Research Article

Comparative Assessment of the Biochemical and Sensory Properties of Branded Canned Beef and Chicken Luncheon Meats Available in Retail Markets of Baghdad, Iraq

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Abstract | Processed chicken and beef meat products are the prime source of animal proteins in global food systems because of their easy accessibility, prolonged shelf-life, and nutrient-rich profile. However, their nutritional quality and microbiological and sensory attributes could vary according to the raw meat source, processing mechanisms, and the manufacturer's brand. This research work was carried out to compare the biochemical, microbiological, and sensory properties of canned chicken and beef luncheon meats from some imported brands available in the retail markets of Baghdad, Iraq. Using standardized protocols, total plate count (TPC), pH, protein, moisture, and fat contents, and some organoleptic (sensory) properties were determined for thirty random samples of canned beef and chicken meat products each. Statistical analysis of the results revealed significant differences ($p < 0.001$) between the meat types for all parameters. Beef samples had higher fat and protein contents than chicken meat samples, while the latter exhibited comparatively higher microbial load and moisture contents. According to sensory evaluations, beef products were more preferred over the chicken ones, reflecting superior consumer acceptability. The practical and statistical significance of these variations was further confirmed by the large effect sizes (Cohen's $d > 1.5$) observed across multiple parameters. Overall results revealed the need and importance of targeted quality control and labelling of processed meat products to maintain their consistency, to enhance nutritional value addition, and to ensure food safety.

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Introduction

Animal protein has been an integral part of human nutrition around the globe. Processed and canned products of meat and chicken luncheons are the prime source of animal proteins in the world food systems because of their easy accessibility, prolonged shelf-life, and protein-rich nutrient profile (Toldrá

and Reig, 2014; Małecki *et al.*, 2021). Consumers of all age categories prefer these chicken and beef luncheon meats. There has been a global surge in the consumption of processed canned meat products, primarily boosted by the shifting of dietary patterns of consumers and by fast urbanization (Mudgil, 2019). Although such meat products are more affordable and convenient to consumers, their microbiological and nutritional quality would considerably vary according to the raw meat source, processing mechanisms, and manufacturer's brand (Northcutt et al., 2011; Rebezov *et al.*, 2024). Usually, all these meat products are subjected to some thermal treatment during processing. Moreover, different types of preservation techniques are used to enhance their shelf-life up to six months in some cases (Soyer *et al.*, 2005; Shaltout, 2024).

However, the nutritional, microbiological, and sensory properties of these products change considerably depending on the raw materials used, formulations prepared, processing methods, including hygienic standards, etc. (Pearson and Gillett, 1996; Gómez *et al.*, 2020). Canned beef and chicken meats differ not only in their base meat composition but also in their moisture, fat, and protein contents, which are the critical determinants of both nutritional value and sensory appeal (Naveena *et al.*, 2008; Khalid *et al.*, 2023). The pH level, total plate count (TPC), and organoleptic characteristics also influence the product quality and consumer acceptability (Gill, 1996; El Bayoumi *et al.*, 2023; Torun *et al.*, 2023. Microbiological quality has greater precedence for food safety and for minimizing the associated risks of foodborne pathogens (WHO, 2000; Sánchez-Aldana *et al.*, 2020). Several studies on chicken and beef meat products have assessed the quality attributes with varying degrees of physicochemical and sensory parameters reported among the different types and brands (Ockerman and Basu, 2012; Carpenter, 2018; Abbas *et al.*, 2025). However, few studies have looked simultaneously into the chemical composition, bacteriological load, and sensory acceptance of the canned beef and chicken meat products of imported origin.

Furthermore, the increased importation of processed foods, including meat products, into developing countries' markets necessitates subsequent surveillance studies that would inform the regulation and consumer safety frameworks (Asfia *et al.*, 2021; Hossain *et al.*, 2021). This study, however, seeks to fill the gap by undertaking a comparative analysis between the canned beef and chicken luncheon meats sourced from various imported brands. The particular study objectives included the determination of different physico-chemical, microbiological, and organoleptic sensory attributes, assessed by using a s well-structured experts' panel test. Results of the study are envisaged to provide consumers a better understanding of the relative quality of processed meat products, along with the provision of valuable insights for policymakers and meat industry stakeholders.

Materials and Methods

Sample collection

A batch of sixty canned luncheon meat samples, half of which were of chicken and half were beef, was examined for the study. All of the samples were imported brands that were gathered from big-box stores in cities. To illustrate a range of widely accessible commercial brands, the selection was made at random. The products were selected within the shelf-life limits and were stored at ambient temperature (25°C) until further analysis.

Experimental design

The experiment was performed following a completely randomized design (CRD) with two independent groups (*i.e.*, beef vs. chicken). All samples were subjected to the same protocols for their chemical, bacteriological, and sensory evaluation in different foreign laboratories.

Chemical analyses

All chemical analyses were performed in triplicate, and the average values of all parameters were recorded. The pH was determined by a digital method using a pH meter (Hanna Instruments, USA). For pH measurement, about 10 g of a homogenized meat sample was mixed thoroughly with 90 mL of distilled water. The moisture contents were determined by the oven-drying of the sample at 105°C for 24 h according to AOAC Method 950.46 as described by Toldrá and Reig (2014). The protein contents were analysed by using the Kjeldahl conversion procedure (AOAC Method 981.10), where the nitrogen was multiplied by 6.25 to obtain the amount of protein content of the sample. Fat contents were analysed by the Soxhlet apparatus (AOAC Method 960.39), using petroleum ether as solvent.

Microbiological analysis

For the determination of total heterotrophic bacteria present in the meat and chicken samples, the total plate count (TPC) was performed following serial dilution and pour plate technique using Plate Count Agar (PCA) as the culture medium (Mulyani *et al.*, 2026). The incubation was done at 37°C for 48 hours. Results were expressed in terms of log CFU/g of sample (Soyer *et al.*, 2005).

Evaluation of sensory parameters

A trained panel of ten members carried out the sensory evaluation of all samples under controlled conditions. For sensory evaluation, each sample was given a coded identity and was presented to the panel in a random sequence. The panellists scored each sample on a nine-point hedonic scale (9 = like extremely; 1 = dislike extremely) in terms of appearance, flavour, texture, and overall acceptance; these scores were averaged to form the final sensory score for each sample (Wichchukit and O›Mahony, 2015).

Statistical analysis

Statistical software Jamovi (version 2.4) was used to perform all the statistical analyses. Percentages and mean values of the study parameters were used for descriptive analysis of each parameter. Independent samples *t*-tests were performed to compare the beef and chicken groups for all variables. A significance level of $p \leq 0.005$ was adopted. Effect sizes were reported using Cohen's *d* to evaluate the practical significance of group differences. Assumptions of normality and homogeneity of variance were verified before analysis.

Results and Discussion

This study envisaged a comparative evaluation of the canned chicken and beef luncheon meats branded in Iraq by different foreign food companies. Evaluation and comparison were done in terms of physicochemical, microbiological, and sensory or organoleptic parameters, including moisture content, pH, TPC, fat and protein contents, and different sensory scores.

The descriptive statistics of the physicochemical, microbiological, and sensory or organoleptic parameters of the canned beef and chicken luncheon meat samples are summarised in Table 1. Central tendencies and spread differed widely across all the variables measured among both meat types. Both samples exhibited pH values that were close to neutrality, yet the chicken luncheon meats showed a slightly lower average pH of 6.01 as compared to 6.18 of the beef samples, possibly indicating the higher acidity of chicken samples, which consequently might affect the microbial stability and protein structure of the samples (El-Kewaiey, 2012; Musa *et al.*, 2019; Barcenilla *et al.*, 2022).

Regarding the moisture level, the chicken samples' moisture level was higher (72.10%) than that of the beef samples' average moisture level (67.80%), suggesting considerable variations in meat texture and water retention abilities of the samples. This result is in line with the findings of Morshdy *et al.* (2023). It is quite evident that the excess moisture would make the food product softer and optimal for microbial proliferation during processing, packaging, and marketing (Cerveny *et al.*, 2009). Beef samples, on the other hand, exhibited a higher protein level (18.00%) than that of chicken (15.90%), making beef samples more nutrient-dense as compared to chicken, as narrated by Rodríguez-Martín *et al.* (2023). Similarly, the average fat content of the beef samples was higher (9.98%) than that of chicken ones (8.11%), which consequently would affect both the flavour and energy content of the samples (Al-Abdullah and Al-Majali, 2011). In case of microbiological determination, the chicken samples exhibited a higher TPC value (5.64 log_1^1 CFU/g) than that of beef samples (4.95 $long_1^1$ CFU/g), suggesting the potential variations in their shelf-life or hygiene standards.

These results are consistent with the results of Dabasso *et al.* (2021) that chicken meat products show a short shelf-life, most probably due to high TPC. In case of sensory or organoleptic characteristics of the samples, analysis of the results showed that canned beef samples exhibited a higher rating or score (7.64 ± 0.47) than that of chicken samples (6.70 ± 0.34) (Table 1). These results might be due to higher fat content and better umami attributes of beef products, which enhance the mouthfeel and flavour of the meat samples. Such sensory features of the meat products are particularly important from the consumers' preference point of view. These results are in agreement with some previous reports on processed meat products (Hossain *et al.*, 2024; Hossain *et al.*, 2025). In general, these results present a descriptive summary of the studied characteristics of the samples, and can provide baseline

Table 1: *The summary statistics for pH, moisture, protein, fat, total plate count (TPC), and sensory scores of branded canned beef and chicken luncheons acquired from the retail markets of Baghdad, Iraq.*

	Sample type	pH	Moisture (%)	Protein (%)	Fat (%)	TPC	Sensory score
N	Beef	30	30	30	30	30	30
	Chicken	30	30	30	30	30	30
Missing	Beef	0	0	0	0	0	0
	Chicken	0	0	0	0	0	0
Mean	Beef	6.18	67.8	18.0	9.98	4.95	7.64
	Chicken	6.01	72.1	15.9	8.11	5.64	6.70
Median	Beef	6.18	67.9	18.0	9.97	5.04	7.64
	Chicken	6.02	72.1	15.7	8.16	5.72	6.71
Mode	Beef	6.01[a]	64.1[a]	15.4[a]	8.08[a]	4.20[a]	6.90[a]
	Chicken	5.85[a]	67.9[a]	12.8[a]	6.05[a]	4.89[a]	6.08[a]
Standard deviation	Beef	0.09	1.86	0.99	0.91	0.51	0.47
	Chicken	0.11	2.08	1.16	0.92	0.39	0.34
Minimum	Beef	6.01	64.1	15.4	8.08	4.20	6.90
	Chicken	5.85	67.9	12.8	6.05	4.89	6.08
Maximum	Beef	6.36	71.7	19.6	12.5	6.10	8.86
	Chicken	6.39	76.6	18.1	10.1	6.55	7.54

[a] *More than one mode exists, only the first is reported.*

data for the inferential analysis to assess the actual statistical significance of these observed differences (Munn, 1998).

Table 2: *Independent samples t-test regarding the pH, moisture, protein and fat percentages and total plate count (TPC), and sensory scores of branded canned beef and chicken luncheons acquired from the retail markets of Baghdad, Iraq.*

Study parameter	Statistic	d.f.	p-value	Effect size (Cohen's d)
pH	6.91	58.0	<.001	1.78
Moisture	-8.52	58.0	<.001	-2.20
Protein	7.74	58.0	<.001	2.00
Fat	7.94	58.0	<.001	2.05
TPC	-5.87	58.0	<.001	-1.51
Sensory score	8.89	58.0	<.001	2.29

Indeed, statistically significant variations have been recorded through independent *t*-test analysis at $p \leq 0.001$, for almost all the studied parameters of canned chicken and beef luncheon meat samples. Moreover, these differences appeared to exert very large effect sizes with significant Cohen's d values. In brief, beef meat samples exhibited a higher and statistically significant pH with a large effect size as indicated by Cohen's d value of 1.78 (Table 2), suggesting that higher pH of meat samples would subject them to risks of microbial proliferation and protein denaturation (Grajales-Lagunes and Anda-Salazar, 2010). It is well established that even if all is kept within safety range, unsuitable thermal protocols during processing would increase the pH of the chicken products, moisture perturbations, and post-processing contaminations (Lawrie and Ledward, 2006; Naveena *et al.*, 2008; Rout and Srivastav, 2023).

On the contrary, a substantially higher moisture level was detected in chicken meat samples as compared to beef ones with a Cohen's d value of -2.20, and this high moisture content can significantly affect the water activity, texture, and shelf-life of the chicken products (Taormina and Sofos, 2014). A large effect size (Cohen's d = 2.00) was recorded regarding the protein contents of the beef meat samples, indicating a superior animal protein-related nutritional profile of these beef samples as compared to chicken ones (Schilling *et al.*, 2026). Similarly, a large effect size (Cohen's d = 2.5) was recorded regarding the fat contents of the beef meat samples, which is important in terms of differential mouthfeel and flavour of both meat types (Frank *et al.*, 2016).

In case of TPC, chicken samples exhibited a large effect size (Cohen's d = -1.51), demonstrating poor hygiene standards or microbiological quality

maintenance during the packaging and processing stages of these samples. Beef luncheon meat samples were also superior to chicken ones regarding overall sensory or organoleptic ratings with a large effect size (Cohen's d = 2.29), indicating the overall consumers' preference of canned beef products over chicken products in terms of appearance, texture, and flavour. These results are consistent with the findings of some previous studies (Resurreccion, 2004; Sow and Grongnet, 2010; Garmyn, 2020).

These results demonstrate overall a considerable difference between the two canned meat types studied in this research work and advocate the necessity of differential processing, packing, labelling, and marketing approaches for both types of meat products (Ilbery *et al*., 2005). Moreover, consistently large effect sizes across all studied variables clearly indicate that these sample differences are not by chance but actually reflect meaningful variations among the characteristics of mean products (Pouta *et al*., 2010; Anggita *et al*., 2023).

Beef luncheon samples exhibited better nutritional profile and overall sensory characteristics with extended shelf-life. From the consumers' perspective, these meat products were considered better because of their superior texture, taste, and overall acceptability. While higher microbial load and moisture level of chicken samples as found in this study—even when at least within acceptable limits—make these samples more vulnerable to biochemical degradation, which consequently reduces the nutritional quality, sensory attributes, and shelf-life of these samples (Sakaridis *et al*., 2014; Kumar *et al*., 2020). This necessitates looking for more improved processing and marketing strategies of canned chicken products, particularly of ready-to-use chicken-based products.

These findings clearly demonstrate the essential implications for the manufacturers and consumers of processed meat products. From a nutrition point of view, beef products stand superior regarding their higher protein and richer flavour, whereas chicken products would appeal to consumers seeking more leaner options with greater moisture levels. Nevertheless, lower sensory preference and high microbial load in chicken samples underscore the implication of necessary interventions to improve the control of microbial degradation and to enhance the products' shelf-life, stability, and taste. Moreover, these differential attributes of both meat types should also be taken into account by the food regulatory authorities and food safety inspectors while developing the product-specific standards and guidelines.

Conclusions and Recommendations

In terms of sensory attributes, the consumers preferred the canned beef luncheon samples because of their fattier, proteinaceous, and overall nutritious profiles compared to those of chicken ones, which, on the other hand, exhibited greater moisture level and microbial loads, raising questions about their food safety and shelf-life. Our study hypothesis regarding the differential quality and acceptability is reinforced by the substantial effect sizes recorded in all comparisons. Producers, regulators, and consumers can utilize this baseline information to make well-informed decisions about the product quality and labelling.

Moreover, for a better understanding of the microbial proliferations within canned products over time, further research may be focused on shelf-life determination under different storage environments. This can be achieved by employing modern microbial characterization techniques, including 16S rRNA profiling and metagenomics, which can help identify specific food-spoiling microorganisms (Muñoz-Martinez *et al*., 2025). Moreover, more comprehensive comparisons can be done in future by taking a broader range of local and imported brands of canned meat products and by conducting larger product preference studies involving more diverse consumers to get more robust data regarding sensory outcomes. In addition, careful use of food additives and preservatives in these canned food formulations can help mitigate microbial contaminations (Kiprotich and Aldrich, 2022; Mohaisen *et al*., 2026). Overall results of this study help in the development of more nutritious, safer, consumer-friendly, and consumer-acceptable canned meat products.

Novelty Statement

In our work entitled "Comparative Assessment of the Biochemical and Sensory Properties of Branded Canned Beef and Chicken Luncheon Meats Available in Retail Markets of Baghdad, Iraq", we summarized their work as developing of more nutritious, safer, consumer-friendly, and consumer-acceptable canned

meat products.

Author's Contribution

Raed Mohammed Khalaf Al-Zaidi: Conceptualization, investigation, data collection, writing – original draft supervision, methodology, data analysis, reviewing & editing
Mohammed Jawad Mohaisen: Supervision, methodology, data analysis, reviewing and editing
Jaafar Nozad Aakef: Experimental design, laboratory analysis, validation
Mayson Thafir Hadi: Statistical analysis, data interpretation, writing – review & editing
Eman J. Al-Attar: Sample preparation, sensory evaluation, literature review

Generative AI and AI-assisted technology statement
The authors declare that no generative AI and AI assisted technology was used in the creation of this manuscript.

Conflict of interest
The authors have declared no conflict of interest.

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