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Sensory Characteristics of Papad Prepared using Mushroom Powder

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Abstract Mushroom cultivation and consumption is increasing in this modern world. Mushroom is a form of plant life and considered as one of the useful and delicious member of the vegetable kingdom. Utilization of dried & powdered oyster mushrooms into traditional foods has increased these days. Papad is the one of most popular Indian snack consumed either after deep-fat frying or roasting and it is one such snack where mushroom powder can be added. For the present study, experimental papads were prepared using oyster mushroom powder at 10% (E1), 15% (E2) & 20% (E3) levels with black gram & green gram dhals. Papads were sun dried and roasted on LPG gas-stove & deep fried and compared with control papad for palatability. Appearance of E3 papad received comparatively lower scores because of darker colour imparted by mushroom powder. E1 & E2 papads were well accepted for all sensory attributes. Mushroom papads prepared in the present study were good in protein, dietary fiber, iron, calcium and phosphorus. It can be concluded that oyster mushroom powder can be incorporated in papad without affecting the sensory quality.
Keywords *Mushroom powder; papad; oyster mushroom; palatability*

1. Introduction

The history of mushroom is as old as the origin of man himself. These have existed for millions of years and are considered as valuable food for flavour and nutrition. Mushrooms have been used by man from time immemorial and their use of culinary purpose is closely related to the history of mankind. In the more affluent countries, mushrooms are considered as somewhat expensive type of vegetables that are eaten almost entirely for their culinary properties, and for providing flavour and/or garnish for other foods (Flegg, 1977).

A need for food protein compels one to explore unconventional protein sources is the single cell protein. Mushrooms are the oldest single cell protein food of man. There is a great demand for edible mushroom for its flavour and nutrient content and therefore, it leads itself to many novel recipes. The most popular varieties of mushrooms are white button (*agaricus bisporus*), paddy straw *(volveriella volvacea*), shiitake (*lentinus edodes*) and oyster *(pleurotus species)*. But mushroom being highly

perishable forces the producer to preserve and process it. In many regions of Europe and Asia, mushrooms are gathered every year in quantities and immediately pickled or salted or dried for use during the winter (Sawaya et al., 1985).

Mushroom is the most priced commodity among vegetables not because of its nutritive value but because of its characteristic aroma and flavor. However, it is now a well-established fact that mushrooms are excellent sources of vitamins and minerals (Khader, 1999). Fresh mushrooms contain about 85-95% moisture content, 3% protein, 4% carbohydrate, 0.3-0.4% fat and 1% minerals and vitamins. They also contain appreciable amount of niacin, pantothenic acid and biotin. In addition, mushroom also contain folic acid and vitamin B_{12} which are absent in most of the vegetables (Ude and Ezenwugo, 2001). It is also good in calcium (3%), iron (1.3%), magnesium (18%), phosphorus (120%) & selenium (2.6%) (http://nutritiondata.self.com/facts/vegetables-and-vegetable-products/3050/2).

Mushroom shows activity against cancer. It has shown antitumor, anti-inflammatory, antiviral and antibiotic activities. The consumption of mushroom-containing diet prevented serum cholesterol increase at the end of four week period and lowered by almost 40% as compared with control group which have not had mushroom in their diet (Ghosh and Chakravorty, 1990). Oyster mushrooms are also suitable additions to the diets of people with obesity, diabetes, dyslipidemia and high blood pressure. This is primarily because these mushrooms are low in sodium and zero in cholesterol. Other health benefits include antioxidant and anti-bacterial properties (Gregori et al., 2007; Cheung, P.C.K., 2010 & http://www.diethealthclub.com/health-food/oyster-mushrooms.html).

Mushroom may be baked, fried, boiled, creamed, roasted, pickled and stuffed. In India, it is mostly consumed fresh. However, where mushrooms can be grown at ambient temperature (i.e. hilly areas) but cannot be transported quickly to consumption places, the only way to its utilization is its processing. They can be processed as canned, dried or frozen mushrooms. The vitamins in mushroom are well retained during cooking, canning and dehydration. The moisture content in dried mushrooms should be between 5 and 8%. Drying of mushrooms is done to remove free water to such a level such that the biochemical and microbial activity are checked due to reduced water activity (Suguna, S. et al., 1995; Lidhoo, C.K. and Agrawal, Y.C., 2006). Dried mushrooms are rich in calories (300%), protein (10%), carbohydrates (80%) & total dietary fiber (10%) (https://ndb.nal.usda.gov). Further their high lysine, leucine, valine and tryptophan content make them good supplement to cereal-based Indian diets (Bano and Rajarathnam, 1988 & https://ndb.nal.usda.gov). These characteristics have made them a very valuable food. Mushroom powder have been used by many researchers for development of variety of food products like mathri & rava idli (Singh, V., and Verma, A., 2013), besan laddoo (Verma, A. and Singh, V., 2014), jam & squash (Lakshmipathy, G. et al., 2013) & biscuits (Wakchaure, G.C. et al., 2010). Regula, J. and Michalowska, G. (2010) successfully prepared cookies & breads with 10 and 20% dried mushroom powder added to the flour & they recommended it as a good quality dietary supplement.

A large section of population consumes papads. Papad is one of the many preserved dehydrated form of foods. Since centuries, papad has been a popular snack item of India and many varieties are available commercially (Saxena et al., 1989). Papads are mostly prepared either on cottage scale or on home scale, some of which have grown into large organized sectors.

This study was undertaken with the objective of developing papad with incorporation of oyster mushroom powder.

2. Materials and Methods

2.1. Procurement of mushroom powder

Dried samples of oyster mushrooms were obtained from Mushroom Research Centre (Jawahar Lal Nehru Agriculture college of Jabalpur). Dried mushrooms were grinded in a mixer grinder and passed through 60 mesh sieve to get very fine powder. Other ingredients were purchased from the local market of Nagpur city, Maharashtra, India.

2.2. Preparation of papad

Standardized recipe of papad was selected from one of the leading Griha Udyog from Nagpur city. Dried mushroom powder was incorporated at different levels (10%, 15% & 20%).

2.3. Composition of papad

Standard method of preparation of papad was used as shown in Table 1. Papads were sundried & stored in airtight container for palatability trials.

Table 1: *Composition of Control and Experimental Papad*

Sr. No.	INGREDIENTS	Quantity (g)			
		Control (C)	Experimental 1 (E1) (10% Mushroom Powder)	Experimental 2 (E2) (15% Mushroom Powder)	Experimental 3 (E3) (20% Mushroom Powder)
1	Black gram dhal	125	115.6	110.9	106.2
2	Green gram dhal	62.5	53.14	48.4	43.7
3	Common salt	7.5	7.5	7.5	7.5
4	Papad khar	5.62	5.62	5.62	5.62
5	Black pepper	7	7	7	7
6	Cumin seeds	3	3	3	3
7	Soda	0.11	0.11	0.11	0.11
8	Asafoetida	0.06	0.06	0.06	0.06
9	Mushroom powder	-	18.75	28.12	37.5
10	Water (ml)	75	80	88	99

2.4. Sensory evaluation of Papad

The sensory characteristics of papads were screened by six trained judges in three trials for consecutive three days. Coded papad samples (roasted on LPG stove & deep fried at 180^0C) were served to the panelists in random order to guard against any bias. Water at room temperature was used to clear the mouth before the each test sample. Scoring was done for maximum score of 10 to a minimum score of 4 for sensory attributes like appearance, texture, flavour, taste and acceptability (Table 2 & 3).

Table 2: Sample *Score Card for Sensory Evaluation of Papad*

Sr. No.	Papad Codes	Trials	Appearance	Texture	Flavour	Taste	Acceptability
1	C	T1					
		T2					
		T3					
2	E1	T1					
		T2					
		T3					
3	E2	T1					
		T2					
		T3					
4	E3	T1					
		T2					
		T3					

Table 3: *Key Sensory Evaluation of Papad*

Sr. No.	Appearance	Texture	Flavour	Taste	Acceptability	Score
1	Very good	Very good	Very good	Very good	Highly acceptable	10
2	Good	Good	Good	Good	Acceptable	8
3	Fair	Fair	Fair	Fair	Fairley acceptable	6
4	Poor	Poor	Poor	Poor	Unacceptable	4

2.5. Nutritive value of papad

Nutritive value of papad was calculated using food composition tables given by Gopalan et al. (2006) & USDA (https://ndb.nal.usda.gov).

3. Statistical Analysis

Results of sensory evaluation were collected and tabulated. Means were calculated. Comparisons between control & experimental papads were done by using students ‘t’ test. A level of significance at both 5 % and 1 % levels was assumed to draw conclusions.

4. Results and Discussion

Figure 1 shows data on moisture content of papads. With increase in the level of mushroom powder, moisture content was also found to be high (14.05 to 15.14 %).

An attempt was made to record absorption of oil in deep fried papads (Figure 2). With increase in the level of mushroom powder in papads, % oil absorption was found to be decreased (from 1.95 to 1.6%).

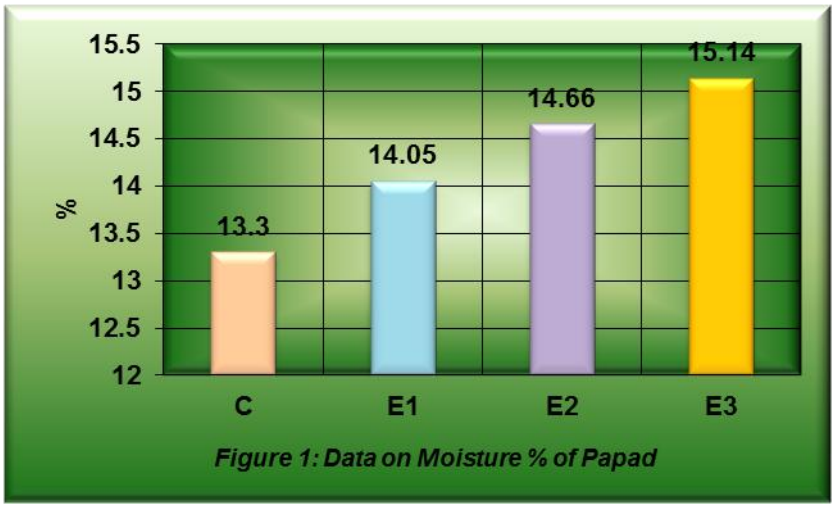

Figure 1: *Data on Moisture % of Papad*

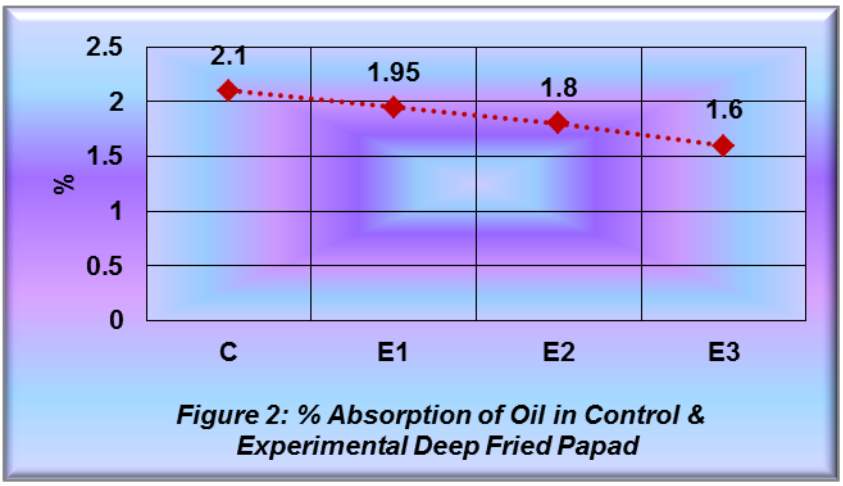

Figure 2: *% Absorption of oil in control & experimental deep fried papad*

Table 4: *Basic Data for Control & Experimental Papad*

Sr. No.	Papads	Water Required for Kneading (ml)	Kneading Time (min)	Weight of Dough (g)	Total No. of Papad	Weight of Papad (g)	
						Raw	After Sun Drying
1	C	90	8.5	282	23	9.0	8.9
2	E1	92	8	286	24	9.2	9.0
3	E2	95	7.5	295.6	24	10	9.2
4	E3	98	7	299.6	25	11	9.4

Increment in the quantity of mushroom powder also increased amount of water required for kneading dough. Yield was found to be also increased (Table 4).

Table 5: *Mean Palatability Evaluation Scores & Statistical Interpretation of Comparison between Various Sensory Attributes of Control and Experimental Papad*

Sr. No.	Sensory Attributes	Mean Palatability Evaluation Scores				t Values		
		C	E1	E2	E3	C vs. E1	C vs. E2	C vs. E3
1	**Roasted Papad**							
i	Appearance	9.5	9.3	8.0	7.8	0.42	2.34*	2.57*
ii	Texture	9.5	9.4	9.4	9.4	0.83	0.19	0.23
iii	Flavour	8.8	8.9	8.9	8.5	0.17	0.16	0.48
iv	Taste	9.5	9.1	9.1	8.3	0.88	1.50	2.52*
v	Acceptability	9.4	8.9	8.9	8.53	1.16	1.37	1.55
2	**Deep Fried Papad**							
i	Appearance	9.4	8.6	7.7	7.6	0.41	2.21*	2.24*
ii	Texture	9.2	9.3	8.9	8.6	0.15	0.73	0.42
iii	Flavour	8.8	8.7	8.5	8.2	0.13	0.46	0.89
iv	Taste	9.7	9.4	9.0	8.4	0.74	1.14	2.43*
v	Acceptability	9.3	9.2	8.76	8.4	0.57	1.06	1.47

*- Signification at 0.05 level but in significant at 0.01 level (0.01<p<0.05)
All the values show insignificant differences at both 0.05 & 0.01 levels (p>0.05)

Appearance of roasted & deep fried E3 papad prepared from 20% mushroom powder received lowest mean scores (7.8 & 7.6, respectively) as compared to C papad (t=2.57 & 2.24, respectively, 0.01<p<0.05, Table 5). Similar results were obtained for comparison between E2 & C papad for appearance. E1 papad prepared using 10% mushroom powder was well accepted for appearance. Lower mean scores for appearance of mushroom papad might be because dark brownish colour imparted by addition of mushroom power. Roasted papad were more acceptable than deep fried papad for appearance (t=0.23 to 1.12, p>0.05).

All experimental roasted & deep fried papads were well accepted for their texture, with insignificantly lower mean scores than control papad (t=0.83, 0.19 & 0.23 & 0.15, 0.73 & 0.42, respectively for comparison for C vs. E1, C vs. E2 & C vs. E3, respectively for roasted & deep fried, p>0.05). Papads were found crisp after roasting & deep frying. Roasted papad received slightly higher mean scores for texture than deep fried papad (Table 5).

Flavour of roasted mushroom papads was found to be acceptable. Insignificant differences between flavour of control & experimental roasted & deep fried papads were noted (t=0.16 to 0.18 for roasted & t=0.13 to 0.89 for deep fried papad, p>0.05). It was noted that addition of 20% mushroom powder was also rated good for flavour. It indicates acceptability of mushroom powder for its flavour. Scores for flavour of roasted papad were found to be slightly higher than deep fried papad.

Increment in the level of mushroom powder in E3 papad reduced the taste profile (t=2.52 for roasted & t=2.43 for deep fried, 0.01<p<0.05). However, E1 & E2 papads were very well accepted for their taste indicating suitability of mushroom powder up to 15% in making papad. Insignificant differences were obtained when control papad was compared with E1 & E2 (t=0.88 & 1.50 for roasted & t=0.74 & 1.14 for deep fried papad, respectively, p>0.05). Control, E1 & E3 deep fried papad rated higher than roasted papad for their taste.

Both roasted & deep fried experimental papads were well accepted when compared with control with very insignificant differences as also clear from Table 5 (t=1.16 for C vs. E1, 1.37 for C vs. E2 & 1.55 for C vs. E3 for roasted papads and t=0.57 for C vs. E1, 1.06 for C vs. E2 & 1.47 for C vs. E3 for deep fried papad).

Table 6: *Nutritive Value of Papad (per 100 g)*

Sr. No.	Nutrients	C	E1	E2	E3
1	Energy (kcal)	324	317	313	310
2	Carbohydrate (g)	55.22	54.43	54.04	53.64
3	Protein(g)	22.15	24.49	24.60	24.71
4	Fat (g)	1.63	1.65	2.14	2.16
5	Crude Fibre (g)	1.44	2.54	3.09	3.64
6	Calcium (mg)	144.2	136.3	132.8	129.0
7	Phosphorus (mg)	129.7	491.7	556.3	621.1
8	Iron (mg)	3.99	3.79	3.70	3.61
9	Sodium (mg)	1457	1454	1452	1451
10	Potassium (mg)	828	1155	1307	1471

Mushroom papads prepared in the present study can serve a very good source of protein, dietary fiber, calcium and phosphorus. Protein content of mushroom found to be increased with increased level of mushroom powder in experimental papad (24.49 to 24.71%) whereas energy & carbohydrate contents decreased (Table 6). Protein content of mushroom fortified rava idli & mathari developed by Singh, V. and Verma, A. (2013) was 12.93 and 8.26%, respectively. The mean values of protein of besan laddoo prepared with 10% & 15% oyster mushroom powder by Verma, A. and Singh, V. (2014) were reported as 9.4 & 9.6%, respectively.

These papads were found to be high in fiber & hence, can serve a very good source for those who need fiber rich diets. Calcium, phosphorus, iron, sodium & potassium content of these papads were found to be good (Table 6). Mushroom fortified papads can be prescribed for vegetarian population like children, pregnant & lactating women & as these are low in fat, these papads can also be recommended for diabetics, obese individuals & also for heart disease patients in roasted form.

For the present study, dehydrated oyster mushroom powder was successfully incorporated in making papads. Papads prepared with 10% & 15% dehydrated mushroom powder did not affect appearance, texture, flavour, taste and overall acceptability. 10%-15% of mushroom powder can be incorporated in papads with black gram dhal and green gram dhal without any significant adverse effect on sensory quality of papads.

Result of present study confirmed the fact that dehydrated mushroom powder can be successfully incorporated without affecting sensory qualities.

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