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Effect of age on meat quality of black Bengal goat meat in different agro-climatic zones in west Bengal

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Abstract

The study was conducted on sixteen numbers of castrated male Black Bengal goats from four different agro climatic zones of west Bengal at the age group of 6-9 month, 9-12 month and above 12 month age were selected from registered farmer under "AICRP on goat improvement, Black Bengal field unit-Kolkata" to compare the meat quality and physio-chemical characters of Black Bengal goats. In the present study, the moisture (%) of Black Bengal meat obtained from different clusters namely, Nadia, Murshidabad, Jhargram and Sundarban under four different agro-climatic zones at different age groups viz. 6-9 month, 9-12 month and above 12 month were found to be 75.27 ± 0.25 , 74.33 ± 0.25 & 71.75 ± 0.25 in Nadia; 75.33 ± 0.25 , 74.58 ± 0.25 & 71.83 ± 0.25 in Murshidabad; 75.31 ± 0.25 , 74.33 ± 0.25 & 2.25 ± 0.25 in Jhargram; and 75.50 ± 0.25 , 74.17 ± 0.25 & 72.08 ± 0.25 in Sundarban cluster respectively. It was found that all age groups, the protein (mg/100ml) content of Black Bengal meat was found to be significantly lower in Nadia cluster. At 6-9 month and above 12 months the protein content was higher in Sundarban cluster. Regarding ash (%) content of Black Bengal meat significantly higher values were observed in Nadia cluster at 6-9 month age group and lower values were recorded in Sundarban cluster irrespective of age. There was significant variation in different ages has been observed for pH, cholesterol, water holding capacity and muscle fiber diameter of meat but no variation was recorded for pH, cholesterol, water holding capacity and muscle fiber diameter of meat among different cluster. Data has analyzed for the effect of age on meat quality among four agro-climatic zones and the current findings implies that not only age but the agro-climatic variations also has no influence on proximate composition and physico-chemical quality of goat meat.

Keywords: Black Bengal goat, agro-climatic zones, proximate composition, physico-chemical quality

Introduction

Goats are among the main meat-producing animals in India and goat meat (Chevon) fetches huge domestic demand, with no social, cultural, and religious taboos. Rearing of livestock is mainly traditional in India (Bhat and Taneja, 1998) [5]. Livestock rearing is very significant for rural financial system and supplements a farmer's income and often act as a support in times of agricultural crop collapse. Rearing of Bengal goats readily accepted by the farmers due to its high priced meat, good quality of leather and high prolificacy rate. Goats easily marketable and it earn more liquid form of capital than cattle (Sendros, 1993) [16]. West Bengal holds the first position (15.07 million) in India (123 million) (Annual Report, 2007-08) [2] and holds a valuable genetic resource of dwarf goats, known as Black Bengal Goat (Syn. Bengal Goat). As per 19th Livestock Census [12], the population of Bengal goat in West Bengal is 1, 15, 05, 950 which is about 8.51% of the Indian goat population. Out of 23 districts, Paschim Medinipur District possessed the highest number of goat (10.65% share with 12, 25, 898 goats), followed by Murshidabad District (9.43% share with 10, 85, 099 goats) and Bardhaman District (8.90% share with 10, 24, 136 goats). In West Bengal, contribution of goat meat is around 0.242 MT (19th Livestock Census) [12] and more than Rs. 106 billion annually to the national economy, providing livelihood to millions of marginal and small farmers and agricultural labourers (Kumar, 2007) [11]. Goat being a multipurpose animal which can produce meat, milk and hide is an important choice to the small and marginal farmers of India, especially West Bengal. Consumers' highly expect that the products they purchase are of high quality and this is especially true for meat and meat food products (Thulasi, 2006) [16]. Meat production is the most important output of goat farming in the tropics (Devendra and Burns, 1983) [8]. In West Bengal, there are six different agro-climatic zones which may influence the proximate

composition and physico-chemical quality of Goat Meat. But the inference in this regard is still scanty due to very minimum attempt of research. In consideration to the above, the present research programme has been carried out in four agro-climatic zones of West Bengal to compare the effect of agro-climatic zones on meat quality of Black Bengal goat meat in different ages.

Materials and Methods

A pilot survey for designing data collection format was conducted during the month of September, 2017 to March, 2018. All Parameters were studied at the Department of Livestock Products Technology, F/O-Veterinary and Animal Sciences, West Bengal University of Animal and fishery Sciences. The research programme was carried out in four adopted clusters of the ongoing project "AICRP on Goat Improvement, Black Bengal Field Unit - Kolkata" distributed in four agro-climatic zones (Coastal Saline Zone: Sundarban; Gangetic Alluvial Zone: Nadia; Undulating Red and Lateritic Zone: Jhargram and Old alluvial zone: Murshidabad) of West Bengal. In the present study, 6 nos. of castrated male Black Bengal goats from each agro climatic zone at the age group of 6-9 month, 9-12 month and above 12 month age were purchased from registered farmer under AICRP. Goats were weighted and kept off-feed overnight with free access to water and were slaughtered and dressed by the halal method in different local slaughter booths in the study areas. Immediately after dressing, chest circumference, carcass length and leg circumference of the carcass hanging with Achilles tendon were recorded using a measuring tape in centimetre. Carcasses were washed thoroughly using tap water after taking measurements. All the samples were weighed, covered with plastic wrap to prevent moisture loss and kept in chilled with ice pack and transported to departmental laboratory for storage and further study at 4±1°C. The moisture, protein, fat and ash content of meat samples were determined by the method described by AOAC (1995) [3]. The pH of muscle was determined blending 10 g of sample with 50 ml of distilled water by a digital pH meter (WTW®, Germany, Model 330i fitted with Sen Tixsp electrode). Cholesterol content of minced meat was determined using cholesterol test kit. Water-holding capacity (WHC) of meat was estimated by a centrifugation method (Wardlaw *et al.*, 1973) [17]. The muscle fibre diameter, sarcomere lengths were determined by using the method

prescribed by Jeremiah and Martin (1977) [10] and Cross *et al.*, (1981) [7], respectively. All the data which were obtained during the present investigation were analyzed statistically to draw valid conclusion in SPSS (Version 16.0) software.

Results and Discussion

In the present study, the moisture (%) of Black Bengal meat obtained from different clusters namely, Nadia, Murshidabad, Jhargram and Sundarban under four different agro-climatic zones at different age groups viz. 6-9 month, 9-12 month and above 12 month were found to be 75.27±0.25, 74.33±0.25 & 71.75±0.25 in Nadia; 75.33±0.25, 74.58±0.25 & 71.83±0.25 in Murshidabad; 75.31±0.25, 74.33±0.25 & 71.83±0.25 in Jhargram; and 75.50±0.25, 74.17±0.25 & 72.08±0.25 in Sundarban cluster respectively (Table-1). There was no significant differences in moisture (%) and fat (%) of Black Bengal meat among all age groups as well as areas were found. Table-1 represented protein (mg/100ml) content of Black Bengal meat of different age group and different clusters. In all age groups, the protein (mg/100ml) content of Black Bengal meat was found to be significantly lower in Nadia cluster. At 6-9 month and above 12 months the protein content was higher in Sundarban cluster. Whereas at 9-12 month age group higher values were observed in Jhargram cluster. Regarding ash (%) content of Black Bengal meat significantly higher values were observed in Nadia cluster at 6-9 month age group and lower values were recorded in Sundarban cluster irrespective of age. At age group 9-12 month lower values was recorded in Jhargram cluster and higher values was observed in Sundarban cluster respectively. At above 12 month higher values were observed in Nadia cluster and lower values were observed in Murshidabad cluster. Gopalan *et al.*, (1989) [9] reported that meat consist of 74.2, 21.4, 3.6 and 1.1% moisture, protein, fat and minerals respectively. Asaduzzaman *et al.*, (2009) [4] reported that the percentage of moisture, protein, fat and ash contents were 72.79, 21.9, 3.72 and 1.15 for Black Bengal goat. Murshed *et al.*, (2014) [13] reported that dry matter 23.34, crude protein 24.54, ether extract 4.14, ash 0.95 respectively. There was significant variation in different ages has been observed for Moisture and Fat of meat but no variation was recorded for Moisture and Fat of meat among different cluster. The deviation of the results of our study may be due to age of the animal as well as geographical location and agro-climatic condition.

Table 1: Age wise variation of Proximate Composition of Black Bengal goats

Parameter	Cluster	Age Group			
		6-9 month	9-12 month	Above 12 month	Overall
Moisture (%)	Nadia	75.27±0.25 ^p (6)	74.33±0.25 ^q (6)	71.75±0.25 ^r (6)	73.78±0.14 (18)
	Murshidabad	75.33±0.25 ^p (6)	74.58±0.25 ^q (6)	71.83±0.25 ^r (6)	73.92±0.14 (18)
	Jhargram	75.31±0.25 ^p (6)	74.33±0.25 ^q (6)	72.25±0.25 ^r (6)	73.97±0.14 (18)
	Sundarban	75.50±0.25 ^p (6)	74.17±0.25 ^q (6)	72.08±0.25 ^r (6)	73.92±0.14 (18)
	Overall	75.35±0.12 ^e (24)	74.35±0.12 ^f (24)	71.98±0.12 ^g (24)	
Protein (mg/100ml)	Nadia	19.25±0.19 ^{cr} (6)	19.75±0.19 ^{sq} (6)	21.25±0.19 ^{bp} (6)	20.08±0.11 ^c
	Murshidabad	19.28±0.19 ^{br} (6)	19.90±0.19 ^{abq} (6)	21.41±0.19 ^{bp} (6)	20.20±0.11 ^{bc}
	Jhargram	19.41±0.19 ^{abr} (6)	20.11±0.19 ^{aq} (6)	21.88±0.19 ^{abp} (6)	20.47±0.11 ^{ab}
	Sundarban	19.55±0.19 ^{ar} (6)	19.83±0.19 ^{bq} (6)	22.20±0.19 ^{ap} (6)	20.53±0.11 ^a
	Overall	19.37±0.09 ^s (24)	19.90±0.09 ^t (24)	21.69±0.09 ^e (24)	
Fat (%)	Nadia	2.62±0.13 ^f (6)	2.88±0.13 ^g (6)	3.38±0.13 ^p (6)	2.96±0.08 (18)
	Murshidabad	2.73±0.13 ^f (6)	3.00±0.13 ^g (6)	3.75±0.13 ^p (6)	3.16±0.08 (18)
	Jhargram	2.71±0.13 ^f (6)	3.08±0.13 ^g (6)	3.75±0.13 ^p (6)	3.18±0.08 (18)
	Sundarban	2.83±0.13 ^f (6)	2.85±0.13 ^g (6)	4.03±0.13 ^p (6)	3.24±0.08 (18)
	Overall	2.72±0.06 ^s (24)	2.95±0.66 ^t (24)	3.72±0.06 ^e (24)	
Ash (%)	Nadia	2.87±0.31 ^a (6)	3.03±0.31 ^a (6)	3.61±0.31 ^a (6)	3.17±0.18 ^a (18)

	Murshidabad	2.65±0.31 ^{ab} (6)	2.51±0.31 ^b (6)	3.00±0.31 ^{ab} (6)	2.72±0.18 ^{ab} (18)
	Jhargram	2.55±0.31 ^b (6)	2.47±0.31 ^b (6)	2.11±0.31 ^b (6)	2.38±0.18 ^b (18)
	Sundarban	2.11±0.31 ^b (6)	3.15±0.31 ^a (6)	1.68±0.31 ^b (6)	2.32±0.18 ^b (18)
	Overall	2.55±0.16 (24)	2.79±0.16 (24)	2.60±0.15 (24)	

#Means ± SE brief with super scripts a, b, c & p, q, r, significant within different cluster and different age group

The table-2 showed that, the pH of Black Bengal meat in different clusters namely Nadia, Murshidabad, Jhargram and Sundarban under four different agro-climatic zones at different age groups viz. 6-9 month, 9-12 month and above 12 month were found to be 6.15±0.07, 5.98±0.07 & 5.73±0.07 in Nadia; 6.15±0.07, 5.95±0.07 & 5.73±0.07 in Murshidabad; 6.17±0.07, 5.97±0.07 & 5.65±0.07 in Jhargram; and 6.18±0.07, 5.88±0.07 & 5.67±0.07 in Sundarban cluster respectively. Experiment represented Cholesterol (mg/100gm), Water Holding Capacity (%), Muscle Fibre Diameter (mm) and Sarcomere Length (µm) of Black Bengal goats of different age groups and different clusters. There was significant variation in different ages has been observed for pH, cholesterol, water holding capacity and muscle fibre diameter of meat but no variation was recorded for pH, cholesterol, water holding capacity and muscle fibre diameter

of meat among different cluster. Biswas *et al.*, (2007) [6] reported that the pH 6.60 WHC 6.68 fibre diameter 5.58, sarcomere length of longissimus dorsi muscles of Black Bengal goat 2.13 µm. Amin *et al.*, (2000) [11] reported that muscle fibre diameter were 38.9µm and 29.8µm in thigh muscles in case of Black Bengal goat. In neck those values were 31µm and 25.8µm respectively. Sikder *et al.*, (2013) [15] reported that different agro climatic zones the pH of Black Bengal goat was 6.11±0.19, 6.20±0.96, 6.38±0.61, 6.47±0.38 at 6-9 month age and 6.58±1.04, 6.49±1.44, 6.66±1.39, 6.83±1.34 at 9 month and above age. The cholesterol content (mg/100ml) was 59.81±0.39, 59.70±0.73, 58.88±0.10, and 59.05±0.22 at 6-9 month & 64.07±1.67, 65.92±1.50, 65.66±1.94, 65.83±1.74 at 9 month & above. The deviation of the results of our study may be due to age of the animal as well as geographical location and agro-climatic condition.

Table 2: Age wise variation of Meat Quality (Physico-Chemical) parameters of Black Bengal goats

Parameter	Cluster	Age Group			
		6-9 month	9-12 month	Above 12 month	Overall
pH	Nadia	6.15± 0.07 ^p (6)	5.98±0.07 ^q (6)	5.73±0.07 ^r (6)	5.96±0.04 (18)
	Murshidabad	6.15±0.07 ^p (6)	5.95±0.07 ^q (6)	5.73±0.07 ^r (6)	5.94±0.04 (18)
	Jhargram	6.17±0.07 ^p (6)	5.97±0.07 ^q (6)	5.65±0.07 ^r (6)	5.93±0.04 (18)
	Sundarban	6.18± 0.07 ^p (6)	5.88±0.07 ^q (6)	5.67±0.07 ^r (6)	5.91±0.04 (18)
	Overall	6.16±0.03 ^e (24)	5.95±0.03 ^f (24)	5.70±0.03 ^s (24)	
Cholesterol (mg/100ml)	Nadia	56.47±0.54 ^r (6)	56.45± 0.54 ^q (6)	58.75±0.54 ^p (6)	57.22±0.31 (18)
	Murshidabad	55.55±0.54 ^r (6)	56.27±0.54 ^q (6)	58.00±0.54 ^p (6)	56.57±0.31 (18)
	Jhargram	55.17±0.54 ^r (6)	55.78±0.54 ^q (6)	57.70±0.54 ^p (6)	56.22±0.31 (18)
	Sundarban	55.40±0.54 ^r (6)	57.38±0.54 ^q (6)	57.78±0.54 ^p (6)	56.86±0.31 (18)
	Overall	55.64±0.02 ^s (24)	56.47±0.27 ^t (24)	58.03±0.27 ^e (24)	
Water Holding Capacity (%)	Nadia	45.83±0.67 ^p (6)	41.00±0.67 ^q (6)	38.83±0.67 ^r (6)	41.89±0.39 (18)
	Murshidabad	43.83±0.67 ^p (6)	43.33±0.67 ^q (6)	39.83±0.67 ^r (6)	42.33±0.39 (18)
	Jhargram	43.33±0.67 ^p (6)	43.17±0.67 ^q (6)	37.83±0.67 ^r (6)	41.44±0.39 (18)
	Sundarban	45.00±0.67 ^p (6)	42.17±0.67 ^q (6)	38.00±0.67 ^r (6)	41.72±0.39 (18)
	Overall	44.50±0.33 ^c (24)	42.41±0.33 ^f (24)	38.62±0.33 ^s (24)	
Muscle Fibre Diameter (mm)	Nadia	21.17± 0.52 ^q (6)	20.83±0.52 ^r (6)	25.17±0.52 ^p (6)	22.39±0.30 (18)
	Murshidabad	21.83±0.52 ^q (6)	20.67±0.52 ^r (6)	23.83±0.52 ^p (6)	22.11±0.30 (18)
	Jhargram	21.50±0.52 ^q (6)	20.00±0.52 ^r (6)	25.50±0.52 ^p (6)	22.33±0.30 (18)
	Sundarban	21.50±0.52 ^q (6)	20.50±0.52 ^r (6)	25.67±0.52 ^p (6)	22.56±0.30 (18)
	Overall	21.50±0.26 ^f (24)	20.50±0.26 ^s (24)	25.04±0.26 ^e (24)	
Sarcomere Length (µm)	Nadia	2.24±0.05 (6)	2.33±0.05 (6)	2.29±0.05 (6)	2.29±0.03 (18)
	Murshidabad	2.33±0.05 (6)	2.29±0.05 (6)	2.22±0.05 (6)	2.28±0.03 (18)
	Jhargram	2.30±0.05 (6)	2.33±0.05 (6)	2.26±0.05 (6)	2.30±0.03 (18)
	Sundarban	2.30±0.05 (6)	2.30±0.05 (6)	2.30±0.05 (6)	2.30±0.03 (18)
	Overall	2.29±0.02 (24)	2.31±0.02 (24)	2.26±0.02 (24)	

#Means ± SE brief with super scripts a, b, c & p, q, r, significant within different cluster and different age group

Conclusion

There was significant variation in different ages has been observed for moisture and fat of meat but no variation was recorded for moisture and fat of meat among different cluster. There was significant variation in different ages has been observed for pH, cholesterol, water holding capacity and muscle fiber diameter of meat but no variation was recorded for pH, cholesterol, water holding capacity and muscle fibre diameter of meat among different cluster.

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