

Effects of Environmental Factors on Body Weight of Sistani Goat at Different Ages

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Abstract: The objective of this study was to evaluate the effect of some non-genetic factors on pre-weaning and post-weaning growth in Sistani goat kids. Data from 81 records (36 males and 45 females) were analyzed. The data were collected from the Institute of Research Domesticated Animals, Zabol University in Sistan and Baluchestan province and Iran in 2008. The effects of dam weight after kidding, sex, birth type and time of weaning on the weights at birth, weaning, 6, 9 and 12 months of age and average pre and post weaning daily gain were studied. The average birth weight of male kids was about 3% higher than female kids. The overall means of Body Weight at birth (BW), Weaning 3 (WW3), Weaning 4 (WW4), 6 (W6), 9 (W9) and 12 (W12) months of age were 1.915, 7.796, 9.900, 15.597, 26.253 and 34.2 kg, respectively. Birth weight averaged 2.398, 2.355, 1.858 and 1.865 kg for single males and females, twin males and females, respectively. Kids had a faster growth rate from 6-9 months with daily gain 118.4 (g day⁻¹) that the average daily gain in kids decreased with the age increase from 9-12 months of age. Average pre-weaning daily gain of female was also higher than male but there was no significant difference observed in pre-weaning gain heavy dam produced heavy kid ($r = 0.319$) but later weight had no relation with dam weight. Male kids in comparison with female kids and single born kids in comparison with twin born kids had higher birth weight and weaning weight.

Key words: Sistani goat, environmental effect, birth weight, weaning weight, daily growth

INTRODUCTION

Growth dynamic of young generation may be used as one of indicators to evaluate the level of adaptation of a gene fund under conditions of a production system which is different from its origin place. Growth period of young generation until the puberty age can be divided into three phases: maternal phase from birth to weaning, phase of development of bio-physiological mechanisms of growth and individual response to environmental conditions from weaning to 6 months old and growth phase from the age of 6 months to puberty one (Kume and Hajno, 2010).

Growth of kids from birth to marketing or for replacement is a trait of great economic importance and requires particular attention for increasing total goat productivity although, weight is an important objective in selection. The potential for genetic and phenotypic parameters of this trait upon which selection may be applied.

Moreover, environmental influences can be controlled and corrected to permit more accurate identification of genetic differences between

individual goats (Hermiz *et al.*, 2009; Hermiz, 1998; Mavrogenis *et al.*, 1984; Das *et al.*, 1996). The birth weight and early growth rate of animals are determined not only by genetic potential but also by maternal and environmental factors (Zhang *et al.*, 2009; Mandal *et al.*, 2006).

Production traits are affected by various non-genetic factors like sex, season, year and type of birth (Bharathidhasan *et al.*, 2009; Kumar *et al.*, 2007).

Goats are known to be potential genetic resources for meat, milk, skin and fibre throughout the tropical and developing countries. They also play an important role in the socio-economic life of the people as they feature prominently in socio-cultural functions like ceremonies and religious festivities. In fact, goats play a significant role in household nutrition and food security of pastoral people (Alade *et al.*, 2010).

Age at the time of weaning can differ very much. According to preformed research the transition to feeding only dry feed can be implemented successfully already at 3 weeks of age (Memisi *et al.*, 2009).

Goats comprise one of the most important domestic livestock species in Iran and play an important role in the

livelihood of a large proportion of small and marginal farmers and landless laborers. Since, the goat provides a good source of meat, milk, fiber and skin, it is popularly known as the poor man's cow (Sadeghi *et al.*, 2010).

Hence, an attempt has been made to know the effects of various non-genetic factors on the body weight at birth, weaning weight and pre and post weaning weight gain of Sistani goat under southeastern agro-climatic conditions of Iran.

MATERIALS AND METHODS

The data were collected from the research center of domestic animal of university of Zabol in 2008. After kidding, the new-born kids were marked and weighed. The birth weight was recorded and the kids were left with their dams for sucking till weaning age at 3 or 4 month. They received *ad libitum* fresh alfalfa and hay beginning the 3rd week.

They consisted of birth weight and monthly weight up to 12 months of age from 81 Sistani goat kids divided in to 2 groups: group 1 contained 39 kids (18 male and 21 female) were weaned at 3 months age and group 2 contained 42 kids (18 male and 24 female) were weaned at 4 months age.

Birth weight and body weights at ages of 3, 6, 9 and 12 months were used in this study as the dependent observations kids were kept on door most of the time during the 1st 4 months and permitted to outdoor environment when it was suitable. Then, they stayed outdoor all day time with shade against direct solar radiation and indoor during night period.

Dams and their kids were kept together in the same pen at night. The animals (mothers) were released daily to graze and browse natural pastures during the day and were penned after grazing.

Kids were fed a concentrate mixture (prepared on the farm) with a standard chemical composition with 16.5% protein (barely 32, corn 19, cotton seed 3 and soya 9%. Alfalfa 30, straw 5, limestone 0.5 and salt 1% an min+vita 0.5%) water was also provided *ad lib*.

Study the weight effect of mother on kid weights at different age kids were divided into 3 groups according to the dam weight after kidding. Groups of the dam's weight were as follows:

Light (<30 kg), medium (30-37 kg) and heavy (>37 kg). The effects of dam weight, sex, type of birth and stage of weaning on kids weights at different age were analyzed using the following model:

The General Liner Model (GLM) procedure of Statistical Package for the Social Sciences (SPSS 16) was used to analyze the data. Fixed effects evaluated for pre

and post weaning growth were sex of kids (male, female), litter size of kids (single and twin), dam weight (light, medium and heavy) and time of weaning (3 and 4 months). The following model was fitted:

$$Y_{ijklm} = \mu + Y_i + P_j + S_k + Z_l + e_{ijklm}$$

Where:

Y_{ijklm} = Records of the nth animal

μ = The overall mean

Y_i = The fixed effects of ith sex (i = 1 or 2; 1 = female, 2 = male)

P_j = The fixed effect of the jth type of birth (j = 1 or 2, 1 = Single, 2 = Twin)

S_k = The fixed effect of the kth weight of dam (k = 1, 2 or 3; 1 = light, 2 = medium 3 = heavy)

Z_l = The fixed effect of the lth time of weaning (1 = group1 or group 2 group1 = 3 months and group 2 = 4 months)

e_{ijklm} = The residual effects

RESULTS AND DISCUSSION

Number of records (N), Least-Squares Means (LSM) and Standard Errors (SE) of BW, WW, W6M, W9M, W12M and ADG (BW-WW), ADG (WW-6M), ADG (6-9M) and ADG (9-12M) for Sistani goat in various fixed effects are shown in Table 1 and 2.

The overall means of BW, WW, W6M, W9M and W12M were 1.915±0.046, 8.852±0.209, 15.597±0.297, 26.253±0.535 and 34.201±0.675 kg, respectively.

Birth weight range of Sistani kids were 1.823-2.007 kg. Its range was 2.215-2.451 for single males and 1.958-2.165 kg for single females. Those of twins were 1.903-2.356 and 1.858-2.142 kg, respectively.

Kids had a faster growth rate from 6-9 months with daily gain 118.4 (g day⁻¹) that the average daily gain in kids decreased with the age increase from 9-12 months of age. Table 1 shows that male kids were heavier than females. The average birth weight of male and female kids was 1.94±0.05 and 1.88±0.05 kg, respectively. Even though male kids weighed 3.09% higher birth weight than female kids, there was no significant difference observed.

These results agree with other studies by several researchers (Jimenez-Badillo *et al.*, 2009; Amoah *et al.*, 1996; Mahgoub and Lodge, 1996; Alexandre *et al.*, 1999; Al-Shorepy *et al.*, 2002; Portolano *et al.*, 2002; Browning *et al.*, 2004; Liu *et al.*, 2005).

Average pre-weaning daily gain of female was also higher than male but there was no significant difference observed in pre-weaning gain. In this study effect of sex

Table 1: Number of records (N), least squares mean±SE for BW, WW, W6M, W9M, W12M by sex, type of birth, weight of dam and time of weaning

| Effects | N | BW (kg) | N | WW (kg) | N | W6M (kg) | N | W9M (kg) | N | W12M (kg) |
|------------------------|----|-----------|----|-----------|----|------------|----|------------|----|------------|
| Mean | 81 | 1.91±0.04 | 81 | 8.85±0.20 | 81 | 15.6±0.300 | 81 | 26.25±0.53 | 81 | 34.2±0.670 |
| Sex | | | | | | | | | | |
| Male | 36 | 1.94±0.05 | 36 | 9.44±0.25 | 36 | 16.93±0.36 | 36 | 28.73±0.65 | 36 | 37.53±0.81 |
| Female | 45 | 1.89±0.05 | 45 | 8.27±0.25 | 45 | 14.27±0.35 | 45 | 23.77±0.63 | 45 | 30.87±0.80 |
| Type of birth | | | | | | | | | | |
| Single | 48 | 2.21±0.05 | 48 | 8.98±0.21 | 48 | 15.32±0.30 | 48 | 26.03±0.55 | 48 | 33.48±0.69 |
| Twins | 33 | 1.61±0.06 | 33 | 8.72±0.30 | 33 | 15.87±0.43 | 33 | 26.47±0.77 | 33 | 34.92±0.97 |
| Weight of dam | | | | | | | | | | |
| Light | 6 | 1.36±0.11 | 6 | 7.81±0.52 | 6 | 15.52±0.73 | 6 | 26.5±1.320 | 6 | 34.36±1.66 |
| Medium | 57 | 2.15±0.03 | 57 | 9.51±0.16 | 57 | 15.6±0.220 | 57 | 26.57±0.40 | 57 | 34.64±0.51 |
| Heavy | 18 | 2.23±0.06 | 18 | 9.23±0.30 | 18 | 15.67±0.44 | 18 | 25.69±0.79 | 18 | 33.6±0.990 |
| Time of weaning | | | | | | | | | | |
| Months | 3 | - | 39 | 7.8±0.260 | 39 | 15.04±0.36 | 39 | 25.95±0.66 | 39 | 34.46±0.83 |
| Months | 4 | - | 42 | 9.91±0.26 | 42 | 16.16±0.37 | 42 | 26.55±0.66 | 42 | 33.94±0.83 |

Table 2: Number of records (N), least squares (mean±SE) for ADG (BW-WW), ADG (WW-6M), ADG (6-9M) and ADG (9-12M) of Sistani goat in various fixed effects as sex, type of birth, weight of dam and time of weaning

| Effects | N | BW-W W (g) | N | WW-6 M (g) | N | 6-9 M (g) | N | 9-12 M (g) |
|------------------------|----|------------|----|--------------|----|--------------|----|------------|
| Mean | 81 | 14.86±0.45 | 81 | 90.800±3.60 | 81 | 118.40±4.080 | 81 | 88.31±2.95 |
| Sex | | | | | | | | |
| Male | 36 | 14.73±0.54 | 36 | 100.800±4.30 | 36 | 131.18±4.920 | 36 | 97.72±3.55 |
| Female | 45 | 14.99±0.53 | 45 | 80.790±4.22 | 45 | 105.60±4.800 | 45 | 78.91±3.50 |
| Type of birth | | | | | | | | |
| Single | 48 | 12.17±0.46 | 48 | 85.200±3.70 | 48 | 118.98±4.200 | 48 | 82.71±3.03 |
| Twins | 33 | 17.55±0.65 | 33 | 96.400±5.18 | 33 | 117.80±5.890 | 33 | 93.92±4.25 |
| Weight of dam | | | | | | | | |
| Light | 6 | 20.97±1.10 | 6 | 102.280±8.83 | 6 | 121.96±10.00 | 6 | 87.4±7.260 |
| Medium | 57 | 12.21±0.34 | 57 | 84.223±2.70 | 57 | 121.88±3.080 | 57 | 89.66±2.22 |
| Heavy | 18 | 11.40±0.66 | 18 | 85.880±5.30 | 18 | 111.34±6.000 | 18 | 87.89±4.36 |
| Time of weaning | | | | | | | | |
| Months | 3 | 11.44±0.55 | 39 | 80.83±4.400 | 39 | 121.29±5.000 | 39 | 94.52±3.60 |
| Months | 4 | 18.29±0.55 | 42 | 100.76±4.400 | 42 | 115.50±5.000 | 42 | 82.11±3.63 |

on pre-weaning weight gain of Sistani goat found non significant. Similarly, Bharathidhasan *et al.* (2009) found non significant effect of sex on pre-weaning weight gain of Barbari goat.

Differences in sexual chromosomes, probably in the position of genes related to growth, physiological characteristics, difference in endocrinal system (type and measure of hormone secretion especially sexual hormones) lead to difference in animal growth. In relation to endocrinal system, estrogen hormone has a limited effect on the growth of long bones in females. That could be one of the reason in which females have smaller body and lighter weight against males (Roshanfekr *et al.*, 2011; Rashidi *et al.*, 2008).

ADG for male kids was higher than females as it can be shown in Table 2. Differences between male and female kids were small and non significant before weaning ($p \geq 0.05$).

Hence, average pre-weaning daily gain of female was also higher than male but there was no significant difference observed in pre-weaning gain. Similarly, Bharathidhasan found non significant effect of sex on pre-weaning weight gain of Barbari goat. Birth and weaning weight kids born as singles (Table 1) were

heavier than twins. The influence of type of birth on birth weight was also highly significant ($p < 0.01$), with single and twin recording 2.21±0.05 and 1.61±0.06 kg, respectively. The kids born as single were significantly heavier birth weight than those born as twins. This finding was in agreement with that of Mukundan *et al.* (1981) in Malabari and its Sannen half-breeds, Khan and Sahni (1883) in Jamunapari kids, Sheikh *et al.* (1996) in Changithangi kids, Malik and Kanaujia (1991) in Beetal kids, Singh *et al.* (2000) in Beetal halfbred kids and Soundararajan *et al.* (2006) in non-descript kids.

In general, kids body weights decreased as litter size increase. According to the results reported in the literature (Das and Sendalo, 1992; Mourad and Anous, 1998; Alexandre *et al.*, 1999; Al-Shorepy *et al.*, 2002; Portolana *et al.*, 2002; Browning *et al.*, 2004; Liu *et al.*, 2005). This effect is attributed mainly to the fact that single kids do not have to compete for space or nutrients in their mother's uterus, unlike what happens when two or three kids were developed. The type of birth did not significantly affect the weaning weight whilst no differences were found between single and twin kids (Table 1). Despite the presence of numerical differences in the ADG they were not statistically significant. This result agrees with results of Liu *et al.* (2005).

Average weight for dams of light, medium and heavy groups was 27.35 ± 0.551 , 35.153 ± 0.179 and 38.788 ± 0.318 kg, respectively. The dam weight at kidding influenced kid early weights (at birth and weaning weight) but not at later ages. Significant regression of birth weight on weight of dam at kidding revealed that heavier kids were born to heaviest dams ($r:0.319$) which was in agreement with the findings of Biswas *et al.* (1990), Koul *et al.* (1996) and Karna *et al.* (2001).

Weight of doe at kidding significantly affect BW ($p < 0.01$) and WW ($p < 0.05$) and W6M, W9M and W12M ($p > 0.05$). As it can be shown in Table 2, kids born from dams of light had a faster growth rate from birth to 6 months old age than those which were born from heavier does.

Time of weaning had a significant effect ($p < 0.05$ and $p < 0.001$) on all traits studied except for 9 and 12M. The kids weaned at 120 days of age were significantly ($p < 0.01$) heavier by 2.13 kg than the kids weaned at 90 days of age. The higher weight 6 and 9M of group 2 kids than group 1 kids was 1.118 and 0.597 kg, respectively. Different periods post weaning, already at the WW until 6M, results for trends of average daily gain for kids show significant differences ($p < 0.01$) between 2 groups.

CONCLUSION

This study showed the importance of certain environmental factors on growth traits. The BW, W6M, W9M and W12M as well as ADG from Birth until slaughter weight were influenced by sex, type of birth, weight of dam and time of weaning.

Moreover, the birth weight, weaning weight and growth rate of males were found to be higher than females. These weights influenced kid early weights (at birth and weaning weight), heavier does produced heavier kids indicating the influence of the mothering ability of doe. Hence, the producers should consider maternal ability for improvement of weaning weight and growth rate of kids in the population. In addition, weaning weight of kids should be considered for selection of parent stock in order to increase productivity and eventually the economic efficiency of the farm herd.

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REFERENCES

- Al-Shorepy, S.A., G.A. Alhadrami and K. Abdulwahab, 2002. Genetic and phenotypic parameters for early growth traits in Emirati goat. *Small Rumin. Res.*, 45: 217-223.
- Alade, N.K., M.A. Dilala and A.O. Abdulyekeen, 2010. Phenotypic and genetic parameter estimates of litter size and body weights in goats. *Int. J. Sci. Nat.*, 2: 262-266.
- Alexandre, G., G. Aumont, J.C. Mainaud, J. Fleury and M. Naves, 1999. Productive performances of Guadeloupean Creole goats during the suckling period. *Small Rumin. Res.*, 34: 155-160.
- Amoah, E.A., S. Gelaye, P. Guthrie and J.C.E. Rexroad, 1996. Breeding season and aspects of reproduction of female goats. *J. Anim. Sci.*, 74: 723-728.
- Bharathidhasan, A., R. Narayanan, P. Gopu, A. Subramanian, R. Prabakaran and R. Rajendran, 2009. Effect of non-genetic factors on birth weight, weaning weight and preweaning gain of Barbari goat. *Tamilnadu J. Vet. Anim. Sci.*, 5: 99-103.
- Biswas, J.C., G.L. Koul and G.S. Bisht, 1990. Body weight and morphometry at birth in Chegu Pashmina producing goat. *Ind. Vet. Med. J.*, 14: 256-258.
- Browning, Jr.R., S.H. Kebe and M. Byars, 2004. Preliminary assessment of Boer and Kiko does as maternal lines for kid performance under humid, subtropical conditions. *S. Afr. J. Anim. Sci.*, 34: 1-3.
- Das, M.S., J.E.O. Rege and S. Mesfin, 1996. Phenotypic and genetic parameters of growth traits of blended goats at Malya, Tanzania. *Proceedings of the 3rd Biennial Conference of the African Small Ruminant Research Network*, Dec. 5-9, 1994, ILRI, Nairobi, Kenya, pp: 63-70.
- Das, S.M. and D.S. Sendalo, 1992. Comparative Performance of Improved Meat Goats in Malya. In: *Small Ruminant Research and Development in Africa*, Rey, B., S.H.B. Lebbie and L. Reynolds (Eds.). ILCA, Addis Ababa, Ethiopia, ISBN: 92-9053-258-0, pp: 445-452.
- Hermiz, H.N., 1998. Additive and multiplicative adjustment factors for milk traits in Iraqi local goat. *Iraqi J. Agric.*, 3: 164-173.
- Hermiz, H.N., J.E. Alkass, A.A. Hobi and M.K. Asofi, 2009. Genetic and phenotypic parameters of body weight in Iraq local goat and their crosses with damascus. *J. Duhok Univ.*, 12: 189-194.
- Jimenez-Badillo, M.R., S. Rodrigues, C. Sanudo and A. Teixeira, 2009. Non-genetic factors affecting live weight and daily gain weight in Serrana Transmontano kids. *Small Rumin. Res.*, 84: 125-128.

- Karna, D.K., G.L. Koul and G.S. Bisht, 2001. Birth weight, morphometry and relative gain in body weight in Cheghu kids. *Ind. J. Anim. Sci.*, 71: 180-182.
- Khan, B.U. and K.L. Sahni, 1883. Pre-weaning body weight and linear body measurements in Jamunapari goats. *Ind. J. Anim. Sci.*, 53: 835-840.
- Koul, G.L., G.S. Bisht, J.C. Biswas and B.D. Gupta, 1996. Studies on pre-and post weaning body weights in Cheghu breed of pashmina producing goats. *Ind. J. Anim. Health*, 35: 1-5.
- Kumar, A., U. Singh and A.K.S. Tomar, 2007. Early growth parameters of Kutchi goats under organized farm. *Indian Vet. J.*, 83: 105-106.
- Kume, K. and L. Hajno, 2010. Study of growth curve variations for kids 0-6 months old of Alpine goat breed in Albania. *Archiva Zootechnica*, 13: 54-62.
- Liu, W., Y. Zhang and Z. Zhou, 2005. Adjustment for non-genetic effects on body weight and size in Angora goats. *Small Rumin. Res.*, 59: 25-31.
- Mahgoub, O. and G.A. Lodge, 1996. Growth and body composition in meat production of Omani Batina goats. *Small Rum. Res.*, 19: 233-246.
- Malik, C.P. and A.S. Kanaujia, 1991. Studies on growth in Beetal kids. *Ind. J. Anim. Manage.*, 7: 49-52.
- Mandal, A., F.W.C. Naser, P.K. Rout, R. Roy and D.R. Notter, 2006. Estimation of direct and maternal (co)variance components for pre-weaning growth traits in Muzaffarnagari sheep. *Livest. Sci.*, 99: 79-89.
- Mavrogenis, A.P., A. Constantinou and A. Louca, 1984. Environmental and genetic causes of variation in production traits of Damascus goats. 1. Pre-weaning and post-weaning growth. *Anim. Prod.*, 38: 91-97.
- Memisi, N., M. Zujovic, Z. Tomic and M.P. Petrovic, 2009. The effect of time of weaning on body mass and gain of kids. *Biotechnol. Anim. Husbandry*, 25: 993-998.
- Mourad, M. and M.R. Anous, 1998. Estimates of genetic and phenotypic parameters of some growth traits in Common African and Alpine crossbred goats. *Small Rumin. Res.*, 27: 197-202.
- Mukundan, G., P.N. Bhat and B.U. Khan, 1981. Genetic analysis of birth weight in Malabari breed of goats and its halfbreeds. *Ind. J. Anim. Sci.*, 51: 630-634.
- Portolana, B., M. Todora, R. Finocchiaro and J.H.C.M. van Kaam, 2002. Estimation of the genetic and phenotypic variance of several growth traits of the Sicilian Girgentana goat. *Small. Rumin. Res.*, 45: 247-253.
- Rashidi, A., M.S. Mokhtari, A.S. Jahanshahi and M.R.M. Abadi, 2008. Genetic parameter estimates of pre-weaning growth traits in Kermani sheep. *Small Rumin. Res.*, 74: 165-171.
- Roshanfekar, H., M. Mamouei, K. Mohammadi and E. Rahmatnejad, 2011. Estimation of genetic and environmental parameters affected Pre-weaning Traits of Arabi Lambs. *J. Anim. Vet. Advan.*, 10: 1239-1243.
- Sadeghi, R., B. Mahmoudi, M. Bayat, A. Jafarzade, S.M. Gh, S. Seyyedsafavi and M. Nejadgashti, 2010. Genetic diversity of Raeini goat population based on microsatellite. *J. Anim. Vet. Adv.*, 9: 661-665.
- Sheikh, N.A., T.A.S. Ganai and G.M. Wani, 1996. Non-genetic factors affecting body weight of Changithangi goats. *Ind. J. Anim. Sci.*, 66: 402-404.
- Singh, D.K., N.S. Singh and L.B. Singh, 2000. Nongenetic factors affecting growth of Beetal halfbred kids. *Ind. J. Anim. Sci.*, 70: 1165-1166.
- Soundararajan, C., T. Sivakumar and R. Palanidorai, 2006. Factors affecting birth weight in goats. *Ind. Vet. J.*, 83: 803-804.
- Zhang, C.Y., Y. Zhang, D.Q. Xu, X. Li, J. Su and L.G. Yang, 2009. Genetic and phenotypic parameter estimates for growth traits in Boer goat. *Livest. Sci.*, 124: 66-71.