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Growth performance and nutrient digestibility in beetal kids fed with two different types of mineral mixture along with conventional diet system

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Abstract
The objective of this study was to compare the efficacy of feeding of two different types of mineral mixtures on nutrient utilization, and growth performance in Beetal kids. For this purpose, sixteen healthy male beetal goat kids of three months old were divided into two groups of eight animals each on the basis of their initial body weight. Animals were fed on concentrate mixture (comprising one-third equal proportions of maize, GNC and barley, mineral mixture and salt part). The concentrate mixture fed to group 1 was supplemented with university (LUVAS) prepared mineral mixture and in case of group 2 commercial mineral mixture was supplemented with conventional diet system. The results of the study revealed that the total dry matter intake, digestibility coefficients (DM, CP, EE, NFE) in group 1 and group 2 were found statistically similar in both the groups. However, crude fiber (CF) nutrient digestibility showed significant ($p < 0.05$) differences in between treatment 1 and treatment 2. FCR and nutrient intake were found statistically similar in between the groups.

Keywords: Beetal Kids, LUVAS MM, growth performance, nutrient digestibility

Introduction

India has a pride of place on livestock map because of enormity of livestock wealth with amazing genetic diversity in spite of having smaller geographical area (2.4%). The total livestock population is 536.76 million in India, out of which 148.88 million is goat population which is near about 27.74% out of total population, showing an increase of 10.1% over the last census. This high growth of goats in developing countries is largely due to the multiple roles of goats: reliable producers in bad time, fast breeders, lower nutritional requirements, inquisitive feeding habits, good market price. Goats are generally maintained on zero or minimum input system (extensive/semi-intensive), which adversely affect the productivity due to low level of nutrients intake. Therefore, energy, protein and minerals were the most deficient in goat diets, when compared with the nutrient requirement of ICAR (2013) [6]. The goats are especially useful in the semi-arid and arid zones, where they can sustain themselves on sparse vegetation and extreme climatic conditions where other species of animals may perish. In rural areas, feeding of small ruminants is mainly dependant on grazing on the available wide variety of vegetation such as grasses, legumes, herbs, shrubs, tree leaves and agricultural by-products. These feed resources are usually deficient in protein, energy, minerals, and vitamins; in addition, the presence of certain anti nutritional factors further inhibit their utilization (Ramachandra and Sampath, 1995) [15]. In goat ration mineral mixtures are usually mixed with concentrate mixture @ 2% to improve their growth rate, reproduction efficiency, feed utilization efficiency, milk production, immune response and general health (Kalita *et al*., 2003) [7] but it is very difficult to assess which mineral mixture is best for the animals since different mineral mixtures are available commercially with different brand names and formulations (McDowell, 1992) [11]. At present, commercial mineral mixtures are prepared and marketed without considering the actual deficiency or excess of minerals in particular region. An excess of minerals is taxing to the animal system because of the stress on organs and the extra energy animals spend in their excretion. Also the use of excess minerals adds to the cost of feed. A wide variety of mineral mixtures are present in market but because of their higher prices they are not suitable for use by farmers. Our university also prepares mineral mixture having lower prices and which will fulfill animal mineral requirement for various activities.

Material and Methods

Housing and management

Sixteen healthy Beetal male kids of 3-months age were selected from goat herd of department of Animal Genetics and Breeding, LUVAS, Hisar. They were housed in semi covered sheds. An adjustment period of fifteen days was given before the start of the experiment. Standard animal management practices were followed in the farm.

Feeding and Watering

The kids were maintained on conventional type of feed consisting of concentrate mixture, green fodder and gram straw following ICAR (2013) [6] specification. Animals were fed individually twice a day and offered maize fodder and concentrate mixture to meet the nutrients requirement. Clean drinking water was provided according to the requirement and experimental animals were dewormed with full course of fenbendazole @ 5-7.5 mg/kg body weight, if, required. Feed ingredients used for ration formulations were evaluated for various proximate nutrients *viz*. dry matter (DM), crude protein (CP), ether extract (EE), crude fibre (CF) and total ash (TA) as per AOAC (2013) [1]. The evaluated values of proximate nutrient of feed ingredients used in preparing the diets are presented in Table 1. Proximate composition of different ingredients in concentrate mixture and composition of mineral mixtures used in different dietary groups are represented in table (2) and table (4) respectively. Ground form of these ingredients was mixed in the vertical mixer for final preparation of concentrate. The composition of 100 kg concentrate mixture prepared from above ingredients for different dietary treatments is presented in Table (3).

Table 1: Proximate composition of feed offered (%DM basis)

Ingredients	DM	CP	EE	CF	ASH	NFE
Green maize	19.32	8.31	3.91	26.2	9.2	52.38
Gram straw	89.91	4.6	2.09	38.4	8.7	46.21
Concentrate T_1	89.59	19.8	3.4	5.23	9.27	62.3
Concentrate T_2	89.61	19.6	3.37	5.09	9.64	63.2

Table 2: Proximate composition of ingredients of concentrate mixture (% DM basis)

Ingredients	DM	CP	EE	CF	ASH	NFE
Maize	89.68	9.09	3.40	2.96	3.00	81.64
GNC	90.29	42.12	6.01	6.60	7.50	37.89
Barley	89.45	11.04	2.00	7.12	4.10	75.78

Table 3: Percent ingredient composition of concentrate mixture

Ingredient	T1	T2
Maize	32.4	32.4
Barley	32.3	32.3
Groundnut	32.3	32.3
Mineral mixture	2	2
Common salt	1	1
Total	100	100

Table 4: Composition of different mineral mixtures supplemented in ration of kids

Element	Specifications as per BIS	LUVAS M.M.	Commercial M.M.
Calcium (%)	20.00 (Min.)	20	24
Phosphorus (%)	12.00 (Min.)	12	12
Copper (%)	00.10 (Min.)	0.1	0.12
Zinc (%)	00.80 (Min.)	0.8	0.96
Iron (%)	00.40 (Min.)	0.4	0.5
Manganese (%)	00.12 (Min.)	0.12	0.15
Total ash (%)	78-85 (Max.)	80.43	84.61

Observation recorded and calculated

Feed intake= was calculated at weekly interval by subtracting residue from the offered amount of feed throughout the experiment.

Body weight gain = The kids were weighed individually at fortnightly intervals before feeding and the body weights were recorded to calculate body weight gain up to 120 days of the experimental period.

Metabolic body weight, $W^{.75}$ (kg) = $\sqrt{\sqrt{(W)^3}}$
Where, W = Live body weight

Feed conversion ratio = Feed consumed (g) per day /Body weight gain (g) per day

Metabolism trial: A metabolism trial was conducted at the end of the experimental period to study the nutrients intake and nutrients digestibility. All the sixteen kids were transferred to separate metabolic cages. Feeding was done as per ICAR (2013) [6] specifications. A preliminary period of 3 days was given for adaptation to the kids to new system of housing and management, followed by a collection period of 5 days.

Collection of samples: During the collection period, Samples of feed residue and faeces voided were collected every day in the morning in zip-bags. Urine sample were also collected in the morning in clean plastic bottles to carry out the laboratory analysis. Represented samples from thoroughly mixed excreta were drawn daily for dry matter and nitrogen estimations. After completion of the collection period faeces samples were pooled and ground in mixer and stored in zip-bags for further proximate analysis. Fresh samples were used for crude protein estimation.

Analytical procedures: The feed residue and excreta voided were weighed and properly recorded for final calculations of the total daily feed consumption and excreta voided. Representative sample of feed and faeces were analyzed for proximate principles i.e. dry matter, total ash, crude protein, crude fiber, ether extract and nitrogen free extract as per AOAC (2013) [1].

Statistical Analysis: Data was analyzed statistically (Snedecor and Cochran, 1994). Student T-test was used to study the differences between treatment means.

Results and Discussion

Nutrients Utilization- The data pertaining to nutrients utilization in kids under different dietary treatments recorded is presented in table (5).

Table 5: Dry matter intake and Nutrient digestibility under different treatment groups

Attributes	T_1	T_2
DM intake (g/d)	774.65±16.03	795.88±21.10
DM intake (%BW)	3.26±0.09	3.39±0.07
DMI (g/kg $W^{0.75}$)	72.05±0.77	74.76±0.69
Nutrient digestibility (%)		
Dry Matter	62.74±0.39	60.93±1.17
Crude Protein	69.42±0.39	67.54±1.59
Ether Extract	72.68±0.78	71.65±0.57
Crude Fibre	61.03^b±0.31	58.78^a±0.36
Nitrogen Free Extract	69.48±1.36	67.28±0.16

Dry matter intake (DMI): The average daily DM intake with respect to (g/d), (%BW) and (g/kg metabolic body wt.) were presented in the table (5). The mean values of DMI recorded in treatment 1 and treatment 2 were 774.65 and 795.88 (g/d) in% body weight were 3.26, 3.39 (%BW) and in terms of g per kg metabolic body weight were 72.05 and 74.76 (g/kg $W^{0.75}$) respectively. No significant differences were observed in both dietary treatment groups with respect to any of the parameters regarding dry matter intake. Garg *et al.* (2008) [5] and Kumar *et al.* (2010) [9] also did not observe any change in DMI in kids when they were supplemented with Zn in their diets. Mondal *et al.* (2004) also did not observe any change in DMI with the dietary supplementation of $CuSO_4$ but significant differences (p< 0.05) were observed when Cu- proteinase were supplemented in their diets. Similar observations were reported on supplementation of 10 ppm Cu in feed of growing kids (Mondal and Biswas, 2007) [12]. No effect on DMI was observed on supplementation of 7 to 14 ppm Cu in heifers (Mullis *et al*., 2003) [14] and 10, 20 or 30 ppm Cu in Cashmere goats (Zhang *et al*., 2009) [18]. Kalita *et al.* (2003) [7] also observed that addition of mineral mixture had no significant effect on dry matter intake and these findings were in consonance with the earlier report of Chhabra *et al.* (1986) [2].

Nutrients digestibility: In case of nutrient digestibility, crude fiber (CF) digestibility showed significant (p< 0.05) difference in between the treatment groups and showed significantly (p< 0.05) higher value in treatment 1 that was 61.03% and 58.78% in treatment 2. Whereas the average values obtained for the digestibility coefficient of dry matter (DM), crude protein (CP), ether extract (EE) and nitrogen free extract (NFE) in treatment 1 and treatment 2 were similar in between the groups. It means that both the mineral mixtures i.e., equally improve their dry matter intake and nutrient digestibility's of dry matter, crude protein, ether extract and nitrogen free extract. Shinde *et al.* (2013) did not observe any effect of organic Cu supplementation on digestibility of DM, OM, CP, EE, CF and NFE in Chokla rams. Mudgal *et al.* (2007) found that supplementation of 10 ppm Cu and 0.3 ppm of Se did not any effect on nutrient digestibility. Waghmare *et al.* (2014) also observed that the supplementation of 7 ppm Cu (as $CuSO_4$) or 7 ppm and 3.5 ppm Cu (as Cu-methionine) did not have any effect on the digestibility of DM, OM, CP, EE, NDF and ADF.

Body weight Changes and Nutrient Intake: The influences of various dietary treatments on growth pattern in kids were represented in table (6). The average initial body weights (kg) of kids in treatment 1 to 2 were 12.13kg and 12.06 kg, respectively. It was very clear from the table that the two groups were identical with regards to their initial body weights that were 12.13 kg and 12.06 kg in the first and second treatment respectively. And the final body weights (kg) of both the treatment groups were also very similar to each other which were 23.65 kg and 23.42 kg in treatment 1 and treatment 2 respectively. That means no significant differences were observed in case of final body weight attained by the animals. Average daily weight gain(g/d) by the kids of both the dietary groups were 94.20 and 94.04 g/d showing a slightly higher value in group 1 as comparison to that in group 2 although the difference obtained was not significant at all. And while comparing nutrient intake (g/d), in terms of DCP and TDN. The values obtained for DCP and TDN were 73.44 g/d, 72.48 g/d and 498.43 g/d and 496.79 g/d in treatment 1 and treatment 2 groups respectively. Similar findings were observed by Mondal *et al.* (2004) that source of Cu either in the form of $CuSO_4$ or Cu- proteinase did not affect the daily gain in weight in kids although it showed a significant difference (p< 0.05) when compared with the control group. No significant results were seen on supplemental Cu on the performance of finishing steers by Engle *et al.* (1997) [4]. Mandal *et al.* (2007) [10] did not find any difference in DCP and TDN intake due to different levels of Zn in the ration of calves. The nutritive value in terms of DCP and TDN present of the different rations fed to kids were not affected by Zn supplementation and source of Zn. Khan (1978) [8] did not observe any effect on TDN intake when supplemented 20 ppm Cu in the diet of Holstein Friesian calves. No effect was observed in feed: gain ratio in Simmental steers supplemented with either 10 or 40 ppm Cu (Engle and Spears, 2001) [3] or in Simmental and Angus growing heifers supplemented with 7 or 14 ppm Cu in feed (Mullis *et al*., 2003) [14].

Table 6: Average body weight, FCR and nutrient intake in kids under different dietary treatments

Attributes	T_1	T_2
Initial body wt.(kg)	12.13±0.78	12.06±0.59
Final body wt.(kg)	23.65±0.79	23.42±0.63
Body weight gain(Kg)	11.53±0.11	11.36±0.07
Average Daily Weight gain(g/d)	94.20±0.82	94.04±0.65
FCR (dim/kg b.wt. Gain)	8.22±0.17	8.45±0.18
Nutrient intake (g/d)		
DCP	73.44±1.64	72.48±1.83
TDN	498.43±9.65	496.79±12.69

Ethical Approval: The authors confirm that the ethical policies of the journal, as noted on the journal's author guidelines page, have been adhered to and the appropriate ethical review committee approval has been received. The authors confirm that they have followed EU standards for the protection of animals used for scientific purposes. The animal experiment was conducted in accordance with guidelines approved by the Institutional Animal Ethics Committee (IAEC), 18/CPCSEA dated 12-03-2021 in the Department of Animal Nutrition, LUVAS.

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