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Research Article

Regional effect on meat quality traits of Buffalos in Bangladesh

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Abstract

The study was aimed to determine the management practices of buffaloes and the meat quality test at different villages of Pauba upazilla in Rajshahi, Madargonj upazilla in Jamalpur and sadar upazilla in Mymensingh district of Bangladesh. Total 15 respondents were randomly selected from three villages; each village consists of variable numbers of respondents. The period of data collection was from February to April, 2016. The data were collected through personal interview from the individual respondent present in their own house. Only buffalo rearing was the major occupation of the farmers followed by agricultural crop production. Most of them (70.0%) kept their buffaloes on their own land; but some of them (30.0%) kept buffaloes on a hired place. The farmers (60.0%) basically have no training skill for buffalo rearing but some of them have influences from the buffalo farmers (40.0%). Most of the buffalo farmers purchased one pair of buffalo at a time and reared buffalos for at least 2 years. They fed their buffaloes with locally available roughages and tree leaves which contained more crude protein (CP) and less crude fibre (CF). In time of autumn season, they send their buffalo in Sunamgonj or Sylhet region for proper feeding. Buffalo farmers mainly maintain semi-intensive feeding system. The major diseases of buffaloes in those areas were Foot and Mouth Disease, anthrax and black quarter. Most of them performed vaccination collected from the local market and they also practiced medication and deworming. The farmers were satisfied with the marketing facilities. In case of meat quality parameters with proximate analysis and the results indicate that the better management gives us better quality of meat. It can be suggested that, management practice is very important fact in our country to get good quality of meat. So, we should improve our management practice through scientific approach.

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Introduction

The economy of Bangladesh is mainly based on Agriculture. About 90 percent of the total animal protein comes from the livestock sector in our everyday life (DLS, 2022). The contribution of the livestock sub-sector to gross domestic products (GDP) during FY 2021-22 was 1.90 percent (DLS, 2022). Buffaloes have a large body size than the native cattle. It is a triple purpose animal, used for milk, meat and draught. Farmers prefer to use buffaloes for farm work because of their great draught power, long working life and docile temperament. Most of them are kept by small-scale farmers for draught purpose. Domestic buffaloes occupy an important position in animal agriculture of the South Asian region. About 96% of world river buffalo population is found in Asia and buffaloes are almost exclusively raised by small holders and landless farmers (FAO, 2008).

The management practices adopted by buffalo raisers usually depends on the type of production in which they are involved. At the village level production is usually based on a small herd of mixed ages and sexes generally for draught and breeding purposes. In a semi-intensive production system, buffaloes are kept mainly for specific purposes, i.e., either for draught or for milk production. The low productivity is due to the genetic character of the breed and also poor-quality nutrition. It is suggested that productivity of these buffaloes mainly depends on genetic improvement, good ration, good management and also climatic conditions of an area (Saadullah, 2012). Husbandry and production systems for buffaloes vary depending on the topography and vegetation patterns of the country. Buffaloes are raised under an extensive system in the coastal and hilly areas where large-scale pasture land and enough green forage are available. Buffaloes are raised under a semi-intensive system on plain land and marshy land where there is limited pasture land. An intensive system for buffalo production is not practiced anywhere in Bangladesh even for institutional herds (Faruque, 2003). Saadullah (2012) reported that most of the farmers are rural small holders who have traditionally integrated their livestock with crop production and buffaloes are raised mainly to provide draught power in crop production. The feed resource base for these buffaloes are scavenging and consists of crop residues, household waste, tree fodder, roots and tuber, grain by-products and anything edible found in the immediate environment. The staple food for buffaloes is Bangladesh is rice straw, which is an inadequate source of energy and protein. Sugarcane leaves, micro silage of sugarcane leaves, cassava leaves, roadside grass, elephant grass, and maize with corn cob and pineapple bran are also used as feeding stuffs (Rahman et al., 1997, 1998, 1999 & 2002; Faruque, 2003). About 42.8%, 39.9% and 11.8% buffaloes are found in the

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sugarcane belt, coastal areas and marshy land, respectively among the total buffalo population of the country (Faruque et. al., 1990). They are seasonal breeder, calving in the winter and early spring. They can be utilized very low-quality roughages and have a high degree of resistance against common diseases though evidences of high calf mortality have been reported (Hussain and Chowdhury, 1989; Faruque et al., 1985, 1990; Faruque, 1994; Faruque and Amin, 1994 & 1995). In fact, buffaloes have better capacity of converting coarse feed stuffs into quality milk and meat. Though they can utilize roughage in the same ability as the cattle, their ability to process and communicate forages appears to be associated with relief of protein deficiencies other than to extract energy (Kennedy, 1988). The productivity of indigenous buffaloes in term of milk production is low. Their reproductive efficiency is very low and 2 calves in 3 years are common (Faruque et al., 1990; Faruque, 1994). This means indigenous buffaloes can't produce high quantity of milk. Characterization and evaluation of indigenous buffalo in some places have been done by Amano et al. (1987). The characterization and evaluation of exotic improved buffaloes (Nili-Ravi and Murrah) and their crossbred progenies, observed in sane localized area of the country as well as in some commercial farms which generally produce more milk, may contribute better to fulfill the demand. Production of buffalo in farm condition of Bangladesh is not available, though some buffaloes indigenous, exotic and their crosses are being maintained in small number at two institutional farms (Bangladesh Agricultural University Dairy Farm at Mymensingh and Buffalo Breeding and Development Farm at Bagerhat). In Bangladesh, like other developing countries, systems of animal production and use vary widely in accordance with climate, soil and socio-economic opportunities. Traditionally small farmers are bulk producers of milk and meat. Besides, milk and meat livestock are valued for one or several of the following traits: capital, credit, traction, hides and skins, fuel and fertilizer. Saadullah (2012) concluded that large numbers of buffaloes are being kept by the farmers under different systems of husbandry. Now, there is tendency towards larger herd size with improved management practices. Buffalo is a part of their farming enterprises to supplement their farm income. Farmers usually produce some green fodder in their normal crop rotation or collect by cut and carrying systems from fellow land and utilize the cereal straws and by-products produced at their farm. Their feed supply is closely tied with the cropping system and available land for grazing. Most of the farmers are rural small holders who have traditionally integrated their livestock with crop production. Buffaloes are raised mainly provide draught power in crop production. Family labour is available whenever needed. Throughout the South East Asian countries, farmers maintain only sufficient number of buffaloes as a source of draft power on their farms in different region of Bangladesh. Buffalo milk and meat is not accepted by all people in the country especially in the urban area. The exceptions are in coastal areas of Bangladesh where buffalo meat is equally relished like cattle meat.

In Bangladesh, very little work has been done so far on meat quality of the buffalo and the management practices of buffaloes. Buffalo has some significant importance on livelihood improvement. It is not possible to investigate the status of buffaloes and the farmers throughout Bangladesh at a time but this is an attempt to know about the regional status of the buffalos and the buffalo farmers. Keeping these in mind, an attempt was made to conduct this investigation to investigate the management practices of buffaloes in some selected areas of Pauba upazilla in Rajshahi, Madargonj upazilla in Jamalpur and Sadar upazilla in Mymensingh district and to observe the meat quality on the basis of management practices in the selected areas.

Materials and methods

Selection of the study site & respondent

The study was conducted at three villages in Rajshahi, Mymensingh and Jamalpur district of Bangladesh. Where plenty of feeds and fodders are available for buffaloes and buffaloes can perform their productive and reproductive performance easier in this region. Therefore, these areas are very much suitable for buffalo rearing and at the same time to improve producing good quality of meat.

In total 100 respondents were chosen from three villages & classified into three distinct groups according to the upazilla level. The farmers belong to Groups, who were living in Sadar upazilla in Mymensingh, belongs to Group-m, were living in Madargonj upazilla in Jamalpur and belongs to Group-p were living in Pauba upazilla in Rajshahi.

Table 1. Buffalo Population of the study area

Study Area	Buffalo Population	Farmers Population
Mymensingh	9849	3278
Jamalpur	6853	3098
Rajshahi	13686	5762

Preparation of interview schedule

A draft schedule was developed before preparing the final schedule. The draft schedule was then pre-tested with selected farmers in the study area and then it was rearranged and modified as required. The schedule was developed in a simple manner to avoid misunderstanding and to get accurate answer. Eventually it was finalized according to the experience gathered in the preliminary field survey. This helped the respondents to understand the interview schedule easily and furnish the required information swiftly and systematically.

Data collection procedure

The researcher collected the information through personal interview from the individual respondent present in their own house. An introductory visit was made to the study area when the aims and objects of the study were explained to most of the respondents. This helped to have a friendly orientation of the respondents. Brief information regarding the nature and purpose of the study was made to the respondents before actual interview. The researchers also established desire rapport with respondents. Questions were asked systemically and explain whenever it was felt necessary. The information supplied by the respondents was recorded directly on the interview schedule. The information was checked carefully before leaving the study area in order to minimize errors. Data were collected in local unit. These were subsequently converted into appropriate standard unit. The respondents were interviewed at their own house so they could give accurate information without any hesitation and sound mind. No serious problem was faced by the respondents during data collection. Excellent cooperation was received from all respondents at the time of data collection period. Data was collected during February to April, 2016. After completion of field

survey all the interview schedules were set for its data tabulation for coding and reduction. All the individual variables of the interview schedules were transferred to master sheet to facilitate tabulation. Tabulation as well as cross tabulation were done on the group basis.

Measurement of variables

The selection of variables and their measurements constitute an important task in research. The selected variables in this study area follows: age of the farmers, education, no of the buffalos, socio-economic status, livestock status, breeding condition, feeding condition, housing condition, disease and health care, daily routine activities of farmers for buffalo rearing, annual cost of production for one buffalo, annual income from one buffalo, use of buffalo income for livelihood (food, cloth, house, education, health care, social status), problems of buffalo rearing, milking condition, training of farmers, farmers suggestion to increase buffalo production.

Collection of meat from these regions

After completing of survey or data collection I collect the buffalo meat (amount 2kg) without fat or bone (only fresh meat) from these regions. For the fulfillment of the objectives it stores in separate condition in refrigerator. After collection of meat I test only pH of meat for getting accurate results.

Collection of meat for estimation of cooking loss & drip loss

Firstly, samples were collected and weighted and then Samples were prepared with polybag and boiled 70˚C for about 30mins. After collection of samples weight, cooking loss was measured. Samples were prepared and it stay in refrigerator for loss. After 24 hours samples were collected for weight and got drip loss.

Proximate composition of the meat

Proximate composition of some different region (Mymensingh, Jamalpur & Rajshahi) collected meat were done according to AOAC, 2005.

Collection and preservation of buffalo meat

Approximately buffalo meat was collected from the study areas between February to April, 2016.

Chemical analysis

Few of the samples were ground in a grinding for chemical analysis. Chemically, buffalo meat had significantly ($P < 0•05$) less intramuscular fat and significantly ($P < 0.001$) more moisture than other meat. The sarcoplasmic protein concentration of the buffalo was significantly ($P < 0.001$) while the myofibrillar protein concentration was similar in all ruminant species. Buffalo meat was darker red in color. It had significantly ($P < 0.001$) superior water-holding capacity and less cooking losses. Meat flavor was significantly ($P < 0•05$) less strong.

Enumeration of yeasts and molds counts

(Colony count technique at 25°C): Yeasts and molds count were enumerated according to the method of IDF (1990). Pre prepared test sample (1 ml) of 10, 10 and/or 10 dilutions was transferred into sterile petri dishes through dispensing pipette (1000 p) with sterile plastic tips and warm (45±1°C) sterile potato dextrose agar medium (15 ml) was mixed with inoculums. The mixture was allowed to solidify and incubated (25 C) for 5 days Parallel to that control plates were also prepared using medium (15 ml) to cheek the sterility. The disc containing more than 10 and/or fewer than 150 colonies were selected and counted using colony counter.

Statistical analysis of the data

All the collected data were checked and cross checked before transferring to the master sheets. The data were coded, compiled, tabulated and analyzed to accomplish the objectives of the study. Qualitative data were converted into quantitative by means of suitable scoring technique wherever applicable. Data were presented mostly in the tabular form widely used and easy to understand. Various statistical measures like number, average, percentage distribution, Chi-square test etc. were done in describing the variables.

Result and Discussion

Management practices

Most of the farmers arrange locally available feed which is costless. In winter season, feeding of buffalo is very difficult due to scarcity of feed that is why farmers of Trisal in Mymensingh and Madargonj in Jamalpur regions send their animal in sylhet or Sunamgonj region for proper rearing. The farmers of Pauba in Rajshahi fed highest amount roughage and concentrate feed to the buffalo than other two regions of Bangladesh as well as give more permanent shelter. But the farmers of Trisal in Mymensingh take more training on buffalo rearing than other two regions (Table 2). Saadullah (2012) observed that the management practices adopted by buffalo raisers usually depends on the type of production in which they are involved. At the village level production is usually based on a small herd of mixed ages and sexes generally for draught which is similar with the present finding. Saadullah (2012) reported that most of the farmers are small holders who have traditionally integrated their livestock with crop production and buffaloes are raised mainly to provide draught power in crop production. The feed resource base for these buffaloes are scavenging and consists of crop residues, household waste, tree fodder, roots and tuber, grain by-products this is also agree with the present result. Most of the animals are kept loose in an open paddock throughout the day and night. The open paddock is provided with shelter. A common watering tank and feeding manager is provided to make management more effective which is also quite similar with the finding of (Calub, 1980).

Table 2. Survey results at different Location

Location	Types of Feeding	Types of Housing	Training Practices
Pauba in Rajshahi	Roughage-70% Concentrate-8%	Permanent-5% Temporary-30% Others-65%	15%
Trisal in Mymensingh	Roughage-63% Concentrate-6%	Permanent-3% Temporary-25% Others-72%	17%
Madargonj in Jamalpur	Roughage-57% Concentrate-5%	Permanent-2% Temporary-28% Others-70%	12%

Morphometric characteristics of buffalo

Morphometric characters refer to body weight, shoulder height, body length, chest width, chest depth, chest girth, skull length, skull width, skull height, ear width, ear length, cannon girth, horn length, horn girth and distance between horns and body morphology characters refers to horn position, head color, body color and scheme of body color of the buffaloes. The data in the Table 3 show the comparison among the three groups. Comparison of body height, face length and ear length differ significantly ($p<0.01$) among the three groups. The highest body height and face length were found in Rajshahi region than other two regions, but highest ear length was found in Jamalpur region than other two regions. On the other hand, body length, chest girth, paunch girth, face width, horn length and tail length does not differ significantly among the three groups.

Table 3. Phenotypic characters of buffalo at three different regions of Bangladesh

Parameters	Mymensingh	Jamalpur	Rajshahi	Level of sig.
Body Height (BH)	126.76^{b}±0.61	130.44^{ab}±1.11	135.18^{a}±3.31	**
Body Length BL	128.85±1.29	126.85±3.51	136.12±2.45	NS
Chest Girth(CG)	193.43± 3.43	196.19±2.54	201.10±2.36	NS
Paunch Girth(PG)	201.39±1.50	200.49±6.78	208.53±3.53	NS
Face Length(FL)	41.27^{b}±0.86	40.38^{c}±2.05	46.58^{a}±1.68	**
Face Width(FW)	22.23±0.76	21.62±0.69	22.12±0.43	NS
Horn Length(HL)	33.49±1.42	31.79±0.88	33.09±1.14	NS
Ear Length (EL)	24.88^{c}±0.91	28.36^{a}±0.93	26.57^{b}±0.58	**
Tail Length(TL)	92.84±2.25	92.95±0.95	96.78±1.00	NS

Means with different superscripts within the same column differ significantly; ** = Significant at 1% ($p<0.01$) level of probability; *= Significant at 5% ($p<0.05$) level of probability; NS= Non significant; Figures in the parentheses indicate the number of observation.

Chemical composition of buffalo meat

The data above the Table 4 show the comparison of proximate analysis of meat among the three groups. Comparison of CP contents differ significantly ($p<0.05$) among the three groups. The highest CP content was found in Mymensingh region than other two regions. On the other hand, EE, DM and Ash content does not differ significantly among the three groups. Kim and Lee (2003) also showed that no significant difference was found in crude protein content among the groups. They showed that the percent of crude protein contents were 19.77±0.38, 20.63±0.35 and 20.62±0.86 in Grade l, Grade 2 and Grade 3 LD muscles in Hanwoo Korean native beef cattle, respectively which are dissimilar with the finding of this present study. Duarte et al. (2011) showed that maturity did affect moisture content ($p>0.05$) which differ the result of present study. Duarte et al. (2011) found that there was an effect ($p<0.05$) of maturity on the ether extract (EE) content of beef samples. Beef from animals with 2 permanent incisors had lower ($P<0.05$) EE content compared to those from animals belonging to the 4 and 6 teeth groups, which did not differ from each other (>0.05). Kim and Lee (2003) carried out an experiment on Hanwoo Korean native beef cattle and reported that Grade 1 LD muscles had the highest fat contents (9.87±0.91 %), and grade 2 LD muscles had higher fat contents (7.67±0.52%) than third LD muscles (6.13±0.71%; $P<0.05$) which is almost similar with the results of this experiment. Kim and Lee (2003) also showed in Hanwoo Korean native beef cattle that no significant difference was found in crude ash content among the groups. They showed the percent of crude protein contents of 1.67±0.21, 1.63±0.34 and 1.58±0.36 in Grade 1, Grade 2 and Grade 3 LD muscles, respectively. In a study of Duarte et al. (2011) they showed that dental maturity did not affect ($P>0.05$) beef ash and these results are also agreed with the result of this study.

Table 4. Proximate analysis of meat of three different regions of Bangladesh

Parameters	Mymensingh	Jamalpur	Rajshahi	Level of sig.
CP (%)	18.09^{a}±0.43	16.21^{b}±0.36	14.51^{c}±0.57	*
EE (%)	8.89±0.09	9.91±0.05	7.97±0.06	NS
DM (%)	25.01±0.11	25.59±1.00	24.83±0.75	NS
ASH (%)	1.35±0.27	1.43±0.09	1.59±0.26	NS

Means with different superscripts within the same column differ significantly; ** = Significant at 1% ($p<0.01$) level of probability; *= Significant at 5% ($p<0.05$) level of probability; NS= Non significant; Figures in the parentheses indicate the number of observation.

Physicochemical properties

The data above the Table 5 show comparison of meat quality among the three groups. Comparison of PH, drip loss, cooking loss, and color differ significantly at 1% ($p<0.01$) and at 5% ($p<0.05$) level of probability among the three groups. The highest pH and drip loss were found in Jamalpur region than other two regions, but highest cooking loss was found in Rajshahi region than other two regions. On the other hand, meat color also differs from region to region. pH measurements alone can be used to follow glycolytic changes in muscles. Kim and Lee (2003) also showed in Hanwoo Korean native beef cattle that twenty-four hours postmortem, when glycolysis is considered to be complete, the pH values were the same in all quality groups (all mean values were between 5.47 and 5.49), and not significantly different. Han et al. (1996) also reported that pH values of quality grade groups from Hanwoo LD muscles were not statistically different ($P>0.05$). Duarte et al. (2011) in their study that there was no effect ($P>0.05$) of dental maturity on the carcass ultimate PH, with a mean value (6.4) slightly above values typically observed in beef carcass (5.5-5.9) which is differ from the result of this study. Kim and Lee (2003) worked on Hanwoo Korean native beef cattle and reported that the drip loss increased steadily as time postmortem increased, after 7 days' postmortem storage, drip loss for grade 1 (4.53%) group was significantly lower than that for grade 3 (6.26%) which is almost similar with result of this experiment. Kim and Lee (2003) also showed in Hanwoo Korean native beef cattle that Grade 1 and grade 2 cow LD muscles had lower cooking loss (27.72 and 28.08% respectively) than grade 3 LD muscle (29.11%) that value is highly differ from this result. A survey of Kauffman et al. (1992) found that only 16% of the carcass has ideal lean quality based on colour, firmness and water-holding capacity. Color may be the most important factor that influences the appearance and attractiveness of beef to consumers (Faustman and Cassens, 1990). The appearance of the meat surface to consumers depends on, among other factors, the quantity and physical state of myoglobin. Regardless of species, breed or gender muscle composition varies with increased animal age (Lawrie, 1998). Duarte et al. (2011) showed in their study that regarding beef color, there were no differences ($P>0.05$) for the redness (a*) among dental age maturity groups. Similarly, there was no effect of dental maturity ($P>0.05$) on L* (brightness). They also showed that mean b* values were affected by dental maturity ($P>0.05$). Kim and Lee (2003) conduct an experiment on Hanwoo Korean native beef cattle and reported that a* and b* and L* value did not differ among the quality grade groups ($P>0.05$) and these results differ from this result.

Table 5. Meat quality of three different regions of Bangladesh

Parameters	Mymensingh	Jamalpur	Rajshahi	Level of sig.
pH	$6.34^{b}\pm0.02$	$6.47^{a}\pm0.02$	$5.60^{c}\pm0.05$	**
Drip Loss	$5.47^{b}\pm0.19$	$6.06^{a}\pm0.29$	$4.85^{c}\pm0.35$	**
Cooking Loss	$7.72^{b}\pm0.24$	$7.47^{c}\pm0.52$	$10.15^{a}\pm0.55$	**
Color	$L=19.14^{b}\pm0.02$	$L=30.91^{a}\pm0.04$	$L=31.76^{a}\pm0.01$	**
	$a=3.92^{b}\pm0.03$	$a=4.24^{a}\pm0.4$	$a=3.23^{b}\pm0.02$	*
	$b=3.38^{c}\pm0.04$	$b=5.19^{b}\pm0.05$	$b=6.14^{a}\pm0.01$	*

Means with different superscripts within the same column differ significantly; ** = Significant at 1% ($p<0.01$) level of probability; *= Significant at 5% ($p<0.05$) level of probability; NS= Non significant; Figures in the parentheses indicate the number of observation.

Microbial Parameters

The data above the Table 6 show the comparison of microbial count of meat among the three groups. TVC, TCC and TYMC content of meat does not differ significantly among the three groups.

Table 6. Microbial count(log cfu/g)±SD of meat of three different regions of Bangladesh(Immediately after slaughtering)

Parameters	Mymensingh	Jamalpur	Rajshahi	Level of sig.
TVC	4.794±0.01	4.781±0.02	4.75±0.02	NS
TCC	1.547±0.02	1.531±0.01	1.549±0.02	NS
TYMC	1.750±0.02	1.8±0.01	1.777±0.01	NS

Means with different superscripts within the same column differ significantly; ** = Significant at 1% ($p<0.01$) level of probability; *= Significant at 5% ($p<0.05$) level of probability; NS= Non significant; Figures in the parentheses indicate the number of observation.

Conclusion

The study was conducted at three villages of three upazilla in Mymensingh, Rajshahi and Jamalpur district of Bangladesh to survey of the buffalo farmers, feeds and feeding, feeding systems of buffaloes, disease and health management of buffaloes, daily routine activities for buffalo rearing, housing condition of buffalo for the quality of buffalo meat in the selected areas. Duration of buffalo rearing was mostly practiced for two years for farmers (40.0%). It is evident that meat quality depends on management practices, feeding type, farmer's condition, housing condition etc.

Conflicts of Interest

The authors declare that there are no potential conflicts of interests.

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