Scientific Papers. Series D. Animal Science. Vol. LXVIII, No. 1, 2025
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

ANALYSIS OF TECHNOLOGICAL, SENSORY AND FOOD SAFETY CHARACTERISTICS OF SEMI-PREPARED PRODUCTS MADE FROM CHICKEN INNER FILET

Andrada Elena MOISE[1], Ioan PEȚ[2], Goran PANICI[2], Elena Gabriela STAN[1], Denisa Veronica LUNGU[1], Andreea Ionela ZINCA[1], Dănuț Nicolae ENEA[1], Dumitru DRĂGOTOIU[1]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Animal Production Engineering and Management, 59 Marasti Blvd, District 1, Bucharest, Romania
[2]University of Life Sciences "King Mihai I" from Timişoara, Faculty of Animal Resources Bioengineering, 119 Calea Aradului Street, Timisoara, Romania

Corresponding author email: veronicalungu49@gmail.com

Abstract

This paper provides a comparative evaluation of three semi-prepared products made from chicken inner fillet, differentiated by the type of coating applied: classic breadcrumbs, corn flakes, and pumpkin seeds. The study integrates technological, sensory, and food safety perspectives to assess the impact of each variant on thermal behavior, oil absorption, structural stability, and consumer acceptance. Technological parameters such as core temperature during thermal treatment, freezing dynamics, and the performance of critical control points (CCPs) were analyzed in relation to the crust type. Microbiological and chemical analyses confirmed the safety of all products, with results complying with current European regulations. Nutritional profiling revealed the superior functional value of the pumpkin seed variant, while sensory evaluation favored the corn flakes product due to its crispy texture and appealing flavor. These findings support the optimization of technological workflows and the development of safe, high-quality products tailored to the demands and preferences of consumers.

Key words*: critical control points, food safety, functional coatings, inner fillet, nutritional profile, sensory evaluation.*

INTRODUCTION

Meat is a staple food in the human nutritional structure, being considered a concentrated source of proteins with high biological value, essential amino acids, fatty acids, water-soluble vitamins of the B complex, as well as bioavailable minerals such as heme iron or zinc (Stanciu et al., 2015; Ianiţchi et al., 2024). In parallel with this physiological importance, meat consumption reflects a number of socio-economic influences, being sensitive to factors such as urbanization, globalization of supply chains and increasing awareness of healthy eating (Curea et al., 2023; Moise et al., 2024). In this context, poultry meat has recorded a steady positive dynamic in consumer preferences, due to its favorable nutritional profile, technological versatility and relatively affordable cost (Almeida et al., 2015; Costache et al., 2019; Usturoi et al., 2021; Tudorache et al., 2022). According to the data published by the Food and Agriculture Organization of the United Nations (FAO), in 2021 Romania recorded an average annual consumption of 22 kg per capita of poultry meat, expressed as net edible weight, which consolidates this category in second place in the hierarchy of national consumption, after pork (FAO, 2023). This development is correlated with the expansion of the segment of semi-prepared products, in particular poultry meat products, which simultaneously meet the requirements of speed of preparation, long shelf life and food safety (Chugunova et al., 2021; Giucă et al., 2023; Custură et al., 2024). Semi-prepared poultry-based products occupy a central place in the diversification strategy of the food industry, due to their potential to combine attractive sensory characteristics with microbiological safety and high nutritional value (Custură et al., 2019; Gheorghe et al., 2022b; Antoniv & Adamchuk, 2024). These products usually involve the application of a partial heat treatment followed by blast freezing, with a rigorous control of the technological steps, starting with the selection

of the raw material and ending with the stability of the structure during storage (Boriosova et al., 2021). An essential element in the realization of these products is the crispy coating system, which influences not only the organoleptic profile, but also the thermal behavior and shelf-life. Traditional coatings, such as wheat flour and classical breadcrumbs, are commonly used due to their predictable technological behavior and specific texture contribution (Xu et al., 2025). Flour contributes to surface uniformity and interior moisture retention, while breadcrumbs provide a stable crunchy crust (Chaunier et al., 2007). Corn flakes represent a valuable technological solution due to their ability to give the product an expanded texture, characterized by low density and mechanical properties that favour the auditory perception of crunchiness during consumption, an essential aspect in sensory evaluation (Farroni & Buera, 2014). Their structure and texture are directly dependent on the physical states of water and processing conditions, including gelatinization and starch retrogradation, both when used for the crust and when embedded in the structure of the products (Sumithra & Bhattacharya, 2008; Chaunier et al., 2005; Ianiţchi et al., 2023). Corn flakes, due to their expanded structure and low absorption capacity, represent an optimal technological support for the integration of functional ingredients or for creating a crunchy texture, contributing to the versatility of their application in processed food products (Singu et al., 2020). Pumpkin seeds are increasingly emerging as valuable functional ingredients in modern food formulations due to their complex chemical composition and remarkable nutritional density. They are a significant source of good quality plant proteins, essential fatty acids (especially polyunsaturated), dietary fiber and micronutrients such as zinc, magnesium and iron, as well as bioactive compounds with antioxidant and anti-inflammatory roles, such as phytosterols, tocotrienols and polyphenols (Fatima et al., 2025; Dotto & Chacha, 2020). Previously considered as low-value agro-industrial by-products, pumpkin seeds are now recognized for their contribution to the prevention of chronic diseases, while being promoted as sustainable ingredients compatible with food strategies oriented towards functionality and waste reduction (Syed et al., 2019). Their physico-chemical characterization further reveals technologically relevant properties such as low density, controllable moisture and a favorable absorption capacity, directly impacting their behavior in frying or baking processes (Devi, 2018). These qualities recommend them for integration into meat-based food products, especially in value-added semi-finished products, where they can simultaneously perform structural, sensory and nutritional roles (Fatima et al., 2025). The presence of pathogens such as *Salmonella* spp. or *Listeria monocytogenes* is unacceptable in incompletely heat-treated products, as these agents can survive the initial processing and multiply during improper handling or storage (Kataoka et al., 2017; Simpson-Beauchamp et al., 2010). In addition, physico-chemical indicators such as pH and readily hydrolyzable nitrogen can provide essential information on the freshness and degree of spoilage of meat (Surmei et al., 2013). From the perspective of chemical contaminants, plant sources in the composition of coatings can be exposed to the presence of mycotoxins (DON, aflatoxins, ochratoxin A), heavy metals (lead, cadmium) or newly formed compounds such as acrylamide (Ji et al., 2024; Andrade et al., 2018; Castells et al., 2008). The microbiological and physico-chemical quality of semi-finished poultry meat products is proving to be a critical point in the production chain, given their increased susceptibility to bacterial contamination. This reality calls for the establishment of rigorous processing, handling and storage protocols aimed at minimizing consumer health risks (El-Kewaiey, 2012). The application of modern analytical methods for the detection and quantification of pathogens or chemical contaminants becomes imperative to ensure compliance with European food safety standards (Pogurschi et al., 2022). In tandem, studies on consumer perceptions of semi-prepared products and food labeling show a growing concern for traceability, ingredient content and the potential presence of allergens (Grapă et al., 2022). The use of novel ingredients, such as pumpkin seeds, may also require adaptations in consumer

communication strategies (Silva de Lana et al., 2025). At the same time, the meat industry in Romania is in a process of modernization and adaptation to European standards, supported by investments in technologization and diversification of the range of value-added products (Uliu & Vladu, 2021; Custură et al., 2012; Gheorghe et al., 2022a). Fully valorizing native agro-food resources, including the integration of plant co-products in meat products, is a strategic direction to increase competitiveness (Rățu et al., 2023; Nistor et al., 2015).

Therefore, this work aims to comparatively investigate three variants of semi-finished chicken fillet-based products, differentiated by the coating applied, classic breadcrumbs, corn flakes and pumpkin seeds, from the perspective of sensory, technological and food safety characteristics. The study provides an integrative, science-based approach to optimize formulations and validate them against current market expectations and regulatory requirements.

MATERIALS AND METHODS

The products analyzed in this study were produced in an industrial meat-processing plant using frozen chicken tenderloin (commercially known as "inner" or "tenderloin") as raw material. The fillets were gradually brought to the chilled state to avoid thermal shock and to prevent damage to the muscle structure. Each batch was then X-rayed for bone fragments to ensure that the product complied with food safety requirements. Due to its anatomical fragility and small surface area, an immersion marinating process was used, which ensures that the compounds gradually diffuse into the meat without altering its integrity. The marinade used consisted of a saline solution with plant extracts, water stabilizing agents, natural antioxidants and spices, and was applied under controlled refrigeration to allow uniform diffusion and prevent the risk of microbial growth. Björkroth (2005) demonstrated that in marinated products packaged in modified atmosphere, psychrotrophic lactic acid bacterial species such as *Leuconostoc gasicomitatum* can become dominant, thus contributing to organoleptic defects and shortening shelf life. Prior to marinating, the fillets were portioned using specialized Marel equipment calibrated to meet the weight requirements. This equipment allows high precision portioning, compensating for the extra weight generated by the subsequent crust coating. The technological flow continued with the coating stages, common to all three variants analyzed, up to the point of application of the final breadcrumbs. Initially, each portion was passed through a thin layer of white wheat flour to act as a sticking agent, followed by a first pass through egg mixture. This is a semi-liquid technological mixture of whole liquid egg, skimmed milk, salt and stabilizing agents (food starch or functional proteins) to provide adherence between successive layers. After a second pass through the breadcrumbs, which is intended to reinforce the base layer, the product was prepared for the application of the final layer of breading, specific to each recipe. By analogy with the study by Cakmak et al. (2013), in the case of breaded products, coating meat with a successive layer of flour, breadcrumbs and breadcrumbs can benefit from the same functional principles, in the sense that the interaction between meat proteins and the compounds in the applied layers contributes to better adhesion, stability of the composition during heat treatment and improved sensory characteristics of the crust.

At this stage the three technological variants were differentiated:

Variant 1: the use of standard breadcrumbs, with a medium grain size and medium oil absorption, applied uniformly to ensure a homogeneous crust;

Variant 2: involved the use of shredded corn flakes, which, due to their porous structure and high starch content, provided a more aerated crust, but with an increased capacity for oil absorption during frying;

Variant 3: use of coarsely ground pumpkin seeds, which, due to their high unsaturated lipid content, influenced the final texture, generating a crust with increased density and a specific flavor profile.

Considering the specific nature of the ingredients used in the corn flakes and pumpkin seed variants, it was necessary to implement enhanced sanitation protocols at the

level of technological equipment, in accordance with the principles of good manufacturing practice. This was aimed at preventing cross-contamination between batches, particularly in the context of the risk of exposure to allergens or compounds with the potential to induce food intolerances. The products were then placed in an industrial deep fryer, where they were quickly fried for approximately 28 seconds, sufficient to form a crispy outer crust without excessive oil penetration into the protein mass. After frying, the products were transferred to a professional oven, where they were baked at 120°C for 5 minutes in a controlled environment with 80% steam opening. This parameter was chosen to limit excessive evaporation of water, thus preventing the product from drying out and preserving the characteristic juiciness of the fillet inside. Rigorous control of the internal temperature was essential at this stage. The aim was to achieve a minimum temperature of 72°C in the center of the product, which is considered microbiologically critical. Reaching this level allows the effective inactivation of pathogenic bacteria of major interest in the poultry industry, in particular *Salmonella* spp. and *Listeria monocytogenes* (Ehuwa, 2021), agents commonly associated with poultry meat. Although the product is intended for consumption after further thermal preparation in a domestic environment, compliance with this minimum threshold at the industrial stage provides added food safety in the event that the consumer does not complete the thermal process properly. After the heat treatment, the products were placed on racks and transferred to the blast freezing tunnel, where an internal temperature of -18°C was monitored, in line with industry standards for the safety and microbiological stability of frozen products. According to Barbut (2012), in the case of breaded products, this step is essential not only for safety reasons, but also to ensure good adhesion and stability of the coating during handling and further transportation. Rapid freezing to a minimum internal temperature of -18°C, applied immediately after the heat treatment, prevents the formation of large ice crystals, which could damage the internal texture, preserves the crispness of the breadcrumbs and maintains the structural integrity of the finished product according to current industry standards. The products were then individually packaged according to the customer's requirements, labeled accordingly and stored in temperature-controlled refrigerated rooms.

During the technological flow, potential differences were noted between the three types of coatings used, not only in terms of oil absorption and moisture loss, but also in terms of visual appearance, crust texture, flavor and baking behavior. Given observed technological differences, particularly in visual appearance, crust texture, flavor, and baking behavior, a sensory analysis was subsequently carried out to assess how these variations were perceived by consumers. Sensory analysis was carried out under controlled conditions, in a space dedicated to organoleptic testing, without odor or light interference that would influence the perceptions of the participants. The evaluation panel was made up of 30 naive tasters, aged between 18 and 35, selected from among ordinary consumers, without professional training in sensory analysis. The choice of this age range was not accidental, but was based on current consumer realities: this category of population, professionally and socially active, is frequently associated with an alert lifestyle and limited time available for cooking, aspects that determine a high predisposition to the consumption of semi-prepared products, considered a practical and quick alternative for daily meals.

To ensure compliance with food safety standards and to verify the absence of chemical and microbiological hazards, a series of targeted analyses were performed on both crust components and the final semi-prepared products. The analyses were carried out by accredited laboratories, according to international standards (ISO/IEC 17025), and the methods applied were in full accordance with current European legislation, notably Regulation (EU) No. 915/2023 concerning contaminants in foodstuffs and Regulation (EC) No. 2073/2005 on microbiological criteria.

In the case of the corn flakes coating, chemical contaminant analyses focused on compounds relevant to cereal-based ingredients. The main objectives were to determine the presence and

concentrations of the following mycotoxins: Aflatoxins B1, B2, G1, G2 and total, Fumonisins B1 and B2, Zearalenone, as well as chlorate and perchlorate residues. The applied methods included VICAM AflaTest WB (Instruction Manual # GN-MC9536-0 Rev. B, 2008) for aflatoxins and method MP.2360:R1.2023 for fumonisins and zearalenone. Chlorate and perchlorate were analyzed according to the standard method H-MA-M 02-155, using LC-MS/MS technology (method version: 2023-05).

Considering the oleaginous nature of pumpkin seeds (Leichtweis et al., 2025), which are known to be susceptible to ochratoxin contamination during storage, specific analyses were conducted to detect this mycotoxin. The determination was performed using method MP.2360:R2.2024, adapted to high-lipid matrices.

As for the finished product, the breaded and frozen chicken inner fillet microbiological safety was assessed through determinations for reference pathogens and hygiene indicators. The presence of *Salmonella* spp. was specifically tested in 25 g of product, using the reference method SR EN ISO 6579-1:2017, which is harmonized with EU legislation (Regulation (EC) No. 2073/2005). The analysis was performed on five independent subsamples. Additionally, determinations were conducted for *Escherichia coli*, coagulase-positive Staphylococci, yeasts, molds, and the total viable count, in line with microbiological performance standards.

In the case of the breadcrumb-based variant, the acrylamide content of the classic breadcrumb coating was also determined, due to the known risk of its formation during high-temperature baking. The method applied was MSZ EN 16618:2015, which complies with EU recommendations on process contaminants.

RESULTS AND DISCUSSIONS

The technological differences between the three products analyzed, although subtle in the overall manufacturing flow, become evident at the coating stage and manifest themselves in complex ways in the thermal behavior, sensory characteristics and structural stability of the finished product. Double layering, carried out by applying flour, egg-based breadcrumbs and then a crispy coating (classic breadcrumbs, corn flakes or pumpkin seeds), leads to relevant variations in oil absorption, moisture loss, texture and final appearance.

For products coated with classic breadcrumbs, oil absorption during heat treatment (28 seconds in the oil bath) was in the moderate range, due to the relatively compact structure of the granules and their ability to form a uniform barrier on the surface. This characteristic contributed to a crispy, well-browned crust with a regular appearance and a golden-brown color typical of traditional bread products.

Moisture losses during baking were observed empirically and estimated to range between 4-8%, while still maintaining the juiciness of the interior, a key factor in reaching the core temperature of ≥72°C, maintaining the juiciness of the interior, which is essential for achieving the core temperature of ≥72°C, set as the critical limit under Critical Control Point 1 (CCP1 - heat treatment). Therefore, in the case of breaded products, the heat treatment carried out at industrial level and the confirmation of reaching the target core temperature is not only a technological requirement but an essential food safety measure, fulfilling all the conditions of a Critical Control Point (CCP), according to HACCP principles, as also argued by Molins (2001). The texture was homogeneous and the flavor profile discrete, with no dominant notes interfering with the natural flavor of the meat.

In contrast, products coated with corn flakes exhibited a distinctive behavior. Although the aerated and porous structure of the corn flakes facilitated a visibly higher surface oil uptake during frying, the final fat content was the lowest among all three samples (8.5 g/100 g, Table 2). This seemingly contradictory result can be explained by the inherently low lipid content of corn flakes and the brief duration of frying (28 seconds), which limits oil penetration beyond the surface layer. Moreover, the subsequent baking phase, performed at 120°C for 5 minutes with 80% steam, according to the product's technical processing specification, caused partial evaporation of surface oil., contributing to the lower final fat content. Moisture losses were observed during baking for this variant were

estimated at approximately 7-8%, is attributed to the irregular crust geometry and open structure, that allowed greater steam release. From the PCC1 perspective, this variant required careful monitoring of the internal temperature distribution, given the uneven thermal dispersion associated with the aerated structure of the outer layer.

On the other hand, the products coated with pumpkin seeds showed reduced oil absorption during frying. However, despite the lower frying absorption, this variant recorded the highest overall fat content (11 g/100 g, Table 2), which is attributed to the naturally high lipid concentration in pumpkin seeds themselves. During baking, this variant showed greater moisture retention, but also a denser and less expanded crust. The visual appearance was darker, with a specific greenish-brown color, which led to a less familiar visual perception for the tasters. Aromatically, the coating introduced intense oleaginous and vegetal notes, which slightly dominated the taste of the preparation, thus influencing the sensory evaluation. Due to the dense texture and more inert thermal behavior, a rigorous monitoring of the temperature value in the center of the product (PCC1) was necessary, to avoid possible cold zones that would compromise complete microbiological inactivation, in correlation with other results (Sumithra & Bhattacharya, 2008).

Continuing the technological process, after the heat treatment stage, critical control point 2 (PCC2) is established, which targets the deep freezing phase of the semi-finished product. This control aims to guarantee microbiological stability and extend the shelf life, by reaching an internal temperature of at least −18.5°C in the center of the product. Respecting this critical limit is essential to prevent the development of post-processing residual microflora and to maintain the structural integrity of the product during storage and distribution, in accordance with the results of other studies (Kataoka et al., 2017). Comparatively, the three analyzed variants differ in their freezing behavior, directly influenced by the composition and texture of the coating. Products coated with corn flakes, having an expanded and aerated structure, facilitate rapid thermal diffusion, which allows reaching the critical temperature in a shorter time. In contrast, products coated with pumpkin seeds have a denser and more compact crust, associated with lower thermal conductivity, which determines a greater thermal inertia and requires an extension of the freezing time, according to the product's technical specification.

This adjustment is justified by the crust's structural density, which slows down heat transfer and requires prolonged exposure to the freezing environment to meet microbiological safety standards. The variant coated with classic breadcrumbs is located between the two, with a stable and predictable thermal behavior. These observations justify adjusting the technological parameters depending on the type of coating, to ensure compliance with the requirements established at this control point.

After freezing, the product is subjected to verification through critical control point 3 (CCP3), corresponding to metal detection. This step has the role of eliminating the risk of physical contamination with metal fragments from processing or handling equipment, such as knives, conveyor belts or fasteners. Detectors calibrated for ferrous, non-ferrous and stainless steel are programmed to automatically identify and reject any product that exceeds the preset sensitivity threshold (minimum 3.5 mm) (Liu & Zhou, 2011). Although the detection system works uniformly regardless of the product, the type of coating used can indirectly influence the efficiency of this step. Products coated with pumpkin seeds or corn flakes generate a more voluminous crust, with variable density, which can affect, in rare cases, the accuracy of detection by attenuating the electromagnetic signal. In addition, these ingredients pose an increased risk of cross-contamination, especially for people with food allergies, which is why cleaning and validation of equipment become more demanding after processing these variants. Therefore, the frequency of testing with standards and rigorous documentation of maintenance interventions become imperative to maintain compliance at this critical point. Each stage controls specific risks, from the inactivation of pathogens, to microbiological stabilization over time and the prevention of physical contamination. Structural differences

generated by the type of coating applied (breadcrumbs, corn flakes, pumpkin seeds) influence the behavior of the products in relation to these critical parameters, requiring fine technological adaptations to maintain compliance and quality standards.

Table 1 presents the critical control points identified in the production process, highlighting the main objectives, the associated critical limits and how the type of coating influences each stage, with significant differentiations between the products analyzed.

Table 1. Critical control points and the influence of the type of coating

Critical Control Point	Main Objective	Critical Limit	Differentiated Impact Between Products
CCP1 – Thermal treatment	Inactivation of pathogenic agents (*Salmonella* spp., *Listeria monocytogenes*)	≥ 72°C at the core of the product, maintained for at least 26 seconds	The dense crust of the pumpkin seed variant requires additional monitoring of internal temperature
CCP2 – Freezing	Microbiological stabilization by reaching freezing temperature	≤ −18.5°C at the core of the product	Cornflakes allow for faster freezing; pumpkin seeds require extended time for complete cooling
CCP3 – Metal detection	Prevention of physical contamination with metal fragments from equipment	Detection of particles ≥ 3.5 mm (Fe, non-Fe, stainless steel)	Irregular crust (corn, pumpkin) may affect detection sensitivity; requires more frequent testing

In all three products, the raw material used is the inner fillet of chicken breast, a fine muscle with a high protein content (22-24 g/100 g) and a low lipid intake. Due to its tender structure and lack of intramuscular fat, this type of meat favors the absorption of marinades, but is susceptible to dryness during heat treatment. The final texture is significantly influenced by the type of coating applied and the processing parameters (Almeida et al., 2015).

Table 2 presents the analysis of the nutritional values of the three semi-finished products made from chicken fillets, coated with classic breadcrumbs, corn flakes and pumpkin seeds, respectively, highlighting significant differences in chemical composition and energy value per 100 grams of product. These variations are mainly attributable to the differences between the types of coatings used, but also to the degree of processing and the auxiliary ingredients included in the recipe.

Table 2. Nutritional comparison between the three variants of semi-prepared products (per 100 g)

Parameter	Classic Breadcrumbs	Cornflakes	Pumpkin Seeds
Energy value (kcal)	250	215	228
Fats (g)	9.4	8.5	11
Saturated fats (g)	–	0.9	2.2
Carbohydrates (g)	27.6	19	12
Sugars (g)	0.7	0.7	1.0
Proteins (g)	13.9	15.5	19
Fibers (g)	–	–	1.5
Salt (g)	1.0	1.3	0.8

The product coated with classic breadcrumbs is notable for its relatively high energy value (250 kcal/100 g), reflecting a higher carbohydrate intake (27.6 g) and a moderate lipid content (9.4 g). Proteins reach a level of 13.9 g, corresponding to a balanced protein density for a standardized bread product. This variant maintains a familiar composition, with added vegetable fibers and basic ingredients (wheat flour, yeast, rapeseed oil), without a significant intake of ultra-processed additives. The product coated with corn flakes presents a lighter nutritional profile in terms of calories (215 kcal/100 g), with a clear reduction in the total amount of carbohydrates (19 g), but also with a higher protein content (15,5 g), which makes it more suitable for a balanced hypocaloric diet. The presence of dextrose, glucose syrup and vegetable protein hydrolysate can contribute to improving the technological and sensory profile, but implies a higher degree of processing. The salt content (1.3 g) is the highest of the three products, being influenced by the multiple additions in the composite breadcrumbs. In contrast, the product coated with pumpkin seeds is distinguished by a higher protein intake (19 g/100 g) and a minimum carbohydrate content (12 g), while being the only product

that naturally contains dietary fiber in a notable percentage (1.5 g). With a moderate caloric intake (228 kcal), this product combines the nutritional advantages of chicken fillet with those of oilseeds, rich in unsaturated fatty acids and bioactive compounds. At the same time, it is the product with the lowest salt content (0.8 g), which makes it recommended for low-sodium diets. The comparative analysis of the nutritional values of the three semi-prepared products made of chicken fillets covered with classic breadcrumbs, corn flakes and pumpkin seeds highlights important differences, influenced both by the type of outer layer applied and by the degree of processing of the ingredients used, correlated with specialized studies (Bourn & Prescott, 2010; Marin, 2017; El-Kewaiey, 2012). The product covered with classic breadcrumbs presents a traditional composition, with a relatively high caloric intake and a high carbohydrate content. In contrast, the cornflakes variant stands out for a lower caloric profile and a moderate to high protein content, but the advanced degree of processing and the increased salt content may constitute limiting factors in the context of a balanced diet. On the other hand, the product coated with pumpkin seeds is distinguished by the most favorable nutritional composition, reflected in the higher protein intake, low carbohydrate and salt content, as well as the presence of dietary fiber and beneficial unsaturated fats. Thus, this variant can be considered the most advantageous from a nutritional point of view, addressing especially consumers interested in functional products and diets oriented towards metabolic health.

In order to confirm the compliance and food safety of the semi-finished product made from chicken fillet, coated with corn flakes, a series of laboratory analyses were carried out, covering the three main risk categories: microbiological, chemical and specific contaminants (mycotoxins, heavy metals, residues).

The results indicated:

• *Salmonella* spp.: not detected in 25 g of product, in all subsamples tested, according to ISO 6579-1:2017. According to the legislation, this bacterium should not be present in partially heat-treated meat products;

• *Escherichia coli, NTG, yeasts and molds*: below the detection limit ($<1x10^1$ CFU/g), indicating appropriate hygiene in the manufacturing process;

• *Coagulase-positive staphylococci*: absent (<10 CFU/g), according to ISO 6888-1, which reflects the lack of contamination with pathogenic flora specific to improper meat handling.

These results are within the limits allowed by European legislation, which provides, for example, a maximum limit of 10^2 CFU/g for *E. coli* in products of this type and zero tolerance for *Salmonella* spp. (Ehuwa, 2021). Thus, from a microbiological point of view, the analyzed product is considered appropriate and safe for consumption.

In addition to microbiological safety, analyzes were also carried out for chemical contaminants, in particular mycotoxins and residual disinfectant compounds (chlorate and perchlorate), specifically applicable to the vegetable components of the crust, in this case, corn flakes.

The results were as follows:

• Aflatoxins B1, B2, G1, G2 and total: all below the detection limit (<0.1 µg/kg), while the maximum legal limit for food is 2.0 µg/kg for B1 and 4.0 µg/kg for total, according to Regulation (EU) 915/2023;

• Fumonisins B1 and B2: <30 µg/kg, with the regulatory limit of 400 µg/kg in cereals and derived products, the result being considerably below this value;

• Zearalenone: <20 µg/kg, compared to the maximum permitted limit of 75-100 µg/kg, depending on the product;

• Chlorate and perchlorate: <0.010 mg/kg, below the limit of toxicological interest (TDI – tolerable daily intake) set at 0.01 mg/kg body weight for chlorate and 0.002 mg/kg body weight for perchlorate, which suggests the absence of contamination with residues from sanitizing substances or contaminated water.

All these results demonstrate that the product is within safety limits, indicating the use of clean raw materials, controlled processing and the absence of contamination from industrial or agricultural sources (El-Kewaiey, 2012; Andrade et al., 2018; Castells et al., 2008; Chaunier et al., 2005).

For the semi-finished product of chicken fillet, covered with a layer of pumpkin seeds, laboratory analyses were carried out to verify microbiological and chemical compliance, as well as the absence of contaminants specific to oleaginous raw materials. The related analysis bulletins cover both the final product (prepared and frozen) and the vegetable component used as breading (pumpkin seeds as such).

The testing was carried out on five distinct sub-samples, and the results confirmed the complete absence of this bacterium in all cases analyzed. Considering that the product is a semi-prepared product, partially heat-treated, but intended for an additional baking or frying step by the consumer, the presence of *Salmonella* spp. would be unacceptable (Ehuwa, 2021). The legislation requires the absence of this bacterium in 25 g of product for all incompletely cooked foods of animal origin. Therefore, the result obtained is in accordance with current food safety requirements, reflecting a hygienic and well-controlled production process.

Considering the oleaginous nature of pumpkin seeds (Leichtweis et al., 2025), laboratory analyses were performed to detect Ochratoxin. A mycotoxin frequently associated with such ingredients. The determination was performed using liquid chromatography with triple quadrupole detection (LC-QQQ), considered an international standard for sensitivity and accuracy. The result indicated a concentration below the detection limit of the method (<1 µg/kg). This is a very low value, in the context of which the maximum limit allowed by European legislation for oilseeds is 5 µg/kg (according to Regulation (EU) No. 915/2023). Thus, the result obtained not only complies with legal limits, but also indicates a superior quality of the raw material, demonstrating that the pumpkin seeds used were not exposed to improper storage conditions or fungal contamination, results also highlighted by other studies (Fatima et al., 2025).

Based on the results of the available analyses, the semi-finished product with pumpkin seed crust can be considered safe for consumption from a microbiological and chemical point of view. The absence of *Salmonella* spp. in the final product, corroborated with the very low levels of mycotoxins in the vegetable component, confirms that the manufacturing process was carried out under conditions compliant with legislative requirements and good practices in the food industry.

In order to validate the quality and health safety of the classic variant of the semi-finished product based on chicken fillets with a white breadcrumb coating, a series of physico-chemical and microbiological analyses were carried out, applied both to the final product and to the component raw materials - meat, breadcrumbs, flour. These analyses comply with the regulations established by Regulation (EC) No. 2073/2005 on microbiological criteria, as well as with Regulation (EU) No. 915/2023 on chemical contaminants in food.

The results showed:

• *Salmonella* spp.: not detected in all 5 subsamples, according to ISO 6579-1:2017;

• *E. coli*, coliforms, yeasts, molds: below 10 CFU/g - well below the guideline limits allowed;

• *NTG*: 1.3 x 10^2 CFU/g - value considered very good for bakery products, according to GHP (Good Hygiene Practice) standards.

The breadcrumbs were tested for acrylamide content, a potentially toxic substance formed by Maillard reactions during baking at high temperatures. The acrylamide level was <10 µg/kg, significantly below the reference level of 50 µg/kg established by Regulation (EU) 2017/2158 for bakery products, indicating a well-controlled baking process and the use of appropriate raw materials (Mesias et al., 2023).

The analysis of the mycotoxin DON, in correlation with specialist studies (Ji et al., 2024), one of the most common in cereals, was carried out on the white breadcrumbs. The result was <14 µg/kg, compared to the maximum permitted limit of 500 µg/kg for bread and cereal-derived products. This result denotes insignificant contamination, within excellent safety limits. Regarding the flour used in the first crumbing stage, the analysis included determinations for aflatoxins B1, B2, G1, G2, zearalenone and ochratoxin A. All values were below the limits of quantification (B1-B2-G1-G2 <0.5 µg/kg, zearalenone <20 µg/kg, ochratoxin A <1 µg/kg), reflecting a safe raw material, originating from controlled supply chains. The determination of the moisture content of the white breadcrumbs

indicated an average value of 6.25 g/100 g, with an uncertainty of ±0.28. Low moisture contributes significantly to the microbiological stability and the crispy texture of the final crust (Silva de Lana et al., 2025).

The hygienic and sanitary quality of the raw material was confirmed by physico-chemical analyses, in particular by determining the content of heavy metals. The values obtained for lead (<0.03 mg/kg) and cadmium (<0.01 mg/kg) were well below the maximum limits allowed by European legislation for poultry meat (0.10 mg/kg for lead and 0.05 mg/kg for cadmium), which attests to the absence of contamination with toxic metals and the suitability of the raw material for food safety (Rebezov et al., 2021).

In addition to these determinations, other essential indicators for evaluating the quality of refrigerated meat are pH and readily hydrolyzable nitrogen, the variation of which is directly correlated with storage time. Increased values of these parameters are associated with biochemical degradation of proteins and, implicitly, with decreased freshness, representing reliable benchmarks for establishing the consumability threshold (Surmei & Usturoi., 2012).

In order to evaluate the *sensory characteristics* of the three product variants, they were subjected to a standardized final heat treatment, consisting of baking in an electric oven at a temperature of 180°C, for 30 minutes. This stage aimed to simulate the home preparation method, under reproducible conditions, allowing an objective assessment of the organoleptic differences between the products.

For carrying out sensory evaluation, participants were previously instructed on how to complete the questionnaire and the evaluation criteria, and the products were graded A, B, C, for easier scoring. Each participant rated the three products based on four fundamental sensory attributes: visual appearance, texture, taste and aroma, using a hedonic scale from 1 to 9, where 1 indicated the minimum level of pleasure and 9 the maximum. The results obtained highlighted differences between the variants.

Figure 1 illustrates the average scores obtained for four sensory attributes: appearance, texture, taste and aroma, in the comparative evaluation of three variants of semi-finished products, differentiated by the type of coating: classic breadcrumbs, corn flakes and pumpkin seeds.

In the sensory analysis, variant A, made with classic breadcrumb coating, recorded moderate and constant scores for all evaluated attributes, ranging from 6.81 to 7.10. These results indicate a high level of acceptability, but without remarkable characteristics that would clearly differentiate it from the other variants.

The use of standard breadcrumbs is integrated into the preferences of the average consumer, being associated with familiar and widely distributed products on the market.

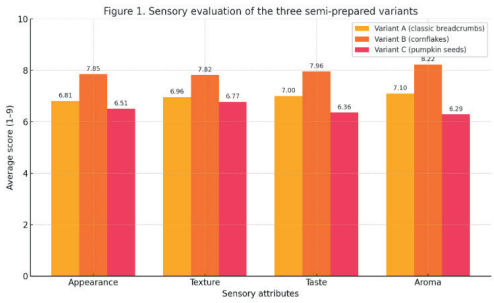

Figure 1. The impact of crust type on the sensory perception of semi-finished products

This familiarity generates a perception of stability and taste predictability, which can support consumer loyalty, but can also limit perceived innovation. The texture of the product was considered adequate, but without offering a distinct experience, which may explain its more modest positioning in the preferences expressed by the participants.

Variant B, covered with corn flakes, was clearly the best appreciated from a sensory point of view, obtaining the highest average scores on all four criteria analyzed, 7.82-8.22. It was particularly noted for its attractive appearance, golden crust and crispy texture, elements that, together, determined a pleasant and memorable consumption experience. The taste was described as balanced, with discreet notes of sweetness and toastiness, and the intense aroma completed the sensory profile in a harmonious way. The success of this variant can be attributed both to its technological qualities and to the fact that corn flakes are a known and accepted ingredient by the general public, often associated with crispy and

appetizing products. The flakes also contribute to the formation of an aerated crust, with a low degree of compaction, which enhances the perception of freshness and lightness when chewing.

In contrast, variant C, with a pumpkin seed coating, obtained lower scores than the other two variants, especially in the taste and aroma attributes, 6.29-6.51. Although the texture was appreciated by some participants as interesting and different, the aromatic profile proved more difficult to accept. This result can be correlated with the low level of consumer exposure to such combinations.

The acceptability of unconventional ingredients is often influenced by eating habits and individual taste repertoire. In this case, pumpkin seeds, although beneficial from a nutritional point of view, are less often used as a coating for semi-prepared products, which may generate an initial reluctance in acceptance. Therefore, the scores obtained do not necessarily reflect a poor sensory quality, but rather a gap between innovation and the level of familiarity of the public with the respective ingredient.

The distribution of preferences expressed by the participants was consistent with the quantitative data: 50% of the tasters indicated the cornflakes variant as their favorite, 33.33% opted for the pumpkin seed variant, and 16.67% chose the product covered with classic breadcrumbs. These results suggest that, although traditional products remain appreciated for their simplicity and safety, moderate innovations, such as cornflakes, can bring added attractiveness, while more avant-garde solutions, such as the use of seeds, require additional communication and consumer education strategies to be fully exploited.

CONCLUSIONS

The comparative study conducted on the three variants of semi-finished products based on chicken fillets, with classic breadcrumb coating, with corn flakes and with pumpkin seeds, highlighted significant differences from a technological, sensory and nutritional point of view.

From the perspective of technological parameters, it was found that the type of coating directly influences the behavior of the product during heat treatment, oil absorption, moisture retention and the efficiency of critical control points (CCP). The variant with corn flakes presented the most balanced behavior during processing, associating a crispy crust with good thermal penetration and efficient freezing, while the pumpkin seeds determined a denser crust and increased thermal inertia, requiring time and temperature adjustments to guarantee microbiological safety. The nutritional analysis revealed a superior profile in the case of the pumpkin seed product, characterized by the highest protein content (19 g/100 g), a reduced intake of carbohydrates and salt, as well as the presence of dietary fiber and unsaturated fats, parameters that recommend it for a functional and balanced diet. In contrast, the classic breadcrumb version stood out for its conventional, familiar composition, but with a higher caloric and carbohydrate intake, without innovative functional elements.

From a food safety point of view, all three products fell within the limits set by European legislation, both in terms of microbiological criteria and chemical contaminants (mycotoxins, heavy metals, residues). The absence of pathogens such as *Salmonella* spp. and very low levels of potentially toxic substances confirm the conformity of the technological process and the quality of the raw materials used. The sensory evaluation demonstrated a clear consumer preference for the cornflakes product, which obtained the highest scores in terms of visual appearance, crispy texture and taste balance. The classic breadcrumb variant was appreciated for its familiarity, but did not highlight any distinctive characteristics, while the pumpkin seed product, although nutritionally valuable, encountered reluctance from consumers unfamiliar with this texture and flavor.

Therefore, the integration of innovative plant ingredients into the structure of semi-finished poultry products proves feasible, both from a technological and food safety point of view, provided that the process is correctly adapted and the market is positioned appropriately.

REFERENCES

Almeida, M. A., Villanueva, N. D. M., Gonçalves, J. R., & Contreras-Castillo, C. J. (2015). Quality attributes and consumer acceptance of new ready-to-eat frozen restructured chicken. *Journal of Food Science and Technology,* 52, 2869-2877. doi: https://doi.org/10.1007/s13197-014-1351-5

Andrade, G. C. R. M., Pimpinato, R. F., Francisco, J. G., Monteiro, S. H., Calori-Domingues, M. A., & Tornisielo, V. L. (2018). Evaluation of mycotoxins and their estimated daily intake in popcorn and cornflakes using LC-MS techniques. *Lwt, 95,* 240-246. doi: https://doi.org/10.1016/j.lwt.2018.04.073

Antoniv, A., & Adamchuk, L. (2024). Investigation of technological parameters of manufacturing meat products from chicken fillet. *Animal Science and Food Technology*, *15*(2), 9-22.

Barbut, S. (2012). Convenience breaded poultry meat products – New developments. *Trends in Food Science & Technology*, *26*(1), 14–20. doi: https://doi.org/10.1016/j.tifs.2011.12.007

Björkroth, J. (2005). Microbiological ecology of marinated meat products. *Meat Science*, *70*(3), 477–480. doi: https://doi.org/10.1016/j.meatsci.2004.07.018

Boriosova, V. L., Terentyev, S. E., Stefanova, I. L., Sazanova, E. A., & Kramlikh, O. Y. (2021). Effective use of meat of meat-and-egg chicken and eggs for the production of specialized semi-finished products. *IOP Conference Series: Earth and Environmental Science, 669.* doi: 10.1088/1755-1315/699/1/012022

Bourn, D., & Prescott, J. (2010). A comparison of the nutritional value, sensory qualities, and food safety of organically and conventionally produced foods. *Critical Reviews in Food Science and Nutrition*, *42*(1), 1–34. doi: https://doi.org/10.1080/10408690290825439

Cakmak, H., Altinel, B., Kumcuoglu, S., & Tavman, S. (2013). Chicken meat added bread formulation for protein enrichment. *Food & Feed Research*, *40*(1), 33–42.

Castells, M., Marin, S., Sanchis, V., & Ramos, A. J. (2008). Distribution of fumonisins and aflatoxins in corn fractions during industrial cornflake processing. *International Journal of Food Microbiology, 123*(1-2), 81-87. https://doi.org/10.1016/j.ijfoodmicro.2007.12.001

Chaunier, L., Courcoux, P., Valle, G. D., & Lourdin, D. (2005). Physical and sensory evaluation of cornflakes crispness. *Journal of Texture Studies, 36*(1), 93-118. https://doi.org/10.1111/j.1745-4603.2005.00007.x

Chaunier, L., Valle, G. D., & Lourdin, D. (2007). Relationships between texture, mechanical properties and structure of cornflakes. *Food Research International, 40*(4), 493-503. https://doi.org/10.1016/j.foodres.2006.07.014

Chugunova, O., Ponomarev, A., Kokoreva, L., & Feofilaktova, O. (2021). Innovative technologies for the production of semi-finished meat products as a factor in the development of the consumer market. *SHS Web of Conferences*, 93(04016).

Costache, M., Custură, I., Tudorache, M., & Van, I. (2019). The nutritional value of meat as seen through the various poultry food species - a comparative analysis with a focus on proteins, fatty acids and mineral content, *Scientific Papers, Series D, Animal Science, 62*(1), 370-379, https://animalsciencejournal.usamv.ro/pdf/2019/issue_1/Art56.pdf

Curea, C.D., Usturoi, M.G., Custură, I., Radu-Rusu, R.M., Rațu, R.N., Prisacaru, M.C., & Usturoi, A. (2023). Efficiency of growing of chicken broilers under conditions of compliance with EU rules of welfare. *Scientific Papers. Series D. Animal Science, 66*(1).

Custură, I., Tudorache, M., Gheorghe, A., Lefter, N. A., Habeanu, M., Bahaciu, G. V., Suler, A. D., & Răducuță, I. (2024). Effects of dietary nutrient concentrations on performance, carcass and meat quality traits of organically reared Barred Plymouth Rock chickens. *The Journal of Animal and Plant Sciences*, *34*(2).

Custură, I., Tudorache, M., Van, I., Marin, M. P., Marmandiu, A., & Pană, E. S. (2019). Researches about influence of pro-biotics on broiler production performances. *Scientific Papers. Series D. Animal Science*, *62*(2), 135–139. https://animalsciencejournal.usamv.ro/pdf/2019/issue_2/Art21.pdf

Custură, I., Van, I., Tudorache, M., Popescu-Micloșanu, E., & Popa, A. (2012). Research on performances of raising certificate chickens. *AgroLife Scientific Journal, 1*, 147–151.

Devi, M. (2018). Physico-chemical characterisation of pumpkin seeds. *International Journal of Chemical Studies, 6*(3), 828-831.

Dotto, J. M., & Chacha, J. S. (2020). The potential of pumpkin seeds as a functional food ingredient: A review. *Scientific African, 10*. https://doi.org/10.1016/j.sciaf.2020.e00575

Ehuwa, O., Jaiswal, A. K., & Jaiswal, S. (2021). Salmonella, food safety and food handling practices. *Foods*, *10*(5), 907. https://doi.org/10.3390/foods10050907

El-Kewaiey, I. A. (2012). Quality assessment of some ready-to-eat and locally produced chicken meat products. *Assiut Veterinay Medical Journal, 58*(132), 1-19. doi: 10.21608/avmj.2012.171845

Farroni, A. E., & Buera, M. P. (2014). Cornflake Production Process: State Diagram and Water Mobility Characteristics. *Food and Bioprocess Technology, 7,* 2902-2911. https://doi.org/10.1007/s11947-014-1270-5

Fatima, H., Hussain, A., Ambreen, Kabir, K., Arshad, F., Ayesha, A., Bibi, B., Ahmed, A., Najam, A., Firdous, N., Yaqub, S., & Zulfiqar, N. (2025). Pumpkin seeds; an alternate and sustainable source of bioactive compounds and nutritional food formulations. J*ournal of Food Composition and Analysis, 137*(B). doi: https://doi.org/10.1016/j.jfca.2024.106954

Gheorghe, A., Hăbeanu, M., Ciurescu, G., Lefter, N. A., Ropota, M., Custură, I., & Tudorache, M. (2022a). Effects of dietary mixture enriched in polyunsaturated fatty acids and probiotic on performance, biochemical response, breast meat fatty acids, and lipid indices in broiler chickens. *Agriculture*, 12(8), 1120. https://doi.org/10.3390/agriculture12081120

Gheorghe, A., Custură, I., Lefter, N., Idriceanu, L., Tudorache, M., Dumitru, M., & Hăbeanu, M. (2022b). Assessment of plasma biochemistry and intestinal microflora in Transylvanian Naked Neck breed compared with commercial breeders. *Scientific Papers. Series D. Animal Science*, *65*(1), 376–386. https://animalsciencejournal.usamv.ro/pdf/2022/issue_1/Art50.pdf

Giucă, A. D., Gaidargi Chelaru, M., & Kuzman, B. (2023). The market of organic agri-food products in Romania. In A. Kurek (Ed.), *Geopolitical perspectives and technological challenges for sustainable growth in the 21st century,* 174-187. doi: 10.2478/9788367405546-018

Grapă, A. Ț., Defta, N., & Oprea, I. (2022). Study on consumer confidence in the food products labelling system. *Scientific Papers. Series D. Animal Science*, *LXV*(1), 493–499.

Ianiţchi, D., Pătraşcu, L., Cercel, F., Dragomir, N., Vlad, I., & Maftei, M. (2023). The effect of protein derivatives and starch addition on some quality characteristics of beef emulsions and gels. Agriculture-Basel 13(4), 772. https://www.mdpi.com/2077-0472/13/4/772.

Ianiţchi, D., Poşan, P., Maloş, I.G., Nistor, L., Maftei, M.L., Nicolae, G.C., Toma (Enache), I.F., & Hodoşan, C. (2024). Effects of meat consumption on consumers' health. Scientific Papers. Series D. Animal Science. Vol. LXVII(1), 465-480. https://animalsciencejournal.usamv.ro/pdf/2024/issue_1/Art59.pdf.

Ji, X., He, Y., Xiao, Y., Liang, Y., Yang, W., Xiong, L., Guo, C., Zhang, J., Wang, X., & Yang, H. (2024). Distribution and safety evaluation of deoxynivalenol and its derivatives throughout the wheat product processing chain. *Food Research International, 192.* doi: https://doi.org/10.1016/j.foodres.2024.114784

Kataoka, A., Wang, H., Elliott, P. H., Whiting, R. C., & Hayman, M. M. (2017). Growth of *Listeria monocytogenes* in thawed frozen foods. *Journal of Food Protection*, *80*(3), 447–453. doi: https://doi.org/10.4315/0362-028X.JFP-16-397R

Leichtweis, M. G., Molina, A. K., Dias, M. I., Calhelha, R. C., Pires, T. C. S. P., Pavli, O., Oliveira, M. B. P. P., Ferreira, I. C. F. R., Petropoulos, S. A., Barros, L., & Pereira, C. (2025). Valorisation of pumpkin by-products: Chemical composition and bioactive properties of pumpkin seeds, peels, and fibrous strands from different local landraces of Greece. *Food Chemistry, 475.* https://doi.org/10.1016/j.foodchem.2025.143306

Liu, B., & Zhou, W. (2011). The research of metal detectors using in food industry**.** *Proceedings of the 2011 International Conference on Electronics and Optoelectronics, 4*, 297–299.

Marin, D. (2017). Research regarding the nutritional value of the food products. *Scientific Papers. Series D. Animal Science*, *50*(1), 123-127.

Mesias, M., Holgado, F., & Morales, F. J. (2023). Formation of process contaminants in commercial and homemade deep-fried breadcrumbs. *Food Research International*, *164*. https://doi.org/10.1016/j.foodres.2022.112357

Moise, A. E., Tudorache, M., Custură, I., Enea, D. N., Osman, A., & Drăgotoiu, D. (2024). Technological advances and socio-economic implications in the poultry industry: An analysis of current trends in poultry meat production and consumption. *Scientific Papers. Series D. Animal Science*, *67*(1), 500–505.
https://animalsciencejournal.usamv.ro/pdf/2024/issue_1/Art62.pdf

Molins, R. A., Motarjemi, Y., & Käferstein, F. K. (2001). Irradiation: A critical control point in ensuring the microbiological safety of raw foods. *Food Control*, *12*(6), 347–356. doi: https://doi.org/10.1016/S0956-7135(01)00035-4

Nistor (Cotfas), L. I., Albu, A., Nistor, A. C., & Usturoi, M. G. (2015). Aspects of eggs quality provided from free range and conventional systems. *Journal of Microbiology, Biotechnology and Food Sciences*, *5*(2), 186–189.

Pogurschi, E. N., Popa, D. C., Dragotoiu, T., & Rusu, A. I. (2022). Technological advantages of methods for the simultaneous detection of several classes of antibiotic residues in chicken meat. *Scientific Papers. Series D. Animal Science*, *LXV* (2), 394–398.

Răţu, R. N., Veleşcu, I. D., Stoica, F., Usturoi, A., Arsenoaia, V. N., Crivei, I. C., Postolache, A. N., Lipşa, F. D., Filipov, F., Florea, A. M., Chiţea, M. A., & Brumă, I. S. (2023). Application of agri-food by-products in the food industry. *Agriculture*, *13*(8), 1559. https://doi.org/10.3390/agriculture13081559

Rebezov, Y. M., Shadrin, M. A., Baydan, D. V., Mileta, E. A., & Gadzhiev, M. G. (2021). Study of semi-finished chopped poultry meat safety indicators. *IOP Conference Series: Earth and Environmental Science*, 677. doi: 10.1088/1755-1315/677/3/032040

Silva de Lana, V., Estevam, P. N., Barcelos de Castro, T., Brilhante de Sao Jose, V. P., Brito-Oliveira, T. C., Santos, P. H., Oliveira, C. A. S., Coreea, C. B., Rostagno, M. A., Martino, H. S. D., & Montezano de Carvalho, I. M. (2025). Nutritional and technological potential of umbu-caja and soursop co-product flours. *Food Research International, 200.* https://doi.org/10.1016/j.foodres.2024.115520

Simpson-Beauchamp, C., Byelashov, O. A., Geornaras, I., Kendall, P. A., Scanga, J. A., Belk, K. E., Smith, G. C., & Sofos, J. N. (2010). Fate of *Listeria monocytogenes* during freezing, thawing and home storage of frankfurters. *Food Microbiology*, *27*(1), 144–149. https://doi.org/10.1016/j.fm.2009.09.007

Singu, B. D., Bhushette, P. R., & Annapure, U. S. (2020). Thermo-tolerant *Saccharomyces cerevisiae var. boulardii* coated cornflakes as a potential probiotic vehicle. *Food Bioscience, 36.*

Stanciu, S., Rizea, R. D., & Ilie, A. G. (2015). Study on the competitiveness of the Romanian meat processing industry. *Amfiteatru Economic*, *17*(9), 1331–1345.

Sumithra, B., & Bhattacharya, S. (2008). Toasting of corn flakes: Product characteristics as a function of processing conditions. *Journal of Food Engineering, 88*(3), 419-428.

Surmei, E., & Usturoi, M. G. (2012). Studies on freshness of refrigerated poultry meat. *Analele Universităţii din Oradea, Fascicula: Ecotoxicologie, Zootehnie şi Tehnologii de Industrie Alimentară*, 115-120.

Surmei, E., Usturoi, M. G., & Albu, A. (2013). Studies on the evolution of refrigerated poultry meat. *Scientific Papers: Animal Science and Biotechnologies, 60*, 170-172.

Syed, Q. A., Akram, M., & Shukat, R. (2019). Nutritional and therapeutic importance of the pumpkin seeds. *Biomedical Journal of Scientific & Technical Research, 21*(2), 15798–15803. https://doi.org/10.26717/BJSTR.2019.21.003586

Tudorache, M., Custură, I., Gheorghe, A., Hăbeanu, M., Lefter, N. A., Pogurschi, E. N., & Popa, D. C. (2022). Effects of genotype and diet on performance, carcass traits, and blood profiles of slow-growing chicks obtained by crosses of local breed with commercial genotype. *Agriculture*, *12*(11), 1906. https://doi.org/10.3390/agriculture12111906

Uliu, D. V., & Vladu, M. (2021). Studies on the economic results of some meat processors who have accessed non-refundable funds in the Oltenia region, Romania. *Scientific Papers. Series Management, Economic Engineering in Agriculture and Rural Development*, *21*(1), 771–782.

Usturoi, M.G., Ratu, R.N., Radu-Rusu, R.M., Ivancia, M., & Usturoi, A. (2021). Fatty acid profile in eggs and eggs products. *Scientific Papers. Series D. Animal Science, 64*(2), 399–403

Xu, R.,Ye, H., Zeng, D., Zhang, H., Xu, X., & Wu, F. (2025). Oat flour and β-glucan regulate the quality of cereal flour and cereal products: Unveiling novel physicochemical insights with future perspectives. *International Journal of Biological Macromolecules, 307*(4)https://doi.org/10.1016/j.ijbiomac.2025.142362

***https://www.fao.org/home/en/

***https://www.iso.org/standard/56712.html

***https://www.iso.org/standard/76672.html

***https://eurlex.europa.eu