How Broiler Meat Quality Influenced by Halal and Kosher Slaughtering Methods?

Deshan Weerasekara[1], R.M. Nikzaad[2] and Muneeb M. Musthafa[3]

[1, 2, 3]*Department of Biosystems Technology, South Eastern University of Sri Lanka, Sri Lanka*

[1]tarusha345@gmail.com, [2] mnikzaad@seu.ac.lk, [3] muneeb@seu.ac.lk

Abstract

The increasing global demand for broiler meat has highlighted the significance of religious slaughtering methods, such as Halal and Kosher, due to their impact on meat quality and consumer preferences. This study examines the effects of these methods on the quality of broiler meat, focusing on nutritional composition, physicochemical properties, and sensory attributes. A total of 25 birds were slaughtered using each method, and the resulting meat samples were analysed for moisture, ash, fat, protein content, pH, colour, texture, and sensory qualities. The results showed no significant differences between Halal and Kosher methods in moisture, ash, fat, and protein content. However, Halal meat exhibited higher pH and lightness values, which could influence its appearance and shelf life. Sensory evaluation revealed no significant differences in consumer preference, although Halal meat scored slightly higher in aroma, taste, and overall acceptability. While these findings align with some previous studies, the small sample size limits the generalizability and credibility of the results. Future research with larger sample sizes is necessary to validate these findings and provide a more comprehensive understanding of the differences between Halal and Kosher slaughtering methods. Ultimately, the choice between these methods may be driven more by religious and cultural beliefs than by significant differences in meat quality. This study affirms that both Halal and Kosher methods are effective in producing high-quality broiler meat, reflecting the diversity of dietary practices and the importance of respecting consumer preferences in the global market.

Keywords: Halal, Kosher, Slaughtering, Meat quality, Broiler

I. INTRODUCTION

The global demand for meat products has steadily increased, driven by a growing population, rising incomes, and changing dietary preferences. Among the various types of meat, broiler chicken remains one of the most consumed worldwide due to its affordability, versatility, and nutritional value (Nusairat, 2022). As consumers become more conscious of food safety, animal welfare, and religious dietary laws. Two religiously prescribed methods, Halal and Kosher, have been particularly scrutinized and debated for their impact on meat quality and ethical considerations (Nakyinsige et al., 2012). Halal and Kosher slaughtering methods, which are required by Islamic and Jewish dietary laws, respectively, have gained significant attention in recent years due to the growing demand for religiously-compliant meat products (Bang, 2016; Farah, 2020). Traditionally, Halal and Kosher slaughtering have been the subject of debate, with concerns raised about animal welfare, pre-slaughter handling, and the potential impact on meat quality (Aghwan et al., 2016). Both methods emphasize the importance of humane treatment of animals and the ritualistic aspect of the slaughtering process. Halal, derived from Islamic law (Sharia), requires that the animal be healthy at the time of slaughter, a prayer be recited, and the blood be fully drained (Sukardi et al., 2022). Kosher slaughter, dictated by Jewish law (Kashrut), similarly mandates a swift cut to the throat, complete blood drainage, and adherence to specific handling protocols (Regenstein et al., 2003). These practices are not only rooted in religious traditions but are also believed to affect the physical and chemical properties of the meat.

The quality of broiler meat is assessed based on various attributes, including tenderness, juiciness, flavor, shelf life, and microbiological safety. Factors influencing these attributes encompass the animal's health, handling, slaughtering method, and post-slaughter processing (Pogorzelski et al., 2022). Even though, the quality of broiler meat is

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a key consideration in the global food industry, as it directly influences consumer satisfaction, industry profitability, and public health (Marchewka et al., 2023). Given the distinctive procedures involved in Halal and Kosher slaughter, there is a growing interest in understanding how these methods impact meat quality compared to conventional slaughtering techniques (Farouk et al., 2014). The scientific community has undertaken numerous studies to evaluate the implications of religious slaughtering on meat quality. These studies often focus on parameters such as pH levels, water-holding capacity, color, texture, and microbial load (Lambooij et al., 2014; Sukardi et al., 2022; Farah, 2020; Della et al., 2021). Broiler meat quality with slaughter methods yet to be study. Therefore, objectives of this study are to: compare the nutritional composition (moisture, ash, fat, protein content) of broiler meat obtained from Halal and Kosher slaughtering methods, Evaluate the physicochemical properties (pH, color, texture) of the meat from each slaughtering method and assess the sensory attributes (aroma, taste, overall acceptability). This comprehensive analysis will provide clear insights into the effects of Halal and Kosher slaughtering methods on broiler meat quality.

II. METHODOLOGY

A. Location

The research was conducted at Nelna Farm (Pvt) Ltd. slaughtering of broilers was done at Nelna Processing Plant, Meethirigala, Sri Lanka. Broiler breast meat samples were analyzed in the Animal Science Laboratory at South Eastern University of Sri Lanka (SEUSL).

B. Sample Collection

Breed of Arbor Acres plus broilers were slaughtered at the age of 38+ days with an average weight of 2.05 kg. 25 birds in each methods were selected randomly from cage and slaughtered. Availability of reagents and laboratory facilities; that sample size was limited to 25 birds per method.

C. Halal Method

Birds were shackled by their legs and hung vertically for easy bleeding, with sharp knife a person cut the neck in jugular vein area (just below the gullet and the core of the neck); saying Bismillah and Allahu Akber. Let the birds for bleeding and did the evisceration.

D. Kosher Method

Investigation was performed to check the abnormalities in the birds and individual slaughtering was performed in the presence of butcher called “Shochet”. Then carcass were soaked in clean water for 30 minutes. After soaking drip and dry in a downward position for a few minutes. After dripping, meat is salted and left to hang for 60 minutes to draw out any remaining blood, then did the evisceration.

E. Storing of Samples

Once the packed carcass’s temperature reaches -32 ^{0}C, which transferred into cold room (T -20^{0}C) and kept for 3 days for the travelling arrangements then transferred to Laboratory in SEUSL for the meat quality parameters’ testing and sensory evaluation.

F. Proximate Analysis

Moisture (Air Dry Oven), Ash (Muffle Furnace), Crude fat (Soxhlet apparatus) and Crude protein (Semi-Automatic Kjeldhal Machine) were analyzed through AOAC Analytical Methods (AOAC, 2006).

G. Physiochemical Properties Analysis

pH, Color and Texture parameters were analyzed in the sample.

1) pH

pH measured by 2 g of samples homogenized with 18 mL distilled water (60 s homogenized). The mixture was filtered by using filter paper then filtrate was determined by using a pH meter (Model: EUTECH) at room temperature (25 ^{0}C).

1) Color

Color was measured by using a KONICA MINOLTA Chroma meter (CR-410). The values of lightness (CIE L*), redness (CIE a*), and yellowness (CIE b*) were determined by deriving the average of the recorded measurements.

2) Texture

Texture was measured using a texture analyzer (Model: TA-XT2) and took the readings of hardness, cohesiveness and sponginess.

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H. Sensory Analysis

The sensory evaluation was conducted using the 9-point hedonic scale to assess various sensory attributes, including color, tenderness, aroma, texture, taste, and overall acceptability of fried chicken. The evaluation involved 30 untrained panelists who were randomly selected from students enrolled in the Biosystems Technology courses at the Faculty of Technology, South Eastern University of Sri Lanka.

The panelists were not provided with any prior training, as the goal was to reflect general consumer preferences. To minimize biases, the panelists were not informed of the exact purpose of the study or the specific parameters being tested. The samples of fried chicken were served in a consistent and controlled environment to reduce external factors that might influence the panelists' perception. Randomization of panelists and sample order was employed to avoid order effects. Each participant received the same piece of fried chicken to ensure uniformity in the evaluation process.

Additional measures to control for potential biases included standardized lighting, temperature, and presentation of the samples. Panelists were also instructed to cleanse their palate between samples, ensuring that previous tastes did not affect their subsequent evaluations

I. Data Analysis

Collected data were subjected normality test and identified as a not normal distribution of data. For that, Mann-Whitney U-Test for the comparisons between Halal and Kosher methods slaughtered meat quality parameters and sensory evaluation analyzed by Friedman test. All statistical analysis were performed by SPSS Ver. 25.0 at the significant level of 0.05.

III. RESULTS AND DISCUSSION

J. Nutritional Analysis of Poultry meat

The proximate analysis was conducted to evaluate the nutritional composition of broiler meat obtained through Halal and Kosher slaughtering methods. The analysis focused on determining the moisture, ash, fat, and protein content of the meat samples. The results are presented in Table 01. There is no significant difference between Halal and Kosher slaughtering methods ($p > 0.05$) in all proximate parameters. Moisture content was high value in Kosher method (77.78 %) and least value for Halal (73.53 %). The mean moisture contents for Halal meat and Kosher meat were in close range to the values (74.16%, 77.42% respectively) reported by Rahman et al. 2019. The moisture content of meat is primarily influenced by factors such as the technique of slaughter, the type of meat, the pH value, and the amount of drip loss. During the slaughtering process, the moisture levels in the meat decrease slightly as a result of the dipole forces acting on the tissues (Varnam & Sutherland, 1995). Due to the greater amount of blood extracted during Halal slaughtering compared to other procedures, the moisture level in Halal meat is slightly lower than in meat from other slaughtering methods (Rahman et al., 2019). Ash content of Halal meat was 3.09 % which higher than Kosher meat (3.18 %). Highest crude fat was recorded in Halal meat (2.07 %) and lowest in Kosher meat (2.05 %). In protein highest value recorded in Halal meat (21.23 %) followed by Kosher meat (21.09 %). According to Rahman et al. 2019 that, the decreased value of non-Halal slaughtered meat may be attributed to protein degradation caused by elevated stress levels. During the process of slaughtering, animals and birds experience significant stress, leading to the release of muscle glycogen into the bloodstream and the creation of lactic acid in the muscles. This mechanism leads to the acidification of muscles and triggers several biochemical changes in muscles after death (Bender, 1992). These alterations result in a reduction in the ability to extract protein, leading to an increase in the loss of nitrogen from muscles and ultimately causing protein degradation. In addition, muscle proteins begin to break down shortly after death as a result of several microbial and enzymatic processes. Due to its preference for efficient blood drainage, the Halal method exhibited lower levels of protein degradation compared to alternative slaughter procedures.

K. Physicochemical Properties

3) pH

The highest pH value was observed in the Halal method (6.03 ± 0.02), while the lowest pH was recorded in the Kosher method (5.91 ± 0.01). And there is a significant different between two methods ($p < 0.05$). The pH of meat is mostly determined by the metabolic condition of the muscle at the moment of slaughter. The levels

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fluctuate correspondingly at the beginning and after the last phase of severity mortis. The elevated pH levels observed at the time of slaughter may be attributed to the tension experienced by the muscles during the struggling of birds following the severing of their necks. During the exertion, the glycogen stores were exhausted, leading to a decrease in the generation of lactic acid in the muscles, which in turn caused an increase in pH levels (Grashorn, 2010).

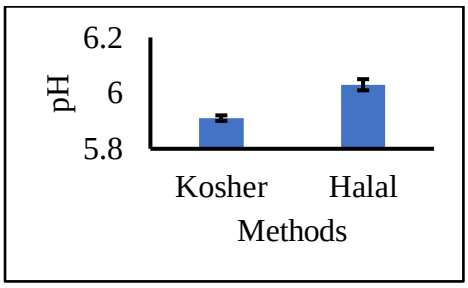

Figure 05: pH of meats

1) Color

The color of meat is strongly associated with the concentration of haem-containing substances, such as myoglobin, hemoglobin, and cytochrome C. Among these three molecules that include haem iron, myoglobin has the most impact on the color of poultry meat (Froning et al., 1968). The myoglobin level in the breast muscle was substantially lower compared to the leg/thigh muscle (Fletcher, 1999). Based on the research there was no significant difference in the redness (8.91 ± 0.57, 9.05 ± 0.44) and yellowness (10.83 ± 0.43, 10.73 ± 0.47) values between the Halal and Kosher slaughtering methods ($p > 0.05$). But significant difference was observed in the lightness of the meat ($p < 0.05$) and Halal slaughtered meat's lightness was 59.62 ± 0.82, Kosher method was 58.39 ± 0.82 (Table 2). The difference in lightness can be attributed to the variation in meat pH; and higher pH level associated with lighter meat color (Wattanachant, Benjakul, & Ledward, 2004). In this research Halal method have high pH (6.03) and lightness than Kosher method.

2) Texture

Texture is the primary sensory attribute that has the most impact on the evaluation of overall quality (Fletcher, 2002). Texture analysis of the meat samples, including measurements of hardness (93.00 ± 1.08, 94.00 ± 1.02), cohesiveness (0.65 ± 0.03, 0.60 ± 0.01) and sponginess (1.49 ± 0.07, 1.58 ± 0.05) revealed that no significant differences between the Halal and Kosher slaughtering methods ($p > 0.05$) (Table 02). These results justified that the slaughtering method does not have a substantial impact on the texture attributes of broiler chicken meat and but get high value of texture in Halal slaughter meat (Rahman et al., 2019). However, it is important to note that other factors such as breed, feed, and pre-slaughter handling, in addition to water-holding capacity and pH, can also influence meat texture (Mir et al., 2017).

L. Sensory Evaluation

The sensory evaluation revealed that (Figure 02), there is no significant different between Halal and Kosher method slaughtered meats ($p > 0.05$); aroma, taste and overall acceptability were recorded high hedonic scale for Halal method (Figure 02). Other parameters except tenderness remain same hedonic scale in both methods. Blood retention and the subsequent development of volatile compounds during cooking has influenced on aroma and taste of the meats that, blood retention negatively effects on aroma and taste (Farouk et al., 2014). Blood retention of poultry meats influenced by pre-slaughter stunning (Gregory, 2005). In this research stunning performed in Kosher method before slaughtering that may influenced the meat quality. Even though both methods were slaughtering by associate humane, that may give same hedonic scale for color and texture; which justified by Kua et al. 2022; Martuscelli et al. 2020, suggesting that consumers may associate humane slaughtering practices with better visual quality of the meat.

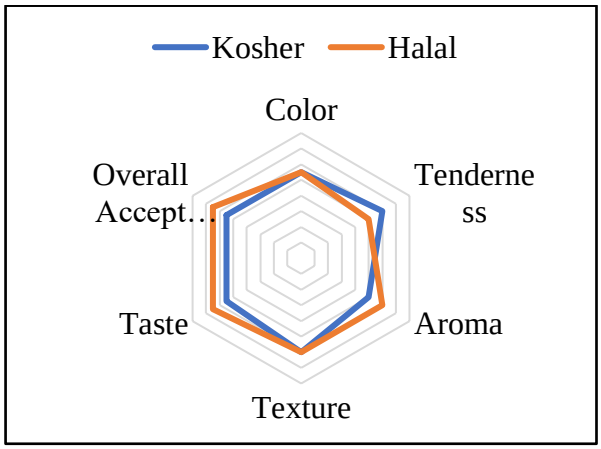

Figure 06: Sensory Evaluation of meats

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IV. CONCLUSION

The findings from this study reveal that both Halal and Kosher slaughtering methods produce broiler meat of comparable quality across most parameters analyzed, including proximate composition, texture, and sensory attributes. While the proximate analysis showed no significant differences in moisture, ash, fat, and protein content, slight variations were observed, with Kosher meat having marginally higher moisture levels and Halal meat showing slightly elevated protein content. These differences are likely due to the specific blood drainage techniques employed in each method. The higher pH and lightness observed in Halal slaughtered meat could influence both the visual appeal and the shelf life of the meat, suggesting potential implications for marketing and storage practices. Sensory evaluation results, where Halal meat scored marginally higher in aroma, taste, and overall acceptability, indicate that subtle differences in meat processing can impact consumer perception and preference.

The small sample size, specific conditions under which the research was conducted, and potential biases inherent in the evaluation processes may have influenced the results. Acknowledging these limitations provides a more balanced view and Indicates the need for further research to confirm these findings across larger samples and different environments. Additionally, the study did not compare Halal and Kosher methods with conventional slaughtering techniques, which could provide a more comprehensive understanding of how these methods stack up against mainstream practices in terms of meat quality and consumer preference.

For the poultry industry and policymakers, these findings suggest that both Halal and Kosher methods are effective in producing high-quality broiler meat, aligning with humane slaughter principles while satisfying consumer expectations. The minor differences observed may be leveraged for targeted marketing strategies that emphasize specific sensory attributes preferred by certain consumer groups. This study contributes to the existing literature by highlighting the subtle but potentially market-relevant differences between Halal and Kosher slaughtering methods, offering valuable insights that can inform product differentiation and consumer choice in a culturally diverse market landscape. These insights underline the importance of considering both religious and cultural practices alongside scientific evidence when shaping industry standards and policies.

Table 01 : Proximate analysis of Halal and Kosher slaughtering methods

[a]

Methods	Moisture%	Ash%	Fat%	Protein%
Kosher	77.78 ± 5.38[a]	3.18 ± 0.51[a]	2.05 ± 0.10[a]	21.09 ± 0.28[a]
Halal	73.53 ± 3.87[a]	3.09 ± 0.53[a]	2.07 ± 0.11[a]	21.23 ± 0.22[a]

superscript, similar superscript not significantly different in column wise at the level of 0.05

Table 01: Color and Texture Parameters of meats from Halal and Kosher slaughtering methods

[a, b]

Methods	Color		
	L*	a*	b*
Kosher	58.39 ± 0.82[a]	9.05 ± 0.44[a]	10.73 ± 0.47[a]
Halal	59.62 ± 0.82[b]	8.91 ± 0.57[a]	10.83 ± 0.43[a]
	Texture		
	Hardness	Cohesiveness	Sponginess
Kosher	94.00 ± 1.02[a]	0.60 ± 0.01[a]	1.58 ± 0.05[a]
Halal	93.00 ± 1.08[a]	0.65 ± 0.03[a]	1.49 ± 0.07[a]

superscript, similar superscript not significantly different in column wise at the level of 0.05

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REFERENCES

Aghwan, Z.A., Bello, A.U., Abubakar, A.A., Imlan, J.C. and Sazili, A.Q., 2016. Efficient halal bleeding, animal handling, and welfare: A holistic approach for meat quality. Meat Science, 121, pp.420-428.

AOAC (Ed.). (2006). Official methods of analysis of Association of Official Analytical Chemists International (18th ed.). Arlington, VA: AOAC Press.

Bang, H.W., 2016. Production of Islamic Knowledge in the European Diaspora: A Case Study of Digital Texts from a British Muslim Halal Certifier. Available at SSRN 2938635.

Bender, A., 1992. Meat and meat products in human nutrition in developing countries.

Della Corte, V., Del Gaudio, G., Sepe, F. and Nevola, G., 2021. Kosher meat and production issues: A bibliometric analysis. Trends in Food Science & Technology, 116, pp.749-754.

Farah, M.F., 2020. Consumer perception of Halal products: An empirical assessment among Sunni versus Shiite Muslim consumers. Journal of Islamic Marketing, 12(2), pp.280-301.

Farouk, M.M., Al-Mazeedi, H.M., Sabow, A.B., Bekhit, A.E.D., Adeyemi, K.D., Sazili, A.Q. and Ghani, A., 2014. Halal and kosher slaughter methods and meat quality: A review. Meat Science, 98(3), pp.505-519.

Fletcher, D.L., 1999. Poultry meat colour. Poultry meat science, 25, pp.159-175.

Fletcher, D.L., 2002. Poultry meat quality. World's Poultry Science Journal, 58(2), pp.131-145.

Froning, G.W., Daddario, J. and Hartung, T.E., 1968. Color and myoglobin concentration in turkey meat as affected by age, sex and strain. Poultry Science, 47(6), pp.1827-1835.

Grashorn, M.A., 2010. Research into poultry meat quality. British Poultry Science, 51(sup1), pp.60-67.

Gregory, N.G., 2005. Recent concerns about stunning and slaughter. Meat Science, 70(3), pp.481-491.

Kua, J.M., Azizi, M.M.F., Abdul Talib, M.A. and Lau, H.Y., 2022. Adoption of analytical technologies for verification of authenticity of halal foods–a review. Food Additives & Contaminants: Part A, 39(12), pp.1906-1932.

Lambooij, E., Reimert, H.G.M., Verhoeven, M.T.W. and Hindle, V.A., 2014. Cone restraining and head-only electrical stunning in broilers: Effects on physiological responses and meat quality. Poultry science, 93(3), pp.512-518.

Marchewka, J., Sztandarski, P., Solka, M., Louton, H., Rath, K., Vogt, L., Rauch, E., Ruijter, D., de Jong, I.C. and Horbańczuk, J.O., 2023. Linking key husbandry factors to the intrinsic quality of broiler meat. *Poultry science*, *102*(2), p.102384.

Martuscelli, M., Serio, A., Capezio, O. and Mastrocola, D., 2020. Safety, quality and analytical authentication of ḥalāl meat products, with particular emphasis on salami: a review. *Foods*, *9*(8), p.1111.

Mir, N.A., Rafiq, A., Kumar, F., Singh, V. and Shukla, V., 2017. Determinants of broiler chicken meat quality and factors affecting them: a review. *Journal of food science and technology*, *54*, pp.2997-3009.

Nakyinsige, K., Man, Y.B.C. and Sazili, A.Q., 2012. Halal authenticity issues in meat and meat products. *Meat science*, *91*(3), pp.207-214.

Nusairat, B., Tellez-Isaias, G. and Qudsieh, R., 2022. *An overview of poultry meat quality and myopathies*. IntechOpen.

Pogorzelski, G., Pogorzelska-Nowicka, E., Pogorzelski, P., Półtorak, A., Hocquette, J.F. and Wierzbicka, A., 2022. Towards an integration of pre- and post-slaughter factors affecting the eating quality of beef. *Livestock Science*, *255*, p.104795.

Rahman, H.U.U., Sahar, A., Khan, M.I. and Jamil, A., 2019. Discerning microbial and quality attributes of differently slaughtered and dead poultry meat. *Journal of Food Safety*, *39*(3), p.e12622.

Regenstein, J.M., Chaudry, M.M. and Regenstein, C.E., 2003. The kosher and halal food laws. *Comprehensive reviews in food science and food safety*, *2*(3), pp.111-127.

Sukardi, D., Hafizd, J.Z. and Setiawan, F.F., 2022. Halal Certification Standards for Chicken Slaughter in Traditional Markets. *Al Hurriyah: Jurnal Hukum Islam*, *7*(2), pp.204-227.

Varnam, A.H. and Sutherland, J.P., 1995. The water of meat. *Am. Lab*, *8*, pp.33-37.

Wattanachant, S., Benjakul, S. and Ledward, D.A., 2004. Composition, color, and texture of Thai indigenous and broiler chicken muscles. *Poultry science*, *83*(1), pp.123-128.