

UNIVERSITI TEKNOLOGI MARA

**DEVELOPMENT OF TEXTURIZED
PEA (*PISUM SATIVUM* L.) PROTEIN
AND SHIITAKE (*LENTINUS
EDODES* P.) MUSHROOM
PROTEIN-BASED PATTIES:
EXTRUSION OPTIMIZATION,
PHYSICOCHEMICAL PROPERTIES,
AND SENSORY ACCEPTABILITY**

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ABSTRACT

The development of texturized legume proteins (TLP), particularly from pea protein, is often limited by the globular structure of plant proteins, which restricts the formation of fibrous textures. This study demonstrated that optimised extrusion conditions enhanced the fibrous structure of texturized pea-shiitake mushroom (TPSM) protein using a single-screw extrusion process. A Box-Behnken design under response surface methodology was applied to optimise feed mixture composition (pea protein isolate (PPI) and shiitake mushroom (SM)), barrel temperature, and screw speed. The optimal conditions identified were 80.91% PPI:19.09% SM, 150 °C barrel temperature, and 151.41 rpm screw speed. These conditions significantly affected the integrity index and water absorption capacity, with barrel temperature being the most influential factor. Chemical analysis showed a protein content of $73.49 \pm 0.3\%$ and a favourable amino acid profile, while protein solubility decreased significantly after extrusion. TPSM exhibited higher water absorption capacity, lower oil absorption capacity, no gelling formation (2–20% w/v), and no significant effects on foaming and emulsifying properties. When TPSM was incorporated into beef patties (20–80%) and compared to a positive control (100% beef), notable improvements were observed in the cooking properties and nutritional profile. Sensory evaluation indicated moderate acceptance (hedonic score 6/9), particularly at 20% TPSM substitution, especially for flavour and texture attributes. These findings highlight the potential of TPSM as a functional ingredient in alternative protein applications.

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CHAPTER 1

INTRODUCTION

1.1 Background of study

Proteins play a crucial role in the development and quality of food products. Due to their structural flexibility and amphiphilic properties, proteins engage in various interactions with other food elements, including fats, carbohydrates, minerals, vitamins, and other proteins (Ismail *et al.*, 2020a). As one of the most important macronutrients in human diets, protein plays a critical role in growth, tissue maintenance, and overall health. (Langyan *et al.*, 2022; Lee *et al.*, 2022). An adequate dietary intake of protein is crucial for human nutrition, with recommended daily intake 0.8-1.52g/kg of protein per day for adults, although a limit of 0.66g/kg of protein per day is advised to avoid deficiencies (Sá *et al.*, 2020).

Dietary proteins can be sourced from both animal and plant origins, with animal proteins traditionally in higher demand. However, the environmental impact of animal agriculture has prompted the need for a more sustainable shift toward plant-based protein sources. Plant-derived proteins offer various benefits, including reduced ecological footprints, ethical considerations related to animal welfare, and a viable solution to protein-energy malnutrition. This shift also addresses sustainability concerns while accommodating dietary preferences, religious beliefs, and the growing demand for food security and affordability (Ismail *et al.*, 2020b; Langyan *et al.*, 2022). Consequently, plant proteins have gained increasing popularity as affordable and versatile alternatives to animal-derived proteins, making them suitable for use in diverse food formulations (Sá *et al.*, 2020).

Plant-based proteins, classified as vegan, are rich in essential amino acids and other key macronutrients, fulfilling dietary requirements for a balanced human diet. Moreover, these proteins are high in dietary fibre, water-soluble vitamins, polyunsaturated fatty acids, oligosaccharides, and carbohydrates. Their versatile functional properties, including thickening, gelling, emulsifying, foaming, and water retention, make them ideal for developing functional food products. They are derived from a wide range of plant sources such as cereals, legumes, pseudocereals, nuts, almonds, and seeds, each exhibiting unique characteristics (McClements & Grossmann,