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Research Paper

Effect of Sex, Age and Agro-climatic Zone on Carcass and Meat Quality Traits of Black Bengal Goats

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ABSTRACT

The aim of this study was to evaluate the effect of sex, age and agro-climatic Zone on carcass quality traits and meat quality parameter of Black Bengal goats reared under extensive managerial practices at farmers door step. For this, both male and female goat of four different age groups (0 – 3, 3 – 6, 6 – 9 and 9 – 12 months and above) were selected from four Agro-climatic Zones viz. Teesta Alluvial, Gangetic Alluvial, Undulating Red and Lateritic and Coastal Saline zones of West Bengal and different carcass quality traits and meat quality parameters were evaluated. Results indicated that birth weight had direct influence on body weight gain irrespective of sex or origin of animals. In general, pH, cholesterol, protein, ether extract and ash contents were increased while moisture contents were decreased in meat from both male and female goats with the inclement of age. Sensory quality of the selected goat meat samples was affected by the age but not by the sex and zones. In conclusion, sex and agro-climatic zones showed little or no significant effect on carcass quality traits, but age has significant influence on meat quality attributes irrespective of sex and agro-climatic zones.

Keywords : *Black Bengal Goat, Carcass traits, Meat quality, Agro climatic zone*

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INTRODUCTION

Goat is considered as 'poor man's cow' in India since goat farming requires relatively low investment, low land requirement, requires less managerial skill and provide a dependable source of income. They can thrive and provide a boost to the rural economy even in areas where it is difficult to raise cows or buffaloes (Bhattacharya 1993). Goat rearing is the backbone of economy of small and landless farmers in India. Under natural grazing the goats are more economical than sheep and cattle (Nandi *et al.* 2011).

Meat production is the most important output of goat farming. Several studies revealed that the growth and development of kids depends on birth weight and carcass characteristics and different meat quality parameters relies upon the breed, age, sex and nutritional management of the animals. Unfortunately, a very few studies conducted on meat production characteristics of Black Bengal goat. Singh and Sengar (1979) compared the meat production characteristics of male Black Bengal or its crosses to that of the Jamnapari, Beetal, Barbari or their crosses. Black Bengal goat found to attain optimum slaughter weight at the shortest period (8.9 months) than the Jamnapari (23.48 months), Beetal (19.46 months) and Barbari (13.46 months). However, this was not a direct measurement rather was an estimation: slaughter weight=(Birth weight×7)-(Birth weight-2). This estimation was based on the assumption of postnatal growth due to the function of living cells delivered at birth (Singh and Sengar 1979). These measurements have also not been validated on the Black Bengal goats. Black Bengal is a dwarf animal produces about 6.0 kg dressed carcasses (Devendra and Owen 1983; Das *et al.* 2002; Moniruzaaman e*t al.* 2002; Abedin *et al.* 2005) at adult**.** Further, carcass yield, cut-up parts weight, growth performance and other meat related parameters as well as meat quality parameters may vary depending on managemental condition, geographical origin, land topography etc. (Sabapara*et al.* 2010). Hussain *et al.* (1997) reported that the growth performance of Black Bengal Goat varied among the locations of Bangladesh having different environmental conditions.

In consideration to the above, the present research programme is carried out to elucidate the effect of sex, age and Agro-climatic Zone on carcass traits and meat quality parameter of Black Bengal Goats reared under extensive managerial practices at farmers' door step.

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MATERIALS AND METHODS

***Experimental design*:** The study was conducted from the period of January, 2014 to June, 2014 in Terai-Teesta Alluvial, Gangetic Alluvial, Undulating Red and Lateritic and Coastal Saline agro-climatic zones of West Bengal. Goats of corresponding male and female groups were slaughtered as per standard method after attaining their age of 3 months and above. Representative meat samples from four Agro-climatic zones (10 each of male and 10 female goats) were considered for chemical analysis.

***Carcass quality traits*:** The carcass quality traits were determined by evaluating birth and pre-slaughter live weight. Data were collected from goat at 0-3, 3-6, 6-9 and 9-12 months and above age groups, and that were compared following standard statistical protocol.

***Meat quality parameters*:** Different meat quality parameters like pH, cholesterol content, proximate composition and sensory evaluation were carried out. All the meat quality data were evaluated on cold carcass i.e. after 2-3 hrs of slaughter. The pH of sample was determined using a digital pH meter as per methodology of Egbert *et al.* (1992). The total cholesterol in the sample was determined by using the method of Zaltkis (1953) with suitable modifications as described by Rajkumar *et al.* (2004). The proximate composition (moisture, crude protein, ether extract and total ash) were determined as per AOAC (1984) method.The sensory qualities of samples were evaluated by descriptive analysis method of Keeton *et al.* (1984). A sensory panel (semi trained) of seven judges drawn from post-graduate students and staff of the University were requested to evaluate the product for different quality attributes *viz:* appearance, visual color, flavor and overall acceptability.

***Statistical analysis*:** Experimental data generated were analysed statistically using standard software package as mentioned by Snedecor and Chochran (1980). Means of birth weight and body weight taken for the optimization of slaughter weight were analysed using one-way ANOVA. Other experimental data relating to effect of sex and four agro-climatic zones on meat quality parameters at different ages were evaluated by two-way ANOVA, homogeneity test and Duncan's Multiple Range Test for comparing means to find the effects between male and female goat meat, between agro-climatic zones and their interactions. The statistical significance was expressed at $P < 0.05$.

RESULTS AND DISCUSSION

***Effect of agro-climatic zone on birth and body weight*:** The birth weight of goats in different agro-climatic zones of West Bengal recorded is showed in Table 1. It was found that Coastal Saline and Undulating Red & Lateritic zone showed to some extent higher birth weight, though not statistically significant. Similar findings were also reported by Kumar and Singh (1983) and Hussain *et al.* (1992). Birth weight is the main determinant of kid survival (Bahuja and Kennedy 1990). Birth weight is positively correlated with growth rate, adult size and kid viability (Devendra and Burn 1983). Within–breed, variation in birth weight is partly genetic, but largely due to variation within the environment, especially nutrition and health (Devendra and Burn 1983). Thus heavier birth weight observed in this study in Coastal Saline Zone indicate better environment, especially nutrition and health that will have positive effect on total kid production by reducing kid mortality and increasing the kid growth rate.

While studied on body weight (BWt) gain, a highly significant ($p<0.01$) variation of body weight at 0-3 months of age was observed within the agro-climatic zones which was found to be highest in Coastal Saline zone (6.368 ± 0.102kg), followed by Gangetic Alluvial (5.814 ± 0.126 kg) then by Undulating Red and Lateritic (5.405 ± 0.105kg) and lastly in Terai-Teesta Alluvial region (4.922 ± 0.098kg).The result was in consonance with the finding of Singh and Singh (2000) and Singh (1997). But when compared body Wt. gain at 3-6 months of age group highest body weight was observed for goat from Gangetic Alluvial Zone followed by Coastal Saline, Undulating Red and Lateritic &Terai-Teesta Alluvial Zone respectively. However, the difference between Gangetic Alluvial and Coastal Saline Zone was non-significant.

The body weights of Black Bengal Goats at 6-9 months of age in four agro-climatic zones of West Bengal also varied significantly ($P<0.01$) and the highest body weight was recorded in Coastal Saline zone followed by Terai-Teesta Alluvial, Gangetic Alluvial and Undulating Red & Lateritic Zone, respectively (Table 1). The result of the present study corroborated with the finding of Singh (1997), who recorded 9 month body weight of Black Bengal to be 11.79 ± 0.19 kg. Bhattacharya (1989) observed the weighted means with standard errors for NS-Non Significant** indicates Significant at 1% Values given in parenthesis are the number of observations body weight (kg) in Bengal breed at 9 month was 9.40 ± 0.20 kg. At 9-12 months of age body weight of Black Bengal Goats in Coastal Saline zone was highest followed by Terai-Teesta Alluvial zone and in Gangetic Alluvial and Undulating Red & Lateritic Zone. Thus, zone-wise variation in body weight at 9-12 month of age was statistically highly significant ($P<0.01$). It was evident from the current study

Table 1: Effect of agro-climatic zone on body weight (Kg) of Black Bengal goat (Mean ± SE) at different age groups.

Agro-Climatic Zone	Birth Wt.	0-3 month wt.	3-6 month Wt.	6-9 month wt.	Wt. at 9 month & Above
Over all Mean	1.115±0.028(170)	5.627±0.054(779)	8.010±0.050(1142)	10.50±0.074(1142)	10.977±0.118(1142)
Terai-Teesta Alluvial Zone	1.047±0.057(27)	4.922±0.098^{d}(213)	7.242±0.100^{c}(248)	10.655±0.186^{b}(138)	11.212±0.38^{b}(40)
Gangetic Alluvial Zone	1.115±0.048(36)	5.814±0.126^{b}(160)	8.699±0.108^{a}(278)	10.577±0.157^{b}(246)	10.928±0.197^{b}(193)
Coastal Saline Zone	1.149±0.036(77)	6.368±0.102^{a}(204)	8.580±0.088^{a}(328)	11.713±0.128^{a}(302)	12.097±0.127^{a}(401)
Red & Lateritic Zone	1.148±0.053(30)	5.405±0.105^{c}(202)	7.519±0.096^{b}(288)	9.075±0.107^{c}(456)	9.671±0.116^{c}(508)
Significance	NS	**	**	**	**

Means bearing same superscripts (a, b, c, d) within a column do not differ significantly.

Effect on pH: The effect of sex on mean pH values of Black Bengal Goat Meat (raw) from different age-groups are presented in Table 2. A slight increment in pH values was noticed with advancement of age. There were significant differences ($p<0.05$) in pH values in between male and female goat at 0-3 months group and above 9 months group. However, non-significant differences ($p>0.05$) were noticed between pH values of male and female in '3-6 months group', and '6-9 months group. Similar observation also recorded for the effect of different Agro-climatic zones (Table 2). A slight increment in pH values was noticed with advancement of age which is significant ($p<0.05$) beyond '6-9 months' age group. The meat from goat of Red & Laterite zones indicated significant differences ($p<0.05$) in pH values of all age groups. However, pH values of all other zones in all age groups showed no significant differences ($p>0.05$) between themselves. The finding of this study corroborates with the observation of Simela *et al.* (2004), who put on record that sex and age has no significant effect on pH of goat meat.

Table 2: Effect of sex and agro-climatic zones on pH of Black Bengal goat meat from different age-group.

Parameters	Age in Months			
	0-3	3-6	6-9	9 & above
	pH			
Male	6.22 ±0.52^{abx}	6.30± 0.39^{bx}	6.37 ± 1.44^{bcx}	6.48 ±0.67^{cx}
Female	6.43 ±0.62^{aby}	6.25 ± 1.27^{bx}	6.39 ± 1.22^{bcx}	6.73±0.20^{cy}
Agro-climatic Zones				
Terai-Teesta Alluvial Zone	5.89±0.36^{ax}	5.99±0.43^{abx}	6.11±0.19^{abx}	6.58±1.04^{bx}
Gangetic Alluvial Zone	5.86±1.55^{ax}	6.05±2.44^{abx}	6.20±0.96^{bx}	6.49 ±1.44^{cx}
Coastal saline Zone	6.02±0.65^{axy}	6.26±1.64^{abx}	6.38±0.61^{bx}	6.66±1.39^{cx}
Red & Lateritic Zone	6.17±0.50^{ay}	6.38±0.11^{by}	6.47±0.38^{by}	6.83±1.34^{cy}
	Cholesterol content (mg/100g)			
Sex				
Male	57.85±0.80^{ax}	57.99±0.79^{ax}	63.71±1.37^{bx}	67.93 ±0.69^{cx}
Female	56.97±0.84^{ax}	57.75±0.84^{ax}	64.84±1.02^{bx}	68.05 ±0.85^{cx}
Agro-climatic Zones				
Terai-Teesta Alluvial Zone	54.28±0.49^{ax}	57.03±0.93^{bx}	59.81±0.39^{bx}	64.07±1.67^{cx}
Gangetic Alluvial Zone	54.28±0.27^{ax}	58.28±0.17^{bx}	59.70±0.73^{bx}	65.92±1.50^{cx}
Coastal saline Zone	53.87±0.19^{ax}	57.94±1.15^{bx}	58.88±0.10^{bx}	65.66±1.94^{cx}
Red & Lateritic Zone	53.99±0.94^{ax}	58.20±0.91^{bx}	59.05±0.22^{bx}	65.83±1.74^{cx}

Means bearing same superscripts row-wise (a, b, c) and column-wise (x, y) do not differ significantly ($p>0.05$). n=10

Effect on cholesterol content: The effect of sex and agro-climatic zones on mean cholesterol content is presented in Table 2.The cholesterol contents showed an increment throughout the advancement of age, however, up to 6 months of age, the changes were non-significant ($p>0.05$) irrespective of sex. The male and females showed non-significant effect ($p>0.05$) between themselves in any of the age group. This supports the findings of Jhonson *et al.* (1995), who postulated that sex class had no effect on cholesterol content of goat meat. In all of the agro-climatic zones, the mean cholesterol values exhibited a significant ($p<0.05$) increment after 3 months of age and again became significant ($p<0.05$) after 9 months of age.

Proximate composition: There was significant effect ($p<0.05$) on moisture content in between male and female animals, however, the values were decreased with the advancement of age (Table 3). Non-significant increment ($p>0.05$) has been noticed between '3-6 months' and '6-9 months' age group. Male and females were exerted non-significant differences ($p>0.05$) between themselves in the all age groups. However, this data partially contradicted with the findings of Johnson *et al.*(1995), who found that female had significant ($p<0.05$) lower moisture and higher fat content. This might be due to the breed variation and different area of study. There were non-significant differences in moisture content of meat from different zones of same age group of animal, however, values were decreased significantly ($p<0.05$) with the advancement of age. The protein content of goat meat increased over the time in both sexes, but the changes were non-significant ($p>0.05$). Sex class did not affect ($P>0.05$) the moisture, fat or protein content of uncooked composite goat samples (Johnson *et al.* 1995). Amongst the different zones protein content increased over the progress of age but remained non-significant ($p>0.05$), which again became significant ($p<0.05$) beyond the age of 9 months in all the zones. Between the zones, no significant effect ($p>0.05$) had been found throughout the advancement of age.

Ether Extract content (%) in between male and female animal were showed significant difference ($p<0.05$) in '0-3 months' group (Table 3). Remaining values between the same age group were non-significant ($p>0.05$). However, the ether extract content (%) of both male and female decreased with the progress of age. Meat from Red and Laterite Zone exhibited a significantly higher ($p<0.05$) ether extract content (%) than other zones for all age groups. Beyond 3-6 months group, the all values were decreased significantly ($p<0.05$). Except for Coastal saline Zone, all zones exhibited a significantly lower ($p<0.05$) ether extract content (%) values beyond 6-9 month group. This result supports the findings of Johnson *et al.*(1995), who found that female had significantly ($p<0.05$) lower moisture and higher fat content. Hogg *et al.* (1992) found that female carcasses had significantly ($P<0.05$) higher fat content than the carcasses from castrates. Values reported by Park *et al.* (1991) were for raw *Longissimus* and *Biceps* muscle that had only 2% fat, whereas fat content in the present study was considerably higher because this study included subcutaneous and intramuscular carcass fat depots. The mean total ash content of goat meat increased significantly ($p<0.05$) beyond 6-9 months group in both the sexes. However, these values did not differ significantly ($p>0.05$) between the male and females in all of the age groups. Similarly Johnson *et al.* (1995) reported that sex class did not influence grams of protein or ash, per 100 g of cooked sample. The effect of Agro-climatic Zones indicated that total ash content was significantly Increased ($p<0.05$) in Teesta-Terai Alluvial Zone after 6 month of age. In Gangetic Alluvial zone, significant rise ($p<0.05$) was noticed in total ash content beyond 6 month and 9 months, whereas, in Coastal Saline Zone and Red & Laterite Zone, after 3 month only, a significant change ($p<0.05$) had been noticed. Between the same age group, no significant zonal effect ($p>0.05$) had been observed except for Red & Laterite zone at 9 month & above group, which was found to be significantly ($p<0.05$) lower.

Sensory evaluation: Non-significant effect ($p>0.05$) amongst the means of appearance scores of different age-groups from both the sexes of goat were observed (Table 4). While compared with agro-climatic zones on mean appearance scores showed significantly ($p<0.05$) higher scores for goat meat at "0-3 month" group in Terai-Teesta Alluvial Zone (6.88 ± 0.62); at "3-6 month" and "6-9 month" group in Gangetic Alluvial Zone (6.88 ± 0.12); at "0-3 month" group in Coastal saline zone (6.90 ± 1.36); and at "9 months and above" group in Red & Laterite zone (6.91 ± 1.12). Within the same age-group, in "0-3 months" age group, score from Gangetic Alluvial Zone got significantly lower rating ($p<0.05$). Non-significant effect ($p>0.05$) of zonal variance had been observed in "9 months and above" age-group.

The visual colour scores indicated that scores of "3-6 months" group differed significantly ($p<0.05$) from other age groups except "0-3 months" group in both male and females. However, sex had non-significant effect ($p>0.05$) in all of the age groups. The effect of agro-climatic zones on visual colours indicated that visual colour score from "0-3 month" group differed significantly ($p<0.05$) from "3-6 months" group and onwards for Terai-Teesta Alluvial Zone & Red Laterite Zone. Highest

Table 3: Effect of sex and agro-climatic zones on proximate composition of Black Bengal goat meat

Parameters	Age in Months			
	0-3	3-6	6-9	9 & above
	Moisture (%)			
Sex				
Male	82.03±0.29^{ax}	79.76±0.79^{bx}	75.33±0.32^{bx}	71.02±0.94^{cx}
Female	81.29±0.39^{ax}	77.75±0.81^{bx}	76.31±1.64^{bx}	69.48±0.37^{cx}
Agro-climatic Zones				
Terai-Teesta Alluvial Zone	82.58±0.48^{ax}	81.03±0.12^{bx}	77.55±0.64^{cx}	71.07±0.29^{dx}
Gangetic Alluvial Zone	82.46±0.65^{ax}	81.01±0.11^{bx}	76.05±0.32^{cx}	72.92±1.92^{dx}
Coastal saline Zone	81.47±0.64^{ax}	79.64±0.35^{bx}	76.15±0.16^{cx}	71.66±1.14^{dx}
Red & Lateritic Zone	81.48±0.34^{ax}	80.44±0.32^{bx}	76.59±0.37^{cx}	70.83±0.24^{dx}
	Protein (%)			
Sex				
Male	16.45±0.95^{ax}	17.39±0.66^{abx}	21.27±0.55^{abx}	22.05±0.96^{bx}
Female	15.86±0.36^{ax}	19.67±0.67^{abx}	20.89±1.33^{abx}	21.34±0.88^{bx}
Agro-climatic Zones				
Terai-Teesta Alluvial Zone	16.44±1.58^{ax}	17.36±0.19^{abx}	20.55±0.94^{bx}	23.24±0.67^{cx}
Gangetic Alluvial Zone	15.88±2.12^{ax}	17.56±0.64^{abx}	20.59±0.25^{bx}	24.33±0.94^{cx}
Coastal saline Zone	15.69±0.37^{ax}	16.99±1.94^{abx}	21.06±0.13^{bx}	23.97±1.32^{cx}
Red & Lateritic Zone	15.94±1.28^{ax}	17.09±0.58^{abx}	20.66±0.54^{bx}	24.24±0.86^{cx}
	Ether Extract (%)			
	4.27±0.17^{ax}	4.71 ±0.26^{ax}	3.2±0.15^{bx}	3.18±0.23^{bx}
Female	4.88± 0.21^{ay}	4.78±0.38^{abx}	3.11±0.19^{bx}	3.30 ±0.24^{cx}
Agro-climatic Zones				
Terai-Teesta Alluvial Zone	4.15± 0.35^{ax}	3.42±0.42^{bx}	2.95±0.19^{cxy}	2.67±0.12^{dx}
Gangetic Alluvial Zone	4.09± 0.45^{ax}	3.83±0.44^{ax}	2.19±0.14^{bx}	2.73±0.25^{cx}
Coastal saline Zone	4.25±0.29^{axy}	3.34±0.48^{bx}	2.86±0.62^{cx}	2.47±0.61^{cx}
Red & Lateritic Zone	4.86± 0.36^{ay}	3.85±0.32^{ay}	2.16±0.18^{by}	2.74±0.23^{cy}
	Ash (%)			
Sex				
Male	0.34 ± 0.19^{ax}	1.77± 0.43^{abx}	2.94± 0.32^{bx}	3.28 ± 0.46^{cx}
Female	0.62 ± 0.49^{ax}	1.84± 0.45^{abx}	3.11 ± 1.46^{bx}	3.42 ± 0.94^{cx}
Agro-climatic Zones				
Terai-Teesta Alluvial Zone	0.81±0.15^{ax}	1.19±0.11^{abx}	1.34±0.54^{bx}	1.28±0.27^{cx}
Gangetic Alluvial Zone	0.89±0.24^{ax}	1.22±0.06^{abx}	1.39±0.95^{bx}	1.34±0.14^{cxy}
Coastal saline Zone	0.92±0.20^{ax}	1.35±0.18^{bx}	1.46±0.23^{bx}	1.37±0.23^{cx}
Red & Lateritic Zone	0.77±0.11^{ax}	1.14±0.14^{bx}	1.56±0.64^{cx}	1.54±0.11^{dy}

Means bearing same superscripts row-wise (a, b, c) and column-wise (x, y) do not differ significantly ($p>0.05$). n=10

Table 4: Effect of sex and agro-climatic zones on sensory quality* of Black Bengal goat meat (Cooked)

Parameters	Age in Months			
	0-3	3-6	6-9	9 & above
Appearance				
Sex				
Male	6.36±0.14	6.37±0.32	6.54±0.27	6.67±1.15
Female	6.41 ±0.96	6.39 ±0.56	6.55 ±0.85	6.72 ± 0.53
Agro-climatic Zones				
Terai-Teesta Alluvial Zone	6.88±0.62^{ax}	6.67±0.33^{bx}	6.69±0.39^{bx}	6.80±0.14^{ax}
Gangetic Alluvial Zone	6.71±0.63^{ay}	6.88±0.12^{by}	6.88±0.65^{by}	6.86±0.54^{bx}
Coastal saline Zone	6.90±1.36^{ax}	6.83±0.36^{ay}	6.82±1.36^{ay}	6.79±0.31^{ax}
Red & Lateritic Zone	6.82±0.62^{ax}	6.58±1.23^{bx}	6.73±1.46a^{xy}	6.91±1.12^{cx}
Visual colour				
Sex				
Male	6.11±0.17^{ax}	6.21±0.33^{ax}	6.35±1.02^{bx}	6.55±0.42^{cx}
Female	6.15±0.29^{ax}	6.27±0.55^{ax}	6.43±1.16^{bx}	6.59±0.44^{cx}
Agro-climatic Zones				
Terai-Teesta Alluvial Zone	6.34±0.45^{ax}	6.55±0.64^{bx}	6.61±0.59^{bx}	6.89±0.57^{cy}
Gangetic Alluvial Zone	6.36±1.57^{ax}	6.46±0.49^{ax}	6.68±0.27^{bx}	6.77±0.66^{bx}
Coastal saline Zone	6.42±1.41^{ax}	6.52±1.76^{ax}	6.86±0.37^{by}	6.87±1.87^{by}
Red & Lateritic Zone	6.30±1.34^{ax}	6.59±1.13^{bx}	6.76±0.67^{bcxy}	6.88±0.24^{cy}
Flavour				
	6.31±0.17^{ax}	6.21±0.33^{abx}	6.28±1.02^{abx}	6.42±0.42^{bx}
Female	6.48±0.29^{bx}	6.33±0.55^{ax}	6.46±1.16^{bx}	6.49±0.44^{bx}
Agro-climatic Zones				
Terai-Teesta Alluvial Zone	6.83±0.61^{bx}	6.59±0.34^{ax}	6.66±0.39^{ax}	6.58±0.84^{ax}
Gangetic Alluvial Zone	6.80±0.21^{ax}	6.55±0.19^{bx}	6.64±0.25^{abx}	6.56±0.34^{bx}
Coastal saline Zone	6.77±1.06^{ax}	6.58±0.16^{bx}	6.62±0.36^{abx}	6.62±0.41^{abx}
Red & Lateritic Zone	6.69±1.49^{ax}	6.57±0.83^{bx}	6.63±0.43^{bx}	6.59±0.62^{bx}
Overall acceptability				
Sex				
Male	6.46±0.14^{ax}	6.57±0.32^{bx}	6.64±0.27^{bx}	6.77±1.15^{cx}
Female	6.49 ±0.96^{ax}	6.59 ±0.56^{bx}	6.59 ±0.85^{bx}	6.70 ±0.53^{cx}
Agro-climatic Zones				
Terai-Teesta Alluvial Zone	6.26±0.72^{ax}	6.27±0.35^{abx}	6.42±0.89^{bx}	6.85±0.18^{cx}
Gangetic Alluvial Zone	6.19±0.69^{ax}	6.25±0.15^{ax}	6.38±0.67^{ax}	6.89±0.14^{bx}
Coastal saline Zone	6.24±0.96^{ax}	6.22±0.76^{ax}	6.39±1.78^{ax}	6.78±0.95^{bx}
Red & Lateritic Zone	6.30±0.60^{ax}	6.24±1.83^{ax}	6.33±0.45^{ax}	6.91±2.72^{bx}

Means bearing same superscripts row-wise (a, b, c) and column-wise (x, y) do not differ significantly ($p>0.05$). n=10; *Based on 8-point descriptive scale, Where 8=extremely desirable and 1=extremely undesirable.

colour score (6.89±0.57) was found in Terai-Teesta Alluvial Zone at "9 months and above" group, whereas lowest colour score (6.30±1.34) was obtained by Red & Lateritic Zone at "0-3 month" group. Between the same age group, no significant zonal effect ($p>0.05$) had been observed except for Coastal saline Zone and Red & Lateritic Zone at "6-9 month" group and in Gangetic Alluvial Zone at "9 month & above" group. Adam *et al.* (2010) reported that colour is an important sensory characteristic for the consumer.

The flavour scores showed non-significant differences ($p>0.05$) amongst the means of flavour scores of different age-groups from both the sexes. Females of 3-6 months group exhibited a significantly lower ($p<0.05$) value when compared with other age groups (Table 4). Rodrigues and Teixeira (2009) investigated the relationships between sex and carcass weight and the sensory characteristics in goats and pointed out that the meat of the males displayed greater juiciness. These authors additionally emphasized that lighter weight carcasses were considered tender with less flavour and odour intensity than heavier carcasses. Almost similar effect was observed due to variations in agro-climatic zones. Carlucci *et al.* (1998) emphasized that the rearing system affected texture more than odour and flavour, whereas sex had little effect on textural attributes compared with odour and flavour.

Sex and agro-climatic were showed non-significant differences ($p>0.05$) amongst the means of overall acceptability scores of different age-groups from both the sexes, although values from both the sexes increased significantly ($p<0.05$) with advancement of age. However effect due to agro-climatic zones, all the zones got significantly highest ($p<0.05$) scores at only "9 months and above" age group. Among the all four zones, "Red & Laterite" zone had got highest score (6.91± 2.72). However, non-significant effect ($p>0.05$) had been noticed when compared within the age-groups.

CONCLUSION

The birth weight had direct influence on body weight gain of goat from different agro-climatic zones. With respect to pH, both male and female goats gradually increased with the progress of age. Values for female goat meat sample always remained slight higher than its male counterpart. The lowest pH value was recorded in meat from Gangetic Alluvial zone at "0-3 month" group and highest value from Red & Laterite zone at "9 months & above" group. Total cholesterol and protein contents were increased while moisture content decreased with the advancement of age, however, sex and agro-climatic zones showed little or no significant effect on carcass quality traits, but age has significant influence on meat quality attributes irrespective of sex and agro-climatic zones. Sensory quality of the selected goat meat samples was affected by the age but not by the sex and zones.

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