

# Optimization of Tempeh-Based Protein Shake Formulations as a Functional Nutritional Alternative for Physically Active Individuals

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## Abstract:

Tempeh, a traditional fermented soybean product, is widely recognized for its high protein content and health benefits. As protein plays a crucial role in muscle recovery and immune function, developing an affordable and high-quality tempeh-based protein shake may benefit physically active individuals. This study aimed to formulate and evaluate tempeh-based protein shakes by analyzing their nutritional composition and sensory properties. Three formulations were prepared using varying ratios of tempeh flour (50 g, 40 g, 30 g) and oat flour (28 g, 48 g, 67 g), combined with almond powder, cocoa powder, stevia, salt, and water. Each formulation was standardized to provide approximately 28 grams of protein per serving. Proximate analysis was conducted to determine moisture, protein, fat, carbohydrate, ash, and crude fiber content. Sensory evaluation was performed using a hedonic scale by 30 semi-trained panelists, assessing taste, texture, aroma, and appearance. The results indicate that tempeh-based protein shakes offer a promising nutritional profile and received positive sensory acceptance, suggesting their potential as a functional food option for active individuals.

**Key words:** Tempeh, protein shake, nutrition, functional food.

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## Background :

Perception of a healthy lifestyle is increasingly evolving and gaining widespread attention in society. The individuals' awareness of the urges to maintain the immune system were increased, reflected from the escalation of physical exercise. These activities had a strategic role to form the quality of human resources, so that they can support the process of enhancing individual capacity. During physical activity, the body experiences an increased energy demand, necessitating an optimal nutritional intake to maintain physiological well-being. Proper nutrition intake contributes to physical performance during exercise to stabilized blood glucose levels, delays hunger, and accelerates post-exercise recovery.

Protein as an essential macronutrient plays a crucial role in energy metabolism and muscle tissues synthesis. In addition as an energy source, protein is fundamental in maintaining muscle growth and repair (Ardiansyah MA *et al*, 2024). Scientific studies indicate that adequate protein consumption enhances muscle strength and expedites post-exercise recovery. Furthermore, protein supports immune system function, contributing to the body's protection against infections. Therefore, physically active individuals require sufficient protein intake to facilitate energy recovery and physiological adaptation following exercise.

With the growing trend of healthy lifestyle, many physically active individuals rely on protein supplements such as whey protein or dairy-based proteins, commonly consumed in the form of protein shakes. Protein shakes are considered a convenient alternative for meeting daily protein necessities due to their ease of preparation and consumption. However, the relatively high price of these products poses a challenge for some individuals to consume protein shakes regularly. Hence, an alternative protein shake that is high-quality, healthy, safe and more affordable is required.

Tempeh, as a widely consumed fermented soybean product in Indonesia, holds great potential as an alternative protein source. According to the data from the Indonesian Central Bureau of Statistic (Badan Pusat Statistik), tempeh consumption in Indonesia was estimated at 7,3 kg per capita in 2022. Indonesians mainly consume Tempeh as a side dish for rice. Tempeh is fermented using *Rhizopus Oligosporus*, which imparts various health benefits, so tempeh is called as a "Superfood". Nutritionally, tempeh is rich in branched-chain Amino Acid (BCAA), including leucine, isoleucine, and valine, which are essential for muscle recovery following intense [physical activity. Additionally, tempeh has high digestibility and contains bioactive compounds such as isoflavones, which function

as antioxidants to reduce oxidative stress in the body (Jauhari M *et al*, 2014). Tempeh consumption is associated with various benefits for health, including antidiabetic effects, reduce cholesterol, improve cognitive function, antitumor and anticancer, anti-aging effects, enhanced digestive health and reduce cardiovascular disease risk (Teoh SQ *et al*. 2024)

Based on its nutritional advantages, availability, affordability and sustainability, tempeh has significant potential for development as an alternative nutritious protein shake. Therefore, this study aims to formulate an optimal tempeh-based protein shake, considering appropriate nutritional composition and sensory acceptability to support body performance through physical exercise.

### **Methodology:**

The primary ingredients utilized in this study include tempeh flour, oat flour, almond powder, cocoa powder, stevia, salt and water. Tempeh-based protein shake formulations are prepared using varying proportions of tempeh flour (50 g, 40 g, and 30 g) and oat flour (28 g, 48 g, and 67 g). These three shake formulations were designed to contain a standardized protein content of approximately 28 grams per serving.

Proximate analysis is performed to assess the nutritional composition of tempeh-based protein shake. The formulated product samples are analyzed in the laboratory to determine moisture, protein, fat, carbohydrate, ash and crude fiber content. This analysis aims to establish the final product's nutrient composition and ensure it meets the dietary requirements necessary for supporting physical exercise.

Sensory evaluation is conducted to assess the organoleptic properties of the product, including taste, texture, aroma and appearance. The sensory test involves panelists selected based on criteria relevant to the study. Panelists are asked to provide ratings using hedonic scale to measure their preference levels for tested products. The acceptance evaluations consist of four categories, "strongly like", "like", "neutral", "dislike", and "strongly dislike". The sensory evaluation involves 30 semi-trained panelists and aims to determine consumer acceptance of the product.

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