CHAPTER-I

INTRODUCTION

Being omnivorous humans have hunted and killed animals for meat since pre-historic times. Now-a-days, in almost every country of the world, meat is considered as one of the most important foods, and in some countries it is evaluated as an essential product with very high consumption rates. The meat consumption pattern of the people varies due to their cultural or religious preferences, as well as economic status worldwide. Family income, prices, individual preferences and beliefs, culture and traditions, as well as geographical, environmental, social and economic factors interact in a complex manner to determine the dietary consumption of meat of any type (Grunert, 2006).

Generally the term "meat" is used to denote the animal flesh that is taken as food by human beings. Most often "meat" refers to the skeletal muscles associated with fat and other tissues, but it may also describe other edible tissues such as offal. Sometimes "meat" is also used in more restrictive sense "the flesh of mammalian species (cattle, pigs, sheep, goat, buffalo etc) raised and prepared for human consumption, to the exclusion of fish, other sea foods, poultry or other animals.

Meat is an excellent source of protein including many other nutrients. All muscle tissue is very high in protein, containing all of the essential amino acids, and in most cases is a good source of zinc, vitamin B_{12}, selenium, phosphorus, niacin, vitamin B6, choline, riboflavin and iron. Muscle tissue is very low in carbohydrates and does not contain dietary fiber. As a nutrient dense food, meat provides a major nutritive contribution to diet relative to the amount of calories it contains.

Numerous aspects of the nutritional composition of meat vary in complex way depending on the species, breed, age, sex, plane of nutrition, training and exercise of the animal, as well as on the anatomical location of the musculature involved. According to many researchers the factors that affect the quality of meat can be classified broadly into intrinsic and extrinsic factors. The intrinsic factors are species, breed or crossbreed, individual genetics, gender, age and weight at slaughter. The

extrinsic factors prior to slaughter include management, diet, production system and pre-slaughter conditions. Extrinsic factors related with slaughter and post-slaughter are slaughter and blood loss, freezing, preservation, ageing, commercialization and consumption (Guerrero *et al*., 2013).

Transporting animals to slaughter is different to shifting of animals from one place to another. Animals experience a great deal of stresses during transportation. During transport numerous microbial, physical and environmental hazards have the potential to affect the health and meat quality of the animals negatively (Southern *et al*., 2006). In case of food animals much of the pain and stress takes place prior to slaughter, particularly during the events of transportation.

Mode of transport, type of animal transported, duration of transport, feed and water deprivation, ambient temperature, air or water quality, stocking density etc., play vital role regarding animal welfare and product quality during transport. It might also have psychological origin, such as separation from group, fear, mixing with unfamiliar animals and environment etc. This stress has both long and short term effect on animal. The exposure of an animal to the stressors results in release of catecholamines (epinephrine and nor-epinephrine) and glucocorticoids in blood. But the level varies based on species, age, sex, breed and individual differences. The secretion of catecholamines results in significant changes in energy metabolism including lipolysis, glycogenolysis in muscle and gluconeogenesis (Kuchel, 1991).

They also decrease the protein degradation (Rooyackers and Nair, 1997). Again increased release of glucocorticoids amplifies the mobilization of energy triggered by catecholamines. Significant depletion of muscle glycogen reserves has a thoughtful and well-recognized effect on key parameters of meat quality such as PH, tenderness, ageing potential, color and water holding capacity (Gregory and Grandin, 2007). The longer the transit time the greater the tendency to have a high muscle PH and dark meat. Ultimate PH is related to tenderness, color, flavor, acceptability, water holding capacity and keeping quality of meats. Maria *et al*. (2003) have analyzed the effect of transport time (30 min, 3 hours or 6 hours) on the quality of beef. They found that transport time have a significant effect on the texture, tenderness, color and overall liking. Thus transport stress affects the quality of meat significantly.

In case of food animal, practice the pre-slaughter management after transport includes resting, feeding, watering and fasting. Among those, one of the important segments is the period of time spent by the animals in lairage prior to slaughter. The duration at lairage and the conditions in lairage are important regarding pre-slaughter stress. Adequate resting at lairage with other practices facilitates the rehydration and recovery from transport stress. The practice of resting duration varies country to country. In case of European countries and North America animals are slaughtered on the day of arrival whereas in Australia, New Zealand and other countries slaughtering is practiced on the day after arrival.

As far know there is no standard practice followed in our country. The environment conditions in lairage such as temperature, air quality, noise, stocking density are also important to minimize the stress. According to Warner *et al*., (1998) the time spent by the animals in lairage tends to increase the incidence of dark cutting in beef. But there is little evidence for the duration of lairage having any effect on the eating quality or tenderness of meat.

Experimentally it is shown that stay time in lairage has no effect on ultimate PH, WHC and color of meat (Maria *et al*., 2003). Commercially, ultimate PH is used as the main indicator to measure meat quality (Gregory and Grandin, 2007). There is found no difference in consumer sensory scores for 5 days aged meat of lamb or mutton animals kept in lairage for 0, 1 or 2 days prior to slaughter (Jacob *et al*., 2005). In case of feedlot cattle no difference is observed in terms of shear force value between animals of 3 hours and 18 hours lairage time (Ferguson *et al*., 2007).

Feeding and watering prior to slaughter are important practice in meat science. During transport animals are deprived of feed and water. This practice is accomplished with increased dressing percentage by recovering the lost weight of animals. By feeding sugar to cattle and pig, the incidence of DFD (Dark, Firm and Dry) meat and the number of dark cutters in fatigued animals can be reduced (Galwey and Tarrant, 1978). Dehydrated animal (cattle) have lighter carcasses than the animals that receive water. In a number of experiments, it is shown that access to water does not wholly

prevent carcass weight losses and offering animals with feed did not slow carcass weight loss more than when the animals were offered water only.
Watering prior to slaughter also reduces the gut microbial load thus has a significant effect on hygienic meat production. Finally, fasting prior to slaughter is the ultimate practice offered to the food animals. Animals intended to slaughter should not be allowed to take feed and water until slaughtering. Animals should be kept in starvation condition at least for 6 hours before slaughtering. Fasting prior to slaughter helps in hygienic meat production. However, there is limited published information regarding effect of transport stress and pre-slaughter practices on the meat quality of animals in Bangladesh. As far known, this is the first research work regarding the meat quality of slaughtered animals in Chittagong. This first attempt is taken to find out the relationship between transport stress and pre-slaughter management with the meat quality of slaughtered animals.

Undoubtedly, the appearance of meat is a critical factor influencing the desire of consumers to purchase meats and ultimately their satisfaction. Meat quality of domesticated animals can be affected by several ante-mortem stress factors (Apple et al., 1995; Kannan et al., 1997), one of which is pre-slaughter transportation. Transport alters both the metabolism and psychological state of animals, which migt produce undesirable changes in meat quality (Owens and Sams, 2000; Pérez et al., 2002a; Leheska et al., 2003). Concentrations of certain plasma hormones, enzymes, and metabolites such as cortisol, corticosterone (CORT), creatine kinase, and glucose have been suggested to be sensitive parameters indicating the level of stress and muscle damage in poultry (Savenije et al., 2002; Nijdam et al., 2005) and livestock (Kannan et al., 2000; Pérez et al., 2002b; Apple et al., 2005) that experience feed-deprived transport.

In addition, pre-slaughter and postmortem glycogen metabolism and lactate accumulation from glycolysis affect important meat quality parameters (Bendall and Swatland, 1988).

Specific objectives of the current study are as follows:

- To assess the quality of broiler meat on the basis of measuring moisture content, P^H, water holding capacity (WHC), extract release volume (ERV), tyrosine value (TV) and thiobarbituric acid value (TBA).

- To identify the effect of transport stress on the quality of broiler meat

- To find out the effect of pre-slaughter practices (resting, feeding, watering and fasting) on the quality of poultry meat.

CHAPTER-III

MATERIALS AND METHODS

3.1 Statement of the experiment:

The present study work was conducted under the Department of Dairy & Poultry Science, CVASU, Chittagong, to appraise the quality of broiler meat based on the samples collected from the different areas of Chittagong Metropolitan Areas (CMA). Chittagong is the best poultry belt in Bangladesh. A total of four markets of CMA was considered a study area, which includes Baddarhat, Riazuddin bazaar, Jawotola, and Phartoli bazar. This experiment was performed from 25th June 2017 to 20th August 2017. Live broiler was collected from these markets, which are selected on the basis of availability of broilers, communication facilities, data collection facility and consumer view etc. A total of twenty shops was selected randomly, from where 2 birds from each market were collected from each live bird markets.

3.2 Collection of meat samples:

A total of forty (40) poultry meat samples was collected for the study. About 20 grams of meat sample was collected. Samples were collected in zipper bag and immediately transferred into ice box. Finally, the samples were transported to Poultry Research Training Center (PRTC) lab of CVASU for details meat quality parameters investigation. During the study period the samples were preserved in a refrigerator.

3.3 Determination of meat quality of collected samples:

The quality of collected meat samples were determined by using following parameters: moisture content, P^H, water holding capacity (WHC), extract release volume (ERV), tyrosine value (TV) , glucose level of blood, thiobarbituric acid (TBA) number. Briefly the procedure to determine each parameter is described below.

3.3.1 Determination of moisture content of meat samples:

To determine the moisture content 5gms of meat sample was taken in a petridish. Then the petridish was placed in the hot oven at a temperature of 105°C. The sample was heated until constant weight. After gaining the constant weight the sample was allowed to cool in desiccators and then weighted. Finally the moisture content of the sample was calculated using formula and expressed in percentage.

3.3.2. Determination of P^H of meat samples:

Slurry method was followed to determine the $P^{H\ of}$ meat samples. About50gm of collected meat sample was grinded by using electric grinder. Approximately 30gm of finely chopped ground meat was taken into a blender. 100ml of distilled water (3 times higher that meat sample weight) was added to the blender, and blended at high speed for 15 to 20 seconds to make a slurry. Finally, the P^H of that slurry was determined by using P^H meter that was calibrated with standard buffer solutions, one buffer at P^H 7.0 and another having P^H value of 4.0.

3.3.3 Determination of water holding capacity of meat samples:

About 300mg of meat sample was taken to assess the water holding capacity of meat. The collected meat sample was placed on a Whatman No 1 filter paper (GE Healthcare UK Ltd., Buckinghamshire, UK), and was placed between two glass slides. On the top of the upper glass slide a 100gm weight was placed for a period of 3minutes so as to exert a downward force. This arrangement was kept on a hard table and the released water from the meat sample was absorbed by the filter paper thus created an impression. The boundary of the area was demarcated carefully by using a sharp pencil. Finally, the area of the impression was expressed as square centimeters (cm^2). An increase in the area wetted by the meat sample was interpreted as a decrease in water holding capacity.

3.3.4 Determination of extract release volume (ERV) of meat samples:

Preparation of extraction reagent:

About 50ml of 0.2M potassium dihydrogen orthophosphate (Merck KGaA, Darmstadt, Germany) was mixed in 3.72ml of 0.2M sodium hydroxide (Merck, Germany) and diluted to 200ml with distilled water to prepare the extraction reagent.

Procedure of determining of ERV:

About 15gm of meat sample was added to 60ml of extraction solution and blended for 2 minutes in a homogenizer. The whole blended content was transferred to a glass funnel (10cm diameter) with a Whatman No 1 filter paper (18.5cm diameter; Whatman International Ltd., Maidstone, UK) folded trice as to make eight sections. The filtrate was collected in a 100ml capacity measuring cylinder. The quantity of filtrate obtained in 15minutes at room temperature was reported as milliliters (ml) of extract release volume of the meat sample.

3.3.5 Estimation of tyrosine value of meat samples:

Preparation of trichloro acetic acid extract:

Meat sample of 20gm weight was blended in a mincer with 50ml of cold 20% trichloro acetic acid for 2 minutes. The whole blended content was rinsed in 50ml distilled water. After mixing properly it was filtered by using Whatman No 1 filter paper (18.5cm diameter; Whatman International Ltd. Maidstone, UK) and the filtrate was collected in a 100ml measuring cylinder. Thus trichloro acetic acid extract was prepared for estimation of tyrosine value of meat sample.

Procedure for determination of tyrosine value:

About 2.5ml of trichloro acetic acid extract was diluted with equal volume of distilled water in a test tube. To that 10ml of 0.5M sodium hydroxide (Merck, Germany) was added followed by 3ml of diluted folinciocalteu phenol reagent (1 part of folinciocalteu phenol reagent : 2 parts of distilled water; LobaChemie Pvt. Ltd, Mumbai, India). After mixing it was left for 15minutes at room temperature. The

developed blue color was then measured as absorbance at 660nm weave length in a spectrophotometer using a blank for comparison. With reference to the standard graph the tyrosine value was calculated and expressed as milligram (mg) of tyrosine in per 100gm meat sample.

3.3.6. Estimation of glucose level form blood sample: The following procedure was followed for the estimation of blood glucose level.

Blood collection:

Forty birds were selected randomly for blood collection from four poultry markets. The blood sample was collected from selected birds. The age of studied broiler was 28 days. Maintaining proper aseptic measures 2ml of blood sample was collected from wing vein. After collection, 1ml of blood was kept in vacutainer tube without anticoagulant for serum separation.

Blood transportation:

Vacutainer tube filled with blood inserted into an ice box for preservation and transportation until reached at the research laboratory of CVASU.

Serum separation:

The vacutainer with blood was kept at a room temperature for 1-2 hours for proper coagulation. After coagulation it was centrifuged @3000 rpm for 30 minutes. then serum was collected by micro titer pipette and kept in eppendorf tube for preservation.

Serum preservation:

The collected serum of each bird was properly labeled and preserved into deep freeze at -20^{o}c for further analysis.

Biochemical analysis:

An automated biochemical analyzer was used to determine the level of glucose by using appropriate kit available in the market.

Biochemical assay:

The sterile eppendrof tube was taken. then required amount of standards and sample was taken in eppendrof tubes. Proper amount of reagents was then added to each eppendrof tube. Then the eppendrof tube was incubated at certain temperature for certain period according to procedure protocol. Each standards with conjugate reagent were examined first for determined of the standard value. Finally all eppendorf tubes containing sample was examined by automated hualyzer and the reading was taken. Standard value was used as a compared tool.

3.4. Estimation of thiobarbituric acid (TBA) number or value of meat:

Preparation of trichloro acetic acid (TCA) extract:

Meat sample of 20gm weight was blended in a mincer with 50ml of cold 20% trichloro acetic acid for 2 minutes. The whole blended content was rinsed in 50ml distilled water. After mixing properly, it was filtered by using Whatman No. 1 filter paper (18.5cm diameter; Whatman International Ltd. Maidstone, UK) and the filtrate was collected in a 100ml measuring cylinder. Thus, trichloro acetic acid extract was prepared for estimation of thiobarbituric acid(TBA) number or value of meat.

Procedure:

Five ml of aliquot was mixed with 5ml of 0.001M thiobarbituric acid. After mixing, the test tube was covered with a round marble and placed in a boiling water bath ($100^{o}c$) for 30 minutes. A blank constituting 5 ml of thiobarbituric acid reagent and 5ml of 10% trichloro acetic acid in another test tube was covered with marble and placed in the boiling water bath along with the sample. After 30 minutes both the test tubes were removed from the water bath and cooled in running water for about 10 minutes. The developed was measured as absorbance value at 532 nm and expressed as the thiobarbituric acid number or value.

3.5. Statistical analysis

All recorded and calculated data were statistically analyzed for analysis of variance in a Completely Randomized Design (CRD) using the Minitab statistical computer package program (Minitab, 2000). The significance of differences between means was tested using the Duncan multiple-range test. Statistical significance was considered at $P \leq 0.05$.

CHAPTER-IV
RESULTS

4.1. Meat quality of broiler chickens

All the factors of meat quality were not measured in this study, even though many factors are involved to affect the meat quality of broiler chickens. Some of the factors such as road distance (RD) of carrying birds to the market, time spent for transporting (TT) broilers to market, meat pH, moisture content (%), water holding capacity (WHC), extract release value (ERV), tyrosine value (TV), blood glucose (Glu) level and thiobarbituric acid (TBA) values etc., are measured herein this study, to assess the quality of broiler meat from different places of CMP. The results of RD, TT, pH, moisture level, WHC, ERV, TV, Glu and TBA values of broiler meat are shown in Table 1.

4.1.1 The road distance (RD) and transportation time (TT)of broilers on meat quality

In present study, the geographic area supplying broiler chickens was divided into four markets, and the distance between productions areas to live birds markets were measured (Table 1). The data show that the RD and TT of broilers differed significantly ($P<0.01$) between treatments. It was found that during transportation of broilers to market, the highest distance (46.80km) was recorded in JT, from production area to marketplace, whereas the distance of remaining three markets being37.40 km, 22.00 km and 20.00 km, in PHT, PH and RB, respectively.

The duration of transporting bird to market was highest recorded (1.65 h) in PHT and BH (1.08 h) and RB (1.0 h) being the lowest.

Table 1: The RD, TT, moisture, pH, WHC, ERV, TV, Glu and TBARS of broiler meats from different markets

Parameters	Age (days)	Treatments				Pooled SEM	P-values
		BH	**JT**	**PHT**	**RB**		
RD (km)	28	22.00^{c}	46.80^{a}	37.40^{b}	20.00^{c}	0.983	0.01
TT (hour)	28	1.08^{c}	1.35^{b}	1.65^{a}	1.00^{c}	0.032	0.01
P^{H}	28	5.93	5.80	5.93	6.08	0.035	0.07
Moisture**(%)**	28	30.40	29.00	29.60	28.00	0.427	0.26
WHC**(%)**	28	5.48	5.02	4.96	5.30	0.102	0.24
ERV**(ml)**	28	22.74	22.67	22.88	22.81	0.194	0.98
TV**(mg /100 gm)**	28	0.54^{b}	0.54^{b}	0.66^{a}	0.57^{b}	0.009	0.01
Glu (**mg/dl)**	28	301.64	308.91	344.62	315.27	9.344	0.39
TBA (mgMDA/100gmeat)	28	0.051^{a}	0.047^{a}	0.024^{c}	0.041^{b}	0.0010	0.01

[Data refer to mean values of 10 birds per treatment group, Treatments refer to markets, *i.e*BH=Bhaddarhat bazaar; JT=Jhaowtola bazaar; PHT=Pahartali bazaar,; RB=Riazuddin bazaar, respectively; TT, transporting time; RD, road distance;WHC;water holding capacity; ERV, extract release value; TV, tyrosine value; Glu, glucose, and TBARS, thiobarbituric acid reactive substance values; SEM, pooled standard error of means;].

4.1.2 The pH, moisture, water holding capacity (WHC), extract release value (ERV), blood glucose (Glu) level of broilers meat

The results of pH, WHC, moisture content (%), ERV, and Glu of broilers are shown in Table 1. It is evident from the data that the parameters (e.g. pH, WHC, moisture content (%), ERV, and Glu) of broiler meat were not influenced ($P>0.05$) by treatments or market places. However, the pH value of meat tended to be significant ($P<0.07$) between treatments (Table 1). It denotes that the meat of RB appears to contain a slightly higher pH (6.08) than that of other markets.

4.1.3 The tyrosine value (TV) of broilers meat

The TV of broiler meat collected from the different markets differed significantly ($P<0.01$) between treatments, as is shown in Table 1. The highest TV (0.66) was found in the meat of PHT, whereas the lowest TV (0.54) being in BH and JH, respectively.

4.1.4 The thiobarbituric acid (TBA) values of broilers meat

The TBARS of broiler meat differed significantly ($P<0.01$) between treatments (Table 1). The meat of BT and JT had higher TBA values (0.051; 0.047 mg/100g) than that of other groups. The lowest TBA value (0.024) was recorded in PHT. Significant variation ($P<0.1$) was found among the different meat samples TBA of four markets.

CHAPTER-V

DISCUSSIONS

The meat is the best source of protein. It is very important for proper body growth and tissue development. Animal protein is better than plant protein. Animal protein has greater biological value with balanced amino acids than plant protein. The digestibility value and protein percentage were also higher in animal protein. That's why, animal protein, particularly meat, is dear to all consumer. We are afraid to mention that, there is a huge protein gap of the country. This gap is increasing day by day due to increasing population and protein demand. The huge protein gap of the country can be met by raising broiler chickens, as broiler chickens grow faster than any other animals. In this regard, the quality and quantity of meat are very important to meet the huge protein gap of the consumer world. The meat quality of broiler chickens might influence by myriad factors as mentioned before in the review section.

5.1 The effects of road distance (RD) and transportation time (TT) of broilers on meat quality

It is clear from the data that RD and time spent in transporting (TT) broilers from producer place to marketing areas influenced significantly between different markets. These factors (TT; RD) can influence the broiler meat quality. Because the broilers carrying from remote areas and spending longer time during travelling or journey, could impose a stress on the live broilers, which in turn, could affect their meat quality.

One of the most stressing factors in handling animals is transportation from farm to the marketing or slaughter house. Several stressing factors are involved: temperature, acceleration and speed of the vehicle, animal immobility, vibration, motion, impacts, fasting, water deprivation, noise, and in general, welfare alterations. All these conditions produce a wide range of consequences, from discomfort to death.

It can increase the levels of epinephrine and glucocorticoids, thus affecting meat quality and increasing the probability of PSE (pale, soft and exudative) meat or physical damage such as bone breaking. Extreme temperature conditions can cause

severe stress. Temperature and time of transportation also increase the incidence of meat discoloration and endogenous microbial growth. Poor ventilation is another detrimental factor. Birds being transported are subject to several stress factors: including catching and handling, food and water deprivation and freedom of normal movement, changes in climate condition, unfamiliar surrounding; noise and sensation. Temperature extremes are important stressors, particularly when birds are waiting in trucks before marketing or slaughtering. It has been reported that during waiting period bird show liver and muscle glycogen alteration that negatively affect such meat quality characters as colour, tenderness, and appearance (Isabel & Hui, 2010).

In general, birds do not receive water during transport or abattoir before marketing or slaughtering. Depending on the journey's duration, poultry could present dehydration symptoms, such as severe thirst, hot and dry body, dry tongue, loss of coordination, and even death. These conditions are severe stressing factors and cause alteration in blood and plasma volume, they can result in deterioration in meat quality, mainly as to texture and water retention ((Isabel & Hui, 2010; Samad, 2005; Sing and Panda, 1992).

5.2 The effects of pH, moisture level, water holding capacity (WHC), extract release value (ERV), blood glucose (Glu) level of broiler chickens on meat quality

From our current study it is obvious that, the pH value, water content, WHC, ERV and blood glucose level of broiler meat procured from the different markets of Chittagong region (CMP), were similar or unaffected between treatments. In this aspect, we can assume that meat quality does not vary in its composition with respect to unchanged parameters, as is observed in this study. P^H is the basic and most important parameter of meat quality and it is used as the main quality indicator of meat in commercial level (Gregory and Grandin, 2007).This P^H value is highly correlated with other parameters of meat quality. The postmortem decline in muscle pH is due to an accumulation of lactic acid as a result of glycolysis (Khan and Nakamura, 1970; Lawrie, 1998).The findings of this study showed strong agreement with Ådnøy*et al*. (2005), who found no significant differences in meat P^H between lambs that did or did not undergo a long, double transport.

Water-holding capacity is another important meat quality attribute and can be evaluated by cook loss. Because postmortem metabolism can affect the functionality of meat proteins responsible for water-holding capacity (Penny, 1969, Swatland, 1993).There was no significant difference of water holding capacity of the broiler of different distances in this study.

Transportation of animals had previously been shown to increase water-holding capacity in turkeys and in swine (Van Hoof, 1979; Becker et al., 1989, McPhee and Trout, 1995),and the findings contradicts with our current results. Glucose is an essential cellular fuel source and metabolic substrate. Transport stress has been reported to cause an elevation in plasma glucose concentration (Kent and Ewbank, 1983, 1986b), primarily due to glycogen breakdown in the liver (Mayes, 1996). However, there was no statistically significant difference was found within the blood glucose level of transported slaughter birds of four markets. Nevertheless, the limited glycogen degradation could not overcome the exhaustion of plasma glucose caused by long-term transport and feed withdrawal, which in turn could cause a significant decrease of plasma glucose concentration in the long-term transport groups. Overall, plasma glucose was affected by transport time, and glucose significantly decreased with the elapsed transport time. Several studies have suggested that poultry, when subjected to long-term transport, consistently develop hypoglycemia that may be the result of exhaustion of hepatic glycogen stores (Halliday et al., 1977; Freeman et al., 1984).

5.3 Effect of tyrosine value (TV) on broiler meat quality:

In this study, we observed that TV was influenced significantly between different market meats. It showed that, TV was increased in the meat of PHT and decreased in meat samples obtained from the markets of BH and JT. The increase in tyrosine value of meat might be due to intrinsic (autolysis) changes in meat and bacterial action (Agnihotri, 1998; Dainty et.al., 1975; Strange et al., 1977).

Our findings can be correlated with the report of Sonale et al. (2014), who observed increased TV in the breast meat of quail. However, the findings can be in agreement with Jayesh and Venkataramanujam (2002) for mutton, Doifode (2007) for chevon, Kandeepan and Biswas (2007) for buffalo meat and Swami (2011) for rabbit meat.

5.4 Effect of thiobarbituric acid (TBA) values on broiler meat quality:

The results regarding TBA values (expressed as mgMDA/kg)of broiler meats showed significant differences due to treatments in this study. The meat of BT and JT had improved TBA values than that of other groups. The lowest TBA value was recorded in PHT. Significant variation was observed among the different meat samples TBA values of four markets. It is evident from exploration that increased malonaldehyde (MDA) /kg meat production reported in the meats of BT and JT markets compared to PHT market, however, TBA value increased as a function of storage (Carmen et al., 2011).It implies that the meat quality of BT and JT is a little bit susceptible to rancid condition, as a result of increased TBA values found in this meat, compared to the meat quality of other markets. However, Frigg (1992) reported that the approximate scale for interpretation of TBA values in meat is, ≤ 0.2 good quality; 0.2 – 0.5 limited, tolerable; 0.5 – 1.5, somewhat oxidized; 1.5 ----5 oxidized; and value more than >5 is considered as rancid. From the scale it can be assumed that, the meat quality of BT and JT markets is in the tolerable range as the values of TBA (0.51; 0.47) of meat fall in the range of 0.2 to 0.5, according to the scale stated by Frigg (1992). Anand et al. (1999) also noticed consistent rise in TBA with progress of storage period. The increase in TBA value during storage period was mainly attributed to the oxygen permeability of packaging material (Sen, 1996), whereas Strange et al. (1977) reported that TBA number might increase due to lipid oxidation and not specifically due to bacterial action.

In general, cardiovascular and atherogenesis problems might be arisen due to consumption of oxidation products. Morrissey and Kiely(2006) reported that lipid oxidation can cause anumber of meat quality parameters (loss of texture, flavor, water-holding capacity) to undesirable changes, and to development of rancid odors and flavors, being the major causes of meat quality deterioration during storage and

shortening the shelf life. As a result, such meat is not assumed to be fresh by the consumer.

Fatty acid composition, dietary fat quality, endogenous prooxidative and antioxidative constituents, water activity and nonmeat additives (prooxidative and antioxidative) etc., are the primary factors, which can induce lipid peroxidation in raw meat products (Rojas and Brewer, 2007). Antioxidants have been successfully added to livestock feeds in order to increase meat oxidative stability. There is a tendency towards the use of natural antioxidants in detriment of synthetic ones. It has been suggested that a combination of different antioxidants might be more effective in retarding lipid oxidation rather than the use of a single antioxidant (Barroeta, 2007). Vitamin E, fish oil and selenium addition to diet can reduce the incidence of rancidity of food, because these factors act as a strong antioxidants (Singh and Panda, 1992).

CONCLUSIONS & RECOMMENDATIONS

It is possible that commercial conditions different from those used in the current studies, such as variable strains of birds, larger number of crates of birds in transport vehicles, and could all differentially influence the stress responses and muscle metabolism. Nevertheless, under the conditions of our experiments with male broilers, it can be concluded that duration of crating is not an important factor in influencing stress responses. Holding crated broilers for a period in a dark quiet place after transport can reduce their stress response prior to processing. However, the level of stress could also vary with such factors as the weather conditions prevailing during transportation and holding. For instance, holding after transport during very hot weather, could be very stressful to the birds. The ante-mortem stress treatments studied in these experiments did not cause any perceivable change in the overall meat quality characteristics, although thigh meat color was affected in some cases. More research is needed in order to better understand how the metabolism of different muscles is affected by different types of stressors.

In summary, this study indicates that transport stress induces the release of plasma CORT, affects the contractive status of muscle fibers by changing their area and density (size), and enhances glycolysis and even lipolysis. However, these metabolic changes were not significant enough to be detrimental to meat quality in this study. A long-term recovery after transport, especially after long-term transport, lowers plasma CORT concentration and reduces muscle glycolysis, which may help maintain meat quality.

From an overview of the results obtained in this study revealed that, road distance and time spent in transportation of broilers to different markets are influenced.. It indicates that long time journey in the remote areas might impose stress on the broilers, which has a much potentiality to affect the meat quality. The moisture content, pH value, water holding capacity, extract release value, and blood glucose level etc. of broiler meat, were found to be unaffected between different market meats. 1t does imply that meat samples collected from the different markets were possessed similar quality. The

TV value was improved in the meat of PHT market. Further, TBA values were elevated in the meat of BT and JT markets in this study. The increased value of TBA as is observed in this study, won't affect the meat quality of broilers, because the TBA value is in tolerable range or limited. From the study it could be concluded that, the meat of broilers collected from four different markets of Chittagong Metropolitan Areas, appears to be good in quality. However, further study can be undertaken with taking large number of population and parameters to elucidate the present findings. Frequent observation and research studies on broiler meat quality might be helpful for the consumer world, by increasing their food safety as well as supplying healthy food item to the people.

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Table: The parameters of meat quality of broilers of four different markets

Tr	Rep	Distances (km)	Transporting time (hour)	P^H	H_20	WHC	ERV	TyrV	Gluc	TBA (mg/100g)
BH	1	22	1.2	6.42	26	4.76	22.1	0.619	30.4	0.054
BH	2	22	1.2	5.89	28	5.67	24.2	0.529	306.9	0.057
BH	3	22	1.2	5.87	26	5.45	21.3	0.558	301.9	0.048
BH	4	22	1.2	5.95	30	4.65	22.3	0.546	316.2	0.058
BH	5	22	1	5.79	31	4.65	24.5	0.555	356.4	0.049
BH	6	22	1	6.05	32	4.55	23.8	0.456	392.7	0.053
BH	7	22	1	5.83	33	5.77	20.6	0.639	273.1	0.056
BH	8	22	1	5.88	31	6.87	24.6	0.506	301.1	0.041
BH	9	22	1	5.75	34	5.98	21.1	0.434	392.1	0.042
BH	10	22	1	5.91	33	6.54	22.9	0.654	345.6	0.052
RB	1	20	1	6.21	27	4.54	22.5	0.615	276.1	0.043

RB	2	20	1	5.94	29	4.76	21.5	0.529	346.9	0.045
RB	3	20	1	6.02	26	5.78	23.5	0.534	305.5	0.041
RB	4	20	1	6.28	29	6.12	24.7	0.531	363.3	0.039
RB	5	20	1	6.13	28	5.65	23.2	0.654	296.5	0.052
RB	6	20	1	6.04	28	4.54	22.9	0.543	360.5	0.049
RB	7	20	1	5.97	28	5.65	23.3	0.575	280.5	0.032
RB	8	20	1	6.11	26	4.54	22.6	0.543	290.1	0.034
RB	9	20	1	5.99	29	5.55	22.1	0.598	330.5	0.039
RB	10	20	1	6.07	30	5.89	21.8	0.589	302.8	0.036
JT	1	36	1.2	5.32	30	4.33	21.4	0.514	303.6	0.043
JT	2	36	1.2	6.21	33	5.44	23.3	0.423	304.5	0.043
JT	3	36	1.2	6.11	32	5.98	24.7	0.428	346.8	0.031
JT	4	36	1.2	6.08	24	5.64	24.3	0.513	283.5	0.038
JT	5	54	1.2	5.43	27	5.43	21.4	0.654	315.9	0.043
JT	6	54	1.5	5.99	29	4.56	20.2	0.589	301.7	0.056
JT	7	54	1.5	5.46	29	4.98	22.1	0.599	264.1	0.067
JT	8	54	1.5	5.89	29	4.76	23.3	0.587	395.5	0.056
JT	9	54	1.5	5.87	28	4.53	22.6	0.576	270.9	0.049
JT	10	54	1.5	5.64	30	4.56	23.4	0.528	302.6	0.051
PHT	1	31	1.3	5.43	34	5.45	24.1	0.695	332.5	0.039
PHT	2	31	1.3	5.76	33	5.12	23.2	0.678	331.2	0.027
PHT	3	31	1.3	6.01	32	5.23	22.8	0.674	370.4	0.024
PHT	4	31	1.3	6.19	35	5.32	22.1	0.654	370.4	0.014
PHT	5	31	1.3	6.14	25	5.87	21.9	0.632	350.4	0.026
PHT	6	31	2	6.12	28	4.43	23.8	0.676	356.5	0.016
PHT	7	47	2	5.98	27	4.54	24.2	0.613	302.2	0.029
PHT	8	47	2	5.99	26	4.78	21.2	0.654	337.5	0.032
PHT	9	47	2	5.67	29	4.65	22.2	0.632	387.6	0.019
PHT	10	47	2	6.03	27	4.23	23.3	0.657	307.5	0.018

[WHC-water holding capacity, ERV, extract release values, Glu-glucose level, TyrV-tyrosine value, TBA-thiobarbituric acid value; BH-Baddar Hat market; PHT-Pahartoli market; JT-Jowtola Bazar, RB-Riyazzudin Bazar]

Biography

This is Md. Mashiur Rahman Khan, son of Mr. Mosharraf Hossain Khan and Late. Mrs. Feroza khanam. I am from Rangpur district. I completed S.S.C in 2010 and H.S.C in 2012 with GPA 5.00. I got admitted into Doctor of Veterinary Medicine (DVM) degree under Chittagong Veterinary and Animal Sciences University in 2012-2013 session. As an upcoming Veterinarian I would like to dedicate my rest of the life for the welfare of animals. I am keen to be a field veterinarian as well as a skilled pet practitioner.