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Effect of feeding Moringa leaves to Sirohi goat kids on their growth performance

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Abstract
The goal of the current study, "Effect of feeding Moringa leaves to Sirohi goat kids on their growth performance," was to determine how feeding Sirohi goat kids concentrate mixtures and Moringa leaves would affect their growth. At the goat farm Krishi Vigyan Kendra in Kota, twenty-four Sirohi goat kids aged one month were randomly chosen and put into three groups, each with eight kids, based on their similar ages and body weights. *Trifolium alexandrinum*, also known as berseem, was employed as roughage, ready-made commercial feed served as a concentrate, and moringa leaves served as an experimental diet for Sirohi goat kids. Berseem was used *ad libitum* during the whole study period in all treatments, supplementing the T_1 (control) group with 100% concentrate, the T_2 group with 75% concentrate plus 25% moringa leaves, and the T_3 group with 50% concentrate plus 50% moringa leaves. Children received berseem feeding in addition to an experimental meal enriched with concentrate and Moringa leaves @ 1.5% of live body weight. The findings demonstrated a considerable rise in the kids' consumption of dry matter across all groups. Goat kids in the T_3 group saw greater total body weight changes and average daily body weight gains than those in the T_2 and T_1 (control) groups. It was determined that feeding Sirohi goat kids, Moringa leaves and a concentrate combination increased their body weight, average daily weight growth, and feed consumption.

Keywords: Body weight, concentrate, Moringa leaves, Sirohi goat kids

Introduction
More than 70% of Indians depend on agriculture for their way of life, which also supports the country's general economic growth. Agriculture is the backbone of the Indian economy. Agriculture and livestock are intimately related, and goats are an important livestock animal everywhere in the globe, but particularly in subsistence agriculture in developing nations, where more than 90% of the world's goat population is situated. The "poor man's cow" goat has a great chance of becoming the "Animal of the Future" for rural wealth. The goat system is a business in which minimal capital inputs and better economic returns are the distinguishing characteristics of small and marginal goat farming systems (Devendra, 2013) [7]. The growth performance of goat kids is an essential component in increasing profitability in goat farming for the production of goat meat (Chevon).

India has the highest goat population of any country in the world. The goat is the most powerful animal, and it is the last to die in times of drought and hunger. Goats are flexible and versatile creatures. They can survive on a wide range of grasses and tree leaves. It is also generally known that goats outperform other ruminants in terms of nutrient utilization efficiency. The Sirohi breed is a domestic dual purpose goat breed from India. It was called for its birthplace, the Sirohi region of Rajasthan in northwestern India. It is mostly raised for milk and meat. It thrives in the dry tropical environment of Rajasthan.

The paucity and variable quality and quantity of feed supplies year after year is a key barrier to animal production in poor nations. Farmers typically sought to give their animals agricultural leftovers and low-quality hay, which are low in nitrogen and high in lingo-cellulose (Sultana *et al*., 2015) [18] and low in vitamin and mineral contents, resulting in lower voluntary intake and low digestibility (Gerbregiorgis *et al.*, 2012) [9]. Poor quality roughages supplied to ruminants without supplementation, particularly during the dry season, caused a variety of illnesses, weight losses, and even mortality in certain cases (Tona *et al*., 2014) [19].

Using shrubs and fodder trees during the dry season might be a viable technique for boosting the quality and quantity of feeds for resource-constrained livestock farmers. Moringa trees provide a rich source of protein and micronutrients at a low cost (Moyo *et al*., 2012) [15]. *Moringa oleifera* tree is a fast-growing, drought-tolerant, multi-purpose, and one of the most beneficial trees in the world due to its nutritional and therapeutic capabilities and is thus referred to as a 'miracle tree'.

Materials and Methods

The research was conducted at the goat farm, Krishi Vigyan Kendra, Kota, and the Agriculture University, Kota. Twenty-four clinically healthy Sirohi goat kids of either sex were randomly allocated to three groups (n=8) and were of relatively uniform age groups (one month) or body weight (7.25±0.052). Throughout the whole trial period, all treatments provided an experimental food (concentrate + moringa leaves) @1.5% BW/kid/d once a day at 10:00 A.M.

Feeding of experimental diets for experimental kids

No. of animal	Groups	Experimental diet	Berseem feeding
24 Sirohi goat kids	T1 (Control), 8 kids	100% concentrate	*Ad libtum*
	T2, 8 kids	75% concentrate+25% Moringa leaves	*Ad libtum*
	T3, 8 kids	50% concentrate+50% Moringa leaves	*Ad libtum*

T1 (control) group received 100% concentrate, T2 group received 75% concentrate + 25% Moringa leaves, and T3 group received 50% concentrate + 50% Moringa leaves. Table 1 shows the chemical makeup of the concentrate combination and moringa leaves. All experimental groups received a baseline diet containing berseem ad libitum twice daily (10:30 A.M. and 4:00 P.M.) and had free access to water.

Table 1: Chemical composition of Moringa leaves and Concentrate (on % DM basis) fed to experimental Sirohi goat kids

Chemical composition %	Moringa leaves	Concentrate feed
Dry matter	85.61	90.39
Crude protein	25.61	19.69
Crude fibre	9.16	6.22
Ether Extract	5.7	3.8
Total Ash	10.23	10.49

At fortnightly intervals up to 13 weeks after the experiment began (from one month of age), the body weight of each experimental child was weighed separately early in the morning before providing the meal. Weighing was done with a digital electric weighing machine (with a maximum capacity of 150.00 kg and a minimum capacity of 0.20 kg). Sirohi kids average weekly weight gain (AFG) was calculated using the following formula:

Average fortnightly weight gain (Kg/fortnight) = Final body weight of the fortnight (kg) – Body weight of previous fortnight (kg)

Growth rate of Sirohi kids was calculated by the following formula:

$$\text{Growth rate (g/day)} = \frac{W_2 - W_1}{T1 - T2}$$

Whereas:
W_1 = Initial body weight of kids
W_2 = Final body weight of kids
T1 & T2 = Respective age

Statistical investigation

RBD standard statistical procedures were used for the statistical analysis, and ANOVA was calculated. Fisher and Yates (1950) proposed this formula. Superscripts are used when there is a substantial difference in means using the DMRT approach. Duncan's new multiple range test (DMRT) is a multiple comparison process created in 1955 by David B. Duncan.

Results and Discussion

Chemical composition of experimental diets

Table 1 shows the percent chemical contents of Moringa leaves and concentrate combination. Moringa leaves included dry matter (85.61%), crude protein (25.61%), ash (10.23%), ether extract (5.7%), crude fibre (9.16%), and concentrate mixture contained dry matter (90.39%), crude protein (19.69%), ash (10.49%), ether extract (3.8%), crude fibre (6.22%), and concentrate mixture contained crude fibre (6.22%). The crude protein content of moringa leaves used in this study was comparable to the values obtained by Sanchez *et al*. (2006b) [7], Manh *et al*. (2005) [13], and Fadiyimu *et al*. (2010) [3], but higher than the values reported by Aregheore *et al*. (2002) [1] and Kakengi *et al*. (2005) [10], respectively (19.3 and 19.5% in DM). The nutritious content of moringa leaves may vary depending to harvesting age, soil type and fertility, proportion of leaf and stem, and agro-ecological zone where moringa trees thrive.

Average fortnightly feed intake

Table 2 shows the effect of moringa leaves combined with concentrate feed on feed intake in Sirohi goat kids. DMI increased considerably (p>0.05) in the T3 group compared to the T2 and T1 (control) groups. Sirohi goat offspring in T1 (control), T2, and T3 groups had DMIs of 166.43±1.24, 175.29±1.39, and 181.57±1.50 g/d, respectively. Sultana *et al*. (2015) [18] found a rise in DMI, as did Asaolu *et al*. (2012) [2], Kholif *et al*. (2016) [11], Demor *et al*. (2017) [6], Choudhary *et al*. (2017) [5], and Meel *et al*. (2018) [4]. Authors Moyo *et al*. (2012) [15] and Tona *et al*. (2014) [19], on the other hand, reported no change in DM consumption. Dry matter intake (DMI) is a significant driver of energy intake and performance in ruminants and is an essential element in their feed (Devendra, 1997) [7].

Table 2: Average dry matter intake (gm/day) fortnightly in all experimental groups

Age of kids (days)	T1 (Mean ± SE)	T2 (Mean ± SE)	T3 (Mean ± SE)	Total (Mean ± SE)
30	109±0.279	108±0.468	109±0.400	109±0.199
45	125±0.223	127±0.406	129±0.340	127±0.202
60	147±0.252	152±0.297	156±0.233	151±0.158
75	165±0.220	177±0.354	182±0.334	175±0.232
90	189±0.294	203±0.311	210±0.245	201±0.215
105	207±0.172	222±0.308	232±0.187	220±0.158
120	223±0.174	238±0.281	253±0.238	238±0.164

Significant at 5% level

Fortnightly body weight changes

Table 3 shows the effect of combining moringa leaves with a

concentrate combination on body weight changes in kids. The average beginning body weight of the kids in treatment groups T1 (control), T2, and T3 was 7.26±0.072, 7.23±0.120, and 7.25±0.102 kg, respectively. The average end body weights of treatment groups T1 (control), T2, and T3 were 14.89±0.046, 15.86±0.073, and 16.88±0.061 kg, respectively. T3 (9.63±0.96 kg) had the greatest change in overall body weight, followed by T2 (8.64±0.92 kg) and T1 (control) (7.63±0.096 kg). Our findings support the findings of Choudhary *et al*. (2017) [5], who discovered that the body weight of experimental does grew progressively with increasing levels of moringa leaf supplementation in the diet. Meel *et al*. (2018) [4], Demor *et al*. (2017) [6], Babeker and Bdalbagi (2015) [4], Melesse *et al*. (2015) [3], and Sultana *et al*. (2015) [18] also found that feeding dried Moringa (*Moringa oleifera*) leaves instead of concentrate mixture improved body weights and average daily body weight gain in goat kids without affecting feed intake. In contrast to our findings, Mushi *et al*. (2009) [16] and Mahgoub *et al*. (2005) [12] discovered that increasing the concentration of concentrate in the diet boosted goat growth rate. The higher total body weights seen in the 50% concentrate combination + 50% Moringa leaves fed groups may be attributable to the larger quantity of Moringa leaves in this group, because Moringa leaves have higher protein quality, palatability, and protein content. The lowest growth rate achieved in this research from the sole concentrate feeding group might be attributed to a lack of fibre in the diet.

Table 3: Fortnightly body weight variations (kg) in Sirohi goat kids fed an experimental diet (n = 24)

Age of kids (days)	T1 (Mean ± SE)	T2 (Mean ± SE)	T3 (Mean ± SE)	Total (Mean ± SE)
30	7.26±0.072	7.23±0.120	7.25±0.102	7.25±0.052
45	8.35±0.057	8.44±0.104	8.58±0.089	8.45±0.052
60	9.80±0.064	10.10±0.078	10.38±0.060	10.09±0.042
75	10.99±0.058	11.79±0.092	12.15±0.085	11.64±0.059
90	12.63±0.075	13.55±0.080	13.98±0.063	13.38±0.054
105	13.83±0.044	14.80±0.080	15.46±0.049	14.70±0.042
120	14.89±0.046	15.86±0.073	16.88±0.061	15.88±0.043
Overall changes	7.63^{c}±0.096	8.64^{b}±0.092	9.63^{a}±0.096	8.63±0.093

Non-significant at 5% level

Average fortnightly weight gain

The average fortnightly weight gain in kg (Table 4) of Sirohi kids was about greater in the T3 group than in the T2 and T1 (control) groups. Moringa leaves had no influence on weekly weight increase (P≤0.05) in the T1 (control), T2, and T3 groups. Previous research by Moyo *et al*. (2012) [15], Tona *et al*. (2014) [19], Babeker and Bdalbagi (2015) [4], Demor *et al*. (2017) [6], and Meel *et al*. (2018) [4] found that eating moringa leaves significantly boosted body weight gain in goat kids.

Table 4: Average fortnightly weight gain (kg) in Sirohi goat kids fed an experimental diet (n = 24)

Age of kids (days)	T1 (Mean ± SE)	T2 (Mean ± SE)	T3 (Mean ± SE)	Total (Mean ± SE)
45	1.09±0.108	1.21±0.081	1.33±0.088	1.21±0.050
60	1.45±0.070	1.66±0.157	1.80±0.107	1.64±0.083
75	1.19±0.106	1.69±0.101	1.78±0.084	1.55±0.062
90	1.64±0.147	1.76±0.120	1.83±0.089	1.74±0.046
105	1.20±0.135	1.25±0.045	1.49±0.113	1.31±0.063
120	1.06±0.102	1.08±0.031	1.41±0.045	1.18±0.046

Non-significant at 5% level

Average daily body weight gain

The average fortnightly weight increase in kg (Table 5) of Sirohi kids was about greater in the T3 group compared to the T2 and T1 (control) groups. The overall impact of Moringa leaves on fortnightly weight increase was non-significant (P≤0.05) across the T1 (control), T2, and T3 groups. Previous research by Moyo *et al*. (2012) [15], Tona *et al*. (2014) [19], Babeker and Bdalbagi (2015) [4], Demor *et al*. (2017) [6] and Meel *et al*. (2018) [4] found that feeding moringa leaves boosted body weight gain in goat babies. There were no negative health effects when standard concentrate was replaced with dried Moringa leaves during the experiment.

Table 5: Growth performance of Sirohi goat kids during experimental period

		Treatments		
Attributes	**T1**	**T2**	**T3**	**SEM**
Initial weight (kg)	7.26±0.072	7.23±0.120	7.25±0.102	0.052
Final weight (kg)	14.89±0.046	15.86±0.073	16.88±0.061	0.043
Total gain (kg)	7.63±0.096	8.64±0.092	9.63±0.096	0.056
Average daily gain (g/day)	84.72±0.322	95.97±0.305	106.94±0.320	0.187

Non-significant at 5% level

Conclusion

According to the findings of this study, feeding Moringa (*Moringa oleifera*) leaves with a concentrate combination boosted body weights and average daily body weight gain in Sirohi goat kids without compromising feed intake or general health.

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