Indian Journal of
Nutrition

Open Science Publications

Volume 9, Issue 3 - 2022

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A Study on the Development and Quality Evaluation of Baked Mushroom Chips as a Source of Unconventional Protein

Research Article

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Article Information: **Submission:** 06/08/2022; **Accepted:** 03/09/2022; **Published:** 05/09/2022

Abstract

The world population of human beings has been hyperbolic up to 250% within the last six decades. This increasing global population places a burden on the food and agriculture sector to feed the population. The want for nutrients cannot be consummated alone by overwhelming typical foods as they'll be unable to sustain the population in the future. Need for one such macronutrient, protein will increase that plays a major role in providing amino acids for the growth and development of body tissues and muscles. Major typical sources of protein within the diet of developing and developed countries will not be sufficient enough in the next decades. Malnutrition related to protein is yet another major concern in developing countries like India.

The purpose of this study was to develop a high-protein snack from mushrooms as a source of unconventional protein. Four trials were conducted which varied in their treatments. Chips were prepared using white button mushroom, vinegar, oil, rock salt, oregano, garlic onion powder, citric acid and potassium metabisulphite (KMS) powder. The chips were analyzed for sensory characteristics using a 5-pointer hedonic scale. According to the results, mushroom chips pretreated with 1% KMS and 0.5% citric acid were most acceptable (4.50). The crude protein content of mushroom chips was found to be 18.81 gm/100g. The chips were shelf-stable for 7 days according to shelf-life studies. Since the consumers are not aware of different mushroom recipes, there is a scope for the food industry to process raw mushrooms into high protein value-added products which are appreciated by the consumers for their taste as well.

Keywords: Mushrooms, Unconventional, Protein, Chips, Sensory evaluation, Value-added product, Functional food

Introduction

When seen globally, the trend in protein consumption has dual nature. The first side is the overconsumption of protein by western and developed countries that consume mainly animal protein. And the second side is the protein deficiency in under-developed and developing countries where their diet lacks animal protein due to socioeconomic status and cultural beliefs. Population exploitation in these countries is also another challenge for agri-food industries to meet the demands of each individual. Often the diet of such populations lacks protein as their primary staple diet is cereal and starch-based. Countries like the U.S.A, Canada, European Union countries, and many other western countries consume almost twice their average daily protein requirement [1]. Thus, there is an urgent need for governments and public health agencies to bridge the huge gap between overconsumption and protein deficiency in the world.

According to a 2019 report by United Nations International Children's Emergency Fund (UNICEF), every second child in India is affected by some type of malnutrition related to protein deficiency in their diets. The recommended dietary allowance (RDA) of protein for an average Indian adult is 0.8 to 1 gm per kg body weight, though; the average intake is about 0.6 gm per kg body weight. Indian diets derive almost 60 % of their protein from cereals with relatively low digestibility and quality [2].

A 2017 survey shows that 73% of Indians are deficient in protein while above 90% are unaware of the daily requirement of protein. A survey conducted across 16 cities in India on perception, knowledge and consumption of protein found a gap in the knowledge of quality protein in daily diets. Numerous myths surround protein consumption with 85% believing it leads to weight gain. The diet of

ISSN: 2395-2326

Indians is predominantly cereal-based, and 60% of protein is from cereals which have a lower digestibility and quality.

A study conducted across eight Indian cities found that 71% of individuals between the ages of 30 to 55 years suffer from poor muscle health. Data indicates variations between states as well as cities, for instance, Lucknow at 81% has the highest percentage of individuals who have poor muscle mass, while Delhi at 64% has a much lesser percentage [3].

The Indian Consumer Market 2020 shows high monthly expenditure on cereals and processed foods with only one-third of the food budget being spent on protein-rich foods. With the rise in the cases of obesity and diabetes, consumption of protein is the way forward for Indians as the inclusion of high protein foods in the diet has been strongly associated with improving insulin response and reducing diabetes [3].

Need for unconventional sources of protein

The world population of human beings has hyperbolic up to 250% within the last six decades with a lift from 2.6 to 7 billion and it's expected that if the expansion will continue at a similar rate, the population may be 9 billion by 2042 according to an agency of United States [4]. This increasing global population places a burden on the food and agriculture sector to feed the population. The want for nutrients cannot be consummated alone by overwhelming typical foods as they'll be unable to sustain the population in the future.

Need for one such macronutrient, protein will increase that plays a major role in providing amino acids for the growth and development of body tissues and muscles. Major typical sources of protein within the diet in developing and developed countries are cereals, meat, pulses, milk and dairy, fish, seafood, oil crops, vegetables, starchy roots, eggs, offals, and fruit; however, they'll not be sufficient enough in next decades [5]. Therefore, it's imperative to look for various other sources of fine quality protein for human consumption apart from conventional sources.

Apart from conventional sources of protein discussed above, there are certain unconventional sources which are not only high in protein but also rich in bioactive compounds which possess health-benefiting properties. Examples of such proteins include spirulina (single cell protein), seitan, duckweed, soy protein, mushrooms and edible insects.

The purpose of this study was to develop a high-protein snack from mushrooms. Mushrooms are considered a healthy food because they are low in calories and fat but rich in proteins and dietary fibre and contain crude protein in the range of 19-38% on a dry weight basis [6]. Mushrooms are an excellent source of vitamins, e.g., B vitamins and vitamin D, and minerals, e.g., phosphorus, magnesium, selenium, copper, and potassium, and are also rich in dietary fibre, chitin and β-glucans. Studies have shown that mushrooms are a rich source of bioactive compounds, e.g., phenolic and flavonoid compounds that exert antioxidant properties, and these could be beneficial to human health [7]. Mushrooms are rich in the essential trace mineral selenium which is a potent antioxidant which helps to fight against free radicals and increases the strength of bones, teeth, hair and nails [8].

Material & Methods

Preparation of chips

For the development of mushroom chips, the following ingredients are required: white button mushroom, vinegar, oil, rock salt, oregano, garlic onion powder, citric acid and potassium metabisulphite (KMS) powder. The above ingredients required for the present experimental study were purchased from a local supermarket store. OTG and an Air fryer were used in the preparation of chips. Table 1 shows the different trials and the variations conducted among these trials. For the packaging of chips, a stand-upzipper pouch of LPDE (Low-Density Polyethylene) material was used.The method of preparation is given in the flow chart (Figure 1).

Proximate analysis, sensory analysis and shelf-life study

Proximate analysis was conducted for parameters such as ash content, moisture content, crude fat, protein, fibre, carbohydrate and energy. The analytical tests were performed using standard methods.

The sensory analysis was carried out as per the experimental sampling protocol. 30 untrained panel members were given the sample for sensory evaluation. A 5-point Hedonic Rating Scale was used for the parameters: Taste, Appearance, Color, Flavor, Texture and Overall Acceptability.

The scoring key used was:

5- Liked extremely, 4- Liked moderately, 3- Neither liked nor disliked, 2- Disliked moderately, 1- Disliked extremely

Mushrooms are highly perishable in nature and deteriorate due to their high respiration rate and delicate epidermal structure [9]. Therefore, it is very important to study the shelf life of prepared mushroom chips. The samples were stored for 15 days to study the shelf life and determine the best before for chips. Moisture content,

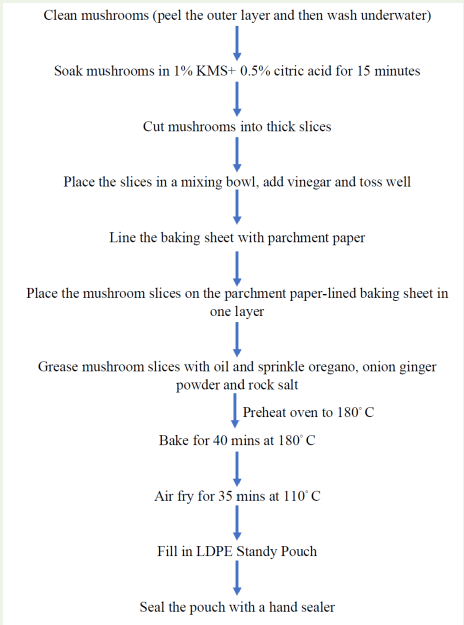

Figure 1: Flowchart of baked mushroom chips.

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Table 1: Trial details with various variations in treatment, baking and air fry time.

	Trial 1	Trial 2	Trial 3	Trial 4
Ingredients	Button mushroom-200g, vinegar-15ml, oil-10g, oregano-5g, rock salt- 2g	Button mushroom-200g, vinegar-15ml, oil-10g, oregano-5g, rock salt- 2g	Button mushroom-200g, vinegar-15ml, oil-10g, oregano-5g, rock salt- 2g	Button mushroom-200g, vinegar-15ml, oil-10g, oregano-5g, rock salt- 2g
Chemical Pre-Treatment	No treatment given	Citric acid- 0.1g KMS- 0.5g for 10 min	Citric acid- 0.5g KMS- 1g for 15 min	Citric acid- 1g KMS- 2g for 15 min
Baking- Time & Temperature	40 min, 180°C	30 min, 180°C	40 min, 180°C	40 min, 180°C
Air Fryer-Time & Temperature	Not used	20 min, 110°C	35 min, 110°C	35 min, 110°C

total plate count and sensory analysis were carried out on the 0th, 7th and 15th day.

Statistical analysis

Analysis of variance (ANOVA) was applied to analyze and interpret the results. For statistical analysis, SPSS software version 16 was used and significance was accepted at $p \leq 0.05$.

Results & Discussion

The data for organoleptic evaluation of four trials reveals that amongst the trials there was a highly significant difference in texture and overall acceptability (p 0.01); a significant difference in appearance and colour (p 0.03) and no significant difference in taste and flavour characteristics ($p \geq 0.05$) (Table 2).

A significantly higher score for texture (4.06) and overall acceptability (4.50) was recorded for mushroom chips pretreated with 1% KMS and 0.5% citric acid (trial 4), whereas the lowest score was recorded for trial 1. A significantly higher score for appearance (4.70) was recorded for mushroom chips treated with 1% KMS and 0.5% citric acid, which was on par with mushroom chips treated with 0.5% KMS and 0.025% citric acid (4.68). A significantly higher score for colour (4.32) was recorded for mushroom chips treated with 1% KMS and 0.5% citric acid, which was on par with mushroom chips treated with 0.5% KMS and 0.025% citric acid (4.29). The highest score for taste (4.65) and flavour (4.62) was recorded for mushroom chips treated with 0.5% KMS and 0.025% citric acid.

Mushroom chips were most acceptable when they were pretreated with 1% KMS and 0.5% citric acid (trial 4) according to the results of sensory evaluation. This was due to the effect of salt and citric acid, which enhances the taste and flavour and potassium metabisulphite helped in better retention of colour and appearance which is in agreement with the results of Dadasaheb Desayi [10].

The protein content of the final product was 18.81g/100g which is considered a high protein source (Table 3). The product has a shelf life of 7 days, after which it develops a rancid flavor (Table 4).

The labelling of the product was designed bearing in mind all these regulations given by Food Safety and Standards (labelling and display) Regulations, 2020 (Figures 2-5).

Conclusion

Although mushrooms are a rich source of protein and are not very expensive as compared to meat and poultry the consumption

Table 2: Organoleptic evaluation of fresh mushroom chips for color, flavour, texture, taste and overall acceptability (Score out of 5).

Characteristics	Mean±SD				F-Test	P
	Trial 1	Trial 2	Trial 3	Trial 4		
Taste	4.56± 0.49	4.53± 0.12	4.65± 0.18	4.63± 0.49	0.253	0.85
Appearance	1.66± 0.47	2.93± 0.73	4.68± 0.6	4.70± 0.68	99.30	0.03
Colour	1.46± 0.50	2.96± 0.66	4.29± 0.60	4.32± 0.67	129.54	0.03
Flavour	4.58± 0.49	4.59± 0.47	4.62± 0.52	4.60± 0.48	0.00	1.00
Texture	1.33± 0.47	3.06± 0.63	3.26± 0.52	4.06± 0.90	91.69	0.01
Overall acceptability	2.06± 0.78	3.56± 0.50	4.23± 0.72	4.50± 0.78	78.73	0.01

Table 3: Result of proximate analysis of baked mushroom chips.

SR. NO.	PARAMETER	Test Method	RESULT
1.	Ash	AOAC 942.05	4.92 %
2.	Moisture	AOAC 930.15	3.20 %
3.	Crude fat	AOAC 2003.05	12.9 g/100g
4.	Crude protein	IS-7219	18.81g/100g
5.	Fiber	AOAC 978.10	26.5 g/100g
6.	Carbohydrate	Difference method	33.67 g/100g
7.	Energy	Using Formula	330 Kcal/100g

Table 4: Result of shelf-life study of mushroom chips.

Parameters	DAY 0th	DAY 7th	DAY 15th
Moisture Content	3.20%	3.51%	4.16%
TPC (Total Plate Count)	Nil	Nil	Nil
Sensory Evaluation	Crispy, umami flavour	No changes	Development of rancid off-flavour, loss of crispiness of chips

Figure 2: Front label.

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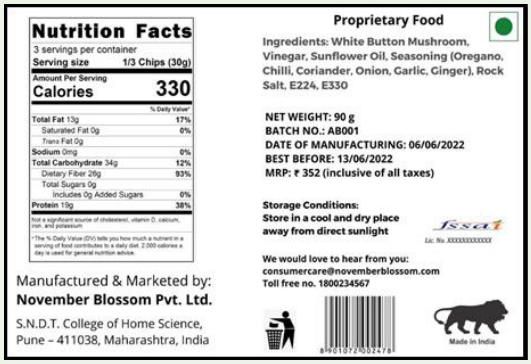

Figure 3: Back label.

Figure 4: Baked mushroom chips.

Figure 5: Final packed product.

rate in India is meagre. This is due to the fact that the consumers are not aware of the nutrient quality of mushrooms and their health benefits. Consumers are hesitant to consume mushrooms due to certain myths, aversion toward the taste/texture of mushrooms or lack of knowledge to prepare different mushroom recipes.

Since the consumers are not aware of different mushroom recipes, there is a scope for the food industry to process raw mushrooms into value-added products which are appreciated by the consumers for their taste as well. Processing adds shelf-life to mushrooms which are otherwise highly perishable. Apart from chips, it can also be processed into flours, noodles, pickles, biscuits, etc. which will not only provide variety to the customer but also a healthy alternative.

References

1. Ranganathan R, Vennard D, Waite R, Dumas P, Lipinski B, et al. (2016) Shifting Diets for a Sustainable Food Future. Working Paper, Installment 11 of Creating a Sustainable Food Future. World Resources Institute: Washington DC.
2. Swaminathan S, Vaz M, Kurpad AV (2012) Protein intakes in India. British Journal Nutr 108: S50-S58.
3. Suri S (2020) India's protein deficiency and the need to address the problem. Observer Research Foundation.
4. Gabriel A, Victor N, du Preez James C (2014) Cactus pear biomass, a potential lignocellulose raw material for Single Cell Protein production (SCP): A Review. Int J Curr Microbiol App Sci 3: 171-197.
5. Maurya NK, Kushwaha R (2019) Novel Protein Foods:Alternative Sources of Protein for Human Consumption. Res Trends Food Technol Nutr. 4: 129-142.
6. Archana V, Neetu S (2016) A comparitive study on nutritional profile of mushroom fortified noodles. Int J Curr Res 8: 35628-35630.
7. Lee-Hoon Ho, Asyikeen Zulkifli N, Tan T-C (2020) Edible Mushroom: Nutritional Properties, Potential Nutraceutical Values, and Its Utilisation in Food Product Development. IntechOpen.
8. Feng L, Kee-Mun Cheah I, Mei-Xi Ng M, Li J, Chan SM, et al. (2019) The Association between Mushroom Consumption and Mild Cognitive Impairment: A Community-Based Cross-Sectional Study in Singapore. J Alzheimers Dis 68:197-203.
9. Singh N, Vaidya D, Mishra V, Thakur KS (2016) Shelf life and storage quality of white button mushrooms (Agaricusbisporus) as affected by packaging material. Int J Adv Res 4: 1790-1799.
10. Desayi D (2012) Development, recovery and sensory evaluation of fresh mushroom chips. Int J Food, Agriculture Vet Sci 2: 190-193.

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