



## Intake, growth performance and worm load in goat kids maintained on conventional soiled or raised wooden slatted floor

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### ABSTRACT

This experiment investigated the effect of raised wooden slatted floor (SLF) over conventional soil floor (SOF) on intake, growth, feed conversion efficiency (FCE) and worm load in goat kids under intensive stall system of feeding in semi-arid regions of India. Thirty post-weaned (4 months old) Jakhrana kids (10.2±0.09 kg) were randomly divided into two equal groups and assigned either to SLF or SOF group. Kids were reared up to 12 months of age, fed *ad lib.* roughage, green fodder and concentrate to meet nutrient requirements for optimum growth. Total gain and average daily gain (ADG) were similar between kids of SLF and SOF groups at 12 months. The ADG was 131.7 g in SLF and 122.0 g in SOF group. Dry matter intake per kg gain in SLF kids was 7.46 kg as compared to 7.72 kg in SOF kids with the overall feed efficiency of 13.40 and 12.95%, respectively were not different between two kid groups. The intake of organic matter, metabolizable energy and crude protein were similar between kid groups. The worm load in terms of coccidial oocysts, cestodes and nematodes eggs in faecal samples of SLF kids was significantly lower than SOF kids. The mean geometric faecal oocysts (GFOC) in SLF kids during first sampling period (March) was 2.5 times lower than SOF kids that reduced significantly on subsequent sampling periods. However, the GFOC was rather increased in SOF kids during second sampling and subsequently reduced during third and fourth sampling periods. The results indicated that the raised wooden slatted floor was effective in controlling coccidiosis, however, feed intake, growth performance and feed efficiency were not changed in kids reared under intensive system of production in semi-arid regions.

**Key words:** Feed efficiency, Growth, Kids, Semi-arid areas, Slatted wooden floor, Worm load

Goat production is an important sector of the agro-economy in India and in Indian sub-continent. Low capital investments and higher economic returns have been the unique features of small and marginal goat production systems (Devendra 2013). Goat products (milk and meat) have provided health promoting constituents to health conscious consumers and thus contribution of goats is increasing to the rising demand of animal products. The increased demand of animal products with health promoting attributes is leading to a gradual shift from small and extensive goat production system to the medium and large with semi-intensive and intensive system of rearing for the goat entrepreneurship development in India and other developing countries. Accordingly, the shelter requirements may vary from merely protecting goats from predators and extreme weather conditions under extensive system of production to rearing goats economically with the maximum efficiency of utilising resources (shelter space, feed, manpower etc.) for intensive goat production system. The floor, where goats are confined for rest, is one of the main component of animal shelters which provides comfort and welfare to the animals and thus effect productivity. The soil

floor is the most common flooring system used for goat production in India and Asian sub-continent, which requires daily cleaning to keep the floor clean and dry. Soil flooring system not only requires more labour for cleaning of bedding but this system of flooring attracts parasitic infections leading to higher magnitude of gastro-intestinal parasitism. Whereas slatted/raised floor made of bamboo is used in goat houses in the high humid and hilly region of India, which does not requires daily cleaning. Moreover, shelter management is known to reduce parasitic loads (Tahir *et al.* 2011) and improves production in terms of growth and milk yield in goats through moderation of environmental factors.

It is known that parasitic infection is closely related to management practices. The change in goat rearing system from extensive and semi-intensive to intensive may precipitate coccidiosis (Schillhorn van Veen 1986) due to the survival of oocysts even in adverse environmental condition and serve as a source of infection to the next flock of animals. Coccidiosis mainly occurs clinically in intensive rearing system, whereas in extensive and semi-intensive system of rearing, clinical coccidiosis does not occur because gradual exposure of young animals to the parasites helps them in gaining effective immunity as age advances.

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In minimizing the cost of goat production, the slatted flooring has been recommended (Kumari *et al.* 2013, Bharambe and and Shinde 2014) to reduce the labour cost for cleaning and having a lower level of parasitic load in intensive system of goat production. Limited studies have been carried out using slatted/raised flooring, which were not conclusive. Some studies (Kumari *et al.* 2013, Bharambe and Shinde 2014) reported improved performance (Catchpole *et al.* 1993, Bhakat and Nagpaul 2009, Tahir *et al.* 2011, Bharambe and Shinde 2014), while other (Graunke *et al.* 2011, Tiruvenkadan *et al.* 2009) have not demonstrated any benefits of slatted floor. Studies demonstrating improvement in performance due to slatted floor were imminent from humid and high rainfall areas, whereas influence of slatted floor on goats in semi-arid dry areas has not reported. Therefore, present study aimed to assess the effect of wooden slatted floor on performance and worm load in post weaned goat kids in semi-arid region of India.

#### MATERIALS AND METHODS

*Location of the study:* Study was conducted at the experimental shed of the Physiology, Reproduction and Shelter Management Division of Central Institute for Research on Goats, Makhdoom (27°10'N latitude, 78°02'E longitude, 169 m above sea level altitude), Farah, Mathura, Uttar Pradesh, India which falls under semi-arid region of India. The mean minimum, maximum, daily temperature, dry and wet bulb temperature, relative humidity, vapour pressure, total rainfall, total sunshine during experimental period were 20.78, 35.03, 27.90, 30.36, 22.40°C, 53.37%, 17.27 mm Hg, 379.40 mm, 1974.10 h, respectively.

*Experimental animals, housing, feeding and management:* Thirty post weaned Jakhrana male kids (10.2 ± 0.09 kg) were selected considering age, body weight and type of birth from general flock and were randomly divided into two equal groups of 15 each, which were assigned to either wooden slatted floor (SLF) or soil floor (SOF) in goat shelters. The kids of each group were reared separately in enclosures with the floor area of 30 m<sup>2</sup> from 4 to 12

months of age. Slatted/raised floor (15' × 20' size) was constructed at height of 3.75 feet from ground using Mirandi wooden slats of 2" width and 1" thick, having 1.5 cm space between the slats. The experimental protocol was approved by the Institute Animal Ethics Committee. Kids were offered *ad lib.* roughage (gram straw-*Cicer arietinum*, Arhar straw-*Cajanus cajan*), concentrate and green fodder (cow pea-*Vigna sinensis*, berseem-*Trifolium alexandrinum*), and drinking water was made available at all the times.

*Growth and feed intake:* Kids were allowed three weeks adaptation to new floor, housing and feeding arrangement, thereafter, daily records of feed intake were maintained. Live weight was recorded at weekly intervals for two consecutive days using electronic weighing scale (Digicontrols Northern Pvt. Ltd., Noida, India), mean of two observations was considered for estimation of live weight gain (LWG) and average daily gain (ADG).

*Chemical analysis of feed and nutrients intake:* Samples of roughage, concentrate and green fodder were drawn at fortnightly intervals and dry matter was estimated by drying at 70°C till constant weight, thereafter, samples of respective feedstuff were pooled and preserved for chemical analysis. The AOAC (1995) analytical procedures were used for organic matter (OM) determination by ashing at 550°C for 4 h, crude protein estimation by a kjeldahl technique (N×6.25) and total lipids were estimated using solvent extraction procedure with soxhlet apparatus, whereas neutral detergent fibre (NDF), acid detergent fibre (ADF) and lignin were determined by a sequential procedure using same sample as per the procedure of Van Soest *et al.* (1991). The dry matter and nutrients intake was calculated by adding intake from all three feedstuffs, whereas metabolizable energy (ME) intake was calculated as per ARC (1990) standard (MEI (MJ) = OMI (g) × 19 × 0.82).

*Worm load:* Faecal samples were collected at every 2 month interval viz., I<sup>st</sup> sampling (March), II<sup>nd</sup> (June), III<sup>rd</sup> (August), IV<sup>th</sup> sampling (October) from all the kids to have worm load across seasons. Faecal eggs/oocysts counts were carried out on freshly collected faecal samples using centrifugal floatation in saturated salt (NaCl) solution and modified McMaster technique (MAFF 1977, Hansen and Perry 1994), which were expressed as eggs/oocysts per gram (EPG/OPG) of faeces.

*Statistical analysis:* Data were subjected to the statistical analyses using SPSS base 16.0 software. Data of growth, feed intake, feed conversion efficiency and nutrient intake under two floors were analysed using independent t-test. The data on faecal egg/oocyst counts were transformed logarithmically and the resulting transformed variables were tested for normality before analysis. The most appropriate transformation log<sub>e</sub> (FEC+100) was used to correct for heterogeneity of variance and to produce approximately normally distributed data. The results were back transformed by taking anti-logarithms of means, subtracting 100 and presented as geometric means (GFEC) (Yadav *et al.* 2006). The GFEC data were subjected to GLM procedure of SPSS to find out significant difference between two

Table 1. Composition of experimental feedstuffs fed to kids

	Concentrate*	Green fodder	Dry fodder
Dry matter (DM)%	94.89	20.54	95.11
<i>Constituents % in DM</i>			
Organic matter	92.39	87.33	89.29
Crude protein	18.17	22.34	7.69
Total lipids	2.93	2.60	1.70
Neutral detergent fibre	27.89	49.65	57.82
Acid detergent fibre	9.20	35.56	45.94
Hemicellulose	18.68	14.09	10.37
Cellulose	6.18	17.18	23.28
Lignin	1.99	18.83	11.59

\*Contained 20 Maize grain, 20 barley grain, 15 wheat bran, 14 deoiled rice bran, 6 groundnut cake, 5 mustard cake, 5 soybean meal, 5 guar korma, 7 molasses, 2 mineral mixture and 1 salt part.

floors, 3 parasitic types and 4 sampling periods. The data are presented as mean±SD and significance based on  $P<0.05$ .

## RESULTS AND DISCUSSION

The chemical composition of feedstuffs (Table 1) in terms of OM, CP, total lipids, NDF, ADF, hemicellulose, cellulose and lignin in concentrate, dry fodders and green fodder were comparable to those reported by Dutta *et al.* (2003) and Tripathi *et al.* (2014). However, nutrient contents of feedstuffs were suitable to support the requirements of growing kids as per ICAR recommendations (ICAR 2013).

Initial and final live weight and total live weight gain was similar between kids of SLF and SOF (Table 2). The kids of SLF group had an ADG of 131.7 g, which was 8% higher than the ADG (121.96 g) of SOF group, and ADG were also similar between groups. The growth trend over the period showed superiority of SLF over conventional SOF in growing post weaned kids. Feed DM intake and feed efficiency were similar between SLF and SOF groups. The kids in present study consumed 7.5 to 7.7 kg feed for each kg live weight gain, showing that the feedstuffs were of high quality in meeting the nutrient need of growing kids.

Similarly, ME and CP intakes did not differ between two kid groups and the kids consumed 13.3 to 13.8 MJ ME and 156 to 163 g CP for having an ADG between 122 to 132 g. The similar growth performance of kids between SLF and SOF indicated that the provision of floor did not effect growth attributes in dry semi-arid regions. This may be due to the *ad lib.* feeding in stallfed conditions wherein the positive effect of surplus nutrients might have nullified the effect of floor on weight gain in kids. Similar to present findings, Thiruvankadan *et al.* (2009) also reported that elevated slatted floor did not have any significant effect on growth rate as compared to mud floor in post weaned Tellichery kids under intensive management system. Similarly, effect of floor on production parameters such as live weight, feed intake and carcass quality was not observed by previous workers (Smit and Daamen 1992,

Lowe *et al.* 2001). Contrary to these, Oliveira *et al.* (1982) and Kumari *et al.* (2013) reported improved performance of kids on ground floor system of housing, whereas, Bhakat and Nagpaul (2005) and Lupton *et al.* (2008) observed improved performance on raised slatted floor. Studies reporting improved performance of kids on raised floors was attributed to higher nutrient intake because raised floor improved feed intake in kids (Bharambe and Shinde 2014). Similar feed intake between SLF and SOF kids corroborates with the findings of Graunke *et al.* (2011) and Rahman and Nagpaul (2013) who also observed similar feed intake and feed efficiency on concrete slats, synthetic rubber slats on aluminium profiles and slotted rubber mats on concrete slats in fully slatted floor pens. Since, feed dry matter and nutrient intakes were similar and kids were raised on a high plane of nutrition, therefore, differences in growth performance between the two floor types were not observed in present study. The ADG of kids was quite higher in comparison of traditional kid production system, due to *ad lib.* feeding, which provided optimum nutrient intake to support desired growth.

The worm load in terms of mean EPG/OPG of kids during four periods is presented in Table 3. The overall mean geometric faecal egg count (GFEC) in SLF kids was 1,696 which was significantly ( $P<0.001$ ) lower than the GFEC in SOF kids irrespective of sampling periods and type of worms. The mean GFEC for coccidial oocysts, cestodes and nematodes were also significantly ( $P<0.001$ ) lower in kids of SLF group. The mean GFOC (coccidia) in SLF kids during first sampling period (March) was 10,320 which was significantly lower ( $P<0.001$ ) than the SOF kids (25,907). The mean coccidial load in kids of SLF was significantly lower on subsequent sampling periods, whereas, the GFOC increased among kids reared on SOF (28,067) during second sampling, which were subsequently reduced during third and fourth sampling periods, but coccidial load was significantly higher ( $P<0.001$ ) in SOF kids in all four sampling periods than in SLF kids. Although, the GFOC in SLF kids increased slightly during fourth sampling but GFOC doubled in SOF kids during the same period. Kids of both the groups showed considerable level of cestode infection during first sampling period, though the GFEC was significantly lower ( $P<0.001$ ) in SLF kids than the SOF kids. Upon deworming, no cestode eggs appeared in subsequent sampling periods. There was no nematode eggs in the faeces of experimental kids irrespective of the sampling periods and floors, except, the kids reared on SOF had nematode eggs (GFEC-853 and 627) in the faeces during third and fourth sampling periods.

During the first sampling period (March), the worm and coccidial load was present considerably in the faecal samples of kids reared on both type of the floors, which might be due to housing in shared enclosures before the start of the experiment and absence of deworming before commencing the experiment. The coccidial load in SOF kids increased considerably during second sampling (June) as that of first sampling (March). On the contrary, the

Table 2. Effect of floor type on growth, feed intake, feed conversion efficiency and nutrient intake in kids

Attribute	Slatted floor	Soil floor	P Value
Initial weight (kg)	11.9±2.01	12.11±1.69	0.428
Final weight (kg)	43.38±4.83	41.26±3.05	0.124
Live weight gain (kg)	31.48±3.63	29.15±2.89	0.453
Average daily gain (g)	131.71±15.2	121.96±12.08	0.455
Feed DMI/kid (kg)	234.96±27.12	225.05±22.28	0.566
Feed efficiency (kg feed DMI/kg Gain)	7.46±0.98	7.72±1.04	0.387
Percent (%) nutrient intake	13.4±0.28	12.95±0.19	0.322
Organic matter intake (g/day)	888.24±102.54	850.75±84.24	0.546
ME intake/day (MJ)	13.84±1.6	13.25±1.31	0.546
CP intake (g/day)	163.1±18.83	156.21±15.47	0.546

significant reduction ( $P<0.001$ ) of coccidial load in SLF kids during second vis-à-vis first sampling indicated that the slatted type elevated flooring reduced the coccidial load in kids. Further, in the SLF kids shed, the infection upon administration of anti-coccidial, could not pick up from the soil again due to the flooring type. Almost no coccidial load in SLF kids during third and fourth sampling also confirms

Table 3. Mean±SD for logarithmic faecal oocyst/egg count\* (LFOC/ LFEC)  $\{\log_e (FOC \text{ or } FEC+100)\}$  of Jakhrana kids under slatted vs soil floor at 4 sampling periods

Type	Sampling periods				Mean
	First (March)	Second (June)	Third (August)	Fourth (October)	
<i>Slatted floor</i>					
Coccidia	4.96±0.34 (10,320)	4.93±0.04 (7,987)	4.62±0.01 (213)	4.62±0.01 (347)	4.78±0.24 (4,717)
Tape worms	4.67±0.02 (1,480)	4.61±0.00 (0)	4.61±0.00 (0)	4.61±0.00 (0)	4.63±0.05 (370)
Bursate	4.61±0.00 (0)	4.61±0.00 (0)	4.61±0.00 (0)	4.61±0.00 (0)	4.61±0.00 (0)
Mean	4.75±0.25 (3,933)	4.72±0.17 (2,622)	4.61±0.01 (71)	4.61±0.01 (115)	4.67±0.16 (1,696)
<i>Soil floor</i>					
Coccidia	5.23±0.15 (25,907)	5.43±0.08 (28,067)	4.72±0.02 (2,480)	4.82±0.03 (4,947)	5.05±0.45 (15,350)
Tape worms	4.74±0.06 (3,533)	4.61±0.00 (0)	4.61±0.00 (0)	4.61±0.00 (0)	4.64±0.13 (883)
Bursate	4.61±0.00 (0)	4.61±0.00 (0)	4.65±0.01 (853)	4.61±0.00 (627)	4.62±0.04 (370)
Mean	4.86±0.45 (9,813)	4.88±0.43 (9,356)	4.66±0.06 (1,111)	4.69±0.12 (1,858)	4.77±0.33 (5,534)
<i>Overall</i>					
Coccidia	5.09±0.50 (18,100)	5.18±0.35 (18,027)	4.67±0.07 (1,347)	4.72±0.13 (2,647)	4.92±0.38 <sup>a</sup> (10,033)
Tape worms	4.71±0.18 (2,507)	4.61±0.00 (0)	4.61±0.00 (0)	4.61±0.00 (0)	4.63±0.10 <sup>b</sup> (627)
Bursate	4.61±0.00 (0)	4.63±0.04 (0)	4.63±0.04 (427)	4.62±0.03 (313)	4.62±0.03 <sup>b</sup> (185)
Mean	4.80±0.37 <sup>a</sup> (6,873)	4.64±0.04 <sup>a</sup> (6,009)	4.64±0.05 <sup>b</sup> (591)	4.65±0.09 <sup>b</sup> (987)	4.72±0.27 (3,615)

\*Units eggs/g. Value in parenthesis indicates the geometric faecal oocyst/egg count (GFOC/GFEC). P value: Floor ( $P<0.001$ ); Sampling periods ( $P<0.001$ ); Type of parasitic oocysts/eggs ( $P<0.001$ ); Type × Floor ( $P<0.001$ ); Type × Sampling periods ( $P<0.001$ ); Type of parasitic oocysts/eggs ( $P<0.001$ ).

the absence of picking up the infection from the soil. The current findings were in agreement to the previous reports of Catchpole *et al.* (1993) and Tahir *et al.* (2011) who reported that the raised slatted flooring in goat reduced the prevalence of coccidiosis by preventing and stopping the chance of picking up infection from the floor. Tahir *et al.* (2011) observed lower oocyst counts in goats on slatted floor under intensive management system as compared to the extensive system. Though the SOF kids shed the oocysts after deworming, the oocysts persisted in the soil and they were again picked up by the animals. The significant reduction in GFOC in samples of SOF kids during third sampling may be explained by the fact that the oocysts shed in the faeces were not able to withstand the harsh dry summer in the semi-arid conditions of the study area. As the oocysts are susceptible to dryness, and a drop in the oocyst count in the surrounding actually helped in reducing the coccidial load in SOF kids too. Almost two fold increase in oocysts count during fourth sampling might be due to the favorable moisture in the environment with the onset of monsoon and resulted in better survival of the oocysts in the surrounding and increase the uptake of infection through faeco-oral route.

The lack of detectable nematode in kids of both the floors in the present study may be due to stall feeding and lack of grazing. After treatment of the kids, the complete absence of cestode eggs in subsequent sampling indicated that the floor did not have any influence in controlling the cestode infection. The only nematode infection in SOF kids during third and fourth sampling may be explained to picking up infection from soil, though the GFEC level was lower than normal level that causes infection or warrants deworming in the animals. However, Faizal *et al.* (2001) observed significantly lower mean coccidial OPG and higher nematodal EPG (1,641) as compared to the present study in extensively reared young goats of Sri Lanka in dry areas, wherein goats were penned at night in stilted goat sheds with slatted floor. Thiruvankadan *et al.* (2009) reported that the faecal egg count was similar in Tellichery kids reared on elevated and mud floor and attributed this due to the lower rainfall (less than 800 mm) of the study area.

Findings of the study concluded that the wooden slatted floor in goat shelters in semi-arid areas might not benefit in increasing performance of growing kids, but effectively controlled coccidiosis. Further studies are required in addressing the economic benefits of raised slatted floors in terms of reduced labour in intensive stall-fed kid production system.

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REFERENCES

AOAC. 1995. Official Methods of Analysis, 16<sup>th</sup> edn. Association

- of Official Analytical Chemists, Washington DC, USA.
- ARC. 1990. Feeding Standards for Australian Livestock. Ruminant subcommittee, CSIRO, Australian Agriculture Council, Melbourne, Australia.
- Bharambe V Y and Shinde S S. 2014. Effect of different housing systems on performance of Osmanabadi kids in Konkan region of India. *Indian Journal of Small Ruminants* **20**: 132–33.
- Bhakat C and Nagpaul P K. 2005. Effect of housing systems on growth performance of crossbred goats. *Indian Journal of Animal Sciences* **75**: 69–73.
- Catchpole J, Norton C C and Gregory M W. 1993. Immunisation of lambs against coccidiosis. *Veterinary Record* **132**: 56–59.
- Devendra C. 2013. Investments on pro-poor development projects on goats: ensuring success for improved livelihoods. *Asian Australasian Journal of Animal Sciences* **26**: 1–18.
- Dutta T K, Rao S B N and Singh N. 2003. Development and evaluation of milk replacers in kids under different geo-climatic regions of India. NATP Final Technical Report RPPS–12. Central Institute for Research on Goats, Makhdoom, Farah, Mathura, India. P 1–18.
- Faizal A C M and Rajapakse R P V J. 2001. Prevalence of coccidian and gastrointestinal nematode infections in crossbred goats in the dry areas of Sri Lanka. *Small Ruminant Research* **40**: 233–38.
- Graunke K L, Telezhenko E, Hessle A, Bergsten C and Loberg J M. 2011. Does rubber flooring improve welfare and production in growing bulls in fully slatted floor pens? *Animal Welfare* **20**: 173–83.
- Hansen J and Perry B. 1994. The epidemiology, diagnosis and control of helminth parasites of ruminants. ILRAD, Nairobi, Kenya. Xt, pp. 171.
- ICAR. 2013. Nutrient Requirement of Animals- Sheep, Goat and Rabbits, Publication No. 02, Indian Council of Agricultural Research, New Delhi, India.
- Kumari A, Baig M I, Kodape A H, Dagli N R, Patwardhan S H and Ghorpade P P. 2013. Growth performance of Osmanabadi kids under different housing systems. *Indian Journal of Small Ruminants* **19**: 215–16.
- Lowe D E, Steen R W J and Beattie V E. 2001. Preferences of housed finished beef cattle for different floor types. *Animal Welfare* **10**: 395–404.
- Lupton C J, Huston J E, Hruska J W, Craddock B F, Pfeiffer F A and Polk W L. 2008. Comparison of three systems for concurrent production of high quality mohair and meat from Angora male kids. *Small Ruminant Research* **74**: 64–71.
- MAFF. 1977. Manual of Veterinary Laboratory Diagnostic Techniques. Bulletin Number 18. Ministry of Agriculture Fisheries and Food MAFF. HMSO, London, pp. 5–50.
- Oliveira E R, Lima F A M and Pant K P. 1982. Housing, pasture management and roughage supplementation on the pre-weaning growth of goats in the tropical northeast of Brazil. *Pesquisa Agropecuária Brasileira* **179**: 1389–97.
- Rahman I M K A and Nagpaul P K. 2013. Effect of two different shelter systems on milk yield and composition, feed intake, feed conversion efficiency and physiological responses in lactating crossbred goats during winter season. *Egyptian Journal of Sheep and Goat Sciences* **8**: 89–94.
- Schillhorn van Veen T W. 1986. Coccidiosis in ruminants. *Comparative Food Animals* **8**: 52–58.
- Smits A C and Daamen P J. 1992. Rubber is more comfortable. *Landbouwmecanisatie* **43**(8): 39–41.
- Tahir M S, Ibrahim T A T and Babjee S M A. 2011. Study on coccidia infection and species in Cyprus Shami goat population. 6<sup>th</sup> Proceedings of the Seminar on Veterinary Sciences. pp. 46–50.
- Thiruvenkadan A K, Karunanithi K, Babu R N and Arunachalam K. 2009. Effect of housing system on growth performance of Tellicherry goats. *Indian Veterinary Journal* **86**(5): 500–02.
- Tripathi P, Dutta T K, Tripathi M K, Chaudhary U B and Kumar R. 2014. Preparation of complete feed pellet from monsoon herbage (*Dactyloctenium aegypticum*, *Cenchrus ciliaris* and *Teprosia purpurea*) and its utilization in kids. *Indian Journal of Small Ruminants* **20**: 31–36.
- Van Soest P J, Robertson J B and Lewis B A. 1991. Methods for dietary fiber, neutral detergent fiber and non-starch polysaccharides in relation to animal nutrition. Symposium: Carbohydrate methodology, metabolism and nutritional implications in dairy cattle. *Journal of Dairy Science* **74**: 3583–97.
- Yadav N K, Mandal A, Sharma D K, Rout P K and Roy R. 2006. Genetic studies on faecal egg counts and packed cell volume following natural *Haemonchus contortus* infection and their relationships with live weight in Muzaffarnagari sheep. *Asian Australasian Journal of Animal Sciences* **19**: 1524–28.