Explor Anim Med Res,
Vol. 8, Issue - 1, 2018, p. 69-75

ISSN 2277- 470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Research Article

A COMPARATIVE STUDY ON BODY MORPHOMETRIC, REPRODUCTIVE AND VITAL PARAMETERS AMONG INDIGENOUS GOAT POPULATION OF ODISHA, INDIA

Siddhant Sekhar Sahoo[1], Chinmoy Mishra[2*], Gangadhar Nayak[3], Kamdev Sethy[4], Kumaresh Behera[5]

Received 09 September 2017, revised 03 April 2018

ABSTRACT: The importance of goat in Indian economy is inevitable. A study on phenotypic traits of goats will give a better insight to their individuality and potentiality for future improvement. Phenotypic data on goat from different agroclimatic zones of Odisha were collected and analysed. The least square means of height at wither, height at rump, heart girth, punch girth, neck girth, body length (60.78 ± 0.93, 64.04 ± 0.91, 60.21 ± 0.43, 65.71 ± 0.47, 35.20 ± 0.52, 54.81 ± 0.74 cm) were found to be highest in Ganjam goat population followed by Koraput (Raighar) and Black Bengal goat with significantly ($p < 0.01$) positive correlation. For reproductive traits, the least square means of litter size (2.36 ± 0.11, 1.57 ± 0.13, 1.75 ± 0.11) and kidding interval (6.63 ± 0.24, 10.93 ± 0.28, 8.62 ± 0.23 months) for Black Bengal, Ganjam and Koraput (Raighar) goat breeds differed significantly ($p < 0.05$). The least square means of rectal temperature and skin temperature were found to be higher in Ganjam goat (102.38 ± 0.07 ºF, 100.95 ± 0.07 ºF) as compared to Koraput (Raighar) (102.19 ± 0.08 ºF, 100.85 ± 0.07 ºF) and Black Bengal goats (101.33 ± 0.10 ºF, 100.16 ± 0.11 ºF). But, the least square means of heart rate and respiration rate were found to be higher in Black Bengal goat (74.08 ± 1.61, 37.28 ± 1.06) as compared to Ganjam (72.47 ± 0.58, 31.35 ± 0.54) and Koraput (Raighar) goats (70.54 ± 0.42, 26.73 ± 0.35).

Key words: Correlation, Goat, Morphometry, Vital parameters.

INTRODUCTION

Goats play an important role in the rural economy for being the most preferred meat producing animals. Moreover, its milk is a pricey product because of high digestibility best suited for infants and invalids as well as for its medicinal values. Goats are often called as moving fertilizers because of the high manorial value of its dropping. Most of the goat breeds in India have evolved naturally through adaptation to agro-ecological conditions. Genetic diversity is essential for the sustainability of livestock genetic improvement, for selection of new traits and to prevent poor performance due to inbreeding. The coat colour patterns in indigenous goats are highly variable, indicative of the uncontrolled and indiscriminate mating of stock. The phenotypic diversity portrays the adaptability of goats to various agroclimatic zones in which they are raised. Moreover, local breeds are also part of our cultural heritage and many have a socio-economic value, as they are necessary for the livelihood of rural masses in harsh areas (Gandini and Villa 2003).

MATERIALS AND METHODS

Odisha state is comprised of 30 districts divided into 10 different agroclimatic zones (Fig. 1). A total of 150 adult female goats were selected from 10 different districts (Fig. 2) representing the 10 different agroclimatic zones. These goats belonged to three different goat populations *viz*. Black Bengal (n=80), Ganjam (n=50) and Koraput (Raighar) goat (n=20).

The phenotypic observations on age, sex and coat colour, on body measurements (body weight, body length, neck girth, heart girth, punch girth, height at wither, height at rump and leg length), on reproductive traits (age at sexual maturity, age at first breeding, litter size and kidding interval) and on physiological traits (rectal temperature, skin temperature, respiration rate and pulse rate) were recorded in each goat. Body weight (kg) was taken using a weighing scale. Body length (cm) was recorded as the length from point of shoulder to the pin bone. Height at withers (cm) was recorded as the height of the point of withers from the ground. Heart girth (cm)

[1]MVSc Scholar, [2] Assistant Professor, [3] Professor and Head, Department of Animal Breeding and Genetics, College of Veterinary Science and Animal Husbandry, Orissa University of Agriculture and Technology, India.
[4]Assistant Professor, Department of Animal Nutrition, [5] Assistant Professor, Department of Livestock Production and Management, College of Veterinary Science and Animal Husbandry, Orissa University of Agriculture and Technology, India.
**Corresponding author. e-mail: drchinmoymishra@gmail.com*

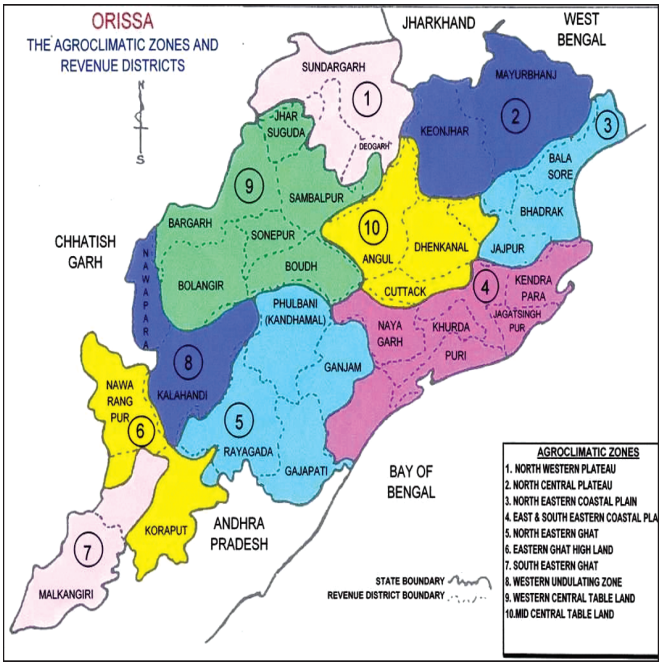
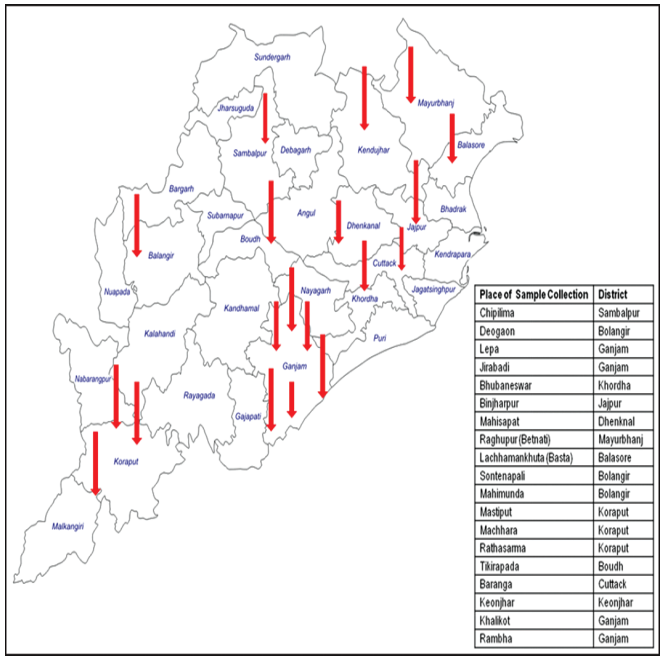


Fig. 1. Different agroclimatic zones of Odisha.



Place of Sample Collection	District
Chipilima	Sambalpur
Deogaon	Bolangir
Lepa	Ganjam
Jirabadi	Ganjam
Bhubaneswar	Khordha
Binjharpur	Jajpur
Mahisapat	Dhenknal
Raghupur (Betnati)	Mayurbhanj
Lachhamankhuta (Basta)	Balasore
Sontenapali	Bolangir
Mahimunda	Bolangir
Mastiput	Koraput
Machhara	Koraput
Rathasarma	Koraput
Tikirapada	Boudh
Baranga	Cuttack
Keonjhar	Keonjhar
Khalikot	Ganjam
Rambha	Ganjam

Fig. 2. Operational areas for sample collection.

was recorded by passing the measuring tape around the chest immediate behind the point of elbow. Punch girth (cm) was taken as the body circumference in front of sacrum. The qualitative traits like head type (convex/ straight), ear type (drooping/ horizontal/ erect/ pendulous) wattle (present/absent), beard (present/absent) horn (present/absent) and coat colour (black/brown/white) were also recorded.

The vital parameters were recorded in between 1:00 PM and 3:00 PM to predict the maximum effect of heat stress when temperature of the day usually remained the highest. The rectal temperature was recorded by digital thermometer (Hicks®, India). The skin temperature was recorded from a distance by infra red thermometer (HTC®, India). The heart rate was recorded by a stethoscope and respiration rate was recorded by observing the flank movement from a distance without disturbing the animal.

Statistical analysis

All the statistical examination was done by SPSS 22 statistical software package. Duncan multiple comparison test was used for comparison among the groups.

Breed wise analysis was done to estimate the effect of breed on height at wither, height at rump, chest girth, punch girth, neck girth, body length by applying univariate model with Duncan multiple range test as post-hoc analysis in statistical package of SPSS 22.

The effect of breed on body morphometric traits (*viz.* height at wither, height at rump, chest girth, punch girth, body length), on the reproductive traits (*viz.* age at sexual maturity, age at first breeding, litter size and kidding interval) and on the vital parameters (*viz.* rectal temperature, skin temperature, respiration rate and pulse

Table 1. Least square means ± standard error of body morphometric traits in goats.

Breed	Height at Wither	Height at Rump	Chest Girth	Punch Girth	Neck Girth	Body Length
Black Bengal	54.54^{a}± 0.784	56.17^{a}± 0.772	52.43± 0.782	55.82± 0.675	30.98^{a}± 0.494	51.49^{a}± 0.627
Ganjam	60.78^{b}± 0.932	64.04^{b}± 0.918	60.21± 0.435	65.71± 0.478	35.20^{b}± 0.524	54.81^{b}± 0.746
Koraput (Raighar)	58.22^{c}± 0.831	62.37^{b}± 0.818	56.36± 0.193	59.39± 0.298	28.68^{c}± 0.587	53.69^{b}± 0.665

Traits having different superscript under a column differ significantly ($p < 0.05$).

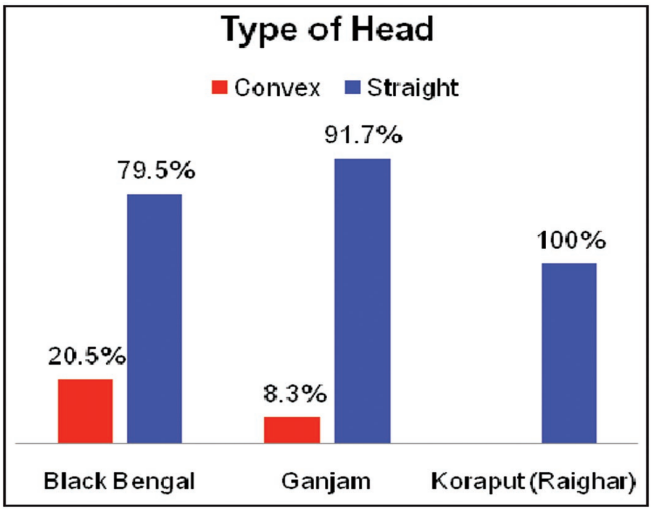


Fig. 3. Head pattern in percentage.

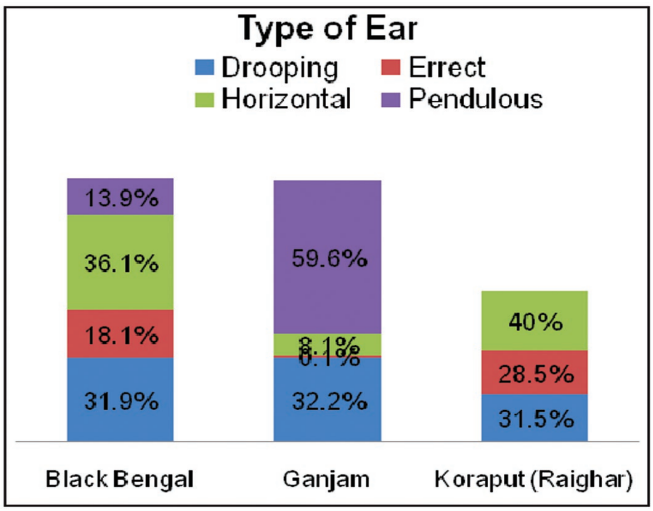


Fig. 4. Ear pattern in percentage.

rate) were done separately using univariate analysis of linear model,

$Y_{ik} = \mu + B_i + E_{ik}$

where

Y_{ik} is the trait measured on each of the k^{th} animal under i^{th} breed

μ is the overall mean,

B_i is the fixed effect associated with the i^{th} breed,

E_{ik} is the random error component

RESULTS AND DISCUSSION

Survey and recording of phenotypic traits

Phenotypic characteristics based on morphometry traits can provide a good representation of variation amongst populations. The head was mostly straight type in all the studied goat populations (Fig. 3). The ears are mostly horizontal type in Black Bengal and Koraput (Raighar) goat. However, in Ganjam goat pendulous ear is mostly prevalent (Fig. 4). Very few animals had wattles in Black Bengal and Ganjam goats. Rest of the animals including all the studied goats of Koraput (Raighar) goats were devoid of any wattle (Fig. 5). In most of the goats, beard was absent with few occurrence (Fig. 6). In most of the goats, horns are present with highest percentage of occurrence in Koraput (Raighar) goats (Fig. 7). In most of the goats, the highest percentage of black coat colour was observed in Black Bengal followed by Ganjam (Fig. 8).

It was observed that height at wither, height at rump and body length differ significantly ($p<0.05$) among Black Bengal ~ Ganjam and Black Bengal ~ Koraput goats, but there is no significance difference between Ganjam ~ Koraput (Raighar) goat population. Neck girth differed significantly between Black Bengal, Koraput (Raighar) ~ Ganjam goats.

Mean values of height at withers were observed to be 54.54 ± 0.78 cm, 60.78 ± 0.93 cm and 58.22 ± 0.831 cm in adult females of Black Bengal, Ganjam and Koraput

Table 2. Correlation values among body morphometric traits in goats.

Traits	Height at wither	Height at rump	Neck girth	Heart girth	Punch girth	Body length	Leg length	Body weight
Height at wither	1	0.888**	0.549**	0.871**	0.807**	0.720**	0.452**	0.489**
Height at rump	0.888**	1	0.519**	0.778**	0.721**	0.650**	0.334**	0.494**
Neck girth	0.549**	0.519**	1	0.513**	0.499**	0.568**	0.663**	0.564**
Heart girth	0.871**	0.778**	0.513**	1	0.962**	0.704**	0.471**	0.464**
Punch girth	0.807**	0.721**	0.499**	0.962**	1	0.659**	0.531**	0.444**
Body length	0.720**	0.650**	0.568**	0.704**	0.659**	1	0.542**	0.587**
Leg length	0.452**	0.334**	0.663**	0.471**	0.531**	0.542**	1	0.387**
Body weight	0.489**	0.494**	0.564**	0.464**	0.444**	0.587**	0.387**	1

** Correlation is significant at the 0.01 level (2-tailed).

Table 3. Least square means ± standard error of reproductive traits in goats.

Breed	Age at sexual maturity (Months)	Age at first breeding (Months)	Litter Size	Kidding Interval (Months)
Black Bengal	7.446[a]± 0.308	9.283[a]± 0.336	2.361[a]± 0.119	6.636[a]± 0.240
Ganajm	12.982[b]± 0.357	15.025[b]± 0.389	1.575[b]± 0.137	10.939[b]± 0.287
Koraput (Raighar)	7.813[a]± 0.3	9.875[a]± 0.326	1.750[c]± 0.115	8.625[c]± 0.233

Traits having different superscript under a column differ significantly ($p < 0.05$).

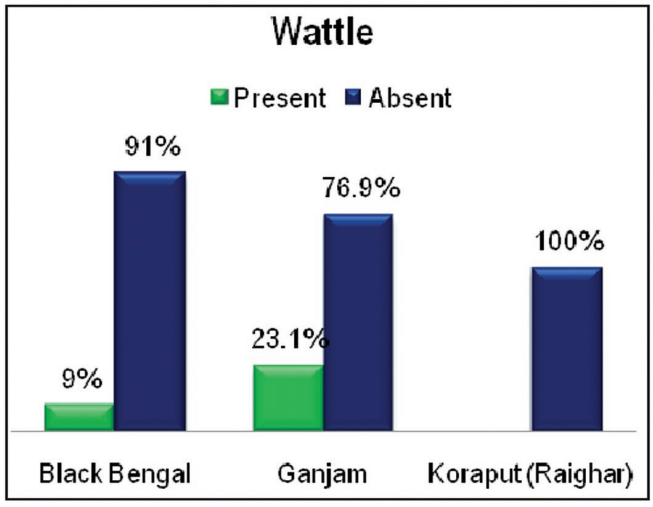


Fig. 5. Occurrence of wattle in percentage.

(Raighar) goats, respectively (Table 2). There was significant difference of height at withers ($p < 0.05$) between the breeds in our studied population. Our estimated result from the present study almost coincides with the earlier reports on Black Bengal (56.00 ± 0.92 cm) and indigenous goats of Keonjhar (53.11 ± 0.10 cm) district (Singh *et al.* 1979, Singh Bariha *et al.* 2008). Lower values of height at withers were reported in Chegu (44.88 ± 0.59 cm) and Black Bengal (49.44 ± 2.15 cm) goats (Karna *et al.* 2005, Rao *et al.* 2002, Paul *et al.* 2011). Higher values of height at withers were reported in Ganjam (79.03 ± 0.11 cm) goats (Rao *et al.* 2009). Mean values of height at rump were observed to be 56.17 ± 0.77, 64.04 ± 0.91 and 62.37 ± 0.81 cm in Black Bengal, Ganjam and Koraput (Raighar) goats, respectively (Table 1). However, any comparison could not be made due to lack of such type of earlier study. Statistically significant ($p<0.05$) difference values for height at rump was observed between Black Bengal~ Ganjam and Black Bengal~ Koraput (Raighar) goat.

Mean values of neck girth were observed to be 30.98 ± 0.49, 35.20 ± 0.52 and 28.68 ± 0.58 cm in Black Bengal, Ganjam and Koraput (Raighar) goat, respectively (Table 1). Comparison among the breeds could not be carried out due to lack of such type of earlier study in relation to neck girth. Statistically significant ($p < 0.05$) difference values for neck girth were observed among all the studied breeds of goat. Mean values of chest girth were observed to be 54.43 ± 0.78, 60.21 ± 0.43, 56.36 ± 0.19 cm in Black Bengal, Ganjam and Koraput (Raighar) goat, respectively (Table 1). Estimated results of our study almost coincide with the earlier reports on Black Bengal, Berari (53.4.0 ± 0.83 cm) and indigenous goats of Keonjhar (53.45 ± 0.16 cm) district (Paul *et al.* 2011, Kharkar *et al.* 2014, Karna *et al.* 2005). Lower values of chest girth were reported in Black Bengal (50.21 ± 0.45 cm) goats (Rao *et al.* 2002). Higher values of chest girth were reported in Ganjam (86.10 ± 0.11) goats (Rao *et al.* 2009). Mean value of punch girth were observed to be 55.82 ± 0.67, 65.71 ± 0.47 and 59.39 ± 0.58 cm in Black Bengal, Ganjam and Koraput (Raighar) goat, respectively (Table 1). Our calculated result on Black Bengal goat mostly coincides with the earlier reports on indigenous goats of Keonjhar (55.48±0.15 cm) district of Odisha (Singh Bariha *et al.* 2008). Similarly mean value of punch

Table 4. Least square means ± standard error of vital parameters in goats.

Breed	Rectal temperature (^{0}F)	Skin temperature (^{0}F)	Heart rate (min)	Respiration rate (min)
Black Bengal	101.33[a] ± 0.10	100.16[a] ± 0.11	74.08 ± 1.61	37.28[a] ± 1.06
Ganjam	102.38[b] ± 0.07	100.95[b] ± 0.07	72.47 ± 0.58	31.35[b] ± 0.54
Koraput (Raighar)	102.19[b] ± 0.08	100.85[b] ± 0.07	70.54 ± 0.42	26.73[c] ± 0.35

Traits having different superscript under a column differ significantly ($p < 0.05$)

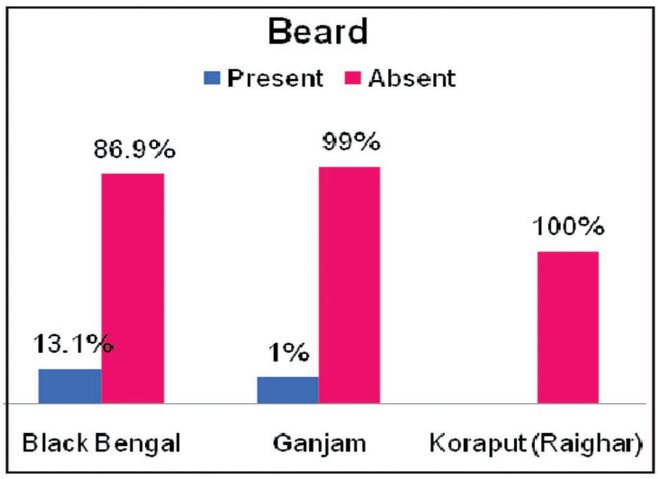


Fig. 6. Occurrence of beard in percentage.

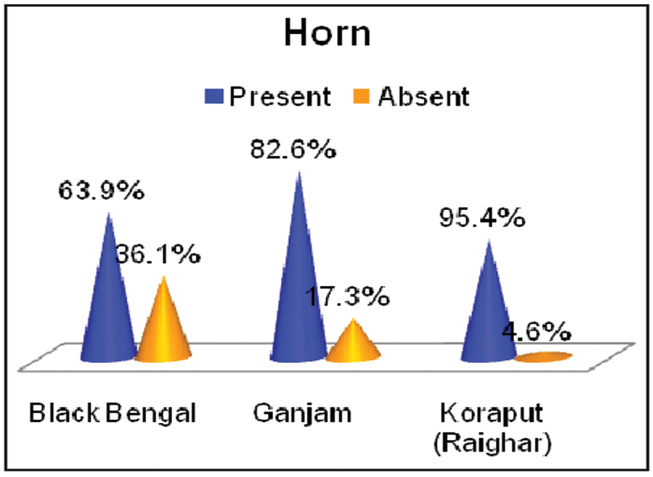


Fig. 7. Occurrence of horn in percentage.

girth of Ganjam goat was almost similar with the Berari (64.35 ± 0.49 cm) goat (Kharkar *et al.* 2014). Lower values of punch girth were reported in Black Bengal (50.27 ± 0.93 cm) and Ganjam (53.01 ± 0.93 cm) goats (Rao *et al.* 2002). Higher values of punch girth were reported in Ganjam (82.88 ± 0.12 cm) goats (Rao *et al.* 2009). Punch girth of Koraput (Raighar) goat population was found to be in between values of Black Bengal and Ganjam goat population lacking any statistical significance ($p > 0.05$) difference.

Mean values of body length were observed to be 51.49 ± 0.62 cm, 54.81 ± 0.74 cm, 53.69 ± 0.66 cm in Black Bengal, Ganjam and Koraput (Raighar) goat, respectively. There was significant difference ($p < 0.05$) between Black Bengal ~ Ganjam, Black Bengal ~ Koraput (Raighar) but no such significant difference between Ganjam and Koraput (Raighar) goats were found. It was found that least square means of height at wither, height at rump, heart girth, neck girth, punch girth, body length were highest in Ganjam goat population. For Koraput (Raighar) goat, it was in between Ganajm and Black Bengal goat. The Pearson correlation values were calculated among height at wither, height at rump, neck girth, heart girth, punch girth, body length, leg length and body weight. Highly significant positive correlation ($p<0.01$) values were recorded among the morphometric traits (Table 2).

Estimated results from the present study almost coincide with earlier reports on Black Bengal (50.7 ± 0.67 cm) goats (Singh *et al.* 1979, Kanaujia and Balaine 1983). Lower values of body length were reported in Black Bengal (43.11 ± 0.57, 42.15 ± 0.55 cm) and Ganjam (48.38 ± 0.92 cm) goats (Rao *et al.* 2002, Deshpande *et al.* 2009). Higher values of body length were reported in Barbari (65.20 ± 1.20 cm), Chegu (58.49 ± 0.59 cm) and Ganjam (60.907 ± 0.180 cm) goats (Mittal 1979, Karna *et al.* 2005, Rao *et al.* 2009).

Mean value of age at sexual maturity were observed to be 7.44±0.3, 12.98±0.35, 7.81±0.3 months in Black Bengal, Ganjam and Koraput (Raighar) goat population, respectively (Table 3). There was significant difference ($p < 0.05$) of age at sexual maturity between Black Bengal ~ Ganjam, Koraput (Raighar) ~ Ganjam goat population but any significant difference ($p > 0.05$) between Black Bengal and Koraput (Raighar) goat population was not found. Our estimated results from present study coincided with earlier reports on Black Bengal goat population (Zeshmarani *et al.* 2007, Faruque *et al.* 2010, Mukherjee *et al.* 2014). Higher values of age at sexual maturity were reported in Ganjam and Black Bengal goats (Rao *et al.* 2009, Rahman *et al.* 1977, Rao *et al.* 2002). Lower values were reported in Black Bengal and Ganjam goats (Myenuddin and Wahab, 1989).

Mean values of age at first kidding were observed to be 14.28 ± 0.33, 20.02 ± 0.38, 14.87 ± 0.32 months in Black Bengal, Ganjam and Koraput (Raighar) goat, respectively (Table 3). Statistically significant effect ($p<0.05$) of breed on age at first kidding was observed. There was significant difference ($p<0.05$) between Black Bengal ~ Ganjam and Koraput (Raighar) ~ Ganjam goat population but any statistical significant difference ($p>0.05$) values on age at first kidding could not be observed between Black Bengal and Koraput (Raighar) goat population. Our results for Black Bengal goat in the present study are in the same line of earlier reports on Black Bengal and local goat population of Kalahandi district (Ali *et al.* 1973, Rahman *et al.* 1977, Mohanty *et al.* 2006). Similarly results on Ganjam goat corroborated with earlier reports on Ganjam goat population (Rao *et al.* 2009). Mean value of age at first kidding of Black Bengal exactly coincided with Surti goat population in south Gujarat (Sabapara *et al.* 2010). Lower mean values of age at first kidding were reported for Black Bengal

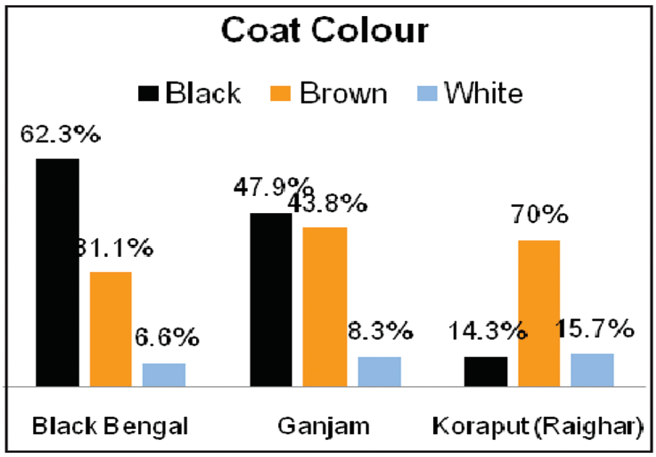


Fig. 8. Coat colour pattern in percentage.

and Ganjam goats (Das *et al.* 2008, Singh Bariha *et al.* 2008, Faruque *et al.* 2010). Higher mean values were reported for Ganjam and Black Bengal goats (Rao *et al.* 2002).

Mean value of kidding interval were observed to be 6.63 ± 0.24, 10.93 ± 0.28 and 8.62 ± 0.23 months in Bengal, Ganjam and Koraput (Raighar) goat, respectively (Table 3). Statistically significant effect ($p<0.05$) of breed on kidding interval was observed. Statistical significant difference ($p<0.05$) of kidding interval between all the three goat breeds was also observed. Our estimated results on kidding interval precisely corroborated with earlier reports on Black Bengal and Ganjam goats (Myenuddin and Wahab 1989, Rao *et al.* 2009). The kidding interval of Berari goats of Maharastra and local goat population of Kalahandi district were found nearly similar with the Koraput (Raighar) goat population of our study. Lower mean values on kidding interval were reported in Black Bengal and Ganjam goats (Ali *et al.* 1973, Madeli *et al.* 1977). Higher mean values were reported in Ganjam and Black Bengal goats (Rahman *et al.* 1977, Das *et al.* 2008, Rao *et al.* 2002). In univariate analysis, it was observed that age at sexual maturity and age at first breeding differed significantly ($p<0.05$) between Black Bengal, Koraput (Raighar) ~ Ganjam goats. The litter size and kidding interval differed significantly among all the studied goat population.

The least square means of rectal temperature and skin temperatures were found to be higher in Ganjam goats as compared to Koraput (Raighar) and Black Bengal goats (Table 4). During the study in similar line, the average rectal temperature and skin temperature was observed to be 38.9 ^{0}C and 31.0 ^{0}C in Garfagnina goat and rectal temperature was observed to be 39.08 ^{0}C in Osmanabadi goats (Riberio *et al.* 2016, Shilja *et al.* 2015). However, the least square means of heart rate and respiration rate were found to be higher in Black Bengal goat as compared to Ganjam and Koraput (Raighar) goats (Table 4). During the study in similar line, the average heart rate and respiration rate was recorded to be 87 per min and 39 per min in Garfagnina goat. Similarly, the respiration rate and pulse rate was observed to be 69.17 per min and 39.08 per min in Osmanabadi goats (Riberio *et al.* 2016, Shilja *et al.* 2015).

For rectal temperature, significant difference ($p< 0.05$) was observed between Black Bengal ~ Ganjam and Black Bengal ~ Koraput (Raighar) goats. However, no significant difference could be observed between Ganjam ~ Koraput (Raighar) goats. For skin temperature, similar type of findings was observed as that of rectal temperature. For respiration rate, significant difference was observed among all the populations *i.e.* Black Bengal ~ Ganjam, Black Bengal ~ Koraput (Raighar) and Ganjam ~ Koraput (Raighar) goats differed significantly. The environment surrounding an animal at any particular instant influences the amount of heat exchange. Under tropical climatic conditions, high temperature and relative humidity are major environmental factors for heat stress which influences the productivity of animals. Among the other climatic components that may impose influence on the animals are air movement, radiation and photoperiod. Similarly significant effect of breed was observed in Nigerian goat *i.e.* West African Dwarf (WAD), Red Sokoto (RS) and Sahel (SH) goats on pulse rate and respiration rate (Yakubu *et al.* 2016). While the WAD goats seemed better in pulse rate [86.36 ± 4.14 (WAD), 109.47 ± 6.41 (SH) and 113.88 ± 4.13 (RS); $p<0.05$], the SH goats appeared superior in terms of respiratory rate (35.03 ± 3.20 (SH), 48.47 ± 2.07 (RS) and 35.03 ± 3.20 (SH); $p<0.05$].

CONCLUSION

The findings from the current study can be instrumental in standardizing the baseline data for selection of superior germplasms. Further, the phenotypic characterization may aid in genetic characterization in future. Distinct variation in the phenotypic and reproductive information of the Koraput (Raighar) goat from other goat breeds of Odisha may pave the path for its registration.

ACKNOWLEDGEMENT

The authors are thankful to the authority of Orissa University of Agriculture and Technology for providing necessary facility to carry out the research work. The necessary funding for the research work was provided by ICAR, New Delhi under ICAR Extramural Project.

REFERENCES

Ali SZ, Hogue MM, Haanath MA (1973) A study on growth and reproductive performance of Black Bengal goats under farm conditions. Ind Vet J 50: 438-440.

Das AK, Manna MK, Sahoo AK, Deb R, Paul RK (2008) Studies on reproductive traits of Bengal goats in a part of West Bengal. Ind J Small Rum 14(2): 259-261.

Deshpande SB, Desai PM, Kharadi VB, Sabapara GP (2009) Phenotypic and performance characteristics of Surti goats. Ind J Small Rum 15(1): 108-112.

Faruque S, Chowdhury SA, Siddiquee NU, Afroz MA (2010) Performance and genetic parameters of economically important traits of Black Bengal goat. J Bangladesh Agri Univ 8(1): 67-78.

Gandini GC, Villa E (2003) Analysis of the cultural value of local livestock breeds: a methodology. J Anim Breeding Genet 120: 1-11.

Kanaujia AS, Balaine DS (1983) Final technical report "Evolution of Genetic potential of some Indian breeds of goats", Haryana Agriculture University, Hissar, India.

Karna DK, Bisht GS, Koul GL (2005) Genetic and non-genetic factors affecting morphometry of Cheghu goats. Ind J Small Rum 11(1): 62-64.

Kharkar K, Kuralkar SV, Kuralkar P, Bankar PS, Chopade MM, Hadole KA (2014) Factors affecting body weight and morphometric characters of Berari goats. Ind J Small Rum 20: 112-114.

Madeli UC (1977) Inheritance of some production traits in a flock of Ganjam goats. M.V.Sc. Thesis, Faculty of Veterinary Science and Animal Husbandry, O.U.A.T., Bhubaneswar, Odisha, India.

Mittal JP (1979) A Study on birth weight of Barbari and Jamunapari kids. Ind J Anim Sci 49: 45-47.

Mohanty GP, Mohapatra AK, Dash SK, Sahoo G (2006) Study of management practices and performance of Kalahandi goats in Orissa. Ind J Anim Prod Mgmt 20(1-4): 92-93.

Mukherjee R, Koyal A, Banerjee PK (2014) Studies on morphological and morphometric variation of Black Bengal goat (*Capra hircus bengalensis*) in some villages of Hooghly and Howrah districts, West Bengal. Inter J Multi Appr Stud 1(6): 284-294.

Myenuddin M, Wahab MA (1989) Reproductive performance of Black Bengal Goats in Manikganj. Bangladesh, Veterinarian 6(1): 48-49.

Paul S, Khandoker M, Moinuddin MA, Paul RC (2011) Characterization of Black Bengal goat. J Bangladesh Agri Univ 9(1): 61-66.

Rahman AM, Hossain A, Ahmed MU, Sen MM (1977) Studies on some reproductive performance and biometry of the female genital tract of Black Bengal goats. Ind J Anim Sci 47(11): 724-725.

Rao PK, Dash SK, Patro BN, Nayak S (2002) Studies on Ganjam, Black Bengal goats and their crosses found in Orissa. Ind J Anim Prod Mgmt 18(3-4): 135-138.

Rao PK, Dash SK, Singh MK, Rai B, Singh NP (2009) Ganjam goat of Orissa and its management practices. Ind J Small Rum 15(1): 44-50.

Ribeiro NL, Costa RG, Filho ECP, Ribeiro MN, Crovetti A, Saraiva EP, Bozzi R (2016) Adaptive profile of Garfagnina goat breed assessed through physiological, haematological, biochemical and hormonal parameters. Small Rum Res 144: 236-241.

Sabapara GP, Deshpande SB, Singh G, Joshi BK (2010) Reproduction and production performance of Surti goats in its native tract. Ind J Small Rum 16(2): 195-198.

Shilja S, Sejian V, Bagath M, Mech A, David CG, Kurien EK, Varma G, Bhatta R (2015) Adaptive capability as indicated by behavioral and physiological responses, plasma HSP70 level, and PBMC HSP70 mRNA expression in Osmanabadi goats subjected to combined (heat and nutritional) stressors. Inter J Biomet 15: 1124-1125.

Singh Bariha SP, Rao PK, Patro BN, Dash SK, Panda P (2008) Genetic analysis of indigenous goats of Keonjhar district of Orissa. Ind Vet J 85: 843-845.

Singh CSP, Mishra HR, Sharma BD, Mukherjee DK, Singh DK (1979). A note on body measurements of Black Bengal goats. Ind J Anim Sci 49: 669-671.

Yakubu A, Salako AE, Donato MD, Takeet MI, Peters SO, Wheto M, Okpeku M, Imumorin IG (2016) Interleukin-2 ((IL-2) gene polymorphism and association with heat tolerance in Nigerian goats. Small Rum Res 141: 127-134.

Zeshmarani S, Dhara KC, Samanta AK, Samanta R, Majumder SC (2007) Reproductive performance of goats in Eastern and North-eastern India. Liv Res Rural Dev 19: 114-117.

***Cite this article** as: Sahoo SS, Mishra C, Nayak G, Sethy K, Behera K (2018) A comparative study on body morphometric, reproductive and vital parameters among indigenous goat population of Odisha, India. Explor Anim Med Res 8(1): 69-75.