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Comparative growth performance of male and female Sirohi goats under farm condition in Malpura block of Tonk district, Rajasthan

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ABSTRACT

The present study was conducted to assess the socio-economic and demographic characteristics of Sirohi goat owners under field conditions in Malpura and Uniyara tehsils of Tonk district, Rajasthan. A total of 120 respondents, comprising 60 goat owners from each tehsil, were selected for the study. Primary information was collected through a structured interview schedule covering religion, age, social category, occupation, education, family type, housing condition, landholding status, grazing practices, grazing land type, migration status and family composition. Growth performance was assessed on the basis of body weight and important morphometric traits, viz., heart girth, body length and height at withers, at birth and at 3, 6, 9, 12 and 15 weeks of age followed by assessment at the adult stage. At birth, the body weight of male and female kids was 3.55 ± 0.05 and 3.32 ± 0.04 kg, respectively. At 15 weeks, body weight increased to 21.65 ± 0.16 kg in males and 20.32 ± 0.15 kg in females. In adult animals, males attained a mean body weight of 57.84 ± 0.31 kg compared with 52.46 ± 0.29 kg in females. Similar trends were observed for heart girth, body length and height at withers throughout the growth period. The findings indicate clear sex-associated differences in growth and body conformation of Sirohi goats under the observed farm conditions. The consistently greater body size of males highlights the importance of sex as a factor when evaluating growth performance and body measurements in Sirohi goats under semi-arid conditions.

Keywords: Sirohi goat, Sex, Growth performance, Body weight, Heart girth, Body length, Height

Introduction

Goat production plays an important role in the livestock-based economy and livelihood security of rural households in India, particularly among small and marginal farmers (Devendra and Chantalakhana, 2002; Bett *et al.*, 2009) [2, 1]. Goats are well adapted to diverse agro-climatic conditions and can efficiently utilize locally available feed resources under resource-constrained production systems (Kumar *et al.*, 2010) [3]. In Rajasthan, goat rearing is particularly important because of the adaptability of goats to hot and semi-arid environments. Among the indigenous breeds, the Sirohi goat is an important breed known for its adaptability and growth potential under farm and field conditions (Gowane *et al.*, 2011; Waiz *et al.*, 2018) [4, 5]. Growth performance is an important criterion for evaluating the productive potential and economic efficiency of meat-producing goats. Body weight and morphometric traits such as heart girth, body length and height at withers provide useful information on growth and body conformation (Mehta *et al.*, 2015; Waiz and Gautam, 2020) [6, 7]. Growth is influenced by several genetic and non-genetic factors, including sex, type of birth, nutrition, management, season and environmental conditions (Dudhe *et al.*, 2015; Gowane *et al.*, 2011) [8, 4]. Sex is an important factor affecting growth, as male and female goats may differ in growth rate, body size and mature weight. Studies on Sirohi goats have reported higher body weight and morphometric measurements in males than females at different ages (Waiz *et al.*, 2018; Yadav *et al.*, 2023) [5, 9]. Morphometric measurements are also useful for estimating body weight where weighing facilities are limited, particularly under farm and field conditions (Waiz and Gautam, 2020; Shashikant *et al.*, 2023) [7, 10]. Early assessment of growth differences between sexes can therefore assist in selection, breeding and management decisions. However, growth performance may vary with location, management system and environmental conditions. Therefore, evaluation of sex-wise growth under specific farm conditions is important for establishing realistic growth profiles. The present study was undertaken to compare the growth performance of male and female Sirohi goats maintained under farm conditions in Malpura block of Tonk district, Rajasthan, with particular emphasis on body weight, heart girth, body length and height at withers from birth to 15 weeks and at the adult stage.

Materials and Methods

The present study was conducted in Malpura and Uniyara tehsils of Tonk district, Rajasthan, representing a semi-arid agro-ecological region where mixed crop–livestock farming constitutes an important component of rural livelihoods. The study area was selected considering the prevalence of Sirohi goat rearing and its importance in the local livestock production system. A total of 120 Sirohi goat owners were selected for the study, comprising 60 respondents from Malpura tehsil and 60 respondents from Uniyara tehsil. The respondents were selected from identified villages through a suitable sampling procedure, ensuring adequate representation of households actively engaged in Sirohi goat rearing under prevailing field conditions. Primary data were collected through personal interviews using a structured and pre-tested interview schedule. For assessment of growth performance, Sirohi kids maintained under the selected farm conditions were observed from birth through different growth stages, viz., birth, 3, 6, 9, 12 and 15 weeks of age, followed by observations on adult animals. Male and female animals were evaluated separately to assess sex-wise differences in growth performance. The growth parameters recorded included body weight (kg), heart girth (cm), body length (cm) and height at withers (cm). Body weight was recorded using a suitable weighing device, while morphometric measurements were taken using standard livestock measuring procedures. Heart girth was measured around the thoracic region immediately behind the forelimbs, body length was measured from the point of shoulder to the pin bone, and height at withers was measured vertically from the ground to the highest point of the withers. Measurements were recorded at the specified ages under comparable management conditions. The observations were compiled and subjected to appropriate statistical analysis to obtain mean and standard error (SE) for each growth trait and age group. The performance of male and female Sirohi goats was compared on the basis of body weight and morphometric measurements to determine sex-associated differences in growth and body development under the prevailing farm conditions of Tonk district.

Results and Discussion

The comparative growth performance of male and female Sirohi goats maintained under farm conditions in Malpura and Uniyara tehsils of Tonk district is presented in Table 1. A progressive increase in body weight and morphometric measurements was observed with advancement in age in both sexes.

Body weight

The body weight of male and female Sirohi goats at different stages of growth is presented in Table 1. Body weight increased progressively with advancement in age in both sexes; however, male kids consistently recorded higher body weight than females at all stages. At birth, male kids recorded a mean body weight of 3.55 ± 0.05 kg, compared with 3.32 ± 0.04 kg in female kids. At 3 weeks, body weight increased to 6.72 ± 0.07 kg in males and 6.31 ± 0.06 kg in females, while at 6 weeks it reached 10.12 ± 0.10 and 9.48 ± 0.09 kg, respectively. At 9 weeks, male and female kids recorded 13.42 ± 0.12 and 12.58 ± 0.11 kg, respectively. Further, at 12 weeks, the corresponding values were 17.82 ± 0.14 and 16.74 ± 0.13 kg, while at 15 weeks male kids attained 21.65 ± 0.16 kg compared with 20.32 ± 0.15 kg in females. In adult animals, body weight reached 57.84 ± 0.31 kg in males and 52.46 ± 0.29 kg in females. Thus, males maintained a consistent advantage in body weight throughout the observation period. The progressive increase in body weight with age observed in the present study is in agreement with the general growth pattern reported in Sirohi goats under farm and field conditions. Gowane *et al.*, (2011) [4] reported significant variation in growth traits of Sirohi goats and emphasized the contribution of genetic and environmental factors to body-weight development. Similarly, Dudhe *et al.*, (2015) [8] reported that sex, type of birth, year and season of birth and other non-genetic factors influenced body weight in Sirohi goats. The comparatively greater body weight of males observed in

the present study may be associated with sex-related differences in growth potential and mature body size. Similar higher body weights in male Sirohi goats have been reported under farm and field conditions by Waiz *et al.*, (2018) [5] and under field conditions by Yadav *et al.*, (2023) [9].

Heart girth

The mean heart girth of male and female Sirohi goats increased continuously with age (Table 1). At birth, male kids recorded a heart girth of 30.10 ± 0.22 cm, whereas females recorded 29.42 ± 0.20 cm. At 3 weeks, the corresponding values increased to 36.48 ± 0.21 and 35.82 ± 0.20 cm, respectively. At 6 weeks, heart girth increased to 41.82 ± 0.22 cm in males and 40.94 ± 0.21 cm in females. At 9 weeks, males recorded 46.35 ± 0.23 cm, compared with 45.16 ± 0.22 cm in females. The values further increased to 50.62 ± 0.25 and 49.54 ± 0.23 cm at 12 weeks and 55.34 ± 0.24 and 53.96 ± 0.23 cm at 15 weeks in males and females, respectively. In adult goats, heart girth reached 83.15 ± 0.18 cm in males and 80.74 ± 0.17 cm in females. The progressive increase in heart girth indicates continuous development of the thoracic region with advancing age. The consistently greater heart girth of males suggests greater overall body development in male Sirohi goats. Mehta *et al.*, (2015) [6] reported significant effects of sex and other genetic and non-genetic factors on body girth and other morphometric traits in Sirohi goats. Similarly, Waiz *et al.*, (2018) [5] reported progressive increases in heart girth with age and higher measurements in males under farm and field conditions. The present findings are also important because heart girth has been reported to be strongly associated with live body weight and can therefore be used as a practical field indicator of body weight.

Body length

Body length also increased progressively with age in both male and female Sirohi goats. At birth, male kids recorded a mean body length of 28.72 ± 0.19 cm, compared with 28.03 ± 0.18 cm in females. At 3 weeks, body length increased to 34.86 ± 0.20 cm in males and 34.15 ± 0.19 cm in females. At 6 weeks, the respective values were 40.16 ± 0.21 and 39.12 ± 0.20 cm, while at 9 weeks males and females recorded 44.82 ± 0.22 and 43.58 ± 0.21 cm, respectively. At 12 weeks, body length increased to 51.34 ± 0.28 cm in males and 49.95 ± 0.26 cm in females. At 15 weeks, the corresponding values were 55.86 ± 0.24 and 54.32 ± 0.23 cm, respectively. Adult males recorded a body length of 82.35 ± 0.17 cm, whereas adult females recorded 79.42 ± 0.16 cm. The gradual increase in body length with age indicates continuous skeletal and structural development. The higher values observed in males throughout the growth period indicate greater linear growth in males than females. Similar differences in body length between sexes have been reported in Sirohi goats by Mehta *et al.*, (2015) [6], who observed significant effects of sex on morphometric characteristics. Waiz *et al.*, (2018) [5] also reported progressive development of body length with age in Sirohi goats under farm and field conditions. Furthermore, body length has been found to have a positive association with body weight, indicating its usefulness as an indirect measure of growth performance.

Height at withers

Height at withers showed a steady increase with advancement in age in both sexes. At birth, male Sirohi kids recorded a mean height at withers of 28.34 ± 0.18 cm, whereas females recorded 27.71 ± 0.17 cm. At 3 weeks, the values increased to 34.52 ± 0.18 and 33.81 ± 0.17 cm, respectively. At 6 weeks, males and females recorded 39.74 ± 0.19 and 38.82 ± 0.18 cm, respectively. At 9 weeks, height at withers reached 44.28 ± 0.20 cm in males and 43.06 ± 0.19 cm in females. At 12 weeks, the corresponding values were 49.68 ± 0.21 and 48.53 ± 0.20 cm, while at 15 weeks, males recorded 54.94 ± 0.22 cm compared with 53.48 ± 0.21 cm in females. The adult values were not recorded for height at withers in the supplied Table 1, and therefore no adult comparison is made for this trait.

The continuous increase in height at withers reflects progressive skeletal growth and overall body development. Male kids consistently

exhibited greater height than females, indicating comparatively greater linear growth in males. Mehta *et al.*, (2015) [6] reported that sex significantly influenced body height in Sirohi goats, supporting the sex-associated differences observed in the present study. Similar age-related increases in body height have been reported by Waiz *et al.*, (2018) [5]. Height at withers, together with heart girth and body length, can therefore provide useful information about body conformation and growth status in Sirohi goats.

Overall comparison of growth traits

Overall, all four growth traits, viz. body weight, heart girth, body length and height at withers, increased progressively from birth to 15 weeks in both male and female Sirohi kids. At birth, male kids recorded higher body weight (3.55 ± 0.05 kg), heart girth (30.10 ± 0.22 cm), body length (28.72 ± 0.19 cm) and height at withers (28.34 ± 0.18 cm) than females, which recorded 3.32 ± 0.04 kg, 29.42 ± 0.20 cm, 28.03 ± 0.18 cm and 27.71 ± 0.17 cm, respectively. At 3 weeks, these values increased to 6.72 ± 0.07 kg, 36.48 ± 0.21 cm, 34.86 ± 0.20 cm and 34.52 ± 0.18 cm in males, compared with 6.31 ± 0.06 kg, 35.82 ± 0.20 cm, 34.15 ± 0.19 cm and 33.81 ± 0.17 cm in females. At 6 weeks, male kids recorded 10.12 ± 0.10 kg body weight, 41.82 ± 0.22 cm heart girth, 40.16 ± 0.21 cm body length and 39.74 ± 0.19 cm height at withers, whereas the corresponding female values were 9.48 ± 0.09 kg, 40.94 ± 0.21 cm, 39.12 ± 0.20 cm and 38.82 ± 0.18 cm, respectively. At 9 weeks, the body weight of males increased to 13.42 ± 0.12 kg, while females recorded 12.58 ± 0.11 kg. Similarly, male heart girth, body length and height at withers were 46.35 ± 0.23 , 44.82 ± 0.22 and 44.28 ± 0.20 cm, respectively, compared with 45.16 ± 0.22 , 43.58 ± 0.21 and 43.06 ± 0.19 cm in females. At 12 weeks, male kids attained 17.82 ± 0.14 kg body weight, 50.62 ± 0.25 cm heart girth, 51.34 ± 0.28 cm body length and 49.68 ± 0.21 cm height at withers, whereas females recorded 16.74 ± 0.13 kg, 49.54 ± 0.23 cm, 49.95 ± 0.26 cm and 48.53 ± 0.20 cm, respectively. By 15 weeks, males recorded the highest values of 21.65 ± 0.16 kg body weight, 55.34 ± 0.24 cm heart girth, 55.86 ± 0.24 cm body length and 54.94 ± 0.22 cm height at withers, compared with 20.32 ± 0.15 kg, 53.96 ± 0.23 cm, 54.32 ± 0.23 cm and 53.48 ± 0.21 cm, respectively, in females.

The magnitude of increase from birth to 15 weeks further demonstrates the rapid growth of Sirohi kids during the early growing period. Male body weight increased from 3.55 to 21.65 kg, representing

an increase of 18.10 kg, while female body weight increased from 3.32 to 20.32 kg, representing an increase of 17.00 kg. Similarly, heart girth increased by 25.24 cm in males and 24.54 cm in females. Body length increased by 27.14 cm in males and 26.29 cm in females, while height at withers increased by 26.60 cm in males and 25.77 cm in females. Thus, although both sexes exhibited substantial growth, males maintained a consistent numerical advantage across all measured traits.

The adult observations further confirmed the persistence of sex-wise differences in body development. Adult males recorded a mean body weight of 57.84 ± 0.31 kg, heart girth of 83.15 ± 0.18 cm and body length of 82.35 ± 0.17 cm, compared with 52.46 ± 0.29 kg, 80.74 ± 0.17 cm and 79.42 ± 0.16 cm, respectively, in adult females. Therefore, the male advantage observed during the early growth period was also evident at maturity. The consistently greater body size of males may be associated with sex-related differences in growth pattern, skeletal development and mature body size. Similar sex-associated differences in body weight and morphometric traits have been reported in Sirohi goats by Gowane *et al.*, (2011) [4], Dudhe *et al.*, (2015) [8] and Mehta *et al.*, (2015) [6]. The present findings are also comparable with the observations of Waiz *et al.*, (2018) [5], who reported progressive increases in body weight and morphometric measurements of Sirohi goats under farm and field conditions in southern Rajasthan. The simultaneous increase in body weight and body measurements observed in the present study indicates coordinated growth and development of the animals. Waiz *et al.*, (2020) [7] reported that morphological traits, particularly heart girth, body length and height at withers, could be effectively used for estimating live body weight in Sirohi goats. Similarly, Shashikant *et al.*, (2023) [10] reported significant relationships between body weight and zoometric traits in Sirohi goats. Thus, the present study indicates that male Sirohi goats exhibited consistently higher growth performance than females from birth through 15 weeks and at the adult stage, while both sexes showed a continuous and substantial increase in body weight and morphometric measurements with age. The results highlight the importance of considering sex and age simultaneously when evaluating growth performance and body conformation of Sirohi goats under farm conditions. The information generated may be useful for growth monitoring, selection of superior animals and development of appropriate feeding and management strategies under the semi-arid conditions of Rajasthan.

Table 1. Comparative Growth Performance of Male and Female Sirohi goats Under Farm Condition in Malpura Block of Tonk District, Rajasthan

Age Group	Body Weight (kg) Mean $\pm$ SE		Heart Girth (cm) Mean $\pm$ SE		Body Length (cm) Mean $\pm$ SE		Height at Withers (cm) Mean $\pm$ SE	
	Male	Female	Male	Female	Male	Female	Male	Female
Birth	3.55 ± 0.05	3.32 ± 0.04	30.10 ± 0.22	29.42 ± 0.20	28.72 ± 0.19	28.03 ± 0.18	28.34 ± 0.18	27.71 ± 0.17
3 Weeks	6.72 ± 0.07	6.31 ± 0.06	36.48 ± 0.21	35.82 ± 0.20	34.86 ± 0.20	34.15 ± 0.19	34.52 ± 0.18	33.81 ± 0.17
6 Weeks	10.12 ± 0.10	9.48 ± 0.09	41.82 ± 0.22	40.94 ± 0.21	40.16 ± 0.21	39.12 ± 0.20	39.74 ± 0.19	38.82 ± 0.18
9 Weeks	13.42 ± 0.12	12.58 ± 0.11	46.35 ± 0.23	45.16 ± 0.22	44.82 ± 0.22	43.58 ± 0.21	44.28 ± 0.20	43.06 ± 0.19
12 Weeks	17.82 ± 0.14	16.74 ± 0.13	50.62 ± 0.25	49.54 ± 0.23	51.34 ± 0.28	49.95 ± 0.26	49.68 ± 0.21	48.53 ± 0.20
15 Weeks	21.65 ± 0.16	20.32 ± 0.15	55.34 ± 0.24	53.96 ± 0.23	55.86 ± 0.24	54.32 ± 0.23	54.94 ± 0.22	53.48 ± 0.21
Adult	57.84 ± 0.31	52.46 ± 0.29	83.15 ± 0.18	80.74 ± 0.17	82.35 ± 0.17	79.42 ± 0.16	-	-

Conclusion

The present study demonstrated a clear and progressive increase in body weight, heart girth, body length and height at withers of Sirohi goats from birth to 15 weeks of age under farm conditions in Malpura and Uniyara tehsils of Tonk district, Rajasthan. Male kids consistently recorded higher values for all measured growth traits than female kids at each observation stage, and this difference was maintained in adult animals. Body weight increased from 3.55 ± 0.05 to 21.65 ± 0.16 kg

in males and from 3.32 ± 0.04 to 20.32 ± 0.15 kg in females between birth and 15 weeks. Similarly, progressive increases in heart girth, body length and height at withers indicated continuous skeletal and body development in both sexes. The higher growth performance of males suggests the influence of sex-related differences on growth and mature body size. The close increase in body weight and morphometric traits further indicates that these measurements can serve as useful indicators for monitoring growth under farm conditions. Overall, the findings provide useful baseline information on the sex-wise growth pattern of Sirohi goats under the semi-arid conditions of Tonk district

and may assist in selection, growth monitoring, feeding management and improvement of meat-production efficiency.

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