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Influence of vanadium supplementation on growth performance of Barbari goat kids

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Abstract
This study aims to investigate to see the impact of vanadium (V) supplementation inclined on growth performance of Barbari kids. Twenty-one Barbari kids (6 to 12-months) was elected form LRC-2, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, according to their body weight (16.27 ±0.89 kg) and age (6.0±0.15 month months), the goat kids were separated into three groups (n=7) as Control, T_1 and T_2, randomly. Control group was provided a total mixed ration (TMR) basal diet without any supplementation of vanadium. T_1 group was provided TMR basal diet with vanadium @ 1.5 mg/kg DM/kids/day). T_2 group was offered TMR basal diet with vanadium @ 3.0 mg/kg DM/kids/day for 90 days investigational period. Body weight was monitored every fortnight. The body weight gain and feed conversion ratio were calculated using the body weight and feed consumption. Body weight was significantly (p<0.05) difference among the groups over all fortnight of investigational period. In the vanadium-treated groups, body weight and feed consumption were increase significantly (p<0.05) than in the control group. Feed conversion ratio was shows no significant (p>0.05) difference in vanadium supplemented groups during the study period.

Keywords: Barbari kids, vanadium, TMR, body weight, feed consumption

Introduction
India has the world's second- largest goat population, accounts for nearly 3.5 percent of the entire population and generating roughly 19 percent of the country's total meat production. According to the 20th Livestock Census (2019-2020), India's goat population is 148.88 million, accounting for 27.80 percent of the overall livestock population. IGFRI (2013) [4] estimates, the country has a severe fodder shortage in supply-demand to feed livestock. Green fodders from agricultural land and pastures are predicted to be available against a demand of 1012.7 MT by 2050. Similarly, the total availability of dry residues and by-products of grain, commercial crops and dry grass from grazing areas and woods are estimated to provide 547.7 MT of dry fodder, compared to a demand of 631.0 MT. On a per-crop basis, India planted just 8.4 million hectares of fodder. Vanadium (V) has not been reported as an essential mineral in ruminants, although it's well-known role as an insulin-a mimic agent for catalysis enzymatic activities in lower organisms and rat models. Biologists and biomedical specialists have yet to decide on the importance of this element as a micronutrient. Despite its toxicity, it remains essential to investigate the element's many biological functions. Vanadium compounds have been linked to various effects in the development of human illnesses as well as the maintenance of healthy body function. Vanadium salts interrupt a wide range of enzyme systems, including ATPases, protein kinases, ribonucleases and phosphatases. Several genes are regulated by this element or its compounds, including genes for tumor necrosis factor-alpha (TNF-), Interleukin-8 (IL-8), activator protein-1 (AP-1), c-raf-1, mitogen-activated protein kinase (MAPK), p53, nuclear factors-KB and others, while vanadium deficiency accounts for several physiological malfunctions such as thyroid, glucose and lipid metabolism etc. Vanadium imposes in the animals shall be on the same dietary plan except that the respective groups were additionally supplemented with 0.0, 2.5 and 5.0 mg of V/kg dry matter (DM), during the experimental period of 90 days. There was a linear increase (p<0.05) in mean DMI and ADG in the 5.0 mg of V/kg DM-supplemented group (Gupta *et al*. 2020) [2]. Anke (2004) [1] recorded that in the gathering given lower portion of vanadium i.e. < 10 µg V/kg dry matter, the feed admission was 20% less during lactation than the control goats. Vanadium supplementation @ 1, 2 and 3mg V as vanadyl sulphate/animal/daily did not change dry matter intake but adding V improved feed efficiency (p = 0.03) in mahabadi goat

kids (Zarqami *et al*. 2018) [10]. The dietary supplementation of vanadium did not affect the average daily gain in male Sahiwal calves (Singh *et al.* 2020) [7].

Materials and Methods

All the procedures followed in this study were sanctioned by the Institutional Animal Ethics committee, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut. Twenty-one Barbari kids (6-12 months old) were sorted out from LRC-2, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut and arbitrarily distributed into three groups (n=7) after blocking by body weight (16.27 ±0.89 kg) and age (6.0±0.15 month). The diet was provided to the experimental kids in the form of a total mixed ration (TMR). Total mixed ration prepared as per feeding standard and offered daily in the morning (07.00 h), noon (13.00 h) and evening (17.30 h). Kids were fed a TMR without vanadium (control) or with vanadium supplementation at 1.5 mg/kg DM/kids/day (T_1) and 3.0 mg/kg DM/kids/day (T_2) for 90 days of experimental period. Clean and fresh tap water was offered *ad-libitum*. Experimental animals were kept under a conventional housing system. The shed were washed and cleaned daily to prevent the chances of any infections. During the entire period of study, various management practices viz., deworming, washing, grooming and treatment, etc. were followed as per the standard procedure of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut. Body weight was measured by digital electronic balance before the start of the experiment and afterward repeated fortnightly for 90 days of the study period. The offered and refused feeds were recorded daily for the calculation of feed intake. Average daily gain (ADG) was calculated from the BW of the experimental animals by the following formula

BWG = BW of current fortnight – BW of previous fortnight

Feed consumption (FC) was calculated at fortnightly intervals by the given formula

FC = Offered feed – Residual feed

Feed conversion ratio (FCR) was calculated at fortnightly intervals for 90 days of study periods.

FCR = FI (kg) / BWG (kg)

Statistical analysis

Analysis of variance techniques was used to analyze the data using the GLM procedure of SPSS (V20: SPSS Inc., Chicago, IL, USA). Duncan's Multiple Range Test was conducted to compare the means.

Results and Discussion

Body Weight

Table 1 and Figure 1 shows the impact of vanadium supplementation on the body weight of Barbari kids. Initial body weights of the control, T_1 and T_2 groups were 15.39, 16.43 and 16.98 kg, respectively. Final, body weight of the control, T_1, and T_2 groups were 21.20, 22.29 and 23.44 kg, respectively. The respective mean of body weight was recorded 18.26, 19.37 and 20.20 kg, which indicates higher significant (p<0.05) among groups. Vanadium showed a positive effect on body weight. These results were confirmed by earlier findings Zaporowaska and Wasilewski (1989) [2] in rats but Hansard *et al*. (1982) [3] reported that dietary fed of vanadium was not affected in sheep.

Table 1: Effect of vanadium supplementation on body weight (kg) of Barbari kids

Fortnight	Treatment			SEM	P Value		
	Control	T_1	T_2		Contrast	Linear	Quadratic
0	15.39	16.43	16.98	0.89	0.448	0.218	0.828
1	16.27	17.41	18.07	0.89	0.366	0.167	0.828
2	17.15	18.45	19.09	0.87	0.287	0.126	0.759
3	18.03	19.35	20.19	0.86	0.227	0.092	0.817
4	19.43	20.35	21.27	0.92	0.375	0.167	0.996
5	20.32	21.32	22.37	0.92	0.299	0.125	0.980
6	21.20	22.29	23.44	0.91	0.238	0.095	0.978
Mean	18.26^{a}	19.37^{ab}	20.20^{b}	0.89	0.007	0.002	0.789

Control, group without vanadium supplementation; T_1, vanadium supplemented group (1.5 mg/kg DM); T_2, vanadium supplemented group (3.0 mg/kg DM); SEM, Standard error mean

Mean with different superscripts (a and b) in a row differs statistically at (p<0.05)

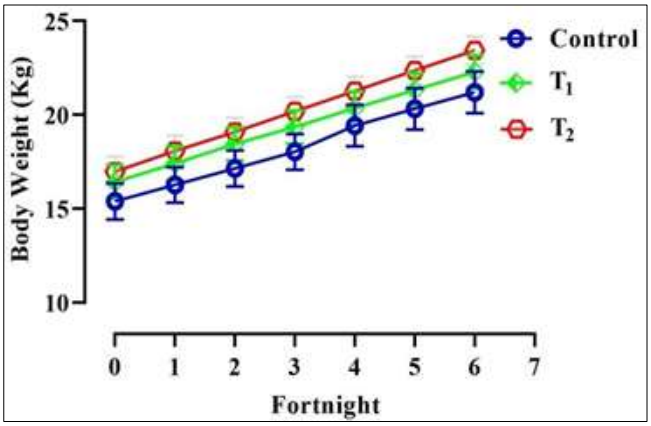

Fig 1: Fortnight changes of body weight supplemented with vanadium

Body Weight Gain

Table 2 and figure 2 shows the effect of dietary vanadium supplementation on body weight growth of Barbari kids. The body weight gain in the first fortnight was 0.058, 0.065 and 0.072 kg/day in the control, T_1 and T_2 groups, respectively, and was significantly greater (p<0.05) in the control and T_2 groups than in the T_1 group.

Table 2: Effect of vanadium supplementation on body weight gain (kg/day) of Barbari kids

Fortnight	Treatment			SEM	P Value		
	Control	T_1	T_2		Contrast	Linear	Quadratic
1	0.058^{a}	0.065^{b}	0.072^{c}	0.001	<0.001	<0.001	0.938
2	0.058	0.069	0.069	0.002	0.138	0.098	0.254
3	0.059^{a}	0.060^{a}	0.073^{b}	0.001	0.002	0.001	0.096
4	0.093	0.066	0.072	0.023	0.599	0.460	0.495
5	0.059^{a}	0.065^{b}	0.073^{c}	0.001	<0.001	<0.001	0.091
6	0.059^{a}	0.065^{b}	0.071^{c}	0.001	<0.001	<0.001	0.878
Mean	0.065	0.065	0.072	0.005	0.253	0.136	0.468

Control, group without vanadium supplementation; T_1, vanadium supplemented group (1.5 mg/kg DM); T_2, vanadium supplemented group (3.0 mg/kg DM); SEM, Standard error mean

Mean with different superscripts (a, b and c) in a row differ statistically at (p<0.05)

At the 3rd, 5th and 6th fortnights of the study period, the body

weight gain in the T_1 and T_2 groups was significantly higher (p<0.05) than in the control group. The total mean body weight gain in the control, T_1 and T_2 groups was 0.065, 0.065 and 0.072 kg/day, respectively but repeated and shows no significant differences (p>0.05) between the three groups. Dietary supplementation of vanadium was affected the body weight gain in Barbari kids. Similar detection was obtained by Kumar *et al*. (2017) [5] in crossbred calves, Gupta *et al*. (2020) [2] and Zarqami *et al.* (2018) [10] @ 1, 2, or 3 mg/kg DM in goat-kids.

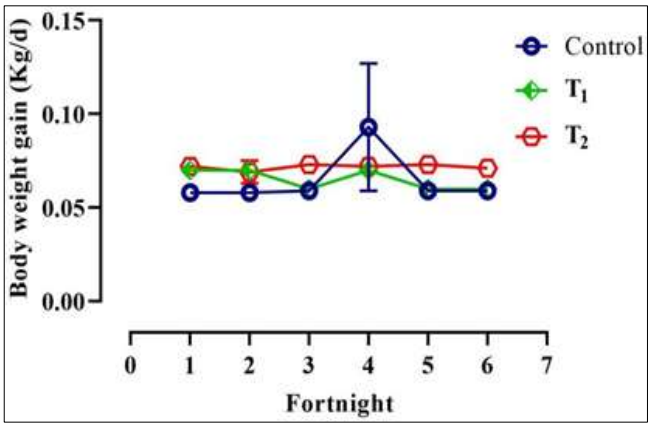

Fig 2: Fortnight changes of body gain weight supplemented with vanadium

Feed Consumption

In Table 3 and Figure 3, the feed consumption of Barbari kids is shown. The feed consumption of the 1st fortnight was 0.28, 0.31 and 0.36 kg/day in the control, T_1 and T_2 groups, respectively, with the T_2 group showing a greater (p<0.05) significance Mean with different superscripts (a, b and c) in a row differ statistically at (p<0.05) than the control and T_1 groups. Similarly, feed consumption indicates a higher (p<0.05) significance of the experimental time on various days. In the control, T_1 and T_2 groups, the average mean was 0.32, 0.36 and 0.41 kg/day, respectively, with higher significant (p<0.05) in all groups. The results are in agreement with Zarqami *et al.* (2018) [10] in goat kids and Gupta *et al.* (2020) [2] reported that vanadium has a positive effect of vanadium on feed consumption in the Hariana heifers, but Anke (2004) [1] reported that the impact of vanadium fed decreases the feed consumption in lactating goats.

Table 3: Effect of vanadium supplementation on feed consumption (kg/day) of Barbari kids

1	Treatment			SEM	P Value		
	Control	T_1	T_2		Contrast	Linear	Quadratic
1	0.28^a	0.31^b	0.36^b	0.02	0.006	0.002	0.778
2	0.29^a	0.33^{ab}	0.38^b	0.02	0.003	0.001	0.811
3	0.31^a	0.35a^b	0.40^b	0.02	0.001	<0.001	0.728
4	0.33^a	0.37a	0.43^b	0.02	0.002	0.001	0.567
5	0.35^a	0.38^a	0.45^b	0.02	0.001	<0.001	0.531
6	0.36^a	0.40^a	0.47^b	0.02	0.001	<0.001	0.508
Mean	0.32^a	0.36^b	0.41^c	0.02	<0.001	<0.001	0.349

Control, group without vanadium supplementation; T_1, vanadium supplemented group (1.5 mg/kg DM); T_2, vanadium supplemented group (3.0 mg/kg DM); SEM, Standard error mean

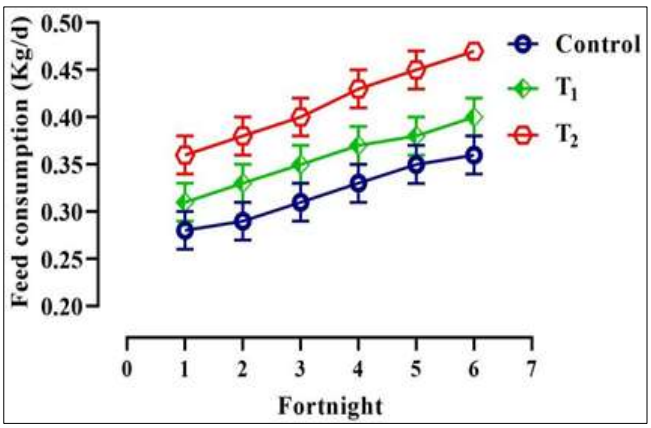

Fig 3: Fortnight changes of feed consumption supplemented with vanadium

The influence of vanadium supplementation in feed conversion ratio is depicted

Feed Conversion Ratio

In Table 4 and Figure 4, the 1st fortnight of the trial, the feed conversion ratios in the control, T_1 and T_2 groups were 4.75, 4.79 and 5.00, respectively. The total mean feed conversion ratios in the control, T_1, and T_2 groups were 5.29, 5.55 and 5.88, respectively, indicating that there was no significant (p>0.05) difference in the all - fortnight interval and the overall mean among groups. It is obvious from the present study that the dietary fed of vanadium was declined the feed conversion ratio in goat kids. The results of the current study are in accordance with Wang *et al.* (2016) [8] in poultry and Gupta et al. (2020) [2] were reveal that the feed conversion ratio does not affect by vanadium supplementation dose with 2.5 or 5.0 mg/kg DM in the Hariana heifers. Singh *et al.* (2020) [7] who also reported that the impact of vanadium supplementation does not have an impact on feed conversion ratio in Sahiwal heifers.

Table 4: Effect of vanadium supplementation on a feed conversion ratio of Barbari kids

Fortnight	Treatment			SEM	P Value		
	Control	T_1	T_2		Contrast	Linear	Quadratic
1	4.75	4.79	5.00	0.25	0.748	0.482	0.789
2	4.99	4.88	6.12	0.59	0.403	0.270	0.442
3	5.21	5.99	5.55	0.37	0.400	0.544	0.230
4	4.86	5.54	5.88	0.36	0.230	0.096	0.747
5	5.82	5.92	6.10	0.27	0.765	0.476	0.911
6	6.14	6.20	6.60	0.29	0.494	0.278	0.648
Mean	5.29	5.55	5.88	0.35	0.073	0.023	0.885

Control, group without vanadium supplementation; T_1, vanadium supplemented group (1.5 mg/kg DM); T_2, vanadium supplemented group (3.0 mg/kg DM); SEM, Standard error mean

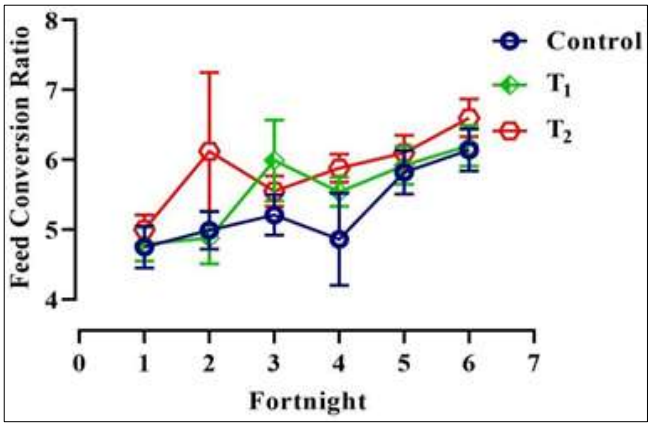

Fig 4: Fortnight changes of feed conversion ratio supplemented with vanadium

Conclusions

The dietary of vanadium supplementation increased body weight, body weight gain, feed consumption and decreased feed conversion ratio. The results indicates that vanadium supplementation might improve the growth of Barbari kids.

Acknowledgments

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