Growth and Reproduction Performances of Chaugarkha Goat of Kumaon Region of Uttarakhand

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Abstract

Chaugarkha goats are small size meat purpose breed distributed in temperate Kumaon region of Uttarakhand, India and the breed is identified as a unique new breed since 1992. The breeding tract of Chaugarkha goat is spread across four mountainous districts Almora, Bageshwar, Champawat and Pithoragarh of Kumaon region. The growth performance was analyzed by least squares analysis and information on reproduction parameters of Chaugarkha goats was generated. Least squares means at birth, three months, six months, nine months and twelve months were 1.83±0.03, 7.67±0.13, 11.45±0.17, 14.89±0.27 and 18.98±0.26 kg, respectively. Age at first mating (days), age at first kidding (days), kidding interval (days), service period (days) and gestation period (days) were 439.65±23.93, 583.83±32.66, 267.46±10.23, 204.30±17.57, and 148.98±0.70, respectively. The litter size was 1.23±0.04. Oestrous cycle length (days) and estrus duration (hrs) were 21.31±0.32, and 52.0±1.36, respectively. In the cluster 4 higher performances were recorded and it was carried forward from three months through six and nine months upto twelve months. But, no definite trend was observed for the effects of year. The male had higher estimates than females at all ages, which is along the expected line. The generated reproduction parameters will be helpful in the formulation and implementation of breeding plans.

1. Introduction

The small ruminants require a smaller investment compared to larger livestock (like cattle and buffalo) and with their short breeding cycle, a quicker return on investment is ensured. Moreover, the flocks of small ruminants recover quickly after the incidence of natural calamities like drought (Mayberry et al., 2018). Among the small ruminants, goats are considered the prized animal for meat industry because of their some attributes like hardiness, disease resistance, prolificacy, and lack of socio-religious taboo for goat meat consumption (Gowane et al., 2011). Further, as compared to larger animals, goats can be maintained on marginal lands due to their lesser requirement for feed, goats are better at digesting

roughages, and they can easily browse trees and shrubs (Mayberry et al., 2018). But, goat production is hampered by shortage of feed and health issues, which are often graded as the most significant constraints of goat production (Assen and Aklilu, 2012; Suresh and Chaudhary, 2015; Vijay et al., 2014). Since the 1960s, a dramatic rise in the global goat population has been witnessed. The global goat population in 2013 was over one billion, seeing a significant rise compared to previous years (FAO, 2019). The developing countries owned about 98% of the global goat population, contributing 76% share of the goat breeds (Devendra, 2010). Of the global population of goat, Asia accounts for about nearly 60% of the world's goats, (Miller and Lu, 2019), with India contributing a significant proportion to the global goat population. The goat is one of the important livestock species of India, contributing 27.80% of the total livestock population in India (20th Livestock Census, 2019). As of today, the total number of registered goat breeds in India is 34 (NBAGR).

Reared mainly for meat purposes, Chaugarkha goats are small size breed, distributed in temperate Kumaon region of Uttarakhand (Jana et al., 2018). The breed has been identified as a unique new breed since 1992 (Joshi, 1992). Later, some characterization work on the breed was done by Singh and Barwal (2007) and Barwal et al. (2010). A study on genetic diversity of Chaugarkha goat using microsatellite markers has been done by Ganie et al. (2017). The breed is found in three colours, namely black, fawn and a characteristic white with stripe on face(Madhusoodan et al., 2019). The breeding tract of Chaugarkha goat is spread across central Himalayan regions, particularly in four mountainous districts Almora, Bageshwar, Champawat and Pithoragarh of Kumaon region. The breed is also found in some pockets of Nainital district (Jana et al., 2018). The breed is eponymously named after *Chaugarkha Patti*, which spreads from Chitai to Danya village in Almora district. The majority of goat population in Kumaon region is reared under low inputs and semi-intensive system production system (Jana et al., 2018). The most of the households keep small number of goats (ranging from 2-20) with high proportion of breeding does. Adult males above age 24 months are very rarely found in the flock, as farmers sell them off or the animals are slaughtered at an early age. The goats are allowed to graze during day time and are sheltered during night time in structures mainly made up of locally available materials like bricks and hill slabs with *kaccha* floor (shelters are locally called "*Goth*"). In addition to grazing, the leaves of trees like Bhimal (*Grewia optiva*), Timla *(Ficus nemoralis),* Kharsu (*Querceus semicarpifolia*) and Banj (*Quercus leucotrichophora*) are provided to the goats (Jana et al., 2018).

Growth performance and reproduction parameters are economically important traits for efficient production of goats. Study of growth rate helps us to take decision in selection and culling of animals, while study of reproduction parameters help in implementation of breeding plans. There are only scanty reports on studies of growth rate and reproduction parameters of Chaugarkha goats. Hence, the present study was undertaken to determine the factors affecting growth rate and generate information on reproduction parameters of Chaugarkha goats.

2. Materials and Methods

The studies on Chaugarkha goat were undertaken during 2016 to 2020. The records were collected from Chaugarkha goats distributed over four village clusters in the Kumaon region of Uttarakhand. These four clusters are part of a field unit of Chaugarkha goat under ICAR-All India Coordinated Research Project (AICRP) on Goat Improvement, and the unit is in operation since June, 2014 with the prime aim of improvement of Chaugarkha goats in Kumaon region of Uttarakhand, India. The records of growth performance over five years (2016 to 2020) were taken at target ages at birth, three months, six months, nine months and twelve months. Kids were weaned at three months of age. The reproduction parameters considered for the study were age at first mating (days), age at first kidding (days), kidding interval (days), gestation period (days), litter size at birth, service period (days),oestrous cycle length (days), and estrus duration (hrs).Data on service period (days), oestrous cycle length (days), and estrus duration (hrs) were recorded on farm bred animals, while data on other traits were recorded on the animals under field conditions. Data for growth performances were adjusted for effects of cluster (four levels), year (five levels)and sex (two levels) by least squares analysis. For growth performance, following statistical model was used:

$$y_{ijkl} = \mu + C_i + Y_j + S_k + e_{ijkl}$$

Where,

Y_{ijklm} is a phenotypic observation for weights at birth, three months, six months, nine months and twelve months

μ=Population mean common to all the observations.

C_i=Effect of ith cluster

Y_j=Effect of jth year of birth

S_k=Effect of kth sex

e_{ijklm}=Random residual

The least squares analysis was performed in R package *emmeans*, version 1.5.5-1 (Lenth, 2021) in R programming environment, version 4.0.2 (Anonymous, 2020) and SPSS, version 21 (Anonymous, 2012).

3. Results and Discussion

3.1. Growth performance of Chaugarkha goat

Least squares means at birth, three months, six months, nine months and twelve months are reported in the Table 1. Of note, we have avoided the categorisation of results as 'significant' and 'non-significant', because the thresholds for significance levels are arbitrary (Schneider, 2015), and large

Table 1: Growth performance of Chaugarkha goat

	Birth weight	Three months	Six months	Nine Months	Twelve months
Least squares means	1.83±0.03	7.67±0.13	11.45±0.17	14.89±0.27	18.98±0.26
Cluster	(P=0.303)	(P=0.089)	(P=0.000)	(P=0.017)	(P=0.018)
1	1.78±0.07	7.38±0.37	11.54±0.45	14.78±0.58	18.21±0.52
2	1.77±0.04	7.97±0.25	11.49±0.32	14.14±0.46	19.69±0.41
3	1.90±0.07	7.13±0.37	10.00±0.50	14.65±0.82	17.87±0.68
4	1.85±0.04	8.22±0.18	12.78±0.27	15.98±0.36	20.16±0.40
Year	(P=0.816)	(P=0.015)	(P=0.000)	(P=0.014)	(P=0.003)
2016	1.83±0.06	7.50±0.30	11.23±0.38	14.96±0.52	19.61±0.50
2017	1.80±0.05	8.69±0.33	12.66±0.42	15.03±0.59	19.43±0.46
2018	1.86±0.06	7.61±0.28	11.09±0.35	14.29±0.54	19.87±0.51
2019	1.80±0.05	7.04±0.26	10.11±0.35	13.73±0.48	17.65±0.51
2020	1.85±0.05	7.54±0.30	12.18±0.44	16.42±0.72	18.34±0.75
Sex	(P=0.843)	(P=0.706)	(P=0.755)	(P=0.644)	(P=0.659)
Male	1.83±0.04	7.72±0.19	11.50±0.26	14.99±0.40	19.09±0.39
Female	1.82±0.03	7.63±0.15	11.41±0.19	14.78±0.30	18.88±0.30

P values in parentheses against each effects

P-value does not mean no difference and smaller P-value does not necessarily mean more significant (Kim and Bang, 2016). Therefore, as recommended by Schneider (2015), we have provided the results as least squares estimates and actual *P* values. The overall least squares means at birth was 1.83±0.03, with slightly higher estimate for male than female. The highest least squares means was recorded for year 2018 followed by year 2020. In the years 2017 and 2019, lowest least squares means were recorded. Cluster 3 had the highest estimate of least squares mean followed by cluster4 and cluster 1. As reported by Ince (2010), the average birth weight kids of Saanen goats raised under extensive conditions of Turkey were found to be 3.06 kg, which is much higher than the birth weight of Chaugarkha goat kid in our study. Sirohi goats under semi-intensive system had higher birth weight (Gowane et al., 2011), while Pantja goats had comparable birth weight at birth (Khadda et al., 2019).

At three months (weaning age), overall least squares mean was 7.67±0.13. As expected, male had higher estimate than female. Cluster4 outperformed all other clusters and cluster3 had the lowest performance. Year 2017 had the highest performance at three months of age. Year 2019 had the lowest performance. The weaning weight of kids of Saanen goats raised under extensive conditions of Turkey was 12.91 kg (Ince, 2010), much higher than Chaugarkha goats under this study. Similarly, both Sirohi goats and Pantja goats had higher three months body weight (Gowane et al., 2011; Khadda et al., 2019).

The estimate of overall least squares mean at six months of age was 11.45±0.17. As with three months of age, cluster 4 had the highest estimate of least squares mean. This was followed by cluster 1 and cluster 2 while cluster 3 had the lowest estimate. At six months of age, both Sirohi goats and Pantja goats higher body weights, which is probably due to their higher daily weight gain between three to six months of age (Gowane et al., 2011 and Khadda et al., 2019).

At nine months of age, again cluster 4 had the highest estimate of least squares, followed by cluster 1 and cluster 3. In the year 2020, the highest performance was recorded followed by Year 2017 and year 2016 for nine months of age. Males had higher estimate of weight at nine months than females, which was along the expected line. The overall estimate of least squares means at nine months of age was 14.89±0.27. As with six months of age, both Sirohi goats and Pantja goats again higher body weights, which is probably due to their higher daily weight gain continuing after six months of age (Gowane et al., 2011 and Khadda et al., 2019).

At twelve months of age, the overall estimate of least squares means was 18.98±0.26. The highest performance at twelve months of age for the Cluster4 was carried forward from that at nine months of age. Cluster3 recorded lowest performance. The year 2018 outperformed all other years at twelve months of age, while lowest performance was recorded for the year 2019.As with all other ages, the males had higher performance than females. Pantja goats (Khadda et al., 2019) and Chaugarkha goats under this study had almost comparable body weights at twelve months of age, while Sirohi goats had much higher body weights at twelve months (Gowane et al., 2011).

3.2. Reproduction performance of Chaugarkha goat

Age at first mating (days), age at first kidding (days), kidding interval (days), service period (days) and gestation period (days) were 439.65±23.93, 583.83±32.66, 267.46±10.23, 204.30±17.57 and 148.98±0.70, respectively. The litter size was 1.23±0.04. Oestrous cycle length (days) and estrus duration (hrs) were 21.31±0.32, and 52.0±1.36, respectively (Table 2).

Table 2: Reproduction performance of Chaugarkha goat

	Mean±SE*
Age at first mating (days)	439.65±23.93
Oestrous cycle length (days)	21.31±0.32
Oestrus duration (hrs)	52.0±1.36
Age at first kidding (days)	583.83±32.66
Kidding interval (days)	267.46±10.23
Service period (days)	204.30±17.57
Gestation period (days)	148.98±0.70
Litter size	1.23±0.04

*SE=Standard Error

Goats can attain puberty as early as 4–6 months while full sexual maturity at 6–8 months of age (Doney et al., 1982). The age at first conception in Sangamneri goats was 10.40±0.73 months (Deokar et al., 2007). According to Ince (2010), the age at first mating was 12.9 months in Saanen goats raised under extensive conditions of Turkey. The estimate of age at first mating (14.63 months) of Chaugarkha goat was higher in our study as compared with all the studies reported here. The age at first mating of Chaugarkha goat was also higher than those of Black Bengal, Assam Hills and Manipuri non-descript goats (Zeshmarani et al., 2007). The age at first kidding in Sangamneri goats was 15.52±0.48 months (Deokar et al., 2007). The estimate of age at first kidding in our study was higher than that reported by Deokar et al. (2007).As was the case with the age at first mating, age at first kidding of Chaugarkha was higher than those of Black Bengal, Assam Hills and Manipuri non-descript goats (Zeshmarani et al., 2007).

The service period in Sangamneri goats was 73.55±1.47 days (Deokar et al., 2007). Doney et al. (1982) have opined that a kidding interval of 8 months is possible for goats. The kidding interval in Sangamneri goats was 218.48±10.44 days (Deokar et al., 2007).

Gestation length averages about 149 days, but there maybe a little variation between breeds (Mellado et al., 2000). The gestation period in Sangamneri goats was 148.26±1.43 days (Deokar et al., 2007). Greyling (2000) reported that gestation lengths of 149.0±0.31 days, 151.7±0.28 days and 151.4±0.46 days in Granadina, Toggenburg and Alpine goats, respectively. According to Ince (2010), gestation length was 150.1 days in Saanen goats raised in extensive conditions of

Turkey. The gestation length in this study was comparable with Sangamneri and Assam Hills goats (Deokar et al., 2007; Zeshmarani et al., 2007), while it was lower than those of Granadina, Toggenburg, Alpine Saanen and Manipuri non-descript goats (Greyling, 2000; Ince, 2010; Zeshmarani et al., 2007). Gestation length in Chaugarkha goat was also higher than that of Black Bengal goat (Zeshmarani et al., 2007).

Abdoli et al. (2019) reported average litter size of 1.3 in Markhoz goat of Iran. According to Gunia et al. (2010),the litter size in Creole breed of Franch is 2.10, while in Jining Grey goat breed of China, a very high litter size of 2.37 have been reported (Feng et al., 2011). The litter size in Chaugarkha goat in this study was smaller than all reports cited here.

The estrous cycle length was 21 days in Saanen goats raised under extensive conditions of Turkey (Ince, 2010). The oestrous cycle duration in Sangamneri goats was 29.14±0.13 days (Deokar et al., 2007). The estrous cycle length in our study is similar to Saanen goats but smaller than Sangamneri goats. There is great variation in the duration of oestrous in goats. The duration of oestrous behavior in goats is about 36 h ranging from 24 h to 48 h, which depends on age, individuals, breeds, season and the presence of a male (Fatet et al., 2011). According to the reports of Shelton (1978) and Tamboura et al. (1998), as cited by Fatet et al. (2011), Angora goats and Mossi goats show a short oestrus of only 22 h and 20 h, respectively while the duration of oestrous period in Boer goats is about 37 h (Greyling, 2000). The duration of oestrous may last about 58 h in Matou goats of Central China (Moaeenud-Din et al., 2008). Deokar et al. (2007) have reported that oestrous duration in Sangamneri goats was 47.96±1.06 hours. The oestrous duration (52.0±1.36 hrs) in the current study is higher than Angora goats, Mossi goats, Boer goats and Sangamneri goats. Only Matou goats of Central China of have higher oestrous duration than that in our study.

4. Conclusion

Chaugarkha goat is recently recognized breed and it is categorized as the small size meat purpose breed. The higher performance for cluster 4 was carried forward from three months through six and nine months upto twelve months. But no definite trend was observed in the effects of year. The male had higher estimates than females at all ages, which were along the expected line. The generated reproduction parameters will be helpful in the formulation and implementation of breeding plans.

5. Acknowledgment

6. References

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