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Quality assessment of meat products available in different companies in Bangladesh

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***Abstract*:**
Background: *Meat and meat products are important foods with essential nutritional components such as essential amino acids, fatty acids, vitamins, and minerals that form a significant component of the normal physiological and biochemical processes. The microbiological quality of meat and meat products can be judged by the hygienic quality. Raw meat and other meat products can act as vehicles of various hazards that may have serious impact on human health. There are various types of hazards, which may be chemical, biological or physical. From safety viewpoint, refrigerated meat and meat products have been linked to outbreaks of pathogenic bacteria like Escherichia coli O157:H7 and Salmonella, and many others, thus, consumers may be exposed to food borne illness through unsafe preparation of such products. Therefore, the study investigated the chemical composition and microbial load in processed meat products available in different companies in Bangladesh.*
Materials and Methods: *Different meat products of Kazi farms kitchen, Bengal meat, and Paragon were purchased from the local market and characterized according to their production process. The chemical composition of meat products was analyzed by AOAC method in the laboratory. The number of pathogenic bacteria i.e. E. coli and Salmonella presents in the meat products were counted in the laboratory using EMB and SS agar.*
Results: *The CP, EE and CF percentages of meat products of Kazi farm, Bengal meat, and Paragon company were similar according to the companies recommended level and these meat products are good source of protein. The high CP percentage was present in chicken nuggets (33.0%), chicken lollipop (33.0%) of Kazi farms kitchen and chicken shami kabab (43.0%) of paragon company. The highest EE is present in Bengal meat fried chicken (60.0%) and chicken shami kabab (35.0%) in the Paragon company. In microbiological study, no growth of E. coli and Salmonella was found in most of the samples.*
Conclusion: *The study suggested that Kazi farms, Bengal meat and Paragon companies' meat products are the good source of nutrients and consumer should follow the companies' instructions for storage and cooking to avoid contamination.*
Keyword*: Quality, assessment, meat products, different companies, safety issue*

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I. Introduction

Meat and meat products are concentrated sources of high-quality protein and their amino acid composition usually compensates for shortcomings in the staple food. Meat is well known as an excellent protein and energy source for our daily diets and after digestion, provides excellent nutrition (Chang & Huang, 1991). They supply easily absorbed iron and assist the absorption of iron from other foods as well as zinc and are rich sources of some of the vitamins in the B group. By providing such nutrients, meat consumption can alleviate common nutritional deficiencies. Meat often protects against malnutrition and improves child cognitive development. In most countries, meat consumption increases as economic development improves (Fuller, 1996). Meat can be obtained from camel, cattle, buffaloes, goat, pig, sheep, besides poultry and fishes. Meat and meat products play a vital role in the maintenance of human health by providing all essential nutrients such as protein, vitamins, and minerals. It is relevant to mention that about 30% of zinc in our diet comes from meat and meat products. In this framework, Bradeeba & Sivakumaar (2013) reported that protein and vitamins (especially A and B_{12}) in meat cannot be substituted by plant sources. Today, a large population of the world depends on meat and meat products as a source of food (Pal, 2014).

Meat and meat products can act as an important vehicle for many microbes, which can either cause spoilage or food poisoning. Microbial spoilage of food can result from the failure or inability to control organisms at one or more stages of food production. Therefore, microbiological testing at various stages of food production is significant to reveal and understand the characteristic trends in the distribution of microbiological contamination (ICMSF, 2011). Meat and meat products are highly perishable commodities and hence, they should be properly stored, processed, packed, and distributed in order to prevent microbial growth (Heetun *et al.*, 2015). Pathogens, such as *Aeromonas hydrophila, Bacillus cereus, Campylobacter jejuni, Clostridium perfringens, Escherichia coli, Listeria monocytogenese, Salmonella* spp., *Staphylococcus aureus and Yersinia enterocolitica* can also grow and cause illness either by multiplication in the human body (food infection), producing toxins (food intoxication) or multiplying and releasing toxins in the body (food toxico-infection). The presence of pathogens in the food supply is considered to be undesirable as they are the major cause of gastrointestinal disease throughout the world. It has been mentioned that hazards such as bacteria, fungi, allergens, chemicals, and foreign matter can be present in meat products (Ismail *et al*., 2013). Major bacterial pathogens found in meat include *Bacillus cereus, Clostridium botulinum, Clostridium perfringens, Salmonella*, *Escherichia coli,* and *Staphylococcus aureus* (Hobbs & Roberts, 1993). Therefore, it is very necessary to assess the microbial load of the food by employing standard microbiological techniques (Kozaèinski *et al.,* 2006). The consumer needs to be provided with safe and wholesome meat, which will not cause any health problems.

Meat processing in industrial plants is a very recent addition to the food processing industry in Bangladesh. They process meat into beef sausages, beef bacon, beef chilli salami, beef ham, beef italian sausage, chicken sausages etc. Nevertheless, it is important to save meat products from harmful bacteria or other microorganisms. It is also imperative to know the chemical composition of the meat products available in Bangladesh in respect of a nutritional standpoint. Therefore, there is significant interest to examine the chemical composition and microbial quality of meat products in Bangladesh. So, the objectives of this study are to observe the chemical composition and the microbial load in Bangladeshi processed meat products.

II. Materials and Methods

Location of the experiment:

The research project was conducted at the Animal Nutrition, Genetics and Breeding laboratory of Sher-e-Bangla Agricultural University, Dhaka.

Collection and characterization of meat products available in market of Bangladesh

There are many meat products producing companies available in Bangladesh such as Bengal meat, Kazi farms kitchen, CP Bangladesh, Brac, Golden harvest, Jhatpot, etc. The meat products from the different companies were purchased from the local market and categorized according to their production process.

Determination of chemical composition of different processed meat products

The chemical composition (protein, fat, and fibre) of processed meat products from Kazi farms, Bengal meat, and Paragon was determined according to the methodology provided by the AOAC method.

Microbial analysis of meat products

The samples were collected from the core of the meat products randomly from different packets of each meat product. EMB (eosin methylene blue) and SS (*Salmonella shigella*) agar were purchased from the local market (HIMEDIA company) in Bangladesh. The sample of each product was diluted and EMB and SS agar were used to culture the *E. coli* and Salmonella bacteria respectively. Then, the Petri dishes were sent to the bacterial growth chamber for 24 hours at 37^0C. The population of bacteria in each agar was estimated as CFU g-1 (colony-forming unit).

Data collection:

After each experiment data will be collected and recorded. Data were collected and recorded for the CP, EE, and fibre of the different meat products and the microbial count of the different meat products.

Statistical analysis:

Total data were compiled, tabulated, and analyzed by the objectives of the study. Excel analysis by applying one-way ANOVA using Statistical Package for Social Sciences (SPSS version 16.0). Differences between means were tested using Duncan's multiple comparison test, LSD, and significance was set at $P<0.05$.

III. Results and Discussion

Selection of meat products available in local market:

There are many meat products available in different companies in Bangladesh such as Bengal meat, Kazi farms kitchen, CP Bangladesh, Paragon, Golden harvest, Jhatpot, etc. In this study, we analyzed the Kazi farm's kitchen, Bengal meat, and Paragon companies' meat products which is presented in Table 1. Foods are important and suitable mediums for the human being to carry the essential nutrients that may develop their health. Animal meat is of high biological value and a good source of proteins in many countries. Meat and meat

products are ideal sources of soluble minerals, vitamins, essential fats, amino acids and many other nutrients having a specific function to the body (Biesalski, 2005). Meat and meat products is a good source of omega-3 fatty acids, proteins, vitamin B_{12} and high level of iron (Bender, 1992). There is a growing demand for healthier meat and meat products containing low levels of fat, cholesterol, reduced content of sodium chloride and nitrite, efficient fatty acid profile composition and added health-enhancing ingredients among consumers worldwide. Recently, there is an increasing concern about health-oriented functional meat products as a result of downsides incorporated with muscle foods and its related health hazards. In India, approximately, 12,000 tons of frozen products are produced and consumed annually. Nowadays, large population of the world depends on meat and meat products as a source of food (Pal, 2014).

Chemical composition of different meat products in Bangladesh:

The protein, fat and fiber percentage of different meat products in three companies were analyzed in the laboratory by AOAC method (Table 2). The CP, EE and CF percentage of meat products of Kazi farms, Bengal meat and Paragon company was similar according to the companies recommended level. The high protein percentage was found in chicken nuggets (33.00%), chicken lollipop (33.00%) of Kazi farms kitchen and chicken shami kabab (43.00%) of Paragon Company. The highest EE is present in Bengal meat fried chicken (60.00%) and chicken shami kabab (35.00%) in Paragon company. Similarly, the highest CF content found in chicken shami kabab (3.00%) in Paragon company. The standard parameter was fixed for chicken sausage in Brazil stating that fresh-type sausages should have 70.00% maximum moisture content, 30.00% maximum fat content, and 12.00% minimum protein content (Demeyer et al., 2008). Sausage may contain up to 30.00% fat which the maximum amount is allowed by Jordanian standards specifications, fat provides sausage with flavor, texture and juiciness and its role in meat emulsion. Dharmaveer et al. (2007) reported 18.36% protein in sausages. Quasem et al. (2009) also reported 12.76% protein in Jordan sausage. The plant-based derivatives like fruits, nuts, vegetables, herbs, and spices are mainly used now a day for the production of modified and healthier meat products with improved shelf life. Dietary fibers and antioxidants addition are the most approaching step in the development of novel

Table 1: Meat products studied in Kazi farms, Bengal meat and Paragon companies

Company name	Meat products
Kazifarms kitchen	Chicken strips
	Chicken meatballs
	Chicken popcorn
	Chicken teasers
	Chicken nuggets
	Chicken cutlets
	Chicken lollipop
	Beef sausages
Bengal meat	Kids nuggets
	Chicken drumstick
	Chicken cutlet
	Chicken pops
	Chicken lollipop
	Chicken finger
	Fried chicken
	Beef sausages
Paragon	Chicken popcorn
	Chicken ball
	Chicken lollipop
	Chicken nuggets
	Chicken shami kabab
	Beef sausages

Table 2: Chemical composition of meat products in different companies

Meat products	Company name	Chemical composition (%)		
		CP	EE	CF
Chicken strips	Kazifarms kitchen	24.5	2.00	0.07
Chicken meatballs		28.5	7.0	1.0
Chicken teasers		14.0	3.6	0.9
Chicken nuggets		33.0	6.0	0.9
Chicken cutlets		12.5	2.5	1.0
Chicken lollipop		33.0	6.1	0.9
Kids nuggets	Bengal meat	17.0	8.0	0.5
Chicken drumstick		16.0	7.5	1.0
Chicken cutlet		17.0	10.0	1.0
Chicken pops		20.0	3.5	0.7
Chicken lollipop		18.0	10.0	1.0
Chicken finger		20.0	3.0	0.7
Fried chicken		13.5	60.0	1.0
Beef sausages		15.0	10.0	0.14
Chicken popcorn	Paragon	16.0	2.5	1.0
Chicken ball		32.0	6.0	1.0
Chicken lollipop		18.5	3.2	1.1
Chicken nuggets		18.3	2.5	1.0
Chicken shami kabab		43.0	35.0	3.0
Beef sausages		7.0	14.5	0.2

meat products. The fiber incorporation is on demand because of its technological use and benefits to human health (Vendrell-Pascuas et al., 2000). The chemical composition of meat is affected by many factors such as age, species, and feeds (Tariq et al., 2013; Madruga et al., 2006) Amongst the fermented foods, meat and meat products play a very important role in human nutrition (Ahmad and Srivastava, 2007). Being highly perishable, their storage and marketing demand a considerable amount of energy input in the form of refrigeration and freezing, which are costly and scarce in countries of South Asia (Ahmad and Srivastava, 2007; Venugopal, 2005). Food nutritionist and technologist are targeting to develop functional meat products with great efforts that possess natural antioxidants and antimicrobials, low fat, lesser sodium content, enriched with dietary fibres and ω-3 and ω -6 fatty acids (Hygreeva et al., 2014). The dietary fiber in meat products is mainly considered clinically better as compared to that of traditional meat products (Mehta et al., 2015). Therefore, meat and meat products are concentrated sources of high-quality protein and their amino acid composition usually compensates for shortcomings in the staple food.

Microbiological assessment of meat products:

The number of *E. coli* and Salmonella in the meat products of different companies was counted and the data has presented in Table 3. There were few numbers of Salmonella was found in the sample of Kazi farms chicken nuggets, Bengal meat chicken lollipop and Paragon's beef sausages, but the number is not significant. In the other meat products of different companies, no Salmonella was growth. The reasons Salmonella growth of some meat products that possible contamination from the outside during sampling of the meat products storage temperature and conditions was not maintained. In case of *E. coli* count, Kazifarms kitchen chicken popcorn & lollipop, Bengal meat chicken meatballs & lollipop and Paragons chicken meatballs, popcorn & beef sausages but the number is not significant. In the other meat products of different companies, no *E. coli* growth was found. The most often identified bacterial pathogens linked with consumption of beef products are *Salmonella* spp., *Bacillus cereus*, *Campylobacter* spp., *Clostridium perfringens*, *Staphylococcus aureus*, *Escherichia coli*, *Listeria monocytogenes*, *Staphylococcus aureus*, *Yersinia enterocolitica* and *Vibrio parahaemolyticus* (Biswas et al., 2011). Pathogens such as *B. cereus*, *C. jejuni*, *E. coli*, *L. monocytogenses*, *S. aureus*, *Y. enterocolitica* are known to produce food-borne infections and intoxications in humans (Elmal and Yaman 2005; Tachbele et al., 2006). Microbial quality of meat and meat products can be assessed by total viable

counts (total aerobic counts), coliform counts, psychotropic counts, anaerobic counts, yeast and mould counts, and specific pathogen counts such as *E. coli* 0157:H7; *S. aureus*, *L. monocytogenes*, *Salmonella*, *Y. enterocolitica* (Stagnitta et al., 2006; Selvan et al., 2007; Collins and Thato, 2011; Pal, 2012; Ismail et al., 2013; Thomas et al., 2015). The consumer needs to be provided with safe and wholesome meat, which will not cause any health problem. The reasons of *E. coli* growth of some meat products that possible contamination from the outside during sampling of the meat products or storage temperature and conditions was not maintained. Biological hazards are of concern because the microorganisms or pathogens are found naturally in the environment or even on live animals (Sofos, 2014). Therefore, the occurrence of pathogens on raw meat can be due to different factors, which include poor farm animal management, improper slaughter practices processing, storage conditions and lack of meat safety knowledge among meat handlers (Marais et al., 2007). The consumer needs to be provided with safe and wholesome meat, which will not cause any health problem. This can be achieved by practicing better farm animal management, good personal hygiene and providing adequate knowledge on food safety to all the meat handlers in the production chain (Haileselassie et al., 2013; Sofos, 2014). Meat is nutrient-rich food, but also they are highly perishable due to they provide the nutrients needed for multiplication and growth of many microorganisms (Kalalou et al., 2004). Moreover, meat and meat products should be properly stored with recommended temperature and maintained the companies cooking instructions.

Table 3. Growth of Salmonella collected from different companies in Bangladesh

Sl	Kazifarms kitchen					Bengal meat					Paragon				
no.	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	+	-	-	-	+	-	-	-	-	-	+
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- = No growth, + = Growth
A= Chicken meatballs, B= Chicken popcorn, C= Chicken nuggets, D= Chicken Lollipop, E= Beef sausages

Table 4. Growth of *E. coli* collected from different companies in Bangladesh

Sl	Kazifarms kitchen					Bengal meat					Paragon				
no.	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
4	-	-	-	+	-	-	-	-	-	-	-	+	-	-	+
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-
7	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- = No growth, + = Growth
A= Chicken meatballs, B= Chicken popcorn, C= Chicken nuggets, D= Chicken Lollipop, E= Beef sausages

V. Conclusion

The present study was conducted to investigate the chemical composition and microbial load in processed meat products available in different companies of Bangladesh. From this study it could be concluded that there are various meat products available from different companies of Bangladesh. The chemical composition of meat products from Kazi farms, Bengal meat and Paragon companies are almost similar to companies recommended level. These meat products are good source of protein and no significant *E. coli* and Salmonella bacteria was found. Therefore, Kazi farms, Bengal meat and Paragon companies' meat products can be consumed as nutritious food and should follow the companies' instructions for storage and cooking.

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