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Plant-Derived Proteins as Partial Replacements for Animal Proteins in Meat Products: Functional, Nutritional, and Technological Perspectives

Costoae (căs. Dâlv) Diana Maria, Bolosin (căs. Tonța) Alina*, Mihaela Cazacu, Stoin Daniela, Cocan Ileana
Faculty of Food Engineering, University of Life Sciences "King Mihai I" from Timisoara, Calea Aradului 119, Timișoara 300645,
România
*ileanacocan@usvt.ro

Abstract: This study investigates the potential of plant-derived proteins as a partial alternative to animal proteins in the meat industry, with the aim of enhancing both the economic efficiency and nutritional quality of meat products. Plant proteins possess significant functional properties, including fat emulsification, water binding, and texture enhancement, making them widely applicable in emulsified meat products such as sausages, pâtés, and salamis. Soy, pea, and wheat are the primary sources of plant proteins due to their high protein content and favorable technological characteristics. Soy protein isolates (SPI), in particular, provide excellent water retention and structural stability, and are the most commonly used ingredients for partial replacement of lean meat.

In conclusion, the partial replacement of animal proteins with plant-derived proteins in meat products contributes to cost optimization, improves nutritional quality, and maintains desirable sensory properties, offering an innovative and sustainable approach to meat product formulation.

Keywords: Plant proteins, meat alternatives, soy protein isolates, functional properties, nutritional quality.

• Introduction

During injection and marination processes, plant proteins contribute to improved product juiciness and tenderness, reduce cooking losses, and enhance overall yield. In minced meat products, such as meatballs, sausages, and nuggets, textured plant proteins—especially soy-based—impart a meat-like texture, allowing for fat reduction while preserving sensory qualities. In fermented and dried sausages, plant proteins serve both to reduce production costs and to develop low-fat products with enhanced functional properties.

Additionally, the study underscores the potential of chickpea (*Cicer arietinum*) as a valuable source of plant proteins, vitamins, and minerals. Chickpeas also exhibit antioxidant, digestive, and hypocholesterolemic effects, representing a sustainable and nutritionally rich alternative to animal proteins.

The primary objective of this research was to develop an innovative plant-based meat product designed to provide enhanced functional and nutritional benefits. The production process followed specific technological stages, after which the final product was subjected to comprehensive physico-chemical and sensory evaluation. Physico-chemical analysis focused on determining key compositional parameters, including moisture, protein, carbohydrate, lipid, and energy content, while sensory evaluation assessed appearance, taste, aroma, and texture.

Material and method

The main raw and auxiliary materials used in the basic pâté recipe were as follows: Raw materials: pork liver – 250 kg, pork jowl – 500 kg, broth from boiling the raw materials – 50 kg. Seasonings: bay leaves – 15 kg, onion – 100 kg, pepper – 1 kg, salt – 20 kg. For the experimental variants, part of the pork meat was replaced with chickpeas in different proportions: 10%, 20%, and 30%, in order to obtain products with improved nutritional value and functional potential. The following pâté samples were analyzed in the study: PM: control pâté (without chickpeas); P10: pâté with 10% chickpeas; P20: pâté with 20% chickpeas; P30: pâté with 30% chickpeas. These samples were subjected to organoleptic, sensory, and physicochemical analyses to highlight the influence of chickpea addition on the final product's quality. The technological process for obtaining the pâté sample is shown in Figure 1.

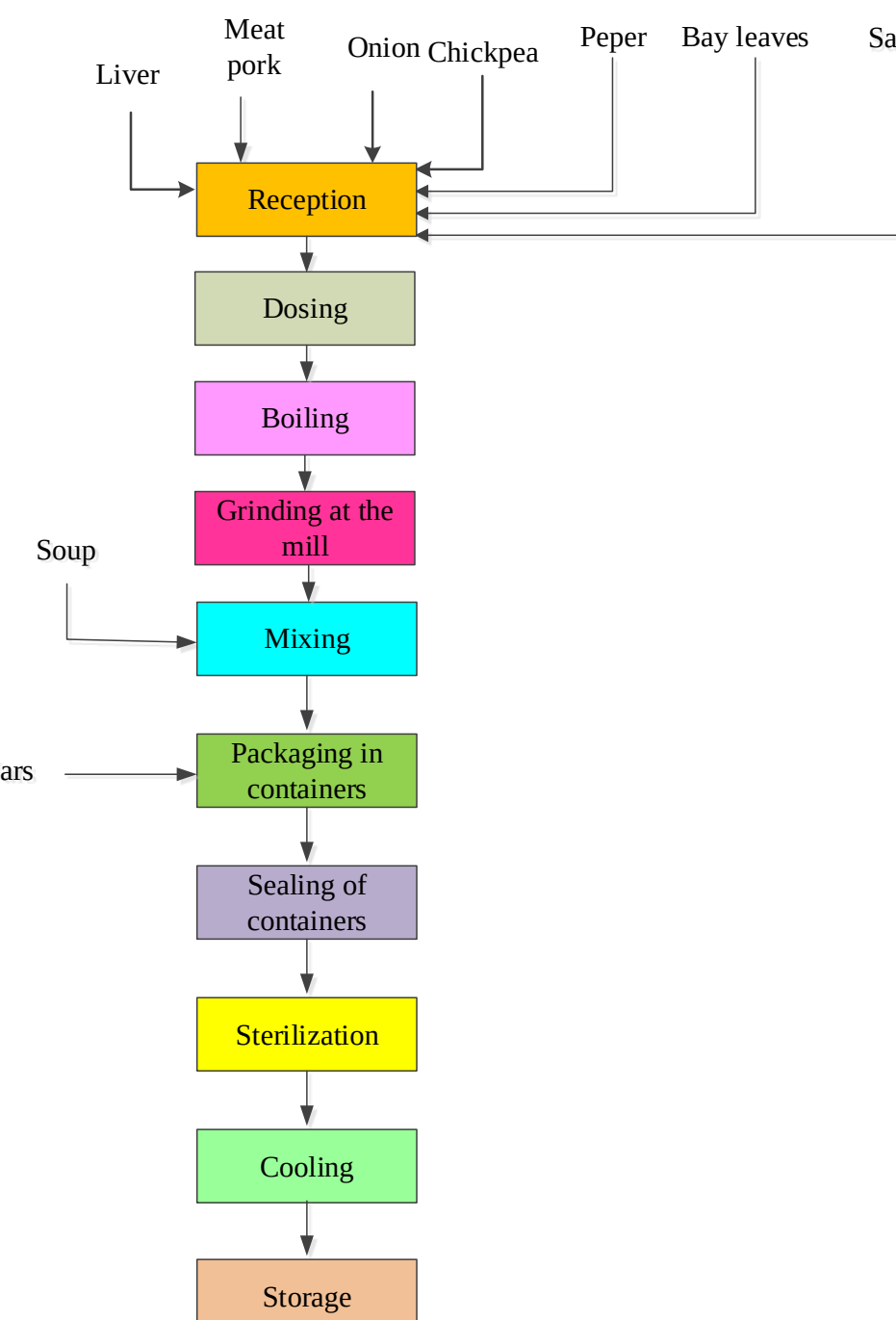


Figure 1. Technological diagram for obtaining the pâté samples

Physico-chemical analysis was performed according to the following standards: Determination of moisture content (SR ISO 1442:2010); Determination of protein content (SR ISO 937:2007); Determination of mineral substances (SR ISO 936:2009 ver. eng.); Determination of lipid content (SR ISO 1443:2008); Determination of carbohydrate content (EC Regulation 1169/2011); Determination of the energy value of the product (Conf. Regulation EC 1169/2011).

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• Results and discussions

Proximate composition of the pâté samples

The pâté samples with chickpeas was compared with a pâté control sample made using a similar technology.

Table 2. Proximate composition of the pâté samples

Sample	Chemical Parameters					
	Moisture content (g/100 g)	Ash (g/100 g)	Protein (g/100 g)	Lipids (g/100 g)	Carbohy- drates (g/100 g)	Energy Value (kcal/100 g)
PM	58.81	0.65	15.03	22.24	1.71	267.12
P10	59.58	0.75	17.47	18.46	2.15	244.62
P20	60.28	0.84	18.28	16.94	2.08	233.90
P30	60.96	0.99	19.75	14.36	2.25	217.24

The results in the table show that as the percentage of chickpeas in the pâté composition increased, the moisture and ash contents slightly increased, while fat content and energy value decreased. Protein content showed a progressive rise, from 15.03 g/100 g in the control sample (PM) to 19.75 g/100 g in the sample with 30% chickpeas (P30), highlighting the protein contribution of chickpeas. Carbohydrate content also increased, indicating an improvement in nutritional value. Overall, the addition of chickpeas contributed to obtaining a more nutritionally balanced product with lower lipid and energy content.

Sensory analysis

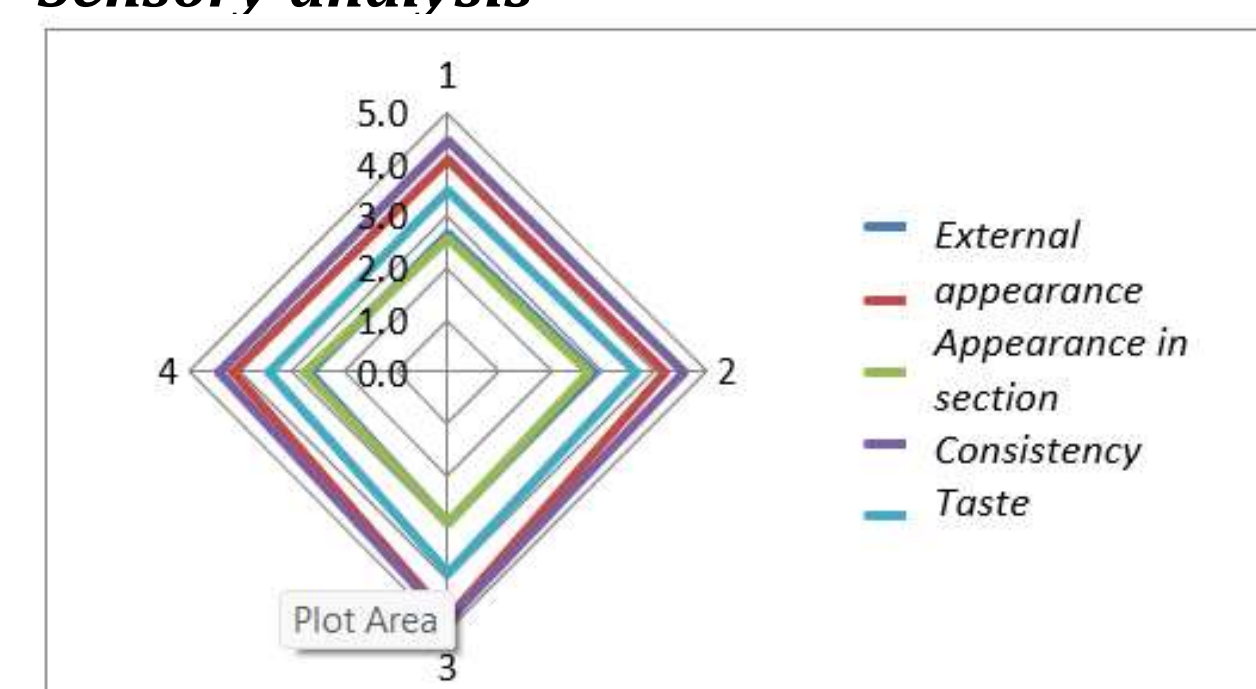


Figure 2. Sensory analysis of the analyzed pâté samples

The sensory analysis results showed that the total scores for the pâté samples ranged between 17.25 and 19.30, with the highest value recorded for the pâté containing 20% chickpeas. This sample achieved the best scores for all evaluated characteristics: external appearance (2.9), cross-sectional appearance (4.8), consistency (2.9), taste (4.8), and smell (3.9). The pâtés with 10% chickpeas had similar values, while those with 30% chickpeas and the control sample showed lower scores. In conclusion, adding chickpeas in a 20% proportion significantly improves the sensory properties of the pâté.

• Conclusions

The research in this study focused on obtaining four types of pâté: one control sample made entirely from pork meat and three variants in which the meat was partially replaced with chickpeas at levels of 10%, 20%, and 30%. The products were analyzed physicochemically (moisture, protein, fat, ash, NaCl, carbohydrates, and energy value) and sensorially. All samples met the requirements of Order No. 210/2006. The addition of chickpeas led to an increase in protein and mineral content, a reduction in fat and energy values, and a negative Kreiss reaction. Sensory evaluation showed that the 20% chickpea pâté was the most appreciated, confirming the positive effect of moderate chickpea addition.