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Effect of Different Drying Treatments on Functional and Nutritional Composition of Oyster Mushroom (*Pleurotus ostreatus*) Powder

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***Abstract*:** Present study aimed to determine the effect of different drying treatments on functional, nutritional and organoleptic properties in dried oyster mushroom (*Pleurotus ostreatus*) powder. The fresh oyster mushrooms were dried under sun drying, vacuum drying @ 70°C, freezer drying@ -40°C, hot air drying@ 55°C and tray drying@ 50°C. The hot air drying recorded maximum oil holding capacity, hydration capacity, TSS and total sugars 2.47 gm/gm, 4.36 gm/gm, 3.40°B, 10.04 per cent, respectively. The proximate composition protein content was also high in hot air drying (17.10 gm/100gm) followed by vacuum drying @ 70° and freezer drying@ -40°C. The energy content was maximum in sun drying (333.02 Kocal/100gm) followed by tray drying@50°C and freezer drying@ -40°C. Calcium, sodium, potassium and magnesium were highest in hot air-drying method.

***Keywords*:** Mushroom Flour, Processing, Mycelium, Sensory and functional properties

The very popular name of oyster mushrooms is of *Pleurotus* genus and among all the mushrooms it consumed throughout the world. Mushrooms are low in calories, cholesterol and fat with good quality proteins. Besides this it contains minerals, vitamins, and dietary fibers. The highly perishable nature of fresh mushrooms is attributed to their high moisture content (85%-95%) which favors microbial activities, high respiration rate, delicate texture, and high enzymatic activities (Jiang 2013). Higher moisture content leads to reduced shelf life of mushrooms and therefore, distribution and marketing as fresh produce limits consumption. The methods such as cold storage, drying, freezing, modified atmosphere packaging, controlled atmosphere storage, and canning are applied to extend the shelf-life and maintain the postharvest quality of mushrooms (Candir et al 2019). Drying is one of the oldest methods of preservation and mushrooms are also preserved by using this method. For proliferation and growth microbes required moisture. Free water is lost during drying process and thereby it slows down biological reactions and enzymatic activity thus results into longer keeping life of the mushrooms. The dried food products when packed and stored in air tight containers can help in continent for transportation. There are various methods used for the drying of the food products. However, method of drying affects the different functional and nutritional profile of the food. Therefore, the present study was planned to study the different drying treatments effect on oyster mushrooms' functional properties and nutritional components.

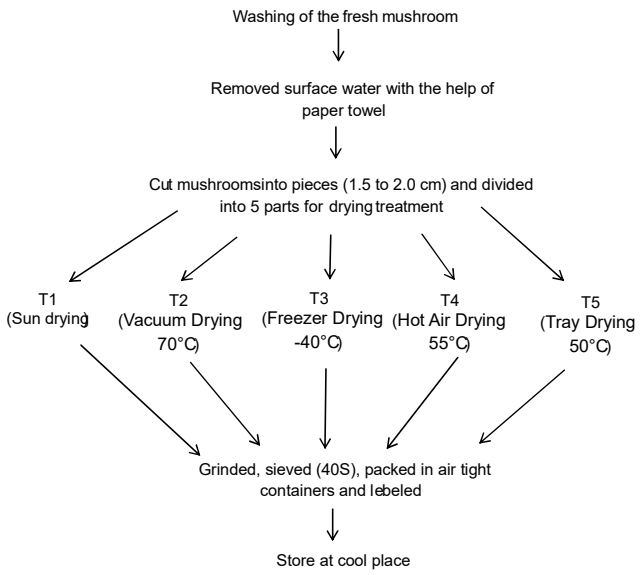
MATERIAL AND METHODS

Fresh mushrooms were procured in single lot from local market of the Gwalior, Madhya Pradesh, India and washed with tap water 3-4 times to clean the foreign material present on the surface of the mushroom. The extra water on the surface of the washed mushroom was cleaned with help of paper towel. The washed and cleaned mushroom was further subdivided into five groups (Flowchart 1). All the dried samples were further grided with the help of grinder for analysis.

Functional Properties

TSS: The homogenized sample was used for determination of T.S.S (°Brix) with the help of hand refractometer. The 5gm dried mushroom powder sample was dissolved in 50 ml of distilled water and left for 30 minutes. This was filtered with the filter paper and filtrate was used for the analysis with the help of digital refractometer (Rangana 2012).

Oil holding capacity (OHC): This was determined by a slight modification of the method described by Zhang *et al* (2011). In one gm mushroom powder, 20 gm of refined oil was added. This was mixed by stirring the mixture in vortex for 30 min. This solution was centrifuged at 4200 rpm for 30 min.



Flowchart 1. Drying treatment of mushroom for analysis and further study

The supernatant was removed and weighed. The results were expressed in gm/gm.

Hydration capacity (HC): Hydration capacity was determined standard method suggested by Mateos-Aparicio (2010). The 0.5g of sample was added in a test tube and 10 ml water was poured into it. This solution was starred and left to hydrate for 30 min. After 10 minutes the mixture was centrifugated at 4200 rpm and supernatant was collected after its settlement. The collected sediment was weighed and results were expressed in gm/gm.

Estimation of sugars: Total sugars and reducing sugar were estimated in Nelson, 1944. However non-reducing sugars were estimated by the difference of total and reducing sugars.

Evaluation of Proximate composition of treated mushroom powder: Moisture, crude protein, crude fat, crude fibre, total minerals, of the samples was determined AOAC, 2009. Carbohydrate content was calculated by difference method and energy content the physiological fuel Mudambi et al (1989)

Vitamin D estimation: It was estimated in two phase viz sample extraction and final estimation. Vitamin D in the sample was extracted by 99% ethanol (v/v) and 50% potassium hydroxide (2:1; w/v). The mixture was saponified for 30 min under reflux at 85°C. The organic layer was evaporated to dryness at 50°C in rotary evaporator. The dried sample extract was dissolved in 2 ml of a mixed solution of eluent (methanol/ acetonitrile = 75:25 v/v) and isopropyl alcohol (2:1 v/v). The UV detection of elute for Vitamin D was performed at 264 nm (Sarioglu et al 2001).

Estimation calcium, sodium, potassium and magnesium: The sample was prepared by using wet ash method by digesting the samples with 5 ml of diacid mixture (HNO3 and sulfuric acid) until its turn cleared. The volume was made up 50ml with the help of deionized water. The calcium, sodium, potassium and magnesium were estimated by using AAS (Bishnoi and Brar 1988).

Organoleptic evaluation: The dried mushroom powder was given to 15 panel members for organoleptic evaluation. The taste, flavour, aroma, overall acceptability was analysed organoleptically. On the basis of organoleptic evaluation of differently dried mushroom powder (Larmond 1970).

RESULTS AND DISCUSSION

Functional properties: The OHC of the treated mushroom powder ranged between 2.43 gm/gm to 2.47 gm/gm (Table 1). The HC and TSS was maximum in T4 i.e. 4.36 gm/gm and 3.40 °B respectively. Similarly, percent total sugars and non-reducing sugars was high in T4 i.e. 10.04 and 5.60 respectively. Physical properties of mushroom powders were significantly affected by different drying methods. This may be due to different temperature and duration of exposure to the temperature. The microtomographic images of oyster mushroom dried under different method had recorded heterogeneous structure and number of pores (Piskov et al 2020). Different drying treatments can influence physical properties as well as composition of the raw material (Dalmau et al 2017, Ucar and Karadag 2019).

Proximate composition of oyster mushroom: The proximate composition of oyster mushroom was affected by the different drying treatments (Table 2). The lowest moisture content was in sundried 8.40 gm/100gm followed by tray drying and freezer drying. Lower moisture content in sun dried samples may be due to relative humidity during the treatment. The carbohydrate and energy content were maximum in T1 (sundried) treatment 66.15 gm/100gm and 333.02 Kocal/100gm respectively. However, the protein content was maximum in T4 i.e. hot air oven drying treatment. The overall protein content of the oyster mushrooms in present study was lower than estimated by Bashir et al (2020) maximum crude protein in freeze dried oyster mushroom. Bülent and Mehmet (2020) studied the effect of different drying treatment (*viz.* oven drying, vacuum drying, solar drying, and freeze-drying) on the Keme mushroom (*Terfezia boudieri Chatin*) and found significant difference in ash and water activity of the mushrooms with non-significant difference between the moisture content of the dried mushrooms.

Mineral content in oyster mushroom powder dried: The calcium, sodium, potassium and magnesium were also

analysed to understand the effect of drying treatments on respective mineral content in oyster mushroom (Table 3). The oyster mushrooms were had higher potassium content and ranged between 1439.67 and 1710.33 mg/100gm. The maximum calcium, sodium and magnesium were in T4 (hot air drying) (4.04, 12.02, 16.10 mg/100 gm, respectively. However, contrary results were recorded by Bashir et al (2020) and observed highest minerals in freeze dried oyster mushroom and recorded calcium, magnesium, potassium content of 16.12 and 2309.01 mg/100 g, respectively. Least mineral content was recorded in sun dried oyster mushrooms.

Vitamin-D_2 content in oyster mushroom powder: The highest vitamin D2 was noted in T1 (304.67 µg/100g) followed by T4 and T3 (Table 3). A study conducted by Ibrahim and co-workers (2022) on the exposure of oyster

Table 1. Functional properties in drying treatments of oyster mushroom (Mean ±SD)

Treatment	Oil binding capacity (g/gm)	Hydration capacity (g/gm)	TSS (°B)	Total sugars (%)	Non-reducing sugars (%)	Reducing sugars (%)
T_1	2.40 ± 0.006	3.14 ± 0.129	3.10 ± 0.020	6.39 ± 0.200	2.99 ± 0.214	3.40 ± 0.049
T_2	2.46 ± 0.012	4.02 ±0.050	3.35 ± 0.032	9.14 ± 0.079	4.81 ± 0.038	4.33 ± 0.080
T_3	2.45 ± 0.006	3.85 ± 0.137	3.26 ± 0.012	8.03 ± 0.114	4.01 ± 0.162	4.02 ± 0.050
T_4	2.47 ± 0.012	4.36 ± 0.090	3.40 ± 0.026	10.04±0.164	5.60 ± 0.113	4.80 ± 0.055
T_5	2.43 ± 0.006	3.55 ± 0.058	3.20 ± 0.038	7.09 ± 0.104	3.34 ± 0.087	3.75 ± 0.076
CD (p=0.05)	0.029	0.255	0.098	0.472	0.490	0.196

Table 2. Mean proximate composition in drying treatment of oyster mushroom (per 100gm) (Mean ±SD)

Treatment	Moisture (gm)	Crude protein (gm)	Crude fat (gm)	Crude fibre (gm)	Total minerals (gm)	CHO (gm)	Energy (Kcal)
T_1	8.40 ± 0.066	14.40 ± 0.067	1.20 ± 0.098	13.40 ± 0.145	4.85 ± 0.044	66.15 ± 0.226	333.02 ± 0.226
T_2	10.00 ± 0.076	16.42 ± 0.113	1.95 ± 0.023	15.39 ± 0.110	6.03 ± 0.058	60.21 ± 0.206	324.07 ± 0.206
T_3	9.72 ± 0.085	16.03 ± 0.044	1.68 ± 0.088	14.67 ± 0.104	5.86 ± 0.049	61.76 ± 0.174	326.26 ± 0.174
T_4	10.21 ± 0.038	17.10 ± 0.052	2.30 ± 0.056	16.40 ± 0.131	6.90 ± 0.099	57.30 ± 0.173	318.30 ± 0.173
T_5	8.88 ± 0.049	15.62 ± 0.095	1.34 ± 0.053	13.75 ± 0.153	5.48 ± 0.041	63.82 ± 0.232	329.82 ± 0.232
CD (p=0.05)	0.226	0.228	0.224	0.380	0.204	0.535	1.415

Table 3. Mean mineral content in drying treatments of oyster mushroom (per 100 gm) (Mean ±SD)

Treatment	Calcium (mg)	Sodium (mg)	Potassium (mg)	Magnesium (mg)	Vitamin-D_2 (µg)
T_1	3.41 ± 0.011	9.05 ± 0.080	1439.67 ± 0.055	13.40 ± 0.064	304.67 ± 22.696
T_2	3.93 ± 0.030	11.63 ± 0.107	1642.00 ± 0.059	15.89 ± 0.029	216.67 ± 17.638
T_3	3.78 ± 0.045	10.47 ± 0.138	1603.33 ± 0.044	15.57 ± 0.402	263.33 ± 12.019
T_4	4.04 ± 0.067	12.02 ± 0.102	1710.33 ± 0.049	16.10 ± 0.150	276.67 ± 21.858
T_5	3.59 ± 0.014	9.61 ± 0.143	1561.67 ± 0.164	14.26 ± 0.079	196.67 ± 24.037
CD (p=0.05)	0.114	0.317	22.780	0.596	65.198

Table 4. Effect of on organoleptic parameters in drying treatments of oyster mushroom

Treatment	Taste	Flavour	Aroma	Colour	Overall acceptability
T_1	4.88	5.00	4.67	5.00	5.00
T_2	6.33	8.00	7.67	8.00	7.00
T_3	6.00	7.33	7.00	7.33	6.00
T_4	7.33	9.00	8.33	9.00	8.67
T_5	5.67	6.00	5.33	6.33	5.67
CD (p=0.05)	2.242	3.243	3.333	2.855	2.595

mushroom to sunlight for 60 min before drying and found that the vitamin D2 content was increased by 158 per cent. However, the contradictory results were obtained by Simon et al (2011) in button mushrooms (*Agaricus bisporus*).

Organoleptic evaluation of oyster mushroom powder dried by different drying methods: The maximum taste, flavour, aroma, colour and overall acceptability score (7.33, 9.00, 8.33, 9.00 and 8.67) was recorded in treatment T_4 (hot air drying) and was best treatment among all drying treatments, whereas the minimum taste, flavour, aroma, colour, texture and overall acceptability score was recorded in treatment T_1(Sun drying).

CONCLUSION

The different drying treatments viz., sun drying, vacuum drying, freeze drying, hot air drying and tray drying were significantly influenced the physico-chemical properties and nutritional composition of oyster mushroom. The Hot air drying, was significantly superior among all drying treatments and gave the maximum biochemical properties, mineral components and physico-chemical properties, whereas the minimum observations were recorded in Sun drying.

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