Meat Research
Vol 4, Issue 3: 1-6, Article 91, June 2024
ISSN: 2790-1971
https://doi.org/10.55002/mr.4.3.91
http://www.bmsa.info/meatresearch

[1]Department of Animal Science, Bangladesh Agricultural University, Mymensingh, Bangladesh
[2]Poultry Production Research Division, Bangladesh Livestock Research Institute, Savar, Dhaka, Mymensingh
[3]Division of Applied Life Science (BK21 Four), Gyeongsang National University, Jinju 52828, Korea

***Corresponding author:**

MA Hashem
E-mail: hashem_as@bau.edu.bd

Keywords:

Poultry sector
Bangladesh
Chicken processing

Article Info:

Received: May 11, 2024
Accepted: June 14, 2024
Published online: June 30, 2024

Review Article

Poultry processing and value addition in Bangladesh- A review

MA Hashem[1]*, MSK Sarker[2] AMMN Alam[3], N Mia[1], MM Rahman[1]

Abstract

The poultry sector in Bangladesh has experienced substantial expansion, establishing itself as a crucial element of the country's agricultural economy. Bangladesh is experiencing significant growth in its commercial poultry industry, which includes the commercial processing of chicken. The increase in poultry processing factories is driven by the notion that this particular industry offers better food and presents lower risks of food-borne diseases compared to traditional processing in wet markets. This review examines the various complex aspects of chicken processing and further processing along with product dimensions in Bangladesh market. Furthermore, it presents a thorough analysis of the poultry processing industry in Bangladesh and provides valuable insights on how to optimize its ability to add value, to fulfill the demands of both the domestic and export markets.

Introduction

Bangladesh has a population of over 165 million individuals, which positions it as one of the most densely inhabited countries globally (BBS, 2023). The chicken business in Bangladesh has developed into a thriving agricultural sector. The expansion of poultry farming in both rural and urban areas is occurring at a quick pace to meet the regular protein requirements and provide financial support to a significant population. According to studies, this industry contributes between 22% and 27% of the nation's overall meat production (DLS, 2021). Bangladesh possesses a poultry population of over 3.7 million, which makes a significant contribution to the country's gross domestic product (GDP) (BBS, 2023). The economy of Bangladesh is significantly dependent on the growth of its poultry sector, which in turn contributes to job creation and poverty reduction throughout the country. The demand for poultry meat and eggs is growing rapidly in Bangladesh due to its high quality, nutritional content, and affordable pricing. Eggs and broilers have been increasing at the rate of 8–10% per annum (BBS, 2023). As the demand for eggs and poultry meat continues to rise, there is a corresponding increase in the need for poultry feed as well. In Bangladesh, poultry accounts for around 20% of protein consumption and 35.25% of the overall meat supply (DLS, 2021). The poultry industry in Bangladesh is a well-established industry having an overall investment of around 42 million USD (BPICC, 2020). The annual per capita consumption of poultry is likely to range from 6.3 to 8.5 kg (LightCastle 2020). It is projected to have a 17% increase by the year 2025 (Statista 2022). Furthermore, innovative options need to be explored in Bangladesh to cater the growing market and classified customers. The innovation in the meat industry is cultured meat (Post et al., 2020), hybrid cultured meat (Alam et al., 2024a), flexitarian meat (Alam et al., 2024b), Plant-based meat (Kumari et al., 2023), umami enhanced meat products (Hossain et al., 2024), restructured meat (Samad et al., 2024), three-dimensional printing of meat (Alam et al., 2024c and 2024d) and irradiation of meat (Rima et al., 2019; Sadakuzzaman et al., 2023; Islam et al., 2019 and 2022).

There is a disparity in consumption patterns between urban and rural areas, with urban areas exhibiting higher levels of consumption. The factors contributing to increased consumption may include greater urbanization, higher income levels, and increased awareness of the health and nutritional advantages of poultry meat. While chicken production continues to grow steadily, the processing industry has not kept up with the same rate of growth, resulting in only moderate profitability overall. In Bangladesh, the processing rate for chicken is only 10% and for eggs, it is only 1%. According to DLS (2021), 90% of the dressed chickens are sold at the wet market, and 10% are either in chilled or frozen form.

The main limitations in our country regarding processing are the consumer's limited preference for frozen chicken, inadequate infrastructure for maintaining a cold chain, an underdeveloped marketing system, low domestic demand for value-added products, insufficient access to advanced technology, and the failure of export trade due to strict regulations imposed by importing countries (Hashem et al., 2023; Rahman et al., 2023, Rana et al, 2014; Sharker et al., 2024). In this systematic review, we have focused on the processing patterns, storage, distribution, value chain of poultry industry in Bangladesh.

Poultry processing in Bangladesh

Processing and marketing of poultry ranges from live bird markets or a very primitive on-site slaughter and fully automated and International Standards Organization (ISO) certified facilities and ready-to-cook convenience products. Lack of or inadequate refrigeration is probably the single largest obstacle to the marketing of poultry meat. The adoption of modern freezing, packaging, and transportation technologies has provided large poultry companies the flexibility to cater their high quality, mostly value-added premium cuts mostly in and around Dhaka and Chittagong. In combination with the estimated increase in demand, LightCastle (2020) estimates that the number of broilers slaughtered in modern slaughterhouses in Bangladesh will grow from 16 million numbers to 70 million during 2019 to 2025 (BPICC, 2019). This increase of 50-60 million broilers slaughtered per year in modern slaughterhouses, would require approximately 6 – 8 midsized slaughterhouses (25,000 birds/day). Table 1 explains the present scenario of broiler processing in Bangladesh.

Table 1. Live broiler and processing status in Bangladesh

Parameters	Amount/Percentage
Daily Demand for Broiler Chicken	2100 Tons
Demand Fulfill by Chicken Processing Companies	10-15%
The Total Market for Frozen Products per Month	About 40 crore taka
Monthly Produced Processed Chicken	1225 tons
Total Market Size about Processed Chicken including Products	624 crore taka
Poultry Products Processed Hygienically	only 2%

Sources: BPICC (2019)

Table 2 explains the market status of chicken processors in Bangladesh. The market share of processed chicken in Bangladesh is CP Bangladesh-12%, Paragon-7%, Quality Foods-7%, Aftab-5%, AG Food-4%, Holly Seed-4%, Bengal Meat-4%, Uttara Broiler-4%, Agro Link-3%, Kazi Farms-1% and others-49%.

Tabel 2. Commercial dressed chicken processors business status

SL.	Company Name	Day (MT)	Monthly (MT)	%	Tk
1	CP Bangladesh	4.3	130	12%	26,000,000.00
2	Aftab	2.0	60	5%	12,000,000.00
3	Paragon	2.7	80	7%	16,000,000.00
4	AG Food	1.7	50	4%	10,000,000.00
5	Holy Seed	1.3	40	4%	8,000,000.00
6	Bangle Meat	1.3	40	4%	8,000,000.00
7	Uttara Broiler	1.3	40	4%	8,000,000.00
8	Agro Link	1.0	30	3%	6,000,000.00
9	Kazi Farms	0.5	15	1%	3,000,000.00
10	Quality	2.7	80	7%	16,000,000.00
11	Others	18.3	130	12%	26,000,000.00
Total		37	1115	100%	223,000,000.00

(Source: Statista, 2022)

Processing techniques

Poultry processing is categorized into pre-processing, primary processing, secondary processing, and further processing in Bangladesh.

Catching of broilers birds

For the best quality meat prior processing involves feed withdrawals of broilers approximately 8-12 hr before slaughter. Feed withdrawal is important to reduce gastrointestinal contents within the bird, which reduces the chance of ingesta or fecal contamination during processing. After catching the birds are loaded into plastic crates and loaded onto trucks and transported to either wet processing market or to the processing plant.

Bird receiving and inspection

Upon arrival, the birds go through health inspection by a registered veterinarian and then weighed in a group of ten pieces. The average live weight gets registered in record books. This process held in a holding shed to provide some minimal protection from the external environment. The loading, unloading as well as transportation of poultry birds should preferably be done during evening or early morning.

Slaughtering of birds

Primary processing includes slaughter, evisceration and chilling. In the modern and automated poultry processing plants, the coops are unloaded from the truck and a machine tilt and dump the entire coop onto a conveyor that transports the birds to the hanging area. The birds are hung upside down on the overhead shackles where they remain for the duration of steps in the slaughter area, (approximately 6-7 min total). The birds are stunned using electrical stunning device (water troughs), passing a current of 20-25 mA through the head and body. Immediately after stunning, the birds are slaughtered either manually maintaining the halal compliance. After the slaughter, exsanguination (i.e. bleeding) takes approximately 2 min.

Scalding and defeathering

Followed by proper bleeding birds go through scalding where the birds are submerged in hot water (67 °C) which assists in feather removal. Usually in the small plant and wet market scalding and defeathering is done manually in a large stainless steel bucket having rubber fingers. In automated factories, the process is carried out continuously using either a single stage or multistage scalding bath, while the birds are hung from a moving shackle line. Feathers are being plucked using a defeathering equipment. The defeathering equipment is equipped with rubber fingers that rub the feathers off the carcass. Following the

removal of feathers, the heads, oil glands, crop, and feet are separated. On-farm and small-scale processors often decapitate the animals manually, whereas large-scale factories employ machinery to extract the heads, ensuring the removal of the esophagus as well. The feet are amputated at the knee joint. After the process of scalding and selecting, small plants utilize evisceration shackles to restrain birds. After the removal of the feet, the birds in big plants are then suspended on the shackles. Initially, birds are most conveniently suspended by their feet, but when they are rehung, they are suspended by the knee joint.

Evisceration

During the evisceration stage the contents of the bodily cavity are removed. The body cavity can be accessed by creating a tiny incision in close proximity to the vent, and then expanding the incision around the vent. Once the abdomen is incised, the internal organs can be extracted through the incision. It is crucial to thoroughly extract all the internal organs, including the lungs that are connected to the posterior side. During this phased a heavy-duty vacuum pressure is used to completely remove any remaining impurities inside the body cavity. Once all the contents of the cavity are extracted, the bird undergoes a comprehensive internal and external cleansing with chlorinated chilled water (0-2 ºC). The consumable by products, which consist of the heart, liver, and gizzard segregated and thoroughly cleansed in a separate area (Babji, 2001; Bilgili, 2001).

Chilling of the carcass and storing

Once the dressing process is complete, the carcass is promptly cooled through immersion chilling at chilled water having flake ice to bring down the core temperature of the carcass between 0-2 °C chilled carcass is then transferred to chiller (0-4 °C) until immediate delivery. Carcass for short term or long-term storage go through blast freezing at -40°C for 2 hours and transferred to -20°C cold storage for either further processing or future delivery.

Carcass delivery

Carcass delivery is done depending on the preferences of the buyer in chilled (0-4°C) through chiller van and frozen (-20°C) through freezer van. Figure 1 illustrates the total process of broiler processing in Bangladesh for a better understanding.

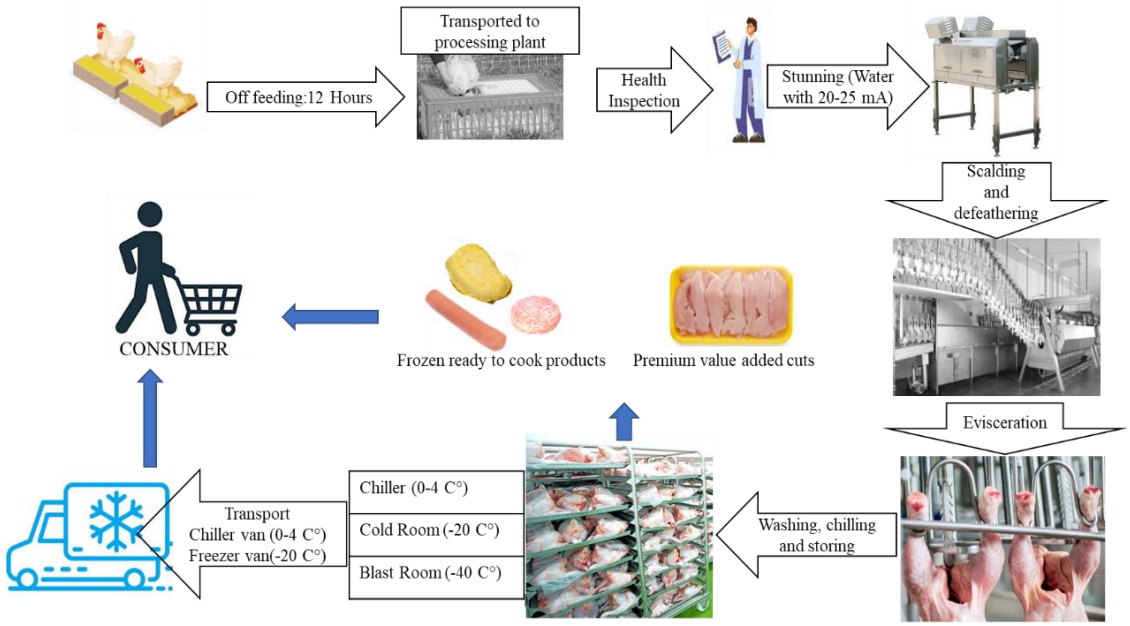

Figure 1. Broiler processing flow chart.

Further processing of carcass

Further processing is done to produce value-added products or ready to cooked form products. Secondary processing encompasses activities such as cut-ups, deboning, and portioning. Various methods exist for dissecting a bird carcass. Poultry can be marketed in various forms based on market demand, including as a complete bird that is ready to cook, divided into two halves, or separated into different pieces such as wings, legs, and breasts. It can also be offered with or without skin and bones, for example, boneless breast (Desikan & Megarajan, 2014; Hamid et al., 2017).

Ready to cook (RTC) frozen snacks

Urbanization and the growth in income levels directly correlated with an increased adaptation to western cuisine in terms of dietary habits in Bangladesh. Consumers' busy work schedules and evolving lifestyles are contributing to a consistent rise in the consumption of frozen RTC products. The introduction of frozen value-added chicken items has brought a new aspect to the food consumption habits of Bangladeshi consumers. Manufacturing of RTC products involves the addition of ingredients, and/or heat treatment to poultry meat to create a variety of value-added products. Poultry industries involved with the processing have developed hundreds of processed products. Some processed forms include marinated, chopped and formed, breaded, glazed, oven roasted, fried and char-grilled varieties. Major product forms include patties (breaded or roasted), nuggets, tenders, fillets, wings, drums, and thighs, prepared and either par-fried (partially cooked in oil for less than a minute) or cooked in many different possible forms.

Commercial aspect of RTC

The demand for frozen RTC poultry products is experiencing significant growth among urban residents in Bangladesh. The frozen food industry in the country, valued at Tk 50 crore a decade ago, has now exceeded Tk 800 crore and is projected to reach Tk 3,000 crores by 2024 (Supriya, 2022). The sector in Bangladesh has significant potential due to the changing per capita income, nuclear family structure, tastes, and fashion trends in the country (Ares et al., 2017). Examples of frozen RTC meat products include fried chicken, chicken lollipop, cutlets, nuggets, sausages, burger patties, strips, shami kabab, spring rolls, wings, popcorn etc. Kazi Farms, Aftab Bahumukhi Farms Ltd, AG Agro, BRAC, CP Bangladesh, Paragon Group, Eon Group and other companies are the dominant players in Bangladesh's chicken processing business.

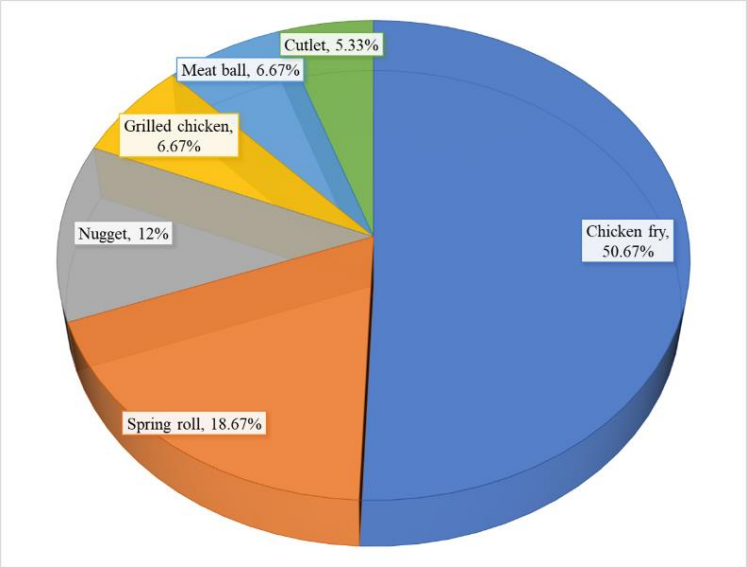

Figure 2. Consumption pattern of RTE chicken products in Bangladesh (Modified from Thuiching et al., 2023).

Business prospects in retail sector

Currently, customers are experiencing a significant increase in food safety awareness due to the widespread use of electronic and social media. The trend in consumption is shifting towards packaged and secure food products. The demand for frozen or chilled chicken meat from hotels and fast-food restaurant chains is on the rise. Ensuring proper hygiene and sanitation is of utmost importance in the meat processing industry. Chicken processing plants utilize imported machinery and adhere to strict hygienic protocols, ISO standards, and HACCP guidelines. This includes monitoring employees' health, water sources, sanitary conditions, and cold chain facilities. Adapting new techniques like aging and high-intensity ultrasonication could be useful in developing products with distinct flavors and tastes (Son et al., 2024), which can raise the retail business segment.

The retail sector is being stimulated and expanding due to the implementation of creative strategies by poultry integrators. These strategies include the establishment of 'Own outlets" and "Franchise outlets" all over Bangladesh. These outlets sales processed frozen chicken and all sorts of chicken ready to cook products and fried products as well. In addition, the rise is being bolstered by the backing of supermarkets and retail malls. Consumers are increasingly prioritizing high-quality and sanitary food, leading to a growing demand for processed meat and meat products. An overview of the retails market of RTC products and companies has been explained in Table 3.

Table 3. RTC product processors in Bangladesh

Company Name	Market Share	Total Quantity Monthly (MT)	Total Amount Monthly (BDT)
Golden Harvest	27%	56.2	21,304,000
Kazi Farms	17%	36.7	14,351,000
Pran	10%	21	7,630,000
AG Food	3%	6.5	2,488,000
Harvest Rich	4%	9	3,810,000
Brac Chicken	5%	11	5,170,000
Aftab	5%	10	4,140,000
Uroasia	1%	3	1,130,000
CP Bangladesh	6%	12	6,600,000
BD Food	2%	4	1,320,000
ATR	2%	4	1,880,000
Paragon	1%	3	1,200,000
Bangel Meat	2%	5	2,350,000
Lamisa	4%	9	3,390,000
Others	10%	20	6,880,000
Total	**100%**	**210.4**	**83,643,000**

(Source: Statista, 2022.)

Food safety issues

Poultry meat safety in Bangladesh is greatly threatened by microbial contamination, which is a highly urgent matter. Research has indicated that a notable proportion of poultry meat available in markets is tainted with harmful germs such Salmonella, Escherichia coli, and Campylobacter (Azad et al., 2021 and 2022; Barua et al., 2012; Islam et al., 2008, Sarker et al., 2021). An additional crucial concern is the improper utilization and excessive application of antibiotics in chicken agriculture. The utilization of antibiotics is frequently employed to stimulate growth and mitigate the risk of illness. However, this technique can result in the existence of antibiotic residues in poultry meat. The ingestion of meat containing antibiotics can lead to the development of antibiotic resistance, which can make it more challenging to treat bacterial infections in humans (Khatun et al., 2016).

The absence of rigorous rules and monitoring systems to govern the utilization of antibiotics in chicken farming in Bangladesh worsens the issue. Inadequate handling and processing methods at different points in the poultry supply chain might result in the contamination and deterioration of meat. Numerous slaughterhouses and wet markets function without complying with fundamental sanitary regulations. This encompasses insufficient infrastructure for waste management and absence of potable water for poultry sanitation, leading to the proliferation of microorganisms (Hossain et al., 2015). Inadequate cold chain management, particularly in rural regions, results in the fast deterioration of meat. Not only does this provide health hazards, but it also leads to financial setbacks. Consumer understanding regarding the safety of poultry meat is relatively low in Bangladesh. A significant number of customers have insufficient awareness regarding the potential hazards linked to mishandled or infected meat (Mia et al., 2023 and 2024).

The safety of poultry meat in Bangladesh is impaired due to microbial contamination, antibiotic residues, and inadequate handling procedures. It would be useful to apply cutting edge analytical techniques to detect the impurities, antibiotic residues and actual quality parameters in meat (Alam et al., 2024c; Hashem et al., 2022). To tackle these problems, a comprehensive strategy is needed that includes more stringent rules, enhanced enforcement, educating consumers, and implementing better procedures throughout the supply chain. By implementing these measures, Bangladesh can guarantee the security and excellence of its chicken meat, safeguarding public health and bolstering customer trust. Table 4 illustrates the proposed action plans in Bangladesh to strengthen the poultry processed meat industry.

Table 4. Present an action plan for the recommended solution, proposed program, key actors and time frame

Recommended Action Plan Time	Frame	Execution
Formation of a regulatory body (Poultry Development Board)	2021-2022	DLS, GoB
Guidelines for farming and processing plants	2022-2025	DLS, Research, Academia, GoB
Training of farmers, dealer and agents on safe farm production and practices	2022-2025	WPSA, DLS, Universities, NGOs
Development of compliance systems on food safety including Inspection and quality control	2022-2028	DLS, GoB
Development of strategy for private investment for establishing slaughter house/processing plant	2022-2028	DLS, GoB, WPSA
Strengthening poultry extension activities related to safe broiler production, processing & value Addition	Continuous	DLS, WPSA, GoB
Linkage among Research, Extension agent & academia for scientific intervention	Continuous	GoB, DLS, Research Organizations, Universities

Conclusion

The poultry industry in Bangladesh is experiencing rapid growth and is emerging as one of the most dynamic markets in the meat production sector. Furthermore, there has been a shift in dietary consumption habits towards meat products. While the poultry production industry has experienced significant growth, the processing and further processing industries have not kept up at the same rate. The marketing of chicken products has numerous challenges, including an unpredictable market, rising taxes on raw materials, exorbitant transportation fees, inadequate cold chain infrastructure, and non-compliance with food safety regulations. The favorable elements contributing to the development of the chicken processing business are rapid urbanization, industrialization, increased affluence, and changing food preferences. Poultry meat products that offer added value are currently popular due to their ability to provide more convenience to consumers by reducing preparation time, streamlining preparation stages, allowing for the use of specific portions, eliminating kitchen dangers, and enhancing the overall value of the product. As additional processing and development of new products increase, there is a potential for poultry consumption to grow at a quicker rate. However, it is necessary to adhere to stringent quality assurance standards in accordance with established criteria in order to meet the demands of the export market.

References

Alam AN, Kim CJ, Kim SH, Kumari S, Lee SY, Hwang YH, Joo ST. 2024a. Trends in hybrid cultured meat manufacturing technology to improve sensory characteristics. Food Science of Animal Resources, 44(1), 39. https://doi.org/10.5851/kosfa.2023.e76

Alam AMM, Lee E Y, Hossain MJ, Kim SH, Kim CJ, Hwang YH, Joo ST. 2024b. Physicochemical and sensory characteristics of hybrid flexitarian pork loin steak combined with different plant ingredients. Food Science of Animal Resources. https://doi.org/10.5851/kosfa.2024.e43

Alam AN, Kim CJ, Ki SH., Kumari S, Lee EY, Hwang YH, Joo ST. 2024c. Scaffolding fundamentals and recent advances in sustainable scaffolding techniques for cultured meat development. Food Research International, 114549. https://doi.org/10.1016/j.foodres.2024.114549

Alam AMM, Hashem MA, Matar A, Ali M, Monti J, Hossain M, Yusuf H, Mia N. 2024d. Cutting edge technologies for the evaluation of Plant-based food and meat Quality: A Comprehensive review. Meat Research, 4(1). https://doi.org/10.55002/mr.4.1.79

Ares G, Machín L, Girona A, Curutchet MR, Giménez A. 2017. Comparison of motives underlying food choice and barriers to healthy eating among low medium income consumers in Uruguay. Cadernos de saude publica, 33, e00213315. https://doi.org/10.1590/0102-311X00213315.

Azad MAK, Rahman MM, Hashem MA. 2022. Meat microbiota: A conceptual review. Meat Research, 2: 2, Article No. 20. https://doi.org/10.55002/mr.2.3.20
Azad MAK, Kikusato M, Zulkifli I, Rahman MM, Ali MS, Hashem MA, Toyomizu M. 2021. Comparative study of certain antioxidants - electrolyzed reduced water, tocotrienol and vitamin E on heat-induced oxidative damage and performance in broilers. Meat Research, 1: 1, Article 7. DOI: https://doi.org/10.55002/mr.1.1.7
Babji AS. 2001. Asian poultry processing adjusts to domestic market demands. World Poultry, 17, 22-24.
BBS, 2023. Bangladesh Bureau of Statistics. Preliminary Report of Agricultural Census, Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic of Bangladesh.
Barua H, Biswas PK, Olsen KE, Christensen JP. 2012. Prevalence and characterization of motile Salmonella in commercial layer poultry farms in Bangladesh. PloS one, 7(4), e35914. https://doi.org/10.1371/journal.pone.0035914
Bilgili SF. 2001. Poultry products and processing in the international market place. In Proc Internat Anim Agric & Food Sci Conf Indianapolis, IN USA (available online at www. fass. org/fass01/pdfs/Bilgili. pdf)(Accessed on July 15. 2024).
Bangladesh Poultry Industries Coordination Committee (BPICC). 2019. Annual report, 2019.
Bangladesh Poultry Industries Coordination Committee (BPICC). 2020. Annual report, 2020.
Desikan T, Megarajan B. 2014. Prospects of value-added poultry products marketing in India. Animal and Veterinary Sciences, 2(4), 118-123. https://doi.org/10.11648/j.avs.20140204.16
DLS, Department of Livestock Services. 2021. Livestock Economy at a Glance. Available online at: http://dls.portal.gov.bd/sites/default/files/files/dls.portal.gov.bd/files/a7c2c046_864e_41c5_adcc_c9858ebc7887/2021-08-18-05-41-28ed36a96d0db%20342b627f416f5d1f97a.pdf
Hamid MA, Rahman MA, Ahmed S, Hossain KM. 2017. Status of poultry industry in Bangladesh and the role of private sector for its development. Asian Journal of Poultry Science, 11(1), 1-13. https://doi.org/10.3923/ajpsaj.2017.1.13
Hashem MA, Islam MR, Hossain MM, Alam AMMN, Khan M. 2022. Prediction of chevon quality through near infrared spectroscopy and multivariate analyses. Meat Research, 2(6).
Hashem MA, Islam SM, Tushar ZH, Rahaman MH, Akhter S. 2023. Can live and dead broiler meat be identified through sensory and physicochemical attributes?.Meat Research, 3(5).
Hossain MJ, Alam AN, Lee EY, Hwang YH, Joo ST. 2024. Umami characteristics and taste improvement mechanism of Meat. *Food Science of Animal Resources*, 44(3), 515. https://doi.org/10.5851/kosfa.2024.e29.
Hossain MZ, Fakruddin MD, Chowdhury A, Ahmed MM. 2015. Detection of Microbial Contamination of Poultry Products in Bangladesh. International Journal of Food Contamination, 2(1), 5.
Islam MA, Hossain MA, Sadakuzzaman M, Khan M, Rahman MM, Hashem MA. 2022. Effect of gamma irradiation on the shelf life and quality of mutton. Turkish Journal of Agriculture-Food Science and Technology, 10 (2): 117-124.
Islam A, Sadakuzzaman M, Hossain MA, Hossain MM, Hashem MA. 2019. Effect of gamma irradiation on shelf life and quality of indigenous chicken meat. Journal of Bangladesh Agricultural University, 17(4): 560-566.
Islam MA, Mondol AS, De Boer E, Beumer RR, Zwietering MH, Talukder KA, Heuvelink AE. 2008. Prevalence and genetic characterization of shiga toxin-producing Escherichia coli isolates from slaughtered animals in Bangladesh. Applied and environmental microbiology, 74(17), 5414-5421. https://doi.org/10.1128/AEM.00854-08
Khatun M, Howlider MAR, Jahan MS, Hossain ME. 2016. Impact of Antibiotic Residues on Poultry Meat Safety in Bangladesh. Asian Journal of Medical and Biological Research, 2(3), 421-427.
Kumari S, Alam AN, Hossain MJ, Lee EY, Hwang YH, Joo ST. 2023. Sensory evaluation of plant-based meat: Bridging the gap with animal meat, challenges and future prospects. Foods, 13(1), 108. https://doi.org/10.3390/foods13010108
LightCastle. 2020. Poultry sector study Bangladesh. Ministry of foreign affiars, commissioned by the Netherlands Enterprise. Vol RVO-163–2020/RP-INT. https://www.rvo.nl/sites/default/files/2020/12/Poultry%20sector%20study%20Bangladesh.pdf. Accessed on 15 July 2024
Mia N, Alam AMMN, Rahman MM, Ali MS, Hashem MA. 2024. Probiotics to enhance animal production performance and meat quality: A review. Meat Research. 4 (2): Article No. 85.
Mia N, Rahman MM, Hashem MA. 2023. Effect of heat stress on meat quality: A review. Meat Research. 3 (6): Article No. 73.
Post MJ, Levenberg S, Kaplan DL, Genovese N, Fu J, Bryant CJ, Moutsatsou P. 2020. Scientific, sustainability and regulatory challenges of cultured meat. Nature Food, 1(7), 403-415. https://doi.org/10.1038/s43016-020-0112-z
Rahman MM, Hashem MA, Azad MAK, Choudhury MSH, Bhuiyan MKJ. 2023. Techniques of meat preservation-A review. Meat Research. 3 (3): Article No. 55.
Rana MS, Hashem MA, Akhter S, Habibullah M, Islam MH, Biswas RC. 2014. Effect of heat stress on carcass and meat quality of indigenous sheep of Bangladesh. Bangladesh Journal of Animal Science, 43 (2): 147-153.
Rima FJ, Sadakuzzaman M, Hossain MA, Ali MS, Hashem MA. 2019. Effect of gamma irradiation on shelf life and quality of broiler meat. SAARC Journal of Agriculture, 17: 149-159.
Sadakuzzaman M, Hossain MA, Rahman MM, Azad MAK, Hossain MM, Ali MS, Hashem MA. 2021. Combined effect of irradiation and butylated hydroxyanisole on shelf life and quality of beef at ambient temperature. Meat Research, 1: 1, Article 3. https://doi.org/10.55002/mr.1.1.3
Samad A, Alam AN, Kumari S, Hossain MJ, Lee EY, Hwang YH, Joo ST. 2024. Modern Concepts of Restructured Meat Production and Market Opportunities. Food Science of Animal Resources, 44(2), 284. https://doi.org/10.5851/kosfa.2024.e18.
Sarker MIA, Hashem MA, Azad MAK, Ali MS, Rahman MM. 2021. Food grade vinegar acts as an effective tool for short-term meat preservation. Meat Research, 1:5.
Sharker B, Mia N, Ali MS, Hashem MA, Rahman MM, Khan M. 2024. Effect of freezing period on the quality of doe liver. Meat Research, 4(2). https://doi.org/10.55002/mr.4.2.90
Son YM, Lee EY, Alam AN, Samad A, Hossain MJ, Hwang YH, Seo JK, Kim CB, Choi JH, Joo ST. 2024. The Application of High-Intensity Ultrasound on Wet-Dry Combined Aged Pork Loin Induces Physicochemical and Oxidative Alterations. Food Science of Animal Resources, 44(4):899-911. https://doi.org/10.5851/kosfa.2024.e26.
Statista. 2022. Bangladesh poultry consumption per capita. https://www.statista.com/statistics/757647/bangladesh-poultry-consumption-per-capita/. Accessed 15 July 2024.
Supriya K. 2022. Can Roja convince Bangladeshis to fall in love with seafood snacks? The Business Standard. Published 11 January 2022.
Thuiching K, Islam NM, Hassan MM, Resmi SI, Tabasum S. 2023. A Study on Consumer Perception for Frozen Value-added Poultry Meat Products in Dhaka City. International Journal of Innovative Research, 8(1): 1-5.