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EFFECT OF BLANCHING AND STORAGE CONDITIONS ON THE CHEMICAL COMPOSITION OF OYSTER MUSHROOMS (*PLEUROTUS OSTREATUS* SPP.)

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The investigations were carried to study the effect of blanching times and storage conditions on the chemical composition of dehydrated oyster mushrooms. The sliced mushrooms were blanched in hot water at 98° for 0, 2, 5 and 7, minutes and sulphited by dipping in 0.25% $K_2 S_2 O_5$ solution for 15 minutes. The dehydrated mushrooms were stored in polyethylene bags for 6 months at 20° and at ambient temperatures. The results showed that moisture content was reduced greatly in dehydrated mushrooms stored at ambient temperature, whereas it was increased stored at constant 20° temperature. The ether extracted lipid, protein and crude fibres contents decreased during storage. The ash content increased from 8 to 12% when stored at 20° and whereas it decreased from 11 to 15% under storage at ambient temperature conditions.

Key words: Oyster mushrooms, *Pleurotus ostreatus* spp., Chemical composition.

INTRODUCTION

Mushrooms have been relished as a delicacy for centuries because of their subtle flavour [4], nice aroma and special taste appeal [2]. They are also medicinally used [3, 4] and have a ritual use [5]. Mushrooms are an exotic source of vegetarian protein [6-9]. Technically mushroom is a fungus; grown on compost in mushroom houses under controlled conditions of temperature and humidity, 4 or 5 harvests can be produced during a 2-3 months period. They are harvested daily, cooled immediately and processed the same day to delay veil opening and reduce weight loss [5].

Mushroom cultivation has a great prospect as a cottage industry in Pakistan. Agricultural waste amount to about 11.0 and 3.2 million tonnes of wheat and paddy straw respectively per annum. If half of this quantity were used as bedding material for cultivation of oyster mushroom, the country's foreign exchange would benefit by about 10,500 million dollars annually from exporting 2.1 million tonnes mushrooms [5]. During the year 1984-85, Pakistan earned Rs. 49.2 millions as foreign exchange from exporting dried mushrooms at the rate of Rs. 942/- per kilogram [7]. Being a highly perishable commodity, processing and preservation of mushrooms is of vital importance to this cottage industry.

Mushrooms are rich in protein, carbohydrated and minerals and contains a little fat. For example, Saudi Arabian truffles (*Terfezia claveryi* and *Tirmania nives*) have been reported [8-10] as containing 19.6 and 27.2% protein, 2.8 and 7.4% fat, 7.0 and 13.2% crude fibre, 4.6 and 5.4% ash (on a dry weight basis). Mushrooms being a perishable comodity, the shelf life is important. Fresh and processed oyster species have been prolonged by a factor of 4 when stored in a atmosphere of 40% CO_2 and 1-2% O_2 at 20° [11]. The storing of mushrooms (*Pleurotus flabelletus*) at ambient temperature has resulted in loss of soluble carbohydrate and water. The degree of discolouration also increases with duration of storage time [12]. However, dehydrated mushrooms stored at 25° at 60% relative humidity were acceptable for 2 months [13] but off flavour developed in unblanched oyster mushrooms after 3 months at 30° [14]. Hot water blanching for 2-7 minutes at 80-98° inhibited the activity of peroxidase and o-diphenol oxidase, which resulted in a longer shelf life and maintenance of acceptable quality. Zhuk and Tsapalova [15] blanched mushrooms at 80° and 90° for 2, 5 and 7 minutes using a ratio of 1 mushroom, 4 water and found changes in the soluble carbohydrate content, but no change in total nitrogen content. Blanching at 80° for 2-5 minutes was found to be optimum. Pruthi *et. al.* [11], found that water blanching for 5 minutes was superior to steam blanching for colour retention in dried mushrooms.

Keeping this in view, investigation were carried out to produce a standard product by dehydration of oyster mushrooms and investigate its keeping quality at ambient temperature and in store at 20°.

MATERIALS AND METHODS

The investigations were carried out in the Food Technology Department, University of Agriculture, Faisalabad in 1987. The freshly harvested oyster mushrooms (*Pleurotus ostreatus*) were collected from the Plant Pathology De-

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partment, U.A. Faisalabad and cleaned under sprays of water. The mushrooms were then sliced parallel to their longitudinal axis and placed in a solution of citric acid (0.1% w/v) to prevent browning, before blanching in hot water at 98° for 0, 2, 5 and 7 miunutes. Each lot of blanched mushrooms were sulphited by dipping in 0.25% $K_2 S_2 O_2$ solution for 15 minutes. The peroxidase test [16] was used to determine the adequacy of blanching. A representative macerated sample of 2 g was the roughly mixed with sufficient quantity of 0.5% guaiacol (in 50% ethyl alcohol) solution in China dish. Then similar amount of 0.08% hydrogen peroxide was added. A heavy reddish brown colour formation after 3 minutes indicated the presence of peroxidase activity (positive) and no change in colour indicated absence of peroxidase activity (negative). The results were as follow.

Each batch of blanched mushrooms were spread uniformaly on drying trays at the rate of 1 kg/m² and dried to about 5% moisture level using a tunnel dehydrator (inlet temperature 40°), outlet temperature 70° and air velocity of 152.4 m/min. The dehydrated mushrooms were ground, packed in polyethylene bags (0.04 ± 0.01 mm thickness) and sealed manually using a heat sealer. Eighteen bagged dried mushrooms per treatment were stored at 20° and ambient temperature which ranged from 2.5° during January to 46.0° during June. Three samples were collected at monthly intervals and analyzed for moisture, ether extractive lipid, protein, crude fibre and ash by standard AOAC methods [17]. Data were analyzed statistically by analysis of variance [18].

Table 1. Effect of blanching time on peroxidase activity in fresh mushrooms.

Blanching time (min.)	Test
0	+
2	–
5	–
7	–

A blanching time of 2 minutes was the minimum for effective inactivation of the peroxidase enzyme (no colour formation).

RESULTS AND DISCUSSION

An analysis of variance (Table 2) and depicted in (Fig. 1.) indicated highly significant differences for storage periods and blanching times independent of each other. The moisture content decreased substantially from 17.9 to 23.2% during storage at ambient temperature, which may be attributed to dry environment under these conditions. Conversely, mushrooms stored at 20° gained from 14 to 18% moisture, due to the higher relative humidity under these conditions. The actual moisture content ranged from 5.0 to 6.0, which is well below other reported values [11].

The data in Table 3 and illustrated in (Fig. 2) indicated highly significant differences due to different blanching times and storage intervals. The ether extractives lipid content decreased significantly with increase in blanching time under all storage conditions. The decrease in ether extractives lipid during blanching, an increase in moisture content

Table 2. Effect of blanching time on moisture content (%) in dried mushrooms during storage at ambient temperature and 20°.

Storage period (months)	Blanching time (min.) 0 Amb	0 20°C	2 Amb	2 20°C	5 Amb	5 20°C	7 Amb	7 20°C	Mean Amb	Mean 20°C
0	5.6	5.0	6.5	5.0	6.6	5.2	6.7	5.1	6.4	5.1
1	5.3	5.2	5.4	5.2	6.5	5.3	6.6	5.4	6.0	5.3
2	4.7	5.4	6.2	5.4	6.5	5.4	6.5	5.5	6.0	5.4
3	4.5	5.5	6.2	5.5	6.3	5.5	6.4	5.7	5.9	5.6
4	4.3	5.6	5.7	5.6	5.9	5.7	5.9	5.8	5.5	5.7
5	4.3	5.8	5.5	5.6	5.4	5.7	5.7	6.0	5.2	5.8
6	4.3	5.9	5.3	5.7	5.2	6.0	5.5	6.0	5.1	5.9
Mean	4.7	5.5	5.8	5.4	6.1	5.5	6.2	5.6		

Treatments	Stat. Significance Temperature °C	LSD P = 0.05	LSD P = 0.01	S.E. ±
Storage	Ambient	0.90	0.12	0.045
	20°	0.03	0.05	0.017
Blanching	Ambient	0.07	0.09	0.033
	20°	0.02	—	0.010

– All values are averages of three replicates.

during storage at 20° or the formation of lipid peroxidation products due to high storage temperature. The lipid content ranged from 2.5 to 4.8% in *Pleurotus ostreatus* mushrooms, somewhat lower than reported fat values (6.7 to 7.4%) in other species of mushrooms [1, 8, 10]. This variation may be due to species differences, the substrate used and environmental conditions.

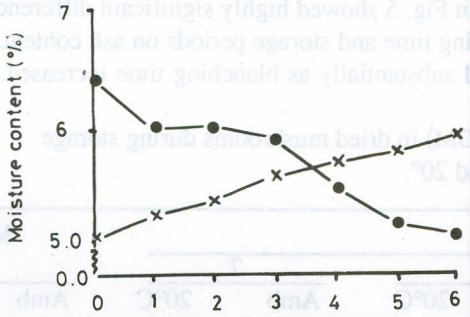

Fig. 1. Storage period (months).

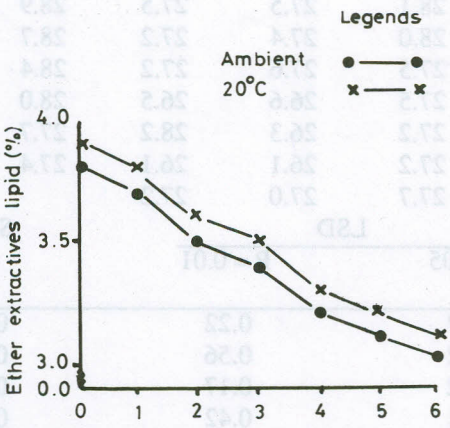

Fig. 2. Storage period (months).

The blanching time and storage intervals showed a highly significant effect on protein content of dried mushrooms (Table 4, Fig. 3). There were highly significant losses in protein content in dried mushrooms with blanching times due to leaching and storage periods under conditions of high relative humidity at 20°. These results agree with other published data [11]. The protein content was about 31% which agreed with other published values [8-10].

Differences in the crude fibre (Table 5, Fig. 4) content were highly significant correlated with blanching time and storage period. The crude fibre content progressively during storage at both ambient temperature and 20°, but increased with blanching time at ambient temperature stor-

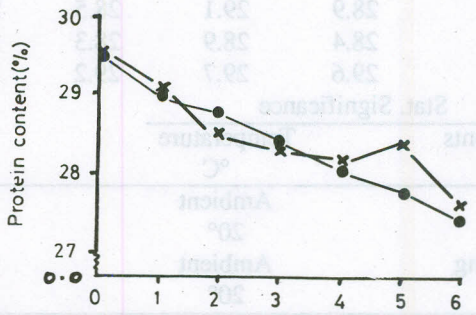

Fig. 3. Storage period (months).

Table 3. Effect of lanching time on ether extractives fat content (% of DM) in dried mushrooms during storage at ambient temperatue and 20°.

Storage period (months)	Blanching time (min.) 0 Amb	0 20°C	2 Amb	2 20°C	5 Amb	5 20°C	7 Amb	7 20°C	Mean Amb	Mean 20°C
0	4.8	4.6	3.8	3.8	3.7	3.7	3.4	3.4	3.9	3.9
1	4.4	4.5	3.7	3.7	3.5	3.4	3.2	3.2	3.7	3.7
2	4.3	4.4	3.6	3.5	3.3	3.3	3.1	3.1	3.6	3.6
3	4.2	4.3	3.3	3.2	3.2	3.4	2.9	3.0	3.4	3.5
4	3.9	4.0	3.1	3.1	3.1	3.1	2.7	2.8	3.2	3.2
5	3.8	3.6	3.0	3.0	2.9	3.0	2.6	2.7	3.1	3.1
6	3.8	3.9	2.8	3.0	2.8	2.8	2.5	2.5	3.0	3.0
Mean	4.2	4.2	3.3	3.3	3.2	3.2	2.9	3.0		

Stat. Significance Treatments	Temperature °C	LSD P = 0.05	LSD P = 0.01	S.E. ±
Storage	Ambient	0.06	0.08	0.032
	20°	0.09	0.12	0.045
Blanching	Ambient	0.04	0.06	0.022
	20°	0.07	0.09	0.034

– All values are averages of three replicates.

age, while it remained relatively unaffected at 20° storage. This agrees with the observations of Prestley [1] who found that the content of hot water soluble material leached from fibre increased as blanching time increased, and those of Hussain and Eid [8]. However, Hussain and Eid [8] and Sawaya *et. al.* [10] reported higher value of crude fibre. Again variations may be due to species, substrate used and environmental conditions.

An analysis of variance of data (Table 6) and illustrated in Fig. 5 showed highly significant differences due to blanching time and storage periods on ash content. This decreased substantially as blanching time increased. The val-

Table 4. Effect of blanching time on protein content (% of DM) in dried mushrooms during storage at ambient temperature and 20°.

Storage period (months)	Blanching time (min.) 0		2		5		7		Mean	
	Amb	20°C	Amb	20°C	Amb	20°C	Amb	20°C	Amb	20°C
0	31.0	31.0	30.3	30.3	28.4	28.4	27.7	27.7	29.4	29.4
1	30.5	30.5	29.6	29.7	28.1	28.1	27.5	27.5	28.9	29.0
2	30.0	29.6	29.4	29.3	28.0	28.0	27.4	27.2	28.7	28.5
3	29.5	29.4	29.2	29.2	27.4	27.5	27.6	27.2	28.4	28.3
4	29.1	29.2	29.0	29.1	27.3	27.5	26.6	26.5	28.0	28.1
5	28.9	29.1	28.5	28.9	27.1	27.2	26.3	28.2	27.7	28.4
6	28.4	28.9	28.3	28.2	26.8	27.2	26.1	26.1	27.4	27.6
Mean	29.6	29.7	29.2	29.2	27.6	27.7	27.0	27.2		

Stat. Significance		LSD		S.E. ±
Treatments	Temperature °C	P = 0.05	P = 0.01	
Storage	Ambient	0.17	0.22	0.083
	20°	0.42	0.56	0.208
Blanching	Ambient	0.12	0.17	0.063
	20°	0.31	0.42	0.157

– All values are averages of three replicates.

Table 5. Effect of blanching time on crude fibre content (% of DM) in dried mushrom during stroage at ambient temperature and 20°.

Storage period (months)	Blanching time (min.) 0		2		5		7		Mean	
	Amb	20°C	Amb	20°C	Amb	20°C	Amb	20°C	Amb	20°C
0	5.9	5.0	6.7	5.1	6.7	5.1	6.8	5.0	6.5	5.1
1	5.9	5.1	7.0	5.2	6.5	5.3	6.6	5.4	6.5	5.3
2	5.7	5.3	6.1	5.5	6.3	5.4	6.4	5.5	6.1	5.4
3	5.5	5.4	5.6	5.6	6.0	5.8	6.2	5.6	5.8	5.6
4	5.4	5.5	5.4	5.7	5.8	5.6	6.0	5.8	5.7	5.7
5	4.4	5.8	5.1	6.0	5.5	5.8	5.6	6.0	5.2	5.9
6	4.3	6.1	4.8	6.2	5.1	6.1	5.3	6.2	4.9	5.2
Mean	5.3	5.5	5.8	5.6	6.0	5.6	6.1	5.6		

Stat. Significance		LSD		S.E. ±
Treatments	Temperature °C	P = 0.05	P = 0.01	
Storage	Ambient	0.16	0.22	0.081
	20°	0.12	0.17	0.062
Blanching	Ambient	0.12	0.16	0.061
	20°	0.09	0.12	0.047

– All values are averages of three replicates.

Table 6. Effect of blanching tiem on crude fibre content (% of DM) in dried mushroom during storage at ambient temperature and 20°.

Storage period (months)	Blanching time (min.) 0 Amb	0 20°C	2 Amb	2 20°C	5 Amb	5 20°C	7 Amb	7 20°C	Mean Amb	Mean 20°C
0	6.1	6.1	5.4	5.4	4.8	4.8	4.2	4.3	5.1	5.2
1	6.1	6.1	5.5	5.5	4.8	4.8	4.3	4.3	5.2	5.2
2	6.3	6.2	5.6	5.6	4.8	4.9	4.3	4.4	5.3	5.3
3	6.4	6.3	6.0	5.7	4.9	5.2	4.5	4.5	5.5	5.4
4	6.5	6.4	5.8	5.7	4.9	5.2	4.6	4.6	5.5	5.5
5	6.6	6.4	5.9	5.8	5.1	5.2	4.7	4.5	5.6	5.5
6	6.8	6.5	6.0	5.9	5.3	5.3	5.8	4.8	5.7	5.6
Mean	6.4	6.3	5.7	5.7	4.9	5.1	4.5	4.5		

Stat. Significance Treatments	Temperature °C	LSD P = 0.05	LSD P = 0.01	S.E. ±
Storage	Ambient	0.11	0.15	0.055
	20°	0.09	0.12	0.045
Blanching	Ambient	0.08	0.11	0.041
	20°	0.07	0.09	0.034

– All values are averages of three replicates.

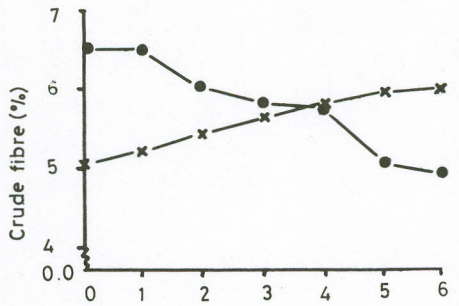

Fig. 4. Storage period (months).

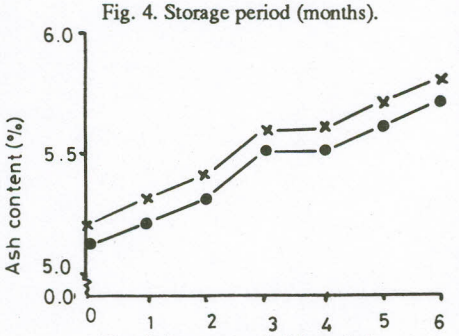

Fig. 5. Storage period (months).

ues (around 6.0% of PM) were greater than for Kuwaiti and Saudi Arabian Truffles [8].

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