



¹Department of Animal Science,
Bangladesh Agricultural University,
Mymensingh, Bangladesh

Review Article

Market and value chain of chicken meat products in Bangladesh: A revolutionary impact on employment generation, enterprise development and food security

MR Amin¹, MS Ali¹, KMM Rahman¹, MSK Sarker¹, MF Sharmin¹, MA Hashem^{1*}

*Corresponding author:

MA Hashem

E-mail: hashem_as@bau.edu.bd

Abstract

This study aims at assessing the revolutionary impact of chicken meat products on employment generation, enterprise development and livelihood improvement of people in Bangladesh through market and value chain analysis. Based on information from specialized meat companies, fast food shops, special restaurants and super markets through surveys, FGDs and KIIs it tries to assess revolutionary impact of chicken meat products on employment, income generation and consumers preference. Poultry sector contributes 37% of total meat production and about 22-27% of the total animal protein supply in the country. Fried chicken, chicken burger, chicken sandwich, chicken roll, chicken cutlet, chicken kebab, chicken samosa and chicken singara are very popular in fast food shops whereas chicken sandwich, chicken burger, chicken roll, crispy and spicy chicken fry are common in departmental stores. In restaurant, the most common items are grill chicken, chicken curry, chicken paratha, fried chicken, fried chicken wing, fried chicken drumsticks, chicken with cashew nut, sliced chicken with capsicum, sweet and sour chicken, fried boneless chicken, boneless chicken gravy, masala chicken curry and chicken chilli dry. The process of making variety of chicken products and branding are going on by different producers. Important chicken meat products available in the market are sausages, nuggets, meatballs, spring roll, samosa, singara, cutlet, kebab, burger, sandwich, sharma, lollipop, wonton, grilled chicken, and fried chicken. There are 28-30 Companies are producing frozen foods (Chicken). The markets of safe chicken meat products are gradually being expanded over the years. The market size of frozen food including meat products will be from BDT 10 to 12 thousand million. Several millions of trained people are engaged in the sector to produce and sell of chicken meats and earn a handsome amount of money and improve their livelihood. Value chain analysis shows that value of chicken meat products varies from BDT 517 to BDT 1800 for per kg boneless chicken meat at company level. These products may vary from BDT 620 to BDT 2160 restaurant level where they vary BDT 724 to BDT 2520 at fast food shop level for per kg boneless chicken meat.

Keywords:

Chicken
Meat products
Value chain

Article Info:

Received: July 01, 2024

Accepted: August 10, 2024

Published online: August 31, 2024

Introduction

Poultry sector contributes 37% of total meat production in Bangladesh. This sector contributes about 22-27% of the total animal protein supply in the country. According to the Bangladesh Poultry Industry Central Council (BPICC), Bangladesh's poultry sector currently produces 1.5 to 1.6 percent of the country's GDP. In addition, the sector employs approximately 6 million people directly and indirectly in the country of which 40% are women. The present growth rate of this sector is around 12-15 per cent and total investment is more than BDT 350 billion (BBS, 2021; BPICC, 2022). Lion share of the sector is chicken. Chicken and chicken products are the cheapest sources of animal protein. Now-a-days, chicken meat products are the most palatable and preferred by younger people of the country (Farzana et al., 2017; Islam et al., 2019; Hashem et al., 2022). Availability and access to meat products are largely contributed by meat industries, fast food shops, departmental stores and restaurants. The above actors have been maintaining the quality, safety and shelf life through branding, packaging, product differentiations and various product ingredients (Ali et al., 2022; Hossain et al., 2021). In the poultry sector, broiler chicken, with a current population of 525 million birds, is the most produced and consumed variety. Sonali chicken is a local variety with relatively high meat content and has been the fastest growing segment in recent years. The local indigenous chicken has the highest consumer preference and hence is also the most expensive. Out of the 525 million broilers annually consumed in Bangladesh, approximately 60% are reared in commercial farms, the remaining in semi-scavenging / traditional rural backyard conditions (NEA, 2020). Due to rapid urbanization, people are becoming busy with different economic and social activities and have little time for making foods with their own and mostly dependent on processed meat products, namely ready to cook and ready to eat (Islam et al., 2018; Islam et al., 2019; Disha et al., 2021).

Further, in case of office entertainment, people absolutely rely on ready to eat products. The chicken products market has been becoming larger in spite of vigilant of meat industries and other stakeholders in the market. Changes of food habits of younger people like school, college and university going students are another reason for the development and enlargement of such markets.

Various entrepreneurship and self-employments have been created among young people centering these products (Islam et al., 2018; Siddiqua et al., 2018).

Chicken meat products are produced by varieties brand name of different companies and finally, these products are available in their own respective outlets or super shops of big cities. In fast food shops or departmental stores, products are made by their own technologies. Fried chicken, chicken burger, chicken sandwich, chicken roll, chicken cutlet, chicken kebab, chicken samosa and chicken singara are very popular in fast food shops whereas chicken sandwich, chicken burger, chicken roll, crispy and spicy chicken fry are very common in departmental stores. In restaurant, the most common items are grill chicken, chicken curry, chicken paratha, fried chicken, fried chicken wing, fried chicken drumsticks, chicken with cashewnut, sliced chicken with capsicum, sweet and sour chicken, fried boneless chicken, boneless chicken gravy, masala chicken curry and chicken chilli dry. The process of making variety of chicken products and branding are going on by different producers. Important chicken meat products available in the market are sausages, nuggets, meatballs, spring roll, samosa, singara, cutlet, kebab, burger, sandwich, sharma, lollipop, wonton, grilled chicken, and fried chicken. These products are available in ready to eat and ready to cook forms (Hashem et al., 2022; Sultana et al., 2023).

There are 28-30 Companies those are producing frozen foods (Chicken) like ready to cook and ready to eat. They are Pran, RFL, Kazi Farms, Golden Harvest, BRAC Chicken, Aftab Foods, AG Foods, Rich Food, CP, AG Agro, Paragon, Bengal Meat, EON, Country Natural, Quality Foods, Jhatpot, Nourish, Lamisa, Urosia, etc. In Chattogram city, some of the companies like Roja, Tava, Mafco, Essentials, Busket, Swapno are producing chicken meat based frozen foods. Golden Harvest started production and marketing of frozen food (Chicken) products from 2006 in the country. Their frozen food products are chicken paratha, chicken spring roll, chicken singara, chicken samosa chicken nugget and various types of other chicken meat products. Chicken meat ball, sweet and spicy chicken wings, chicken popcorn, chicken strips are also produced and marketed by Golden Harvest. Rahman et al. (2017) suggest that the poultry industry in Bangladesh may become multi-dimensional and more stable in the near future as it establishes sufficient backward and forward linkages to input and output supplies.

Now, peoples are very much alert about their health. White meats are being more preferred compared to that of red meats by all types of consumers of the country. Thus, the markets of safe chicken meat products are gradually being expanded over the years (Boby et al., 2022). The production system and traceability has always significantly influence meat quality and consumer perception (Hashem et al., 1999; Moniruzzaman et al., 2002). Intensive farming systems, while efficient, often raise concerns about animal welfare, antibiotic use, and environmental impact, which can affect meat texture, flavor, and nutritional composition (Rana et al., 2014; Hossain et al., 2016; Torun et al., 2023; Tushar et al., 2023). In contrast, free-range and organic systems are generally perceived as producing higher-quality meat with better texture, lower fat content, and fewer chemical residues (Sarker et al., 2017; Hashem et al., 2020). Traceability systems, enabled by digital technologies such as blockchain and IoT, enhance transparency by tracking production practices, feed sources, and processing methods. This reassures consumers about food safety, ethical sourcing, and sustainability, ultimately shaping purchasing decisions and brand trust. Improved traceability not only strengthens regulatory compliance but also meets the growing demand for ethically produced and high-quality poultry products (Hashem et al., 2008; Murshed et al., 2014).

Packaged frozen food products are now being produced and marketed considering consumers' preferences and demands. Most of the frozen foods are made from chicken. Cooking is a matter of nuisance for working women after maintaining their schedule official works from dawn to dusk. For this reason, frozen food is getting popularity. The demand for packaged chicken meat products is rapidly growing to get rid of cooking problem to reduce cooking time. The main objectives of packaged chicken foods are to fry or cook quickly and easy serving. The packaged and frozen meat products are juicier, softer and safer compared to directly slaughtered meats as packaged products are made through properly and chilling of meat (Rahman et al., 2023). The demand of packaged frozen food is rapid increasing in the havoc of COVID-19. Peoples did not show such type of interest to buy frozen food in the past. Now, the packaged frozen food is being sold in one day, in past, it did not sell in a week. The demand of chicken fry, chicken nuggets, french fry, chicken meat ball increases 40-50% in this corona havoc. Customers feel better to buy this type of packaged frozen food. Jhatpot is a brand of Pran-RFL group introduce their frozen food market in 2013. Chicken roll, chicken nugget, chicken patty, chicken sausage, puri, popcorn, strips, French fry are the products under this brand. Gradually, frozen food is getting popularity to escape the difficulties of cooking or to avoid spending a long time for making snack in the busiest life. Specially, at present, the demand of frozen food increases because in the corona havoc peoples go very rare in the hotel, restaurant, and small food shop of locality (Akter et al., 2022). Jhatpot frozen foods also export to the abroad. But the present situation, demand has been increased into the country, for this reason, a small amount is exported to the America, Australia, Canada, England, New Zealand and Singapore.

The frozen food market has been growing well for the last four to five years; the average annual growth is 20 percent. Now, the market size of frozen food including meat products will be from one thousand crore taka to one thousand two hundred crore taka. Corona has increased that possibility even more. As a result, it is expected that by 2025, this market will be double of Tk. 2,500 crore. Kazi Foods Industries started the business of frozen food products in the country's market in 2014. In addition to various chicken items produced on its own farm, the company also sells teasers, strips, spring rolls, nuggets, paratha, puri and somucha. Kazi Farms has its own outlet called Kazi Farm Kitchen. Besides, their products are being sold in super shops and general grocery stores (Nasrin et al., 2016).

As per the DLS report (2019), the country is producing approximately 46.6 million eggs and 3.1 million kg of poultry meat per day in 2019 compared to 30.1 million eggs and 2.2 million poultry meat per day in 2015.

This study aims at assessing the impact of chicken meat products on employment generation, enterprise development and food security of people in Bangladesh.

Methodology

This study is based on survey data comprising qualitative and quantitative information. It was carried out in five divisions like Dhaka, Chattogram, Mymensingh, Rajshahi and Khulna. Several surveys are made to get information from specialized meat companies, fast food shops, special restaurants those who are preparing chicken products in their own ways, and super markets.

Some trained enumerators were employed to carry out the surveys, which were strictly monitored by the researchers themselves. In addition to survey, some Focus Group Discussion (FGDs) was conducted with different stakeholders and consumer's groups, like general people, school, college and university going students. Consumer's preferences for different meat products were assessed during FGDs. Organoleptic evaluations of different products of different companies, fast food shops and restaurants were made during visits of those organizations. Further, some Key Informant Interviews (KIIs) were carried out with heads of organizations of different meat products producers as key informants. FGDs, organoleptic evaluations and KIIs were carried out by the researchers where some trained enumerators worked as facilitators. Some descriptive and inferential analyses were done in the study.

Results and discussion

As mentioned earlier, many meat companies have engaged in producing meat products especially from chicken. They are producing different meat products with various branding and packaging. Only products of some companies have been discussed here through a sample survey. These are mostly ready to cook products. However, they are called ready to eat products when they are served at fast food shops, restaurants and Chinese restaurants. Kazi Food Industries Limited is an important and pioneer in the field of making different meat products. Thirty-two chicken products with their prices of Kazi Food Industries have been presented in Table 1. Main plant of this company is located in Ashulia, at Shavar, Dhaka. This company has own business outlets in different places Dhaka. Huge number of manpower has been engaged in these industries to produce chicken products and selling of products and have been earning a handsome amount of money as salary in every month.

Table 1: Chicken meat products (ready to cook) and their prices of Kazi Food Industries Limited

Serial No.	Product Name	Amount (g)	Price (BDT)
1.	Sausage Stick	750	500.00
2.	Sausage Plain	170	115.00
3.	Sausage Spicy	170	120.00
4.	Sausage Plain	340	225.00
5.	Sausage Spicy	340	230.00
6.	Bologna Lollipop	504	280.00
7.	Meatball Stick	920	500.00
8.	Meatball Stick	250	175.00
9.	Meat Ball Spicy	250	175.00
10.	C. Teasers	250	180.00
11.	C. Lollipop	300	225.00
12.	Strips Outlet	550	450.00
13.	Strips Box	250	210.00
14.	8 Cut	1100	630.00
15.	13 Cut	1250	640.00
16.	Drumstick	500	350.00
17.	Wings	550	270.00
18.	Kebab Roll Stick	1000	1800.00
19.	Chicken Shashlik	1000	1000.00
20.	Burger Petty	280	500.00
21.	Chicken Kiev	360	310.00
22.	Nuggets Outlet	450	300.00
23.	Chicken Burger	200	160.00
24.	Chicken Cutlet	200	165.00
25.	C. Nuggets	250	160.00
26.	C. Nuggets Kids	250	165.00
27.	C. Nuggets Spicy	250	165.00
28.	Mini Burger	200	240.00
29.	French Fry	1000	240.00
30.	French Fry	500	130.00
31.	Chicken Popcorn	250	250.00
32.	Chicken Popcorn Outlet	1000	800.00

Bengal Meat Company is another important company and has been producing three types of meat products like freshmeat, ready to cook meat and ready to eat meat. Near about hundred products are produced by this company (Table 2). This company has also been exporting meat products to different countries. The main plant of this company is located in Pabna. Demand for chicken products has been increasing day by day with popularization of these products by different professionals engaged in this company. Thousands of people have been engaged in this company to carry out all the activities like production, promotion and marketing of different products. This company has own business outlets in the capital city Dhaka.

Table 2: Chicken and poultry bird products available at markets of Bengal Meat Company

Serial No.	Fresh meat	Ready to cook meat	Cold Cuts & Sausages (Ready to eat meat)
01.	Chicken Whole-Skin On	Crispy Chicken Meatball	Chicken Salami
02.	Chicken Whole-Skin Off	Chicken Cordon Bleu	Chicken Chili Salami
03.	Chicken Breast-Boneless	Chicken Lemongrass Lollypop	Chicken Loaf
04.	Chicken Breast-Bone In	Breaded Chicken Cutlet	Chicken Pepperoni
05.	Chicken Breast-Bone In Skin On	Chicken Nuggets	Smoked Chicken Roll
06.	Chicken Drumstick	Chicken Sausage	Smoked Chicken Loaf
07.	Chicken Whole Leg-Skin On	Chicken Burger Patty	Chicken Rasher
08.	Chicken Wings	Chicken Samosa	Chicken Mortadella
09.	Chicken Thigh-Bone In	Chicken Mini Samosa	Turkey Apple Mortadella
10.	Chicken Thigh-Boneless	Chicken Mini Spring Roll	Chicken Cheese Cocktail Sausage
11.	Native Chicken Skinless	Chicken Finger	
12.	Roast Chicken	Chicken Drumstick	

Serial No.	Fresh meat	Ready to cook meat	Cold Cuts & Sausages (Ready to eat meat)
13.	Soup Chicken	Chicken POPs	
14.	Local Duck	Chicken Kids Nuggets	
15.	Muscovy Duck	Chicken Sausage	
16.	Pekin Duck	Chicken Chorizo Sausage	
17.	Pigeon		
18.	Quail Bird		
19.	Chicken Feet		
20.	Chicken Liver		
21.	Chicken Gizzard		

A survey of a Super Market namely Ameena Big Bazar of Uttara, Dhaka shows that it sells meat products of different companies like EON Foods Limited, Kazi Foods Limited, Golden Harvest, Bengal Meat and CP Foods. Most of products are ready to cook products. Types, amount and product prices have been presented in Table 3. It is evident that there are wide ranges of variation of product quality, quantity, branding and prices among different meat competitive companies. This super market also sell different chicken parts mostly made for different cooking purposes (Table 4). However, before cooking, people need to add different spices and condiments to them (Table 4). To furnish different activities different super markets employ many people there.

Table 3: A Survey on available Chicken Meat Products (ready to cook) in Ameena Big Bazar of Uttara, Dhaka

Serial No.	Company Name	Product Name	Amount(g)	Price (BDT)
01.	EON	Chicken Burger Patty	300	250.00
02.	Foods	Chicken Kofta	300	250.00
03.	Limited	Double Bites Chicken Samosa	250	155.00
04.		Chicken Spring Roll	300	160.00
05.		Chicken Spicy Lollipop	400	300.00
06.		Chicken Samosa	300	165.00
07.		Chicken Sausage	300	215.00
08.		Chicken Breaded Crispy Strips	250	210.00
09.		Chicken Finger	250	220.00
10.		Chicken Spicy Nugget	250	195.00
11.		Chicken Kids Nuggets	250	190.00
01.	Kazi Foods	Chicken Sausage Spicy	340	230.00
02.	Limited	Chicken Sausage	340	225.00
03.		Chicken Nugget	250	160.00
04.		Chicken Nugget Spicy	250	165.00
05.		Chicken Liver Singara	300	100.00
06.		Chicken Shami Kabab	250	185.00
07.		Chicken Strips	250	210.00
08.		Chicken Spring Roll	250	160.00
09.		Chicken Samosa	250	155.00
10.		Chicken Burger Patty	200	160.00
11.		Chicken Meat Ball	250	175.00
12.		Chicken Meat Ball Spicy	250	175.00
13.		Chicken Kids Nugget	250	165.00
14.		Chicken Lollipop	300	225.00
15.		Chicken Mini Spring Roll	250	160.00
16.		Chicken Garlic Butter Kiew	360	310.00
17.		Chicken Teasers	250	180.00
18.		Chicken Cutlet	200	165.00
19.		Chicken Popcorn	250	250.00
01.	Golden	Chicken Wings & Drumstick	500	300.00
02.	Harvest	Chicken Samosa (mini)	500	300.00
03.		Chicken Samosa (mini)	250	155.00
04.		Chicken Samosa (large)	250	140.00
05.		Chicken Nugget	250	160.00
06.		Chicken Burger Patty	200	160.00
07.		Chicken Strips	300	250.00
08.		Chicken Spring Roll	300	155.00
09.		Chicken Meat Ball	400	245.00
10.		Chicken Nugget	300	180.00
01.	Bengal Meat	Smoked Chicken Slice	225	221.00
02.		Chicken Pepperoni	250	253.00
03.		Chicken Salami	225	240.00
04.		Chicken Chilli Fritz	200	239.00
05.		Chicken Chilli Fritz	175	209.00
06.		Chicken Chilli Fritz	195	233.00
07.		Chicken Nugget kid	250	185.00
08.		Chicken Nugget	250	175.00
09.		Chicken Samosa	250	145.00
10.		Chicken Mini Spring Roll	250	145.00
11.		Chicken Drumstick	500	345.00
12.		Chicken Finger	200	185.00
13.		Chicken Meat Ball Crispy	360	295.00
14.		Chicken Burger Patty	360	240.00
15.		Chicken Pops	250	225.00
16.		Chicken Lollipop	360	300.00
17.		Chicken Cocktail Sausage	270	230.00
18.		Chicken Cutlet	280	195.00

Serial No.	Company Name	Product Name	Amount(g)	Price (BDT)
19.		Chicken Fillet	320	196.00
20.		Chicken Fillet	295	181.00
21.		Chicken Fillet	350	215.00
22.		Chicken Keema	420	273.00
23.		Chicken Wings	430	139.00
24.		Chicken Keema	455	295.00
25.		Chicken Taowk Kabab	310	182.00
26.		Chicken Kali Kabab	350	210.00
27.		Chicken Maxican Wings	460	179.00
28.		Chicken Drumstick	455	209.00
29.		Chicken Drumstick	385	155.00
01.	CP Foods	Chicken Hot Sausage	400	270.00
02.		Chicken Frank Sausage	400	270.00
03.		Chicken Frank Cocktail	340	200.00
04.		Chicken Bologna	340	270.00
05.		Spicy Chicken Ball	500	270.00
06.		Plain Chicken Ball	500	270.00

Table 4: Processed poultry meats in Ameena Big Bazar Uttara, Dhaka

Serial No.	Portion Name	Amount (kg)	Price (BDT)
01.	Chicken Breast Fillet	1	425.00
02.	Chicken Drumstick	1	225.00
03.	Chicken wing	1	240.00
04.	Chicken Liver	1	220.00
06.	Chicken Roast	Per Piece	145.00
07.	Fresh Duck Meat	Per Piece	410.00

A survey of Agora, Dhaka shows that it sells different chicken products mostly whole chicken and cut chicken some of which presented in Table 5. Amount and prices of different chicken products, cuts, whole and green chicken vary widely (Table 5). Agora has own meat supplier in addition to specialized meat company. However, Thai Chinese and other restaurants sell their own meat products, which are variant form of other meat products produced by meat companies. They serve these chicken meat products mixing with other food items. These types of restaurants always modify their dishes considering consumer's preferences and demand. These restaurants absorb huge number of highly trained manpower. Twenty-nine special chicken food items have been identified in Thai Chinese & Sichuan Restaurant in Uttara, Dhaka. Several thousand restaurants of such types have been operating in Bangladesh (Table 6).

Table 5: Processed green chicken and chicken meats and their prices in Agora, Dhaka

Serial no.	Product name	Amount (kg)	Price (BDT)
01.	Green Chicken without skin	1	320.00
02.	Green Chicken with skin	1	300.00
03.	Green Chicken Drumstick	1	425.00
04.	Green Chicken	1	290.00
05.	Turkey Fresh Meat	1	600.00
06.	Fresh Duck Meat	Per Piece	410.00
07.	Chicken Drumstick skinless	1	390.00
08.	Chicken with skin	1	290.00
09.	Chicken Drumstick with skin	1	380.00
10.	Chicken Keema	510g	242.00
11.	Chicken Local	1	365.00
12.	Broiler with skin	1	242.00
13.	Broiler Skinless	1	258.00
14.	Chicken Liver & Gizzard	1	185.00
15.	Chicken Pakistani	1	440.00
16.	Chicken Keema	540	275.00
17.	Chicken for Roast	275-300g	155.00

Table 6: Chicken meat products in Thai Chinese & Sichuan Restaurant Uttara, Dhaka

Serial No.	Product Name	Product type	Price (BDT)
01.	Chicken Satey	Appetizers	695.00
02.	Fried Chicken	Appetizers	495.00
03.	Fried Chicken Wings	Appetizers	450.00
04.	Fried Chicken Drumstick	Appetizers	490.00
06.	Chicken Cutlet with Frence Fries	Appetizers	550.00
07.	Thai Style Fried Chicken	Ready to eat	650.00
08.	Grilled Chicken	Ready to eat	695.00
09.	Chicken Basil Leaf	Ready to eat	550.00
10.	Chicken in Foil Paper	Ready to eat	750.00
11.	Sliced Chicken with Mushroom and Ginger	Ready to eat	550.00
12.	Chicken With Cashewnut	Ready to eat	580.00
13.	Sliced Chicken with Capsicum	Ready to eat	555.00
14.	Chicken Wrapped in Paper	Ready to eat	750.00
15.	Sweet and Sour Chicken	Ready to eat	550.00
16.	Lemon chicken with mushroom	Ready to eat	595.00
17.	Chicken red/ Green Curry	Ready to eat	620.00
18.	Fried Spring Chicken	Ready to eat	550.00
19.	Fried Boneless Chicken	Ready to eat	695.00
20.	Fried Chicken with chilli oil	Ready to eat	740.00

21.	Boneless Chicken Gravy	Ready to eat	520.00
22.	Chicken with Pineapple	Ready to eat	520.00
23.	Chicken with Vegetable	Ready to eat	380.00
24.	Chicken Chilli Onion	Ready to eat	470.00
25.	Chicken Chilli Gravy	Ready to eat	490.00
26.	Masala Chicken Curry	Ready to eat	480.00
27.	Sliced Chicken with Hot Sauce	Ready to eat	525.00
28.	Dies Cut-Chicken with Cashewnut	Ready to eat	625.00
29.	Chicken Chilli Dry	Ready to eat	600.00

As mentioned earlier, AG Foods Limited is another most important and popular meat company in Bangladesh. It is observed that it produces about 18 ready to eat and 18 ready to cook chicken meat products. Product names and prices have been presented in Table 7. Like other companies, it also employs several thousand educated and trained personnel to carry out its business. Most of the meat companies have their own broiler farms or contact farmers for supplying live broiler to these companies. Similar to other companies, Quality Foods Limited produces about 30 ready to eat and 15 ready to cook chicken meat products (Table 8). Most of the people who are very busy at work especially in cities prefer these meat products since make these products consumable to them needs less time and money. Businesses run by these companies are sustainable as they generate handsome money to them. Quality Foods Limited also produces processed chicken meats in the form of dressing and cut into pieces to attract different buyers or consumers (Table 9).

Table 7: Chicken meat Products and their prices of AG Foods Limited

Serial no.	Ready to eat products	Price (BDT)	Product in no.	Serial no.	Ready to cook products	Amount(g)	Price (BDT)
1.	French Fries (per serving)	50.00		1.	Chicken Nuggets (Spicy)	250	170.00
2.	Spicy Chicken	50.00	1	2.	Chicken Nuggets (kids)	250	170.00
3.	Chicken Crispy (drumstick)	60.00	1	3.	Chicken Sausages	340	220.00
4.	Chicken Crispy (wings)	60.00	1	4.	Chicken Drumstick	500	320.00
5.	Chicken Crispy Breast (smart)	65.00	1	5.	Chicken Meat Ball (spicy)	250	165.00
6.	Chicken Crispy (thigh)	90.00	1	6.	Chicken Samosa	250	155.00
7.	Chicken Crispy Breast (mega)	115.00	1	7.	Chicken Samosa Jumbo	400	200.00
8.	Chicken Kabab	35.00	1	8.	Chicken Cutlet	200	165.00
9.	Chicken Nuggets (spicy/kids)	50.00	4	9.	Chicken Spring Roll	250	155.00
10.	Chicken Meat Ball (spicy)	25.00	4	10.	Chicken Popcorn	250	180.00
11.	Chicken Sausage	25.00	1	11.	Chicken Hot Wings	500	290.00
12.	Chicken Bologna	40.00	1	12.	Chicken Strips	250	210.00
13.	Hot Wings	75.00	4	13.	Chicken Burger Patty	200	160.00
14.	Chicken Chap	45.00	1	14.	Chicken Singara	300	90.00
15.	Mini Chicken Samosa	25.00	4	15.	Chicken Shami Kebab	250	230.00
16.	Mini Chicken Singara	25.00	4	16.	Giblet Singara	300	95.00
17.	Chicken Spring Roll	25.00	4	17.	Chicken Spring Roll Jumbo	400	230.00
18.	Giblet Singara	25.00	3	18.	French Fries	500	160.00

Table 8: Chicken meat Products and their prices of Quality Foods Limited

Serial no	Ready to eat products	Price (BDT)	Product in no.	Serial no	Ready to cook products	Price (BDT)	Amount(g)
1.	BBQ Burger	130.00	1	1.	Chicken Nuggets	180.00	250
2.	Crispy Burger	130.00	1	2.	Chicken Sausage	210.00	350
3.	Grill Burger	130.00	1	3.	Chicken Samosa	155.00	250
4.	BBQ Burger (Mini)	65.00	1	4.	Chicken Spring Roll	155.00	250
5.	Crispy Burger	65.00	1	5.	Chicken Meat Ball	160.00	250
6.	Grill Burger	65.00	1	6.	Chicken Strips	200.00	250
7.	Chicken Pattie Burger	65.00	1	7.	Chilli Cheese Salami	215.00	200
8.	Chicken Salami Sandwich	35.00	1	8.	Smoked Chicken Salami	200.00	200
9.	Chicken Sandwich	35.00	1	9.	Smoked Sausage	225.00	350
10.	Chicken Club Sandwich	140.00	1	10.	Chicken Nuggets Kids	180.00	250
11.	Sub Sandwich	95.00	1	11.	Chicken Popcorn	190.00	250
12.	Crunchy Sausage	40.00	1	12.	Chicken Burger Patty	195.00	240
13.	Curly Sausage	25.00	1	13.	Italian Chicken Pizza	240.00	2 pcs
14.	Chicken Sausage	25.00	1	14.	Chunky Chicken Pizza	300.00	2 pcs
15.	Chicken Hot Wings	95.00	4	15.	Chicken Crispy Meat Ball	300.00	250
16.	Spicy Chicken	55.00					
17.	Supreme Wings	90.00	4				
18.	Chicken Breast Fry	125.00	1				
19.	Chicken Thigh Fry	95.00	1				
20.	Chicken Leg Fry	65.00	1				
21.	Chicken Wings Fry	65.00	1				
22.	Chicken Shashlik	70.00	1 stick				
23.	Crunchy Pop	45.00	1 stick				
24.	Chicken Strips	80.00	5				
25.	Chicken Lollipop	30.00	1				
26.	Chicken Pop	60.00	10				
27.	Chicken Nuggets	70.00	5				
28.	Chicken Spring Roll	20.00	4				
29.	Chicken Samosa	20.00	4				
30.	Chicken Ball	25.00	1 stick				

Table 9: Processed green chicken meats and their prices of Quality Foods

Serial No.	Portion Name	Amount (kg)	Price (BDT)
01.	Dressed Chicken with Skin	1	250.00
02.	Dressed Chicken without Skin	1	270.00
03.	Chicken Breast with Bone	1	320.00
04.	Chicken Breast Boneless	1	450.00
05.	Chicken Leg with Bone	1	320.00
06.	Chicken Leg Boneless	1	420.00
07.	Chicken Thigh Special Cut	1	320.00
08.	Chicken Thigh Boneless	1	420.00
09.	Chicken Drumstick	1	320.00
10.	Chicken Wings	1	220.00
11.	Chicken Keema	1	450.00

A survey of Chattogram meat market shows a different scenario where Mafco, ATR Food, Country Natural and Jhatpot companies have been operating own meat businesses and super market Swapno is found to produce own chicken meat products (Table 10). Products of all meat companies are available all over the country. However, products of Mafco are available only in Chattogram. Most of the products are ready to cook products. Dhaka division is the most intensive area for chicken meat products consumption. However, other three old divisions like Chattogram, Rajshahi and Khulna are similar in terms of chicken meat products consumption. A χ^2 test suggests that there are significant differences of number of products of various companies available among the divisional markets.

Table 10: Survey on chicken meat products (ready to cook) and their prices in Chattogram markets

Serial No.	Company Name	Product Name	Amount (g)	Price (BDT)
1.		Chicken Wings	500	310.00
2.		Chicken Wonton	12 pcs	160.00
3.		Chicken Meatball	250	175.00
4.	ATR Foods	Chicken Drumstick	500	345.00
5.		Nuggets	250	180.00
6.		Chicken Burger Patty	250	155.00
7.		Chicken Finger	250	175.00
8.		Chicken Samosa	250	155.00
9.	Mafco	Chicken Roll	300	155.00
10.		Chicken Nuggets	250	175.00
11.		Premium C. Samosa	200	153.00
12.	Swapno	Premium C. Spring Roll	200	153.00
13.		Chicken nugget	250	160.00
14.		Chicken Ball	200	150.00
15.		Chicken Spring Roll Double Bites	250	170.00
16.		Chicken Samosa	250	170.00
17.		Chicken Spring Roll	300	190.00
18.		Chicken meat ball	250	180.00
19.		Chicken samosa	300	200.00
20.	Country Natural	Chicken Burger Petty	300	260.00
21.		Chicken Strips Breaded Crispy	250	225.00
22.		Chicken Sausage	300	220.00
23.		Chicken Nugget	250	195.00
24.		Chicken Cutlet	200	165.00
25.		Chicken meat ball	250	180.00
26.		Chicken Sausage	340	240.00
27.		Chicken Nugget	300	200.00
28.		Chicken Strips	250	220.00
29.	Jhatpot	Chicken Momo	300	200.00
30.		Chicken Burger Patty	200	160.00
31.		Chicken Popcorn	150	150.00
32.		Chicken Jali Kabab	300	295.00

Table 11 shows the amount of monthly produced processed chicken products of different companies during 2021 and 2022. It was observed that amount of products produced by different significantly increased in the 2022 compared to the previous year 2021 except for the companies BRAC Chicken and BD Food. Total monthly productions of processed products were respectively 459.12 metric tons and 583.34 metric tons in the year 2021 and 2022. Total amount of products in the year 2022 was 27 percent higher compared to the previous year 2021. Similarly, total market value of all products also increased significantly in the year 2022 compared to the previous year 2021. Total market values of the products were respectively BDT 413.21 million and 525.01 million per month in the year 2021 and 2022. It was observed that value of chicken products was also 27 percent higher in the year 2022 compared to the previous year 2021 at constant price (Table 11).

Table 11: Comparison of processed chicken products for different companies produced per month in the year 2021 and 2022

Company Name	Production(tons/month)		Level of Significance	P-Value
	2021	2022		
Golden Harvest	30.73 (1.07)	60.03 (0.97)	S	0.010
Kazi Food Industries Ltd.	80.68 (1.16)	100.15 (1.57)	S	0.018
Pran	20.37 (1.04)	25.63 (0.64)	S	0.046
AG Food	20.64 (0.24)	25.18 (0.11)	S	0.022
Harvest Rich	9.54 (0.43)	12.36 (0.25)	S	0.047
BRAC Chicken	11.58 (0.40)	12.13 (0.43)	NS	-
Aftab (IG Foods)	10.09	15.85	S	0.047

	(0.62)	(0.17)		
CP Bangladesh	80.34	90.50	S	0.013
	(0.09)	(0.48)		
BD Food	5.20	5.66	NS	-
	(0.52)	(0.33)		
ATR	15.73	20.86	S	0.039
	(0.26)	(0.14)		
Paragon	30.79	35.37	S	0.016
	(0.33)	(0.30)		
Bengal Meat	70	80.61	S	0.022
	(0.65)	(0.32)		
Lamisa	20.10	35.78	S	0.032
	(0.75)	(0.33)		
Others*	53.33	63.23	S	0.040
	(0.78)	(0.17)		
Total production	459.12	583.34	S	0.014
	(0.48)	(0.66)		
Total market value (million BDT/month)	413.21	525.01	S	0.015
	(0.96)	(1.36)		

Figures in the parentheses indicate standard deviations, *Others means they are produced by other companies. Like some restaurants (Chinese, fast food and other) of Dhaka, Chattogram, Khulna and Rajshahi regions, restaurants of Mymensingh produce some local products. Avanti Aroma, CFC and Amigos are important such restaurants which produce own chicken products. Avanti Aroma produces 18 chicken products and CFC is found to produce 23 own chicken products (Table 12). Similarly, Amigos produces 35 own chicken products. Huge trained people are engaged to carry out various business activities (Table 13). These products can be enriched and value added with dietary fiber along with many herbal extracts (Milon et al., 2016; Jamaly et al., 2017; Rahman et al., 2017; Jahan et al., 2018; Siddiqua et al., 2018; Rima et al., 2019; Bithi et al., 2020; Akter et al., 2022; Boby et al., 2022).

Table 12: Chicken products in Avanti Aroma and CFC in Mymensingh town

Chicken products	Price (BDT)	Chicken products	Price (BDT)
Chicken Nugget & Chips	160.00	Chicken Curry	220.00
Chicken Masala	320.00	Fried Rice	
Chicken Curry	320.00	Vegetable Gravy	
Chicken Butter Masala	320.00	Chicken Sizzling Rice	460.00
Chicken Dopiaza	320.00	Maxicana Chicken	210.00
Chicken Tikka Masala	350.00	Fried Rice	270.00
Chicken Tikka Madraz	350.00	Green Salad	
Chicken Biryani	380.00	6 pcs Chicken Strips	
Chicken Tandori	110.00	French Fries	250.00
Chicken Shashlik	120.00	Drink	
Tandoori Wings(6pcs)	200.00	6 pcs Wings	
Chicken Tikka Kabab	200.00		
Chicken Reshmi Kabab	280.00		
Chicken Tangri Kabab	320.00	4 pcs Chicken Fry	40.00
Thai Soup(1:3)	380.00	2 French Fries	
Chicken Corn Soup(1:3)	250.00	2 Drinks	
Khichuri, chicken curry, egg bhuna, pickle, firni	250.00	Chilli Chicken Burger Combo	235.00
		Chicken Fry, French Fries,	290.00
		Drink	
Plain Polao		Super Cheese Burger	320.00
Chicken Tikia		French Fries	
Chicken Butter Masala		Drink	
Sabji Do Piazza	350	French Fries	
Salad		BBQ Pizza	280.00
Firni		BBQ Pizza	450.00
Drink		Chicken Pizza	270.00
		Chicken Pizza	430.00
		Chilli Chicken Rice	210.00
		Chicken Chilli Rice (white)	230.00
		Tanduri Rice	290.00
		Kids First Choice	180.00
		Snack Combo	270.00
		CFC Burger Combo	210.00
		CFC Burger Cheese Combo	240.00
		BBQ Burger Combo	235.00
		Chicken Chowmein	180.00
		Chicken Pasta	190.00

Table 13: Chicken products of Amigos Restaurant in Mymensingh town

Product name	Specific Name	Amount	Price (BDT)
Appetizer	Chicken Wings	6 pcs	180.00
	Chicken Tempura	6 pcs	180.00
	Chicken Wonthon	6 pcs	260.00
Salad Junction	Chicken Vegetable Salad		200.00
	Chicken Cashew Nut Salad		300.00
	Chicken Fuljhuri		250.00
Indian Mughals	Curry	Chicken Karai	200.00
		Chicken Malai Masala	250.00
		Chicken Ginger	255.00

Product name	Specific Name	Amount	Price (BDT)
	Red Chilli Chicken		220.00
	Chicken Kosha		200.00
Kabab-Ruti-Naan	Chicken Boti Kabab	8 pcs	180.00
	Chicken Afghani Kabab	8 pcs	200.00
	Chicken Hariyali Kabab	8 pcs	220.00
	Peshawari Chicken Kabab	8 pcs	220.00
Kabab-Ruti-Naan	Tandoori Chicken (Quarter)		150.00
	Chicken Corn Soup	1 person	90.00
Soup Gallery	Chicken Corn Soup	1:3 person	250.00
Rice & Biryani	Kasmiri Polao with Chicken Roast		300.00
	Chicken Bhuna Khichuri + Fried EggPlant		180.00
	Chicken Panjabi Biryani		160.00
Chinese and Thai	Chicken Chilli Onion	1 person	120.00
	Chicken Chilli Onion	1:3 person	350.00
	Thai Fried Chicken	3 pcs	150.00
	Thai Fried Chicken	6 pcs	280.00
	Chicken Chilli Dry	1 person	150.00
Continental	Chicken Chilli Dry	1:3 person	400.00
	Chicken Grill		495.00
Set Item-01	Fried Rice		
	Fried Chicken 2 pcs		250.00
	Chinese Vegetable		
	Chicken Chilli Onion		
Set Item-02	Soft Drinks-250ml		
	Fried Rice		
	Fried Chicken 2 pcs		250.00
	Chinese Vegetable		
Set Item-03	Beef Chilli Onion		
	Soft Drinks-250ml		
	Fried Rice		
	Fried Chicken 1 pcs		250.00
Set Item-04	Chinese Vegetable		
	Red Chilli Chicken		
	Soft Drinks-250ml		
	Fried Rice		
Set Item-05	Fried Chicken 1 pcs		
	Chinese Vegetable		
	BBQ Chicken 1 pcs		
	Soft Drinks-250ml		250.00
Set Item-06	Chicken Biryani		
	Egg		
	Jali Kabab		250.00
	Salad		
Set Item-06	Soft Drinks-250ml		
	Chicken Vhuna Biryani		
	Egg		
	Achar		
Sizzling	Salad		250.00
	Soft Drinks-250ml		
Sizzling	Chicken Sizzling		300.00

Marketing and value chain analysis of chicken meat products in Bangladesh

Marketing and value chain analysis is essential part of farm business analysis to enhance profitability. Marketing chain is an important aspect to carry out business of any products. There involves various actors or agents in this process like farmer, wholesaler, retailer, restaurant, meat company, super market, fast food shop, departmental outlet and consumer. Farmers are found to sell live chicken to wholesaler, retailer, meat company directly. Some meat companies have contact farmers to supply live chicken to them with fixed price. Wholesalers are found to sell live chicken to restaurant and meat company. However, they are also found to sell dressed whole chicken to fast food shops. Retailers are important actors in the marketing chain and they are found to sell live chicken to restaurant and consumer. Different meat companies produce different meat products and they sell products to fast food shops, super market and restaurant. Many meat companies have departmental shops or outlets, which directly sell chicken products to consumer. Super markets sell chicken products to the consumer. Marketing chain of chicken and chicken meat products is given below (Figure 1). Islam (2003) suggests that modern poultry processing plant, preserving technology and proper marketing channels are needed make the enterprises related to poultry products sustainable.

In case of value chain analysis, it was observed that prices varied widely among different types of products. That is, value is added in every composition and branding of products. However, farmers were found to sell 2 kg of live chicken at BDT 300 to wholesaler or retailer but wholesalers or retailers were found to sell 2 kg of live chicken to meat company at the price of BDT 360 (Figure 2).

Meat companies sell processed chicken meat products whole, cut, ready to cook or ready to eat. As mentioned earlier, prices of these products varied widely among branding, meat companies, restaurants and fast food shops (Figure 2 & 3). Figure 3 shows prices of 1 kg boneless different meat products may vary from BDT 517 to BDT 1800 at company level. These products may vary from BDT 620 to BDT 2160 for per kg of boneless meat at restaurant where they vary BDT 724 to BDT 2520 at fast food

shop level. Consumers are willing to pay even more if are ensured that the chicken meat products are safe and healthy (Saha *et al.*, 2022). Khatun *et al.* (2016) proclaim that ensuring available safe and quality poultry and poultry derived food products to meet consumers demand, value chain actors especially entrepreneur's public private partnership initiative need to come forward to run processed or further processed business to a great extent. Like Bangladesh, in other countries too, chicken sub-sector has been playing a pivotal role in economic growth and rural development (Aslam *et al.*, 2020). It is envisaged that more branded chicken products will come to the markets by the existing and new entrepreneurs. More people will be involved in the marketing and value chain of products.

Conclusions

Chicken is an important enterprise in Bangladesh. About 16 million people are engaged to rear chicken and other poultry, produce, sell, promote chicken products and entertain consumers in hotels, restaurants and fast food shops in the country. Chicken is the most important venture to supply protein to the consumers with cheaper prices. It ensures food security of assetless people in the rural Bangladesh through rearing them. Other about 8 million people working in the marketing and value chain of chicken products have been earning handsome money which increase access to food, which is an important component of food security. Many industry or private limited meat companies have come forward to produce chicken products and have been working in the marketing and value chain of products in the country. The products are palatable, hygienic and safe. There is huge demand for these products in home and abroad. That's why; some meat companies have been exporting these products to foreign countries. People those who are in service in the big cities mostly rely on chicken meat products as these require less time to cook or consume. To keep pace with the increased demand for products, some new sophisticated entrepreneurs and enterprise may be developed in near future. However, rearing of chicken is subjected to several constraints like high price of day old chick (DOC), higher feed and medicine prices, disease attack and low price of live chicken. The above problems can be minimized by governmental interventions like allocation of bank credit with minimum interest rate, supply of subsidized medicine and feed to the farmer. Adoption of good management practices (GMP) may hinder outbreaks of diseases. Sustainable value addition of products and adoption of proper marketing chain may enhance the returns from chicken rearing by farmers. To implement the all business principles and promotions of chicken products will engage more people in the process. However, sustainable supply of chicken products needs sustainable production of live birds. In the poultry sector, broiler chicken, with a current population of 525 million birds, is the most produced and consumed variety. Sonali chicken is a local variety with a relatively high meat content and has been the fastest growing segment in recent years. The local indigenous chicken has the highest consumer preference and hence is also the most expensive. The current egg production in Bangladesh is approximately 15.5 billion per year. Compared to other markets in Asia-Pacific, the poultry sector in Bangladesh is relatively underdeveloped in virtually all steps of the value chain, though what stands out is the absence of a professional downstream segment (slaughtering, further processing and cold chain logistics infrastructure). Modern slaughtering is limited to Dhaka and Chittagong (covering only 2-3% of all broilers consumed in Bangladesh), the remaining birds being slaughtered manually at wet markets. Out of the 525 million broilers annually consumed in Bangladesh, approximately 60% are reared in commercial farms, the remaining in semi-scavenging / traditional rural backyard conditions. In general, broiler farmers in Bangladesh still have a lot to gain in terms of technical performance, in terms of feed conversion, cycle length and mortality ratios amongst others.

References

- Akter R, Hossain MA, Khan M, Rahman MM, Azad MAK, Hashem MA. 2022. Formulation of value added chicken meatballs by addition of Centella leaf (*Centella asiatica*) extracts. *Meat Research*, 2(2): 1-7.
- Ali MS, Rahman MM, Habib M, Kabir MH, Hashem MA, Azad MAK. 2022. Quality of spent hen sausages incorporated with bee honey. *Meat Research*, 2(1): 1-6.
- Aslam HB, Alarcon P, Yaqub T, Iqbal M, Häsler B. 2020. A value chain approach to characterize the chicken sub-sector in Pakistan. *Frontiers in veterinary science*, 3(7): 361. <https://doi.org/10.3389/fvets.2020.00361>
- BBS. 2021. Bangladesh Bureau of Statistics, Year Book of Agricultural Statistics-2021, Ministry of Planning, Government of Bangladesh.
- Bithi MAA, Hossain MA, Rahman SME, Rahman MM, Hashem MA. 2020. Sensory, nutritive, antioxidant and antimicrobial activity of telakucha (*Coccinia cordifolia*) leaves extract in broiler meatballs. *Journal of Meat Science and Technology* 8(2): 23-31.
- Boby F, Hossain MA, Hossain MM, Rahman MM, Azad MAK, Hashem MA. 2021. Effect of long coriander leaf (*Eryngium foetidum*) extract as a natural antioxidant on chicken meatballs during at freezing temperature. *SAARC Journal of Agriculture*, 19(2): 271-283.
- BPICC. 2022. Self Sufficiency in Protein: Poultry Industry in Bangladesh, Bangladesh Poultry Industry Central Council's (BPICC), Business Inspection, February 1, 2022. <https://businessinspection.com.bd/poultry-industry-in-bangladesh/>
- Das A, Hashem MA, Azad MAK, Rahman MM. 2022. Edible oil marination in broiler meat for short term preservation. *Meat Research*, 2(3): 1-10.
- Disha MNA, Hossain MA, Kamal MT, Rahman MM, Hashem MA. 2021. Effect of Different Level of Lemon Extract on Quality and Shelf Life of Chicken Meatballs During Frozen Storage. *SAARC Journal of Agriculture*, 18(2): 139-156.
- DLS. 2019. Livestock Economy at a Glance. 2017-18, Department of Livestock Services, Livestock Economic Division, Dhaka. <http://www.dls.gov.bd/site/page/22b1143b-9323-44f8-bfd8-647087828c9b/Livestock-Economy>
- Farzana N, Habib M, Ali MH, Hashem MA, Ali MS. 2017. Comparison of meat yield and quality characteristics between indigenous chicken and commercial broiler. *Bangladesh Veterinarian*, 34(2): 61-70.
- Hashem MA, Begum M, Hasan MM, Al Noman MA, Islam S, Ali MS. 2022. Effect of sodium alginate on the quality of chicken sausages. *Meat Research*, 2(4): 1-7.
- Hashem MA, Islam T, Hossain MA, Kamal MT, Sun MA, Rahman MM. 2020. Production performance of Jamuna basin lamb under semi-intensive management system in Bangladesh. *Journal of Animal and Veterinary Advances*, 19(11): 150-158.
- Hashem MA, Jun KY, Lee E, Lim S, Choo HYP, Kwon Y. 2008. A rapid and sensitive screening system for human type I collagen with the aim of discovering potent anti-aging or anti-fibrotic compounds. *Molecules and Cells*, 26(6): 625-630.
- Hashem MA, Moniruzzaman M, Akhter S, Hossain MM. 1999. Cattle fattening by rural farmers in different districts of Bangladesh. *Bangladesh Journal of Animal Science*, 28(1-2): 81-88.
- Hashem MA, Touhid MM, Hasan MT, Kamal MT, Islam MM, Azad MAK. 2022. Addition of wheat flour in chicken meatball increases the food value through prompting sensory, physicochemical, biochemical and microbial properties. *Meat Research*, 2(4): 30.
- Hossain MD, Hossain MM, Hashem MA, Bhuiyan KJ. 2016. Organic beef cattle production pattern at Shahjadpur upazilla of Sirajgonj district in Bangladesh. *Bangladesh Journal of Animal Science*, 45(1): 25-30.
- Hossain MS, Rokib M, Habib M, Kabir MH, Hashem MA, Azad MAK, Rahman MM, Ali MS. 2021. Quality of spent hen sausages incorporated with fresh ginger extract. *Meat Research*, 1(1): 1-6.

- 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, F., Hossain, M.A., Rahman, M.F., Hashem, M.A., Rahman, M. and Azad, M.A.K. (2018) Effect of synthetic or herbal preservatives on the quality of beef meatballs at different shelf life periods. *SAARC Journal of Agriculture*, 16(1): 23-34.
- Islam MA. 2003. Poultry Products Processing and Marketing System in Bangladesh. *Pakistan Journal of Biological Sciences*, 6(10): 883-886.
- Jahan I, Haque MA, Hashem MA, Rima FJ, Akhter S, Hossain MA. 2018. Formulation of value added beef meatballs with pomegranate (*Punica granatum*) extract as a source of natural antioxidant. *Journal of Meat Science and Technology*, 6(1): 12-18.
- Jamaly SI, Hashem MA, Akhter S, Hossain MA. 2017. Wheat flour as dietary fiber on fresh and preserved beef meatballs. *Bangladesh Journal of Animal Science*, 46(1): 35-43.
- Khatun R, Ahmed S, Hasan MA, Islam MS, AS Uddin, ASMA, Mahmud MS. 2016. Value Chain Analysis of Processed Poultry Products (Egg and Meat) in Some Selected Areas of Bangladesh. *American Journal of Rural Development*, 4(3): 65-70.
- Milon M, Kabir MH, Hossain MA, Rahman M, Azad MAK, Hashem MA. 2016. Value added beef meatballs using turmeric (*Curcuma longa*) powder as a source of natural antioxidant. *International Journal of Natural and Social Sciences*, 3(4): 52-61.
- Moniruzzaman M, Hashem MA, Akhter S, Hossain MM. 2002. Effect of feeding systems on feed intake, eating behavior, growth, reproductive performance and parasitic infestation of Black Bengal goat. *Asian-Australasian Journal of Animal Sciences*, 15(10): 1453-1457.
- Murshed HM, Sarker MAH, Rahman SME, Hashem MA. 2014. Comparison of carcass and meat quality of Black Bengal goat and Indigenous sheep of Bangladesh. *Journal of Meat Science and Technology*, 2(3): 63-67.
- Nasrin S, Kabir MH, Hossain MA, Hossain MM, Hashem MA. 2016. Formulation of value added beef meatballs using bottle gourd (*Lagenaria siceraria*) leaf extracts and wheat flour. *International Journal of Applied Research*, 2(3): 164-171.
- NEA. 2020. Poultry sector study Bangladesh, Netherlands Enterprise Agency, Embassy of the Kingdom of the Netherlands in Bangladesh. <https://www.rvo.nl/sites/default/files/2020/12/Poultry%20sector%20study%20Bangladesh.pdf>.
- Rahman MM, Hashem MA, Azad MAK, Choudhury MSH, Bhuiyan MKJ. 2023. Techniques of meat preservation-A review. *Meat Research*, 3(3): 1-12.
- Rahman M, Kabir MH, Hossain MA, Milon M, Hossain MM, Hashem MA. 2017. Effect of kalogira (*Nigella sativa*) and BHA (beta hydroxyl anisole) on quality control and shelf-life of beef meatballs. *International Journal of Natural and Social Sciences*, 4(1): 85-94.
- Rahman MM, 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(1): 1-9.
- Rahman MS, Jang DH, Yu CJ. 2017. Poultry industry of Bangladesh: entering a new phase. *Korean Journal of Agricultural Science*, 44(2): 272-282.
- 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(1): 149-159.
- Saha SM, Prodhhan MMH, Rahman MS, Haque AM, Iffah K, Khan MA. 2022. Willingness to pay for safe chicken meat in Bangladesh: a contingent valuation approach. *Journal of Food Quality*, 2022(1): 3262245. <https://doi.org/10.1155/2022/3262245>
- Sarker AK, Amin MR, Hossain MA, Ali MS, Hashem MA. 2017. Present status of organic sheep production in Ramgoti Upazila of Lakshmipur district. *Journal of Environmental Science and Natural Resources*, 10(2): 95-103.
- Siddiqua T, Hossain MA, Khan M, Hashem MA. 2018. Formulation of value added beef meatball using tulsi (*Ocimum sanctum*) leaf extract as a source of natural antioxidant. *Journal of Bangladesh Agricultural University*, 16(2): 260-265.
- Sultana N, Islam R, Bhakta S, John AS, Sinza SI, Hashem MA. 2023. Role of Clove and Tulsi on broiler health and meat production. *Saudi Journal of Biological Sciences*, 30(6): 103654.
- Torun MMR, Khan MMH, Rahman MM, Sadakuzzaman M, Hashem MA. 2023. Influence of degree of doneness on the sensory, physiochemical, nutri-tional, and microbial properties of beef. *Meat Research*, 3(5): 1-9. <https://doi.org/10.55002/mr.3.5.69>
- Tushar ZH, Rahman MM, Hashem MA. 2023. Metmyoglobin reducing activity and meat color: A review. *Meat Research*, 3(5): 1-8. <https://doi.org/10.55002/mr.3.5.67>