Original Research

Effect of Feeding Different Levels of *Prosopis cineraria* Dry Leaves and Barley Grain on Growth Performance and Body Conformations of Goat Kids

Priyanka Meena, Athar Uddin, Vinod Kumar Paswan* and Satya Prakash Yadav

Department of Livestock Production Management, S. K. N. College of Agriculture, Sri Karan Narendra Agriculture University, Jobner, Jaipur-303329, Rajasthan, INDIA

***Corresponding author:** vkpaswan.vet@gmail.com

Rec. Date:	Dec 19, 2017 12:45
Accept Date:	Feb 14, 2018 16:59
DOI	10.5455/ijlr.20171219124504

Abstract

This study was conducted to assess the body weight gain, body conformational changes and to develop the equation to predict the body weight gain based on body measurements in goat kids fed with different level of diets. Twenty seven goat kids divided into three equal groups were fed for 90 days on a composite feed mixture (CFM), prepared with roughage Prosopis cineraria dry leaves and barley grain in ratio of 80:20 (D_1), 60:40 (D_2) and 40:60 (D_3) respectively, along with 2% mineral mixture and 1% common salt. The percentage of DM, CP, NDF, ADF, cellulose, lignin and tannins was higher in D_1 and D_2 than that of D_3 CFM. The final body weight, height, heart girth and punch girth were higher ($P<0.05$) in D_3 (15.88kg, 57.77, 58.72 and 65.69 cm) followed by D_1 (14.40 kg, 56.63, 57.94 and 64.02 cm) and D_2 (13.92 kg, 57.44, 56.91 and 63.25 cm) kids, whereas, the length was higher in D_1 (47.63 cm) followed by D_2 (47.47 cm) and D_3 (47.41) CFM fed kids. The total body weight gain and average daily gain were highest ($P<0.05$) in D_3 (3.39 kg and 43.70 g) and lowest in the D_2 (3.08 kg and 34.32 g) kids. Total feed intake (kg) during the experiment was higher ($P<0.05$) in D_1 (53.02) and D_3 (51.46) than in D_2 (50.97) kids. The group-wise regression coefficients (R^2) for predicting the body weight gain using the body conformations ranged from 73.81 (D_3) to 97.68% (D_1), whereas the overall R^2 was 84.47%. The study revealed that body measurements can be used for prediction of body weight. It is also concluded that a mixture of Prosopis cineraria dry leaves and barley grain in ratio of 80:20 proved better for feeding of kids.

Key words: Body Conformations, Goat Kids, Growth Performances, *Prosopis cineraria* Leaves

How to cite: Meena, P., Uddin, A., Paswan, V., & Yadav, S. (2018). Effect of Feeding Different Levels of Prosopis cineraria Dry Leaves and Barley Grain on Growth Performance and Body Conformations of Goat Kids. International Journal of Livestock Research, 8(7), 201-211. doi: 10.5455/ijlr.20171219124504

Introduction

Animal growth is the function of cell multiplication, which requires balanced supply of energy and protein for optimized growth performance. Since at younger age protein deposition favoured due to muscular development hence higher levels of dietary protein require, while at maturity and older stage fat

deposition takes place therefore protein need reduces and energy need increases. Kids, those grow faster attains marketable weight at a younger age, which generally means that they require a shorter feeding period and have less risk of death loss. Faster growth potential of kid has higher nutritional needs, especially with regards to protein for bone and tissue growth. Creep feeding and supplemental feeding of lambs and kids are practiced to sustain high early growth and to attain early finishing weight.

Improved livestock production could be achieved through cultivation of high quality forage adapted to local conditions as well as feeding concentrate. Concentrate feeds promote rapid growth of goat, reduce methane and increase propionate production in rumen, thereby lowering energy losses and contributing to higher overall efficiency of utilization of dietary energy for body weight gain (Mandebvu and Galbraith, 1999). Therefore, tree foliage or forage based ruminant feeding with an appropriate level of concentrate may provide optimum nutrient balance to improve animal productivity. Existing feedstuffs in tropical countries often provide inadequate energy, protein, minerals and vitamins to support optimum animal productivity (Reed *et al*., 1990). Growing small ruminants supplemented with concentrates in addition to grazing in semi-arid regions of India (Karim *et al.*, 2007), is the prevailing kid production system; however their growth performance is not optimum. The forage based ruminant feeding with an appropriate level of concentrate may provide optimum nutrient balance to improve the animal productivity. Therefore, the present study was conducted to assess the weight gain on different roughage concentrate ratio and body conformational changes in goat kids to develop the prediction equations to have a computed idea regarding body weight gain based on the body measurements in kids fed different level of diets.

Materials and Methods

The experiment was conducted at goat farm, S.K.N. college of Agriculture, Jobner District Jaipur, (Rajasthan, India). Twenty seven goat kids were randomly allotted to 3 equal groups of 9 of each in Completely Randomized Design (CRD). Kids were penned in well-ventilated enclosures for the experiment. Three experimental composite feed mixtures (CFMs) were prepared by varying roughage to concentrate levels with dry Khejri leaves and barley grain in ratio of 80:20, 60:40 and 40:60 respectively, along with 2% mineral mixture and 1% common salt. The feeding trail of kids was continued for 90 days. The three CFMs was fed *ad-libitum* to kids of three groups individually. The amount of feed offered and the refusal was weighed for each animal to determine the feed intake. All animals had free access of clean fresh drinking water.

Feed samples were collected at weekly intervals and then pooled, mixed thoroughly for further analysis. These samples were analysed for dry matter (DM), crude protein (CP) and total ash according to AOAC (2000). Neutral detergent fiber (NDF), acid detergent fibre (ADF), cellulose, hemicelluloses and lignin

DOI 10.5455/ijlr.20171219124504

were analysed following the procedures of Van Soest *et al.* (1991). The growth trial lasted for 90 days in randomized block design during which feed intake was recorded daily. The body weight and body conformations viz. height, length, heart girth and punch girth of the kids were recorded for 2 consecutive days at fortnightly intervals before offering feed and water. The mean records of 2 days weight were used to determine the growth and body conformational changes. Pattern of growth and body conformations was calculated at fortnightly intervals.

The data on feed intake and feed efficiency ratio were subjected to test of significance among the treatments using least square analysis of variance (SPSS for windows release 16.0.0). The significant treatment means were compared by Duncan's multiple range tests. Fortnightly change in body weight and body conformation of individual kids was traced by fitting polynomial curves and the generated constants were subjected to analysis of variance to assess treatment difference. The pooled constants of 3 groups are presented in fig. 1 to show their growth and body size profile. Group-wise and overall prediction equations for body weight on the basis of body conformations were fitted using multiple linear regressions.

Results and Discussion

The kids of three groups were fed with varying level of barley (concentrate) along with Khejri dry leaves to have low, medium and high plan of nutrition and offered grinded barley at 20%, 40% and 60% of the diet respectively along with 2% mineral mixture and 1% common salt. The result pertaining to chemical composition of diets, growth performance, feed efficiency and body measurements of kids are as follows.

Table 1: Chemical compositions (%) of feed ingredients and diets

Attributes	Diets*			Major Ingredients	
	D_1	D_2	D_3	Khejri(*Prosopis cineraria*) leaves	Barley grain
Dry matter	97.91	97.88	97.83	97.95	97.82
Organic matter	90.85	92.1	93.6	89.5	96.55
Crude protein	13.54	13.18	12.99	14.97	12.07
Crude fat	3.22	2.75	2.52	3.4	2.24
NDF	37.63	33.7	32.2	39.31	27.02
ADF	26.09	20.25	15.08	29.27	5.82
Hemicellulose	11.54	13.45	16.92	10.04	21.18
Cellulose	11.03	9.38	7.28	12.19	5.18
Ash	9.87	7.7	6.55	10.49	3.44
Lignin	13.32	10.78	6.88	16.25	0.49
Total phenols	10.43	8.75	6.94	12.16	3.48
Total tannins	10.09	8.45	6.8	11.73	3.47
Condensed tannins	3.65	2.95	2.2	4.29	0.91

**Diets fed to kids contained Khejri (Prosopis cineraria) dry leaves : barley grain (grinded) in proportions, D_1, 80:20; D_2, 60:40 and D_3 40:60 respectively.*
Significant at the 5% level

DOI 10.5455/ijlr.20171219124504

Table 1 revealed that the chemical composition of both the feed ingredients (Khejri & Barley) and diets is quite different. The organic matter (OM) and crude protein (CP) contents were 89.50 and 14.97% in khejri leaves and 96.55 and 12.07% in barley grain. The OM and CP of diets were 90.85 and 13.54% in D_1, 92.10 and 13.18% in D_2 and 93.60, and 12.99% in D_3. Mann *et al.* (1980) and FFN (1991) reported slightly lower CP (14.34 and 13.8%) content in dry Khejri leaves. The neutral detergent fiber (NDF) and acid detergent fiber (ADF) contents were 39.31 and 29.27% in Khejri leaves and 27.02 and 5.82% in barley grain, 37.63 and 26.09% in D_1, 33.70 and 20.25% in D_2 and 32.20 and 15.08% in D_3. The similar data in Khejri leaves were also reported by Pal *et al*. (2014) in respect to OM (88.8%), CP (13.4%), NDF (43.1%), ADF (28.2%), lignin (13.5%), hemicelluloses (14.9%), and cellulose (14.7%). The tannins (9.1%) was higher than reported by Bhatt *et al* (2007); Kumar and Vaithiyanathan, (1990). The composition of Barley grain was found to be in similar in respect to ADF (5.8%) but a lower CP (13.5%) and higher NDF (18.1%) was reported in present study in comparison with NRC, (1985).

Table 2: Growth performance and feed efficiency of goat kids during post- weaning period (90 days feeding)

Attributes	Diets#			SEm±	P- value
	D_1	D_2	D_3		
Initial weight (kg)	9.50±3.350	9.34±1.720	10.20±2.261	0.474	0.75
Final weight (kg)	14.40±4.161	13.92±2.975	15.88±3.642	0.69	0.497
Total gain (kg)	3.45±0.961	3.08±1.069	3.93±1.199	0.211	0.27
Average daily gain (g/day)	38.39^{b}±10.6	34.32^{c}±11.882	43.70^{a}±13.322	2.344	<0.001
Total feed intake (kg)	53.02±1.632	50.97±0.430	51.46± 0.527	0.254	<0.001
Feed Efficiency ratio (kg feed/ kg gain)	15.34±5.495	16.50±7.408	13.08±4.171	1.139	0.282

 # Diets fed to kids contained Khejri (Prosopis cineraria) dry leaves: barley grain (grinded) in proportions, D1, 80:20; D_2, 60:40 and D_3 40:60 respectively; Significant at the 5% level

The growth performance and feed efficiency of kid presented in Table 2. The mean final body weight ranged from 13.92 (D_2) to15.88 kg (D_3) among the kids fed on three level of concentrate, which was not significantly different (P<0.05) in kids fed on high plane of concentrate compared to low and medium plan of concentrate. However, kids fed low, medium and high plane of concentrate had a non-significant difference in their final body weight, total gain and average daily gain. Total gain of 3.08 (D_2), 3.45 (D_1) and 3.93 kg (D_3) was found in 90 days growth experiment and average daily gain (ADG) of 34.32 (D_2), 38.39 (D_1) and 43.70g / day (D_3) was observed, which were also higher (P<0.05) in kid fed on high plane of concentrate (D_3). Das and Ghosh (2001) and Assefu *et al.* (2012) reported that ADG increased significantly with the increasing levels of concentrate feed supplementation in kids and lambs. Yadav *et al.* (2009) reported higher live weight gain (9.12 kg) in kids supplemented with concentrates 150 g along with 10 g mineral mixture. Kharkar *et al.* (2014) was reported the body weights at birth, 3, 6, 9, and 12 months of age as 2.46, 9.22, 15.41, 18.33 and 22.64 kg in the male Berari goats. Nubian male goat kids

 DOI 10.5455/ijlr.20171219124504

had average daily gain between 56 and 80 g, and achieved live weights 7.78, 13.3, 17.4 and 22.4 kg respectively at 3, 6, 9 and 12 months of age (Gubartella *et al.*, 2002). The increase in concentrate levels have not shown significant improvement in final body weight ($P<0.05$), total gain ($P<0.05$) and ADG ($P<0.05$) of kids in present study.

Plan of nutrition affects the roughage and concentrate intake, while total feed intake remained similar among three levels of nutrition. During 90 days of growth experiment kid maintained at high plane of concentrate had low ($P<0.05$) roughage intake. Concentrate intake was significantly ($P<0.05$) different among three dietary levels. The roughage intake reduced while concentrate intake increased with increased levels of concentrate feeding. Das and Ghosh (2007) conducted an experiment and supplemented concentrate (maize 35%, mustard cake 32%, rice bran 30%, mineral mixture 2% and common salt 1%) at approximately 2% of BW. However, 25 and 50% of the concentrate was replaced with jackfruit leaves for groups II and III, respectively. ADG and DMI/kg gain were not adversely affected when the level of replacement was restricted to 25%; however, at the 50% of replacement both parameters were adversely affected ($P < 0.05$). Papi *et al.* (2011) concluded that the diets containing of alfalfa hay-to-concentrate ratios (DM basis) of 70:30, 50:50, 30:70 and 10:90, with metabolizable energy (ME) 9.12. 9.96, 10.67, and 11.34MJ/kg DM and crude protein (CP) 14.3,15.2,16.1 and 17.4% respectively have decreased dry matter intake and feed conversion ratio (FCR) linearly ($P<0.001$) as concentrate level increased in the diet. Dutt *et al.* (2009) was reported that kids fed high level of concentrate had Roughage: Concentrate (R: C) intake approximately 50:50, which recommended suitable to optimize growth of kids for better economic returns.

The feed consumption for per kg gain was significantly ($P<0.05$) high in kids fed 40% concentrate. Kids consumed 16.50 kg (D_2) feed for each kg gain, while 15.34 (D_1) and 13.08 kg (D_3) feed was consumed for every kg of gain. Feed efficiency of kids improved ($P<0.05$) with decreasing concentrate level (Table 2). Improved feed conversion efficiency (%) in Jamunapari kids was reported between complete feed (CP 12% and TDN 60%) and total mix ration with varying level of energy and protein (Sing *et al.*, 2010). Although, energy dense diets reduced intake during growing phase, however supplementation of high-energy diets improved growth and feed efficiency in lambs (Bhatt *et al.*, 2011). Feeding of concentrates from 0.7 to 2.1% of live weight, the performance of growing lambs was improved linearly, whereas higher concentrate feeding reduced feed intake and improved feed conversion efficiency (Tripathi *et al.*, 2007). The growth of kids in present study is within the reported range of variation for kids of early growing phase (Dutta *et al.*, 2009; Dutta and Singh, 2009; Das and Ghosh, 2007). The body conformation parameters, viz. height, length, heart girth and punch girth were almost similar among the three groups of kid initially (Table 3). At the end of experimental period all parameters were higher ($P<0.05$) in D_3 as compared to D_1 and D_2 kids except the body length which was higher in D_1.

 DOI 10.5455/ijlr.20171219124504

Table 3: Changes in body conformation (cm) of goat kids during post- weaning period (90 days feeding)

Attributes	Diets#			SEm±	P- value
	D_1	D_2	D_3		
1. Height					
Initial	49.00±4.632	49.58±2.328	49.66±2.701	0.626	0.901
Finishing	56.63±5.651	57.44±1.999	57.77±2.492	0.699	0.804
2. Length					
Initial	40.80±3.712	41.191.451	40.91±1.166	0.444	0.939
Finishing	47.63±4.309	47.47±1.877	47.41±1.916	0.542	0.986
3.Heart girth					
Initial	49.55±4.125	49.75±1.611	50.27±1.756	0.512	0.848
Finishing	57.94±5.338	56.91±2.616	58.72±2.964	0.723	0.612
4. Punch girth					
Initial	52.50±5.154	52.50±2.165	54.44±2.732	0.688	0.428
Finishing	64.02±0.847	63.25±3.826	65.69±3.885	0.847	0.503

 # Diets fed to kids contained Khejri (Prosopis cineraria) dry leaves: barley grain (grinded) in proportions, D_1, 80:20; D_2, 60:40 and D_3 40:60 respectively; Significant at the 5% level

At finishing, the height, heart girth and punch girth were higher in D_3 (57.77, 58.72 and 65.69 cm) followed by D_1 (56.63, 57.94 and 64.02 cm) and D_2 (57.44, 56.91 and 63.25cm) kids, whereas, the length was higher in D_1 (47.63cm) followed by D_2 (47.47 cm) and D_3 (47.41cm) respectively. Mahmud *et al.* (2014) was reported the proper measurement of live body weight of the animals. The values observed for body height, heart girth and punch girth at 3 month and 5 month of age in present study are almost similar to those observed in intensively fed Berari goats (Kharkar *et al.*, 2014).The present value of body length is in agreement with the finding of Mondal *et al*. (2015) in indigenous sheep.

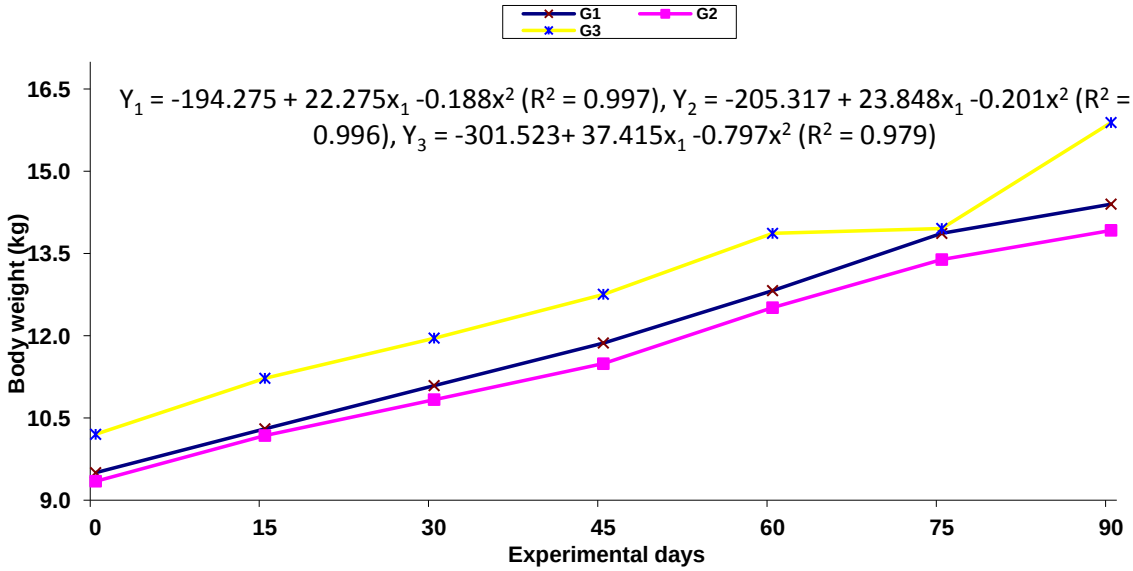

Fig. 1: Body weight changes of experimental kids (during feeding experiment)

DOI 10.5455/ijlr.20171219124504

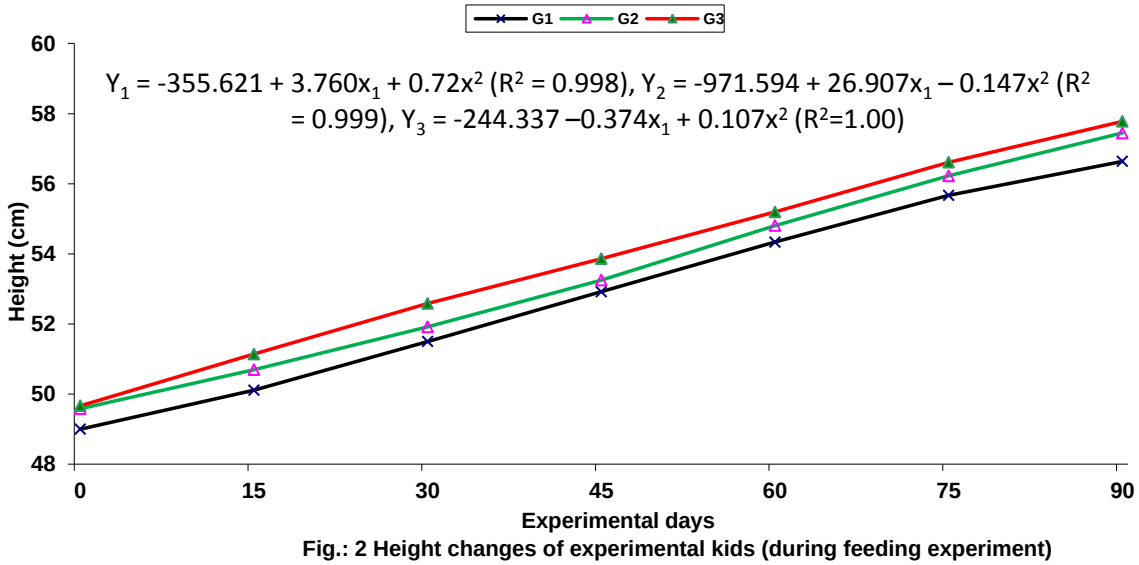

Fig.: 2 Height changes of experimental kids (during feeding experiment)

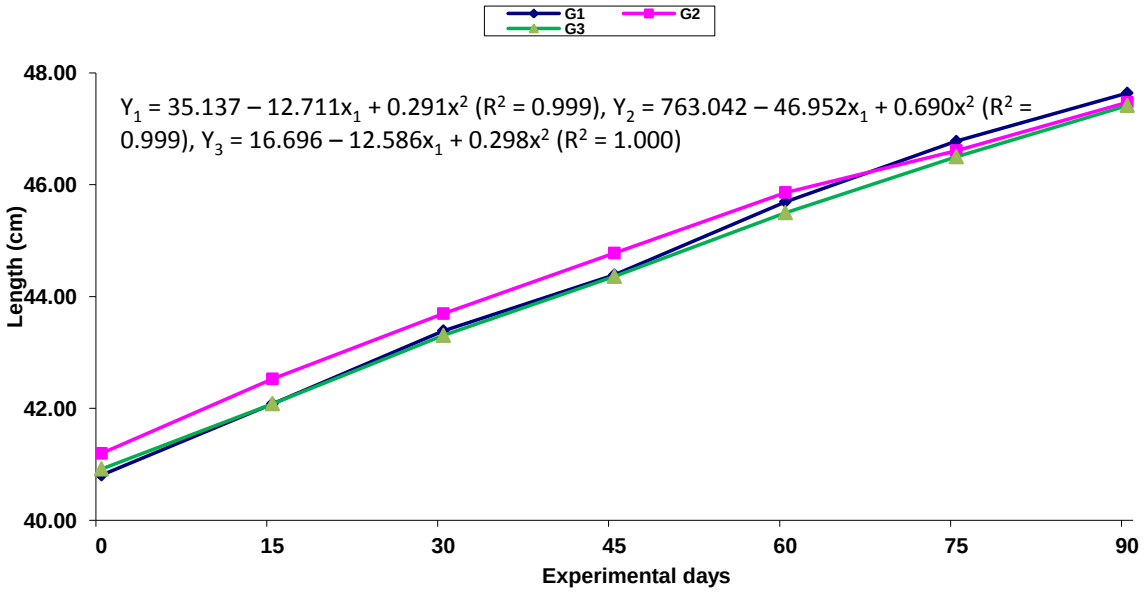

Fig. 3 Length changes of experimental kids (during feeding experiment)

The growth pattern of kids is presented in Fig.1. The growth rate was relatively better in kids fed complete feed mixture (CFMs) having 60% of concentrate (D_3) than 20% (D_1) and 40% (D_2). The kids of D_3 groups make a difference in body weight gain than the other groups during adaptation period, which was maintained up to end of the trail. The fortnightly changes in body height, length, heart girth and punch girth are presented in Figs. 2, 3, 4 and 5 respectively. Like body weight, the body conformation also increased with the advancement in age and was relatively higher in kids fed 60% concentrate than

DOI 10.5455/ijlr.20171219124504

other groups. The increment in body weight in D_1, D_2 and D_3 was not significant but dissimilar after 90 days of feeding experiment. The D_1 kids showed lower ($P<0.05$) improvement in body height as compared to D_2 and D_3 kids. However, the height of D_3 kids increased more rapidly ($P<0.05$) during 90 days of experimental period (Fig. 2). The body length was higher ($P<0.01$) in D_2 kids (Fig. 3). The heart girth (Fig. 4) and punch girth (Fig. 5) of D_3, D_1 and D_2 kids increased ($P<0.05$) progressively throughout the experimental period.

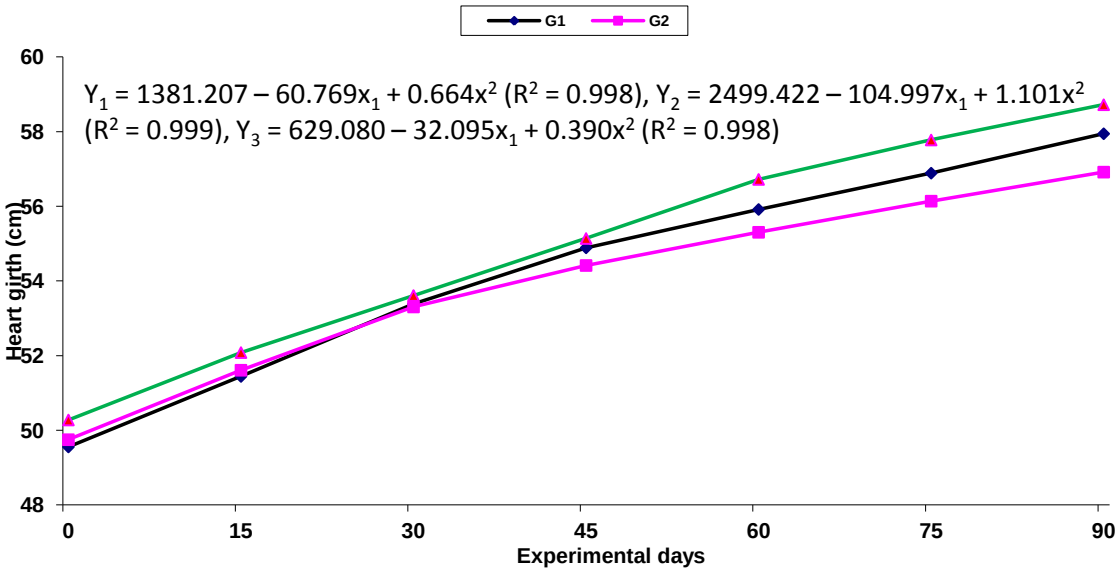

Fig. 4 : Heart girth changes of experiment kids (during feeding experiment)

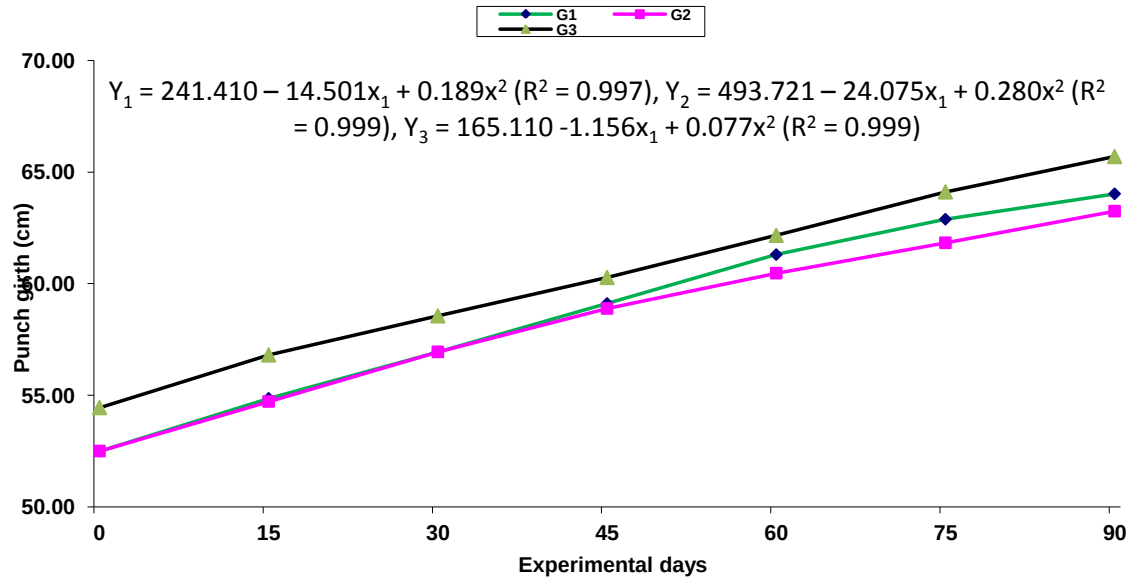

Fig. 5: Punch grith changes of experimental kids (during feeding experiment)

DOI 10.5455/ijlr.20171219124504

However, the D_2 kids showed poor improvement in heart girth and punch girth during experimental period. Mondal *et al.* (2015) reported lower values for these traits in Changathangi X Non descript goats in Kargil. The present findings of height, heart girth and punch girth are similar to the finding of Kharkar *et al.* (2014) in Berari goats of native tract. The lower average values for heart girth and punch girth in Kilakarsal sheep was reported by Ravimurugan *et al.* (2013).

Table 4: Constants for predicting the body weight based on body conformations from birth to 150 days of age

Groups	Regression coefficients						
	b_0 (Intercept)	**b_1 (Height, cm)**	**b_2 (Heart girth, cm)**	**b_3 (Length, cm)**	**b_4 (Paunch girth, cm)**	**R^2 x 100**	**Level of significance**
G_1	-24.120±2.905	0.254 ±0.180	0.127±0.229	-0.070 ±0.177	0.344 ±0.164	97.680	<0.001
G_2	-27.134 ±4.922	0.016 ±0.083	0.037±0.178	0.145 ±0.160	0.546±0.149	97.676	<0.001
G_3	-52.402 ±25.418	0.411 ±0.341	0.858 ±0.596	0.146 ±0.552	-0.113 ±0.393	73.811	<0.001
Overall	**-26.241±3.848**	**0.242±0.118**	**0.341±0.194**	**-0.137±0.138**	**0.246±0.133**	**84.477**	**<0.001**

Significant at the 5% level

The constants for predicting the weight using body height, length, heart girth and punch girth are given Table 4. The group-wise regression coefficient (R^2) values ranged from 73.81 (D_3) to 97.68% (D_1), where as the overall R^2 was 84.47%. These regression coefficients for predicting the body weight using body conformations are comparable to those observed in intensively fed Malpura lambs (Chaturvedi *et al.*, 2003). It is obvious from regression coefficient values that body height, length, heart girth and punch girth together can be used effectively for predicting the body weight. Further, the estimated values of body weight between groups are dissimilar to those observed values, and equation may be used for body weight calculation of intensively fed kids with 84.47% confidence. Ravimurugan *et al.* (2013) was also found R^2=0.783 in Kilakarsal sheep.

Conclusion

It may be concluded that, inclusion of concentrate feeds up to 60% in the Khejari leaves based diet resulted in decreased total feed intake, improved plane of nutrition, average daily gain and feed conversion efficiency. The body confirmations were also improved. Analysis of regression coefficient values suggested that body height, length, heart girth and punch girth together can be used effectively for predicting the body weight with 84.47% confidence.

Acknowledgements

The authors are thankful to Dr. M. K. Tripathi and Dr. Ramkesh Meena for their support provided during chemical analysis at CIRG, Makhdoom Mathura UP.

DOI 10.5455/ijlr.20171219124504

References

1. AOAC, 2000. *Official Methods of Analysis of the AOAC international. 17th edition,* Vol. 1 and 2, *AOAC International, Gaitherburg, MD,* USA.
2. Assefu, G. 2012. Comparative feedlot performance of Washra and Horro sheep fed different roughage to concentrate ratio. *MSc Thesis submitted* to Haramaya University.
3. Bhatta, R., Vaithiyanathan, S., Singh, N.P. and Verma, D.L., 2007. Effect of feeding complete diets containing graded levels of *prosopis cineraria* leaves on feed intake, nutrient utilisation and rumen fermentation in lambs and kids. *Small Ruminant Research,* 67: 75-83.
4. Bhatt, R.S., Soren, N.M., Tripathi, M.K. and Karim, S.A. 2011. Effects of different levels of coconut oil supplementation on performance, digestibility, rument fermentation and carcass traits of Malpura lambs. *Animal Feed Science and Technology,* 164: 29-37.
5. Chaturvedi, O.H., Bhatta, R., Santra, A. Mishra, A.S., and Mann, J.S. 2003. Effect of supplementary feeding of concentrate on nutrient utilization and production performance of ewes grazing on community rangeland during late gestation and early lactation. *Asian-Australasian Journal of Animal Sciences,* 16: 983-987.
6. Das, A. and Ghosh, S.K. 2001. Nutritive value of jackfruit tree leaves for goats. *Indian Journal of Animal Nutrition,* 18: 185-186.
7. Das, A. and Ghosh, S.K. 2007. Effect of partial replacement of concentrates with jackfruit (*Artocarpus heterophyllus*) leaves on growth performance of kids grazing on native pasture of Tripura. *Indian Small Ruminant Research,* 67: 36–44.
8. Dutta, T.K., Agnihtori, M.K., Sahoo, P.K., Rajkumar, V. and Das, A.K. 2009. Effect of different protein and energy ratio in pluse by-product and residue based pelleted feed on growth, rumen fermentation, carcass and sausage quality in Barbari kids. *Small Ruminant Research,* 85: 34-41.
9. Dutta, T.K. and Singh, N.P. 2009. Voluntary feed intake, growth, rumen fermentation and nutrient utilization in different breed of Indian goats reared under intensive system. *Indian Journal of Animal Sciences,* 79*:* 311-315.
10. F'FN. 1991. Spotlight on species: *Prosopis. cineraria. Farm Forestry News,* Vol. 4, No. 3.
11. Gubartella, N. and Elkhidir, O.A. 2002. Production and reproduction traits of a flock of Sudanese Nubian goats fed on molasses or sorghum based diets Sudan. *Journal of Animal Production,* 15: 39-48.
12. Karim, S.A., Tripathi, M.K. and Singh, V.K. 2007. Effect of varying levels of concentrate supplementation on growth performance and carcass trait of finisher lambs. *Livestock Research for Rural Development,* 19(11): 1-16.
13. Kharkar, k., Kuralkar, S.V. and Kuralkar, P. 2014. Growth, production and reproduction performance of Berari goats in their native tract. *Indian Journal of Small Ruminants,* 20(1): 12-15.
14. Kharkar, k., Kuralkar, S. V., Kuralkar, P., Bankar, P.S.,Chopade, M.M. and Hadole, K.H. 2014. Factors affecting body weight and morphometric characters of Berari Goats. *Indian Journal of Small Ruminants,* 20 (2): 112-114.
15. Kumar, R. and Vaithiyanathan, S. 1990. Occurrence, nutritional significance and effects on animal productivity of tannin in tree leaves. *Animal Feed Science and Technology,* 30: 21 – 38.
16. Mahmud, M.A., Shaba, P. and Zubairu, U.Y. 2014. Live body weight estimation in small ruminants. A review *Small Ruminant Research* Vol.2 No.2.
17. Mandebvu, P. and Galbraith, H. 1999. Effect of sodium bicarbonate supplementation and variation in the proportion of barley and sugar beet pulp on growth performance and rumen, blood and carcass characteristics in young entire lambs. *Animal Feed Science and Technology,* 82: 37-49.
18. Mann, H.S. and Shankarnarayan, K. A. 1980. The role of *Prosopis cineraria* in an agropastoral system in Western Rajasthan. *In Browse in Africa,* edited by HN LeHouerou, *International Livestock Centre for Africa, Addis Ababa, Ethiopia.* p. 437-442.
19. Mondal, G., Kakati, B. K. and Roy, B. 2015. Performance of Changathangi X Non descript goats in Kargil (Ladakh). *Indian Journal of Small Ruminants,* 21(1): 20-23.

 DOI 10.5455/ijlr.20171219124504

20. NRC. 1985. Nutrient Requirements of Domestic Animals. *Nutrient Requirement of Sheep (6th Ed.).* Washington, DC. National Academy Press.
21. Pal, K., Patra, A.K., Sahoo, A. and Mandal, G.P. 2014. Effect of nitrate and fumarate in *Prosopis cineraria* and *Ailanthus excelsa* leaves based on methane production and fermentation. *Small Ruminant Research* (in press).
22. Papi, N., Mostafa-Tehrania, A., Amanloub, H. and Memarianb, M. 2011. Effects of dietary forage-to-concentrate ratios on performance and carcass characteristics of growing fat-tailed lambs. *Animal Feed Science and Technology*, 163: 93-98.
23. Ravimurugan, T., Thiruvenkadan, A.K., Sudhakar, K., Panneerselvam, S. and Elango, A. 2013. The estimation of body weight from body measurements in Kilakarsal Sheep of Tamil Nadu, India. *Iranian Journal of Applied Animal Science*, 3(2): 357-360.
24. Reed, J. D., Soller, Hand. and Woodward, A. 1990 Fodder tree and stover diets for intake, growth, digestibility and effect of phenolice on nitrogen utilisation. *Animal science and Technology*, 30: 39-50.
25. Singh, S., Kundu,S .S., Negi, A. S. and Pachouri, V. C. 2010. Performance of growing kids on rations with Lablab (*Lablab purpureus*) grains as protein source. *Livestock Research For Rural Development*, 22 (5).
26. Tripathi, M.K., Chaturvedi, O.H., Karim, S.A., Singh, V.K. and Sisodiya, S.L. 2007. Effect of different levels of concentrate allowances on rumen fluid P^H, nutrient digestion, nitrogen retention and growth performance of weaner lambs. *Small Ruminant Research*, 72:178-186.
27. Van Soest, P.J., Robertson, J.B. and Lewis, B.A. 1991. Methods for dietary fiber, neutral detergent fiber and non-strach polysaccharides in relation to animal nutrition. Symposium: Carbohydrate methodology, metabolism and nutritional implications in dairy cattle. *Journal Dairy Science*, 74:3583-3597.
28. Yadav, C.M., Khan, P.M., Panwar, P., Jeenagar, K.L., Lakhawat, S.S. and Nagar, K.C. 2009. Effect of concentrate and mineral mixture supplementation on growth performance of growing goats. *Indian Journal of Small Ruminants*, 16:109-110.

DOI 10.5455/ijlr.20171219124504