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Research Article

Effect of Feeding Dry Sajina (*Moringa oleifera*) Leaves on Growth Performance and Relative Cost of Feeding in Crossbred Calves

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Abstract

An experiment was carried out to evaluate the effect of feeding dry Moringa oleifera leaf meal (MOLM) on growth performance and cost of feeding. Twenty four numbers of crossbred calves of same age group were selected irrespective of sex and distributed randomly into four groups (T_0, T_1, T_2 and T_3) of six animals in each group. 84 days feeding trial was carried out. The control group (T_0) was fed with conventional feed comprising concentrate mixture, green grass (Napier) and paddy straw. The treatment groups were fed with roughage (green and dry roughage) same as control and iso-nitrogenous concentrate mixture with inclusion of 5% MOLM in T_1, 10% MOLM in T_2 and 15% MOLM in T_3.

The feed intake was not affected due inclusion of MOLM in calves diet. However, total body weight gain, average fortnightly and daily gain differed significantly among the groups and highest observed in T_3 group followed by T_2, T_1 and T_0. Significantly ($P < 0.05$) better FCE was observed with the increasing level of MOLM inclusion i.e. better in T_3 followed by T_2, T_1 and T_0.

The present study revealed that the dried Moringa oleifera can be included in the concentrate mixture of calves upto 15% to improve their performance and to reduce the cost of feeding.

Keywords: *Moringa oleifera*; Leaves; Relative Cost; Feeding; Crossbred Calves

Introduction

India has the world's largest livestock population. According to 20th livestock census (2019) [1] total livestock population in India is 535.78 million in the country showing an increase of 4.6% over Livestock Census 2012. Out of which 192.49 millions are cattle, 109.85 millions buffalo, 74.26 million sheep, 148.88 millions goat and 9.06 millions pig.

Feeding of these lots of population is the most important determining factor of profit in livestock farming; cost analysis indicates that the feeds alone constitute major items of expenditure in livestock production and accounts for about 70% of the total cost of production [5]. One of the major constraints to dairy production in India, is a lack of feed and fodder and high cost of the feed ingredients for the large number of livestock population in our country and estimate that feed scarcity cause high calf mortality which can accounts for nearly half of all losses in Indian dairy production [6].

At present, the country faces a net deficit of 35.6% green fodder, 10.95% dry crop residues and 44% concentrate feed ingredi-

ents [7] The green fodder requirement is 883.95 million tons while 664.73 million tons is the production. Likewise, dry fodder demand is 583.66 million tons and production is 355.93 million tons. In case of concentrate feeds total requirement is 57.16 million tons [8]. Because of these shortage farmers feed their animals mostly on crop residues and poor quality straw/hay that are low in nitrogen, high in lignocellulose and poor in minerals and vitamins that leads to low digestibility and reduced voluntary feed intake [9]. 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 [10].

Non-conventional feed resources (NCFR) are those feed ingredients that haven't been traditionally employed in animal rations. Feed obtained from multipurpose trees and agro-industry products can be utilised for animal feeding as a non-traditional or novel feed supply [4]. NCFRs offer a lot of potential as a feed source for domestic animals. They can successfully be integrated into production systems to provide extra feed supplies for cattle varied diets.

One such fodder which is given to livestock is *Moringa oleifera*, popularly called as "drumstick tree" and is locally known as "Sajina" in Assam. It is a very useful tree, because every portion of the *Moringa oleifera* tree demonstrates beneficial qualities. Moringa Seeds can be used for water purification. Incredible medical capabilities can be found in the *Moringa oleifera* tree's flowers, roots, and bark. Leaves of Moringa are a dense source of nutrient for both animal and humans. It also goes by the name 'Miracle Tree' [3,11,12]. In fact, *Moringa* is said to provide 7 times more vitamin C than oranges, 10 times more vitamin A than carrots, 17 times more calcium than milk, 9 times more protein than yoghurt, 15 times more potassium than bananas and 25 times more iron than spinach [13].

Moringa oleifera is the most widely cultivated species of the Moringaceae family in some Asian countries such as India, Pakistan, Bangladesh and Afghanistan [14]. *M. oleifera* can be grown in humid, hot, dry tropical and subtropical regions. It is a drought tolerant plant that can grow in all types of soils, except those that are waterlogged [2].

As a result, it may be said that green Moringa leaves is available all year long without any effort. The importance of *Moringa oleifera* as cattle feed is supported by its superior biomass output and high nutritional quality, particularly during dry periods [15].

Moringa oleifera leaves contain balanced essential amino acid level, high protein concentration, calcium, iron, Vitamin C and Vitamin A essential for ruminants. Leaves also contain bioactive substances such flavonoids, phenolic acids, glucosinolates, isothiocanates, tannins, and saponins as well as antioxidants like quercetin and chlorogenic acid. Vitamin B-complex, chromium, copper, magnesium, manganese, phosphorus, and zinc are other nutrients found in the leaves. It is used as potential antioxidant, anticancer, anti-inflammatory, antidiabetic and antimicrobial agent [18].

Moringa oleifera leaves is also used as traditional medicine for anemia, diabetes, abnormal blood pressure, cough, cholera, conjunctivitis, diarrhoea, infection of eye and ear, fever, intestinal worms, respiratory disorder, scurvy, skin infection, swelling, sore throat, semen deficiency, tuberculosis and pregnancy [16].

Taking into account the aforementioned characteristics of *Moringa oleifera* and the scarcity of feed and fodder for livestock, particularly protein sources, the present study has been designed to evaluate the potential advantages of *Moringa oleifera* tree on growth performance of crossbred calves.

Materials and Methods

- **Place of work:** The experiment was carried out in the Instructional Livestock Cattle Farm, ILF(C) College of Veterinary Science, AAU, Khanapara, Guwahati. Biological samples were analysed in laboratory of Department of Animal Nutrition, Assam Agricultural University, Khanapara, Guwahati-781022.
- **Experimental animals:** Twenty four (24) nos of crossbred (HF× Jersey) calves (irrespective of sex) of same age group (6-8 months) were selected from ILF(C), College of Veterinary Science Khanapara, AAU, Guwahati-781022. Prior to staring the actual experiment 7 days of conditioning period were adopted during which, the selected calves were dewormed, vaccinated and treated against ectoparasites. After completion of conditioning period calves were split into four groups comprising six calves in each and randomly allotted to four nutritional treatments.

Preparation of experimental ration

- **Preparation of Dry *Moringa Oleifera* Leaf Meal (MOLM):** For the purpose of experiment, fresh *Moringa oleifera* leaves were manually harvested from mature *Moringa* tree found in and around College of Veterinary Science, Khanapara, AAU, Guwahati-22. The collected leaves were spread over a plastic sheets and sun dried for 2 days. The dried leaves were manually ground and kept in safe bag and stored for further mixing with ingredients to prepare concentrate mixture.
- **Preparation concentrate mixture:** Conventional feed ingredients namely Maize grain, Wheat bran, Rice polish, DORB, GNC, SBM, Mineral mixture, and Salt were used to prepare concentrate mixture as per ICAR 2013 for the feeding

of experimental animals in control group (T_0). For treatment groups, the iso-nitrogenous concentrate mixture with T_0 was prepared by inclusion of dried *Moringa oleifera* leaf meal at 5%, 10% and 15% level in T_1, T_2 and T_3 diet respectively. The animals in all the groups fed individually with concentrate and roughage (Napier grass and paddy straw) to meet the nutritional requirements.

- **Management and feeding of experimental animals:** Animals were kept in a well ventilated intensive housing system throughout the experimental period. Calves were kept in head to head orientation. 7 days of conditioning period were given before the feeding of experimental diet. The calves were washed and cleaned at regular interval and precautionary measures were taken to avoid ectoparasitic infestation during the period of experiment. The watering and feeding trough were regularly cleaned.

The animals were given with weighed quantity of feed as per requirement two times a day i.e. 9 A.M. and 3 P.M. during the experimental period. Residues of feed offered were also collected and weighed daily and record of feed intake was maintained. Fresh drinking water was always made available during the experimental period.

- **Feeding trial:** The feeding trial was conducted for 84 days. During the experimental period daily feed consumed, feed residue fortnightly body weight changes (Kg) were taken and recorded.
- **Statistical analysis of data:** The analysis was carried out in statistical software R [17]. The difference between means were analyzed by two way or one way ANOVA followed by multiple comparison using Duncan mean range test.

Result and Discussion

- **Chemical composition:** Data of chemical analysis of Moringa oleifera leaf meal and experimental concentrate mixture is mentioned in table 1. Result showed that moringa oleifera leaf meal (MOLM) had higher content of 25.16% CP, 6.34% EE, 14.24% CF, Ca 4.12%, Fe 397.91 ppm, Cu 30.37 ppm and Zn 70.68 ppm. The crude protein content of the concentrate mixture T_0, T_1, T_2 and T_3 was 22.11, 22.08, 22.14 and 22.21% respectively on DM basis. As iso-nitrogenous concentrate mixture was prepared, CP contents were almost similar in treatment diets. Shankhpal., *et al*. found the values of Moringa oleifera leaves as CP 18.25%, EE 3.42%, CF 29.03%, Total Ash 9.18%, Ca 2.41%, Cu 13.15 ppm, Zn 24.61 ppm, Mn 61.25 ppm and Fe 591.09 ppm. Moyo., *et al*. also reported chemical composition of Dry leaves of *Moringa* and found as Moisture 9.533%, CP 30.29%, Fat 6.50%, Ash 7.64% NDF 11.40%, ADF 8.49%, ADL 1.8%. And mineral contents were Ca 3.65%, P 0.30%.

Growth performance

The average fortnightly, total body weight and average daily in body weight gain has been shown in table 2.1 and 2.2. On statistical analysis significant difference was observed among the groups. T_3 group showed significantly higher average total and average daily gain in body weight followed by T_2, T_1 and T_0. The average daily in body weight was significantly higher in T_3, T_2, T_1 and compared to T_0.

Feed consumption (DM basis)

The fortnightly (Kg) and total feed consumed (Kg) by the experimental calves of treatment groups T_0, T_1, T_2 and T_3 has been shown in the table 3. The total feeds consumed by the treatment groups were 213.65 ± 4.02; 218.58 ± 8.08, 221.38 ± 2.60 and 225.54 ± 3.23 in T_0, T_1, T_2 and T_3 group respectively. The values of feed intake were increased with the increasing level of *Moringa oleifera*. However on statistical analysis no significant difference was observed among the groups in respect of fortnightly and total feed consumption.

Feed conversion efficiency

The average feed conversion efficiency and average fortnightly feed conversion efficiency of calves has been presented in table 4. The average feed conversion efficiency of T_0, T_1, T_2, and T_3 group were 10.16 ± 0.14, 9.64 ± 0.10, 8.83 ± 0.19 and 8.64 ± 0.09 respectively. On statistical analysis significant difference was observed among the groups, better FCE was noticed in T_3 group of animals followed by T_2, T_1 and T_0.

In case of average fortnightly feed conversion efficiency, after being analysed statistically significant difference was observed among the groups from 3rd fortnight onwards. Significant difference was observed in between treatment (T_1, T_2, T_3) and control (T_0) groups. However non-significant difference was observed between T_2 and T_3.

Relative cost of feed in crossbred calves on various treatments

The relative cost of feedin crossbred calves on various treatments has been presented in table 5. The total cost in terms of feed consumption per animal per day was calculated and found to be 34.26, 34.14, 32.86 and 31.99 Rs. (on DM basis) in T_0, T_1, T_2 and T_3 group respectively. Average daily gains were 250.24, 269.78, 298.77 and 310.99 g in T_0, T_1, T_2 and T_3 group respectively. On comparison with daily weight gain in different treatment groups, the cost of production per kg live body weight was found as Rs 136.93, 126.54, 109.98 and 102.87 in T_0, T_1, T_2 and T_3 group respectively and the relative cost of per Kg live weight gain was 100%, 92.41%, 80.32% and 75.13% in T_0, T_1, T_2 and T_3 respectively. The total cost of feeding was lowest in T_3 groups followed by T_2, T_1 and T_0 group. This might be due higher growth rate per day in T_3 as compared to other groups. This result indicated that inclusion of *Moringa*

oleifera in concentrate mixture at 5, 10 and 15% to the crossbred calves will be economically beneficial with higher daily gain in body weight.

Particulars	Concentrate mixture				MOLM
	T_0	T_1	T_2	T_3	
Dry matter	89.41 ± 0.57	90.08 ± 0.68	89.51 ± 0.35	89.93 ± 0.41	91.65 ± 0.62
Organic matter	90.16 ± 0.63	87.96 ± 0.45	88.84 ± 0.48	87.87 ± 0.65	89.31 ± 0.43
Crude protein	22.11 ± 0.12	22.08 ± 0.23	22.14 ± 0.19	22.21 ± 0.16	25.16 ± 0.23
Ether extract	3.63 ± 0.10	3.89 ± 0.09	4.15 ± 0.12	4.35 ± 0.11	6.34 ± 0.11
Crude fiber	7.83 ± 0.14	8.01 ± 0.16	8.43 ± 0.08	8.98 ± 0.18	14.24 ± 0.19
Nitrogen free extract	56.58 ± 0.41	53.98 ± 0.38	54.12 ± 0.44	52.33 ± 0.46	43.58 ± 0.32
Neutral detergent fiber	27.13 ± 0.23	27.67 ± 0.18	28.10 ± 0.25	28.35 ± 0.20	36.81 ± 0.29
Acid detergent fiber	15.64 ± 0.15	16.97 ± 0.11	17.58 ± 0.16	17.97 ± 0.19	14.90 ± 0.21
Total ash	9.84 ± 0.11	12.04 ± 0.13	11.16 ± 0.09	12.13 ± 0.15	10.69 ± 0.18
Calcium	0.89 ± 0.02	1.09 ± 0.05	1.21 ± 0.05	1.43 ± 0.04	4.12 ± 0.05
Phosphorus	0.40 ± 0.04	0.39 ± 0.02	0.37 ± 0.04	0.36 ± 0.01	0.38 ± 0.02
Cu (ppm)	-	-	-	-	30.37
Cr (ppm)	-	-	-	-	3.11
Zn (ppm)	-	-	-	-	70.68
Fe (ppm)	-	-	-	-	397.91
Mn (ppm)	-	-	-	-	109.95

Table 1: Chemical composition Moringa oleifera leaf meal and experimental concentrate mixture.

Fortnight	Group				P value
	T_0	T_1	T_2	T_3	
1st	3.26 ± 0.13	3.26 ± 0.18	3.15 ± 0.22	3.17 ± 0.13	0.945
2nd	3.35 ± 0.15	3.33 ± 0.16	3.61 ± 0.15	3.74 ± 0.12	0.168
3rd	3.25^{c} ± 0.15	3.63^{bc} ± 0.20	4.10^{ab} ± 0.09	4.25^{a} ± 0.19	0.001
4th	3.30^{c} ± 0.28	3.88^{bc} ± 0.23	4.54^{ab} ± 0.23	4.65^{a} ± 0.19	0.002
5th	3.78^{c} ± 0.16	4.17^{b} ± 0.10	4.78^{a} ± 0.18	5.04^{a} ± 0.14	<.0001
6th	4.08^{c} ± 0.03	4.39^{bc} ± 0.27	4.92^{ab} ± 0.25	5.27^{a} ± 0.20	0.003

Table 2.1: The average fortnightly gain in body weight (Kg).

†abc Mean values with different superscripts within row differ significantly.

Particulars	Group				P VALUE
	T_0	T_1	T_2	T_3	
Average initial body weight (Kg)	75.74 ± 1.45	76.15 ± 1.70	75.83 ± 1.12	77.08 ± 1.89	0.93
Average final body weight (Kg)	96.76 ± 1.41	98.81 ± 2.25	100.93 ± 1.37	103.21 ± 2.36	0.13
Experimental period (days)	84 days				
Average total body weight gain (Kg)	21.02^{c} ± 0.29	22.66^{b} ± 0.65	25.10^{a} ± 0.35	26.12^{a} ± 0.52	<.001
Average daily gain in body weight (g)	250.24^{c} ± 3.51	269.78^{b} ± 7.68	298.77^{a} ± 4.15	310.99^{a} ± 6.25	<.001

Table 2.2: Average total body weight gain (kg) and average daily gain in body weight (g/d) of experimental calves during feeding trial.

†abc Mean values with different superscripts within row differ significantly.

Fortnight	Treatment				SEM	P value
	T_0 (0% MOLM)	T_1 (5% MOLM)	T_2 (10% MOLM)	T_3 (10% MOLM)		
1st	33.8 ± 1.94	32.88 ± 1.84	32.78 ± 1.22	32.29 ± 1.71	0.32	0.859
2nd	34.6 ± 2.05	34.35 ± 1.91	35.07 ± 1.57	36.5 ± 1.69	0.48	0.513
3rd	32.86 ± 2.02	35.27 ± 2.01	36.99 ± 1.39	37.74 ± 1.68	1.08	0.067
4th	33.57 ± 2.29	36.62 ± 2.14	37.95 ± 1.92	38.35 ± 1.60	1.08	0.188
5th	37.88 ± 2.41	39.08 ± 2.28	39.12 ± 1.97	39.57 ± 1.58	0.36	0.559
6th	40.93 ± 2.57	40.38 ± 2.41	39.47 ± 1.77	41.11 ± 3.27	0.37	0.067
Total	213.65 ± 4.02	218.58 ± 8.08	221.38 ± 2.60	225.54 ± 3.23	2.50	0.409

Table 3: Fortnightly and total feed consumption (kg) by the experimental calves during the feeding trial.

Particulars	Group				P Value
	T_0	T_1	T_2	T_3	
Initial body weight (Kg)	75.74 ± 1.45	76.15 ± 1.70	75.83 ± 1.12	77.08 ± 1.89	0.93
Final body weight (Kg)	96.76 ± 1.41	98.81 ± 2.25	100.93 ± 1.37	103.21 ± 2.36	0.13
Total body weight gain (Kg)	21.02^{c} ± 0.29	22.66^{b} ± 0.65	25.1^{a} ± 0.35	26.12^{a} ± 0.52	<.0001
Total feed consumed (kg DMI/animal in 84days)	213.65 ± 4.02	218.58 ± 8.08	221.38 ± 2.60	225.54 ± 3.23	0.41
Feed efficiency (Kg DMI/Kg gain)	10.16^{a} ± 0.14	9.64^{b} ± 0.10	8.83^{c} ± 0.19	8.64^{c} ± 0.09	<.0001

Table 2.4: Average feed conversion efficiency (on dm basis) of the experimental calves during feeding trial.

†abc Mean values with different superscripts within row differ significantly.

Particulars	Groups			
	T_0	T_1	T_2	T_3
Feed intake/animal/day (kg)				
Concentrate	0.85	0.87	0.88	0.89
Dry Roughage	1.15	1.16	1.17	1.19
Green roughage	0.55	0.59	0.59	0.60
Cost of feed consumed/head/day (Rs)				
Concentrate	25.80	25.47	24.06	23.06
Dry Roughage	5.74	5.78	5.86	5.96
Green roughage	2.73	2.89	2.935	2.975
Total	34.26	34.14	32.86	31.99
Growth rate (g)/day	250.24	269.78	298.77	310.99
Cost of feed per kg live weight gain				
Absolute	136.93	126.54	109.98	102.87
Relative (%)	100	92.41	80.32	75.13

Table 2.5: Relative cost of feed.

Conclusion

The shortage and higher cost of feed ingredient in India for large number of populations can be countered by inclusion of non-conventional feed resource. *Moringa oleifera* could be a good example of NCFR as it is easily available, inexpensive and its high nutrient contents.

The present study revealed that MOLM inclusion in concentrate ration of calves have positive effect on growth, feed conversion efficiency and cost of feeding in MOLM fed calves. Better response were observed in T_3 (15% MOLM) fed group followed by T_2 (10% MOLM) and T_1 (5% MOLM) group.

Therefore it could be concluded that MOLM can be included in concentrate ration of calves upto 15% level for their better performance. However more future studies are needed to understand the higher level of inclusion of MOLM in concentrate ration to reduce the feed cost.

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