**Innovative Approaches in Developing Value-Added Products from Mushroom**

**ABSTRACT**

Mushrooms are highly nutritious and rich in vitamins, proteins, antioxidants, and amino acids. However, their perishability limits their demand. Value addition on mushrooms enhances their stability, making them more versatile for consumption. This present study explores the development of innovative mushroom-based products aimed at enhancing shelf life, consumer preference, and market potential. Various value-added formulations, including mushroom souffles, brownies, and cookies, were developed by integrating mushrooms into conventional recipes while maintaining their nutritional integrity. Sensory evaluation of these products demonstrated favorable organoleptic properties, with an optimal balance of texture, flavor, and appearance. The incorporation of mushroom powder and extracts into baked and savory items significantly improved their taste. Additionally, these value-added products could provide an opportunity to increase the utilization of mushrooms to create economically viable alternatives for producers. This research highlights the potential of mushroom-based value-added products in promoting sustainable food practices and expanding consumer markets.

**Keywords:** Mushrooms, Nutrients, Vitamins, Value-added product

**1. Introduction**

Mushroom cultivation is expanding rapidly due to its sustainability and relatively simple production process. However, despite this growth, the demand and supply of mushrooms, particularly in India, remain limited due to a lack of consumer awareness about their nutritional value and the challenges of perishability (Royse et al., 2017; Jahan et al., 2019; Seethapathy et al., 2023). Mushrooms are an excellent source of high-quality protein and essential nutrients, such as B vitamins, selenium, copper, and phytonutrients (Barros et al., 2008; Alves et al., 2012; Praveen et al., 2018). They also contain bioactive compounds like β-glucans, which exhibit immunomodulatory, antioxidant, anticancer, and anti-inflammatory properties (Kumar et al.,2021). Additionally, mushrooms serve as a viable meat alternative for vegans due to their rich macro- and micronutrient composition, including potassium (K⁺), phosphorus (P⁺), calcium (Ca²⁺), magnesium (Mg²⁺), and iron (Fe²⁺) (Leema et al., 2023).

However, mushrooms have been extensively utilized as a key component in a variety of value-added products. Recent developments include dried formulations such as the Shanzhen series of mushroom-infused noodles, mushroom black sesame powder, extract-based mushroom flavoring, dried mushroom bean curd, seafood–mushroom nutrient steamed buns, mushroom and vegetable vermicelli, beverages, and edible mushroom-flavored sauces, along with other processed formulations like mushroom sauce, mushroom beef paste, and assorted mushroom sauces. In contrast, earlier product innovations predominantly focused on preserved items, including mushroom jams, pickles, ketchups, preserves, and candies, as well as processed products such as mushroom patties, pakoda, soups, and ready-to-serve curries (Singhal et al., 2019; Shankar et al., 2024).

Hence, the value-added mushroom foods could be a numerous benefit, including improved nutritional intake for children and mothers, increased economic returns for producers, expanded market opportunities, and advancements in packaging and storage technologies that minimize waste and enhance food safety (Devia et al., 2022). The concept of value addition refers to the economic enhancement generated through the production of goods and services and is quantified as the difference between the final output value and the cost of intermediate inputs. Additionally, value-added products contribute to the overall income distribution by compensating labor and capital involved in the production process.

To introduce a new challenge, the focus is on increasing mushroom consumption and shelf life through value-added processing, making them more appealing to a diverse consumer base. Enhancing the production and demand for mushroom-based products can contribute to combating malnutrition, addressing public health concerns, and improving food security while providing economic benefits to cultivators. Developing highly nutritious, palatable, and affordable mushroom-derived products can further promote their integration into everyday diets, ensuring accessibility and acceptance across various consumer groups.

**2. Materials and Methods**

Most mushroom-based products are developed by modifying their physical state through cleaning, oven drying, and grinding. This approach is commonly used in the production of value-added products like biscuits, brownies, candies, instant soup mixes, nuggets, murraba, juices, and papads. However, certain products, including mushroom samosas, kebabs, and paniyaram, do not require grinding and instead incorporate whole or chopped mushrooms. Despite the nutritional and functional benefits of these products, many innovative mushroom-based formulations remain underexplored and have yet to gain widespread consumer acceptance.

**2.1. Mushroom Souffle**

To prepare mushroom souffle, two tablespoons of butter was melted in a pan and half kilogram of the mushrooms, lemon juice, and minced garlic for 2–3 minutes were sautéed separately. The sauteed mushrooms was transferred to a bowl and seasoned with oregano to enhance the flavour. In a separate pan, the remaining two tablespoons of butter was melted with the addition of all-purpose flour, and cooked for 2 minutes before removing from heat. Gradually stir in milk and bringing the mixture to a boil state. Then, the mushroom mixture and egg yolks were incorporated into the sauce. Separately, whisk the egg whites until stiff peaks form and gently fold them into the mixture. The prepared batter was transferred into baking dishes and bake in a preheated oven at 400°F for 8–10 mins to turns golden brown on top with slight modifications as per the procedure by Dietrich et al. (2022).

**2.2. Mushroom Brownie**

Before preparing for the mushroom brownie, the oven was preheated to 180°C. The dark compound chocolate and butter was melted using the double-boiling method until a smooth mixture is obtained. In a separate bowl, the brown sugar thoroughly mixed with fifty grams of mushroom powder to eliminate any lumps. The eggs were added and beated well to achieve a homogenous mixture. Gradually the refined flour (maida), cocoa powder, and the melted chocolate-butter mixture was incorporated, stirring continuously until a smooth batter is formed. To this, pinch of salt and vanilla essence was added for enhanced flavor. The prepared batter was poured into a parchment-lined baking pan and baked in the preheated oven for 15–20 mins, or until the surface appears dry and the edges begin to pull away from the pan. The brownies were allowed to cool before adding toppings or serving. The procedure was performed as per the protocol by De Abreu at al. (2021) with slight modification instead of using seed flour.

**2.3. Mushroom Cookies**

To prepare the mushroom cookies, four and half cups of maida flour, four teaspoons of baking powder, and two teaspoons of salt were thoroughly combined, followed by the incorporation of one and half cups of butter to create a homogeneous base. Subsequently, one and a half cups of finely chopped mushrooms and one and a half cups of Swiss cheese were added. In a separate vessel, eggs and cream were vigorously beaten and then gradually introduced into the dry mixture under gentle stirring to ensure uniform integration. The resulting dough was shaped on a floured surface to conform to the desired pan dimensions, cut into the preferred form, and optionally chilled for one hour to stabilize the structure. Finally, the dough was baked in a preheated oven at 350°F for approximately 30 minutes until the top surface achieved a uniform golden-brown coloration as per the protocol described by Chaudhari et al. (2018).

**3. Result and Discussion**

**3.1. Mushroom Souffle**

The prepared mushroom souffle exhibited a light, airy texture with a well-risen structure, indicating proper incorporation of whipped egg whites. The souffle had a golden-brown crust on the surface, enhancing its visual appeal. Sensory evaluation revealed a rich umami flavor from the infused mushrooms, complemented by the subtle tanginess of lemon juice and the aromatic presence of garlic and oregano. The butter and milk contributed to a creamy feeling in the mouth, while the seasoning balanced the overall taste. The product was well-received for its soft and fluffy consistency, making it an appealing and nutritious mushroom-based dish (Fig. 1A).

**3.2. Mushroom brownie**

The mushroom brownie exhibited a unique integration of traditional brownie attributes with enhanced nutritional benefits from the use of mushroom powder (Fig. 1B). The brownie texture was characterized by a dense, moist crumb complemented by a subtly crisp exterior, while the earthy nuances from the mushroom powder balanced the rich, dark chocolate flavor. Sensory evaluations indicated a harmonious blend of sweetness, aroma, and mouthfeel, with the baking process yielding a uniformly dry top surface and slightly retracted edges that confirmed optimal heat distribution. Overall, the product successfully merged enhanced functional properties with desirable organoleptic qualities, underscoring its potential as an innovative dessert option. Mushroom brownie was the first attempt to use a mushroom-infused product with an appealing taste.

**3.3. Mushroom Cookies**

The final mushroom cookies exhibited a uniform golden-brown surface with a balanced texture, characterized by a crisp exterior and a tender, buttery interior (Fig. 1C). The homogeneous integration of finely chopped mushrooms and Swiss cheese imparted a subtle, savory nuance, which complemented the overall rich flavor profile. Sensory evaluation indicated that the cookies achieved an optimal balance between moisture and firmness, while egg and cream contributed to a smooth, cohesive mouthfeel. Overall, these cookies successfully incorporate functional ingredients without compromising on the desirable organoleptic properties typical of conventional bakery products. The presented results were in accordance with Sood (2022) and Chaudhari et al. (2018).

**4. Conclusion**

Mushrooms are highly perishable and can begin to deteriorate within a few hours when stored under suboptimal environmental conditions, such as high temperature and humidity. The current value addition with mushrooms is below 7%, primarily due to their rapid spoilage and limited consumer acceptance of using mushrooms. However, incorporating mushrooms into value-added products such as cookies, brownies, and souffles can potentially elevate the mushroom product by approximately 20%, thereby enhancing consumer preferences for both nutritional appeal and marketability.

A

B

C

**Fig 1: Value added product of Mushroom. A. Mushroom Souffle; B. Mushroom Brownie and C. Mushroom Cookies**

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**Disclaimer (Artificial intelligence)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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