ITCC 3308) was obtained from Society for Rural Industrialization, Ranchi, India. *P. ostreatus* (MTCC 1802), *P. flabellatus* (MTCC 1799), *P. sajorcaju* (MTCC 1806), *P. pulmonarius* (MTCC 1805), *P. eryngii* (MTCC 1798), *P. citrinopileatus* (MTCC 1796) and *P. fossulatus* (MTCC 1800) were obtained from Microbial Type Culture Collection and Gene Bank, Institute of Microbial Technology, Chandigarh, India and maintained in PDA [3].

Spawn preparation

Wheat grains are chosen for spawn production. 1000 g grains are boiled for half an hour then washed in flowing water. Extra water present is drained off and the grains are spread on the surface of a clean blotting paper and air dried for 15 min. 10 gm of calcium sulphate and 5 gm of calcium carbonate were mixed with the grains. About 100 gm (w/w) of grains is placed in polythene bag and sterilized in autoclave at 121˚C for 15 min. After cooling required mushroom strains are inoculated in the grains and kept in incubator at 25˚C. After 12-14 days these are ready as spawn [10].

Substrate preparation

The chopped rice straw (5-6 cm) has been collected from a local farm. About 230 g of straw has been taken for each bag. After weighing it is soaked in water for overnight. The extra water present in it is drained off and substrate is air dried for 15 min. No sterilization or heat treatment of the substrate has been done. 230 gm wet substrate (~ 85% moisture content) is mixed with 10% spawn (wet wt. / wet wt.). The spawned substrate is then put into 30 cm x 42 cm polythene bags. The bags are closed tightly with pin holes on the surfaces. The bags are kept in spawn running room either at 18 ± 2°C or 25 ± 2°C with a 12 h photoperiod (1500-2000 Lux) with 85-90% relative humidity. Adequate ventilation has been provided to prevent increase of CO_2 concentration [10].

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Biological efficiency day $^{-1}$ (BED)

Biological efficiency day^{-1} (BED) has been calculated by dividing the Biological efficiency [10] with the time (in days) required for any fruiting flush. For second and subsequent flushes the time is calculated by subtracting the initiation of primordia from the previous date of primordia initiation.

Protein determination

Protein concentration was calculated by the method of Lowry et al. [11] with slight modification as mentioned by Das et al. [10].

Statistical Analysis

All the statistical analysis was done by SPSS 13.0 version software unless otherwise mentioned. 9 replicates (3sets x 3batches) for all the mushroom strains were taken for all the analysis of each experiment. As the sample size is small so pair sample 2-tail test was perform to compare the means and corresponding p-value is reported for significance level. 95% confidence level of mean production of different strains and corresponding BED had been calculated based on the t-distribution.

Results

All the eight *Pleurotus* strains produce fruiting body in low temperature (18+2)˚C with different efficiencies (Table 1). 3308, 1802, 1805, 1806 and 1796 produce fruiting bodies in four flushes while the other three strains show three flushes. The yield is best in 3308 followed by 1802 and 1805. The other strains produce less amount of fruiting bodies in terms of yield. 1800 shows the lowest production. When the BED values are considered 3308 also shows the highest efficiency. The yields are decreasing from first flush to second flush and so on. Though the first flush yields are better in all the experiments irrespective of the strains but when BED values are considered it is not true. The maximum BED value 8.293% /day is

Table 1: Mean level along with 95% confidence interval of fruiting body production of different *Pleurotus* spp. at 18˚C.

	Absolute measurement of yield (g)					**BED (%/day)**			
Sample No	**Flush**	**Mean**	**Std Deviation**	**95% Confidence Interval of the Difference**		**Mean**	**Std. Deviation**	**95% Confidence Interval of the Difference**	
				Lower	Upper	Lower	Upper	Lower	Upper
P. florida (3308)	1st	169.000	37.924	139.849	198.151	2.925	0.690	2.395	3.456
	2nd	109.333	9.566	101.981	116.686	8.293	1.739	6.956	9.631
	3rd	74.111	7.833	68.090	80.132	2.132	0.207	1.973	2.291
	4th	20.667	3.279	18.146	23.187	0.626	0.126	0.529	0.723
P. ostreatus (1802)	1st	145.222	17.718	131.603	158.842	4.036	0.590	3.583	4.489
	2nd	115.000	9.341	107.820	122.180	3.706	0.397	3.400	4.011
	3rd	33.000	3.202	30.539	35.461	0.823	0.078	0.763	0.883
	4th	12.444	3.812	9.515	15.374	0.454	0.134	0.351	0.558
P. pulmonarius (1805)	1st	141.444	16.584	128.697	154.192	3.700	0.500	3.315	4.084
	2nd	87.889	10.422	79.878	95.900	2.779	0.322	2.532	3.027
	3rd	65.111	22.575	47.759	82.464	1.538	0.569	1.100	1.976
	4th	16.778	6.037	12.137	21.418	0.360	0.136	0.255	0.464
P. sajir-caju (1806)	1st	134.333	9.028	127.394	141.273	2.686	0.404	2.375	2.997
	2nd	67.222	14.515	56.065	78.380	3.064	0.909	2.365	3.762
	3rd	41.889	18.924	27.343	56.435	0.951	0.476	0.585	1.317
	4th	18.556	7.667	12.662	24.449	0.558	0.552	0.134	0.983
P. citrinopileatus (1796)	1st	98.778	10.269	90.885	106.671	2.702	0.217	2.535	2.869
	2nd	67.333	11.927	58.166	76.501	2.036	0.388	1.738	2.335
	3rd	37.556	16.493	24.878	50.233	0.962	0.566	0.526	1.397
	4th	11.556	3.046	9.214	13.897	0.315	0.085	0.249	0.380
P. eryngii (1798)	1st	90.889	6.294	86.051	95.727	3.657	0.423	3.331	3.982
	2nd	27.222	2.819	25.056	29.389	1.058	0.113	0.971	1.145
P. flabellatus (1799)	1st	106.778	9.217	99.693	113.862	1.952	0.148	1.838	2.065
	2nd	49.111	4.567	45.600	52.622	1.033	0.849	0.968	1.098
P. fossulatus (1800)	1st	77.222	4.738	73.581	80.864	1.618	0.105	1.537	1.698
	2nd	25.333	4.690	21.728	28.939	0.578	0.115	0.490	0.667

found in the second flush of 3308. The least BED value (0.315%/day) was found in fourth flush of 1796 (Table 1). At 25˚C except 1800 all the other seven *Pleurotus* spp produced fruiting bodies. 1798 and 1799 showed fruiting body in a single flush whereas the other five species give two fruiting flushes. 1805 showed the highest BED value (about 6%) followed by 1796 and 1806 (Table 2). Though 1798 showed only single flush but the obtained BED value (3.190) is the second highest value of first flush just beyond the 1805 (3.790). In Table 3, eight species are divided in two tiers and compared within them. In first tier better yielding species at 18˚C ie., 1802, 1805, 1806 and 3308 are placed, the remaining four are placed in second tier. In Table 4, the yield and BED values are compared between all the species (except 1800) at 25˚C. BED values were compared at first flush level, Second flush level as well as combined level. T-value and two tailed significance were compared between the species. Comparison of BED values were done among all the species in both 18˚C and 25˚C (Table 5). The protein values of different species varied significantly (Figure 2 & Table 6). 1802 showed highest protein content whereas 3308 showed lowest protein concentration irrespective of temperatures. All the other species showed moderate protein value.

Discussion

Environmental conditions particularly temperature play a crucial role in fruiting body development in different mushroom [12,13] Kües and Liu described that though growth of vegetative mycelium occurs over a wide range of temperatures but hyphal knot and the primordia initiation might not restricted in a specific temperature. According to Patel et al. [14], oyster mushroom is distributed throughout the world from temperate to tropical region at 12-32°C temperature range. In the present investigation fruiting is studied in two different temperatures i.e 18 ± 2°C and 25 ± 2°C.

Though *Pleurotus* spp. can be cultivated in a number of lignocellulosic substrates including different cereal straw, rice straw showed better results in terms of yield/biological efficiency [15,16,17]. Ashraf et al. [18] showed better yield in rice straw than wheat straw and *P. ostreatus* was better than *P. sajorcaju* and *P. djmor* whereas Kurt and Buyulkalac [19] showed more or less similar yield/Biological efficiency of *P. ostreatus and P. sajorcaju* when cultivated on rice straw. So, in the present investigation rice straw is used as the substrate for oyster mushroom cultivation. In lower temperature (18 ± 2)° C five *Pleurotus* spp. produce fruiting bodies in four flushes whereas 1798, 1799 and 1800 strains show only two flushes in present experimental condition (Table 1). The yield of fruiting body decreased from first flush to second flush and so on in each experiment. Similar results were reported by other investigators [20,21]. Strain 3308 shows maximum yield in first flush as well as in respect to total yield. Total yield in 1805 and 1802 are more or less similar (Table 1). Moderate yields are recorded in 1806 and 1796. 1800 shows the lowest yield. Different researchers mention the yield of different mushroom varies not only species to species but within same species in different cultural and environmental condition. Biological efficiency (BE) is considered as the measurement of fruiting efficiency of mushroom by most of the researchers [20,5]. Here another criterion Biological efficiency day^{-1} (BED) is introduced. BED values are more authentic decisive factor as variation of efficiency also depends upon time which varies not only in different batches in different condition but also within the same batch in a particular environmental condition. As an example the yield of 1st and 2nd flush in 3308 are 169 g and109 g respectively which interpret the BE of 1st flush is more than the 2nd flush but when BE per day (BED) criterion is considered the picture drastically changed, here the BED value in 2nd flush is significantly more than the 1st flush (Table 1). Though the yield or biological efficiency of first flush is more than second flush in all experiments but the BE per day value for 2nd flush are greater in 3308, 1806 and 1796 due to less time requirement for 2nd flushing (Table 1). Previously researchers considered the number of flushes as a factor for efficiency of mushroom but here it is clear that number of flushes is not a major factor. From the data analysis in Table 1 it has been found that for each species BED value are drastically reduced after 2nd flush so, beyond the second flush it is not economically viable. As the third and fourth flushes take more time, the BED values are very less in each species in the present experimental condition. Thus for commercial cultivation fruiting beyond second flush is not recommended. In higher temperature (25˚C) all the species except 1800 produced fruiting bodies. Apart from 1798 and 1799 other five species provide two fruiting flushes whereas 1798 and 1799 present only single flush. 1805 shows the highest BED value followed by 1796 and 1806. 3308 and 1802 shows moderate BED values (Table 2). To make the comparison between the results of BED values in lower temperature (18˚C) eight species are divided into two tiers; in the first tier better

Table 2: Mean level along with 95% confidence interval of fruiting body production of different *Pleurotus* spp. at 25˚C.

Sample No	Absolute measurement of yield (g)					BED (%/Day)			
	Flush	Mean	Std. Deviation	95% Confidence Interval of the Difference		Mean	Std. Deviation	95% Confidence Interval of the Difference	
				Lower	Upper			Lower	Upper
P. pulmonarius (1805)	1st	121.333	12.698	111.573	131.094	3.709	0.365	3.428	3.989
	2nd	73.556	6.692	68.412	78.699	2.199	0.204	2.042	2.355
P. citrinopileatus (1796)	1st	80.000	8.016	73.839	86.161	2.469	0.266	2.264	2.673
	2nd	37.667	3.873	34.690	40.644	1.181	0.141	1.073	1.290
P. ostreatus (1802)	1st	77.444	7.299	71.834	83.055	2.354	0.253	2.159	2.548
	2nd	27.222	4.816	23.520	30.924	0.723	0.146	0.611	0.836
P. sar-caju (1806)	1st	125.556	11.047	117.064	134.047	2.746	0.238	2.563	2.929
	2nd	28.556	5.223	24.541	32.570	0.845	0.181	0.706	0.984
P. florida (3308)	1st	103.444	11.359	94.713	112.176	2.523	0.335	2.265	2.780
	2nd	22.444	5.028	18.580	26.309	0.771	0.168	0.641	0.900
P. eryngii (1798)	1st	77.111	8.695	70.427	83.795	3.190	0.422	2.866	3.514
P. flabellatus (1799)	1st	76.000	9.287	68.861	83.139	2.041	0.270	1.833	2.248
P. fossulatus (1800)	NIL	NIL	NA	NA	NA	NIL	NA	NA	NA

Table 3: Pair wise comparison of BED values in different *Pleurotus spp*. in 18˚C.

Pair samples	First Flush (%/day)				Second Flush (%/day)				Combined First Flush and Second Flush (%/day)			
	Paired Differences		t-Value	Sig. (2-tailed)	Paired Differences		t-Value	Sig. (2-tailed)	Paired Differences		t-Value	Sig. (2-tailed)
	Mean	S.D			Mean	S.D			Mean	S.D		
P. sajir-caju - P. pulmonarius	-1.013	0.806	-3.774	0.005	0.284	0.970	0.879	0.405	-0.729	1.406	-1.555	0.158
P. sajir-caju - P. ostreatus	-1.350	0.681	-5.943	0.000	-0.642	0.699	-2.756	0.025	-1.992	1.224	-4.882	0.001
P. sajir-caju - P. florida	-0.239	0.687	-1.046	0.326	-5.230	2.239	-7.008	0.000	-5.469	2.352	-6.976	0.000
P. pulmonarius - P. ostreatus	-0.337	0.831	-1.215	0.259	-0.926	0.444	-6.260	0.000	-1.263	0.969	-3.911	0.004
P. pulmonarius - P. florida	0.774	0.917	2.532	0.035	-5.514	1.749	-9.460	0.000	-4.740	2.126	-6.689	0.000
P. ostreatus - P. florida	1.111	0.952	3.501	0.008	-4.588	1.829	-7.526	0.000	-3.477	1.711	-6.095	0.000
P. citrinopileatus - P. eryngii	-0.955	0.331	-8.652	0.000	0.979	0.387	7.596	0.000	0.024	0.476	0.151	0.883
P. citrinopileatus - P. fossulatus	1.085	0.245	13.277	0.000	1.458	0.474	9.236	0.000	2.543	0.623	12.237	0.000
P. citrinopileatus - P. flabellatus	0.751	0.313	7.187	0.000	1.003	0.375	8.023	0.000	1.754	0.608	8.651	0.000
P. eryngii - P. fossulatus	2.039	0.430	14.226	0.000	0.480	0.211	6.823	0.000	2.519	0.487	15.529	0.000
P. eryngii - P. flabellatus	1.705	0.463	11.048	0.000	0.025	0.107	0.693	0.508	1.730	0.496	10.461	0.000
P. fossulatus – P. flabellatus	-0.334	0.211	-4.742	0.001	-0.455	0.177	-7.691	0.000	-0.789	0.272	-8.696	0.000

Table 4: Pair wise comparison of BED values of different *Pleurotus* spp. in 25˚C.

Mushroom species	First Flush (%/day)				Second Flush(%/day)				Combined First Flush and Second Flush (%/day)			
	Paired Differences		t-Value	Sig. (2-tailed)	Paired Differences		t-Value	Sig. (2-tailed)	Paired Differences		t-Value	Sig. (2-tailed)
	Mean	S.D			Mean	S.D.			Mean	S.D.		
P. pulmonarius - P. sajir-caju	0.963	0.568	5.083	0.001	1.354	0.308	13.184	0.000	2.316	0.807	8.612	0.000
P. pulmonarius - P. citrinopileatus	1.240	0.550	6.767	0.000	1.017	0.236	12.931	0.000	2.257	0.722	9.377	0.000
P. pulmonarius - P. florida	1.186	0.447	7.964	0.000	1.428	0.240	17.838	0.000	2.614	0.614	12.779	0.000
P. pulmonarius - P. ostreatus	1.355	0.393	10.337	0.000	1.475	0.194	22.844	0.000	2.830	0.495	17.159	0.000
P. sajir-caju - P. citrinopileatus	0.277	0.271	3.073	0.015	-0.336	0.220	-4.583	0.002	-0.059	0.452	-0.390	0.707
P. sajir-caju - P. florida	0.223	0.442	1.517	0.168	0.074	0.165	1.351	0.214	0.298	0.575	1.554	0.159
P. sajir-caju - P. ostreatus	0.393	0.401	2.936	0.019	0.122	0.216	1.693	0.129	0.514	0.582	2.650	0.029
P. citrinopileatus - P. florida	-0.054	0.374	-0.433	0.676	0.410	0.212	5.811	0.000	0.356	0.558	1.915	0.092
P. citrinopileatus - P. ostreatus	0.115	0.286	1.206	0.262	0.458	0.200	6.872	0.000	0.573	0.465	3.698	0.006
P. florida - P. ostreatus	0.169	0.337	1.506	0.171	0.047	0.204	0.699	0.505	0.217	0.523	1.242	0.249

performing species i.e. 3308, 1802, 1805, 1806 are kept whereas in second tier lower performing species i.e. 1796, 1798 , 1799 and 1800 are kept (Table 3). It has been observed that there is significant differences in BED values between 3308 and other three species of Tier 1 and these differences are due to the differences of BED values in 2nd flush level. 1806 and 1802 show significant differences in combined level due to their differences in first flush level.1805 and 1802 show significant differences in combined level which is due to differences of BED in 2nd flush level. 1806 and 1805 show no significant differences in combined level though there are differences in 1st flush level. In second Tier significant differences are observed between all the pairs in combined level except pair 7 i.e. in between 1796 and 1798 though there are significant differences between all the pairs in first flush level. There are no significant differences between 1798 and

Table 5: Comparison of BED values of different species of *Pleurotus* in 18˚C and 25˚C.

Pair No.	Strains	Paired Differences (%/day)					t-value	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% confidence interval of the difference				
					Lower	Upper			
Pair-1	*P. pulmonarius* (25˚C) – (18˚C)	-0.571	0.934	0.311	-1.289	0.147	-1.835	8	0.104
Pair-2	*P. citrinopileatus* (25˚C)- (18˚C)	-1.089	0.500	0.167	-1.473	-0.705	-6.537	8	0.000
Pair-3	*P. sajir-caju* (25˚C) –(18˚C)	-2.158	1.202	0.401	-3.083	-1.234	-5.386	8	0.001
Pair-4	*P. florida* (25˚C) – (18˚C)	-7.925	1.883	0.628	-9.373	-6.478	-12.624	8	0.000
Pair-5	*P. ostreatus* (25˚C) –(18˚C)	-4.665	0.885	0.295	-5.345	-3.985	-15.818	8	0.000

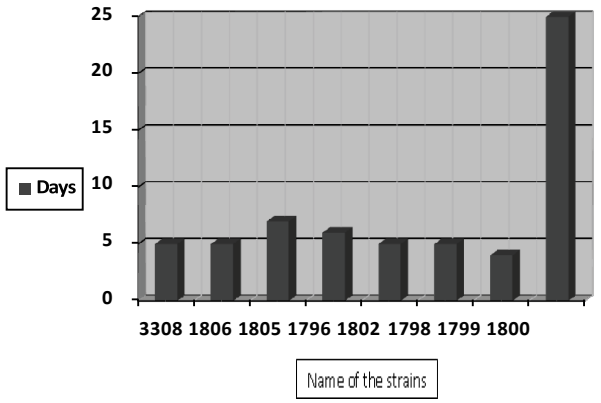

Figure 1: Fruiting life of different Pleurotus strains. All the strains were cultivated on rice straw substrate at (18+2)°C with 10% spawn. Fruiting life of first flushes are considered.

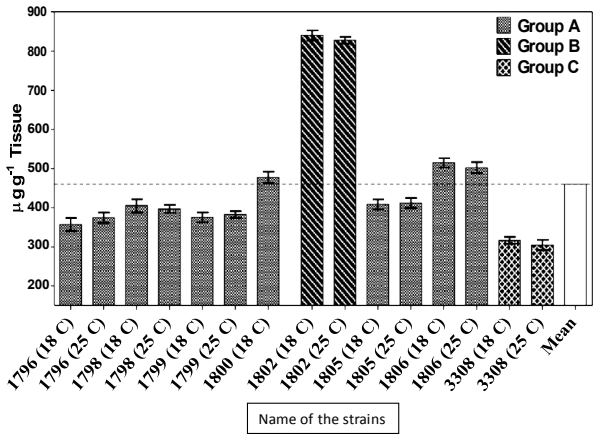

Figure 2: Comparison of protein conc. of different *Pleurotus* strains. All the strains were cultivated on rice straw substrate at different temperature (mentioned in graph) with 10% spawn. Protein values were measured in the day of harvesting.

1799 in second flush level but the combined level show the significant differences due to the greater differences in first flush level (Table 3). At 25˚C all the species except 1800 produce fruiting bodies (Table 4). Except 1798 and 1799, all the other strains present two flushes of fruiting in this temperature. The BED values of five species are compared. Significant differences are found in 1805 with all other four species in first flush and second flush as well as in combined level. Significant differences are found between 1806 with 1796 in both first and second flush level but in combined level there is no difference because the better efficiency of 1796 nullifies by the lower efficiency in second flush level. 1796 also shows significant differences with 1802 in second flush as well as in combined level. 1806 shows significant differences in BED values with 1802 in first flush level and though there is no such differences in second flush level but due to much differences in first flush level, the combined level also shows the significant differences. Out of eight *Pleurotus* species five species fruit at least two flushes. As this level is economically viable so the comparison of efficiency of fruiting is considered up to second flush level in both the temperatures (Table 5). It is found that except 1805 in all other cases there are significant differences in BED values in both the temperature. So, 1805 strain i.e. *Pleurotus pulmonarius* is less temperature sensitive and can be cultivated in this temperature range (18-25)˚C without any change in their fruiting efficiency (BED value). There are significant differences in BED values of other four strains in 18˚C and 25˚C as per the t-values (Table 5). All the strains except 1805 show better efficiency in terms of BED values in lower temperature i.e. 18˚C irrespective of the less time requirement of primordia formation in higher temperatu9re (data not shown). Chandra and Purkayastha [22] and Chang and Miles [23] reported similar observations in *Pleurotus* spp. where lower temperature and relative humidity might be responsible for the delayed initiation of primordia. Here the higher incubation temperature lowered the time for primordia initiation in most of the oyster mushroom species though still the BED values are more in lower temperature .The time required from initiation of fruiting bodies to deliquescence on the bed is a vital factor for commercial mushroom production. The author coined the term as fruiting life [5]. Though, in most of the species it varied from 4-7 days, but in 1800 it is quite high (about 25 days) at 18˚C (Figure 1). In 25˚C the result is more or less same (data not shown) except *P. fossulatus* which could not produce fruiting bodies at 25˚C [7]. Nutrient content is considered as one of the most important factor for evaluation of edible mushroom. One way ANOVA test has been performed for determination of protein conc. of different *Pleurotus* strains which show a significant variation among the strains. A mean value is generated for comparison of protein values of different strains. Turkeys' Multiple Comparison Test places the present experimental strains in three statistical groups. In comparison to mean value 3308 is significant, 1802 is highly significant whereas rest of the species are non-significant (Table 6 and Figure 2). The non-significant variation of protein content is also found in fruiting bodies derived from two different temperatures of any individual strains. Despite the fact that there are a large number of reports on cultivation of different oyster mushroom but possibly this is the first report to compare the cultivation of such a large number of *Pleurotus* spp. in two different temperatures and explained the outcome more scientifically which may be beneficial for all the mushroom grower particularly for commercial cultivation purposes.

Table 6: Turkey's Multiple Comparison Test[1] for protein conc. of different mushroom strains at different temperature.

	q	Significant? P < 0.05?	Summary
	3.639	No	ns
1796 (25˚C) vs Mean	3.031	No	ns
1798 (18˚C) vs Mean	1.930	No	ns
1798 (25˚C) vs Mean	2.230	No	ns
1799 (18˚C) vs Mean	2.996	No	ns
1799 (25˚C) vs Mean	2.743	No	ns
1800 (18˚C) vs Mean	0.6276	No	ns
1802 (18˚C) vs Mean	13.53	Yes	***
1802 (25˚C) vs Mean	13.08	Yes	***
1805 (18˚C) vs Mean	1.816	No	ns
1805 (25˚C) vs Mean	1.701	No	ns
1806 (18˚C) vs Mean	1.954	No	ns
1806 (25˚C) vs Mean	1.500	No	ns
	5.096	Yes	*

[1]The test was done using GraphPad Prism Version 5 software. ns= non-significant

Conclusion

Temperature plays a crucial role in fruiting body development in *Pleurotus* spp. Except *P. pulmonarius* there is variation of yield and BED values of seven other species in two different temperatures (18˚C & 25˚C). In this experimental condition *P. fossulatus* is the most temperature sensitive species; *P. pulmonarius* is the least temperature sensitive species whereas all the other species show moderate temperature sensitivity. In lower temperature though most of the spp. give four flushes of fruiting body but beyond second flush it is not economically viable so for commercial cultivation fruiting is recommended up to second flush only. The variation of protein content is non-significant in fruiting bodies of individual strains derived from two different temperatures though the values may vary significantly from species to species.

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