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Process Standardization and Quality Evaluation of Multigrain *Sev* Blended with Mushroom Powder

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ABSTRACT

Background: The growing demand for functional and health-oriented snack foods has encouraged the development of nutritionally improved traditional products. Multigrain sev offers significant potential for enhancement through the incorporation of bioactive ingredients such as mushroom powder. However, limited studies have focused on its systematic formulation and quality evaluation. Therefore, the present research aimed to formulate, standardize and assess the quality characteristics of mushroom-enriched multigrain sev to develop a functional snack aligned with modern consumer preferences.

Methods: In this laboratory-based product development study conducted during the academic year 2024-25, multigrain *sev* was standardized through preliminary trials. Chickpea flour was partially replaced with soy flour at 15%, 20% and 30% to optimize incorporation. Subsequently, mushroom powder was added at 5%, 10% and 15% as a substitution for chickpea flour. The developed formulations were then evaluated for quality attributes.

Result: The investigation led to the identification of the most acceptable formulation among the developed samples. Sample 3, containing 15% mushroom powder, was found to be superior in overall acceptability. It was distinguished by its pronounced umami flavor, enhanced crispiness and improved nutritional profile, including 26.74% protein and 4.7% dietary fiber with moderate fat content. The findings contribute to the development of a nutritionally enriched functional snack with improved sensory and compositional attributes.

Key words: Functional food, Multigrain snack, Mushroom-enriched sev, Nutritional enhancement.

INTRODUCTION

One popular snack in India is "*sev*," a deep-fat fried snack made from Bengal Gram flour (Besan) and other ingredients such as salt, spices and sodium bicarbonate to give it a crispy texture. Bengal gram (BG), also known as "Chana," is a type of bean widely consumed in India. (Verma *et al*., 2023) Among convenience foods, a major share of market belongs to the category of deep-fried snacks. The origin of most of these products can be traced to the traditional practices of better preservation techniques for which, fried foods naturally became a choice due to their shelf stability. Snacks contribute an important part of many consumers for fulfilling their daily nutrient and calorie intake. (Bagmare and Swami, 2024).

These foods are generally refined, rich in protein, fat, carbohydrates and energy, but lacking in dietary fibre and micronutrients. Therefore, nutritional enrichment of these food products can be advantageous to use them as a carrier of nutrients due to their simple manufacturing process, better shelf life, high acceptability and consumption. (Lende *et al.,* 2022) Ready-to-eat varieties of *sev,* including flavored *sev* are available in Indian stores. It is eaten as a standalone snack as well as a topping on dishes like Bhelpuri and Sev puri. This popular snack being tasty and tempting is simultaneously full of fats as it is deep fried (Patel *et al.,* 2019).

Soya flour, both full fat and defatted has been used as ingredients in the preparation of high protein snacks. Soya snacks could be prepared with full fat soya flour up to the level of 13.5% substitution. Soya proteins have been accepted in many applications because they provide desirable functionalities in fabricated foods at lower cost. Defatted soya flour contains about 50-54% good quality protein and can be used as an ingredient in various types of food (Senthil *et al*., 2002).

Soybean contains phytochemicals namely iso-flavones which helps in reduction of cholesterol thus reducing heart diseases and regulation of menopause. The regular consumption of soybean prevents certain diseases namely diabetes, atherosclerosis and cancer (Pandey and Sangwan, 2020).

Buckwheat is an excellent source of protein, containing all eight essential amino acids. This makes it a good

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choice for vegetarians and vegans who may struggle to get enough protein from other plant-based sources. Buckwheat is naturally gluten-free, making it a safe and nutritious option for people with celiac disease or gluten intolerance. Buckwheat is a good source of dietary fibre, which can help to promote digestive health and may reduce the risk of heart disease. (Sharma and Minhas, 2023) Buckwheat varieties have levels of protein higher than wheat, rice, millet and maize but lower than oats (Breslauer *et al.,* 2023).

Mushroom is a nutritious and palatable food. It is low in calories, fats and high in vegetable proteins as well as vitamins and minerals. The protein content of the fresh mushroom (*Agaricus bisporus*) is 2-3% while it varies from 32 to 42% on dry weight basis. Mushroom protein is intermediate in quality between vegetables and animal proteins and the supplementary value of mushroom protein in vegetarian diet is of considerable significance. Kumar *et al*. (2019) studied the process optimization and characterization of '*sev*' with the incorporation of mushroom powder developed pasta enriched with mushroom powder while Bahri (2016) developed herbal seasoning with the addition of mushroom powder.

MATERIALS AND METHODS

The raw materials used for the preparation of multigrain *sev* including soybean, Bengal gram, buckwheat, mushroom powder and spices (cumin, asafoetida, chilli powder and turmeric) were procured from the local market in Pune, India. The study was conducted in the Department of Food Process and Product Technology, School of Food Technology, MIT ADT University, Loni Kalbhor, Pune.

Formulation of multigrain *sev*

Incorporation of soya flour in food product development has been explored by several researchers. The formulation of various combination of composite flours are shown in Table 1. Multigrain *sev* blended with mushroom powder was prepared by process given by (Lende *et al.,* 2022) with slight modifications. The detailed process flow sheet of multigrain *sev* preparation is presented in Fig 1.

Physical properties

The physical properties were evaluated as per standard methods mentioned in the literature (Kulthe *et al*., 2016b and 2017). The colour of the product was measured in accordance with CIE L*, a*, b* colour space system (Lab Scan XE Hunter Lab Instruments, Virginia, USA) based on the tristimulus value. The analytical equipment's included are Digital model of Vernier caliper for thickness, length, Width, an electronic balance with the accuracy of 0.0001g for weight measurements. Texture analysis is done by texturizer TA. XT2i (Agrawal lab Pune).

Functional properties

Functional properties of flour like water and oil absorption capacity (WAC and OAC) were analyzed using standard methods (Kulthe *et al*., 2025).

Chemical properties

Chemical Analysis includes Moisture, Ash, Fat, Crude fibre, Carbohydrates and Protein were estimated by standard methods (AOAC, 2005). Mineral contents such as calcium, iron and potassium were analyzed by method described by (Kulthe *et al*., 2016a). The energy value was estimated using the sum of the product of respective physiological fuel values and contents of protein, carbohydrate and fat. It was expressed in Kcal/ 100 g (Kulthe *et al*., 2018).

Sensory evaluation

Samples were subjected to organoleptic testing before and after the storage. Organoleptic analysis was carried out in order to determine the various factors like overall acceptability, taste, flavour, colour, aroma etc. and their changes with the number of storage days and parameters. Sensory attributes including appearance, flavour, texture, taste and overall acceptability of the product were evaluated by 9-point Hedonic Rating Test as recommended by Ranganna (1986).

Statistical analysis

Statistical analysis the data obtained was analyzed statistically to determine statistical significance of treatments. Completely Randomized Design (CRD) was used to test the significance of results as per the method of Panse and Sukhatme (1967). The experiments were conducted in quadruplicate and the mean values are reported.

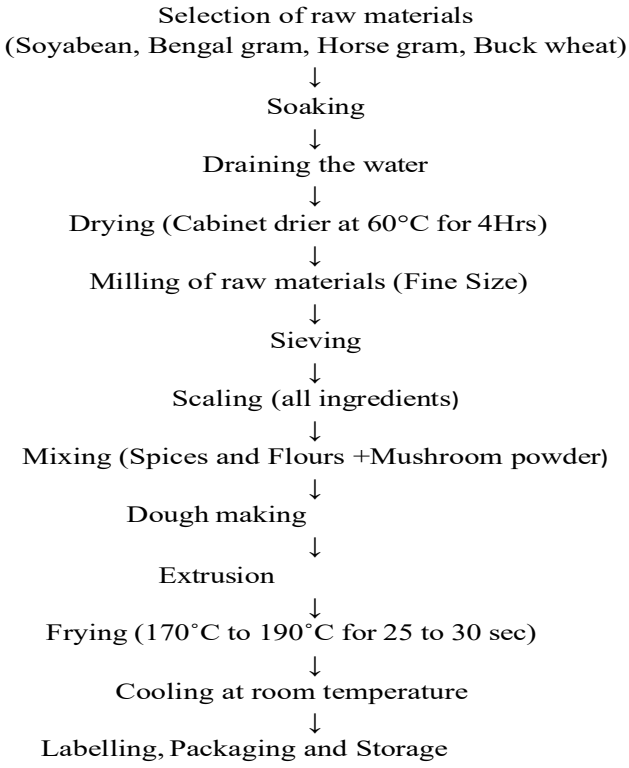


Fig 1: Preparation of multigrain *sev* by incorporation of mushroom powder.

RESULTS AND DISCUSSION

The research was conducted to study the quality parameter of multigrain *sev* by physico-chemical properties, sensory parameters. The raw materials used were analyzed for their functional properties.

Soaking treatment given to the raw material

The soaking of raw materials was done as per the treatments shown in Table 2. A 200 g sample of buckwheat was cleaned, weighed and soaked in 200 mL of distilled water for 6, 12 and 18 hours, following the method described by Mishra and Jain (2019). According to Sarvani *et al.* (2020), the horse gram seeds were soaked in distilled water at a 1:5 (w/v) ratio, ensuring complete immersion and left to stand overnight. The soaked seeds were then air- dried and ground into flour. For the soaking treatment of soybeans, black soybean grains were manually cleaned and soaked in distilled water at a 1:5 (w/v) ratio for 12 and 24 hours, as described by Chauhan *et al.* (2022). Water was used in a 1:2.5 to 1:4 ratio depending on the grain's hardness and soaking capacity. Soaking was done at room temperature (~25°C).

Drying process

After soaking, the grains were drained and lightly patted to remove surface moisture. They were then spread uniformly on trays and dried in a cabinet dryer at 60°C for 4 hours. This ensured the reduction of moisture to a safe level for grinding, while retaining nutritional quality. Jadhav *et al.* (2010) utilized a solar cabinet dryer for the drying of green peas, wherein the drying conditions were maintained within the range of 40-60°C for air temperature, 40-50% for relative humidity and 0.9-1.0 m/s for air velocity.

Flour preparation

Dried grains were milled using a laboratory-grade grinder to obtain a fine flour. The flours were sieved through 80-mesh sieve to ensure uniform particle size (Kulthe *et al.*, 2018). The individual flours were stored in air-tight containers under dry, ambient conditions until further use.

Functional properties of raw materials used in multigrain sev blended with mushroom powder

Table 3 depicts the functional properties of different flours used for preparation composite flour.

Significant measures of flour functioning in snack formulations are the Water Absorption Capacity (WAC) and Oil Absorption Capacity (OAC). The maximum WAC (2.76 ± 0.37 g/g) and OAC (1.85±0.20 g/g) were found in soy flour because of its high protein and fiber content, which improves water and oil retention. Chickpea and mushroom powder both had high WAC, which helped to retain moisture. Buckwheat's significance in taste absorption was supported by its high OAC and lowest WAC. In the production of multigrain snacks, these parameters support the blending of flours to enhance texture, mouthfeel and overall product quality. The WHC and OHC of the samples determined by using the methods suggested by Kakar *et al.* (2022) and Kulthe *et al.* (2025).

Sensory evaluation

The sensory characteristics of multigrain *sev* samples were evaluated using a 9-point hedonic scale and the results are presented in Table 4. Sensory evaluation revealed significant differences among the samples with varying levels of mushroom powder. SMS3 received the highest scores across all sensory attributes, including appearance

Table 1: Formulation of multigrain *sev.*

Ingredients	Control	SMS1	SMS2	SMS3
Chickpea flour	75	60	45	30
Buckwheat flour	10	10	10	10
Horse gram flour	15	15	15	15
Soy flour	-	10	20	30
Mushroom powder	-	5	10	15

Table 2: Soaking treatment given to the raw material.

Grains	Weight (g)	Water Used for soaking	Soaking Time (hours)
Chickpea	100 g	300 mL	8
Buckwheat	100 g	250 mL	6
Horse Gram	100 g	300 mL	8
Soybean	100 g	400 mL	10

Table 3: Functional properties of multigrain *sev* (WAC and OAC).

Flour type	Water absorption capacity (WAC) *(g/g)*	Oil absorption capacity (OAC) *(g/g)*.
Chickpea flour	2.21±0.05	1.03±0.02
Buckwheat flour	1.35±0.04	1.82±0.03
Horse gram flour	2.00±0.06	1.50±0.04
Soy flour	2.76±0.37	1.85±0.20
Mushroom powder	2.50±0.08	1.80±0.05

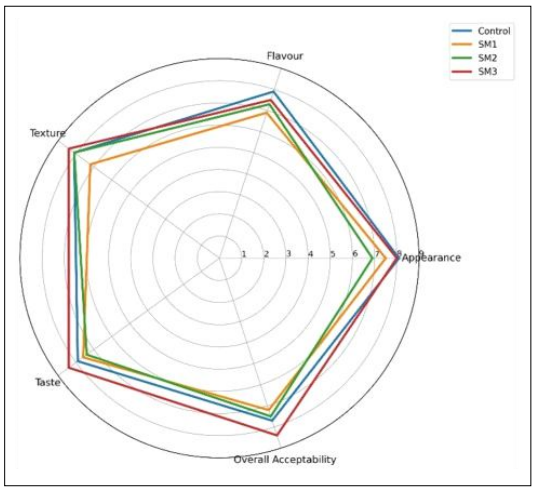


Fig 2: Sensory analysis of multigrain *sev* blended with mushroom powder.

Table 4: Sensory evaluation of multigrain *sev* blended with mushroom powder.

Samples	Appearance	Flavour	Texture	Taste	Overall acceptability
Control	8.1±0.20^{a}	7.9±0.30^{a}	8.1±0.25^{a}	7.9±0.28^{a}	7.7±0.32^{b}
SMS1	7.5±0.33^{b}	6.9±0.35^{b}	7.2±0.40^{b}	7.6±0.30C^{ab}	7.2±0.38G^{bc}
SMS2	6.9±0.36^{c}	7.3±0.32^{ab}	8.1±0.28^{a}	7.4±0.30G^{bc}	7.5±0.35^{b}
SMS3	8.0±0.22^{a}	7.5±0.26^{ab}	8.4±0.20^{aa}	8.4±0.19^{a}	8.4±0.18^{a}

*Means for groups in homogeneous subsets are displayed.

Table 5: Chemical analysis of multigrain *sev* blended with mushroom powder.

Samples	Energy (kcal)	Moisture (g)	Protein (g)	Fat (g)	Fibre (g)	Ash (g)	Carbohydrates (g)
Control	519.6±2.2^{a}	3.25±0.09^{c}	22.40±0.20^{d}	29.10±0.24^{d}	13.80±0.17^{e}	3.80±0.07^{d}	36.45±0.31^{a}
SMS1	511.0±2.1^{b}	3.40±0.10^{bc}	23.30±0.21^{c}	29.60±0.25^{c}	14.40±0.17^{d}	3.92±0.08^{c}	34.98±0.30^{b}
SMS2	505.8±2.1^{bc}	3.48±0.10^{b}	24.10±0.21^{b}	29.90±0.25^{b}	14.90±0.18^{c}	4.01±0.08^{b}	33.43±0.30^{c}
SMS3	501.7±2.2^{d}	3.55±0.10^{b}	24.88±0.22^{ab}	30.26±0.25^{ab}	15.28±0.18^{b}	4.10±0.08^{ab}	32.47±0.30^{d}

*Means for groups in homogeneous subsets are displayed

(8.0), texture (8.4), taste (8.4) and overall acceptability (8.4), indicating strong consumer preference. This could be attributed to the optimal balance between the flours and 15% mushroom powder, which enhanced both flavor and mouthfeel. The control also performed well, particularly in appearance and texture, but had slightly lower overall acceptability (7.7), possibly due to the absence of functional ingredients like mushroom powder. Thus, moderate inclusion of mushroom powder, as in SMS3, proved most effective in improving both nutritional profile and sensory acceptance. The comparative sensory attributes of the developed samples are presented in Fig 2.

Nutritional analysis

The effect of flour formulation on the nutritional profile especially the energy value and proximate composition of multigrain *sev* is shown in Table 5. The proximate analysis shows that increasing mushroom powder enhanced the nutritional quality of the samples. SMS 3, with 15% mushroom powder, balanced high protein (24.88±0.22 g), fat (30.26± 0.25 g) and dietary fibre (15.28±0.18 g) while maintaining good sensory attributes. Protein, fat, ash and fibre increased gradually from SMS1 to SMS3, while carbohydrate and energy values decreased slightly, reflecting the nutritional profile of mushroom powder. Although Sample SMS3 had the highest nutrients, it scored lower in sensory evaluation. The control had the highest energy and carbohydrates but was lower in protein and fibre, confirming the benefits of mushroom enrichment. Overall, SMS3 provided the best nutritional enhancement without compromising acceptability, making it the preferred formulation.

CONCLUSION

The present study successfully developed a nutritionally enhanced multigrain sev by incorporating soy flour and mushroom powder, targeting both improved health benefits and sensory appeal. Among the different formulations, Sample SMS3 (containing 15% mushroom powder and 30% soy flour) exhibited the most favorable results in terms of sensory attributes, functional properties and nutritional composition. It achieved high scores for taste, texture and overall acceptability, while also demonstrating significant improvements in protein and dietary fiber content compared to the control. The study highlights the potential of using underutilized ingredients such as mushroom powder and soy flour in traditional snack formulations to create value-added, functional products suitable for health-conscious consumers. Moderate incorporation levels are key to balancing nutritional enhancement with consumer acceptability. This standardized formulation can serve as a promising alternative to conventional fried snacks in the growing market for functional foods.

Conflict of interest

The authors declare that there is no conflict of interest.

REFERENCES

AOAC. (2005). Official Methods of Analysis 18th Edn., Association of Official Analytical Chemists, Washington DC.

Bagmare, P.A. and Swami, S.B. (2024). Development of sev from multigrain mixes from finger millet malt, moth bean malt and drumstick (*Moringa* sp.) leaf powder. *International Journal of Food and Fermentation Technology*. **14(2):** 649-663.

Bahri, S.S. (2016). Effect of oyster mushroom (*Pleurotus sajor-caju*) addition on the nutritional composition and sensory evaluation of herbal seasoning. *International Food Research Journal*. **23(1):** 262-268.

Breslauer, R., Nalbandian, E., Reinman, T., Rezaey, M., Ganjyal, G.M. and Murphy, K.M. (2023). Buckwheat production and value-added processing: A review of potential western Washington cropping and food system applications. *Sustainability*. **15(20):** 14758.

Chauhan, D., Kumar, K., Ahmed, N., Thakur, P., Rizvi, Q.U.E.H., Jan, S. and Yadav, A.N. (2022). Impact of soaking, germination, fermentation and roasting treatments on nutritional, anti-nutritional and bioactive composition of black soybean (*Glycine max* L.). *Journal of Applied Biology and Biotechnology*. **10(5):** 186-192.

Jadhav, D.B., Visavale, G.L., Sutar, N., Annapure, U.S. and Thorat, B.N. (2010). Studies on solar cabinet drying of green peas (*Pisum sativum*). *Drying Technology*. **28(5):** 600-607.

Kakar, A., Miano, T.F., Soomro, A.H., Yar, A., Memon, S.A. and Khan, B. (2022). Oil and water absorption capacity of wheat, rice and gram flour powders. *International Journal of Ecosystems and Ecology Sciences*. **12(2):** 585-594.

Kulthe, A., Amit, K.P. and Amol, R.K. (2025). processing driven impact on functional and nutritional profile of pearl millet. *Asian Journal of Dairy and Food Research*. **44(2):** 268-272. doi: 10.18805/ajdfr.DR-1997.

Kulthe, A.A., Thorat, S.S. and Khapre, A.P. (2018). Nutritional and sensory characteristics of cookies prepared from pearl millet flour. *The Pharma Innovation Journal*. **7(4):** 908-913.

Kulthe, A.A., Thorat, S.S. and Lande, S.B. (2016a). Characterization of pearl millet cultivars for proximate composition, minerals and anti-nutritional contents. *Advances in life Sciences*. **5(11):** 4672-4675.

Kulthe, A.A., Thorat, S.S. and Lande, S.B. (2017). Preparation of β-carotene enriched pearl millet based cookies. *International Journal of Current Microbiology and Applied Sciences*. **6(2):** 1197-1203.

Kulthe, A.A., Thorat, S.S. and Mhalaskar, S.R. (2016b). Physical stability of β-carotene encapsulated with different wall materials. *The Bioscan*. **11(3):** 1577-1581.

Kumar, N., Nath, N. and Arora, S.K. (2019). Process optimization and characterization of '*sev*' (traditional Indian extruded snack) with the incorporation of mushroom powder. *Journal of Food Science and Technology*. **56:** 1723-1731.

Lende, V.G., Jarhad, M.G., Nehe, K.B. and Mite, G.B. (2022). Formulation of nutrients rich multigrain *sev* and its storage potential. *International Journal of Innovative Research in Technology*. **9(5):** 255-261.

Mishra, M. and Jain, S. (2019). Effect of soaking and germination on nutritional profile and antinutrients of buckwheat whole (*Fagopyrum esculentum*). *International Journal of Current Microbiology and Applied Sciences*. **8(2):** 3384-3393.

Pandey, L. and Sangwan, V. (2020) Development and quality evaluation of sorghum and soybean incorporated value added *Sev*. *International Journal of Current Microbiology and Applied Sciences*. **11:** 1209-1223.

Panse, V.S. and Sukhatme, P.V. (1967) Statistical methods for agricultural workers. ICAR, New Delhi, pp: 70-72.

Patel, S.K., Khan, M.A., Rana, G.K. and Mehra, M. (2019). Formulation, development and quality assessment of nutri-rich snack food (Sev). *Asian Journal of Dairy and Food Research*. **38(3):** 257-260.

Ranganna S. (1986). Handbook of analysis and quality control for fruits and vegetable products. *Tata-Mc Graw Hill Publishing Co. Ltd. New Delhi.* **34:** 7-8, 21-25.

Sarvani, B.H., Suvarna, V.C., Kumar, K.H., Ranadev, P. and Girisha, H.C. (2020). Effect of processing and fermentation on functional properties and on anti-nutritional factors in horse gram (*Macrotyloma uniflorum*). *International Journal of Current Microbiology and Applied Sciences*. **39:** 38-45.

Senthil, A., Ravi, R., Bhat, K.K. and Seethalakshmi, M.K. (2002). Studies on the quality of fried snacks based on blends of wheat flour and soya flour. *Food Quality and Preference*. **13(5):** 267-273.

Sharma, N. and Minhas, R. (2023). Value-added food products from Buckwheat (*Fagopyrum*) species: A functional food. *The Pharma Innovation Journal.* **12(5):** 2109-2113.

Verma, T., Dey, P., Aggarwal, A., Devpal, R. and Sharma, R. (2023). Optimization and storage study of garlic (*Allium sativum*) incorporated herbal multi-millet *sev* snack. *Food Chemistry Advances*. **3:** 100365.