Research, Society and Development, v. 14, n. 12, e144141250410, 2025
(CC BY 4.0) | ISSN 2525-3409 | DOI: http://dx.doi.org/10.33448/rsd-v14i12.50410

Physicochemical parameters of chicken drumstick and breast cuts raised in free-range and conventional systems: Comparative interpretation in the 2024-2025 context

Parâmetros físico-químicos de cortes de coxa e peito de frango criados em sistemas caipira e convencional: Interpretação comparativa no contexto de 2024–2025

Parámetros fisicoquímicos de cortes de muslo y pechuga de pollo criados en sistemas de corral y convencionales: Interpretación comparativa en el contexto de 2024–2025

Received: 12/11/2025 | Revised: 12/18/2025 | Accepted: 12/18/2025 | Published: 12/19/2025

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Abstract
This study aimed to characterize the physicochemical parameters of chicken drumstick and breast cuts from conventional and free-range production systems, reinterpreting original laboratory data in light of technological and regulatory updates from 2024–2025. Moisture, lipid, protein and ash contents were evaluated on a wet basis using official methodologies from the Ministry of Agriculture and current ISO standards. Original results indicated moisture levels between 73.03% and 76.41%, lipids between 0.45% and 2.63%, proteins ranging from 20.09% to 26.81%, and ash contents from 0.98% to 1.52%, all compliant with current Brazilian legislation. Comparative analysis indicates that, despite significant production advances in poultry farming between 2020 and 2025 — including improvements in animal welfare, biosafety, nutrition and traceability — physicochemical parameters of chicken meat have remained stable. It is concluded that differences between anatomical cuts remain more relevant than differences between production systems, demonstrating consistency and robustness of the original data within the contemporary scenario.
Keywords: Chicken; Centesimal Composition; Meat Quality; Free-range System; Conventional System.

Resumo
O presente estudo teve como objetivo caracterizar os parâmetros físico-químicos dos cortes de coxa e peito de frangos provenientes de sistemas de produção convencionais e caipiras, reinterpretando os dados laboratoriais originais à luz das atualizações tecnológicas e normativas vigentes nos anos de 2024 e 2025. Foram avaliados os teores de umidade, lipídios, proteínas e cinzas, em base húmida, utilizando metodologias oficiais do Ministério da Agricultura e normas ISO em vigor. Os resultados originais demonstraram valores de umidade entre 73,03% e 76,41%, lipídios entre 0,45% e 2,63%, proteínas de 20,09% a 26,81% e cinzas de 0,98% a 1,52%, estando todos de acordo com os padrões atualmente

exigidos pela legislação brasileira. A análise comparativa indica que, apesar das profundas transformações produtivas observadas na avicultura entre 2020 e 2025 — incluindo avanços em bem-estar animal, biosseguridade, nutrição e rastreabilidade — os parâmetros físico-químicos da carne mantiveram estabilidade. Conclui-se que as diferenças entre os cortes permanecem mais relevantes que as diferenças entre os sistemas de criação, evidenciando a continuidade e robustez dos dados laboratoriais no contexto contemporâneo.
Palavras-chave: Frango; Composição Centesimal; Qualidade de Carnes; Sistema Caipira; Sistema Convencional.

Resumen
Este estudio tuvo como objetivo caracterizar los parámetros fisicoquímicos de los cortes de muslo y pechuga de pollos provenientes de sistemas de producción convencional y de corral, reinterpretando los datos originales a la luz de las actualizaciones tecnológicas y normativas vigentes entre 2024 y 2025. Se evaluaron los contenidos de humedad, lípidos, proteínas y cenizas, en base húmeda, siguiendo metodologías oficiales del Ministerio de Agricultura y normas ISO actuales. Los resultados originales mostraron valores de humedad entre 73,03% y 76,41%, lípidos entre 0,45% y 2,63%, proteínas de 20,09% a 26,81% y cenizas de 0,98% a 1,52%, todos dentro de los estándares exigidos por la legislación brasileña actual. El análisis comparativo indica que, a pesar de los avances productivos observados en la avicultura entre 2020 y 2025 —incluyendo mejoras en bienestar animal, bioseguridad, nutrición y trazabilidad— los parámetros fisicoquímicos de la carne se han mantenido estables. Se concluye que las diferencias entre los cortes siguen siendo más relevantes que las diferencias entre los sistemas de producción, evidenciando la consistencia y vigencia de los datos laboratoriales en el contexto contemporáneo.
Palabras clave: Pollo; Composición Centesimal; Calidad de la Carne; Sistema de Corral; Sistema Convencional.

1. Introduction

Brazilian poultry production underwent significant transformations between 2020 and 2025, driven by increased requirements related to biosecurity, traceability, sustainability, and animal welfare. The post-pandemic period accelerated the adoption of environmental monitoring technologies, process automation, and more precise nutritional programs tailored to different production stages.

In parallel, changes were observed in consumer preferences, with growing appreciation for attributes associated with differentiated production systems, such as free-range (caipira) poultry production. This system is characterized by strict criteria regarding stocking density, access to outdoor areas, and restricted use of feed additives, aligning with demands for products perceived as more natural and sustainable.

Despite these productive and market-driven innovations, the basic physicochemical parameters of chicken meat have not undergone significant changes, as widely reported in the scientific literature. Proximate composition—comprising moisture, protein, lipids, and ash—remains relatively stable and is predominantly influenced by the type of cut, the age of the animal, and specific muscle characteristics.

In this context, the reinterpretation of previously obtained laboratory data in light of recent sectoral transformations is relevant to validate the current applicability of these results and to compare them with contemporary scientific reference standards.

Therefore, the aim of this study was to analyze the physicochemical parameters of breast and thigh cuts from chickens raised under conventional and free-range production systems, relating the original results to the productive and regulatory updates in force during the 2024–2025 period.

2. Methodology

A mixed-methods approach was adopted, consisting of field and laboratory activities, within a quantitative research design, using simple descriptive statistics with data classes and relative frequency percentage values (Pereira et al., 2018; Shitsuka et al., 2014). The study evaluated refrigerated breast and thigh cuts obtained from chickens raised under conventional and free-range production systems. All analyses were conducted on a wet basis, following official analytical procedures

established by the Brazilian Ministry of Agriculture, Livestock and Supply (MAPA), as well as internationally recognized ISO standards.

Moisture content was determined according to ISO 1442 by oven-drying to constant weight. Lipid content was quantified using the Soxhlet extraction method, in accordance with ISO 1443, employing an appropriate organic solvent. Protein content was determined by the Kjeldahl method following ISO 1871, using a nitrogen-to-protein conversion factor suitable for poultry meat. Ash content was quantified by incineration in a muffle furnace at 550 °C, as described in ISO 936.

All analyses were performed in duplicate to ensure analytical precision and reproducibility. The results were interpreted and discussed based on updated scientific literature published between 2020 and 2025, considering current regulatory standards and the typical variability reported in recent studies on the proximate composition of poultry meat from different production systems.

3. Results and Discussion

The physicochemical values obtained for the analyzed cuts are presented in Table 1. The table highlights the differences between cut types and confirms the stability of the parameters regardless of the production system.

Table 1 – Physicochemical parameters of chicken cuts (breast and thigh) from conventional and free-range production systems.

Samples	Moisture (%)	Ash (%)	Lipids (%)	Proteins (%)
FNC	76.09	1.05	2.63	20.09
FNP	75.53	1.01	0.56	26.81
FCC	76.41	0.98	1.65	20.48
FCP	73.03	1.52	0.45	25.76

Source: Original laboratory data from the study.

The results indicate that thigh cuts present higher lipid content, whereas breast cuts exhibit higher protein content, consistent with the typical muscle physiology of poultry. Variations between production systems do not substantially affect the mean values, indicating that proximate composition is more strongly influenced by the anatomical characteristics of the cut than by the production system itself.

The results are consistent with contemporary literature on the proximate composition of chicken meat, showing similar moisture, protein, lipid, and ash contents in both breast and thigh muscles as reported by Bhawana *et al.* (2023), Zhang & Liu (2023), and Dalle Zotte *et al.* (2020). Between 2020 and 2025, studies have demonstrated that the production system exerts an indirect influence on composition, mainly due to differences in stocking density, animal movement, and feeding practices. However, the pectoral and femoral muscles retain their intrinsic structural characteristics, which explains the predominance of protein in breast meat and lipids in thigh meat.

Moisture content, ranging from 73% to 76%, is in agreement with studies reporting water stability even under different management conditions. The low lipid percentage in skinless cuts, particularly in breast meat, remains compatible with values reported in recent research monitoring the effects of diet and fast-growth genetics.

Protein values within the range of 20% to 27% also corroborate updated studies on protein density in broiler chickens. The free-range production system, characterized by greater muscular activity, may present slight variations in meat firmness, but without relevant impact on physicochemical composition.

These findings reinforce that the productive and regulatory changes implemented up to 2025, although significant in terms of animal welfare and traceability, have preserved the compositional patterns described by scientific literature for decades.

4. Conclusion

The results allow the conclusion that the physicochemical parameters of the analyzed chicken meat—moisture, lipids, proteins, and ash—remain within nationally and internationally established standards, even when reassessed in light of the productive updates in force during the 2024–2025 period. Differences between cuts were more pronounced than those between production systems, confirming that muscle characteristics are the primary determinants of proximate composition. Therefore, the original laboratory data demonstrate robustness and remain valid within the contemporary scientific context.

Acknowledgments

The authors acknowledge the laboratory staff for technical support during the analyses and the institutional support provided for the development of this study.

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