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Husbandry Practices and Phenotypic Characterization of Bidri Goats in Karnataka

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ABSTRACT

Background: The present study is focused on documentation of the husbandry practices and phenotypic characterization of Bidri goats, which is essential in recognition and improvement of this breed.

Methods: A total of 20 random flocks in 7 villages were investigated. Data was collected as per the standard format suggested by ICAR-NBAGR (2012) and was statistically analyzed using analysis of variance in R software environment.

Result: The average flock size of these goats was 33.43±4.73. The smaller flocks were generally housed in the part of residence, whereas, larger flocks (30-40 goats) were housed separately. Random mating was observed as males and females were grazed and housed together. These goats were predominantly black (73%), but black with white patches on ears, forehead, neck and knees (18%) and black with brown coat color (9%) were also found. The eyelids, muzzle and hooves were generally black in color and few exceptions were also seen. The forehead was straight in most of the goats but it was convex and concave shaped in very few. In these goats, 78 per cent were horned and were generally upwards, backwards, outward and curved, 13 per cent had downwards, backwards, outward and curved horns. Majority of these goats have pendulous ears and very few had horizontal ears. The average age at first estrus, first kidding, weaning age and kidding interval observed were 10.33±0.24, 17.57±0.40, 4-6 and 8.48±0.38 months, respectively. Usually the first kidding was single; twinning and triplet was 40 and 5 per cent of the breedable does, respectively. The mean body weight was 32.88±1.04 kg in bucks and 30.08±0.59 kg in does. Bidri goats are distinct and selective breeding would improvise the economic traits in these goats.

Key words: Bidri goat, Characterization, Correlation, Phenotype, Regression.

INTRODUCTION

The goat population in India which was about 47 million in 1952 has reached 148.88 million in 2019 and shown an increase by 10.1 per cent over the previous census (Anonymous 2019). This evinces faster rate of growth in goat species in comparison to others. Similar trend is seen in Karnataka, there has been continuous increase in goat population over the years from 3.7 million in 1972 to the extent of 6.17 million in 2019 (Anonymous 2019). Karnataka stands tenth in the country in goat population which has increased by almost 28.63 per cent compared to the population status in 2012. Our country has huge goat genetic resources with 34 registered breeds and many non-descript goats which have high production potentialities and are yet to be characterized. Characterization (phenotypic and genetic) of a unique animal genetic resource for a particular region is essential to exploit the associated diversity in their breeding tract to meet the local demands. Bidri is recently registered goat breed from Karnataka and are distributed in entire Bidar district and neighboring areas. Bidri goats are reared by people of all communities, mainly by scheduled castes, scheduled tribes (Koli samaj), muslims and kurubas. The kurubas rear goats usually along with the sheep, whereas majority of scheduled castes, scheduled tribes and muslims rear only goats. These goats have very important role in the sustenance of livelihood for majority of rural communities.

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Hence, this research was carried out with aims of documenting goat husbandry practices, phenotypic traits, morphometry and reproductive potentialities of Bidri goats under local field conditions.

MATERIALS AND METHODS

The data related to demography, managemental practices, phenotypic traits, body measurements and reproductive traits of Bidri goats was collected from randomly selected villages of Humnabad and Basavakalyan talukas of Bidar district in the year 2019-2020. Data related to various goat husbandry practices were collected as per the standard format suggested by ICAR-NBAGR (2012). The data regarding management practices (flock size, housing system, feeding, breeding and marketing), phenotypic traits (coat color, forehead shape, horn pattern, ears and tail pattern, udder and teat shape, presence of beard and wattles), reproductive parameters (age at first estrous, age at first kidding, weaning age and kidding interval) and the morphometric measurements {body weight (BW), chest girth (CG), height at wither (HT), body length (BL), face length (FL), ear length (EL), ear width (EW), tail length (TL) and horn length (HL)} were recorded as per standard procedures.

The collected data on various parameters of selected goat populations was classified according to sex and age groups. The age groups of 0-3, 4-6, 7-12 months and adults (above 12 months) were considered. The mean morphometric measurements (BW, CG, HT, BL, FL, EL, EW, TL and HL) of different age groups were estimated for both the sexes. The relationship among various morphometric measurements were analyzed using correlation coefficient module. Pearson correlation coefficients were calculated between BW, HT, CG and BL for male and female goats. To predict the BW from various body measurements, multiple linear regression analysis was done using generalized linear model (GLM) procedure. The data on various reproductive traits were collected by interaction with the flock owners and average values were calculated. The data obtained on various morphometric measurements in different age groups was statistically analyzed using analysis of variance in R software environment for statistical computing and graphics.

RESULTS AND DISCUSSION

Total of 20 random flocks in 7 villages belonging to Humnabad and Basavkalyan talukas of Bidar district were surveyed. The breeding tract encompasses entire Bidar district of Karnataka and also northern parts of Kalaburgi district. The region has semi-arid climate with slightly higher temperatures during summer months. The average elevation of the tract is 640-684 meters from the mean sea level and the average rainfall is 827 mm. The entire breeding tract is covered by Godavari basin, drained by Manjara and Karanja rivers. It has black and lateritic soil; the major crops grown are jowar, paddy, wheat, bajra, maize, pulses, groundnut, sugarcane and cotton. Bidri goats are reared by people of all communities, mainly by scheduled castes, scheduled tribes (Koli samaj), muslims and kurubas.

Goat husbandry practices

The average flock size of Bidri goats observed in this study was 33.43±4.73. This flock size is different from the previous observation of Shettar (2011), who reported a flock size of 21 and of Tantia *et al.* (2018), who reported 74.3 (21-130). Bidri flocks were generally stationary (90%), whereas the goats reared along with sheep go for migration (10%). Smaller flocks were generally housed in the part of the owner's residence, whereas the larger flocks (30-40 goats) were housed separately. Usually the goat sheds were of open type with a thatched/ galvanized iron sheet roof inside it (90%) and the boundaries were constructed by stone bricks. The housing pattern reported in this study was similar to the earlier reports of Shettar (2011) and Tantia *et al.* (2018).

The goats were taken for grazing from 10 AM to 6 PM, generally cover about 5-6 kms in the nearby paddocks, fallow lands and also in reserved forest areas. Goats were commonly fed on shrubs, tree leaves, grasses, green and dry fodder and other crop residues. Occasionally, breeding bucks and lactating does were given some extra ration in the form of concentrates or broken grains for steaming up. Sufficient drinking water was also made available to the goats before leaving for grazing and after their return from grazing. The grazing pattern reported in this study was similar to the earlier reports of Shettar (2011). Random and uncontrolled mating in Bidri goats was observed in present study, since the bucks and does were reared and housed together. The sex ratio of 10:1 to 15:1 was observed in most of the flocks. Usually, the best male kids were retained in the flocks and they replaced the breeding bucks in near future, but there was no practice of changing or exchanging of breeding bucks. The does were kept in the flocks upto 10-12 kiddings or 6-8 years of age. The breeding practices reported in the present study were similar to the earlier reports in Bidri (Shettar, 2011), in Jayawadagi (Devendrappa, 2016) and in Nandidurga goats (Azharuddin, 2011).

Goat farmers generally followed the advice of elderly experienced persons to treat ailments and they also availed allopathic medication from the nearest veterinary hospitals/ dispensaries. It was observed that there was awareness about vaccinations against enterotoxaemia and peste des petits ruminants (PPR), for which farmers generally availed the services of Department of Animal Husbandry and Veterinary Services (DAHVS), Government of Karnataka (GoK). Deworming of the goats was also being practiced once in 3 months with the assistance of DAHVS, GoK. These practices were similar to the earlier reports in Bidri (Shettar, 2011), Jayawadagi (Devendrappa, 2016) and Nandidurga goats (Azharuddin, 2011). Most commonly, the male kids of 6 months age were marketed and sometimes the male kids were castrated and maintained upto 12 months of age and then marketed for much better price in the nearby livestock sandies. Whereas the female kids were reared to replace aged breeding does. These were similar to the earlier reports in Bidri (Shettar, 2011), Jayawadagi (Devendrappa, 2016) and Nandidurga goats (Azharuddin, 2011).

Phenotypic traits

The representative photograph of Bidri doe and buck is given in Fig 1 and 2, respectively. The Bidri goats were predominantly black (73%) in color, but black with white

Fig 1: A representative photograph of Bidri Doe.

Fig 2: A representative photograph of Bidri Buck.

patches on ears, forehead, neck and knees (18%) and black with brown coat color (9%) were also observed. However, Shettar (2011) reported 54.75 per cent black and 30.2 per cent black with white patches over the body and Tantia *et al.* (2018) have noticed predominantly black coat color and few with white spots on ears, forehead, neck and knees. Eyelids, muzzle and hooves were generally black in color with very few exceptions. Similar observations were reported by Tantia *et al.* (2018) and Shettar (2011) in these goats. Forehead was straight in majority of these goats, similar forehead shape was reported by Shettar (2011). Only 5 per cent of these goats had beard (usually bucks) and only 6 per cent had wattles, almost similar observations were reported by Shettar (2011).

Horns were predominantly black colored and very few were white, grey or brown colored. 78 per cent of these goats were horned and were generally oriented upwards, backwards, outward and curved and 13 per cent had downwards, backwards, outward and curved horns, while 9 per cent were polled. Similar horn pattern was reported by Shettar (2011) and Tantia *et al*. (2018). 92 per cent of these goats had pendulous ears and only 8 per cent had horizontal ears. Similar ears pattern was reported by Shettar (2011) and Tantia *et al.* (2018). Most of these goats had short and raised or curved type of tails, Shettar (2011) reported similar tail shape and orientation. Udder was generally hairy and smaller in size and the teats were also smaller. Similar observations were reported by Tantia *et al.* (2018).

Reproductive potentialities

Age at first estrus observed in Bidri goats was 10.33±0.24 months, whereas it was reported to be 10.2 months by Shettar (2011). It was reported to be 8-9 months in Jayawadagi goats by Devendrappa (2016) and 7.80±0.13 months in local goats of Karnataka by Jayashree (2014). Age at first kidding noticed was 17.57±0.40 months and similar observation was made by Tantia *et al.* (2018) and slightly higher age at first kidding (19.6 months) was reported by Shettar (2011). It was 16.94±0.24 months in local goats of southern Karnataka (Jayashree, 2014) and 550.07±3.31 days (18.33 months) in Mandya local goats (Siddalingamurthy, 2016). Kids were weaned at 4-6 months of age and the male kids were marketed immediately after weaning. Similar observation (4.44±0.09 months) was noticed in local goats of southern Karnataka (Jayashree, 2014). Kidding interval of 8.48±0.38 months was observed in these goats and similar observation of 275 days (9.16 months) was reported by Tantia *et al.* (2018), however it was reported as 9.8 months by Shettar (2011). Comparatively lesser kidding interval of 214 days (7.13 months) was observed in Osmanabadi goats (Raskar *et al.*, 2018) and higher kidding interval of 9.53±1.04 months was observed in local goats of Karnataka (Jayashree, 2014). Twinning and triplets observed in this study was 40 and 5 per cent of the breedable does, respectively, whereas it was reported as 25 and 3 per cent, respectively by Shettar (2011). Interestingly, Tantia *et al.* (2018) have reported that twining was common but first kidding was often single. In Osmanabadi goats, 30 per cent twinning and 2 per cent triplets were reported (Raskar *et al.*, 2018). Twinning was very common and at times triplets, quadruplets and occasionally pentuplets were observed in some small flocks and frequency of multiple births was 46.97 per cent in local goats of southern Karnataka (Jayashree, 2014).

Morphometric measurements

Body weight and various body measurements at different age groups are presented in (Table 1). Statistical analysis revealed non-significant difference between the sexes for BW in all the age groups. The average body weight (BW, kg) in 0-3, 4-6 and 7-12 months old male and female Bidri goats in this study was 6.74±0.29 and 7.44±0.28, 11.35±0.34 and 10.57±0.29, and 15.27±0.57 and 14.57±0.39, respectively, which were lower than that reported by Shettar (2011). Also, the average BW of adult male and female goats in this study was 32.88±1.04 and 30.08±0.59, respectively, which was higher than that reported by Shettar (2011), but it was lower than that reported by Tantia *et al.* (2018).

Similarly, statistical analysis revealed non-significant difference between the sexes for chest girth (CG, cm) in 0-3 months, 4-6 months and 7-12 months age groups, however, significant ($p<0.05$) difference was observed between sexes in adult goats. The average chest girth (CG, cm) in 0-3 month old male and female kids in this study was 44.53±0.35 and 44.33±0.42, respectively. The CG of male kids was lower

Table 1: Body weight (kg) and body measurements (cm) at different age groups.

Factor	Sex	0-3 Months	4-6 Months	7-12 Months	Adults
Body weight	Male	6.74±0.29 (19)	11.35±0.34 (20)	15.27±0.57 (15)	32.88±1.04 (17)
	Female	7.44±0.28 (18)	10.57±0.29 (23)	14.57±0.39 (30)	30.08±0.59 (51)
	Overall	7.08±0.21 (37)	10.93±0.23 (43)	14.80±0.32 (45)	30.78±0.53 (68)
Chest girth	Male	44.53±0.35 (19)	52.95±0.55 (20)	64.40±0.82 (15)	78.53±1.43^{p} (17)
	Female	44.33±0.42 (18)	51.48±0.63 (23)	62.43±0.57 (30)	73.39±0.80^{q} (51)
	Overall	44.43±0.27 (37)	52.16±0.43 (43)	63.09±0.48 (45)	74.68±0.75 (68)
Height at wither	Male	46.47±0.35 (19)	55.40±0.66 (20)	65.07±0.85 (15)	73.82±1.35 (17)
	Female	45.22±0.65 (18)	54.04±0.69 (23)	63.17±0.56 (30)	71.04±0.79 (51)
	Overall	45.86±0.37 (37)	54.67±0.49 (43)	63.80±0.48 (45)	71.74±0.69 (68)
Body length	Male	37.06±0.39 (19)	45.95±0.51 (20)	52.67±0.76 (15)	61.18±1.31 (17)
	Female	37.37±0.49 (18)	44.13±0.48 (23)	50.70±0.52 (30)	58.16±0.74 (51)
	Overall	37.22±0.31 (37)	44.98±0.37 (43)	51.36±0.45 (45)	58.91±0.66 (68)
Face length	Male	11.95±0.28 (19)	13.40±0.33^{p} (20)	14.13±0.63 (15)	16.06±0.80 (17)
	Female	10.89±0.31 (18)	11.26±0.30^{q} (23)	13.37±0.32 (30)	15.04±0.33 (51)
	Overall	11.43±0.22 (37)	12.25±0.27 (43)	13.62±0.30 (45)	15.29±0.32 (68)
Ear length	Male	8.58±0.27 (19)	9.9±0.32^{p} (20)	12.53±0.52 (15)	14.12±0.49 (17)
	Female	8.06±0.29 (18)	8.39±0.28^{q} (23)	12.2±0.30 (30)	13.69±0.26 (51)
	Overall	8.32±0.2 (37)	9.09±0.24 (43)	12.31±0.26 (45)	13.79±0.23 (68)
Ear width	Male	6.10± 0.25 (19)	6.30±0.25 (20)	6.47±0.17 (15)	6.94±0.22 (17)
	Female	5.56 ±0.17 (18)	5.96±0.21 (23)	6.37±0.10 (30)	6.78±0.10 (51)
	Overall	5.84±0.16 (37)	6.12±0.16 (43)	6.4±0.09 (45)	6.82±0.09 (68)
Tail length	Male	8.32±0.25 (19)	10.40±0.33 (20)	12.73±0.40 (15)	15.76±0.51 (17)
	Female	7.72±0.25 (18)	9.96±0.28 (23)	12.20±0.22 (30)	15.29±0.25 (51)
	Overall	8.03±0.18 (37)	10.17±0.21 (43)	12.38±0.20 (45)	15.41±0.23 (68)
Horn length	Male	1.32±0.12 (14)	2.33±0.19 (15)	7.33±0.36 (12)	17.29±0.79 (14)
	Female	1.18±0.08 (14)	1.89±0.11 (17)	6.92±0.18 (24)	15.88±0.44 (40)
	Overall	1.25±0.07 (28)	2.09±0.11 (32)	7.06±0.17 (36)	16.24±0.39 (54)

Means with different superscript (p, q) indicates significant difference between males and females at ($p<0.05$). Values in parenthesis indicate the number of observations.

and that of female kids was higher than that reported by Shettar (2011). The average CG in 4-6 and 7-12 months old male and female goats in this study was 52.95±0.55 and 51.48±0.63 and 64.40±0.82 and 62.43±0.57, respectively, which were lesser than that reported by Shettar (2011). However, the average CG of adult male and female goats in this study was 78.53±1.43 and 73.39±0.80, respectively, which was higher than that reported by Shettar (2011) and was lesser than that reported by Tantia *et al.* (2018). Analysis of height at wither (HT, cm) revealed non-significant difference between sexes in all the age groups. The average height at withers (HT, cm) in 0-3, 4-6 and 7-12 months male and female goats in this study was 46.47±0.35 and 45.22±0.65, 55.40±0.66 and 54.04±0.69 and 65.07±0.85 and 63.17±0.56, respectively. These measurements were almost similar to that reported by Shettar (2011). However, the average HT of adult male and female goats in this study was 73.82±1.35 and 71.04±0.79, respectively, which was higher than that reported by Shettar (2011) and it was lesser than that reported by Tantia *et al.* (2018). Analysis of body length (BL, cm) revealed non-significant difference between sexes in all the age groups. The average body length (BL, cm) in 0-3, 4-6 and 7-12 months old male and female goats in this study was 37.06±0.39 and 37.37±0.49, 45.95±0.51 and 44.13±0.48 and 52.67±0.76 and 50.70±0.52, respectively. These measurements were comparatively higher to that reported by Shettar (2011). However, the average BL of adult male and female goats in this study was 61.18±1.31 and 58.16±0.74, respectively, which was higher than that reported by Shettar (2011) and Tantia *et al.* (2018).

Also, the statistical analysis revealed non-significant difference between the sexes for face length (FL, cm) in 0-3 months, 7-12 months and adults age group, however, significant ($p<0.05$) difference was observed between sexes in 4-6 months age group. The average face length (FL, cm) in 0-3, 4-6, 7-12 months and adult male and female goats in this study was 11.95±0.28 and 10.89±0.31, 13.40±0.33 and 11.26±0.30, 14.13±0.63 and 13.37±0.32 and 16.06±0.80 and 15.04±0.33, respectively. The analysis of ear length (EL, cm) data revealed non-significant difference between the sexes in 0-3 months, 7-12 months and adults age group, however, significant ($p<0.05$) difference was observed between sexes in 4-6 months age group. The average ear length (EL, cm)

in 0-3, 4-6 and 7-12 months old male and female goats in this study was 8.58±0.27 and 8.06±0.29, 9.9±0.32 and 8.39±0.28 and 12.53±0.52 and 12.2±0.30, respectively. The average EL of adult male and female goats in this study was 14.12±0.49 and 13.69±0.26, respectively, which was lesser than that reported by Tantia *et al.* (2018). Statistical analysis revealed non-significant difference between the sexes for ear width (EW, cm) in all the age groups. The average ear width (EW, cm) in 0-3, 4-6, 7-12 month old and adult male and female goats in this study was 6.10±0.25 and 5.56±0.17, 6.30±0.25 and 5.96±0.21, 6.47±0.17 and 6.37±0.10 and 6.94±0.22 and 6.78±0.10, respectively. The analysis of tail length (TL, cm) data revealed non-significant difference between the sexes in all the age groups. The average tail length (TL, cm) in 0-3, 4-6 and 7-12 months old male and female goats in this study was 8.32±0.25 and 7.72±0.25, 10.40±0.33 and 9.96±0.28 and 12.73±0.40 and 12.20±0.22, respectively. The average EL of adult male and female goats in this study was 15.76±0.51 and 15.29±0.25, respectively, which was lesser than that reported by Tantia *et al.* (2018). Statistical analysis revealed non-significant difference between the sexes for horn length (HL, cm) in all the age groups. The average horn length (HL, cm) in 0-3, 4-6 and 7-12 months old male and female goats in this study was 1.32±0.12 and 1.18±0.08, 2.33±0.19 and 1.89±0.11 and 7.33±0.36 and 6.92±0.18, respectively. The average HL of adult male and female goats in this study was 17.29±0.79 and 15.88±0.44, respectively, which was higher than that reported by Tantia *et al.* (2018).

Table 2: Pearson's correlation coefficients among body measure -ments.

	BW	CG	HT	BL
BW	1	0.864**	0.680**	0.755**
CG		1	0.910**	0.923**
HT			1	0.892**
BL				1

**Correlation is significant at ($p \leq 0.01$).

Correlation between body measurements and development of prediction equations

In the present study, statistical analysis showed positive and significant ($p<0.01$) correlation between body weight and various morphometric measurements (Table 2). The correlation coefficients of BW with CG, HT and BL were 0.864, 0.680 and 0.755, respectively. This demonstrates the higher correlation between body weight and chest girth when compared to height at withers and body length. Hence, chest girth may be considered as predominant factor in predicting body weight in these goats. Similar to our findings, in Nandidurga goats, there was significant ($p<0.05$) correlation between all the traits, the overall correlation coefficient between BW and BL, HT and CG were 0.91, 0.89 and 0.95, respectively (Azharuddin, 2011). In local goats of southern Karnataka at age groups of 3-6 and 6-12 months of age, the body weight was highly correlated with body measurements, but not in more than 12 months of age group (Jayashree *et al*., 2015). All correlation coefficients between body weight and body measurements in Mandya local goats were positive and highly significant. Body weight was positively and significantly correlated with height at withers (0.80), body length (0.96), chest girth (0.94) and paunch girth (0.94) (Siddalingamurthy *et al*., 2017).

Linear regression equations for prediction of body weight were derived as Y = -14.660 + 1.421CG - 0.775HT for bucks and Y = -13.598 + 1.143CG - 0.465HT - 0.123BL for does with R^2 values of 0.913 and 0.789, respectively (Table 3). These equations indicate CG, HT and BL as the predominant factors for prediction of BW in Bidri goats. Similar to these results, in adult Bidri goats of more than 12 months age group, multiple regression analysis revealed the significant influence of BL alone with high R^2 value in males, and BL and HT with high R^2 value in females for predicting body weight (Shettar, 2011). In local goats of southern Karnataka, non significant correlation between body weight and chest girth (0.097) at more than 12 months of age indicated that chest girth alone cannot be considered for estimating the body weight at later ages; however,

Table 3: Multiple regression analysis for body weight from body measurements.

	Variable	Parameter estimates	Standard error	β	t value	P
Bucks	Intercept	-14.660	4.842		-3.027	0.010
	Chest girth	1.421	0.207	1.965	6.868	0.000
	Body height	-0.775	0.191	-1.007	-4.053	0.001
	Body length	-0.111	0.176	-0.141	-0.634	0.537
Does	Intercept	-13.598	3.786		-3.592	0.001
	Chest girth	1.143	0.150	1.546	7.639	0.000
	Body height	-0.465	0.124	-0.621	-3.764	0.000
	Body length	-0.123	0.146	-0.153	-0.842	0.404

	Prediction equation for body weight	R^2
Bucks	-14.660 + 1.421 CG - 0.775 HT	0.913
Does	-13.598 + 1.143 CG - 0.465 HT - 0.123 BL	0.789

significant correlation between body weight and paunch girth or body length suggested that these can be used to predict the body weight in adult goats (Jayashree *et al*., 2015). In Mandya local goats, multiple regression analysis revealed the significant influence of height at withers in combination with body length and chest girth in predicting body weight with a coefficient of determination ranging between 69.34 to 71.16 per cent (Siddalingamurthy *et al*., 2017).

CONCLUSION

The present study documented goat husbandry practices, phenotypic traits, body measurements and reproductive potentialities of Bidri goats under local field conditions. The study concluded that production potentialities of these goats could be improved with adoption of scientific and managemental practices.

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