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ENHANCEMENT OF NUTRITIONAL VALUE OF KHAKHRA

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The present investigation was undertaken to determine the sensory quality and nutrient content of khakhra prepared with the incorporation of mushroom powder. For the same purpose fresh shiitake (*Lentinus edodes*) mushroom was processed, dried and evaluated for nutrient composition. Khakhra were prepared by using refined wheat flour, salt, water and mushroom powder. The developed khakhra were evaluated organoleptically using nine point scale. Khakhra prepared with 10% of mushroom powder was acceptable and used for their proximate content and total dietary fiber. Result shows that khakhra prepared with mushroom powder was found to be high in protein (25 g), total dietary fiber (7.2 g), crude fiber (5.8 g) and ash (2.2 g) as compared to control khakhra. Addition of mushroom powder increased nutrient density of khakhra. Thus, mushroom based value added products may be beneficial for vulnerable population due its high nutritive value. These would also be advantageous for those who are suffering from degenerative diseases because of its therapeutic properties. The results of the present study suggest that the mushrooms powder can be incorporated up to 10% level in the recipes. Incorporation of mushrooms powder (10%) improves nutritional quality of the recipes.

Keywords: Traditional recipe, Fortification, Mushroom powder, Nutrient content, Sensory evaluation

INTRODUCTION

Food is a part of man's culture and is filled with different meanings and symbolisms for individuals of different age groups. The food should be nutritious, attractive in flavor and appearance, to be eaten and enjoyed. Mushrooms have been valued as edible and medical provisions for humankind. Medicinal mushrooms are mushrooms, or mushroom extracts, that are used or studied as possible treatments for diseases (Wikipedia, 2011). Certain medicinal mushrooms such as Shiitake have history of medicinal use spanning millennia in parts of Asia. *Lentinus edodes* (shiitake) is one of the world's second largest cultivated medicinal and edible mushroom used as 'Functional foods' has a long history in

oriental folklore for treatment of tumors, flu, heart diseases, high blood pressure, obesity, problems related to sexual dysfunction and ageing, diabetes, liver ailments, respiratory diseases, exhaustion and weakness. *L. edodes* is among the most valuable medicinal mushroom (Breene, 1990).

Shiitake mushrooms have excellent nutritional value. Their raw fruit bodies include 88 to 92% water, protein, lipids, carbohydrates, vitamins, and minerals. Dried shiitake mushrooms are nutrient-rich, containing 58 to 60% carbohydrates, 20 to 23% protein (digestibility of 80 to 87%), 9 to 10% fiber, 3 to 4% lipids, and 4 to 5% ash (Hobbs, 2000). In the recent years there is growing concern regarding the

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nutritive value of foods and to nourish the ever increasing population and the inadequacy of essential nutrients can be improved through fortifications and enrichment of food vehicles. A balance of nutrients may be obtained by including whole cereals, vegetables, pulses and milk and milk products etc. Such a diet provides a large proportion of our need for energy, carbohydrate, protein, dietary fiber, amino acid and minerals. Traditional preparations when modified like *khakhra*, with incorporation of mushroom powder could serve a means of enhancing nutritive value of food. Therefore, the present study was undertaken to know the effect of addition of mushroom powder on the nutritive value of *khakhra*.

PROCESSING OF MUSHROOM

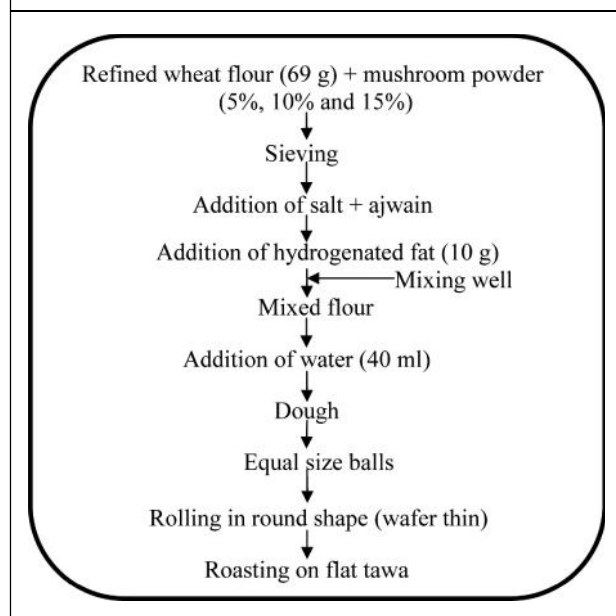
Shiitake (*Lentinula edodes*) mushroom was procured in bulk from Himalaya Research Group, Shimla (H.P.). Mushroom was cleaned and washed in tap water and subjected to oven drying as suggested by Taygi and Nath (2005). Processing steps is given in Figure 1.

Development of *khakhra*: *Khakhra* is also referred as crispy chapatti or roti. It is a common Gujarati Indian bread or snack item served during breakfast or snack time. It is simple to prepare and is made from whole wheat flour adding other ingredients and spices. *Khakhra* is made in several varieties such as methi, jeera, bajri, math and masala flavors.

Figure 1: Flow Diagram of Processing of Mushroom



Figure 2: Flow Diagram for Preparation of *Khakhra*



Having low moisture content than cakes and bread, *khakhra* are generally safer from microbiological spoilage and have long shelf-life (Wang *et al.*, 2002). Levels of incorporation of mushroom powder were 5, 10 and 15%. Ingredients used were refined wheat flour (62 g), oil (20 g), salt (a pinch) and water (40 ml) Figure 2.

Organoleptic Evaluation: The developed value added *Khakhra* was standardized using organoleptic evaluation technique with the help of 10 panel members using 9-point hedonic ranking scale. The developed value added *khakhra* along with control sample was served to the panel members for organoleptic evaluation. Most acceptable level of mushroom powder in *khakhra* was further analyzed for its nutrient content.

Nutritional Evaluation: Nutritional evaluation of the mushroom powder, control and the developed *khakhra* was done for their proximate composition and total dietary fiber (NIN, 2010). Percentage carbohydrate and energy contents of developed recipe were determined by calculation using difference method and Atwater factor, respectively.

RESULT AND DISCUSSION

Organoleptic evaluation: The mean scores of the preparation are presented in Table 1. The overall mean score of *khakhra* ranged from 6.7 to 8.0 on 9 point hedonic scale. This indicated that the recipes were found to fall under the category of 'liked very much to liked moderately. As it can

Table 1: Mean±S.E. of Acceptability Scores of *Khakhra*

Treatments	Color	Texture	Falvor	Appearance	Taste	Overall Acceptability
T0 (control)	8.2	7.9	8.1	8.1	7.9	8
T1 (5%)	7.9	7.7	7.5	7.6	7.7	7.6
T2 (10%)	7	7.6	7.6	7.3	7.8	7.5
T3 (15%)	6.4	7.9	7.1	6.5	7	6.7
General Mean	7.3	7.6	7.5	7.3	7.6	7.5
CD5%	0.54	0.49	0.49	0.6	0.57	0.4
CD1%	0.72**	0.66**	0.66**	0.80**	0.77*	0.54**

be seen from the Table 4.6 that control (T_0) recipe of *khakhra* obtained highest overall acceptability scores (8.0 ± 0.60) as compared to test recipes, *i.e.*, 6.7 ± 0.37 (T_3), 7.5 ± 0.35 (T_2), and 7.6 ± 0.41 (T_1) with 15, 10 and 5% mushroom powder respectively. Amongst the test recipes, sensory scores of *khakhra* prepared with 5% level of mushroom powder has been ranked highest for all sensory attributes, *i.e.*, 7.9 ± 0.31 (color), 7.7 ± 0.48 (texture), 7.5 ± 0.70 (flavor), 7.6 ± 0.51 (appearance) and 7.7 ± 0.67 (taste), than the *khakhra* prepared with 10 and 15% level of mushroom powder. Further, it can be discerned that there was a general decrease in all sensory attributes with increase in the incorporation level (15%) of mushroom powder. Statistical data revealed that there was significant difference in taste, color, flavor, texture, appearance and overall acceptability of *khakhra* at $p \leq 0.01$. Study conducted by Sharma (2010) showed that incorporation of AVL (aloe vera leaf powder) at 12% in snacks items like *khakhra*, *masala parwal* and *sev* maintained their moderately liked status.

Nutritional Evaluation: Table 2 shows nutrient composition of Shiitake (*L. edodes*) mushroom. The moisture content of dried powder was 10.3%. Julita and Marek (2007) reported slightly lower moisture content in dried shiitake mushroom, *i.e.*, 7.14%. Shiitake (*L. edodes*) are good source of protein for humans as compared to green vegetables. Regarding protein content of dried shiitake mushroom powder, the present observation (33%) can be considered comparable with those (32.9%) reported by Stamets (2005). The difference in protein content of mushroom may be due to number of factors, namely, the stage of development, the part of samples, level of nitrogen available and the location (Khan *et al.*, 2008). Mushrooms are potential source of dietary fibre due to the presence of non-starch polysaccharides.

Result of present investigation revealed that shiitake mushroom powder consist of 15.6% of crude fibre. The total dietary fibre content was found to be 43.2% in dried shiitake mushroom, which is comparable with the value 46.1%, reported by Julita and Marek (2007) for shiitake mushroom. Soluble and insoluble dietary fibre content was 17.9 and 25.3% respectively in present investigation. According to Kaul (2001) the high fibre or polysaccharide content of these mushrooms might be responsible for their several medicinal importances. Fat content of mushroom powder was 1.63% on dry weight basis. Hung and Nhi (2012) reported high fat content in dried shiitake mushroom, *i.e.*, 2.3%. Carbohydrate and energy content of dried mushroom powder were 44.5 g

Table 2: Proximate Composition of Mushroom Powder on 100 g (Dry Weight Basis)

Nutrients	Mean±S.D.
Moisture (g)	10.3±0.9
Protein (g)	33.0±2.8
Crude fibre (g)	15.6±2.6
Fat (g)	1.6±0.5
Ash (g)	5.5±0.2
Carbohydrate (g)	44.5±4.7
Energy (kcal)	324.8±11.3
Total dietary fibre (g)	43.2±0.4
Soluble fibre (g)	17.9±0.1
Insoluble fibre (g)	25.3±0.1

Table 3: Proximate Composition of Value Added Biscuit (on Dry Weight Basis)

Biscuit	Moisture (%)	Crude Protein (%)	Crude Fat (%)	Crude Fiber (%)	Ash (%)	Carbohydrate (%)	Energy (kcal)	Total Dietary Fiber (g)
Control	3.5	13.9	2.7	2.1	2	50.8	396.6	2.6
Test	5.6	24.9	5.9	5.8	2.2	61	379	7.2
<i>t</i> value	2.98	10.4*	4.69*	8.26*	0.39	8.7**	0.27	1.64*

Note: Values are mean±SD of three replicates. *significant at 1% significant; **significant at 5% significant.

and 324.8 kcal percent respectively. Regarding the ash content of mushroom powder, the present observation (5.5%) can be considered comparable with those (5.8%) reported by Mattila *et al.* (2002). From the present findings it can be concluded that the shiitake mushroom, is protein and fibre rich with low fat content. The ash (total minerals) content was also considerable and the carbohydrate content was less than other foods. These nutrients content made mushroom as a low energy, healthy foodstuff and this mushroom may also be used as protein and fibre supplements.

Data from Table 3 unfold the nutritional contents of control and developed *khakhra*. Moisture content of control and test samples was 3.5% and 5.6%, respectively. Crude protein content was observed lower (13.9%) in control sample whereas higher value (25%) was observed in developed sample. This increase was as a result of substitution of refined - wheat flour with mushroom powder of high protein content. Data from the table depicts that 2.7% and 5.9% crude fat found in control and developed sample. Sharma (2010) recorded slightly higher value for *khakhra*, i.e., 6.2% than that of present finding (5.9%) for test recipe. Fat content of papad prepared with *Pleurotus* mushroom was 5.4% as recorded by Tyagi and Nath (2005). Crude fiber content of control and developed *khakhra* was 2.16% and 5.80% respectively, indicating higher crude fiber in the developed sample than its control counterpart. Similar result for crude fibre content of *khakhra* (5.29%) was reported by Sharma (2010).

On the other hand, ash content was 2.09% and 2.2% for control and test recipe respectively. In control *khakhra*, total carbohydrate was calculated 79% whereas in developed sample it was 61%. Energy content of *khakhra* (370.3%), as reported by Sharma (2010) is comparable with the present finding of *khakhra* (379.3%) Table 3. Total dietary fiber content of control sample was 2.6 g, whereas in developed *khakhra* it was 7.2 g. Protein, crude fiber, carbohydrate and

total dietary fiber content of developed *khakhra* were found to be higher and significantly different at 1 and 5% of the control sample respectively.

CONCLUSION

This study has demonstrated that addition of increasing levels (15%) of mushroom powder in the *khakhra* affected the quality of sensory attributes. *Khakhra* with 10% mushroom powder contains the highest amount of protein, fat and ash. The findings of the present study may help in developing commercial processing technology for effective utilization of mushroom powder especially for preparation of *khakhra*. So it can be inferred from the present study that the *khakhra* developed by using medicinal mushroom (shiitake) were nutritious and acceptable. Therefore, results suggest that there is a great scope for use and marketing of value added *khakhra* using mushroom and it can be concluded that mushroom can be utilized for achieving food and nutritional security for nation.

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