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# EVALUATION OF CHEMICAL COMPOSITION AND NUTRITIONAL VALUE OF CHICKEN MEAT

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**Abstract**

Chicken meat is increasingly recognized as a valuable source of high-quality protein and essential fatty acids, including linoleic acid and alpha-linolenic acid, which must be obtained from the diet because the human body cannot produce them. This study provides a critical evaluation of the nutritional value of various chicken cuts, including breast, back, drumstick, and thigh, focusing on their chemical composition, physicochemical properties, and fatty acid profiles. Representative samples were collected from retail markets in North Macedonia, handled under controlled hygienic conditions, and analyzed for protein, fat, moisture, ash content, pH, water-binding ability (WBA), color parameters, and fatty acid composition using standardized methods.

Results revealed that chicken breast contains the lowest fat content (2.40 g/100 g) and the highest protein levels (20.95%), along with a favorable ratio of polyunsaturated to saturated fatty acids. Increased amounts of saturated fatty acids are associated with higher LDL cholesterol. Thigh and back cuts exhibited higher fat content (up to 26.17 g/100 g) but maintained substantial levels of essential fatty acids. Variations in water-binding capacity, pH, and color among cuts were also observed, influencing sensory attributes, juiciness, and technological functionality.

These findings highlight the role of chicken meat as a lean, nutritionally beneficial source of essential fatty acids, supporting cardiovascular health and improved lipid balance. The observed differences among cuts emphasize the importance of selecting specific portions to optimize dietary intake of bioactive fatty acids. From a health perspective, consumption of chicken breast is recommended, while meat from higher-fat cuts should be consumed in moderation.

**Key words:** *chicken meat, chemical composition, essential fatty acids, nutritional quality.*

## INTRODUCTION

Chicken meat represents one of the most widely consumed types of animal protein worldwide, and it constitutes an important component of the human diet due to its high-quality protein content, essential amino acids, vitamins, and minerals (Pinchen et al., 2020; Pereira and Vicente, 2022). Proteins from chicken meat provide all essential amino acids in sufficient quantities, making it a complete protein source that supports muscle growth, tissue repair, and overall metabolic function (Mir et al., 2017). Vitamins such as B-complex vitamins, including niacin, riboflavin, and B6, contribute to energy metabolism, neurological health, and hemoglobin formation, while minerals such as phosphorus, selenium, and zinc play vital roles in bone development, antioxidant defense, and immune function (Pereira and Vicente, 2022).

Beyond its macronutrient composition, chicken meat is increasingly recognized as a source of biologically active fatty acids, which exert beneficial effects on cardiovascular health, lipid metabolism, and inflammatory responses (Scollan et al., 2017; Abdullah, 2023;

Yi et al., 2023). However, only certain fatty acids are considered essential, specifically linoleic acid (C18:2, omega-6) and alpha-linolenic acid (C18:3, omega-3), as they cannot be synthesized endogenously and must be obtained from the diet. These fatty acids play critical roles in maintaining cell membrane integrity, producing signaling molecules such as eicosanoids, and regulating cholesterol and triglyceride levels in the bloodstream (Ros-Freixedes et al., 2016; Pereira and Vicente, 2022). Regular consumption of chicken meat with a favorable fatty acid composition has been associated with improved cardiovascular outcomes, reduced inflammatory markers, and overall metabolic benefits (Scollan et al., 2017; Yi et al., 2023). In contrast, higher intake of saturated fatty acids has been associated with increased LDL cholesterol levels, which may negatively impact cardiovascular health.

The nutritional profile of chicken meat is strongly influenced by the type of cuts, as variations in fat content, protein concentration, and fatty acid composition exist among breast, back, drumstick, and thigh portions (Mir et al., 2017; Vicente and Pereira, 2024). Breast meat is typically lean, with low total fat content and high protein concentration, making it particularly suitable for individuals seeking low-calorie, nutrient-dense protein sources (Pereira and Vicente, 2022). In contrast, back and drumstick cuts generally contain higher amounts of fat, which contributes to their caloric value, flavor, and juiciness, while still providing essential fatty acids (Akter, 2025). These differences have implications not only for dietary intake and nutritional recommendations but also for food processing, culinary applications, and consumer choice (Vicente and Pereira, 2024; Murata, 2025).

Saturated fatty acids (SFA), commonly found in animal fats, are known to increase low-density lipoprotein (LDL) cholesterol levels and have been linked to a higher risk of cardiovascular diseases, including atherosclerosis and hypertension (Ros-Freixedes et al., 2016). Conversely, polyunsaturated fatty acids (PUFA), particularly omega-3 and omega-6 fatty acids, contribute to improved lipid metabolism, reduced inflammation, and enhanced cardiovascular protection (Scollan et al., 2017; Abdullah, 2023). Therefore, analyzing the balance between SFA and PUFA in different chicken cuts is crucial for evaluating their nutritional quality and providing evidence-based dietary recommendations (Pereira and Vicente, 2022; Yi et al., 2023).

In addition to proximate composition and fatty acid content, physicochemical properties such as pH, water-binding ability (WBA), and color significantly influence the functionality, processing characteristics, and sensory quality of chicken meat (Mir et al., 2017; Hoa et al., 2019; Liu et al., 2023). Meat pH affects protein denaturation, tenderness, microbial stability, and shelf-life, while WBA is associated with juiciness, cooking yield, and texture, making it an important quality parameter for both consumers and the food industry (Wood et al., 2004; Abdullah, 2023). Color measurements, typically expressed in L* (lightness), a* (redness), and b* (yellowness) values, are critical for consumer perception, as they provide visual cues regarding freshness, quality, and degree of doneness (Hoa et al., 2019; Liu et al., 2023). By integrating these physicochemical parameters with compositional analysis, a more comprehensive assessment of chicken meat quality can be achieved.

Understanding the nutritional and functional potential of chicken meat is especially relevant in the context of public health and agricultural production. Poultry is a key source of affordable protein, and its production has a lower environmental footprint compared to ruminant meat, making it a sustainable option for meeting the protein demands of growing populations (Pereira and Vicente, 2022). Evaluating the fatty acid composition, protein content, and functional properties of various chicken cuts provides valuable insights for dietary planning, consumer education, and the optimization of poultry production practices (Akter, 2025; Murata, 2025).

The primary aim of this study was to critically evaluate the nutritional value of chicken meat as a source of essential fatty acids by comparing proximate composition, physicochemical characteristics, and fatty acid profiles across four commonly consumed cuts: breast, back, drumstick, and thigh. This approach allows for a deeper understanding of how variations among different cuts influence their nutritional contribution, supports evidence-based dietary recommendations, and informs strategies for the production and selection of high-quality, health-promoting poultry products.

## MATERIAL AND METHODS

Representative samples of chicken meat, including breast, back, drumstick, and thigh cuts, were collected from retail markets across North Macedonia. These cuts were selected because they represent commonly consumed portions with distinct differences in fat content, protein levels, and overall nutritional composition. All samples were handled under strict hygienic conditions, vacuum-packed, and transported at refrigerated temperatures (0–4°C) to the laboratory to preserve freshness and prevent alterations prior to analysis (AOAC, 2019).

The proximate composition of the meat, including protein, fat, moisture, and ash content, was determined using standardized methods approved by the Association of Official Analytical Chemists (AOAC, 2019) and ISO standards (ISO 1442:1997 for moisture; ISO 937:2023 for protein; EN ISO 936:1998 for ash). The pH of each sample was measured with a calibrated penetration electrode (ISO 2917:1999), as pH directly influences meat tenderness, water retention, microbial stability, and overall quality. Water-binding ability (WBA) was assessed by a gravimetric method, providing insight into the capacity of meat to retain water during processing and cooking, which affects juiciness, texture, and functional properties (Wood et al., 2004).

Color parameters were measured using a Minolta colorimeter, with results expressed in the CIE L*a*b* system: L* for lightness, a* for redness, and b* for yellowness. These measurements provided an objective evaluation of meat appearance, which is an important trait influencing consumer perception and acceptance (Hoa et al., 2019; Liu et al., 2023).

For fatty acid analysis, lipids were first extracted from the samples and then converted to fatty acid methyl esters (FAME) according to ISO 5509:2000. The fatty acid profiles, including saturated (SFA), monounsaturated (MUFA), and polyunsaturated fatty acids (PUFA), were determined using gas chromatography with flame ionization detection (GC-FID) in accordance with ISO 5508:1990. Analyses were performed on an SP-2560 capillary column (100 m × 0.25 mm × 0.20 µm) under the following conditions: injector temperature 250 °C, detector temperature 260 °C, helium carrier gas at 1.0 mL/min, split ratio 1:50, and an oven program starting at 140 °C (5 min), increasing at 4 °C/min to 240 °C, and held for 15 min. Identification and quantification of FAMEs were achieved using a certified 37-component FAME standard (Supelco), with C19:0 methyl nonadecanoate used as the internal standard. This method allowed precise identification and quantification of individual fatty acids, including essential fatty acids such as linoleic (C18:2) and linolenic (C18:3) acids (Vicente and Pereira, 2024).

Additionally, production and consumption data for chicken meat in North Macedonia were obtained from the National Statistical Office for the period 2020–2024. These data provided context for dietary trends and enabled the linking of the nutritional composition of different cuts with actual consumption patterns, allowing a comprehensive evaluation of the role of chicken meat in the human diet (National Statistical Office of North Macedonia, 2024).

## RESULTS AND DISCUSSION

Results presented in Table 1 show the proximate composition (protein, fat, moisture, and ash) of breast, back, drumstick, and thigh cuts of chicken meat. Compared to the previous version, values in Table 1 were updated to reflect the corrected nutrient composition, and the discussion was revised accordingly. Breast meat exhibited the lowest fat content (2.40 g/100 g) and the highest protein content (20.95%), confirming its classification as a lean and nutrient-dense cut suitable for low-fat dietary patterns. In contrast, the back cut contained a substantially higher fat level (21.00 g/100 g), which is typical and physiologically justified due to the presence of skin, subcutaneous fat, and intermuscular depots in this anatomical region.

Thigh and drumstick showed moderate fat values (5.00 and 9.00 g/100 g) and relatively high protein levels (20.56% and 20.50%), reflecting their mixed slow- and fast-twitch muscle fiber composition. Moisture content showed an inverse relationship with fat content, with leaner cuts such as breast and thigh exhibiting higher moisture levels (76.55–73.43%). This trend is consistent with the literature (Akter, 2025), where higher muscle hydration is associated with low lipid content. Ash values remained within typical ranges (0.10–1.00%). These findings confirm that nutrient distribution varies significantly across anatomical locations, influencing dietary value, technological processing, and consumer preferences.

**Table 1**. Nutritional composition of chicken meat cuts (g/100 g fresh weight).

| Sample | Protein | Fat | Moisture | Ash |
|---|---|---|---|---|
| Breast | 20.95 | 2.40 | 76.55 | 0.10 |
| Back | 19.00 | 21.00 | 59.00 | 1.00 |
| Drumstick | 20.50 | 9.00 | 69.50 | 1.00 |
| Thigh | 20.56 | 5.00 | 73.43 | 1.00 |

Results presented in Table 2 demonstrate the physicochemical parameters of chicken meat, including pH, color characteristics, and water-binding ability (WBA). pH values ranged from 6.49 to 6.56, which fall within expected post-mortem muscle pH for poultry. Slightly higher pH values in back and thigh meat may be attributed to higher connective tissue content and residual hemoglobin levels.

Regarding color, breast meat exhibited the highest lightness (L = 57.84*) and lower redness (a = 12.43*), while the back cut showed the lowest lightness (L = 40.90*) and highest redness (a = 15.67*). This difference is associated with the amount of blood retained in different anatomical regions, supporting the reviewer's observation. Cuts with more vascular tissue (e.g., back and thigh) retain more hemoglobin and myoglobin, resulting in darker coloration.

WBA values showed a positive association with fat content, with the back and thigh recording the highest values (26.13–27.76%). However, moisture and WBA displayed an inverse pattern: cuts with high moisture (breast, thigh) did not necessarily exhibit the highest WBA. This is expected because WBA is influenced not only by moisture, but also by pH, protein integrity, and intramuscular fat distribution. Fat contributes to water entrapment during heating, which explains the slightly higher WBA in fattier cuts despite lower moisture.

**Table 2**. pH, color parameters, and water-binding ability (WBA).

| Sample | pH | L* | a* | b* | WBA (%) |
|---|---|---|---|---|---|
| Breast | 6.49 | 57.84 | 12.43 | 27.80 | 19.39 |
| Back | 6.56 | 40.90 | 15.67 | 24.94 | 26.13 |
| Drumstick | 6.51 | 47.88 | 12.01 | 19.07 | 27.76 |
| Thigh | 6.51 | 47.88 | 12.01 | 19.07 | 27.76 |

Results presented in Table 3 show the fatty acid composition of chicken meat, including newly added sums of total SFA and total unsaturated fatty acids (MUFA + PUFA) in accordance with reviewer recommendations. Breast meat showed the lowest total SFA (0.77 g/100 g) and total UFA (1.48 g/100 g), confirming its lean profile. The back cut exhibited significantly higher concentrations (total SFA = 8.40 g/100 g; total UFA = 15.88 g/100 g), reflecting its high fat content. Percentage analysis indicates that unsaturated fatty acids account for approximately 65–68% of the total fatty acids in all cuts, which is nutritionally favorable and consistent with established health benefits of poultry meat. Drumstick and thigh demonstrated intermediate fatty acid levels, maintaining relatively high proportions of PUFA (especially linoleic acid), which enhance their nutritional value.

**Table 3**. Selected fatty acid composition (g/100 g) of chicken meat cuts.

| Fatty Acid | Breast | Back | Drumstick | Thigh |
|---|---|---|---|---|
| Palmitic (C16:0) | 0.63 | 6.89 | 2.27 | 1.12 |
| Stearic (C18:0) | 0.14 | 1.51 | 0.26 | 0.29 |
| Total SFA | 0.77 | 8.40 | 2.53 | 1.41 |
| Oleic (C18:1) | 1.01 | 10.78 | 3.89 | 2.09 |
| Linoleic (C18:2) | 0.44 | 4.68 | 2.48 | 1.09 |
| Linolenic (C18:3) | 0.03 | 0.42 | 0.12 | 0.06 |
| Total UFA (MUFA + PUFA) | 1.48 | 15.88 | 6.49 | 3.24 |
| UFA % of total FA | 65.8% | 65.4% | 71.9% | 69.6% |

Overall, the findings demonstrate clear anatomical-based differences in chemical composition, physicochemical characteristics, and fatty acid profiles of chicken meat. Breast meat remains the leanest and highest in protein, with a favorable unsaturated fatty acid ratio, supporting its role as a health-promoting food. The back cut, despite having the highest fat content, provides substantial levels of unsaturated fatty acids (particularly oleic and linoleic acids), making it nutritionally valuable when consumed in moderation. The high fat value in the back cut (21.00 g/100 g) is logical and anatomically justified, as this region naturally contains more subcutaneous and intermuscular fat depots.

Differences in color values are consistent with variations in blood content and muscle pigmentation, explaining why back and thigh cuts appear darker. Variability in WBA reflects interactions between fat, pH, and protein structure, rather than moisture alone, highlighting technological implications for processing and cooking performance.

## CONCLUSION

The comparative evaluation of different chicken cuts, such as breast, back, drumstick, and thigh, highlights substantial variation in their nutritional and compositional characteristics. Chicken breast is distinguished by its low-fat content, high protein concentration, and a favorable fatty acid profile, including elevated levels of polyunsaturated fatty acids (PUFAs) and an optimal PUFA/SFA ratio. These nutritional advantages support cardiovascular health, contribute to improved lipid metabolism, and position chicken breast as one of the leanest and most health-promoting cuts of poultry meat. Cuts such as the back and thigh contain higher total fat and saturated fatty acid (SFA) levels, particularly palmitic and stearic acids, yet they still supply essential fatty acids of dietary relevance, contributing to the overall nutritional value of chicken meat.

Promoting the consumption of leaner cuts, particularly breast meat, while maintaining a balanced intake of higher-fat portions represents a practical approach for optimizing both total fat intake and essential fatty acid consumption. These findings underscore the role of chicken meat as a versatile and health-supportive component of the human diet and provide evidence-based guidance for consumers, nutritionists, and producers in selecting and promoting cuts that align with long-term dietary and health objectives.

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## ЕВАЛУАЦИЈА НА ХЕМИСКИОТ СОСТАВ И НУТРИТИВНАТА ВРЕДНОСТ НА ПИЛЕШКОТО МЕСО

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**Резиме**

Пилешкото месо сè повеќе се препознава како вреден извор на висококвалитетни протеини и есенцијални масни киселини, вклучувајќи линолна киселина и алфа-линоленска киселина, кои мора да се добијат од исхраната бидејќи човечкото тело не може да ги произведе. Овој труд дава критичка евалуација на хранливата вредност на различни парчиња пилешко месо, вклучувајќи гради, грб, батак и бут, фокусирајќи се на нивниот хемиски состав, физичко-хемиски својства и профили на масни киселини. Репрезентативни примероци беа собрани од малопродажните пазари во Северна Македонија, обработени под контролирани хигиенски услови и анализирани за протеини, масти, влага, содржина на пепел, pH, способност за врзување на вода (WBA), параметри на боја и состав на масни киселини со користење на стандардизирани методи.

Резултатите покажаа дека пилешките гради содржат најниска содржина на масти (2,40 g/100 g) и највисоки нивоа на протеини (20,95 %), заедно со поволен сооднос на полинезаситени и заситени масни киселини. Зголемените количини на заситени масни киселини се поврзани со повисок LDL холестерол. Парчињата од бутот и грбот покажаа поголема содржина на масти (до 26,17 g/100 g), но одржуваа значителни нивоа на есенцијални масни киселини. Исто така беа забележани варијации во капацитетот за врзување на вода, pH вредноста и бојата меѓу парчињата, што влијаеше на сензорните атрибути, сочноста и технолошката функционалност.

Овие наоди ја истакнуваат улогата на пилешкото месо како посен, хранливо корисен извор на есенцијални масни киселини, поддржувајќи го кардиоваскуларното здравје и подобрената рамнотежа на липидите. Набљудуваните разлики меѓу парчињата ја нагласуваат важноста на изборот на специфични порции за оптимизирање на внесот на биоактивни масни киселини во исхраната. Од здравствена перспектива се препорачува консумирање пилешки гради, додека месото од парчиња со поголема содржина на маснотии треба да се консумира умерено.

**Клучни зборови:** *пилешко месо, хемиски состав, есенцијални масни киселини, нутритивен квалитет.*