

**RESEARCH PAPER**

Studies on nutritional, quality and sensory evaluation of value added baked products with button mushroom (*Agaricus bisporus*) powder

Monika Thakur* and Karuna Singh

Amity Institute of Food Technology, Amity University, NOIDA (U.P.) INDIA

(Email : mthakur1@amity.edu)

Abstract : Mushroom has been relished as a source of food and medicine throughout the world. The fresh mushroom and dried mushroom powder was analyzed for their nutritional composition. The present study was undertaken with the objective of value addition of mushroom powder in baked products. Mushroom powder has been incorporated in the formulations of cake at 0, 5, 10, 15 and 20 per cent by weight. The effect of various levels of mushroom powder on the physico-chemical properties and nutritional quality of cakes has been observed. The cakes containing mushroom powder in different concentrations were evaluated for their sensory attributes by a panel at 9 pointer hedonic scale. The results revealed that the colour and flavour of cake containing mushroom powder was significantly different from the control cake. Mushroom powder at 15 per cent addition level significantly improved colour, flavour and texture of cake. The texture and overall acceptability of the cakes with mushroom powder was equally acceptable to the control cake.

Key Words : *Agaricus bisporus*, Mushroom powder, Value added products, Sensory evaluation

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INTRODUCTION

Edible mushrooms have been the 'Food of the Gods' and treated as a garnish or delicacy. They have been taken regularly as part of the human diet as a functional food. Mushrooms have been consumed and appreciated for their flavour, economical, ecological values and medical properties for many years (Sanchez, 2010). Edible mushrooms have been widely utilized as human

foods for centuries and have been appreciated for texture, flavor as well as some nutritional and medicinal attributes (Manzi *et al.*, 2001). However, the awareness of mushrooms as a healthy food, as an important source of biological active substances with medicinal value has recently emerged and they have been relished throughout the world as food and medicine (Chang, 1999; Lakhanpal and Rana, 2005; Lakhanpal *et al.*, 2010; Thakur, 2012

* Author for correspondence:

and Singh and Thakur, 2016). All the studies revealed that mushrooms being a complete food source are rich in proteins, vitamins, carbohydrates, dietary fibres and minerals (Alam and Raza, 2001). Mushrooms are good as nutritious food for all ages. They are rich in good quality proteins with lysine and tryptophan that are normally deficient in cereals, bioactive components and as a source of prebiotics also (Thakur and Lakhanpal, 2015).

Button mushroom (*Agaricus bisporus*) is the most popular cultivated mushroom variety and still dominates the Indian and International market. It contributes about 90 per cent of total country's production. Value addition is the process of taking a raw commodity and changing it to produce high quality products. Since mushrooms have very high perishability, the fresh fruiting bodies have to be processed to extend their shelf life. The off seasonal use of the mushroom can be achieved by adopting appropriate post-harvest technology to process the fruiting bodies into novel value added products. The production of value-added products has been a turning point for the mushroom growers not only to reduce the losses but also to enhance their income by value-addition. This will boost the consumption of this very important healthy horticultural crop.

Since, now the people are more aware about the importance of the mushroom they have started preparing and using their value added products. Mushroom powder is the partial replacements of wheat flour with other ingredients to make functional food are in high demand. A lot of research is going on in this field. Different value added products like mushrooms soup, biscuits, nuggets, cookies, pickles and jam, etc. have been developed. Due to modern life style a lot of bakery products are consumed in the market. The focus of Indian mushroom industry is predominantly on trade of the fresh produce rather than the real value-addition. Almost entire domestic trade has been in the fresh form while most of the export is in the preserved form (canned or steeped). Current era has been characterized by greater awareness about quality and above all, with the demand for the readymade or ready-to-make food products. As mushrooms contain high moisture and are delicate in texture, these cannot be stored for more than 24 hours at the ambient conditions. This leads to weight loss, veil opening, browning, liquefaction and microbial spoilage of the product making it un-saleable. Effective processing techniques will not only prevent the post harvest losses

but also result in greater remuneration to the growers as well as to the processors.

The basic ingredient used for the preparation of baked product (cake) is wheat flour (refined) which is deficient in several nutrients including vitamins, minerals as well dietary fibre (Ayo and Nkama, 2003). Wheat flour also lacks essential amino acids such as lysine, tryptophan (Awan *et al.*, 1991). Enrichment of baked products with supplements like protein and vitamins is of current need and nutritional demand in today's scenario. Although mushroom contains approximately 90 per cent water, but its high protein and amino acids content, low fat, vitamins, mineral and various bioactive components presents high-quality source of biological substances for human nutrition (Strmiskova *et al.*, 1992). Mushrooms contain (dry basis) more than 25 per cent protein, less than 3 per cent crude fat and almost 50 per cent of total carbohydrate (Kotwaliwale *et al.*, 2007). Mushrooms are considered to be a healthy diet because it is low in calorie, sodium, fat and cholesterol. Rana *et al.* (2015) also studied the chemical and amino-acid profile of edible mushrooms.

Kulshreshtha *et al.* (2009) discussed various common processing methods for mushrooms as- canning, freezing and drying; but among all canning has been widely used on a commercial scale. Kumar *et al.* (2006) developed mushroom mathri (a deep fried snack). Rai and Arumuganathan (2008) studied the value added products from the mushrooms. They have prepared various mushroom powder value added product like - biscuits, soup powder, nuggets, noodles, papads, candies, pickles, ketch-up, murraba etc. Wakchaure *et al.* (2010) studied the development and evaluation of quality value added mushrooms. Shiekh *et al.* (2010) studied the effect of mushroom powder on the quality of cake and has specified that 15 per cent addition level has best acceptability. Rosli and Aishah (2012) studied that *Pleurotus sajor-caju* (PSC) improves nutrient contents and maintains sensory properties of carbohydrate-based products. Lakshmipathy *et al.* (2013) studied different drying, canning and value addition techniques for *Calocybe indica*. Gadallah and Ashoush (2016) developed the value added biscuit using desert truffle (*Terfezia clavaryi*) Powder. Singh and Thakur (2016) prepared value added products from *Pleurotus ostreatus* powder and showed that 10 per cent addition level has best acceptability.

Mushrooms contribute significantly in overcoming

protein deficiency in developing countries like India, because of their low calorific value, very high proteins content, vitamins and minerals. Mushroom are said to possess many unsubstantiated nutritional properties but documentation, adequate scientific validation and measures for their sustainable utilization is still to be explored. Healthy developed processed foods sometimes provide an acceptable nutritional components and awesomeness in sensorial quality to consumers. Some people even prefer the flavour developed from processed mushroom foods as compared to fresh ones. The present study was undertaken with an objective to incorporate mushroom powder into bakery product -cake. The further assessment was carried out to assess the effect of value addition of mushroom powder on its physical and sensory properties and also the nutritional availability of the value added baked products.

MATERIAL AND METHODS

Fresh mushroom:

Fresh edible button mushrooms (*Agaricus bisporus*) were collected from INA market, New Delhi, India. The mushrooms were cleaned from extraneous matter to remove dirt, soil and other undesirable material.

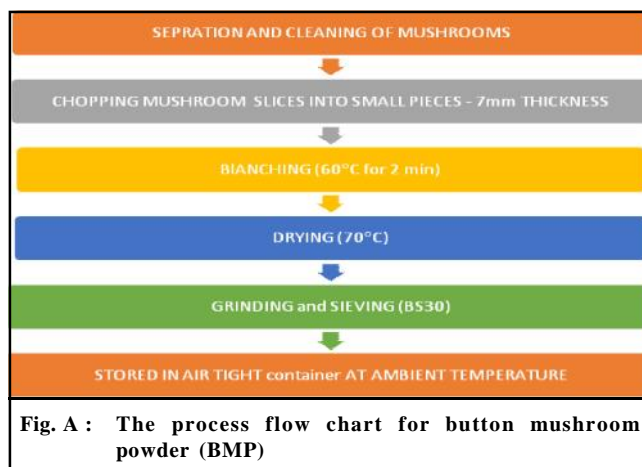
Raw materials and chemicals:

Commercial refined wheat flour (12-13% moisture and 8-9% protein), sugar powder, butter/vegetable oil, milk powder, baking powder, vanilla essence, mushroom powder, salt, were procured from the local market, Noida, U.P., India. High density polyethylene bags were used for packaging and storage of samples. Chemicals and solvents used were of analytical grade.

Preparation of mushroom powder:

The fresh cleaned button mushrooms were sliced

into small pieces of 7 mm thickness (Vernier caliper). 5kg fresh mushroom pieces were pre-treated by blanching in water at 60°C for approx 2 minutes. The pretreated slices were dehydrated in the tray dryer (S. M. Sientech, Kolkata) at 70°C. The velocity of the drying air was kept constant. The samples were dried to a moisture content of 5-10 per cent approximately. The dried mushroom slices were cooled, powdered and sieved at BS 30 and stored in air tight container for further use (Fig. A).



Chemical analysis of fresh and dried mushrooms:

The fresh fruiting bodies and the dried mushroom powder was analyzed for chemical composition. The moisture, protein, fat ash, energy contents were determined by AOAC (2000) and (2005). The total carbohydrate content of the sample was determined by Pearson (1970).

Preparation of composite flour :

The composite flour was prepared by using certain proportions of wheat flour and mushroom powder according to the recipe as shown in Table A.

Ingredients	Control	5% BMP:WF (g)	10% BMP:WF (g)	15% BMP:WF (g)	20% BMP:WF (g)
Wheat flour (refined)	100 g	95g	90g	85g	80g
Mushroom powder	0g	5g	10g	15g	20g
Sugar powder	82 g	82 g	82 g	82g	82g
Sodium bicarbonate	5g	5g	5g	5g	5g
Butter/vegetable oil	65ml	65ml	65ml	65ml	65ml
Milk powder	12ml	12ml	12ml	12ml	12ml
Vanilla essence	1ml	1ml	1ml	1ml	1ml
Salt	A pinch	A pinch	A pinch	A pinch	A pinch

Procedure for preparation of value added cake :**Formulation of cake incorporating mushroom powder:**

The cake was prepared using multi stage mixing method (Atkins, 1971). Composite flour in the ratio of 100:0, 95:5, 90:10 and 85:15, respectively was prepared.

Cake making procedures:

Cakes were prepared by adding wheat flour with different concentration - 5, 10, 15 and 20 per cent of mushroom powder samples in the basic formulation as per method of Rajchel *et al.* (1975). The specified amounts of other ingredients for each cake were weighed accurately. After that the sugar and shortening were mixed in a mixing machine for 20 minutes to produce a cream. In later stages, half of the milk, other ingredients, and finally the flour were mixed using low speed (145 rpm) for 10 minutes to ensure even distribution of all the components. The bowl was scrapped and butter was mixed for additional two minutes at medium speed (250 rpm). The remaining milk was added and the butter mixed at low speed for two minutes. After the bowl was scrapped, the batter was mixed for additional two minutes at medium speed. Portion of butter weighing 150 g was scaled into pre-greased cake pan and all the batter was poured in this. All cakes were baked in convection oven for 40 minutes at 160°C.

Physical evaluation:

The height, length and width of the rectangular shaped cakes were measured with Vernier caliper. Weight was determined with digital weighing balance. Volume of cake was calculated as length × width × height. Density was calculated as weight / volume.

Sensory evaluation:

The organoleptic evaluation was conducted by semi-trained panel for colour, flavour, texture and overall acceptability. 1-9 point hedonic rating test was performed to assess the degree of acceptability of cakes containing mushroom powders in different level. One slice from each lot of cake was presented to 10 panelists as randomly coded samples. The taste panelists were asked to rate the sample for colour, flavour, texture and overall acceptability on a 1-9 point scale, where 9=Like extremely; 8=Like very much; 7= Like moderately; 6=Like slightly; 5= Neither like nor dislike; 4=Dislike slightly; 3= Dislike moderately; 2= Dislike very much;

1=Dislike extremely.

Chemical evaluation of cake containing mushroom powder:

The cake containing 5, 10, 15 and 20 per cent mushroom powders were analyzed for moisture content, protein, ash and crude fat as per the methods of AOAC (2000 and 2005). Carbohydrate content of the cake samples was determined as total carbohydrate by difference method. All of the measurements were performed in triplicates. The data is given either as mean +SD.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Preparation of mushroom powder:

The moisture content of the fresh mushroom was found to be in the range of 88 - 89 per cent, which was reduced to 8 - 10 per cent after tray drying at 70°C for 6 hours.

Table 1 : Percentage yield of mushroom powder	
Weight of fresh mushrooms	Yield percentage of mushroom powder
5 kg	16.67 %

Nutritional composition of fresh and dried mushroom powder :

The fresh and dried button mushroom powders were analyzed for moisture, protein fat, ash and total carbohydrates contents. The results have been presented in Table 2. Comparing the compositions of fresh and dried mushrooms (wet weight bases) it has been observed that the fat, ash and protein content in the dried product has been significantly increased which may due to reduction of moisture during frying, giving a higher nutrient as well as food value for a given quality of dried powder compared to fresh one.

Physical properties of the cake:

The physical properties of cakes prepared by incorporating different percentages of mushroom powders as: 5, 10, 15 and 20 per cent against control have been showed in Table 3. Cake was assessed for volume, weight and density. The physical properties of cakes prepared by incorporating mushroom powder in

different mentioned concentrations against control showed that the weight of all the cake samples were higher than the control cakes. The cakes containing 15 per cent mushroom powder had the higher volume and less density than those with 0, 5, 10 and 20 per cent mushroom powder. The volume of the cakes increased with the increasing levels of mushroom powder and the control cakes had the lowest volume. The density of cake decreased with increase in mushroom concentration. This shows that there is more trapping of air in the cake with increase in concentration of mushroom. The ideal physical properties for cake have been shown is 15 per cent BMP.

Sensory evaluation of cake :

Cakes were evaluated organoleptically for colour,

flavour, texture, taste and overall acceptability (Table 4). The sensory evaluation revealed that the cakes containing 15 per cent mushroom powder were most preferred for colour and texture was higher than the cake containing various other levels of mushroom powder and control. The 15 per cent mushroom powder cake had least acceptability for all attributes. Result showed that increasing percentage of mushroom powder gave higher scores for colour till 10 per cent overall acceptability.

Chemical composition of the cake:

Cakes prepared with incorporation of mushroom powder with varying concentrations were analyzed for fat, protein, ash, moisture and total carbohydrate by difference (Table 5). Mushroom powder incorporation

Table 2: Nutritional value of fresh and dried mushroom powder (mean \pm SD)

Components	Fresh mushroom (g/100g)	Dried mushroom (g/100g)
Moisture (%)	91.02 \pm 0.04	4.38 \pm 0.04
Protein (g/100g)	3.26 \pm 0.08	33.25 \pm 0.08
Fat (g/100g)	0.19 \pm 0.01	1.92 \pm 0.05
Ash (g/100g)	0.78 \pm 0.01	6.98 \pm 0.01
Total carbohydrates (g/100g)	4.75 \pm 0.03	53.20 \pm 0.02
Energy (kcal/100g)	29.55 \pm 0.32	30.62 \pm 0.25

*all data are the mean \pm SD of the three replication mean followed by different letters in the same column differently. Significant P= 0.05

Table 3 : Physical properties of cake incorporating mushroom powder against control

Parameters	Physical properties				
	Control	5%BMP:WF	10% BMP:WF	15% BMP:WF	20% BMP:WF
Volume(cm ³)	80.73	82.93	84.00	86.30	82.32
Weight(g)	150	153	155	156	158
Density (g/ cm ³)	1.85	1.84	1.83	1.80	1.90

Table 4 : Mean sensory attributes of cake incorporating mushroom powder against control

Sample	Points (Mean+ SD)				
	Colour and appearance	Taste	Texture	Flavour	Overall acceptability
Control	8.9 \pm 0.5	8.05 \pm 0.5	7.62 \pm 0.5	8.41 \pm 0.5	8.05
5%BMP:WF	8.32 \pm 0.5	8.03 \pm 0.5	7.31 \pm 0.5	7.58 \pm 0.5	7.10
10%BMP:WF	8.16 \pm 0.5	7.74 \pm 0.5	7.68 \pm 0.5	7.51 \pm 0.5	7.25
15%BMP:WF	8.34 \pm 0.5	7.88 \pm 0.5	7.01 \pm 0.5	7.72 \pm 0.5	7.81
20%BMP:WF	6.02 \pm 0.5	5.17 \pm 0.5	5.81 \pm 0.5	5.84 \pm 0.5	5.02

Table 5 : Chemical composition of cake incorporating mushroom powder against control

Parameters	Control	5%ABP:WF	10%ABP:WF	15%ABP:WF	20%ABP:WF
Fat (%)	17.0	17.096	17.192	17.288	17.34
Protein (%)	7.1	8.66	10.325	11.98	12.05
Carbohydrates (%) by difference	57.95	57.80	54.90	50.30	49.28
Moisture (%)	17.43	17.64	17.86	18.04	18.14
Ash (%)	0.52	0.869	1.18	2.56	2.72

increased the protein content and reduces the carbohydrate content in samples, whereas, the fat percentage increased in the samples as the mushroom powder incorporation increased.

The present study revealed that there is definitely the advantage of drying of fresh mushroom fruiting bodies. The investigation showed that the mushroom powder incorporation has significantly improved the bread protein content and nutritional quality. Mushroom powder at different concentration was incorporated into cake and the organoleptic properties of cakes were evaluated. The colour, flavour, texture and overall acceptability of cake containing 15 per cent mushroom powder was significantly better than those of others concentration. This was also evident that the mushroom incorporation in cake will increase the protein content, but will reduce the carbohydrate content. Therefore, mushroom value addition could be used to improve the nutritional quality of cake which could help in reduction of protein-energy malnutrition prevalent in various developing countries and some more value added products can be explored.

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