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Original Article

Evaluation of lamb production potentiality of the Barind, Jamuna river basin and coastal region sheep of Bangladesh under intensive management

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ABSTRACT

Objective: This study was conducted to investigate the lamb production potentiality in terms of nutrient intake and utilization, growth performances, carcass characteristics and meat quality of three regional native sheep under intensive management condition.

Materials and methods: A total of 24 growing lambs having 08 lambs from each group with 4 to 6 months of age were used in this study. 40% urea molasses straw (UMS) and 60% concentrate mixture of the total diet were supplied according to lamb body weight. The total feed was offered at 4.0% live weight on dry matter basis of each animal. The completely randomized design was used in this experiment.

Results: The dry matter intake was significantly ($P<0.01$) lower but DM, OM, CP and ADF digestibility were higher ($P<0.01$) in Jamuna river basin group compared to other groups. All group having positive N-balance but significantly higher value ($P<0.01$) observed in Barind region sheep. Lower FCR ($P<0.01$) was found in Jamuna river basin group but it not differ significantly with Coastal group. Nevertheless, daily gain and total live weight gain were significantly ($P<0.01$) higher in Costal sheep. However, cost per kg gain, dressing percent, carcass characteristics and nutritive value of meat did not differ among the groups.

Conclusion: All the regional sheep have the potentiality but coastal region sheep are more potential than other regional sheep for commercial lamb production in Bangladesh. The results of this study could be exploited by disseminating this to the wider stakeholders to develop entrepreneurship mechanism on sheep farming.

KEYWORDS

Bengal sheep; Carcass; Lamb; Meat

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INTRODUCTION

Sheep is one of the important small ruminant species which is widely distributed throughout the world. Currently the global sheep population stands at 1,078.2 million head with 19 per cent found in Asia and Africa (FAO, 2008). Worldwide sheep are used for producing meat, milk and wool. It is an important source of income for the sheep farmers involving minimum investment, care and management. Furthermore, the sheep are considered as docile animals having capability of bi-annual lambing and multiple births (Bhuiyan, 2006). In Bangladesh, sheep stand as third in number after cattle and goat population, and are used primarily for meat production purpose. Moreover, lamb is softer than goat meat which easily digests. Sheep available in Bangladesh are mostly indigenous non-descript type which do not belongs any specific breed. But there are some remarkable genetic qualities are found in this local sheep.

Bangladesh possesses 3.34 million sheep at present (DLS, 2016). Small and landless farmers rear about 37.5%, medium farmers 40.0% and large farmers 22.3% of total sheep in Bangladesh (Faylon, 1988). They are sparsely distributed throughout the country but relatively higher concentration (about 32% of total sheep population) are found in three different ecological zones like, Barind, Jamuna river basin and Coastal areas, where farmers maintain larger commercial (meat) flocks (BBS, 2008). Native Bengal sheep found in these three different ecological zones also vary phenotypically. In Bangladesh, sheep production is reputed due to their high prolificacy, early maturity, extreme disease resistance, superior skin quality, and wide range of adaptability under adverse agro-climatic condition (Sultana et al., 2011). But, lamb or mutton is not popular as like goat meat.

The present livestock sector in Bangladesh only produce 30.18% of the total requirement of meat and the per capita consumption of meat is estimated only by 8.6 Kg against 42.1 Kg and 32.2 Kg for world average and developing countries average, respectively (Huque, 2012). To narrowing down this gap, the meat production of the country must be increased in many folds. Therefore, different non-popular species including sheep might be emphasized as a meat animal. These animals were neglected in the past; therefore data regarding comparative lamb production potentiality of three different regional sheep is scarce or not found in systematic way. Nowadays, the Bangladesh government is also emphasizing the raising of sheep and farmers are also aware about sheep farming for the production of lamb. Therefore, the study was undertaken with the objective to investigate the lamb production potentiality in terms of nutrient intake and utilization, growth performances, carcass characteristics and meat quality of three regional native Bengal sheep under intensive management condition.

MATERIALS AND METHODS

Ethical statement: The research work was conducted by following the pprinciples of laboratory animal care (NIH publication No. 85-23, revised 1985).

Experimental site: The experiment was carried out at the Goat and Sheep Research Farm under Goat and Sheep Production Research Division, Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka-1341, Bangladesh during June 2015 to September 2015.

Experimental animals: A total of twenty four growing lamb with 4 to 6 months of age were randomly allocated in three different groups having eight lambs per treatment. All lambs were treated with anti-helminthes (Endex, Novartis, India) before the commencements of the experiment to ensure the lambs were free of intestinal worms. The lambs were reared in individual pens measuring 1.25 m^2 (1.25 m × 1.0 m), and were provided individual feeder and water bucket. The lambs were allowed for 10 days of adjustment period during which they were gradually adapted with the experimental diets.

Experimental diet and feeding management: The lambs were fed 40% Urea molasses straw (UMS) and 60% concentrate mixture according to their body weight. Rice straw was collected from central feed store of BLRI and chopped by scythe into the size of 2 to 2.5 inch for ease of feeding. Subsequently chopping rice straws were mixed with water, molasses and urea to prepare UMS. The conventional concentrate ingredients (broken maize, soybean meal, wheat bran, vitamin mineral premix, DCP and salt) were procured from a local feed mill, and the dietary mixtures were prepared weekly for feeding the lambs. The concentrate mixture contained 42%broken maize, 38% soybean meal, 17%wheat bran,1%vitamin,1% DCP and 1%salt.All diets were formulated to meet the nutritional requirements of the growing lamb adjusted according to their live weight (NRC, 2007). The total feed was offered at 4.0% live weight on dry matter basis of each animal. UMS was offered to each animal 40% of total diet with 20% extra for ad libitum feeding. The required amount of UMS and concentrates were divided into two equal parts and the animals were supplied daily

during morning and evening. The chemical compositions of experimental diet are presented in **Table 1**.

Estimation of feed cost: The ingredients used in experimental ration were rice straw, molasses, urea, broken maize, soybean meal, wheat bran, vitamin-mineral premix, di-calcium phosphate and common salt. Total cost per quintal of each experimental diet was calculated by taking into consideration procurement price of various feed ingredients used and processing cost. The prices of major ingredients were collected from Livestock and Poultry feed market in Savar, Dhaka, Bangladesh. On the basis of this cost, economics of feeding was calculated. Based on total feed cost on dry matter basis, per day feeding cost and cost of one kg body weight gain was calculated.

Digestibility and nitrogen balance studies: These were carried out immediately after the growth trial; four sheep from each of the dietary group were randomly selected for determining digestibility of the feeds and nutrients using the total collection method during the last ten days of the trial. Metabolic trays were placed under individual pens for the collection of faeces and urine separately. The animals were continued to feed the experimental diets. They were allowed 3 days to adjust with the additional management system prior to start of the total collection of urine and faeces for 7 days. The faeces of each of the animals were collected, weighed, and sampled (10%), and kept in a freezer (-20°C) for further analysis. The total urine of each of the animal was weighed, sampled (10%), and kept in plastic containers containing 100 mL 6N H_2SO_4 to prevent ammonia loss. The containers were kept in a freezer. The samples of feed and refusals of the total collection period were mixed thoroughly, and a composite sample for each animal was taken for analysis of the chemical components. Dry matter and crude protein was determined using the fresh sample and the other chemical components (ether extract, ash, neutral detergent fibre, and acid detergent fibre) were analyzed using dried and milled sample.

Slaughter procedure and carcass sampling: At the end of the growth and digestibility trial, four sheep were randomly selected from each of the treatments for slaughtering. All the selected animals were fasted for 24 h and slaughtered according to the '*Halal*' method. The fasted live weights of the animals were recorded prior slaughtering, and individual hot carcass weights were recorded immediately after evisceration. Non-carcass components (*e.g.*, skin, head, liver, spleen, lung, feet, heart, kidneys, gastro-intestinal tract fat and kidney fat) were removed and measured weight. Different parts of compound stomach (rumen, reticulum, omasum and abomasum) and post-ruminal tract (small intestine, large intestine and cecum) were removed and weighed individually.

The digesta content of the stomach and post-ruminal tract were removed, and the empty tract was washed and weighed. Dressing percentage was calculated as hot carcass weight relative to fasted body weight. The carcasses were divided into equal halves along the midline using a carcass saw. The left half was used for the determination of chemical composition, while the right half was assigned for determining carcass composition (lean, bone and fat) and carcass cut. The sample was taken from Longissimus dorsi (LD) area for proximate analysis. The right side of each carcass was weighed and then separated into eight primal cuts according to AUS-MEAT specifications: neck, shoulder, rack, loin, fore shank, flank, leg champ and leg. The cuts were weighed and expressed as percentage of the total hot carcass. Each cut was dissected in to components of lean, bone and fat.

Data collection: Different parameters like, dry matter intake (DMI), live weight gain (LWG), feed conversion ratio (FCR), feed digestibility, carcass characteristics and meat quality of lambs were recorded. Live weight of each animal was recorded at the onset of the trial and later on weekly basis. Feed of known weight was offered and residual weights taken daily to determine total feed intake of animals. The duration of the growth trial was 90 days.

Chemical analysis: Chemical compositions of the experimentally prepared diets are illustrated in the **Table 1**. Experimental diets and dried samples were ground and sieved using a 2 mm filter before analysis. The crude protein present in each sample was determined by using the automated Kjeldahl method (AOAC, 2016). Dry matter content of the feed was measured by drying the samples at 105°C overnight, while ash was measured by burning further at 500°C for 4 h. The neutral detergent fiber (NDF) and acid detergent fiber (ADF) composition were determined as per the method described by Goering and Van Soest (1970).

Experimental design and statistical analysis: The experiment was arranged in a completely randomized design (CRD) and the data were analyzed using the software IBMSPSS Statistics 20. The differences were tested by DMRT test and significant differences were declared when $P<0.05$.

RESULTS AND DISCUSSION

The feed intake and growth responses by different regional native Bengal lambs are shown in **Table 2**. The DMI was significantly ($P<0.01$) lower in Jamuna river basin group compared to other groups. Sultana et al. (2017) found a little bit higher DMI in native growing Bengal lambs in a study where they replace conventional concentrate feed with moriga foliage in a straw based diet. The DMI by lambs on % body weight was the normal range as mention by other researchers for native Bengal lambs (Sultana et al., 2010; Sultana et al., 2017).

At the onset of experiment initial live weight of lambs of different groups were not differ significantly but at the end of trial total live weight gain differ significantly ($P<0.01$). The highest live weight gain observed in Coastal region lambs followed by Barind and Jamuna river basin region lambs. The results suggest that growth response ability of different regional lambs is not similar. The daily live weight gain of lambs also differ ($P<0.01$) among the treatment groups. The highest daily gain observed in coastal region lambs followed by Barind and Jamuna river basin lambs. Different authors (Mazumder et al., 1998; Sultana et al., 2011; Ahmed et al., 2015; Sultana et al., 2017) stated different values for daily weight gain of Bengal lambs at 4-9 months age range. Among them, Sultana et al. (2017) found higher values from this study for daily gain (118.17-134.33 gm/day) but others studies reported much lower values might be due to differences in feed, age of the lambs and condition of the experiments.

The results of FCR and cost per kg gain presented in **Figure 1**. The FCR was lower ($P<0.05$) in Jamuna river basin group but not differ significantly with Coastal group. This lower FCR may also be related with higher ($P<0.05$) DM and OM digestibility of feed by Jamuna river basin group (**Table 3**). Much higher FCR (13.8) was reported by Sultana et al. (2010) in 6-9 months age castrated lambs fed a diet of ad libitum UMS and a concentrate mixture at 1% of their body weight. On the other hand, Sultana et al. (2017) stated lower FCR (5.0), fed a diet containing 30% molasses straw and 70% concentrate of lamb's DM requirements. Ahmed et al. (2015) observed more or less similar results for FCR in native Bengal lambs at similar age. Nevertheless, daily gain and total live weight gain (LWG) were significantly

Table 1. Chemical composition of the experimental diets

Diet	DM (%fresh)	Chemical composition (%DM)					Estimated ME (MJ/Kg DM)
		Ash	OM	CP	ADF	NDF	
Urea Molasses Straw (UMS)	54.71	17.08	82.92	10.74	48.74	78.07	7.93
Concentrate mixture	88.76	7.07	92.93	19.02	8.95	45.74	12.04

Table 2. Feed intake, growth responses, FCR and cost per kg gain by different regional Bengal lambs

Parameters	Barind	Jamuna river basin	Coastal	SEM	Level of Sig.
DMI (kg)	0.68b	0.50a	0.64b	0.05	**
DMI % Body weight	4.43b	3.64b	3.77b	0.15	**
Initial LW	11.54	10.53	12.88	1.02	NS
Final LW	18.87ab	17.11a	21.01b	1.27	*
Total LWG	7.33b	6.58a	8.13b	0.41	**
Daily gain (g/day)	82.37ab	73.88a	91.29b	4.66	**

*DMI=Dry matter intake, LW=Live weight, LWG=Live weight gain, NS=Non significant, * P<0.05,** P<0.01; a, b values within the same raw with different superscripts differs significantly*

Table 3. Nutrient digestibilityof different regional Bengal lambs

Parameters	Barind	Jamuna river basin	Coastal	SEM	Level of Sig.
DMD (%)	73.35a	76.00b	72.33a	1.07	**
OMD(%)	77.51a	79.47b	76.27a	0.93	**
CPD (%)	78.09b	79.06b	75.81a	0.89	**
NDFD(%)	74.72	75.90	73.30	1.07	NS
ADFD(%)	46.21a	53.69b	43.13a	2.77	**
Total N intake (g/d)	20.05b	16.91a	23.36c	0.32	**
Total N excretion (g/d)	7.48 b	5.89 a	11.42 c	0.29	**
NB (g/d)	12.57b	11.01a	11.94b	0.32	**

*DMD=Dry matter digestibility, OMD=Organic matter digestibility, CPD= Crude protein digestibility, NDFD=Neutral detergent fiber digestibility, ADFD=Acid detergent fiber digestibility, NS=Non significant, *P<0.05, **P<0.01; a, b values within the same raw with different superscripts differs significantly*

Table 4. Carcass characteristics and primal cut of different regional Bengal lambs

Parameters	Barind	Jamuna river basin	Coastal	SEM	Level of Significance
Slaughter weight (kg)	21.21b	17.60a	23.35c	0.85	**
Warm carcass wt(kg)	10.36b	8.59a	11.79c	0.42	**
Dressing %	48.86	48.93	50.44	0.98	NS
Fat (% of carcass weight)	12.22	8.30	12.60	0.96	NS
Lean (% of carcass weight)	65.73	66.04	63.49	1.05	NS
Bone (% of carcass weight)	22.04	25.66	23.91	0.79	NS
Lean:Bone	3.00	2.58	2.73	0.13	NS
Lean:Fat	5.52	8.39	5.51	0.63	NS
Carcass:Fat	8.39	12.66	8.51	0.86	NS
Carcass:bone	4.56	3.90	4.26	0.15	NS
Primal cut (% carcass weight)					
Neck weight	7.76	7.67	8.51	0.379	NS
Shoulder weight	29.29	27.57	30.50	0.606	NS
Rack weight	8.34	8.97	8.03	0.317	NS
Fore shank weight	6.31	4.34	3.81	0.532	NS
Loin weight	10.99	9.97	9.27	0.325	NS
Flank weight	5.61	6.72	7.01	0.310	NS
Leg chump weight	26.89	29.41	27.62	0.80	NS
Leg weight	4.81	5.35	5.24	0.138	NS

*NS=Non significant, * P<0.05, **P<0.01; a, b values within the same raw with different superscripts differs significantly*

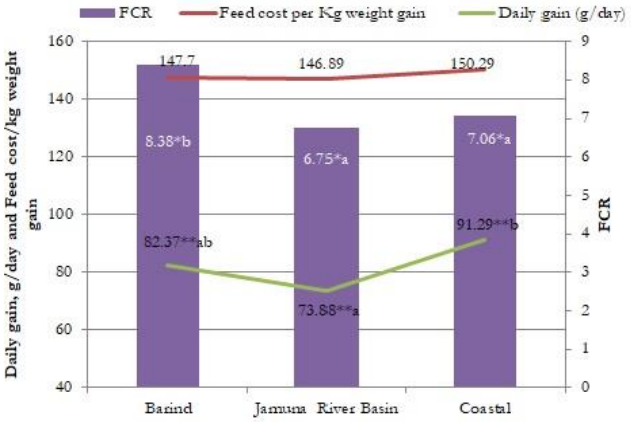

Figure 1: Performances of different regional Bengal lambs in terms of FCR, daily weight gain and cost per kg gain

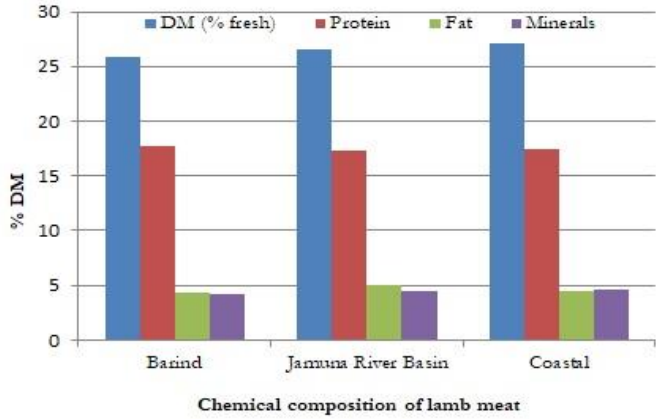

Figure 2: Nutritive value of meat (from longissimus dorsi muscle) of different regional Bengal lambs (*P*>0.05)

(*P*<0.01) higher in Costal lambs and FCR lower in Jamuna river basin lambs (**Table 2**) but feed cost per kg gain not differs significantly among the groups. The average feed cost per Kg gain found in this study is comparatively lower than those of previous reports (Sultana et al., 2010; Ahmed et al., 2015).

Nutrient utilization from experimental diet by different regional Bengal lambs is shown in **Table 3**. The DM, OM, CP and ADF digestibility and N-balance of experimental diets by different groups differ significantly (*P*<0.01). Results suggest that Jamuna river basin lambs are more efficient to utilize nutrients from the intake diets. But lower nitrogen balance observed in Jamuna river basin group that might be influenced in lower daily gain by this group. Positive nitrogen retention in all groups suggests that the experimental diet was sufficient to meet the requirement of lambs for maintenance and growth. Sultana et al. (2010) reported much lower DM, OM, CP and ADF digestibility in 6-9 months age castrated native Bengal lambs fed a diet of ad libitum UMS and a concentrate mixture at 1% of their body weight. But, Sultana et al. (2017) reported more or less similar range of DM, OM, CP and ADF digestibility and N-balance for similar age group of lambs, however, the diet was different.

The carcass characteristics and primal cut per cent of the warm carcass of different regional lambs are presented in **Table 4**. As at end of experiment, lambs live weight gain differ among treatment groups similarly, the slaughter weight and warm carcass weight differ significantly (P<0.01) among the treatment groups although, the initial weight and age range were similar. But the dressing percent did not vary among the treatment groups that indicates different regional lambs produce similar amount of meat in proportion with slaughter weight. The dressing per cent of this study was in similar range that are found in the other studies (Sultana et al., 2011; Sen et al., 2013; Sultana et al., 2017).

However, some other study reported much lower dressing per cent of native Bengal lambs (Mazumder et al., 1998; Ahmed et al., 2015). The production of lean, fat and bone along with lean:bone, lean:fat, carcass:fat, carcass:bone were not vary among the different regional lambs and the average results of these parameters are more or less agree with the result of Sultana et al. (2017).

The productions of primal cuts from different regional lambs are also presented in **Table 4**. No significant differences were found in primal cuts of different groups. The averages of different primal cut portion are more or less similar that obtain by Sultana et al. (2017) from native Bengal lambs with similar age range. The results suggest that all the regional lambs have the potentiality of commercial lamb production.

Nutritive values of meat (from longissimus dorsi muscle) of different regional Bengal lambs are shown in **Figure 2**. There is no significant difference observed in the nutritive value of different regional lamb meat. The average moisture, protein, fat and minerals content in the meat of native Bengal lambs are in the similar range that reported by Sultana et al. (2017).

CONCLUSION

The results of feed intake, digestibility and FCR indicate that both Jamuna river basin and Coastal lambs are better for lamb production in Bangladesh. Although, feed cost per kg gain, carcass characteristics and nutritive value of meat did not vary among the different regional sheep but, Coastal lambs grow faster considering daily weight gain. Thus, it can be concluded that Coastal region sheep have more potentiality than other regional sheep for commercial lamb production in Bangladesh.

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CONFLICT OF INTEREST

There is no potential conflict of interest in this study, including in the preparation of the manuscripts and publications of this article.

AUTHORS' CONTRIBUTION

This work was carried out in collaboration between all authors. SA designed the study, interpreted the data, and drafted the manuscript. MRHR was conducted the field research trial, managed the literature searches and contributed in manuscript preparation. MY conducted the field research trial and involved in collection of data. NS and NJ took part in preparing and critical checking of this manuscript. ME supported the research facilities and funding. All authors read and approved the final manuscript.

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