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Effect of replacing concentrate mixture with *Moringa (Moringa Oliefera*) leaf meal on blood biochemical in Gir calves

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Abstract
This study was conducted to investigate the impact of dietary supplementation of *Moringa* leaf meal on blood biochemical in Gir calves. A total of 20 Gir calves with similar body weight of either sex at 4-6 months age selected and randomly assigned in four experimental groups with five animals in each group. Experiment was continued up to 120 days. *Moringa* leaf meal replacing crude protein requirement were 75% (T_2), 50% (T_3) and 25% (T_4) by the concentrate mixture, respectively. Analysis of variance did not reveal statistically significant ($p \geq 0.05$) for blood biochemical parameter viz., total protein (g/dl), albumin (g/dl), globulin (g/dl), ALT (IU/L), AST (IU/L) among all the groups and found within the normal physiological range throughout the experimental period. Overall mean serum cholesterol was significantly ($p<0.05$) lower in supplemented group than control group, while triglyceride was significantly ($p<0.05$) higher in T_3 group than control group. There was significantly ($p<0.05$) lower in T_2 than control group.

Keywords: *Moringa leaf* meal, Gir calves, blood biochemical, economics

Introduction
The farmers feel burden to raise calves as it is considered uneconomical, largely due to economic compulsion to sell milk for human consumption and perhaps not realizing the potential values of these animals in their adulthood. Thus, it results in underfeeding or starvation with consequence of stunted growth, heavy mortality, economics losses in livestock production. Smallholder dairy farmers experience high calf mortality which can go up to 50% (Moran, 2011) [8]. Nutrition is the most important part of calf management. Poor growth rate of the calf is usually attributed by inadequate feeding due higher cost of feeds. The feeding of any forage is a characteristics feature of the animals, as it depends on the accessibility and nutrient availability (Dubey *et al.*, 2013) [4]. The potential of tree leaves to supply considerable amounts of protein and energy are well recognized. The estimates by different group of workers have consistently pointed out the deficit of the feed resources for livestock in terms of dry roughages, greens and concentrates. Conventional sources of feeds are not enough to mitigate the shortage of feeds and fodder and to make animal production viable and profitable. The gap between the demand and supply also increases year by year (Portugaliza *et al*., 2012) [11]. In order to bridge this gap and to ensure optimum production of livestock throughout the year, use of unconventional feed resources as supplement or replacement of conventional feed has been practiced without compromising the quality of feed for nutrients (Ogbe and John, 2012) [9].

Moringa oleifera is commonly used as animal feed, with its leaves being the preferred component for feeding animals in the form of leaf meal. *Moringa oleifera* is widespread and readily accessible in India. The tree is cultivated in India for both human food and animal feed (Anjorin *et al*., 2010) [2]. Leaves are often considered a protein source. The protein content of fodder varies from 15% to 30% on a dry matter basis, depending on the stage of maturity and the proportions of leaflets, petioles, and stems.

Moreover, *Moringa* leaves possess a high biological value and show outstanding promise as a feed source for ruminant animals as it contain a wide range of essential nutrients such as protein, amino acids, fatty acids, minerals, vitamins, calcium, potassium, phenolics, and oxycarotenoids, which are fundamental components of the animal body (Pradhan, 2016) [10]. These nutrients play a crucial role in osmotic adjustment, enzyme activation, growth hormone regulation, and other organic processes that contribute to growth, functionality, and the overall maintenance of life (Anjorin *et al*., 2010) [2].

Materials and Methods

The present study was conducted at Cattle Breeding Farm, KU, Junagadh, Gujarat, after obtaining permission from Institutional Animal Ethics Committee (JAU/JVC/IAEC/LA/29/2017). Twenty Gir calves of similar body weight and age were selected and randomly assigned in to four experimental groups with five animals in each group and offered nutritional requirements as per ICAR (2013) [6]. *Moringa* leaves were collected from the locally available *Moringa* plots nearer to Junagadh, Gujarat. Collected *Moringa* leaves were sun dried on thick plastic sheets and used for feeding. The control group was fed a basal diet (ISI grade-I concentrate mixture + seasonal green fodder @ 3 kg/calf/day, dry fodder ad-lib) without supplementation (T_1). The other treatment groups were fed the basal diet supplemented dry *Moringa* leaf meal with replacing total requirement of crude protein at @ 25% (T_2), 50% (T_3) and 75% (T_4), respectively. A detail of experimental diet is presented in Table 1. Experiment was continued up to 120 days. To determine the actual intake of nutrients by experimental Gir calves, representative sample of pelleted compound concentrate mixture, green Jowar, groundnut haulms, ground maize grain and *Moringa* leaf meal were taken and dry matter content of the samples was determined by keeping them in hot air oven for 24 hours at 1000 °C. Representative samples of feeds and fodder were analysed for proximate composition (AOAC, 2023) Presented in Table 2. All the experimental calves were housed in a well-ventilated shed and tying arrangements with facility of individual feeding. Experimental Gir calves of all groups were individually offered pelleted compound concentrate mixture every morning at 7:30 a.m. Seasonal green fodder (Green Jowar) was offered @ 5 kg at 10:30 to 11:00 a.m. after chaffing while dry fodder (groundnut haulms) was offered ad-lib at 5:30 p.m.

Table 1: Grouping of experimental animals and their diet

Group	Treatments	Total of animals
T_1 (Control)	Basal diet (CP requirements from ISI grade-1 Conc. Mixture+ Seasonal green Fodder 3 kg/calf/day, Dry fodder ad-lib)	05
T_2	25% CP requirement from Basal diet and 75% CP requirement form *Moringa* leaf meal	05
T_3	50% of CP requirement from Basal diet and 50% CP requirement form *Moringa* leaf meal	05
T_4	75% of CP requirement from Basal diet and 25% from *Moringa* leaf meal	05

Blood samples were collected in without anticoagulant tube for separation of serum and kept in slant position. These tube were incubated for 1 hours at 37° C and then after centrifuged at 2500 rpm for 30 minutes. Serum was pipetted out in small Pyrex tube and kept for analysis. Total Cholesterol, Triglyceride, total protein, albumin, globulin, ALT, AST were estimated from serum samples using standard kits on automatic biochemistry analyzer at the Department of Veterinary Pathology, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Junagadh. Design of experiment was Completely Randomized Design. The Statistical analysis of experimental data was carried out by one way ANOVA. Pair wise difference of means were compared by Duncan's Multiple Range Test (DMRT) and considered significance at $p<0.05$.

Results

Table 2: Proximate composition of feed and fodders (on% DM basis) used in experiment

Nutrients	Concentrate	Green Jowar	Groundnut haulms	Ground Maize grain	*Moringa* leaf meal
DM	90.30	24.30	97.83	91.00	90.86
CP	20.40	05.58	09.82	10.80	25.31
CF	10.60	32.00	27.80	02.97	14.95
EE	03.65	02.90	02.97	03.41	6.21
NFE	52.80	51.60	34.50	80.20	44.17
Total Ash	12.40	07.87	25.36	02.57	8.76

Data of chemical composition of feeds and fodder used in experiments was presented in table 2. Result showed that *Moringa* leaf meal had higher content i.e. of 25.31% CP. Hamza *et al*. (2023) [5] found chemical analysis of *Moringa oleifera* leaf meal (MOLM) was 25.16% CP, 6.34% EE, 14.24% CF, whereas, Shankhpal, *et al*. (2019) [12] found the values of *Moringa oleifera* leaves as CP 18.25%, EE 3.42%, CF 29.03% and Total Ash 9.18%. Damor *et al*. (2017) [3] also reported chemical composition of the *Moringa oleifera* leaves was 26.33% crude protein, 8.82% crude fibre 5.76% ether extract and 14.1% total ash. The variations in nutritive value of *Moringa* leaf meal could be due to the agro-ecological zone where plantation was cultivated, type of soil, stage of harvesting and proportion of leaf and stem.

Table 3: Effect on *Moringa* leaf meal on serum albumin (g/dl) in Gir calves under different treatment groups

Days	T_1 (C)	T_2	T_3	T_4
0	2.51±0.09	2.54±0.12	2.49±0.04	2.60±0.09
60	3.11±0.04	3.02±0.04	3.01±0.03	3.05±0.02
120	3.22±0.05	2.18±0.02	3.22±0.02	3.36±0.04
Overall	2.95±0.06	2.58±0.06	2.91±0.03	3.00±0.05

Mean value of serum albumin (g/dl) in different treatments was presented in Table 3. Overall mean value of serum albumin (g/dl) was 2.95±0.0, 2.91±0.06, 2.91±0.03 and 3.00±0.05 respectively for T_1, T_2, T_3 and T_4 groups. There was non-significant ($p>0.05$) difference was observed between treatments groups and the serum albumin values were within the normal physiological range of the calves. The concentration of albumin found in the present study was in disagreement with the value reported by Damor *et al*., (2017) [3]. They reported that feeding *Moringa* leaves to Mehsana kid was significantly ($p<0.05$) higher serum albumin level in supplemented groups than control group. Kekana *et al*. (2019) [7], concluded that, Micro-supplementation of *Moringa oleifera* leaf meal in lactating dairy cows had significantly higher serum albumin concentration value in 60g/cow/day supplemented group than control and 30g/cow/day supplemented group. Aharwal *et al*. (2019) [1] reported non-significant ($p>0.05$) effect of serum albumin (g/dl) level in

Murrah buffalo calves supplemented with *Moringa* leaf meal. Shankhpal *et al*. (2019) [12] observed that effect of feeding *Moringa oleifera* as a green feed on serum albumin (g/dl) were non-significant (p>0.05) in crossbred cows.

Table 4: Effect on *Moringa* leaf meal on Serum globulin (g/dl) in Gir calves under different treatment groups

Days	T_1 (C)	T_2	T_3	T_4
0	3.56±0.04	4.26±0.02	4.40±0.04	4.31±0.05
60	4.33±0.02	4.22±0.04	4.27±0.04	4.28±0.03
120	4.44±0.03	5.46±0.03	4.17±0.02	4.16±0.05
Overall	4.11±0.03	4.64±0.03	4.28±0.03	4.25±0.02

Mean value of serum globulin (g/dl) in different treatments was presented in Table 4. Overall mean value of serum globulin (g/dl) was 4.11±0.03, 4.64±0.03, 4.28±0.03 and 4.25±0.02 respectively for T_1, T_2, T_3 and T_4 groups. There was non-significant (p>0.05) difference was observed between treatments groups and the serum globulin concentration were within the normal physiological range of the calves. Kekana *et al*. (2019) [7], recorded that there was non-significant (p>0.05) difference observed in serum globulin concentration (g/dl) in lactating dairy cows between the *Moringa oleifera* supplemented group and control group. Similarly globulin concentration in Murrah buffalo calves which were fed with *Moringa oleifera* leaf meal had non-significant (p>0.05) effect was observed between supplemented group and control group reported by Ahrwal *et al*. (2019). The concentration of serum globulin (g/dl) found in present study was in agreement with the values reported by Shankhpal *et al*. (2019) [12]. They reported that feeding of *Moringa oleifera* as a green feed to crossbred cows had no significant (p>0.05) effect on serum globulin (g/dl) concentration.

Table 5: Effect on *Moringa* leaf meal on serum total protein (g/dl) in Gir calves under different treatment groups

Days	T_1 (C)	T_2	T_3	T_4
0	6.07±0.03	6.80±0.03	6.89±0.04	6.91±0.04
60	7.44±0.05	7.24±0.08	7.28±0.07	7.33±0.05
120	7.66±0.04	7.64±0.03	7.49±0.03	7.52±0.09
Overall	7.06±0.04	7.22±0.07	7.22±0.05	7.25±0.06

Mean value of serum total protein (g/dl) in different treatments was presented in Table 5. Overall mean value of serum total protein (g/dl) was at start of the experiment was 6.07±0.03, 6.80±0.03, 6.89±0.04 and 6.91±0.04 and end of the experiment was 7.66±0.04, 7.64±0.03, 7.49±0.03 and 7.52±0.09 respectively for T_1, T_2, T_3 and T_4. Overall mean value of Serum Total Protein was 7.06±0.04, 7.22±0.07, 7.22±0.05 and 7.25±0.06respectively for T_1, T_2, T_3 and T_4. A non-significant difference found between different treatment groups. Aharwal *et al.*, (2019) [1] there was non-significant difference in mean value of total protein among the group, however, inclusion of *Moringa* had no negative effect on serum total protein concentration in Murrah buffalo calves. In contrarily our finding Damor *et al.*, (2016) observed that feeding *Moringa* leaves had significant (p<0.05) effect on total protein of Mehsana goat kid. Kekana *et al*. (2019) [7], who found that serum total protein concentration in lactating dairy cows was significantly (p<0.05) higher in *Moringa oleifera* leaf meal supplemented groups than control group. Shankhpal *et al*. (2019) [12] suggested that, feeding *Moringa oleifera* as a green fodder had non-significant (p>0.05) effect on serum total protein concentration in crossbred cows.

Table 6: Effect on *Moringa* leaf meal on serum cholesterol (mg/dl) in Gir calves under different treatment groups

Days	T_1 (C)	T_2	T_3	T_4
0	139.09±0.27	138.74±0.27	138.78±0.28	139.09±0.33
60	141.06±0.53	140.12±0.36	139.76±0.22	140.17±0.35
120	142.05±0.30	140.68±0.22	140.68±0.33	140.79±0.31
Overall	140.73±037^b	139.85±0.28^a	139.74±0.28^a	140.02±0.33^a

^{ab} Means in a row with different superscripts different significant (p<0.05).

Overall mean value of Serum Cholesterol was140.73±037, 139.85±0.28, 139.74±0.28 and 140.02±0.33 respectively for T_1, T_2, T_3 and T_4, presented in Table 6 There was significant (p<0.05) difference between groups however, Serum Cholesterol level was significantly lower T_3 group followed by T_2 and T_4 group than T_1 group. Abdel-Raheem and Hassan, (2021) reported that, Dietary inclusion of *Moringa oleifera* leaf meal significantly decreased the concentrations of serum cholesterol in growing buffalo calves. Similar to the present finding, Damor *et al.*, (2017) [3] recorded lower serum concentration in Mehsana goats fed *Moringa* leaves in their diet and Kekana *et al.*, (2019) [7] also reported that, *Moringa* supplementation significantly (p<0.05) reduced blood cholesterol levels in lactating dairy cows. Present finding was disagreement with Sankhpal *et al*. (2019), they reported that, total cholesterol was non-significantly affect by feeding *Moringa oleifera* as a green fodder in crossbred cows.

Table 7: Effect on *Moringa* leaf meal on Serum Alanine Aminotransferase (ALT) (U/L) in Gir calves under different treatment groups

Days	T_1 (C)	T_2	T_3	T_4
0	22.18±0.15	21.43±0.19	21.94±0.10	22.40±0.07
60	21.77±0.17	21.12±0.16	21.80±0.08	22.01±0.08
120	21.45±0.14	21.53±0.17	21.43±0.11	21.39±0.07
Overall	21.80±0.15	21.03±0.17	21.72±0.10	21.93±0.07

Mean value of serum total alanine aminotransferase concentration (U/L) in different treatments was presented in Table 7. Overall mean value of ALT was 21.80±0.15, 21.03±0.17, 21.72±0.10 and 21.93±0.07respectively for T_1, T_2, T_3 and T_4. There was non-significant (p>0.05) difference between treatments group. There was maximum overall serum ALT in T_1 group followed by T_3 group. This finding was agreement with values reported by Damor *et al.*, (2017) [3]. They reported that feeding *Moringa* leaves to Mehsana kids had no significant (p>0.05) effects on serum ALT concentration.

Table 8: Effect on *Moringa* leaf meal on serum aspartate aminotransferase (AST), (U/L) in Gir calves

Days	T_1 (C)	T_2	T_3	T_4
0	23.26±0.1	23.58±0.11	23.75±0.03	23.76±0.04
60	22.55±0.18	22.66±0.13	22.80±0.05	22.38±0.22
120	22.13±0.21	22.07±0.16	21.91±0.26	21.54±0.17
Overall	22.65±0.16	22.77±0.13	22.56±0.11	22.56±0.14

Mean value of serum aspartate aminotransferase concentation (g/dl) in different treatments was presented in Table 8. Overall mean of AST was 22.65±0.16, 22.77±0.13, 22.56±0.11and 22.56±0.14respectively for T_1, T_2, T_3 and T_4. There were non-significant difference between different treatment groups. In contrast, Damor *et al.*, (2017) [3] recorded that feeding of *Moringa* leaves to Mehsana goats significantly

(p<0.05) increase serum AST concentration than control group.

Table 9: Effect on *Moringa* leaf meal on serum triglyceride (mg/dl) in Gir calves

Days	T_1 (C)	T_2	T_3	T_4
0	43.37±0.21	43.53±0.16	43.41±0.17	43.49±0.13
60	44.17±0.25	44.41±0.24	43.87±0.09	44.44±0.14
120	44.62±0.24	44.93±0.19	44.51±0.21	45.11±0.04
Overall	44.05±0.23^{ab}	44.29±0.20^{b}	44.35±0.16^{a}	44.35±0.10^{b}

^{ab}Means in a row with different superscripts different significant (p<0.05).

Mean value of serum triglyceride concentration (mg/dl) in different treatments was presented in table 9.Overall mean of serum triglyceride was 44.05±0.23, 44.29±0.20, 44.35±0.16 and 44.35±0.10 respectively for T_1, T_2, T_3 and T_4. There were significant (p<0.05) difference between treatment groups. Maximum overall average serum triglyceride was in T_3 group and minimum overall average serum triglyceride was in T_1 group. Shankhpal *et al*. (2019) [12] concluded that serum triglyceride (mg/dl) in crossbred cows was non-significantly (p>0.05) affected by *Moringa* as as a green fodder.

Conclusions

Present study concluded that *Moringa oleifera* is palatable and is a highly nutritious fodder with antioxidant properties, which has reflected on the overall improvement of health. There were non-significant effect of dietary supplementation of *Moringa* leaf meal on blood biochemical of total protein (g/dl), albumin (g/dl), globulin (g/dl), ALT (IU/L), AST (IU/L) in Gir calves. Overall mean serum cholesterol was significantly (p<0.05) lower in supplemented group than control group among all the groups and found within the normal physiological range throughout the experimental period.

Conflict of Interest

Not available

Financial Support

Not available

Reference

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