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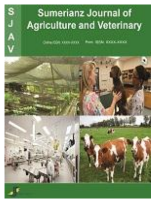

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The Physical, Chemical, Organoleptic and Microbiological Quality of Meat and Meat Products: A Case Study in Gazipur district

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Abstract

Meat is one of the most significant foods in the diet of the vast majority of individuals. The aim of this study was to determine the physical, chemical, organoleptic and microbiological quality of meatand meat products produced by aprivate enterprise in Gazipur District. For convenience, the samples of meat were randomly collected from the enterprise. All the samples were subjected to physical and chemical quality tests consisted of temperature test, acidity (pH) test, water activity (Aw) test, total ash contents test and formalin test. For microbiological quality determination, standard plate count (SPC) and coliform count were performed while for organoleptic tests; odor, color, texture, appearance tests were conducted. In addition, the water used in the meat plant was subjected to organoleptic, physical and chemical quality tests: Odor, color, appearance,pH test, TDS test, iron test and hardness test. The results of temperature test, acidity (pH) test, water activity (Aw) test, total ash contents test, formalin test were -3 °C, 7.6, 0.75, 0.7, nil, respectively.Standard plate count (SPC) and coliform count tests showed the result less than 30 cfu/ml, < 10 cfu/ml, respectively. Organoleptic tests results highlighting odor, color, texture and appearance were, as a whole, satisfactory. The quality parameters of the water used in the meat plant wereacceptable: p^H test-6.6, TDS test-60ppm, iron test-0.1 and hardness test-45.Considering all the parameters, it can be concluded that the meat and meat products were of good quality and safe enough for the consumers. The overall results of the study suggest that the meat industry could be a promising in Bangladesh if the meat plants maintain such good enough hygienic condition.

Keywords: Physical; Chemical; Microbiological quality; Organoleptic; Meat.

1. Introduction

Meat is animal flesh that is eaten as food. Humans have hunted and killed animals for meat since prehistoric times. The advent of civilization allowed the domestication of animals such as chickens, sheep, pigs and cattle. This eventually led to their use in meat production on an industrial scale with the aid of slaughterhouses [1]. The word meat comes from the Old English word mete, which referred to food in general. The term is related to mad in Danish, mat in Swedish and Norwegian, and mature in Icelandic and Faroese, which also mean 'food'. The word mete also exists in Old Frisian (and to a lesser extent, modern West Frisian) to denote important food differentiating it from swiets (sweets) and dierfied (animal feed) [2].

Paleontological evidence suggests that meat constituted a substantial proportion of the diet of even the earliest humans. Early hunter-gatherers depended on the organized hunting of large animals such as bison and deer.The domestication of animals, of which we have evidence dating back to the end of the last glacial period (10,000 BCE),allowed the systematic production of meat and the breeding of animals with a view to improving meat production. The animals which are now the principal sources of meat were domesticated in conjunction with the development of early civilizations [3].

Table-1. Basic composition of meat [4]

Type	Percentage
Moisture	60-70%
protein	10-20%
Fat	2-22%
Ash	1%

Meat is mainly composed of water, protein and fat. It is edible raw, but is normally eaten after it has been cooked and seasoned or processed in a variety of ways. Unprocessed meat will spoil or rot within hours or days as a

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result of infection with and decomposition by bacteria and fungi. Most often, meat refers to skeletal muscle and associated fat and other tissues, but it may also describe other edible tissues such as offal. Meat is sometimes also used in a more restrictive sense to mean the flesh of mammalian species (pigs, cattle, lambs etc.) raised and prepared for human consumption, to the exclusion of fish, other seafood, poultry, or other animals [3-5].

Figure-1. Chicken and beef meat

Table-2. Composition of meat (chicken) [5]

Nutrient	Skinless, boneless breast	Skin-on, Bone-in breast	Drumstick, Skinless	Drum stick, skin on	Thigh skin less	Thigh skin-on	wing skin on	Wing without skin	whole chicken, meat only	Whole chicken meat and skin
Calories	114	172	119	101	119	211	222	126	119	215
Protein (garms)	21.2	20.8	20.6	19.3	19.7	17.3	18.3	22	21.4	18.7
Total fat (garms)	2.6	9.3	3.4	8.7	3.9	15.3	16	35	3.1	15.1
Saturated fat	0.6	2.7	0.9	2.4	1	4.3	4.5	0.9	0.8	4.3
Monosaturaed fat	0.8	3.8	1.1	3.4	1.2	6.3	0.4	0.8	0.9	0.2
Polyunsaturated fat (germs)	0.4	2	0.8	1.9	1	3.3	3.4	0.8	0.8	3.2
Cholesterol (mili grams)	0.4	0.4	77	81	83	84	77	57	70	75
Sodium (mili gram)	116	63	88	83	86	76	73	81	77	75
Iron (mili gram)	0.4	0.7	1	1	1	1	0.9	0.9	0.9	0.9

Here in this case study, physical, chemical, organoleptic and microbiological quality of meat and meat products were tested in a meat industry plant of Gazipur District, Bamgladesh.

2. Materials and Methods

2.1. Organoleptic Test

The organoleptic test permits rapid segregation of poor quality meat at the meat receiving platform. No equipment is required, but the meat grader must have good sense of sight, smell and taste. The result of the test is obtained instantly and the cost of the test is low. Meat which cannot be adequately judged organoleptically must be subjected to other more sensitive and objective tests.

2.1.1. Procedure

Meat, meat products and water were taken in tray and in test tube, respectively. Immediately meat, meat products and water were smelt, followed by observance of the color of meat, meat product and water. Then they were touched. Finally, appearance of the meat, meat products and water was observed.

2.2. Physical and Chemical Test

2.2.1. Physical Test Method for Water

Several tests of water were conducted: PH test, TDS test, iron test and hardness test. In this industry most of the tests are normally done by the test kit.

2.2.1.1. p^H Test for Water

Equipements: Buffer solution, p^H meter, beaker.

Procedure: At first, electrode of the p^H meter was washed with distilled water, then measure the sample water p^H as per standard protocol. p^H value was recorded when it showed a stable reading

2.2.1.2. TDS Test for Water

TDS of water was measured by TDS meter.

Equipment: Beaker, TDS meter.

2.2.2. Procedure

The TDS meter was washed with distilled water and the reading was recorded while it showed a stable reading.

2.2.2.1. Iron Test for Water

Iron test is done by iron test kit.

Equipment: Iron test kit, beaker.

Procedure: Plastic vessels were washed by distilled water, then 10ml water was taken and mixed with 1packet of reagent HI.3834-0, replacing the cap and mixing solution until solids dissolve. The cap was removed and the solution was transferred into the color comparator cube, observed for 4minutes. Finally, determined which color matches the solution in the cube and record the result 05 mg/L(ppm)iron.

2.2.2.2. Water Hardness Test

Equipment: Hardness test kit, Beaker, Burrate, pipette, conical flask.

Reagent: EDTA, phenolphthalein indicator.

Procedure: Five ml of water was taken into a beaker, followed by addition of 5 drops buffer & 1drop of phenolphthalein. Mixing the solution produced red violet color. Then EDTA was added drop by drop and the color was turned into purple color from red violet color. The reading was taken when it showed a stable color.

2.3. Physical Test Methods for Meat Processing

Important parameters for physical test methods for meat processing were- temperature test, acidity (pH) test, water activity (a_W) test, total ash content test, formalin test. Other physical parameters were light intensity and mechanical testing for texture. All routine physical testing are normally carried out with portable instruments.The test of Bird flu, antibiotic, pesticide & heavy metal testsgenerally are not done in many meat processing plants because meat is collected from those suppliers who perform the tests like Bird flu, antibiotic, pesticide & heavy metal in their own laboratory before meat supply.

2.3.1. Temperature Test for Meat

Equipment: Electronic thermometer

Procedure: To determine the inner temperature of meat and meat products, the electronic thermometer was pushed into the meat sample & meat products sample.The one welding point of the thermocouple of the reference temperature and other welding point showed the current temperature in the inside of meat.

2.3.2. Acidity (p^H) test for Meat

Equipment: p^H meter, beaker.

Procedure: P^H meter was calibrated first, then electrode was washed with distil water followed by pushing the pH meter into the sample meat. Then the reading was observed when the PH meter showed a stable reading.

2.4. Water Activity Test for Meat

Equipment: a_W meter

2.4.1. Procedure

A test tube was filled with 100gm of meat and a_W meter was given into the meat sample. The reading was observed.

2.5. Test of Total Ash Content in Meat

Equipment: Crucible, muffle furnace

Procedure: The defatted sample was placed in a constant weight porcelain cruciblewith cover.The crucible was then placed in a muffle furnace, and at a temperature of 600°C the sample was ignited for two hours. After ignition the crucible was placed in the oven to bring down the temperature for about 30 minutes, then cool in a dessicator for another 30 minutes. The sample was then weighed.

3. Test for Formalin Addition

3.1. Apparatus

Formalin test kit was used to determine formalin in meat.

3.2. Procedure

The vial or tube was rinsed with water sample and was filled it with 2ml.syringe. Then 15 drops of 1ml.RAEL "PG" Solution was added, followed by addition of 15 drops of 1ml. Of RAEL "CH" acidic reagent. Finally it was swirled and mixed.In a few minutes, a white precipitate was formed which rapidly turned Pink and then red if formalin present.

4. Microbiological Test

4.1. SPC (Standard Plate Count)

SPC is a common microbiological teat used in company for monitoring quality of individual feed ingredients, as well as complete diets.SPC indicates the number of bacterial colonies growing on a non-specific solid nutrient agar (medium) after a given period of incubation.This count can sometimes be used to indicate the microbiological quality and spoilage level of the feed or ingredient in question. Selective testing for pathogens, is costly, time consuming and risky.SPC is generally a cheaper and quicker test.

4.2. Procedure

A sample of product was blended in an appropriate solution and aliquots of the suspension, after dilution as necessary, were applied to the medium. The inoculated plate was incubated under required condition and after a specified time, the number of visible colonies was counted. The results were typically expressed as colony forming units (C.F.U)/g or/ ml.

5. Pour Plate Method

5.1. Procedure

Sample meat was taken and washed it with water and then the water was taken for test.One ml of meat washed water was delivered to 9ml sterile saline tube (10^{-1}),mixed and transferred 1ml diluted water from tube 1to tube 2 (10^{-2}), similarly to tube 3(10^{-3}), and accordingly to tube 4(10^{-4}) and to tube 5(10^{-5}). One ml meat wash water was delivered to an empty Petri dish from each tube. Nine ml nutrient agar was poured to each Petri dish, mixed well. It was left to solidify and incubate at 37C for 48hrs.Number of colonies was counted and multiplied by dilution factor to determine the number.

6. Coliform Count

6.1. Procedure

A solid medium violet Red Bile Agar was used. Sample was poured into Petri dish by using micro pipette.After incubation at 40 C for 22-24 hours, the red colonies typical for coliform were counted and expressed as the number per ml of meat water.

7. Result and Discussion

Meat, a food source of animal protein, is the most widely consumed by the common people worldwide [6]. Foods, with special reference to, meat and meat products, excessively contaminated with pathogenic and spoilage micro-organism are undesirable and can cause food borne illnesses. As a result, it has been one of the major challenges and concerns for producers, consumers and public health officials to ensure safe and healthy food supply worldwide[7].

The quality of meat as purchased by consumers depends mostly on- the slaughter process, sanitation during processing and packaging, maintenance of adequate cold chain storage from theprocessing to the retail level and to the consumer and finally sanitation during handling at the retailend. Microorganisms from the environment, equipment and operators hands can contaminate meat [8-10].

This paper discusses the results of a study, as presented below, on the assessment of the physical, chemical, organoleptic and microbiological quality of meat and meat products, conducted at a meat industry plant, which aimed to supply the quality meat and meat products.

7.1. Organoleptic Test

Table-3. Result of Organoleptic Test of Meat

Tasting Parameter	Raw meat	Meat products	Standard
Odor	Normal	Normal0	Pleasant
Colour	Normal	Normal	Red
Texture	Normal	Normal	Smooth
Appearance	Normal	Normal	Pleasant

Table-4. Result of water test

Serial No	Test type	Test name	Test result	Normal/Standard range
1	Organoleptic test	Odor Color Appearance	Normal Colorless Good	- - -
2	Physical and chemical test	p^H test TDS test Iron test Hardness test	6.6 60 ppm 0.1 45	6.5-8.5 Less than 1000 ppm 0.3 Less than 300

Overall, organoleptic tests results highlighting odor, color, texture and appearance were acceptable (Table 3). The results of temperature test, acidity (pH) test, water activity (Aw) test, total ash contents test, formalin test were -3 °C, 7.6, 0.75, 0.7, nil, respectively, which were good enough in comparison to standard value (Table 5). Standard plate count (SPC) and coliform count tests showed the result less than 30 cfu/ml, < 10 cfu/ml, respectively. The microbiological quality was satisfactory [6] (Table 6 and 7). The quality parameters of the water used in the meat plant were acceptable: p^H test- 6.6, TDS test- 60 ppm, iron test- 0.1 and hardness test- 45 (Table 4).

Table-5. Result of meat and meat product tests

Test Type	Test Name	Result	Normal/Standard range
Physical and chemical test	Temperature test	-3 C	-5 C
	Acidity (pH) test	7.6	6.5-8.5
	Water activity (a_W) test	0.75	1
	Total ash contains test	0.7/g	1/g
	Formalin test	Nil	-

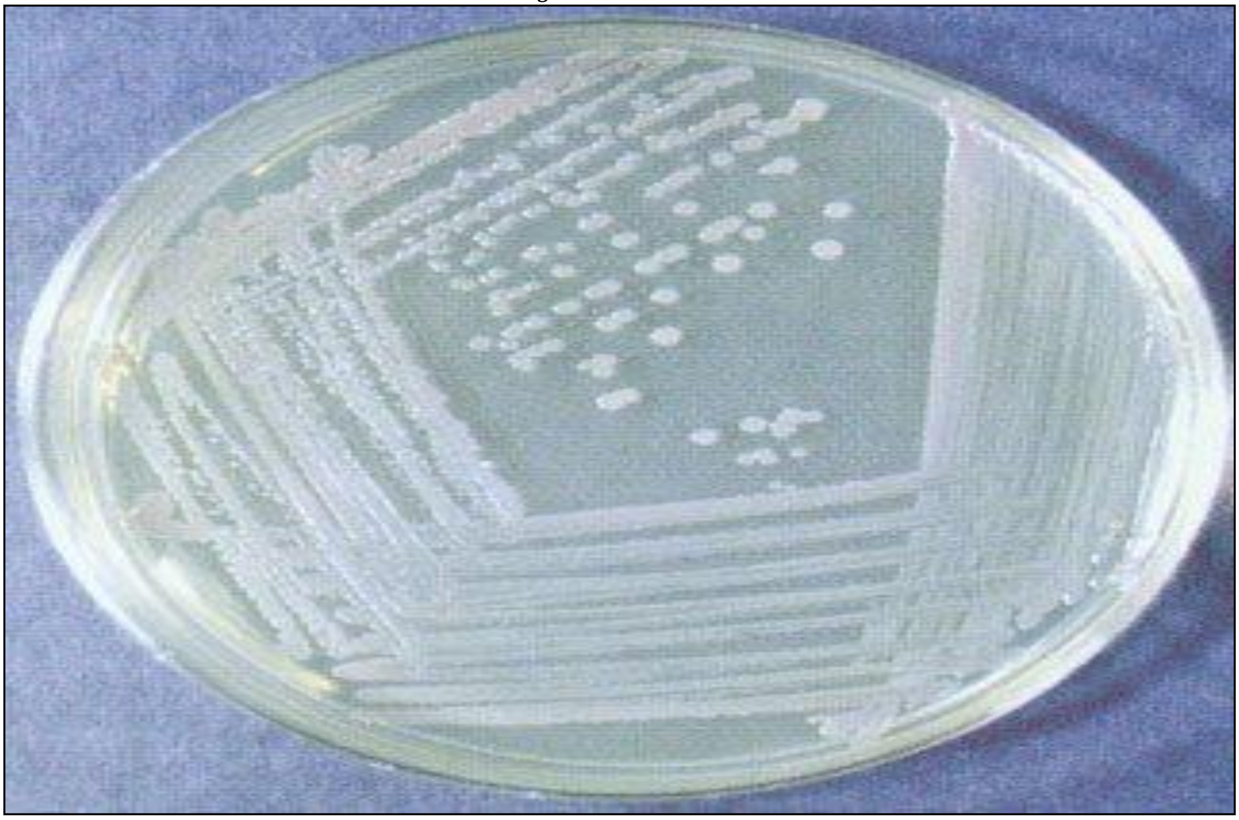
7.2. Standard Plate Count (Spc)

The following bacteriological standards are are widely accepted:

Table-6. Standard Plate Count of raw meat

Grade of meat	Amount of colony	Standard range	Quality	Accept /Reject
Grade A	0 to 2 lakh per ml	0-2 lakh	Very good	Accept
Grade B	2lakh to 10 lakh per ml	2-10.5 lakh	Good	Accept
Grade C	11lakh to 50lakh per ml	11-50 lakh	Fair	Not satisfactory, meat separated or Rejected
Grade D	< 50 lakh per ml	<50 lakh	Poor	Rejected

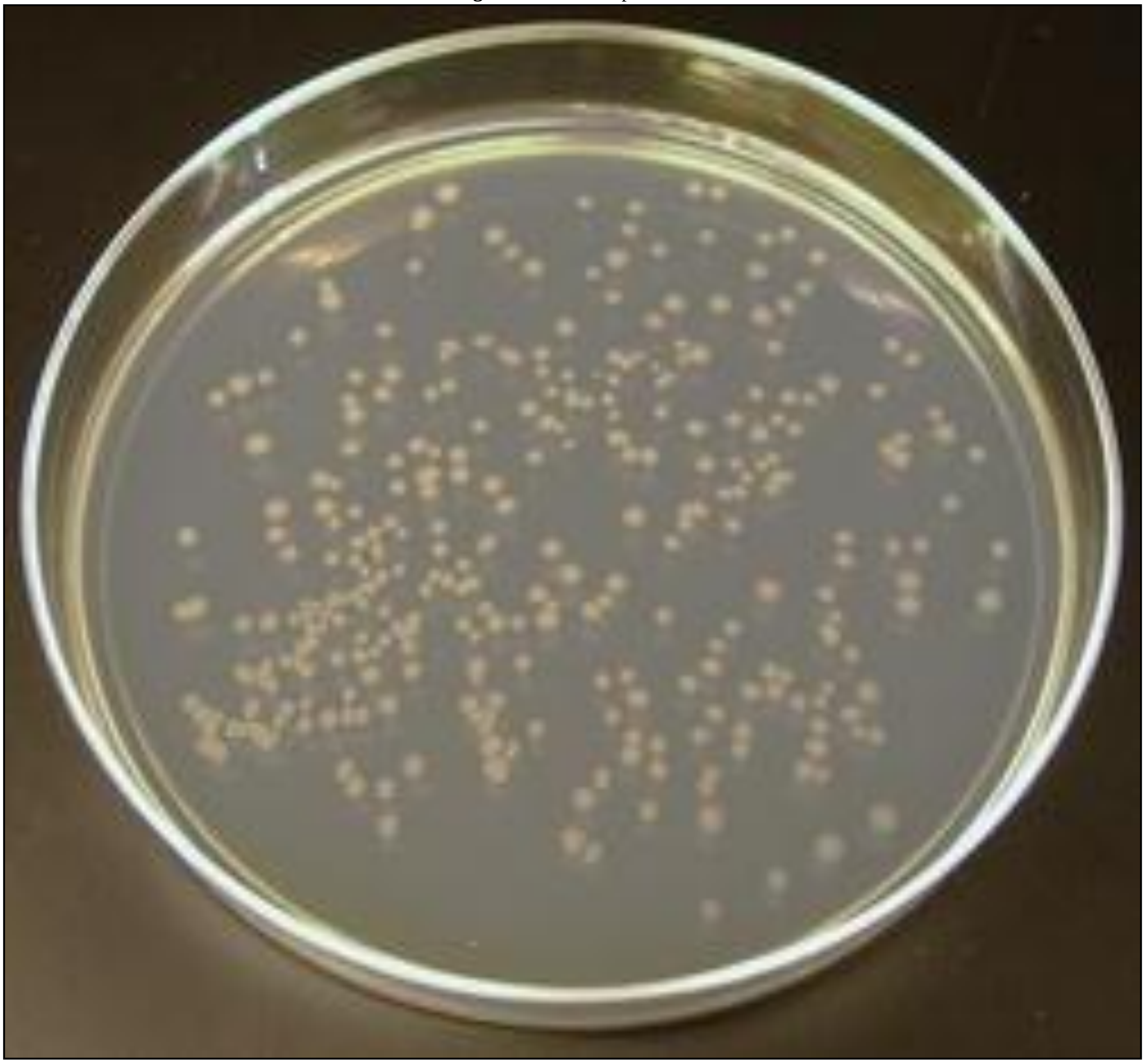
Fig-2. SPC of raw meat



7.3. Meat Products Standard Colony Count

Tests soon after packaging -less than 30.009/ml.
Tested soon after 24 hr at 170C -less than 500.009/ml.

Fig-3. SPC for meat products



7.4. Meat Products Standard Colony Count

7.4.1. Meat Ball

Less than 30.000 per gram, standard less than 50.000 per gram.

7.4.2. Chicken Stripes

Less than 30.000 per gram, standard less than 50.000 per gram.

7.4.3. Beef Burger Patty

Less than 50.000 per gram, standard less than 10.000 per gram.

7.5. Limitations of SPC

A low SPC, likewise, does not guarantee samples are pathogen free.SPC does not measure the entire bacterial population, but rather the number of microbes that grow on the specific medium under particular growing conditions.The medium /agar /may not support growth of certain pathogenic bacteria.It is difficult to distinguish between feed particles and bacteria.Bacteria colonies may be small to be seen. Conversely, the colonies can be over-crowded or clumped together, increasing error in reporting. Careful consideration must be given to the agar or medium being used, temperature and time of incubation, length of time and storage conditions of samples, potential contamination of samples, proper dilution of the sample to avoid overcrowding of colonies on plates,etc.

8. Coliform Count

Higher number of coliforms in raw meat indicates unhygienic production and manipulation conditions.

Fig-4. Coliform count for meat products

Table-7. Result of Coliform Count of meat

Grade of meat	Amount of colony	Standard Range (/ml)
Grade A	< 10per ml	0-10
Grade B	>10per ml	11- unlimited

It can be concluded the meat and meat products, have the good physical, chemical, organoleptic and microbiological quality, with special reference to standard plate count (SPC), coliform count of the meat did not exceed the maximum limit of microbial contamination. The overall results of the study suggest that a good hygienic and quality environment is maintained in the meat plant.

9. Limitations of the Case Study

There were some limitations of access information, which were strictly confidential for the company.The company officials didn't provide sufficient current information such as information on company existing market share, actual customer demand, sales volume of competitors, accurate financial statement, cash flow statement, etc.Sometimes workers didn't use gloves. They were not following the HACCP properly. Only Dhaka and its nearly city was consider as end -users but other end users of other city was ignored.In this study, non-probability sampling technique (convenience sampling) was used as the data were not available.Some respondents were reluctant to provide more information about the subject matter the researchers were concerned.The agents, wholesalers, retailers, company sales representatives (SR) were not sincere and cordial in providing sales information.

10. Conclusion

Meat and meat products are an important source of nutrition for people. Now a days, it also gives livelihood opportunities for farm families, processor and other people who are directly or non-directly involved in meat or meat products processing. Consumer, industry and governments need up-to-date information on how meat and meat products can contribute to human nutrition and meat processing industry development can best contribute to increasing food security and alleviating poverty.

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