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Effect of Non urea and Urea based concentrate supplementation on nutrient utilization and growth performance of goats

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Abstract
The quest for sustainable goat production and aptness of concentrate supplementation prompted the current investigation. Eighteen post-weaned local male kids (9.5 ± 0.24 kg BW) were divided into three equal groups *viz*. T_1, T_2 and T_3 to study the effect of supplementation of concentrate mixture with and without urea under a semi-intensive system of management. The kids under all three groups were allowed 6 to 7 h of grazing daily. Additionally, besides grazing Group T_1 was un-supplemented (control), Group T_2 was supplemented with a non-urea-based concentrate mixture (CP 16%, TDN 70%) and group T_3 was supplemented with a urea-based concentrate mixture (CP 16%, TDN 70%) at 200 g daily. The duration of experimental feeding was 90 days. The parameters studied were nutrient utilization, growth performance and economics of feeding. Intake and digestibility of nutrients were significantly ($P< 0.01$) lower in control but no significant difference was observed between supplemented groups. The average daily gain (ADG) was significantly ($P< 0.01$) higher in both the concentrate fed groups then sole grazing group (58. 40 and 55. 44 vs. 26.40). The net return from supplemented groups was higher as compared to control. It is concluded that supplementation of 200 g concentrate mixture in local browsing kids reared under semi-intensive management resulted in increased intake and digestibility of nutrients which, in turn, resulted in higher growth performance. The urea-based concentrate mixture is equally effective as a traditional concentrate mixture and supplementation is economical in growing kids.

Keywords: Concentrate, nutrient utilization, urea, growth, goats

Introduction
The shortage of grazing and browsing resources in the country is the main constraint for goat production. Under such conditions, the only alternative, remains, is supplementation to meet the requirements of all nutrients. Supplementation of critical nutrients (Das, 2008) [1] or their appropriate combination (Khadda *et al*., 2018) [2] is the most promising and convenient approach to improving the productivity of goats. The non-descript local female kids maintained on grazing (6-8 h daily) supplemented with concentrate mixture at (1.5% of BW) had (ADG) of 59 g which was 1.7 times higher than the daily gain of control kids (Yadav *et al*., 2015) [3]. Similarly, Das (2009) [4] concluded that ADG was higher when the concentrate was supplemented at 1% of the kids' body weight. However response of concentrate supplementation on growth performance may vary widely in different studies (Das *et al.* 2012 [5]; Kushwaha, *et al*. 2016) [6] depending upon the level and nature of the supplement. Non-protein nitrogenous (NPN) substances are a welcome sources and a good approach to reduce the cost of concentrate mixture for ruminants when partially replaced with costly oilseed cakes. The efficient utilization of dietary nitrogen depends upon the ruminal microbial metabolism, as well as metabolic changes operating in the animal body (Puga *et al*., 2001)[7].Urea is a low cost NPN substance that can be utilized to supply a part of the protein requirement of goats and economize the feeding cost. Mane *et al*. (2006) [8] have reported that 1% Urea in complete feed supported very good growth in kids. Under these circumstances study was conducted to evaluate the effect of supplementation 2% urea based concentrate mixture over conventional protein source (Soya DOC) based concentrate mixture on the nutrient utilization, growth performance and economics of feeding of goats under a semi-extensive system.

Materials and Methods
The experiment was carried out during the autumn and summer season (February-April) at

Indore district, Malwa region of Madhya Pradesh facing less average annual rainfall for the last 4-5 years due to this the grazing on natural feed resources become meagre in most seasons of the year. Eighteen non-descript male kids of four to five mounts of age (BW 9.5 ± 0.24 kg) were selected. All animals were in proper health and alert in appearance. The kids were dewormed before the start of the experiment. These animals were divided into three groups of 6 each and reared under a semi extensive system of feeding. Apart from routine 6-7 hours grazing kids were randomly assigned into three dietary treatments. Group T_1 was given no concentrate mixture (Control). Group T_2 was given 200 g non-urea based concentrate daily. Group T_3 was given a 200 g urea-based concentrate mixture daily. The composition of the concentrate mixture is presented in Table 1. The composition of concentrate mixtures was computed in such a way that both were isonitrogenous (16% CP), isocaloric (70% TDN) and adequate in critical minerals.

The growth trial was conducted for three months. The experimental kids in each group were allowed for feeding in the respective feeding schedule. Clean water was freely available to all the animals throughout the experimental period. The animals were weighed at fortnightly intervals in the early morning before watering and feeding. The data were used for calculation of body weight gain and average daily gain (ADG) during the experimental periods.

A digestion trial of 7 days collection period was carried out at the mid of the study the effect of concentrates supplementation on nutrient utilization. Daily the weighed quantity of tree leaves mixture (Mango, Pipal and Ber in equal quantity as basal feed) was offered to animals along with respective dietary treatments.

The refusal of the previous day was weighted and aliquots from feed offered and refusal of each treatment group was collected and kept in a hot air oven for dry matter estimation, during the digestion trial. The quantity of faeces voided in 24 hours was collected in faeces collection bags.

The total weight of faeces voided was recorded daily at a definite time in the morning and the total quantity of faeces of an animal was mixed thoroughly and suitable aliquots were taken for the determination of the dry matter and other proximate principals as per AOAC (1990) [9].

The data of growth, intake and digestibility were analyzed with one way ANOVA using a completely randomized design as per the standard statistical methods detailed by Snedecor and Cochran (1995) [10] using SPSS version 22.

Table 1: Composition of Concentration mixtures

Ingredients (%)	T_2	T_3
Maize crushed	55	55
Maize flour	-	5
Soya DOC	17	-
Wheat bran	25	35
Urea	-	2
Mineral mixture †	2	2
Salt	1	1

† Composition per 250 g mineral-vitamin feed supplement contends Ca 70. g, P 20. g, I 0.10g, Fe 0.75g, Zn 1.50g, Cu 0.20g, Co 0.045g, Vitamin A 5,00,000IU, D_3 1,00,000IU, B_2 0.2g, K 0.1g, B_{12} 600µg.

Results and Discussion

Bodyweight gain

The results of the growth performance of kids indicated that on natural vegetation, they do not obtain sufficient nutrients to sustain normal growth. The ADG in T_1 (control) group was only 26.4, which was significantly ($P< 0.01$) improved to 58.4 in T_2 and 55.4 in T_3. The difference in growth performance of goats fed concentrates vs. control in the present study reflects the variations in feed intake and conversion efficiency. Concentrate supplementation with grazing based feeding improves the utilization of feeds to ruminants by improving the digestibility of dry matter (DM), organic matter (OM) and protein through improved efficiency of rumen fermentation (Kushwaha *et al*., 2016) [6]. The extra weight gain of T_2 and T_3 over T_1 kids can be due to, increased DM, protein and minerals intakes makes more nutrients available for improved growth performance. The results of the present study corroborated the findings of earlier workers. Shah *et al.* (2003) [11] observed that the ADG was improved 30 g to 60 g in Barbari kids when provided 300 g / day additional concentrate mixture along with tree leaves. Das (2009) [4] observed maximum ($P< 0.05$) ADG when the concentrate was supplemented @ 1% of BW in weaned Sikkim local male kids in the summer season. Similarly, improved nutrient availability through supplementation of concentrate (at 1.5% of BW) resulted in increased growth performance by Das (2008) [1]. Also, Das *et al*. (2012) [5] observed that daily supplementation of 150 g concentrate in Ganjam goats increased ADG 31g to 63g. The average daily gains of kids were not significantly different in T_2 and T_3, indicates that concentrate supplementation with 2% urea in concentrate mixture was sufficient to replace the entire protein supplement and capable to support equal growth rate. Growth efficiency of the kids fed urea-based concentrate supplementation may also have been benefited by the supply of starch and key amino acid for effective utilization of urea by rumen bacteria to synthesized microbial protein. A similar response of urea-based supplemental feeding was also observed in Alpine goat kids by Galina *et al.* (2004) [12] reported ADG of goat kids were superior with the slow-intake urea supplement diet compared to a balanced concentrate diet ($P< 0.05$). When using 1% urea in complete feed higher weight gain rate in growing goats was achieved over isonitrogenous conventional feed (Mane *et al*., 2006) [8].

Nutrient intakes

The average nutrient intakes of different experimental diets during the digestion trials have been presented in Table 2. The DMI as a percentage of body weight was 3.92 in T_1 which were significantly improved to 4.33 in T_2 and 4.16 in T_3, although were within dry matter requirement of growing kids of the small breed (10 kg weight with 70g ADG) is 4% of their BW (NRC,1981) [13]. Kids consumed the entire amount of their respective concentrate resulted significantly reduces the intake of tree leaves mixture (basal feed) however it did not differ between T_2 and T_3. Previous reports suggest that DMI increased due to concentrate supplementation in low-quality forage diets (Shah *et al*., 2003 [11]; Das, 2008 [1]; Das, 2009 [4]; Mondal and Kakati, 2013) [14].

Table 2: Chemical composition of tree leaves mixture and concentrates (% DM basis)

	DM	CP	EE	CF	NFE	Ash	Ca	P
Tree leaves mixture	38.25	11.98	3.12	21.85	49. 90	13.15	1.25	0.32
Concentrate mixture (Without Urea)	92.50	15.94	2.93	6.25	67.57	7.41	0.64	0.72
Concentrate mixture (With Urea)	91.96	16.03	2.64	6.05	68.22	7.06	0.61	0.70

Table 3: Effect of concentrate supplementation on feed intake and nutrient digestibility

	T_1	T_2	T_3	SEM	Significance
Feed consumption (g/d)					
Tree leaves	414.7^b	333.2^a	302.6^a	11.61	$P< 0.01$
Concentrate mixture	-	196.3	196.5	2.48	NS
Total	414.7^a	528.6^b	498.7^b	11.35	$P< 0.01$
DMI (% body weight)	3.92^a	4.33^b	4.16^{ab}	0.05	$P< 0.05$
DMI (g/kg $W^{0.75}$)	70.96^a	80.70^b	77.55^{ab}	2.03	$P< 0.05$
Digestibility of nutrients (%)					
DM	61.24^a	69.78^b	69.16^b	1.45	$P< 0.01$
CP	53.23^a	69.59^b	73.96^c	1.48	$P< 0.01$
EE	47.83^a	61.60^b	61.60^b	1.55	$P< 0.01$
CF	58.07^a	66.90^b	65.90^b	1.57	$P< 0.01$
NFE	70.13	74.46	74.90	1.44	NS

Digestibility of the nutrients

The digestibility coefficient (%) of various nutrients of experimental kids is presented in Table 3, it is evident that supplementation of concentrate mixture to kids reared under the semi-intensive system has an associative effect on the apparent digestibility of other nutrients. The digestibility of DM, CP, EE, and CF were significantly ($P< 0.01$) improved by concentrate supplementation. The improved digestibility of the supplemented groups might be due to additional nutrient intake by concentrate changes basal feed consumption and associative effect on digestion & retention in the digestive tract. (Bowman and Sowell, 1997) [15]. Concentrate supplementation might be increased rate of rumen ammonia nitrogen production provided desired rumen environment of increased microbial growth this increased microbial growth might have influenced the fibre digestibility (Das *et al.*, 2012) [5]. A similar observation of increased nutrient digestibility of forage due to concentrate supplementation was also reported by (Shah *et al*., 2003 [11]; Das, 2008 [1]; Das, 2009 [4]; Chanjula *et al.*, 2008 [16]; Das *et al*., 2012 [5]; Dutta *et al*., 2020) [17]. The protein digestibility was significantly ($P< 0.01$) higher in T_3 than T_2, credited by urea incorporation in the concentrate mixture. The increase in digestibility might be due to differences in the quantity and route of nitrogen excretion. The excess ruminal ammonia is absorbed and excreted in the urine in the form of urea, decrease faecal count and increased protein apparent digestibility (Chanjula *et al*., 2008) [16].

Table 4: Effect of concentrate supplementation on growth performance and economics

	T_1	T_2	T_3	SEM	Significance
Initial body weight (kg)	9.48	9.60	9.50	0.06	NS
Final body weight (kg)	11.86^a	14.86^b	14.46^b	0.14	$P< 0.01$
Body weight gain in 90 days (kg)	2.38^a	5.26^b	5.03^b	0.13	$P< 0.01$
Average daily gain (g)	26.40^a	58.40^b	55.44^b	1.46	$P< 0.01$
Additional weight gain (kg)	-	2.88	2.60	0.12	NS
Additional feed intake (kg)	-	18	18	-	-
Cost of concentrate feed (Rs./kg)	-	18.90	15.29	-	-
Cost of Additional feed (Rs.)	-	340.20	275.22	-	-
Cost of grazing (Rs.)	300.00	300.00	300.00	-	-
Total feeding cost (Rs.)	300.00	640.20	575.22	-	-
Cost of per kg body weight gain (Rs.)	126.05	121.71	114.36	-	-
Return from live weight gain @ Rs 250 /kg	595	1315	1258	-	-
Net return (Rs.)	295	675	683	-	-
Benefit: Cost ratio	1.98	2.05	2.18	-	-

Economics of feeding

As regards to cost-benefit analysis of experimental goats, since the farmers were providing their labour in management and grazing of goats so its minimum cost @ Rs 100/ per kid/ per month considered in all treatment groups and cost of respected concentrate mixture as additional cost in supplemented groups.

The feeding of only 200 g concentrate along with grazing is beneficial. However, the beneficial effect of concentrate with urea over without urea is little more.

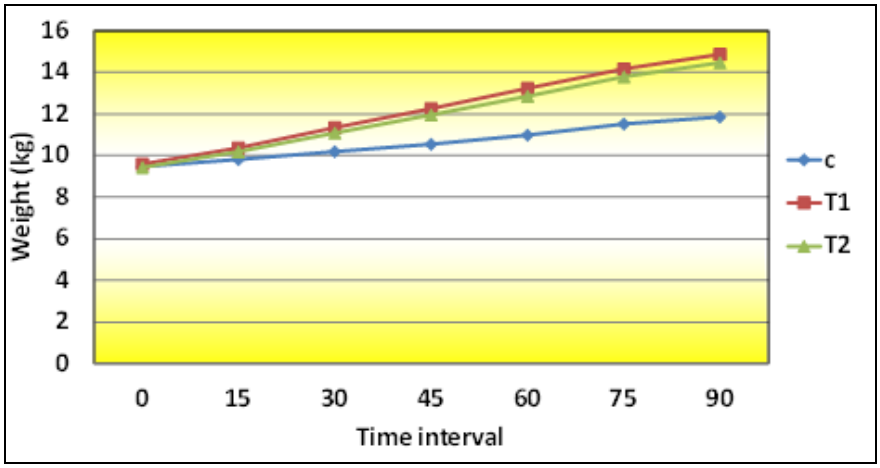

Fig 1: Average body weight in kg of experimental animal at fortnight interval

Conclusion

It may be concluded that when a minimum amount of 200 g concentrate mixture is offered daily to browsing goats it fulfils the nutritional deficiencies of the natural vegetations. This resulted in a higher DM intake, digestibility of nutrients, body weight gain, feed conversion efficiency and reduced cost of feeding per kg gain. When the nitrogenous component of the mixture is replaced by urea at 2% level of concentrate mixture, it has no adverse effect on the parameters studied. This type of feeding system is economical under field conditions.

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