MEAT QUALITY ASSESSMENT OF LOCAL CATTLE AND BUFFALO THROUGH NUTRITIVE AND PHYSIOCHEMICAL EVALUATION OF BLOOD AND MEAT

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ABSTRACT

A one way anova experiment was conducted to evaluate the meat production and physicochemical properties (pH, Color, Drip loss, Cook loss, TC, TG, Cholesterol, LDL, HDL and Iron content) of cattle and buffalo meat and blood. Five buffaloes and five cattle of similar age were considered as two groups and kept under a single plane of nutrition. No significant difference was observed between the groups in case of BCS, pH, drip loss and cooking loss of fresh or chilled meat. Buffalo meat reflected (L *) low lights ($P<0.05$) and showed significant ($P<0.01$) deep red - greenness (a *) contrast than cattle meat. Iron content of meat was found ($P<0.05$) higher in buffalo meat. In chemical composition, only ash and OM content differed significantly ($P<0.05$) between the species. IM fat and TC of buffalo meat was found significantly low ($P<0.001$) than cattle. Significant difference of TG and HDL ($P>0.05$) indicated the better quality of buffalo meat. But, LDL of meat and lipid profile of blood found non - significant. Finally we observed that, buffalo meat is better than cattle meat in context of nutritive value or physiochemical properties.

Keywords: *Bubalus bubalis*, buffaloes, species, meat, blood, physiochemical properties, lipid profile

INTRODUCTION

Bangladesh now is ranked as a lower middle economic country and with this development life style of men in country changed a lot. It is very logical that the change of food preference and increased demand with the increment of income resulting a huge pressure on more food production. Thus, high demand of the products originated from meat and milk is observed (Diouf, 2009). Beside this, World - wide peoples are consuming energy more and more from animal protein and fat sources and in Bangladesh same thing is happening. But, they are highly concerned to get safe and quality food. So, sufficient amount of protein and fat rich foods providing with assurance of safety and quality is a great challenge of government (Walker *et al*., 2005). Moreover, from last decade food safety recognized as a massive importance for governments, producers of food products and consumers as well (Islam and Hoque, 2013). Safe and quality meat production is only possible when the sufficient knowledge on the physiochemical and functional parameters of the meat is available.

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Cattle and buffaloes are two main meat producers. Every year Bangladesh produces 1.17 million tons meat where the demand is 6.31 million ton i.e. deficit is 5.14 million tons. Per capita requirement of meat is 120 gm per day where availability is only 21 gm. So, Per capita availability of meat is far below the normal requirement of an individual (Saadullah, 2012). For producing red meat the resource of Bangladesh are 23.20 million of cattle and 1.44 million of buffaloes. Cow contributes 0.40 million metric tons of meat annually where buffalo contributes only 0.01 million metric tons of meat (Rahman, 2012). Production of more meat from cattle and buffalo possibly may be the possible solution. In this case, slower growth rate of beef producing animal and the trend of hike of market prices of beef are the major problems (Fatema, 2014).

Evaluation of the meat quality of buffalo may help the strategic improvement of beef productions of the country (Roy *et al*., 2017). Buffalo being seen today as a savior animal to meet up the increased requirements of food (Otte, 2013). Buffalo meats are not consumed usually in urban area of Bangladesh because of just some obscurantism but it is sold widely under the gofers of cattle meat. Only exceptions are seen to some extent in rural and coastal areas of Bangladesh where buffalo meat is sold in raw market and eaten equally like cattle meat. Buffalo meat has a distinct importance for human nutrition (Williams, 2007). Health status of people in under - developed countries is not satisfying which is associated with utilization of poor quality foods such as poor quality meat (Brown *et al*., 2000). The meat quality usually described by the characteristics of color, intramuscular fat, moisture and ultimate pH. Because, physicochemical characteristics of meat are closely correlate with its nutritional and commercial value (Li and Zan, 2011). However, meat sometimes increases the risk of developing hyperlipidemia, which in turn leads to cardiovascular diseases, heart attacks, strokes, diabetes mellitus and other problems. Meat itself also associated with increased of some cancers (Chao *et al*., 2005). Thus consumers always think of avoiding red meat and resulting the daily requirement of protein remains unfulfilled. In this study, we determined whether the nutritive value of buffalo meat is enough to be considered as a good protein source as compared to beef or not. Therefore, this experiment was undertaken with the objectives of i) Evaluation of meat production performances of cattle and buffalo and ii) Determination of physicochemical properties of meat and blood of cattle and buffalo for distinguish their meat quality.

MATERIALS AND METHODS

A one way anova experiment was carried in the Cattle farm of Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka with five native buffaloes and five BCB - 1 (BLRI cattle breed - 1; Pabna cattle) cattle of 24 months of age in a single plane of nutrition for 10 months. Deworming practiced and blood sample was collected from each animal. Animals were slaughtered at BLRI Modern Slaughter House following `Halal' method and then meat samples were collected as well.

Body condition score, slaughter weight, meat pH, color, drip loss and cook loss determination

The visual plus palpation techniques of body condition score (BCS; 1 - 6 scale) was done following proper guideline (Prasad, 1994). Just before of slaughter the live weight of all animals

were recorded using a digital platform weighing balance. The pH of chilled meat was determined with a digital pH meter (Model no. HANNA Instruments, HI 2211 pH / Orpmeter). Meat color was determined using Chromameter (CR400, Konica Minolta inc. Japan). Meat pieces were soaked with tissue paper then chromameter was placed on the meat and reading of machine was taken. Drip loss and Cook loss of meat sample (sir loin muscle) was measured following proper method (Yang *et al*., 2006).

Preparation of meat homogenate, extraction of total lipid from meat homogenate and estimation of TC, TG, HDL and LDL levels in the meat sample

By electric grinder (Weston Pro Series 22 Electric Meat Grinders,1 - HP – 750 Watts) finely grinded meat samples were bottled, minced and homogenized with ice cold phosphate buffer (0.1 M, pH 7.4) containing 1% phenylmethylsulfonyl fluoride (PMSF) (100 mg of tissue / mL of buffer) using tissue homogenizer (POLYTRON - PT 6100 Homogenizers, Kinematica). Then, centrifuged at 1000 × g to remove unbroken tissues and the resultant homogenates were used for lipid profiling. Total lipid was extracted from meat sample homogenate accordingly (Folch *et al*., 1957). TC, TG and HDL - C (total cholesterol, triglycerides and high density lipoprotein, respectively) level in meat sample homogenate was estimated by using commercially available reagent kit by using the CHOD / PAP method, as described by Röschlau *et al*. (1974). GPO / PAP method as described by Burtis and Ashwood, (2006) and PEG / CHOD - PAP Method respectively. The serum level of LDL - C (low density lipoprotein) was calculated by using Friedewald's formula 1 (Cohn *et al*., 1988). LDL – C = TC – [(TG/ 5) + HDL Cholesterol, Serum lipid profile was analyzed following the same procedures described above.

Proximate analysis and estimation of iron concentration

The fresh meat samples (sir loin muscle) from each animal was collected and chemical composition i.e.; Dry matter (DM), Organic matter (OM), moisture, crude fat, crude protein (CP) and ash content, of those sample was determined in Animal Nutrition laboratory of BLRI following AOAC, 2005 method (Horwitz and Latimer, 2005). The meat samples were digested according to Mello *et al*., 1998. Iron content was determined from the digested samples, using an atomic absorption spectrophotometer (AA - 7000, Shimadzu Corporation, Japan) coupled with an auto sampler, ASC 7000. The amount of iron in each sample was calculated from concentrations of standard based slope of the standard curve and expressed as μg / mg of meat sample.

Statistical analysis

Statistical analysis was performed by 11.5 SPSS program. The mean values were calculated with regard to different animal species (buffalo and cattle) to observe the significant difference among different parameter of meat quality along with several physicochemical parameters. Results were expressed as mean ± SEM (Standard error of mean). Inter - group differences were analyzed by one way ANOVA, $P<0.05$ was considered statistically significant.

RESULTS

Physical properties of meat of the experimental animals

Performance of gaining body mass was non - significant (P>0.05) between buffalo and cattle at slaughter, as shown in Figure 1. Difference of body condition score of buffalo and cattle was also non - significant, as shown in Table 1. Except color no significance difference was observed in any physical parameters of meat. But, the pH value and drip loss percentage of fresh meat of buffalo was non - significantly higher than cattle, as shown in Table 1. In case of cook loss percentage of fresh meat and drip loss and cook loss percentage of chilled meat also wasn't differed significantly but higher values was observed with cattle than buffalo, as shown in Table 1. Significantly higher (P<0.01) lightness (L *) was observed in cattle meat (43.46±1.91) than buffalo meat (36.54±1.56) and in contrast significantly higher (P<0.05) red - greenness (a *) was observed in buffalo meat (18.22±0.73) than cattle meat (14.95±1.40). But, in case of yellow - blueness and color intensity there was no significant difference between the species, as shown in Table 2.

Nutritive value of meat

Organic matter percentage, ash and iron content of meat differed at 5% level of significance between the species. Higher organic matter was found in cattle meat (96.70±0.17) than buffalo meat (96.03±0.24). Higher percentage of ash was found in buffalo meat (3.97±0.25) than cattle meat (3.29±0.18). In case of iron content higher value was also found in buffalo meat (16.70±3.26) than cattle meat (11.19±2.57). There was no significant difference was observed between the species in case of moisture, dry matter and crude protein percentage, as shown in Table 3.

Lipid profile

From the obtained results it is observed that, total fat (intramuscular) percentage of meat sample of cattle (3.15±0.17) was higher than buffalo (0.40±0.01) at 1% level of significance, as shown in Figure 2. Total cholesterol (TC) of meat of cattle was more than double (875.62±61.92 ug/g) than buffalo meat (408.19±62.43 ug/g) which differed also at 1% level of significance, as shown in Figure 3. In case of triglyceride (TG) and high density lipoprotein (HDL) content significant difference (P<0.05) was observed between the species; in where higher triglyceride content was found in cattle meat than buffalo meat (2608.71 and 911.29 ug / g, respectively), as shown in Table 4. No significant difference was found in low density lipoprotein (LDL) of meat of two species, as shown in Table 4. In case of blood serum of cattle and buffalo, different parameters in lipid profile showed that, there was no significant difference (P>0.05) between the species, as shown in Table 5.

DISCUSSION

Buffalo, familiar as heavier animal; found better (P>0.05) body condition score than cattle (5.30 and 5.18, respectively) which was resembles to the findings of (Anzar *et al*., 2003). Slaughter weight can be achieved (P<0.01) much more from buffalo than cattle (Hamid *et al*., 2016). Although in this experiment average slaughter weight was non - significantly (P>0.05) differed between the species but higher in buffalo than cattle, which may happened because of the small size of treatment.

Meat quality depends at a large on its pH level and the ultimate pH of meat within 5.4 to 5.6 considered as high quality meat (Węglarz, 2010). In this study, the ultimate pH of meat of buffalo and cattle was 5.34 and 5.26, respectively and the group difference was non - significant (P>0.05).

Table 1. Effect of species on physical characteristics of meat (Mean±SEM).

Parameters	Species		F - value	Level of sig.
	Cattle	Buffalo		
BCS	5.18±0.073	5.30±0.03	2.25	NS
pH	5.26±0.09	5.34±0.04	0.63	NS
Drip loss% (fresh meat)	11.75±0.31	11.93±1.03	0.03	NS
Cook loss% (fresh meat)	20.42±1.83	18.12±0.81	1.31	NS
Drip loss% (chilled meat)	14.98±1.89	13.42±0.57	0.62	NS
Cook loss% (chilled meat)	21.57±0.80	18.72±1.83	2.02	NS

Results are expressed as mean ± SEM (Standard error of mean).

Data were analyzed by one - way ANOVA.

Level of sognificance was considered P>0.05.

NS = Non - significant

Table 2. Effect of species on color in meat of local cattle and buffalo (Mean±SEM).

Parameters	Species		F - value	Level of Sig.
	Cattle	Buffalo		
L*	43.46±1.91	36.54±1.56	10.28	**
a*	14.95±1.40	18.22±0.73	5.12	*
b*	10.18±1.09	11.76±0.83	1.31	NS
Color intensity	19.05±1.64	21.50±0.40	2.10	NS

Results are expressed as mean ± SEM (Standard error of mean).

Data were analyzed by one - way ANOVA.

Level of sognificance was considered P<0.05. L* = lightness component or value;

a* = red – greenness; b* = yellow – blueness; * = P<0.01; ** = P<0.05;

P>0.05 = Non - significant (NS).

Table 3. Effect of species on chemical composition of meat of local cattle and buffalo (Mean±SEM).

Parameters (Fresh basis)	Species		F-value	Level of Sig.
	Cattle	Buffalo		
Moisture%	74.38±0.62	75.75±0.59	2.50	NS
Dry matter (DM)%	25.62±0.62	24.25±0.59	2.50	NS
Organic matter% (OM)	96.70±0.17	96.03±0.24	4.75	*
Crude protein% (CP)	19.16±0.20	19.22±0.33	0.02	NS
Ash	3.29±0.18	3.97±0.25	4.75	*
Iron (ppm)	11.19±2.57	16.70±3.26	-	*

Results are expressed as mean ± SEM (Standard error of mean).
Data were analyzed by one - way ANOVA. Level of sognificance was considered * = P<0.05; ** = P<0.01; *** = P<0.001; P>0.05 = Non - significant (NS).

Table 4. Lipid profile in meat of local cattle and buffalo (Mean±SEM).

Parameters	Species		F-value	Level of sig.
	Cattle	Buffalo		
TG (ug / g)	2608.71±382.79	911.29±76.40	18.91	**
HDL (ug / g)	107.96±2.43	121.85±6.83	8.77	**
LDL (ug / g)	161.21±38.46	102.28±38.05	1.19	NS

Results are expressed as mean ± SEM (Standard error of mean).
Data were analyzed by one - way ANOVA. Level of sognificance was considered P<0.05.
TC = Total Cholesterol; TG = Triglyceride; HDL = High Density Lipoprotein;
LDL = Low density lipoprotein; * = P<0.05; ** = P<0.01; *** = P<0.001;
P>0.05 = Non - significant (NS).

Table 5. Lipid profile of blood serum of local cattle and buffalo (Mean±SEM).

Parameters	Species		F - value	Level of Sig.
	Cattle	Buffalo		
TC (mg / dl)	140.89±6.27	128.05±4.90	2.61	NS
TG (mg / dl)	127.61±4.74	126.13±4.89	0.05	NS
HDL (mg / dl)	41.98±0.72	42.13±1.58	0.01	NS
LDL (mg / dl)	73.39±5.67	60.69±3.33	3.74	NS

Results are expressed as mean ± SEM (Standard error of mean).
Data were analyzed by one - way ANOVA. Level of sognificance was considered P<0.05.
TC = Total Cholesterol; TG = Triglyceride; HDL = High Density Lipoprotein;
LDL = Low density lipoprotein.* = P<0.05; ** = P<0.01; P>0.05 = Non - significant (NS).

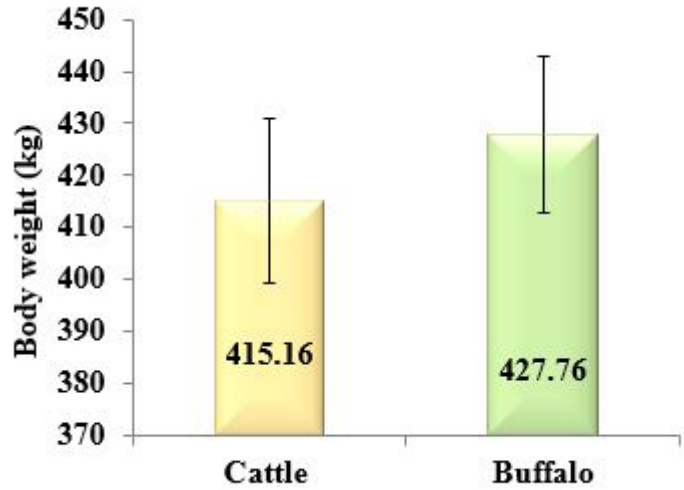

Figure 1. Slaughter wt. of cattle and buffalo.

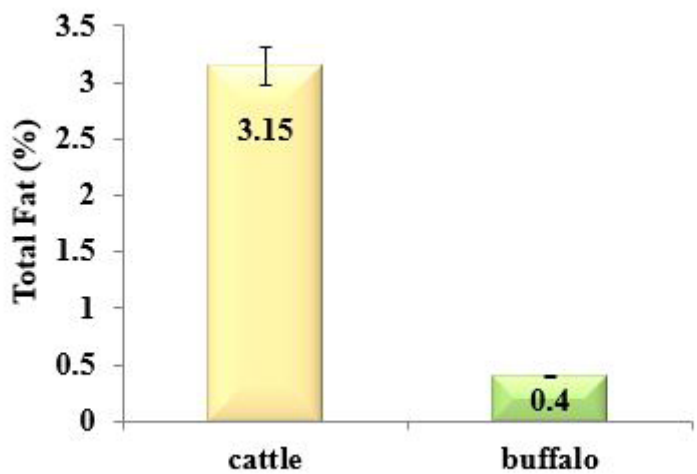

Figure 2. Total fat content of meat of local cattle and buffaloes.

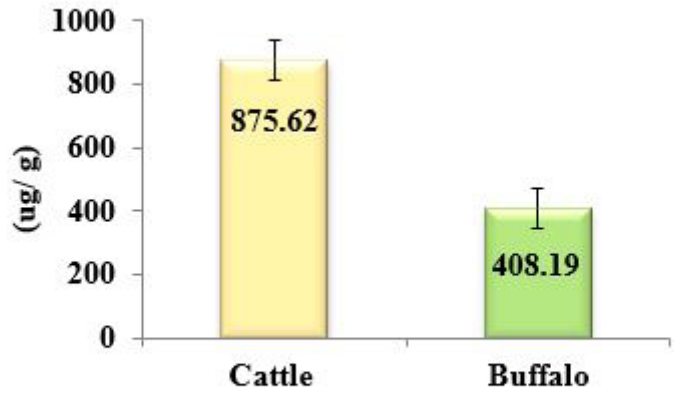

Figure 3. Total cholesterol level of meat of two species.

So, it could be said that, postmortem pH of buffalo meat declined at slower rate than cattle meat but in the study of Neath *et al*. (2007) declining rate of pH of buffalo meat was significantly slower than cattle. The moisture percentage of buffalo meat was higher (P>0.05) in this experiment than cattle (75.75 and 74.38, respectively) and this finding was in line with the findings of Lapitan *et al*. (2008). The ash content of buffalo meat differed significantly at 5% level with cattle meat (3.97 and 3.29, respectively) and this finding was similar to the study of Lapitan *et al*. (2008). The crude protein percentage of buffalo meat was also non - significantly higher than cattle (19.22 and 19.16, respectively) and this findings was also similar of the findings of Lapitan *et al*. (2008); (21.7 and 21.4, respectively).

It is known that, meat and meat products of buffalo are darker in color compared to other livestock species (Kandeepan and Biswas, 2007) and in this experiment same things was observed i.e.; buffalo meat had significantly (P<0.05) higher red - greenness (a *) than cattle meat (18.22 and 14.95, respectively). However, Kandeepan and Biswas (2007) reported that, buffalo meat constitutes higher protein, low fat and cholesterol and Anjaneyulu *et al*. (2007) reported that buffalo meat contained 76.4% moisture, 20.4% protein, 1.5% fat and 1.0% of ash. In another findings it is observed that, buffalo meat contained significantly higher protein than cattle and cattle meat contained significantly higher fat than buffalo (Aziz *et al*., 2014). In this experiment, crude fat of cattle meat was found significantly higher (P<0.001) than buffalo meat (3.15 and 0.40, respectively). Iron content of buffalo meat was higher and differed significantly at 5% level with cattle meat in this experiment and the report of Cedres. (2002) was supportive with this who stated that, buffalo meat contained higher iron and protein content and lower fat than other species. However, obtained results of this study was resembles with these statement

very well. So, it could be said that, light absorption makes the buffalo meat darker which may the cause of unwillingness of consumed buffalo meat in Bangladesh. But, through the examined results and far discussion it is assessed that, quality buffalo meat was better than cattle meat in the context of nutrition or physiochemical evaluation.

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