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Impact of Bypass Fat on Growth and Testicular Measurements in Gaddi Goat Bucks

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ABSTRACT

The present study was conducted with the objective to compare the morphometric, antioxidative and immunity parameters of Gaddi goat kids fed rumen protected fat and control group for 120 days. Twenty two Gaddi male goat kids (6-8 months) were selected from the flock and divided into two groups (10 kids each) in a completely randomized design. The kids were taken for grazing for 6-8 hours in the day time and offered concentrate mixture 300g to both of the group and in the evening fortified with bypass fat 15g per goat kid in the treatment group. The overall average daily body weight gain in control and treatment group was 60.2 and 76.3 g per day respectively, and significantly higher gain ($P<0.05$) in treatment group as compared to control. The overall average scrotal circumference and scrotal volume, of Gaddi bucks in control and treatment group were significantly more ($P<0.05$) in treatment group as compared to control at the end of the experiment (4th month). The average length of the right testis in treatment group was significantly ($P<0.05$) higher on 90 and 120 days of treatment. Similarly the width of the right testis in treatment group was more as compared to control at 120 days of treatment. Results of the present study indicate that feeding of bypass fat can be useful strategy for the improvement of growth performance and morphometric parameters in Gaddi bucks.

KEYWORDS: Body weight, Bypass fat, Gaddi goat kid, Scrotal circumference

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INRODUCTION

Gaddi goats are traditionally reared by the Gaddi pastoralist since ages under migratory goat production system. Gaddi goat also known as White Himalayan goat and is most common breed of north western Himalayan region with its home tract in the Himachal Pradesh. Farmer's own flock is the source of breeding buck, with most of the flocks having higher buck to doe ratio as they are maintaining only 2-3 bucks (Sankhyan et al., 2016). Hence, the physical and reproductive health of the bucks is important for improving the overall performance of the flocks. Balanced nutrition is important for the improvement of health and reproductive efficiency. Young male animals, more suscetible to dietary restrictions of energy and protein than in adult and may lead to permanent histological changes at the level of the testis (Brown 1994) The energy density of the daily ration can be improved by adding cereal grains, but the risk of subclinical rumen acidosis may limit the inclusion levels (Sutton et al., 2003).An alternative strategy to lower that risk could be the use of rumen Protected nutrients, which gets fermented at a lower degree in the rumen, which becomes available at the lower part of the gastrointestinal tract for the subsequent digestion and absorption. In addition to this, the rumen protected nutrients impart a steady supply of nutrients in place of providing all the nutrients immediately with sudden bursts from easily soluble nutrients (Walli et al., 1995). Bypass nutrients escape rumen degradation and then get digested and absorbed in the lower gastrointestinal tract (Yadav and Chaudhary, 2010). To increase the efficiency of dietary fat utilization, use of protected nutrients supplementations were suggested (Garg and Mehta 1998). The inclusion of protected lipids or inert fats in the diet can increase diet energy content, increase microbial protein synthesis can lead to better growth performance (Ramirez-Zamudio et al., 2021). Goat reproductive morphometric values are useful in breeding soundness evaluation to determine

fertility potential of breeding males. However, relatively fewer studies have been done on the use of protected fat in growing male goats. Hence, an experiment was conducted to study the effect of feeding of bypass fat on growth performance, morphometric, antioxidative and immunity parameters in Gaddi goat kids.

MATERIALS AND METHODS

Location of the study

The study was conducted in the sub-Himalayan ranges of Himachal Pradesh (Palampur) on goat flock maintained under AICRP, Gaddi field unit project by Department of Animal Genetics and Breeding, CSKHPKV, Palampur (H.P.).

Selection of animals

This experiment was conducted on twenty male Gaddi goat kids (5-6 months) selected from the field flocks and divided into two groups i.e. control and treatment (10 kids each) in a completely randomized design on the basis of average initial body weight.

Housing and Feeding

The kids were grazed on pasture during the day time and offered concentrate mixture in the evening @ 300g per day. Treatment group concentrate mixture fortified with bypass fat (Kemin Ener FAT™Plus Dry) @ 15 g per kid. Concentrate mixture consisted of Barley 200g/Kg, maize grain 400 g/Kg, Rice Polish 70 g/Kg, groundnut cake 300 g/Kg, mineral mixture 20 g/Kg and common salt 10 g/Kg.

Chemical analysis of feed sample

The concentrate were sampled at the beginning, mid and end of the experimental period. All the samples were grounded individually, labelled and analyzed for proximate composition as per AOAC (2005) and cell wall constituents as per Goering and Van Soest (1970).

Measurement of body weight

Body weight (BW) of the animals were recorded at monthly interval for two consecutive days before offering feed and water using electronic weighing balance.

Morphometric parameters

Various body measurements viz., Body length, Height at wither and Heart girth of kids in different groups were recorded at monthly intervals.

Scrotal biometry

Scrotal biometry was done at monthly intervals. Scrotal circumference (SC) was measured using flexible measuring tape in the medium position of scrotum, around the two gonads and scrotal skin, at the point with the largest dimension (Goyal and Memon, 2007). Scrotal volume was calculated through water displacement using calibrated beaker filled water and dipping the scrotum up to its neck. Testicular Length (TL) and Testicular width (TW) of left and right testes were measured in centimeter using Vernier calipers.

Statistical analysis

Statistical analysis of the data was by Student 't' test as per Snedecor and Cochran (1994) with the SPSS (1998).

RESULTS AND DISCUSSION:

Chemical composition (%) of concentrate feed supplemented to ration of kids during the experimental period of 150 days contained DM 90.0, OM 92.8, and CP 20.4, EE 3.32, and ADF 19.5 and total ash 6.56 DM basis. In the present study the chemical composition of compound feed in control and treatment group is almost similar as the difference in both groups is only of rumen protected fat which is added while feeding the goat.

The body weight of male bucks increased significantly with the advancement of age, after 120 days of experimental feeding, the final body weight in treatment group (34.14 Kg) was significantly higher ($P \leq 0.05$) as compared to control (32.24 Kg; Table 1). The overall average daily body weight gain in control and treatment group was 60.21 and 76.31 g per day respectively, and significantly higher gain ($P \leq 0.05$; Table 2) in treatment group as compared

to control. Earlier Suman et al. (2015 and 2022) recorded a daily weight gain i.e. 60-80g in different group which was closer to the value recorded in control groups. Feeding of protected fat, which is inert in rumen can enhance energy density of ration and energy intake without compromising rumen cellulolytic bacterial activity (Tyagi et al., 2010). Findings of the present study are in agreement with Fiorentini et al. (2012) who observed higher average daily weight gain in animals, supplemented with the protected fat in diet. Similar to this Kumar and Thakur (2007); Thakur and Shelke (2009) also found increase in weight gain by feeding bypass fat in animals.

The body length and chest girth of kids on 120 days of feeding of bypass fat in treatment group (66.6 and 69.5 cm) was significantly higher ($P \geq 0.05$) as compared to control (60.3 and 66.0 cm; Table 3). Wither height shows only numerical difference between groups. Similar studies carried out by Antil et al. (2019) and Suman et al. (2022), indicated existence of positive correlation between body weight and measurements. Gaddi bucks were primarily on grazing and meet their requirement by feeding herbages in the pasture, so the inclusion of rumen protected fat in the diet can increase the energy density without affecting fermentative digestion in the rumen, which ultimately improve the morphometric performance of animals.

Table.1 Fortnightly average body weights (kg) of Gaddi goat kids fed with or without bypass fat.

Months	Control	Treatment
0	23.0±0.69	23.0±0.76
I	25.1±0.56	26.2±0.70
II	27.3±0.65	28.7±0.54
III	28.8[a]±0.61	30.9[b]±0.40
IV	32.2[a]±1.08	34.1[b] ±0.49
Mean	27.1±1.29	28.7±1.64

[a,b]Values with different superscripts in a row differ significantly ($P<0.05$).

Table.2 Average daily gain (g) per day of Gaddi goat fed with or without bypass fat.

Months	Control	Treatment
I	69.9[a] ±12.2	91.6[b] ±17.0
II	71.3±14.0	83.0±8.92
III	50.7[a] ±10.9	72.9±4.37
IV	48.9±7.31	57.7±2.78
Mean	60.2[a] ±6.01	76.3[b]±10.0

[a,b]Values with different superscripts in a row differ significantly ($P<0.05$).

Scrotal and testicular measurements

Scrotal Circumference

The scrotal circumference (SC) in growing bucks differed significantly ($P \leq 0.05$) with the advancement of age and significantly more ($P \leq 0.05$) in treatment group as compared to control on III and IV month of treatment (Table 3). Various researchers have reported the scrotal circumference in the breeding buck in this range which is supporting our results (Shamsuddin et al., 2000; Kumbhar et al., 2017; Suman et al., 2022). Rumen protected fat influenced the growth rate positively (Walli, 2004; Meshram et al., 2017), due to its effect on nutrient utilization and meeting the energy requirement of growing animals. The biometry of scrotum was closely related to the growth rate of bucks (Mehta et al., 1992), Similar many researchers found positive correlation between

body weight and SC in bulls (Bitto and Egbunike 2012,in goats (Sahi et al, .2019;Suman et al,.2022), and rams (Kwari and Ogwuegbu, 1992).

In the present study overall mean of scrotal volume, was numerically higher but significantly (P≤0.05) higher in treatment group (290.83 ml) as compared to control (302.50 ml; Table 4) on 120 days of treatment. During the growing phase, the increment in scrotal volume could be due to physiological changes and growth of testicular parenchyma, i.e., growth of testes in length, width and thickness (Patni et al., 2016). The lower volume in control group might be due to less growth rate as compared to the treatment group. Testicular measurement affected by capability, better semen quality and thus improves the fertility of the animals (Alade et al., 2009; Akpa et al., 2012). The growth rate affected by the good plane of nutrition so feeding of growing bucks with protected fat as a source of energy is useful strategy to enhance the reproductive efficiency.

Table 3. Body Measurements of Gaddi goats fed with or without bypass fat.

Months	Body length (cm)		Chest girth (cm)		Wither height (cm)	
	Control	Treatment	Control	Treatment	Control	Treatment
0	56.3±1.04	62.1±1.43	65.7±1.37	67.1±0.95	59.3±0.74	60.5±1.14
I	61.2±1.23	66.2±1.05	64.3±1.10	65.6±1.15	62.7±0.98	63.8±1.00
II	61.5±1.64	67.5±1.19	66.1±1.17	70.2±1.23	63.4±1.24	64.4±1.07
III	63.2±1.45	69.6±1.09	67.9±1.41	72.1±1.18	65.4±1.24	67.1±1.07
IV	65.2^{a} ±1.45	71.9^{b} ±1.09	68.9^{a} ±1.41	73.1^{b} ±1.18	67.4±1.41	70.1±1.39
Mean	60.3 ±1.69	66.6 ±1.73	66.0 ±1.24	69.5 ±0.95	62.6±1.52	65.6±1.94

[a,b]Values with different superscripts in a row differ significantly (P<0.05).

The size of the testes in present study varied in groups and variation in size in right and left testes has been observed between groups (Table 4). The average length of the right and left testis in treatment group was more and in right testes it was significantly (P≤0.05) higher on III and IV month of treatment. Similarly overall average width of the right and left testis in treatment group was more as compared to control. This study indicated that length and breadth of testes were increased with the advancement of age of animals which matches with the findings of Kabiraj et al. (2011) and Suman et al., 2022. It has been found that body weight, scrotal and testicular parameter had positive correlation among each other (Gore et al., .2020). The increase in testicular measurements with advancing age was in agreement with the observations of earlier workers (Souza et al., 2011; Akpa et al., 2012; Moulla et al., 2018) in different breeds of goat and sheep. The length, and width of right and left testis differed significantly (P<0.05) might be due to this interaction and might be attributed to difference in body weight of bucks in different groups and individual variation. Nutrition is directly related to growth rate and reproduction efficiency. Growing animals have high requirement of energy and proteins, so supplementing rumen bypass fat is one of the way of increasing metabolizable energy intake, improved weight gain and FCR (Bhatt et al., 2013). A positive relationship exists between the reproductive performances and testicular size and latter is known to vary with nutrient intake (Suman et al., 2022 and Fernandez et al., 2004). In the present study supplementation of rumen bypass fat has been found useful and have significant effect on testicular size and ultimately it is going to affect reproductive growth, spermatogenesis, and seminal characteristics.

Table 4. Scrotal circumference (cm) and Scrotal volume (ml) of Gaddi goats fed with or without bypass fat.

Months	Scrotal circumference (Cm)		Scrotal volume (ml)	
	Control	Treatment	Control	Treatment
0	22.8±0.54	23.0±0.52	154.7±8.9	159.2±18.5
I	23.9±0.44	24.7±0.62	184.5±11.1	189.50±15.6
II	24.9±0.56	25.9±0.57	210.3±12.6	215.33±12.6
III	25.5 [a] ±0.58	27.5 [b]±0.74	239.2±19.7	260.67±9.5
IV	25.7 [a]±0.58	28.1 [b] ±0.83	260.8 [a] ±20.4	274.5 [b] ±10.1
Mean	24.6±0.50	25.9±0.84	209.9±27.9	220.4±28.6

[a,b]Values with different superscripts in a row differ significantly (P<0.05).

Table.5. Testicle parameters of Gaddi goats fed with or without bypass fat.

Months	Right testicle length (cm)		Right testicle width (cm)		Left testicle length (cm)		Left testicle width (cm)	
	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment
0	7.90±0.26	7.93±0.45	4.44±0.15	4.22±0.16	7.94±0.21	8.04±0.33	4.41±0.15	4.55±0.24
I	9.11±0.17	9.14±0.25	4.63±0.10	4.66±0.86	8.50±0.82	8.56±0.28	4.71±0.21	4.90±0.19
II	9.15±0.19	9.43±0.19	4.86±0.90	5.24±0.10	9.07±0.19	9.08±0.23	4.98±0.19	5.21±0.18
III	9.35 [a] ±0.22	9.86[b]±0.15	4.99±0.85	5.33±0.20	9.20±0.17	9.53±0.27	5.09±0.19	5.42±0.17
IV	9.50 [a] ±0.22	10.25 [b]±0.18	5.10 [a] ±0.85	5.72 [b] ±0.20	9.36±0.16	10.06±0.32	5.35±0.15	5.68±0.14
Mean	9.01±0.25	9.32±0.36	4.81±0.12	5.08±0.27	8.81±2.62	9.03±0.34	4.91±0.16	5.15±0.19

[a,b]Values with different superscripts in a row differ significantly (P<0.05).

CONCLUSION

From the present study it may be inferred that feeding of rumen bypass fat to the Gaddi goat kids can be an effective strategy to augment growth performance and reproductive morphometric values which are useful in determination of breeding soundness and fertility potential of breeding males.

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