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Carcass Traits and Value of Meat and Byproducts of Goat

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ABSTRACT

A study was conducted to collect data on carcass traits covering 1517 goats across India. The results indicated that the live weight and dressed carcass weight of goats ranged from 12.54 to 28.16 kg and 5.84 to 13.41 kg, respectively with an average dressing percentage of 46.86%. There was a significant difference (P<0.005) in the overall live weight, carcass weight, dressing percentage and overall yield of byproducts of goats of different body weight groups (viz., less than 15 kg (Group 1), between > 15 to < 20 kg (Group 2), >20 to <25 kg (Group 3) and more than 25 kg (Group 4) of different states. It was also found that the majority of the goats slaughtered were in the weight group of >15 to >20 kg (36.85 %). The overall average live weight of goats from Maharashtra (20.58 kg) and Andhra Pradesh (19.51 kg) were higher when compared to other states. Except skin, all the byproducts are utilized for human consumption and the yield of edible (blood, head, feet, stomach and intestine, heart, liver, lungs, kidney and fat) and inedible (skin) byproducts as percentage of live goat weight were 43.79 and 9.35 %, respectively. In terms of commercial value of goat carcass, major revenue comes from meat (81.07 – 85.78%), followed by edible offal (11.55 – 16.47%) and skin (2.39 – 2.68%).

Keywords: *Carcass traits, Carcass, Byproducts, Goat, Value.*

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INTRODUCTION

Traditionally small ruminants serve as source of livelihood and financial security to large section of Indian society, mainly comprising of 20 million resource-poor small and marginal farmers and landless labourers (National Action Plan DADF, 2017). Goat rearing ensures self-employment and acts as a mean to mitigate in distress situations like drought and famine. India occupies second position in terms of goat population and as per the 20th Livestock survey, goat population in the country in 2019 is 148.88 Million, showing an increase of 10.1% over the previous census (DADF, 2019). There are thirty four well defined Indian breeds such as Barbari, Beetal, Black Bengal, Jamunapari, Osmanabadi, etc. in addition to large number of non-descriptive goats (NBAGR, 2020). Besides meat and milk, goats also produce good quality skin, valuable Pashmina fiber and manure. Since ancient times, goat milk is consumed for its medicinal properties and has recently gained importance in human health due to its proximity to human milk for easy digestibility and it's all round health promoting traits. Goat meat (Chevon) is most preferred and widely consumed meat in the country without any taboo. The goat sector contributes Rs. 14,453 crores to the agricultural economy of the country through meat (Rs. 6851 crores), milk (Rs. 4588 crores), skin (Rs. 648 crores), etc. which accounts for around 8 per cent of the Gross Domestic Product (GDP) from livestock sector (National Action Plan DADF, 2017). Goat meat accounts for about 13% of India's total meat production (DADF, 2016). The demand for goat meat is progressively increasing in domestic market as Indian consumers prefer Chevon among all meats. This could be one of the reasons for 98% of total meat produced from small ruminants is consumed in the country itself with a meager export. The country has exported 18,425 MT of sheep and goat meat to the world for the worth of Rs. 790 crores during the year 2018-19 (APEDA, 2020). The goat industry in India has yet to be firmly laid down on scientific lines. Goat keepers are maintaining goats in various kinds of situations depending upon their economic status, ecology and other circumstances. Though goats are traditionally kept under extensive "zero input" management and reared on natural vegetation, shrinkage of grazing land, sharp increase in livestock population and controversy over the role of goat in ecological degradation, soil erosion and deforestation, difficulties in maintaining of large flocks of goats under extensive system, lead to adoption of semi-intensive and intensive system (Chandramouli et al., 1992). In last few years, goat production in the country gained momentum in the form of a commercially viable enterprise as evidenced by increasing number of young entrepreneurs taking up commercial goat farming. It is high time to evaluate the economy and efficiency of goat rearing system to make the goat husbandry a viable and sustainable enterprise. Being an important food animal, the meat production potential of goat need to be evaluated thoroughly. Information on carcass traits is essential to estimate the economical potential of any meat producing animals (Kondaiah et al., 1983). The slaughter traits are modulated by heredity, breed, feeding regimen and prevailing rearing environment. Age, breed, sex, plane of nutrition, management system etc. have significant influence on important carcass trait like dressing percentage (Das and Raj Kumar, 2010). Based on these data, measures could be formulated to increase the production of meat through integrated approach such as optimizing nutritional and managemental inputs with adequate disease control measures in order to express the genetic merit of indigenous animal for bringing gainful advantages in body weight gains and carcass yield. The breed, sex and slaughter weight have significant effect on carcass composition and meat quality. The data available on the carcass traits of goats are mostly restricted to small group of experimental animals and there is no detailed study covering large number of animals of various states. Further, details on economics of meat production are scanty. Keeping this in mind, a survey was undertaken in different parts of India to get insights into yield and value of carcass and byproducts of goats.

MATERIALS AND METHODS

Data collection: Among the Indian states, Rajasthan has highest number of goats, about 20.84% of population. Uttar Pradesh and Maharashtra together accounts for about twenty five percentage of the goat population. The present study was carried out in four states viz., Uttar Pradesh, Maharashtra, Andhra Pradesh

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and Assam. Data on yield and value of meat and byproducts of goats was collected from 1517 goats from Andhra Pradesh (311), Maharashtra (301), Uttar Pradesh (605) and Assam (300). Parameters include live weight (by pooling carcass and byproducts weight), carcass weight and weights of different byproducts viz., blood, head, fore feet, skin, stomach, intestine, pluck, fat, hind feet and trimmings using electronic weighing balances. Data from Andhra Pradesh and Maharashtra was collected by the National Research Centre on Meat, Hyderabad and Veterinary College, Nagpur, respectively. Whereas, data in Uttar Pradesh were collected by Indian Veterinary Research Institute, Izatnagar, Bareilly and Veterinary College, Mathura. National Research Centre on Pig, Guwahati was involved in collection of data on carcass traits of goats from Assam.

Statistical analysis: The data collected were compiled and grouped under different live weight categories viz., less than 15 kg (Group 1), between > 15 to < 20 kg (Group 2), >20 to <25 kg (Group 3) and more than 25 kg (Group 4) and state wise (Andhra Pradesh, Maharashtra, Uttar Pradesh and Assam). The data were analyzed using statistical software (SPSS for Windows, version 13.0) following the standard procedure for analysis of variance (Snedecor and Cochran, 1995) and Duncan's multiple range tests for comparing the means to determine the effect of slaughter weight and state on carcass traits.

RESULTS AND DISCUSSIONS

Average carcass and byproducts weight (kg) and their yield as percentage of live weight of goats of different body weight groups collected from various states are given in Table 1 and Table 2.

Live weight of goats: The percentage of animals of different live weight groups viz., less than 15 kg (Group 1), between > 15 to < 20 kg (Group 2), >20 to <25 kg (Group 3) and more than 25 kg (Group 4) utilized for meat production were 23.47, 36.85, 23.27 and 16.41 %, respectively. It is worth to note that majority of goats slaughtered for meat production were belong to body weight range of between > 15 to < 20 kg (group 2) with a national average weight of 19.16 kg (Table 1). The FAO report on average live weight of goats used for meat production in India also indicated a similar weight (FAOSTAT, 2020). The overall average live weight of goats from Maharashtra (20.58 kg) and Andhra Pradesh (19.51 kg) were higher when compared to other states. Variation in the kind of breed of goats available in different states of the country, their managemental practices (extensive, semi-intensive and intensive system of rearing), age of slaughter, transport of animals from one part of the country to another for meat production could be the reasons for variation in body weights of goats reaching for slaughter (Chandramouli et al., 1992; Mehta et al., 2000; Sen et al., 2004; Muthukumar et al., 2005; Solanki et al., 2009). Solanki et al. (2009) reported pre-slaughter weight of 14.98 and 13.15 kg for 9-10 months old local goats of Madhya Pradesh reared under semi-intensive and extensive system of management. Similarly, Metha et al. (2000) have reported that the live body weights of 12 months old Sirohi, Marvari and Kutchi goats reared under intensive system were 45.25, 41.25 and 40.38 kg, respectively.

Carcass weight and dressing percentage of goats: The carcass weight and dressing percentage of group 1, group 2, group 3 and group 4 goats were 5.84, 8.06, 10.57 and 13.41 kg and 46.56, 46.52, 47.17 and 47.59 %, respectively. Dressing percentages of 42.92 to 51.18% were reported for different breeds of Indian goats (Kesava Rao et al., 1984; Das and Rajkumar, 2010; Sivakumar 2013). Similarly, Solanki et al. (2009) reported a dressing percentage of 46.00 to 48.20% for 9-10 months old local goats of Madhya Pradesh reared under different managemental systems. However, Metha et al. (2000) indicated a higher dressing percentages of 48.46 to 52.06% for higher body weight (40.38 – 46.52 Kg) Sirohi, Marvari and Kutchi goats grown under intensive system. There was a significant ($P<0.05$) difference in the overall dressing percentage of goats of different body weight groups and the dressing percentage increased with increase in the body weight. A similar trend of increase in dressing percentage with increase in pre-slaughter weight of goats was also reported by Prasad et al. (1992), Metha et al. (2000), Solanki et al. (2009) and Sivakumar (2013). The overall average carcass weight of goats ranged from 8.68 (Utaar Pradesh and Assam) to 9.77 kg (Maharashtra). This indicates variations in the carcass weight of goats produced in different parts of the country. Slaughter studies by Mehta et al. (2000) indicated variation in the dressing percentages due to breed (48.91% (Sirohi), 48.46% (Marwari) and 52.06 % (Kutchi)). Similarly, Solanki et al. (2009) reported an overall carcass weight of 6.05 to 7.22 kg with a dressing percentage of 46.00 to 48.20% for local non descriptive goats in Madhya Pradesh, whereas Sivakumar (2013) reported overall carcass weight of 7.69 kg with a dressing percentage of 45.00% for Kanni goats in Tamil Nadu. The current study recorded an overall carcass weight and dressing percentage of 9.00 kg and 46.86 %, respectively. This is in accordance with the FAO report on average carcass yield for Indian goats, which is estimated as 10 kg (FAOSTAT, 2018).

Edible byproducts weight and yield: There was a significant ($P<0.05$) difference among the goats of different body weight groups collected from various states in the overall yield of edible byproducts (head, feet, liver, heart, kidneys, stomach and fat). However, Sivakumar (2013) reported non-significant difference in the yield of edible offal due to variation in the age and body weight of goats. The average head weight was ranging from 1.26 kg in Maharashtra to 1.37 kg in Uttar Pradesh with a national average of 1.31 kg. Head constituted about 6.93 % of the live weight. Sivakumar (2013) also reported similar yield (6.29 to 6.74%) of head in Kanni goats. The overall weight of feet (both fore and hind feet) was 680 gram. Das and Rajkumar (2010) also reported similar values in Barbari, Jamnapari and Marwari goats. The overall yield of edible offal - pluck (liver, kidney and heart) recorded in this study (3.93%) was similar to the reports of Sivakumar (2013).

Inedible byproducts weight and yield: There was a significant ($P<0.05$) difference in the overall yield of blood, skin and intestine of goats of different body weight groups collected from various states. However, Sivakumar (2013) and Das and Rajkumar (2010) reported no significant influence of slaughter weight and breed on the yield of blood, hide and G.I. Tract. The overall yield of blood was ranged from 2.23 to 4.45% with an average of 4.28 % of the live weight of the goats. The variation in the quantum of blood yield in different body weight groups of goats of various states could be due to variation in the body weight of the animals, bleeding practices and physiological condition of the animals. Normally blood constitutes about 2.4 - 8 % of the total live body weight. Bleeding releases about 50 % of the blood present in the body (Ockerman and Hansen, 2000). Das and Rajkumar (2010)

Table 1: Overall yield of carcass and byproducts (%) as percentage of live weight of goats of different weight groups

Weight groups	No. of goats	Live animal	Blood	Head	Fore feet	Skin	Stomach	Intestine	Pluck	Fat	Hind feet	Trimming	Carcass
Below 15 kg	356	12.54^{a} ±0.10	4.22^{b}± 0.10 (0.54±0.01)	7.21^{b} ± 0.05 (0.91±0.01)	1.90^{c} ±0.01 (0.24±0.002)	9.54^{b}± 0.08 (1.19±0.01)	14.66^{ab}±0.11 (1.83±0.01)	7.75^{b} ±0.10 (0.97±0.01)	4.02^{b} ±0.04 (0.51±0.01)	1.23^{a} ±0.03 (0.15±0.004)	1.82^{b}±0.02 (0.23±0.003)	1.11^{c}±0.04 (0.14±0.01)	46.56^{a}± 0.12 (5.84±0.05)
> 15 -< 20 kg	559	17.32^{b} ±0.10	4.60^{c}± 0.10 (0.80±0.02)	7.10^{b} ± 0.04 (1.23±0.01)	1.84^{bc}± 0.01 (0.32±0.002)	9.31^{ab}± 0.07 (1.61±0.01)	14.98^{bc}± 0.11 (2.60±0.02)	7.40^{a}± 0.07 (1.29±0.01)	3.94^{ab}± 0.03 (0.68±0.01)	1.43^{b}± 0.03 (0.25±0.01)	1.78^{b}± 0.02 (0.31±0.003)	1.11^{c}± 0.02 (0.19±0.004)	46.52^{a}± 0.10 (8.06±0.03)
> 20 -< 25 kg	353	22.41^{c} ±0.10	4.22^{b}±0.10 (0.95±0.02)	6.62^{a}±0.04 (1.49±0.01	1.76^{a}±0.02 (0.39±0.004)	9.03^{a}±0.09 (2.02±0.02)	15.24^{c}±0.13 (3.41±0.03)	7.88^{b}±0.08 (1.77±0.02)	3.85^{a} ±0.03 (0.86±0.01)	1.62^{c} ±0.05 (0.36±0.01)	1.63^{a}± 0.02 (0.37±0.004)	0.99^{a}±0.02 (0.22±0.01)	47.18^{b}± 0.11 (10.57±0.04)
> 25 kg	249	28.16^{d} ±0.20	3.79^{a}±0.10 (1.06±0.02)	6.59^{a}±0.05 (1.85±0.02)	1.81^{ab}±0.02 (0.51±0.01)	9.62^{b}±0.09 (2.71±0.03)	14.33^{a} ± 0.11 (4.03±0.04)	7.93^{b}±0.09 (2.24±0.03)	3.90^{ab} ±0.04 (1.10±0.01)	1.66^{c} ±0.07 (0.47±0.02)	1.77^{b}±0.02 (0.50±0.01)	1.01^{b}± 0.03 (0.28±0.01)	47.59^{c}± 0.11 (13.41±0.11)
Overall	1517	19.16±0.14	4.28±0.10 (0.81±0.01)	6.93±0.02 (1.31±0.01)	1.83±0.01 (0.35±0.003)	9.35±0.04 (1.79±0.02)	14.86± 0.06 (2.84±0.02)	7.68 ±0.04 (1.48±0.02)	3.93 ±0.02 (0.75±0.02)	1.46 ±0.02 (0.29±0.01)	1.75±0.01 (0.33±0.003)	1.07^{c}±0.01 (0.20±0.003)	46.86±0.06 (9.00±0.07)

Values in parenthesis indicate weight in kg

[a-c] Means within a column, not sharing a common superscript, differ significantly (P<0.05)

Table 2: Overall yield of carcass and by products (%) as percentage of live weight of goats of different states

Name of the states	No. of goats	Live weight	Blood	Head	Fore feet	Skin	Stomach	Intestine	Pluck	Fat	Hind feet	Trimming	Carcass
Andhra Pradesh	311	19.51^{b} ± 0.30	3.88^{b} ± 0.02 (0.75± 0.01)	6.49^{b} ±0.03 (1.26±0.02)	1.82^{ab} ±0.01 (0.35±0.01)	10.71^{d} ± 0.05 (2.08±0.03)	14.49^{b} ± 0.06 (2.81±0.04)	8.79^{c} ± 0.08 (1.70±0.03)	3.93^{c}± 0.02 (0.76±0.01)	0.89^{a} ± 0.02 (0.19±0.01)	1.69^{a} ± 0.01 (0.33±0.01)	0.67^{a} ± 0.01 (0.14 ± 0.004)	46.66^{a} ± 0.13 (9.17 ± 0.15)
Uttar Pradesh	305	18.66^{ab} ± 0.20	4.80^{c} ± 0.08 (1.07±0.02)	7.41^{d} ±0.04 (1.37±0.01)	1.77^{a} ±0.02 (0.33±0.004)	8.70^{b} ± 0.08 (1.62±0.02)	14.34^{b} ± 0.12 (2.70±0.04)	6.55^{a}± 0.05 (1.23±0.02)	4.36^{d} ± 0.03 (0.81±0.01)	1.51^{c} ± 0.04 (0.30±0.01)	1.70^{a} ±0.02 (0.31±0.004)	1.40^{d} ± 0.03 (0.26±0.01)	46.46^{a}± 0.11 (8.68±0.10)
Maharashtra	301	20.58^{c} ± 0.40	3.72^{b}± 0.04 (0.76±0.02)	6.16^{a} ±0.03 (1.26±0.02)	1.86^{b} ±0.02 (0.38±0.01)	10.10^{c} ±0.05 (2.08±0.04)	14.00^{a} ±0.07 (2.87±0.05)	9.33^{d} ±0.04 (1.92±0.04)	3.76^{b} ±0.02 (0.78±0.02)	1.05^{b}± 0.02 (0.22±0.01)	1.83^{b}± 0.02 (0.38±0.01)	0.83^{b}± 0.02 (0.17±0.004)	47.37^{b} ±0.09 (9.77 ±0.20)
Assam	300	18.36^{a} ± 0.33	2.23^{a} ±0.01 (0.41±0.01)	7.20^{c} ±0.04 (1.32±0.02)	1.93^{c} ±0.01 (0.35±0.01)	8.47^{a} ±0.04 (1.54±0.03)	17.15^{c}± 0.06 (3.15±0.06)	7.14^{b} ±0.07 (1.32±0.03)	3.23^{a} ±0.01 (0.59±0.01)	2.37^{d} ±0.04 (0.45±0.01)	1.84^{b}± 0.01 (0.34±0.01)	1.06^{c}± 0.01 (0.20±0.004)	47.37^{b}± 0.08 (8.69±0.16)
Overall	1517	19.16± 0.14	4.28±0.05 (0.81±0.01)	6.93^{b} ±0.02 (1.32±0.01)	1.83±0.01 0.35±0.003)	9.35± 0.04 (1.79±0.02)	14.86±0.06 (2.84±0.02)	7.68±0.04 (1.48±0.02)	3.93±0.02 (0.75±0.01)	1.46±0.02 (0.29±0.01)	1.75±0.01 (0.33±0.003)	1.07±0.01 (0.20±0.003)	46.86±0.06 (9.00±0.01)

Values in parenthesis indicate weight in kg

[a-c] Means within a column, not sharing a common superscript, differ significantly (P<0.05)

also reported average yield of blood between 4.37 and 4.66% of live weight of Barbari, Jamnapari and Marwari goats.

Skin/hide is the very important and high valued inedible byproducts from goats. Well finished value added skin fetches high remuneration. The skin constituted about 9.03 to 9.62% of the total live weight of goats with a national average weight of 1.79 kg. The percent yield of skin recorded in the present study is comparable to those reported by Anandan et al. (2003) (8.7 to 9.2%).

Value of saleable meat and byproducts of goats: The parts of the goat carcass which have commercial value include meat, edible and inedible byproducts. When an animal is slaughtered, about one-third of it is harvested as meat and the rest comprise byproducts and waste. Most of the byproducts of goats are utilized for human consumption. Head, pluck (heart, liver, lung), stomach and intestine and fore and hind feet constitute major component of edible byproducts in goats (Mehta et al., 2000). These organs together constituted 43.79 % of the live weight. Most of these offal and byproducts are consumed as variety meat and are usually sold as unit, not on weight basis. Though the fore and hind feet do not contain much meaty portion but are used for soup preparation (Paya) and curry preparation (Lakshmanan et al., 1984). Fat also forms edible part of goat carcass. The proportion of fat in the carcass reflects the nutritional status of animals and therefore high variation exists in the fat content. The proportion of fat content has ranged from 1.23 % in goats of below 15 kg weight group to 1.66 % in goats of above 25 kg weight group. Similarly, Singh et al. (2010) reported an average fat content of 1.60 % in goats weighing around 25 - 30 kg. Based on the prevailing market price collected from the various parts of the country, the value of meat, edible byproducts and skin contributed about 81.07 – 85.78%, 11.55 – 16.47% and 2.39 – 2.68% of total value of animal, respectively. Mehta et al. (2000) report that the meat, skin and edible byproducts of Sirohi, Marvari and Kutchi goats grown under intensive system weighing 40 – 45 kg represented around 88.75 - 89.35 %, 6.38 – 6.62 % and 4.26 – 4.50 % of value of animal. Similar values were also reported by Solanki et al. (2009).

CONCLUSION

Goat husbandry provides glimpses of future hope for employment generation, nutritional security and prosperity to the millions of small and marginal farmers in the country. It may be inferred from the study that wider variation was observed in the live weight of goats (12.54 to 28.16 kg) utilized for meat production in different states. The overall average live weight of goat was 19.16 kg and average carcass weight was 9.00 kg, which indicates an average dressing percentage of 46.86%. There was significant differences ($P<0.005$) in the overall live weight, carcass weight, dressing percentage and overall yield of blood, skin and intestine of goats of different body weight groups collected from various states. The majority of the goats slaughtered were in the weight group of >15 to >20 kg (36.85 %). When expressed as percentage of live goat weight, the yield of edible (blood, head, feet, stomach and intestine, pluck (heart, liver, lungs), kidney and fat) and inedible byproducts (skin) were 43.79 and 9.35 %, respectively. The major revenue comes from the sale of meat (81.07 – 85.78%), followed by and edible offal (11.55 – 16.47%) and skin (2.39 – 2.68%).

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COMPETING INTERESTS: The authors have no known competing interests.

ETHICS STATEMENT: The slaughter and carcass characteristics data was collected from Municipal slaughter houses.

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