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Research Article

Development and Evaluation of White Button Mushroom Based Snacks

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ABSTRACT

Snacks are different from meals in terms of size, nutritional content, hunger, and thirst sensation before and after the event. Considering the nutritive value, available snacks in the market are rich in carbohydrates and fats; being less in dietary fibre and functional components such as antioxidants, polyphenolic components which leads to extreme health risks in children and adolescents. Protein, one of the important components required during the growing years is lacking in snack foods, therefore in the present study an attempt was made to develop protein and fibre rich snacks using mushroom as the major component. Two mushroom snack products such as mushroom tikki and stuffed mushroom were developed using white button mushroom (*Agaricus bisporus*), spice mixture, and other ingredients. For the processing of the snack products, technologies such as blanching and in-pack pasteurization were used. The developed products were subjected to proximate analysis; mineral and vitamin profile; functional components; chemical components; organoleptic evaluation and microbial analysis for safety. Mushroom tikki had moisture 40.24%, carbohydrate 17.5%, protein 10.7%, fat 20.12%, fibre 7.91% and ash 3.54%. Stuffed mushroom had moisture 66.11%, carbohydrate 14.5%, protein 4.05%, fat 6.82%, fibre 6.65%, and ash 1.87%. Both the products were good in all the sensory properties and were found microbially safe. The developed snack products, as were rich in protein, dietary fibre, antioxidants and phenolic components helps in the consumption of balanced nutrients in children and adolescents.

Keywords: Mushroom; Snack products; Proximate composition; Functional components; Organoleptic evaluation; Analysis

INTRODUCTION

Agaricus bisporus is commonly recognised as a white button mushroom. The genus *Agaricus* belonging to the family *Agaricaceae*. Button mushroom (*Agaricus bisporus*) is the most popular and mostly consumed all over the world for their edibility, taste, and medicinal importance [1,2]. Mushrooms have been used as foods and food supplements from ancient times [3]. Generally, mushrooms are rich in dietary fiber, minerals, vitamins, and low in fat. Mushrooms contain various polyphenolic compounds such as β-glucan, tocopherol, and vitamin C, etc. The antioxidant activity of *Agaricus bisporus* is due to the presence of ascorbic acid and phenolic compounds [4]. The dietary fibres present in the mushroom are associated with the speeding up of the transit time of bowel contents increases bulk, frequency, and ease of defecation. Carbohydrates and fibre from mushrooms have been used in enhancing texture while reducing formulation cost [5]. Dietary fibre can also provide various functional properties to food. Mushrooms are also known for their curative potential in conditions of hyperacidity and constipation [6]. Some organic acids are responsible for the taste and flavour of a mushroom and can also play a biological role owing to their antioxidant, acidifying, neuroprotective, anti-inflammatory, and antimicrobial properties [7-9]. Mushrooms

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are ranked well above cereals/vegetables or fruits and animal products but below most meats. Therefore, mushrooms can be a good supplement to cereals [10]. Snacking is defined as, food that is eaten in addition to three standard meals. Snacks are different from meals in terms of size, nutritional content, hunger, and thirst sensation before and after the event. There is evidence that frequent snackers are nutritionally disadvantaged and have a higher percentage of body fat. Snacks are perceived as unhealthy food, for example confectionery, which gives empty calories and doesn't provide any other nutrients [11]. In the present study two snack products from white button mushroom *viz.*, mushroom tikki, and stuffed mushroom were developed and evaluated for nutritional composition, functional, and quality parameters. The developed snack products were nutritionally superior in protein, dietary fibre, antioxidants, and phenolic components to the products obtained in the market.

MATERIALS

Materials

Good quality fresh mushrooms, vegetables, and spices were purchased from the local market of Mysore. All the reagents used for the study were of analytical grade.

Methods

Development of mushroom tikki: Freshly harvested button mushrooms were graded, washed, and cut into small pieces. To the pan oil, chopped mushroom (53.41%) and salt (1.06%), were added and sautéed. In another pan oil (5.34%), ginger garlic paste (2.12%) were added and sautéed. Chilli powder (0.26%), garam masala (0.26%) and cumin powder (0.1%) were added and sautéed. To the sautéed mushroom, roasted besan flour (10.68%) were added and mixed well to form a clean dough. Tikki's were made by coating with breadcrumbs (26.7%), the oil was heated and tikkies were shallow-fried until golden brown. The products were packed in a metallic or metalized polyester. In-pack pasteurization was done at 90°C for 180 minutes. The products were stored at ambient temperature (25 ± 2°C).

Development of stuffed mushroom: Freshly harvested button mushrooms were graded, stem from mushrooms were removed. The cap of the mushrooms (28.3%) were cleaned and washed. To the pan, oil, chopped onions (5.66%), ginger-garlic (0.56%) paste were added, and sautéed until the raw smell was gone. Chilli powder (0.42%), garam masala (0.28%), coriander powder (0.28%), and cumin powder (0.14%) and salt (0.7%) were added and sautéed for one to two minutes in a medium flame. Scrambled, boiled, and mashed potato (19.81%) was added, mixed well and the mixture was made. The mushrooms were stuffed with the mixture. To the other bowl, besan flour (19.8%), cornflour (8.5%), baking soda (0.05%), chilli powder (0.56%) and salt (0.7%) were added and mixed well to make a batter. Stuffed mushrooms were dipped in batter, and were deep-fried until golden brown. Products were packed in a metallic or metalized polyester. In-pack pasteurization was done at 90°C for 180 minutes. The products were stored at ambient temperature (25 ± 2°C).

Organoleptic evaluation

The developed Ready-to-eat mushroom tikki and stuffed mushrooms were served to semi-trained panelists for organoleptic evaluation on a nine-point hedonic scale, with score 9 as excellent and score 1 as disliking. Sensory evaluation was carried out by 20 semi-trained panel members. The sensory properties such as colour, texture, aroma, taste, and overall acceptability of finished product were evaluated on the basis of 9 points hedonic scale [12].

Analysis

Moisture content, ash content, and Free Fatty Acid (FFA) values in ready-to-eat mushroom tikki and stuffed mushroom were carried out as per the method of AOAC [13]. Carbohydrates, protein fibre and fat contents were carried out as per the method described by AOAC [14]. Vitamins B_1, B_2, B_6, were carried out as per the method by AOAC [15]. The vit-B_3 analysis was carried by AOAC [16], Vit-C by AOAC [17], minerals such as calcium and iron by AOAC [18]. Phenolic content and total anti-oxidants content were carried out as per the method described by Anand T et al. [19]. Flavonoid content was carried out as per the method described by Bahorun T et al. [20]. Thiobarbituric Acid (TBA) value by Tarledgis et al. [21], total acidity, and peroxide value by AOCS [22]. pH was measured using microprocessor-based digital pH meter (CYBER SCAN, MODEL PH 1500, EUTECH INSTRUMENTS, India). Water activity is measured by Aqualab 4TE water activity meter. Microbiological analysis was carried according to APHA [23] and data were transformed into logarithms of the number of Colony-Forming Units (CFU/ml).

Statistical analysis

The data obtained for all the parameters and effects of storage on them were statistically analyzed through student t-test to see the critical difference at a 5% level of significance using CPCS1 software.

RESULTS AND DISCUSSION

Proximate composition of white button mushroom-based snacks

Initially, the mushroom tikki and stuffed mushroom were analyzed for nutritional composition and the results are given in Table 1. The mushroom tikki had moisture 40.24%, carbohydrate 17.51%, protein 10.70%, fat 20.12%, fibre 07.91%, and ash 03.54%. Stuffed mushroom had moisture 66.11%, carbohydrate 14.55%, protein 04.05%, fat 06.82%, fibre 06.65% and ash 01.87%. Frying in oil showed an increase in fat content. On wet weight basis, button mushroom has the total protein constitute was 3.14 g, total carbohydrate was 3.23 g, fat

was 0.17 g, ash was 0.85 g, and moisture was 87.77 g per 100 g of the sample [24].

Table 1: Proximate composition of white button mushroom based snacks in percentage (%).

Snack products	Moisture	Carbohydrates	Protein	Fat	Fibre	Ash
Mushroom tikki	40.24 ± 0.11	17.51 ± 0.03	10.70 ± 0.09	20.12 ± 0.05	07.91 ± 0.07	03.54 ± 0.07
Stuffed mushroom	66.11 ± 0.02	14.55 ± 0.06	04.05 ± 0.10	06.82 ± 0.01	06.65 ± 0.12	01.87 ± 0.04

Micronutrient contents of white button mushroom-based snacks

The mushroom tikki and stuffed mushroom were analyzed for minerals such as calcium and iron. Mushroom tikki had calcium 36.8 mg and iron 28.3 mg, the stuffed mushroom had calcium 24.0 mg and iron 29.2 mg per 100 g of sample. Khan et al. estimated the minerals such as Fe and Ca were found 18.5 mg and 44.0 mg respectively per 100 g of the dry sample [3].

Table 2: Micronutrients content of white button mushroom-based snacks (mg/100 g).

Micronutrients	Mushroom tikki	Stuffed mushroom
Thiamin	1.27 ± 0.07	1.03 ± 0.04
Riboflavin	0.90 ± 0.06	0.72 ± 0.01
Niacin	1.32 ± 0.17	1.11 ± 0.12
Pyridoxine	1.10 ± 0.04	0.87 ± 0.01
Vitamin C	37.5 ± 0.11	37.5 ± 0.13
Calcium	36.8 ± 0.02	24.0 ± 0.06
Iron	28.3 ± 0.07	29.2 ± 0.03

The mushroom products were analyzed for vitamins such as thiamine, riboflavin, niacin, pyridoxine and vitamin C. Mushroom tikki had thiamine 1.27 mg, riboflavin 0.90 mg, niacin 1.32 mg, pyridoxine 1.10 mg and vitamin C 37.5 mg per 100 g of sample. Stuffed mushroom had thiamine 1.03 mg, riboflavin 0.72 mg, niacin 1.11 mg, pyridoxine 0.87 mg and vitamin C 37.5 mg per 100 g of sample. Matila et al. estimated the vitamins such as vitamin-C, vit-B_1, B_2, folates, niacin and Vit-B_{12} in *Agaricus bisporous* [25]. It was found 17 mg, 0.6 mg, 5.1 mg, 450 µg, 43 mg, and 0.8 mg respectively per 100 g of sample (Table 2).

Functional parameters

Phenols and flavonoids were considered as functional parameters for the mushroom products. Phenolic contents of the mushroom tikki and stuffed mushroom were 83.33 and 66.66 expressed as mg/100 g gallic acid equivalents. Flavonoid contents of the mushroom tikki and stuffed mushroom were 45.00 and 33.61 expressed as mg of quercetin equivalents/100 g of sample. Total anti-oxidant contents of the mushroom tikki and stuffed mushroom were 31.95, 19.93 expressed as percentage inhibition/100 g of sample. Phenolics or polyphenols have received considerable attention because of their physiological function, including antioxidant, anti-mutagenic and antitumor activities [26], which have gained much attention, due to their antioxidant activities and free radical-scavenging abilities, which have potentially beneficial implications for human health [27-29]. The total phenolic content (mg gallic acid equivalents) and total flavonoid content (mg quercetin equivalents) of mushroom were found to be (10.25 and 1.75) mg respectively [30] (Table 3).

Table 3: Functional parameters of white button mushroom-based snacks.

Functional parameters	Mushroom tikki	Stuffed mushroom
Phenolic content (mg/100 g gallic acid equivalents)	83.33 ± 0.04	66.66 ± 0.01
Flavonoid content (mg/100 g quercetin equivalents)	45.00 ± 0.13	33.61 ± 0.09
Total anti-oxidants content (I%/100 g)	31.95 ± 0.02	19.93 ± 0.05

Quality parameters

pH, water activity, titratable acidity (expressed as lactic acid), peroxide value, free fatty acids, and TBA value were considered as quality parameters. Thiobarbituric Acid (TBA) value is widely used as an indicator of the degree of lipid oxidation, and the presence of TBA reactive substances is due to the second stage of auto-oxidation during which peroxides are oxidised to aldehydes and ketones [31]. Mushroom tikki and stuffed mushroom both had a pH of 7.0. The water activity of mushroom tikki and stuffed mushroom were 0.94 and 0.96, respectively. Titratable acidity of mushroom tikki and stuffed mushroom were 0.16% and 0.20% respectively. Peroxide value

of mushroom tikki and stuffed mushroom, were (0.28, and 0.36) mEqO_2/gm respectively.

Table 4: Quality parameters of white button mushroom-based snacks.

Quality Parameters	Mushroom tikki	Stuffed mushroom
pH	7.0 ± 0.21	7.0 ± 0.19
Water activity	0.94 ± 0.12	0.96 ± 0.04
Titrable acidity (%)	0.16 ± 0.17	0.20 ± 0.09
Peroxide balue (MEqO_2/g)	0.28 ± 0.03	0.36 ± 0.02
Free Fatty Acid (%/g)	0.07 ± 0.04	0.05 ± 0.07
TBA (mg malonaldehyde/kg)	0.27 ± 0.06	0.21 ± 0.01

The free fatty acid value of mushroom tikki and stuffed mushrooms were 0.07% and 0.05% per gram respectively. TBA values of mushroom tikki and stuffed mushroom were (0.27 and 0.21) mg malonaldehyde/kg respectively (Table 4).

Sensory parameters

One of the most important criteria for the evaluation of foods is their acceptability which is based on the sensory attributes. In this study, the products were served to 25 semi-trained panel members. Samples were randomly drawn for each experimental block, coded, and served to the semi-trained panelists. They have tasted the mushroom products and rated for their organoleptic characteristics in terms of colour, aroma, taste, texture, and overall acceptability on a 9-point hedonic scale. As shown in Table 5, mushroom tikki was rated as 8.3 for colour, 8.2 for aroma, 8.3 for texture, 8.5 for taste, and 8.3 Overall Acceptability (OAA) on the 9-point hedonic scale. Stuffed mushroom had score of 8 for colour, aroma, taste, and 8.1 for texture and overall acceptability. Both products showed good sensory scores and were highly acceptable.

Table 5: Sensory scores of white button mushroom-based snacks (n=10).

SL.No	Mushroom products	Colour	Aroma	Texture	Taste	Overall acceptability
1	Mushroom tikki	8.3 ± 0.17	8.2 ± 0.11	8.3 ± 0.11	8.5 ± 0.15	8.3 ± 0.13
2	Stuffed mushroom	8.0 ± 0.02	8.0 ± 0.15	8.1 ± 0.06	8.0 ± 0.12	8.1 ± 0.12

The Mushroom products were evaluated for their microbial quality. The microbiological analysis showed the sterilized condition of the product, coliform was nil, which was reflecting the safety of the product.

CONCLUSION

In the present study two mushroom products were developed by using white button mushroom as a main ingredient viz., mushroom tikki, and stuffed mushroom. The ingredients were optimized on the basis of organoleptic evaluation. Both the products were good in all the sensory properties and were microbially safe. Snacking behavior varies across the different regions of the world with rapid development and changing lifestyles of adolescents, the eating habits have also been changing. They are consuming unhealthy snacks and this kind of poor eating habits leads to lifestyle diseases. So that adolescents and children should prefer healthy snacks. White button mushrooms are a good source of proteins, dietary fibre, antioxidants and phenolic components, and the above snack products developed could be a good substitute for commercial snack products. They help in satisfying the consumer hunger and as well as meeting the nutritional needs.

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