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Effect of age on the carcass characteristics, wholesale cuts and meat quality of native Bengal lamb

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ABSTRACT

This study was conducted to evaluate the lamb slaughter age on carcass characteristics and wholesale cuts of lamb and also the quality of lamb meat. A total of twenty four male native Bengal lambs of 06, 07 and 09 months of age were randomly selected from the herd of BLRI Sheep Research Farm with 8 lambs in each age category for this study. Lambs were raised in an intensive management system where they were supplied *ad libitum* German grass (*Echinochloa polystachya*) with a concentrate mixture of 40% Crushed Maize, 26% Soybean meal, 22% Wheat bran, 10% Rice polish, 1% Salt, 0.5% Vitamin-mineral premix and 0.5% DCP, at 1.5% of their body weight. All lambs were fasted for twenty four hours and slaughtered according to the 'Halal' method. Different parameters like slaughter weight, carcass weight, dressing percentage, primal cuts, edible offal, non-edible part of the carcass and proximate composition of the meat were studied. The results of this study indicate that with the increasing age, slaughter weight and carcass weight increase significantly ($P<0.05$) but dressing percentage not differ significantly. Similarly, Lean (meat without fat and bone), fat and bone portion in carcass also not differ significantly at 6, 7 and 9 months of lamb age. In case of primal cut of lamb carcass, only the parameters Loin and Hind shank differ significantly ($P<0.05$) among the treatment groups. As loin consist 12-13% of total carcass and it gives highest weight at 7 to 9 months of age thus results suggest that 7 to 9 months of age may be favorable to slaughter for lamb production. On the other hand, lamb age have no effect on edible offal and not edible part of carcass. Likewise, proximate composition of lamb meat has no significant effect among treatment groups.

INTRODUCTION

Bangladesh is agriculture based developing country where livestock act as leading component of agricultural economy performing multifarious roles. Among the domestic animals, sheep has great importance as multipurpose animal in the subsistence economy, social livelihoods of a large human population in low-input, small holder production systems in Bangladesh. During the last twelve years sheep population increased 2.5 times, with annual growth rate of 5% (BBS, 2008). Now Bangladesh has 3.16 million sheep which secure 3rd position in number among the ruminant species of Bangladesh (DLS, 2014).

About 32% Sheep are reared in three ecological zones such as Barind, Jamuna basin and Coastal areas (Bhuiyan, 2006) and rest 68% widely distributed all over the country. The large numbers of sheep are available in Rajshahi, Dinajpur, Bogra, Rangpur, Tangail Districts and in the delta region of Noakhali Districts (Rahman, 1989; Hossain et al., 1997). Most of the sheep are indigenous with few crossbreds are capable of bi-annual lambing and multiple births (Bhuiyan, 2006). The average live weight is 15 to 25 kg (Mukherjee, 2000) and is adapted to hot humid climate. Their body coat is grey, with black or white patches, and the face, ear and feet are mostly light black and their wool is coarse with high modulation.

In Bangladesh sheep rearing is reputed due to their early maturity, high prolificacy, delicacy of meat, superior skin quality, extreme disease resistance and wide range of acceptability under adverse agro climatic condition (Devendra and Burns, 1983),

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poor management and feeding practices. Moreover, indigenous sheep has good flocking instinct, ability to walk long distances in search of feed, high tolerance to adverse climatic conditions, endurance to droughts and to low and fluctuating nutrient availability (Kosgey et al., 2008). Under traditional feeding systems, the sheep are raised on harvested or fallow lands, roads, and canal sides (Sultana et al., 2010) and also graze on aquatic weeds and grass in knee-deep water. No other domestic animals are capable of existing on such feed. It can nibble tiny blades of vegetation efficiently by their small muzzles and split upper lips compare to other animals (Banerjee, 1989).

Sheep are ideally attractive for the smallholder farmers as they require smaller investments, easy maintenance under rural conditions, have shorter production cycles, higher reproductive capacity and growth performance (Devendra, 1999; Tibbo, 2006).

Lamb is the flesh of a lamb used as food. Nutrition is one of the major limiting factors for sheep production. In the final stages of sheep pregnancy nutrition is one of the very important factors and depends upon many qualities after birth. The most important characteristics of sheep are its prolificacy, lambing twice a year where twin is common (Rahman, 1989).

Sheep is raised primarily for meat production.Meat is the most important source of animal protein for the human diet (McAfee et al., 2010). Among our protein requirement 44 percent of the animal protein comes from livestock. 0.9% of total meat came from sheep and about 9.4 thousand metric tons of meat was annually produced from sheep in Bangladesh (FAO 2007). In case of lamb the approximate protein and fat content are 21 and 3 g per 100 g of lean meat. Although lamb is considered fattier than other meats by a lot of consumers, its fat content is not regarded as a problem as it gives tenderness and more flavor to the meat. So Sheep production has a significant share in the animal protein market but there are various factors affecting meat quality. Numerous factors including species, gender, growth rate and maturation, diet, genetic factors, diseases status, medication and hormone usage, rearing conditions, temperature, relatively humidity and generally husbandry practices have direct and indirect impact on meat quality (Troy and Kerry, 2010) and lead to changes in the consumption or marketing of meat. Although there is little variation in quality of meat of different species (Simonsen et al., 1988), but there is variation in quality of meat according to age and sex within a species. The variation in quality of meat also exists among different parts of carcass of an individual (Yeates et al., 1975). The consumers prefer meat of different wholesale cuts on the basis of colour, odour, quality, texture, age and microbial load of carcass. They want to pay different prices on the basis of such factor. Therefore, correct determination of the relationships between these variables plays an important role in meat marketing and consumption.

Carcass yield is important in the evaluation of animal production because it is directly related to the commercial value of the animal, being usually one of the first indexes to be considered. It is expressed as the percentage ratio between the carcass weight and live animal weight (Zundt et al., 2006). The proper conformation of the carcass indicates a proportional development of the different anatomical regions, and the best conformations are achieved when the parts with the greatest commercial value are well pronounced (Oliveira et al., 2002). These objective and subjective measures can be used to evaluate the characteristics of a carcass (Reis et al., 2001), and estimating the carcass characteristics is important to complement the evaluation of the animal's performance during its development (Jorge et al., 1999).

Sheep industry has received noattention to improve quality and quantity of lamb in Bangladesh (Hossain et al., 1997). Sheep are raising and slaughtering in unplanned way like other ruminants. There is a dearth of information for local sheep of Bangladesh on carcass characteristics (Mazumder et al., 1998). However, there is no information about the quality (physical or chemical) and microbiological status of different wholesale cuts of indigenous sheep carcass. Therefore the present study was undertaken to find out the age effect on carcass characteristics and wholesale cuts of lamb and to

determine the effect of age on the quality of lamb meat.

MATERIALS AND METHODS

Location

The experiment was carried out at the Goat and Sheep Research Farm, Goat and Sheep Production Research Division, Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka- 1341, Bangladesh during January 2017 to June 2017.

Experimental animals and diets

In this study, a total twenty four native male lambs of 06, 07 and 09 months of age were randomly selected from the herd of BLRI Sheep Research Farm with 8 lambs in each age category. Lambs were raised in an intensive management system where they were supplied *ad libitum* German grass (*Echinochloa polystachya*) with a concentrate mixture of 40% Crushed Maize, 26% Soybean meal, 22% Wheat bran, 10% Rice polish, 1% Salt, 0.5% Vitamin-mineral premix and 0.5% DCP, at 1.5% of their body weight. German grass (*Echinochloa polystachya*) was cultivated at BLRI fodder plot near to experimental site. The grasses were chopped into the size of 1 to 1.5 inch to increase their palatability. All feed sources-crushed Maize, soybean meal, wheat bran, rice polish; salt, vitamin-mineral premix and DCP were sourced from an agro-allied shop in Savar, Dhaka, Bangladesh.

Table 1
Chemical composition of existing diets practiced in BLRI Sheep Research Farm.

Diets	DM (% fresh)	Chemical composition (% DM)					
		Ash	OM	CP	NDF	ADF	EE
German Grass	19.91	9.41	90.6	9.01	80.45	51.22	0.54
Concentrate Mixture	87.6	11.63	88.37	18.42	45.95	8.59	2.32

Slaughter procedure and carcass sampling

All the twenty four animals selected were fasted for twenty four hours and slaughtered according to the 'Halal' method. The fasted live weights of the animals were recorded before slaughtering, and individual hot carcass weights were recorded immediately after evisceration. Non-carcass components (skin, head, feet, lung, heart, liver, spleen, kidneys, kidney fat, and gastro-intestinal tract fat) were removed and weighed individually. The stomach (rumen, reticulum, omasum and abomasum) and post-ruminal tract (small intestine, large intestine and caecum) were removed and weighed separately. 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.

Carcass cuts

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.

Chemical analysis

Dried samples were ground and passed through a 2 mm sieve before analysis. The CP of each of the samples was determined using the automated Kjeldahl method (AOAC 1995). Dry matter content of meat was determined by drying the samples at 105^{o}C overnight, while ash was measured by burning further at 500^{o}C for 4 hours. The neutral detergent fibre (NDF) and acid detergent fibre (ADF) composition were analyzed

using the method described by Goering and Van Soest (1970).

Statistical analysis

The experiment was arranged in a completely randomized design (CRD). The data collected were subjected to analysis of variance (ANOVA) using the one way ANOVA considering age of lamb as a fixed factor with SPSS-2014 computer package. Significant differences among means were separated using the Duncan's multiple Range Test (DMRT) at 5% level.

RESULTS AND DISCUSSION

This experiment was conducted to find out the age effect on carcass Characteristics and wholesale cuts of lamb and also to determine the effect of age on the quality of lamb meat. Results obtained from this experiment are discussed in the following sections.

The carcass characteristics of warm carcass of the experimental lambs are presented in Table 3. Slaughter weight and hot carcass weights were differ significantly (P>0.05) among the treatment groups. However, there were no variations (P>0.05) in dressing percentage of different carcasses. The range of values of dressing percentage of the Bengal lambs in the current study was from 48.36 to 51.56%. The warm carcass weight and dressing percentage depend on the final live weight at slaughter (Mushi et al., 2009) and were consequently affected by treatments. The percentages of lean of the hot carcass were higher in the lamb of 6 and 7 months of age compared to the remaining group of animals. Similar range of lean and fat of lamb carcass was reported by Cadavez (2009) and Gavani et al., (2008). Conversely, carcass: fat percentage of carcass weight was increased with the decreasing of lamb age. The differences in bone and lean to bone ratio of the animals of different age groups were not significant (P>0.05).

Table 3
Effect of lamb age on carcass composition of Bengal lamb.

	Lamb age (Months)			
Parameters	6 months	7 months	9 months	Level of sig.
Slaughter wt (kg)	17.03^{a}±0.71	19.27^{ab}±1.20	21.48^{b}±0.89	*
Hot carcass wt (kg)	8.67^{a}±0.67	9.32^{a}±0.61	11.05^{b}±0.42	*
Dressing %	50.55±2.32	48.36±1.25	51.56±1.11	NS
Lean, % of Carcass	59.11±2.12	56.83±1.70	54.88±2.26	NS
Bone, % of Carcass	24.76±1.72	25.90±1.58	24.45±2.41	NS
Fat, % of Carcass	16.13±1.15	17.26±1.47	20.66±2.15	NS
Lean: fat	3.83±0.35	3.54±0.46	2.89±0.37	NS
Carcass: fat	6.41±0.42	6.15±0.63	5.20±0.51	NS
Carcass: bone	4.18±0.30	3.95±0.22	4.34±0.38	NS

^{a,b,c} *Means within a raw with different superscripts are significantly different at P<0.05*

The percentage of primal cuts of warm carcass of different treatment groups is presented in Table 4. No significant differences were observed in primal cuts neck, shoulder, rack, fore shank, flank, and leg chump except the loin and hind shank. Loin was significantly (P<0.05) higher in 7 and 9months treatment groups than 6 months. On the other hand, hind shank was significantly higher in 7 months group. In general, different age groups had no specific trend on the different primal cuts except loin and hind shank.

Table 4
Effect of lamb age on primal cuts of native Bengal lamb (mean± S.E.).

Parameters (% of Carcass)	Lamb age (Months)			
	6 months	7 months	9 months	Level of sig.
Neck	6.53±0.44	6.45±0.55	6.06±0.78	NS
Shoulder	30.48±1.53	31.00±1.20	30.33±0.84	NS
Rack	6.74±0.62	7.43±0.62	7.80±0.35	NS
Loin	10.71^{a}±0.47	12.46^{b}±0.60	12.77^{b}±0.67	*
Fore Shank	3.20±0.12	3.65±0.30	3.39±0.26	NS
Flank	5.99±0.33	6.23±0.41	5.61±0.23	NS
Leg Chump	25.40±1.07	26.36±0.70	26.09±1.14	NS
Hind shank	4.65^{a}±0.20	5.21^{b}±0.12	4.43^{a}±0.11	*

^{a,b,c} *Means within a raw with different superscripts are significantly different at P<0.05.*

Table 5
Effect of lamb age on edible offal of carcass (% slaughter weight) of native Bengal lamb (mean ± SE).

Parameters	Lamb age (Months)			
	6 months	7 months	9 months	Level of sig.
Edible of fals (% of slaughter wt)				
Feet	2.62±0.09	2.60±0.10	2.32±0.10	NS
Head	6.03±0.61	6.32±0.66	6.60±0.52	NS
Empty GI tract	5.52±0.31	5.06±0.57	5.07±0.24	NS
Waste fat	3.37±0.65	4.08±0.59	5.73±1.01	NS
Pluck (trachea, lung, liver, kidney, spleen etc.)	3.85±0.23	3.71±0.28	4.07±0.34	NS
Total edible parts	21.39±0.89	21.77±1.61	23.80±1.07	NS
Non edible parts (% of slaughter wt)				
Skin	11.85±0.43	12.08±0.31	11.58±0.56	NS
Rumen digesta	9.69±0.51	9.77±1.18	11.43±0.65	NS
Gall bladder	0.12±0.05	0.06±0.01	0.07±0.01	NS
Diaphragm	0.30±0.02	0.76±0.40	0.59±0.25	NS
Urinary bladder	0.10±0.01	0.09±0.01	0.11±0.01	NS
Blood	7.32±3.62	2.79±0.36	3.25±0.17	NS
Reproductive organ	0.95^{a}±0.09	1.30^{b}±0.13	1.40^{b}±0.10	*
Total non edible parts	30.69±3.89	26.96±1.25	27.97±0.79	NS

^{a,b,c} *Means within a raw with different superscripts are significantly different at P<0.05.*

The percent of edible and non-edible parts of slaughter weights are summarized in Table 5.The different age treatments did not influence significantly (P>0.05) in the edible parts like feet, head, empty GI tract, waste fat and plunk (respiratory system, heart, kidney, liver and spleen etc.) on the percentage of slaughter weights. On the hand, non-edible parts such as skin, rumen digesta, gall bladder, diaphragm, urinary bladder, and blood was not significantly (P>0.05) different among the treatment groups. However, the reproductive organ was differ significantly

(P>0.05) among those treatments. Besides that the percentage of waste fat increased with the increase of lamb ageThe effect of age of lamb on proximate composition of meat (*Longissimus dorsi* muscle) of Bengal lamb was presented in Table 6. There are no significant differences (P>0.05) were observed in DM, OM, ash, CP and EE composition of meat among the treatment groups. However, DM and CP percentage were comparatively higher in the lambs of 7 and 9 months of age.

Table 6
Effect of lamb age on proximate composition of meat (*Longissimus dorsi* muscle) of native Bengal lamb (mean ± SE).

Parameters	Lamb age (Months)			
	6 months	7 months	9 months	Level of sig.
DM %	26.71±0.58	25.37±0.53	26.90±0.52	NS
OM %	96.52±0.26	96.12±0.34	96.77±0.17	NS
Ash %	3.48±0.26	3.89±0.34	3.23±0.17	NS
CP %	17.93±0.29	18.23±0.22	18.04±0.35	NS
EE/fat %	4.44±0.31	4.14±0.20	3.81±0.22	NS

^{a,b,c} *Means within a raw with different superscripts are significantly different at P<0.05.*

CONCLUSION

In Bangladesh, sheep is reared primarily for meat production. For commercial point of view carcass characteristics, wholesale cuts and quality of lamb meat are very important. This study evaluates the lamb slaughter age on carcass characteristics and wholesale cuts of lamb and also the quality of lamb meat. The results suggest that 7 to 9 months of age may be favourable to slaughter for lamb production in semi intensive management system. On the other hand, lamb age have no effect on edible offal and not edible part of carcass. Likewise, proximate compositions of lamb meat have no significant effect among treatment groups.

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