Indian Journal of Animal Sciences **88** (12): 1370–1373, December 2018/Article

Genetic and non-genetic parameters of Kleiber ratio in Pantja goat under field conditions of Tarai region of Uttarakhand

B S KHADDA[1], BRIJESH SINGH[2], D V SINGH[3], S K SINGH[4], C B SINGH[5] and J L SINGH[6]

G B Pant University of Agriculture and Technology, Pantnagar, Uttarakhand 263 145 India

Received: 5 July 2017; Accepted: 4 September 2017

ABSTRACT

A study was conducted to estimate the Kleiber ratio of 805 Pantja kids of 514 goats sired by 26 bucks maintained by registered farmers under All India Co-ordinated Research Project on Goats (Pantja field unit) during 2015–16. The overall least-squares mean and their standard error for Kleiber ratio at 0–3, 3–6, 6–9 and 9–12 months of age were 15.29±0.16, 5.50±0.15, 4.24±0.09 and 3.53±0.37 g respectively. The random effect of sire had a highly significant effect on KR_1 (0–3 months) and KR_2 (3–6 months) whereas, the effect was significant on KR_3 (6–9 months) and KR_4 (9–12 months). The heritability estimate for Kleiber ratio was 0.28±0.09, 0.27±0.09, 0.22±0.08 and 0.04±0.03 at 0–3, 3–6, 6–9 and 9–12 months of age respectively. Most of the genetic and phenotypic correlations of Kleiber ratio were negative between different periods. It may be concluded that the pre-weaning Kleiber ratio was higher which indicated that the kids were given full care during this period. The post-weaning Kleiber ratio can be improved through better management of kids after weaning.

Key words: Cluster, Heritability, Kleiber ratio, Pantja goats, Tarai

The Kleiber ratio (KR) is a useful indicator of feed conversion and an important selection criterion for efficiency of growth (Koster *et al*. 1994). This ratio is a measurement of efficiency and is independent of body size (Kleiber 1961). KR defined as growth rate divided by body mass$^{0.75}$ was suggested for growth efficiency (Kleiber 1947). Pantja is a newly registered goat breed of Tarai region of Uttarakhand, which is mainly reared for meat purpose by the farmers of this region. They are recognized for similarity with deer in their morphological characteristics. Pantja are medium sized goats having brown red dorsal coat colour with black back line and lighter ventral surface. There is presence of white streak on either side of the face. The population of Pantja goats is approximately 0.6 lakh in the region. The twinning rate is also very high (up to 66%). Genetic studies on KRs in Indian goats, in general and Pantja in particular are lacking. Therefore, the present study was undertaken to identify various factor influencing KR and to estimate genetic and phenotypic parameters of these traits in Pantja goat.

MATERIALS AND METHODS

The final records of 805 kids born from 514 does and 26 sires under field conditions were used for present study. The data were classified according to sire, clusters, sex of kid, season of kidding, type of kidding, flock size, educational level of owner, parity of doe, and type of house. Generally goats were housed during night and allowed to graze in the morning and evening. Goats were primarily kept on natural vegetation consisting of shrubs and trees under semi- intensive system of management. The entire animals were vaccinated against enterotoxaemia, *peste des petits* ruminants and foot and mouth disease regularly. Deworming was done twice in a year. All the goats under genetic improvement programme were registered with suitable identification marks. The body weights of goats were recorded in the morning before feeding at 3 month interval. The average daily gain (g/day) was estimated for individual animals by following equation

$$ADG = \frac{W_2 - W_1}{t_2 - t_1}$$

where w_2-w_1 is the observed weight difference for the corresponding time difference t_2-t_1.

Kleiber ratio at 0–3 (KR_1), 3–6 (KR_2), 6–9 (KR_3) and 9–12 months (KR_4) was calculated by following equation

$$KR = \frac{ADG}{(\text{Body weight})^{0.75}}$$

where ADG, average daily gain for the period expressed in

Present address: [1]PhD Scholar (khadda74@gmail.com), [2,4,5]Professor (singhagb@rediffmail.com, sksinghlpm @rediffmail.com, dr.cbsingh2012@gmail.com), [3]Professor and Head (singh_dvrat@rediffmail.com), Department of Livestock Production Management; [6]Professor (drjlsingh@yahoo.com), Veterinary Medicine, College of Veterinary and Animal Science.

g/day; body weight, metabolic body weight at the latter age of the period for which KR is calculated.

The effect of various genetic and non-genetic factors on Kleiber ratio were further analyzed using mixed model least-squares and maximum likelihood computer program (LSMLMW PC-1 version) for fitting constant to overcome the difficulty of disproportionate sub class frequencies and non-orthogonality of data (Harvey 1990). The difference between means was tested for significance by Duncan's multiple range test (Kramer 1957). Paternal half–sib correlation method was used to estimate heritability. The standard error of heritability was estimated by using the formula given by Swiger *et al.* (1964). The genetic and phenotypic correlations among different traits were estimated from the analysis of variance/covariance using half-sib data as suggested by Becker (1975).

RESULTS AND DISCUSSION

The overall least-squares mean for Kleiber ratio at 0–3, 3–6, 6–9 and 9–12 months of age were 15.29±0.16, 5.50±0.15, 4.24±0.09 and 3.53±0.37 g respectively (Table 1). Similar results had also been reported by Rashidi *et al.* (2011) in Markhoz goats, Barazandeh *et al*. (2012) in Raini Cashmere, Gupta *et al.* (2016) in Mehsana goat, Talebi (2012) in Karakul sheep and Venkataramanan *et al.* (2016) in Sandyno sheep.

The effect of sire was highly significant on KR_1 (0–3 months) and KR_2 (3–6 months) whereas, the effect was significant on KR_3 (6–9 months) and KR_4 (9–12 months), indicating the existence of additive genetic variability

Table 1. Least-squares means and their standard error of Kleiber ratio across different factors in Pantja goats

Factor	KR_1 (0–3 Months)	KR_2 (3–6 Months)	KR_3 (6–9 Months)	KR_4 (9–12 Months)
Overall mean (μ)	15.29±0.16 (805)	5.50±0.15 (715)	4.24±0.09 (597)	3.53±0.37 (485)
Sire	**	**	*	*
Cluster	*	**	**	NS
Bhimtal	15.22^{b}±0.08 (317)	6.05^{a}±0.07 (283)	4.58^{a}±0.06 (241)	3.55±0.34 (202)
Tilpuri	14.90^{b}±0.08 (339)	5.09^{c}±0.07 (298)	4.29^{b}±0.06 (239)	3.04±0.35 (187)
Bara	15.31^{b}±0.11 (121)	5.61^{b}±0.12 (108)	4.16^{b}±0.10 (93)	4.09±0.55 (76)
Kunda	15.73^{a}±0.21 (28)	5.25^{cb}±0.24 (26)	3.93^{b}±0.19 (24)	3.44±1.07 (20)
Season of kidding	NS	NS	**	NS
Summer (Mar–Jun)	15.48±0.20 (182)	5.43±0.18 (164)	4.49^{a}±0.13 (149)	4.47±0.74 (118)
Rainy (July–Sep)	15.25±0.20 (138)	5.48±0.18(115)	4.39^{a}±0.14 (97)	3.57±0.91 (77)
Autumn (Oct-Nov)	15.19±0.18 (232)	5.54±0.17 (209)	4.17^{ba}±0.12 (170)	3.40±0.71 (138)
Winter (Dec–Feb)	15.24±0.19 (253)	5.55±0.17 (227)	3.91^{b}±0.12 (181)	2.65±0.62 (152)
Type of birth	**	**	NS	NS
Single	15.02^{b}±0.12 (311)	5.25^{b}±0.16 (283)	4.20±0.10 (243)	3.47±0.47 (198)
Twin	15.56^{a}±0.10 (494)	5.75^{a}±0.15 (432)	4.28±0.10 (354)	3.59±0.41 (287)
Sex of kid	**	**	NS	NS
Male	15.87^{a}±0.16 (458)	5.75^{a}±0.15 (413)	4.27±0.10 (340)	3.67±0.41 (257)
Female	14.71^{b}±0.16 (347)	5.25^{b}±0.15 (302)	4.21±0.10 (257)	3.39±0.39 (228)
Type of house	*	*	NS	NS
Kaccha	15.78^{ba}±0.21 (440)	4.79^{b}±0.26 (389)	4.03±0.27 (323)	3.16±0.58 (259)
Pucca	16.22^{a}±0.26 (230)	5.42^{b}±0.29 (207)	4.30±0.30 (174)	3.04±0.71 (147)
Slatted	13.87^{b}±0.34 (135)	6.29^{a}±0.36 (119)	4.39±0.47 (100)	4.39±1.26 (79)
Flock size	NS	NS	NS	NS
Small (0–5)	14.89±0.37 (118)	5.56±0.28 (106)	4.19±0.23 (89)	3.60±1.02 (73)
Medium (6–10)	15.70±0.52 (70)	5.22±0.38 (63)	4.27±0.32 (53)	2.47±1.05 (44)
Semi-large (11–20)	15.37±0.29(320)	5.70±0.26 (285)	4.67±0.61 (236)	4.17±0.99 (189)
Large (>20)	15.20±0.31 (297)	5.52±0.34 (261)	3.83±0.49 (219)	3.88±0.87 (179)
Education level	*	NS	NS	NS
Illiterate	14.47^{b}±0.42 (236)	5.49±0.98 (209)	3.81±0.84 (177)	3.17±1.41 (145)
Up to matriculate	14.58^{b}±0.31 (314)	5.31±0.36 (280)	4.25±0.30 (233)	4.64±1.11 (185)
Above matriculate	16.81^{a}±0.40 (255)	5.70±0.96 (226)	4.66±0.84 (187)	2.78±1.32 (155)
Parity of dam	NS	NS	NS	NS
First	15.31±0.23 (115)	5.82±0.21 (103)	4.22±0.17 (89)	4.86±0.95 (70)
Second	15.37±0.18 (200)	5.44±0.16 (181)	4.23±0.11 (147)	3.28±0.54 (119)
Third	15.14±0.17 (239)	5.66±0.16 (207)	4.20±0.11 (178)	3.24±0.50 (145)
Fourth	15.18±0.19 (145)	5.53±0.17 (127)	4.29±0.13 (103)	3.22±0.64 (84)
Fifth	15.36±0.22 (85)	5.48±0.20 (76)	4.41±0.16 (62)	2.99±0.82 (52)
Sixth	15.38±0.34 (21)	5.07±0.30 (21)	4.09±0.49 (18)	3.59±1.37 (15)
Reg. on DWK	0. 026±0.02**	–0.011±0.02	–0.014±0.02	–0.005±0.01

Number of observations are given in parentheses. Estimates with different superscripts differ significantly. F statistic of corresponding effects (**highly significant (P<0.01), *significant (P<0.05), ^{NS}non-significant).

among these traits which can be used effectively for further improvement.

Cluster had a highly significant (P<0.01) effect on KR_2 and KR_3, and significant (P<0.05) effect on KR_1. Different agro-climatic conditions, goat management practices followed by goatherds, socio-economic variability between the goat rearers of the different clusters could be some of the reasons for significant variations in Kleiber ratio amongst the different clusters.

Season of kidding had a non-significant effect on KR_1, KR_2 and KR_4 whereas, this effect was highly significant on KR_3. Non-significant effect had also been reported by Gupta *et al.* (2016) for 0–3 months of age in Mehsana goats and Prakash *et al.* (2012) for 6–12 months of age in Malpura sheep. Contrasting to these findings, Supakorn and Pralomkarn (2012) had reported significant effect of season of birth on Kleiber ratio between 0–3 months of age in Anglo-Nubian, Boer, Saanen goats and their crosses.

The effect of type of birth and sex of kid was highly significant on KR_1 and KR_2. Similar results were also reported by Supakorn and Pralomkarn (2012), Prakash *et al.* (2012), Talebi (2012) and Venkataramanan *et al.* (2016). On the other hand, Gupta *et al.* (2016) reported non-significant effect of sex of kid on Kleiber ratio for 0–3 and 3–6 months of age.

Type of house had significant (P<0.05) effect on KR_1 and KR_2. Kids reared under *pucca* houses had more Kleiber ratio as compared to those reared in *kaccha* houses, which might have been due to the fact that the goats are more comfortable on *pucca* and clean floor which results in enhanced growth. The flock size and parity of dams had a non-significant effect on KR_1, KR_2, KR_3 and KR_4. On the contrary, significant effect of parity of dams on Kleiber ratio was reported by Talebi (2012) in Karakul sheep between 0–3 and 3–6 months and Mandal *et al*. (2015) in Muzaffarnagari sheep between 0–3 months of age.

The effect of education level of goat keepers was significant (P<0.05) only on Kleiber ratio during 0–3 months of age. The finding signified that education level of goat keepers is an important consideration for scientific goat husbandry practices.

The regression of dam's weight at kidding was positive and highly significant (P<0.01) on Kleiber ratio between 0–3 months of age, a finding in agreement with the reports of Prakash *et al.* (2012) and Gupta *et al.* (2016). Positive regression coefficients indicated that heavier kids were produced by dams whose body weight at kidding was higher as heavier dams provided better nourishment and more space for the developing fetus resulting in heavier weight at birth.

The heritability estimate for Kleiber ratio was low to moderate at 0.28±0.09, 0.27±0.09, 0.22±0.08 and 0.04±0.03 during the period of 0–3, 3–6, 6–9 and 9–12 months of age, respectively (Table 2). The results were in close agreement with the reports of Supakorn and Pralomkarn (2012) and Gupta *et al.* (2016).

Most of the genetic and phenotypic correlations of Kleiber ratio were negative between different periods. The present results were in close agreement to those reported by Gupta *et al.* (2016). The high genetic correlation between pre-KR and post-KR may allow selection of kids even at the time of weaning to improve performance based on a six month body weight, and it may permit initial culling even at weaning due to correlated response to selection. Further, the selection for increasing early body weights may bring genetic improvement in body weights at subsequent periods/ ages.

Table 2. Estimates of heritability (on diagonal), genetic correlation (above diagonal) and phenotypic correlation (below diagonal) for Kleiber ratio (KR) at subsequent ages in Pantja goats

Trait	0–3 M	3–6 M	6–9 M	9–12 M
0–3 M	0.28±0.09	–0.57±0.21	–0.73±0.18	0.001±0.39
3–6 M	–0.43±0.04	0.27±0.09	0.41±0.22	–0.68±0.36
6–9 M	–0.30±0.04	0.12±0.05	0.22±0.08	–0.22±0.40
9–12 M	–0.01±0.05	–0.06±0.05	0.03±0.05	0.04±0.03

It can be concluded that the pre-weaning Kleiber ratio was higher which indicated that the kids were given full care during this period. The post-weaning Kleiber ratio can be improved through better management of kids after weaning. Hence, for higher economic gain, selection should be made at earlier age, preferably at 3 to 6 months. Rearing male kids can be more profitable as they achieved higher growth and better feed conversion efficiency. KR gives a good indication of how economically an animal grows which is one of the indices that have been proposed and used to determine the energetic efficiency of goats. Also, KRs could be applied in selection index as an indication of feed efficiency for pre- and post-weaning growth traits.

ACKNOWLEDGEMENT

The authors are thankful to the Director, G B Pant University of Agriculture and Technology, Pantnagar, Uttarakhand for encouragement and providing facilities for the study.

REFERENCES

Barazandeh A, Moghbeli S M, Vatankhah M and Mohammadabadi M R. 2012. Estimating non-genetic and genetic parameters of pre weaning growth traits in Raini Cashmere goat. *Tropical Animal Health and Production* **44**: 811–17.

Becker W A. 1975. *Manual of Quantitative Genetics*. 3rd edn. Publication Program in Genetics, Washington State University, Washington, USA.

Gupta J P, Pandey D P, Panchasara H H and Shah R R. 2016. Factors affecting pre- and post-weaning kleiber ratios and genetic parameters in mehsana goats. *Indian Journal of Small Ruminants* **22**(1): 100–102.

Harvey W R. 1990. *Mixed Model Least Squares and Maximum Likelihood*. Computer Program, PC-1 version, Ohio State University, Columbus, USA.

Kleiber M. 1947. Body size and metabolic rate. *Physiological Reviews* **27**: 511–41.

Kleiber M. 1961. Metabolic rate and food utilization as a function

of body size. Research Bulletin 167, University of Missouri, Missouri.

Koster E, Vander Westhuizen J and Erasmus G J. 1994. Heritability estimates for different Kleiber ratios obtained from growth performance data in a Hereford herd. *South African Journal of Animal Science* **24**: 71–72.

Kramer C V. 1957. Extension of multiple range tests to group mean with unequal number of replications. *Biometric* **12**: 307–310.

Mandal A, Karunakarana M, Sharmab D K, Banehc H and Rout P K. 2015. Variance components and genetic parameters of growth traits and Kleiber ratio in Muzaffarnagari sheep. *Small Ruminant Research* **13**(2): 79–85.

Prakash V, Prince L L L, Gowane G R and Arora A L. 2012. Factors affecting post-weaning average daily gain and Kleiber ratios in Malpura sheep. *Indian Journal of Animal Sciences* **82**: 1598–1600.

Rashidi A, Bishop S C and Matika O. 2011. Genetic parameter estimates for pre-weaning performance and reproduction traits in Markhoz goats. *Small Ruminant Research* **100**: 100–106.

Supakorn C and Pralomkarn W. 2012. Genetic parameter estimates for weaning weight and Kleiber ratio in goats. *Songklanakarin Journal of Science and Technology* **34**: 165–72.

Swiger L A, Harvery W R, Everson D O and Gregory K E. 1964. The variance of intra-class correlation involving groups with one observation. *Biometrics* **20**: 818.

Talebi E. 2012. Heritability estimates for some growth traits and Kleiber ratios in Karakul sheep. *Indian Journal of Animal Sciences* **82**: 620–23.

Venkataramanan R, Subramanian A, Sivaselvam S N, Sivakumar T and Sreekumar C. 2016. Genetic parameters for Kleiber ratio and its relation to other body weight traits in Nilagiri and Sandyno sheep. *Indian Journal of Animal Sciences* **86**(5): 559–63.