

Research Article

Development and Acceptability of Vegetable-Enriched Tempeh Patty

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Abstract: Tempeh Patty is a plant-based product developed as a healthy alternative to conventional meat patties, using tempeh as the primary ingredient. Its nutritional and sensory qualities were enhanced through the addition of vegetables and herbs. Two formulations were produced: Variation 1 (V1) with black pepper and shiitake mushrooms, and Variation 2 (V2) with black pepper and carrots. The production process involved steaming and mashing tempeh, sautéing vegetables and herbs, mixing with textured vegetable protein, breadcrumbs, eggs, and seasonings, then shaping, chilling, and deep-frying the patties. Sensory evaluation by 60 panelists showed V1 achieved the highest overall acceptability.



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1. INTRODUCTION

Tempeh is a traditional fermented soybean food that has gained popularity as a nutritionally strong plant-based protein source due to its high protein content, dietary fiber and beneficial probiotic profile (Kustyawati et al., 2017). Fermentation does not only increase the digestibility of soybeans but also improves the flavor profile and thus, makes tempeh a versatile ingredient of the modern plant-based food (Pratiwi et al., 2019).

Over the last few years, the popularity of plant-based foods in consumer demand has been quickly growing due to the high health awareness levels, environmental factors, and ethical implications related to the consumption of meat products (He et al., 2020). As a result, plant-based meat products, including patties, have reached a certain degree of popularity, especially among consumers

who are interested in convenient and familiar products that would address their busy schedules (Sogari et al., 2021).

However, a significant percentage of the existing plant-based patties are highly processed and thus often do not have the original flavor and texture as expected by the customers (Sha & Xiong, 2020). Despite its nutrient value and sustainability benefits, tempeh has not been fully utilized in the ready-to-eat preparations and has not been developed into appealing and delicious products that can attract broader groups (Ahnann-Winarno et al., 2021).

This study presents Tempeh Patty, a patty that is made by using tempeh as the main ingredient and adding shiitake mushrooms, onions, carrots, and herbs to improve the flavor and sensory attributes. The product aims to provide a healthy and sustainable substitute to the traditional meat patties and combine the traditional tempeh culture with the modern food innovation. Sensory evaluation is applied to determine appearance, saltiness, texture, flavor, and overall acceptability since sensory characteristics are the main predictors of consumer-acceptance in developing plant-based products (Lawless & Heymann, 2010; Meilgaard et al., 2019).

Since it promotes healthy eating practices while maintaining tempeh's cultural identity as an important component of Asian diets, this research has substantial societal significance. Using local components like onions and mushrooms increases the depth of the flavor while encouraging the use of readily available, sustainable resources, supporting local vendors and farmers. The study also discusses the expanding consumer demand for frozen, plant-based, and prepared foods. Customers are looking for more wholesome, practical, and culturally relevant dining options as hectic lifestyles become the norm. In addition to meeting this need, the Tempeh Patty connects consumers throughout the world to the diversity of Southeast Asian cuisine, which could increase its standing in the worldwide market for plant-based foods.

2. LITERATURE REVIEW

The market for plant-based burger patties, which was estimated to be worth USD 2.32 billion in 2024 and is expected to reach USD 8.16 billion by 2033 due to rising consumer demand for sustainable and meatless substitutes, has grown rapidly, according to earlier study (Global Growth Insights, 2025). In a similar vein, research indicates that the market for plant-based burger patties would surpass USD 6.6 billion globally by 2029, indicating that customers are becoming more conscious of environmental and health issues (Technavio, 2024). Based on these insights, this research is timely, aiming to fill a gap in the market for unique frozen snacks that combine ethnic flavors with modern convenience.

By turning tempeh into a convenient patty that fits in with current food trends, the Tempeh Patty seeks to promote and enhance the traditional consumption of tempeh. Despite being a nutrient-dense and culturally important foodstuff in Southeast Asia, tempeh is frequently disregarded by newer generations because of its simple appearance and restricted methods of preparation. This research closes the gap between the traditional plant-based protein culture and contemporary consumer expectations by providing tempeh in an original patty shape, making it appealing and available to a larger audience.

3. METHODOLOGY

3.1 Materials

Table 1 shows the percentage of the ingredients that are used in the making of Tempeh Patty. The materials were obtained from both the Faculty and local retail markets.

Table 1. Formulation of Tempeh Patty.

	PERCENTAGE (%)	
	VARIATION 1	VARIATION 2
Tempeh	33.5%	33.5%
Breadcrumbs	10%	10%
Texture Vegetable Protein	20%	20%
Eggs	3%	3%
Shiitake Mushrooms	20%	0%
Carrot	0%	20%
Onion	12%	12%
Salt	0.5%	0.5%
Blackpepper	0.5%	0.5%
Chicken stock	0.5%	0.5%

Variations:

- i) Variation 1 - Basic ingredients with an addition of shiitake mushroom
- ii) Variation 2 - Basic ingredients with an addition of carrot

3.2 Methodology

3.2.1 Tempeh Patty Preparation

Table 2. Preparation Step of Tempeh Patty.

		Firstly, chop carrot, shiitake and onion.
		Weigh all the ingredients.

	Steam the tempeh for 10-15 minutes until soft.
	Soak TVP for 10 minutes until it swells.
	Sauté the vegetables with onion until fragrant.
	Mix all the ingredients until a uniform patty mixture is formed.
	Divide into equal portion and shape each portion into round, flat patties with consistent size and thickness.
	Freeze the patty at a temperature of -18°C to -20°C.
	Final product: Tempeh Patty

3.2.2 Sensory Evaluation Procedure

Two Tempeh Patty formulations (Variation 1 and Variation 2) were prepared using identical cooking methods and served warm on the day of evaluation. A total of 60 students participated as panellists. The sensory test was conducted in a controlled environment with adequate lighting, low noise, and odor-free surroundings. Samples were coded with random three-digit numbers and served in randomized order. Panellists evaluated appearance, saltiness, texture, flavor and overall acceptability using a 9-point hedonic scale, recording their scores on standardized forms.

4. FINDINGS

A sensory evaluation was conducted to compare two Tempeh Patty formulations: Variation 1 (tempeh with shiitake mushrooms) and Variation 2 (tempeh with carrots). The products were assessed based on five sensory attributes: appearance, saltiness, texture, flavor, and overall acceptability.

Panellists were provided with a scorecard and asked to rate each attribute using a 9-point Likert scale ranging from 1 (extremely dislike) to 9 (extremely like). As illustrated in Figure 1, Variation 1 achieved a higher overall acceptability score than Variation 2, suggesting that it was the preferred formulation among the panellists.

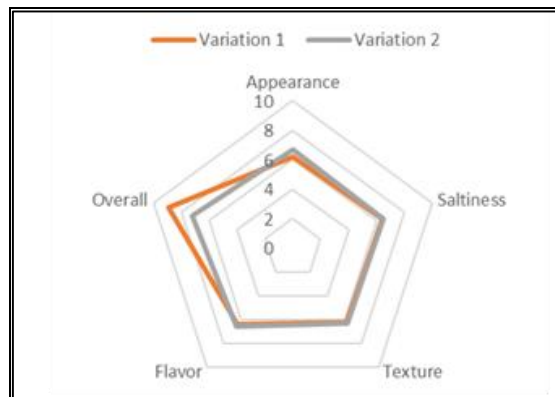


Figure 1. Sensory Evaluation Scores of Tempeh Patty.

4.1 Product Characteristics

As shown in Figure 2, the final product consists of round-shaped tempeh patties with a uniform golden-brown appearance. The texture appears crisp while remaining moist on the inside. The surface appears to have an evenly fried and well-formed structure, tempeh easy to absorb spices or seasoning where it can produce unique flavor at the end of the product.



Figure 2. Final Appearance of Tempeh Patty.

The product is packed in transparent vacuum packaging, as shown in Figure 3, allowing consumers to clearly see the shape, colour, and texture of the Patty Tempeh before purchase. Vacuum packaging is used to maintain freshness by minimizing air exposure and extending product shelf life. Its compact and sealed design also makes the product easy to store and handle for both home use and food service purposes.



Figure 3. The Suggested Packaging for Tempeh Patty.

4.2 Sensory Evaluation Analysis

Table 3 presents the mean sensory scores for two formulations of Tempeh Patty: Variation 1, and Variation 2. The sensory attributes evaluated included appearance, saltiness, texture, flavor and overall acceptability. The results indicate that variation 1 consistently received the highest score across most attributes, suggesting it was the most preferred formulation among panellists.

Table 3. Mean Score of Tempeh Patty.

	Appearance	Saltiness	Texture	Flavor	Overall Acceptability
Variation 1	6.2	6.4	6.2	6.4	8.9
Variation 2	6.7	6.5	6.3	6.6	7.2

5. DISCUSSION

In this product innovation, tempeh has been used as a main ingredient. Tempeh was made from fermented soy bean which was made throughout the fermentation process (Wikipedia contributor., n.d). Today, tempeh has become more popular among consumers because of the benefits and the tastiness, tempeh now has been chosen by consumers for their daily meal and also increased market demand where consumers can get tempeh in health food stores, supermarkets or grocery stores (Tempeh. info., n.d). Tempeh is rich with nutrients where it provides protein, vitamins and minerals with low sodium and carbohydrates, and it also contains prebiotics which can help to support gut health (Ajmera et al., 2025).

The sensory analysis highlights the importance of striking a balance between the critical qualities such as appearance, taste, texture, aroma, and overall acceptability, in an attempt to create a product that meets the expectation of the consumer. Tempeh Patty with addition of shiitake mushroom was the most popular among the two formulations tested and this proved that the use of shiitake mushrooms significantly improves taste, texture and overall likeability.

6. CONCLUSION

Tempeh Patty has already achieved the ability to reinvent the traditional tempeh-based food to a contemporary convenient patty. This is a sustainable and healthy alternative to the conventional meat patties. In addition to making the product more attractive and saleable, the future development should focus on making the patty crunchy and juicy by refining the process of frying it or by resorting to other possible ways of cooking, like air-frying. In addition, exploring seasoning mixes and combinations of herbs can provide a wider range of flavour profiles to suit the wide range of consumer choices. Altogether, the Tempeh Patty has enormous potential in the plant-based food sector since it unites the classical tempeh culture with the modern innovation, thus providing an easy-to-cook, tasty, and healthy alternative to the modern consumers.

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