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Effect of moringa (*Moringa oleifera*) leaf meal on performance of Murrah buffalo calves

Bhavna Aharwal, Biswajit Roy, GP Lakhani and Aayush Yadav

Abstract
The study was designed to evaluate the effect of *Moringa oleifera* leaf meal on feed intake, growth performance, health status and economics of Murrah buffalo calf rearing.
A total of 18 Murrah buffalo calves with similar body weight of either sex at 5th day after birth selected and randomly distributed in three different groups (Control, M5 and M15) with six calves in each group. Control group reared on calf starter/concentrate mixture along with milk. Whereas along with milk calf starter/concentrate mixture was replaced by *Moringa oleifera* leaf meal @ of 5% and 15% for the groups M5 and M15 respectively. The duration of experiment was six month. Result revealed that the body weight changes, average daily gain, dry matter intake, average daily dry matter intake (% BW), crude protein, Protein efficiency were significantly varied among the groups. Average body weight gains of calf (kg) were 50.05, 58.42 and 60.62 in control, M5 and M15 groups respectively. Economic analysis indicated that the recurring cost of rearing Murrah buffalo calves was reduced in M5 and M15 groups in comparison to the control group. Recurring expenditure of body weight gain (₹/kg) were 322.27, 269.35 and 262.15 in control, M5 and M15, respectively. Reduction of recurring expenditure body weight gain (per/kg) in comparison to control group were 52.93 and 60.13 for the M5 and M15, respectively. Per cent decreases of total recurring expenditure in comparison to control group/kg BW gain were 16.42, 18.66 in group M5 and M15, respectively. It can be concluded that Moringa leaf meal can replace upto 15 per cent of calf starter to attend better body weight gain and improve economic efficiency of Murrah buffalo calf rearing.

Keywords: *Moringa oleifera*, Murrah buffalo, calf starter, concentrate mixture

Introduction
In India, buffaloes play a very important role in the economy of small holders as well as landless people of rural India who owned more than 67% of dairy animals. Buffalo contributes 49% of the total milk production (163.7 million tons) in India (BAHS, 2017) [7], although their number is almost half of the cattle population. Buffaloes are the most efficient milk producer and have better adaptability throughout the India. Among the various buffalo breeds, Murrah buffalo is famous for its milk productivity and better adaptability, It is mostly used for up gradation of non-descript breeds of buffaloes in India and many parts of the world (Abbas, 2013) [1]. The need to introduce cheap and readily available alternative feedstuffs to support livestock development has become imperative. Leaf protein sources obtained from leaves of vegetables, legume trees, browse plants, fodder trees and shrubs as rich feed resources to all classes of farm animals offer tremendous potentials and are receiving more attention (Oduro *et al*., 2008) [17]. 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) [15].
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) [10]. 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) [20]. 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) [18].

Recently, a high degree of renewed interest was placed on the nutritional properties of Moringa in most countries where it was not native. This could be due to the claims that it increases animal productivity as it has nutritional, therapeutic and prophylactic properties (Fahey *et al*., 2001) [12]. This includes raising antibodies to fight the infection, as well as using white blood cells to attack pathogens (Ojiako, 2014) [19]. Moringa leaves have a very high biological value and considerable potential for adoption as feed for ruminant fodder resource (Pradhan, 2016) [21]. It is rich in protein, amino acids, fatty acids, minerals, vitamins, calcium, potassium, various phenolic and oxycaroteniod are the basic building blocks of animal body (Deshmukh, 2014) [9]. These nutrients are used for osmotic adjustment, activation of enzymes, growth hormones and other organic molecules that enhance growth, function and maintenance of life process (Anjorin *et al*., 2010) [4]. Looking to the potentiality, nutritional values and availability of *Moringa oleifera* leaves, the use of *Moringa oleifera* can be explored. Moringa leaves are inexpensive, easily available and unconventional source of energy. *Moringa oleifera* plants are readily available in Madhya Pradesh. Despite all these benefits, no as such reports found in the literatures about using *Moringa oleifera* meal in feeding trials with Murrah buffalo calves. To evaluate the effect of *Moringa oleifera* leaf meal on feed intake, growth performance, health status and economics of Murrah buffalo calf rearing.

Materials and Methods

Murrah buffalo calves of either sex at 5 days of age selected. To study the effect of Moringa leaf meal on growth and health status of the calves. All the calves were permanently separated from dam just after birth. Colostrum and milk was offered as per standard protocol table no 2. The experimental animals were fed with dry *Moringa oleifera* leaf meal with calf starter and concentrate mixture. Calves were maintained in individual calf pen (7ft X 5ft). Each pen fitted with feeder and waterer. Half of the total required quantity of milk offered daily at morning 6.30am and rest of amount offered in the afternoon 5.00pm at Livestock farm, Adhartal, College of Veterinary Science & A.H., Nanaji Deshmukh Veterinary Science University, Jabalpur (M.P.). Milk offered to the calves upto 90 days of age. A total of 18 Murrah buffalo calves were selected for the study and grouped as follows

Table 1: Grouping of animals and their diet

S. No	Groups	No. of calves	Treatment
1	Control	6	Calf starter/concentrate mixture
2	M5	6	5% calf starter/concentrate mixture replaced by dry Moringa leaves
3	M15	6	15% calf starter/concentrate mixture replaced by dry Moringa leaves

Table 2: Feeding schedule of buffalo calves followed at livestock farm

Age (days)	Colostrum (kg)	Milk (kg)	Calf starter (g)	Green fodder
0-5	1/10th of body weight	-	-	-
6-30	-	1/10th of body weight	-	-
31-60	-	1/15th of body weight	125	adlib
61-90	-	1/25th of body weight	250	adlib
91-150	-	-	500	adlib
151-180	-	-	750	adlib

Table 3: Composition of calf starter and concentrate mixture

Ingredients (%)	Calf starter (offered upto 3 month)	Concentrate mixture (above 3 month)
Yellow maize	50	39
Groundnut cake	30	28
Fish meal	07	-
Rice polish	-	10
Wheat bran	10	11
Arhar chuni	-	9
Mineral mixture	02	02
Common salt	01	01
Vitamin (A,B_2 and D_3) @ per 100 kg	15g	15 g

Preparation of Moringa leaf meal (MLM)

The branches with leaves and soft twigs used for production of MLM were collected from Moringa trees in an around experimental area by cutting every 45 days. The harvested leaf was sundried for a 2-3 days before the partially dried leaves were removed by threshing and then sun-dried again for approximately 48hrs on a plastic sheets. The dried leaves were finely ground in a hammer mill, packed in sacks and stored in a well-ventilated storeroom.

Proximate analysis of feed and fodder

Green grasses, wheat straw, calf starter and concentrate mixture were analyzed to know the dry matter, crude protein, ether extract, crude fiber, nitrogen free extract and total ash content as per the methods described in the manual of Association of Official Analytical Chemist.

Result

Composition of buffalo milk

During the study period, chemical composition (%) of buffalo whole milk was evaluated and presented in table 4.

Table 4: Composition of buffalo milk

Parameters	Value (%)
Fat	7.05
Protein	3.84
Lactose	4.82
Minerals	0.87
Total solid	16.58
Solid not fat	9.53

Table 5: Proximate composition (%) of feed, fodders and Moringa leaves

Parameters (%)		Dry matter	Crude protein	Ether extract	Crude fibre	Nitrogen free extract	Total ash
Calf starter		92.21	22.12	4.79	8.06	57.22	7.81
Concentrate mixture		92.79	20.11	4.68	8.75	58.35	8.11
Wheat straw		92.01	2.92	2.12	38.22	37.83	18.91
Green fodders	Berseem	16.23	18.25	6.11	22.96	42.44	10.24
	Oat	20.52	14.23	5.11	23.23	47.32	10.11
	Maize	24.51	13.21	5.01	26.64	45.03	10.11
Dry Moringa leaves		90.86	25.31	6.21	14.95	44.77	8.76

Table 6: Proximate composition of calf starter replaced by various level of Moringa leaf meal offered to the experimental calves (upto 3 months age)

Parameters (%)	Control	M5	M15
Dry matter	92.21	92.18	92.05
Crude protein	22.12	22.28	22.60
Ether extract	4.79	4.86	5.00
Crude fibre	8.06	8.40	9.09
Nitrogen free extract	57.22	56.60	55.35
Total ash	7.81	7.86	7.95

Table 7: Proximate composition of concentrate mixture replaced by various level of Moringa leaf meal offered to the experimental calves (above 3 months of age)

Parameters (%)	Control	M5	M15
Dry matter	92.21	92.18	92.05
Crude protein	22.12	22.28	22.60
Ether extract	4.79	4.86	5.00
Crude fibre	8.06	8.40	9.09
Nitrogen free extract	57.22	56.60	55.35
Total ash	7.81	7.86	7.95

Body weight

Average body weight changes are presented in table 8. The per cent increases of body weight over control group were 10.57, 12.63 in M5 and M15 groups, respectively in pre weaning and post weaning period. Statistically there was significant difference (P<0.05) in average body weight, among the groups.

Table 8: Effect of Moringa leaf meal on average of body weight (kg/animal) of Murrah buffalo calves

Periods	Control	M5	M15
Pre weaning	32.78±1.06	33.18±0.94	32.68±1.38
	39.22±1.03	39.16±0.97	38.73±1.32
	44.20±1.02	44.66±1.09	44.18±1.27
	48.70±1.05	49.68±1.24	49.08±1.28
	52.78±1.08	54.53±1.40	53.76±1.30
	56.86±1.12	59.51±1.58	58.62±1.33
Post weaning	60.90±1.15	63.68±1.76	63.73±1.44
	65.63±1.21	69.61±1.98	70.08±1.49
	69.61^{a}±1.22	75.16^{b}±2.16	75.51^{b}±1.54
	73.55^{a}±1.28	80.81^{b}±2.36	81.07^{b}±1.63
	78.13^{a}±1.33	86.11^{b}±2.55	86.43^{b}±1.71
	82.83^{a}±1.38	91.59^{b}±2.79	93.29^{b}±1.84
Per cent increases of body weight over control group	-	10.57	12.63

Means bearing different superscripts within same row differ significantly (^{ab}, p<0.05)

Average daily body weight gain

The average daily body weight gain (kg/calf) of the calves in pre weaning period are presented in table 9 and values were 0.352±0.009, 0.379±0.008 and 0.374±0.007 in control, M5 and M15 groups, respectively. In post weaning period and the values were 0.312±0.005, 0.388±0.010 and 0.417±0.010 in control, M5 and M15 groups, respectively. Statistically there was significant difference (P<0.05) in average daily body weight, among the groups.

Total dry matter intake

The average total dry matter intake (kg/calf/day) at pre weaning period were 0.768±0.018, 0.772±0.019 and 0.768±0.020 in control, M5 and M15 groups, respectively. In post weaning period the values were 1.585±0.005, 1.594±0.064, and 1.618±0.062 in control, M5 and M15 groups, respectively. Statistically there was no significant difference (P<0.05) in total dry matter intake (body weight), among the groups.

Dry matter intake (% body weight)

The average total dry matter intake (%BW) in pre weaning period were 1.680±0.012, 1.657±0.018, and1.666±0.015 in control, M5 and M15 groups, respectively. In post weaning period the values were 2.178±0.053, 2.013±0.062 and 2.024±0.053 in control, M5 and M15 groups, respectively. Statistically there was no significant difference (P<0.05) in total dry matter intake (%BW) among the groups.

Crude protein intake

The average daily crude protein (kg/animal) in pre weaning period were 0.164±0.003, 0.165±0.003 and 0.165±0.003 in control, M5 and M15 groups, respectively. In post weaning period the values were 0.281±0.011, 0.284±0.014 and 0.301±0.014 in control, M5 and M15 groups, respectively. Statistically there was no significant difference (P<0.05) in daily crude protein (kg/calf) crude protein intake (body weight), among the groups.

Table 9: Effect of Moringa leaf meal on average daily body weight gain (kg/animal), Dry Matter Intake (kg/calf/day), Dry Matter Intake % BW and Crude protein (kg/calf) of Murrah buffalo calves

Parameter	Periods	Control	M5	M15
Average daily gain (kg/animal)	Pre weaning	0.352^{a}±0.009	0.379^{b}±0.008	0.374^{b}±0.007
	Post weaning	0.312^{a}±0.005	0.388^{b}±0.010	0.417^{c}±0.010
Total dry Matter Intake (kg/calf/day)	Pre weaning	0.76±0.02	0.77±0.02	0.76±0.02
	Post weaning	1.58±0.05	1.59±0.06	1.61±0.06
Dry matter intake % body weight	Pre weaning	1.68±0.02	1.65±0.02	1.66±0.02
	Post weaning	2.17±0.05	2.013±0.06	2.024±0.05
Crude protein intake (kg/calf)	Pre weaning	0.164±0.003	0.165±0.003	0.165±0.003
	Post weaning	0.281±0.011	0.284±0.014	0.301±0.014

Means bearing different superscripts within same row and parameters differ significantly (^{abc}, p<0.05)

Protein efficiency ratio

Average protein efficiency ratio (kg/animal) presented in table 10. In pre weaning were 2.15±0.08, 2.29±0.07 and 2.29±0.07. In post weaning period the values were 1.25±0.05, 1.60±0.08 and 1.63±0.09 in control, M5 and M15 groups, respectively. However the overall average protein efficiency (kg/animal) were 1.68±0.06, 1.93±0.06 and 1.95±0.06 in control, M5 and M15 groups, respectively. Significant difference (P<0.05) among the groups in post weaning period.

Table 10: Effect of Moringa leaf meal on protein efficiency ratio of Murrah buffalo calves

Period	Control	M5	M15
Pre weaning	2.15^{p}±0.08	2.29^{p}±0.07	2.29±0.07
Post weaning	1.25^{aq}±0.05	1.60^{bq}±0.08	1.63^{bq}±0.09
Overall	1.68^{a}±0.06	1.93^{b}±0.06	1.95^{b}±0.06

Means bearing different superscripts within same row (^{ab}) and same Colum (^{pq}) between the periods differ significantly (P<0.05)

Hematological parameters

The average of various hematological parameters in pre weaning and post weaning period are mention in table no.11. The blood was collected at monthly interval includes Hb(g/dl), PCV%, TP(g/dl), albumin(g/dl), globulin(g/dl), BUN(mg/dl). Statistically there was no significant difference.

Table 11: Effect of Moringa leaf meal on various blood parameters of Murrah buffalo calves

S. No	parameters	Periods	Control	M5	M15
1	Hb	Pre weaning	11.27±0.68	11.93±0.56	11.54±4.47
		Post weaning	11.7±0.41	12.12±0.53	12.48±0.69
2	PCV	Pre weaning	3.94±0.216	3.86±0.143	4.01±0.21
		Post weaning	4.09±0.076	4.07±0.13	4.19±0.16
3	TP	Pre weaning	6.14±0.246	5.93±0.363	6.13±0.136
		Post weaning	6.50±0.163	6.38±0.163	6.33±0.863
4	ALBUMIN	Pre weaning	3.08±0.206	3.19±0.193	3.31±0.185
		Post weaning	3.56±0.193	3.52±0.173	3.49±0.17
5	GLOBULIN	Pre weaning	3.06±0.253	2.73±0.39	3.00±0.186
		Post weaning	3.06±0.311	2.85±0.296	2.84±0.213
6	BUN	Pre weaning	38.89±1.51	35.83±1.66	39.19±1.31
		Post weaning	39.63±1.43	39.51±1.55	38.97±1.34

Occurrence of diarrhoea in Murrah buffalo calves during the experimental period

Occurrence of diarrhoea was recorded during the experimental period. In different groups i.e. control, M5 and M15. The highest incidence recorded in M5 followed by control and M15 groups.

Table 12: Occurrence of diarrhoea in Murrah buffalo calves during the experimental period

Age	Control (n=6)	M5 (n=6)	M15 (n=6)
Upto 15 days	1	1	1
16^{th} day to 3 months	2	3	2
4-6 months	2	2	1
Total	5	6	4

Faecal score

The faecal score in pre weaning period were 2.27±0.38, 2.25±0.22 and 2.25±0.75 in control, M5 and M15 groups, respectively and in post weaning period were 3.67±0.01, 2.83±0.16 and 3.00±0.12 in control, M5 and M15 groups, respectively. Statistically there was no significant difference.

Table 13: Effect of Moringa leaf meal on faecal score of Murrah buffalo calves

Periods	Control	M5	M15
Pre weaning	2.27±0.38	2.25±0.22	2.25±0.75
Post weaning	3.67±0.01	2.83±0.16	3.00±0.12

Economics of buffalo calves rearing

Effect of Moringa leaf meal on economics of rearing of Murrah buffalo calves

Total expenditure (₹/calf) on milk, feed and fodder were 14,179.59, 13,783.83 and 13,940.15 in control, M5 and M15 groups, respectively. Average weight gain of calf (kg) 50.05, 58.42, 60.62 in control, M5 and M15 groups, respectively. Reduction of recurring expenditure (₹/kg) per kg body weight gain in comparison to control group 52.93, 60.13 in M5 and M15 groups, respectively. Per cent decrease of recurring expenditure per kg body weight gain in comparison to control group 16.42, 18.66 in M5 and M15 groups, respectively

Table 14: Effect of Moringa leaf meal on economics of rearing of Murrah buffalo calves

Table 14.1: Summary of feed intake of Murrah buffalo calves during the experiment

S. No.	Particulars	C	M5	M15
1	Milk consumed (kg)	256.43	251.42	258.07
2	Calf starter consumed (kg) (upto 3 months)	11.41	11.90	10.56
3	Concentrate mixture consumed (kg) (>3 months to 6 months)	80.83	79.24	80.83
4	Green fodder consumed (kg)	311.85	331.94	326.34
5	Wheat straw consumed (kg)	29.73	29.45	30.99

Table 14.2: Effect of Moringa leaf meal on economics of rearing of Murrah buffalo calves

S. No.	Particulars	C	M5	M15
1	Expenditure on milk (@₹44/kg)	11,283.07	11,062.33	11,354.93
2	Expenditure on calf starter (C-₹4.88/kg, M5-₹24.24/kg and M15-₹22.95/kg)	247.03	257.64	228.59
3	Expenditure on concentrate mixture (C-₹ 23.00/kg, M5-₹22.45/kg and M15-₹21.35/kg)	1859.01	1635.51	1535.71
4	Expenditure on green fodder (@₹2/kg)	623.70	663.88	652.68
5	Expenditure on wheat straw (₹4/kg)	118.91	117.79	123.95
6	Total expenditure (₹/kg) on milk, feed and fodder	14,179.59	13,783.83	13,940.15
7	Expenditure (₹/kg) on labour /calf for 6 months (@ 1 labour/24 calves and wage ₹7500/ month)	1,875.00	1,875.00	1,875.00
8	Miscellaneous expenditure (₹/kg) (medicines, deworming, tagging etc.) (@₹75/ calf)	75.00	75.00	75.00
9	Total recurring expenditure (₹/kg) during the 6 months experimental period (6+7+8)	16,129.59	15,733.83	15,890.15
10	Reduction of total recurring expenditure (₹/kg) in comparison to control group	-	395.76	239.44
11	Average weight gain of calf (kg)	50.05	58.42	60.62
12	Recurring expenditure (₹/kg) per kg body weight gain (no.9/ no. 12)	322.27	269.35	262.15
13	Reduction of recurring expenditure (₹/kg) per kg body weight gain in comparison to control group	-	52.93	60.13
14	Per cent decrease of recurring expenditure per kg body weight gain in comparison to control group	-	16.42	18.66

Discussion

Buffalo is the backbone of the dairy industry in India. Rearing of buffalo calves has immense importance to maintain replacement stock. Buffalo calves of very young age are sold and subsequently slaughtered indiscriminately. Unwillingness of the farmer's towards rearing of calves is due to major two reasons. First, the farmers feel burden to feed milk the early born calves due to high price and demand of milk. Secondly, the farmers feel worry due to early calves mortality and rearing cost of calves. Therefore, special emphasis needs to be given the calves using unconventional source of feed stuffs. Provided the concentrate mixture is formulated correctly from good-quality ingredients and fed according to the instructions of preparation. Moringa leaves with concentrate mixture is successfully used in buffalo calves (Ahmad *et al*., 2017) [2].

Composition of *Moringa oleifera*

Moringa leaves have a very high biological value and considerable potential for adoption as feed for ruminant fodder resource (Pradhan, 2016) [21]. It is rich in protein, amino acids, fatty acids, minerals, vitamins, calcium, potassium, various phenolic and oxycaroteniod are the basic building blocks of animal body (Deshmukh, 2014) [9]. These nutrients are used for osmotic adjustment, activation of enzymes, growth hormones and other organic molecules that enhance growth, function and maintenance of life process (Anjorin *et al*., 2010) [4]. Looking to the potentiality, nutritional values and availability of *Moringa oleifera* leaves, the use of *Moringa oleifera* can be explored (Sarwatt *et al*., 2004) [22]. Moringa leaves are inexpensive easily available and unconventional source of energy.

Feed intake and dry matter intake

Moringa leaves were supplemented in (M5 and M15) in comparison to the control group. The calves started taking calf starter at 9th day of age. Gradual increased of calf starter intake upto weaning age indicates the appetite towards the calf starter. It was also observed that calf starter intake was higher in post weaning period. Significantly increasing dry matter intake was reported in the M5 and M15 groups in comparison to the control group. This may have contributed to increase growth rate in M15 groups during the study. However, it should be noted that the increase nutrient intake in M15 groups was due to palatability of Moringa leaves. Calf starter and concentrate mixture was replaced with 5% and 15% of Moringa leaves in M5 and M15 groups, respectively on DM basis.

Efficiency of feed utilisation determines how efficiently feed is utilised for the growth of the calves. McDonald *et al*. (1995) [14]. An increase in growth obtained by higher feed intake is usually associated with an increase in overall efficiency of the production. Since, maintenance costs are decreased proportionately as growth rises in a certain period.

Effect of Moringa leaves on feed intake and growth performance

Data of voluntary feed intake indicated that DMI was significantly (p<0.05) higher in DMOL supplemented rations M5 and M15 groups than control group. Growth performance total body weight gain and ADG of buffalo calves fed 5% and 15% DMOL supplemented rations were (p<0.05) higher than those fed control group. It was noticeable that M15 produced the highest weaning weight, total body weight gain and Average Daily Gain (ADG) while, calves fed control group consumed the highest intake and achieved the lowest weaning weight, total weight gain and ADG. The better weaning body weight and weight gain attained by feeding M5 and M15 could be attributed higher.

Body weight (BW) changes and average daily body weight gain

Body weights are commonly used for monitoring nutritional status and growth of animals (Chimonyo *et al*., 2000) [8]. In the present study body weight changes were slow in the pre weaning periods in all the groups. Average daily gain was higher in M15 group in comparison to control groups in pre

weaning period, whereas in post weaning period average daily gain was higher in M5 group, although values were significant. The results of the present study suggested that feeding buffalo calves plus DMOL, at the levels of 5 and 15% could play as natural growth promoter as mentioned by (El-Badawi *et al.*, 2014) [11]. The improvement in body weight gain may be attributed to the rich content of nutrients in DMOL (Fahey *et al*. 2001) [12].

Hematological parameters

In the present study, haematological parameters like PCV (%), Hb (g/dl), TP g/dl, Albumin g/dl, globulin g/dl, BUN mg/dl) were found non-significant among the groups. However, inclusion of *Moringa* had no negative effect on haematological parameters.

Faecal score

Diarrhoea or scours is one the most common problem reported in Calves upto 3 months old. In the present study, average daily gain and overall feed intake were maintained across the groups. Thus, maintained average daily gain and feed intake along with unaffected fecal score suggest that such known and unknown anti-nutritive factors usually found in Moringa leaves may have been mostly separated or inactivated during the drying of leaves.

Economic analysis

One of the main reasons of not rearing the calves in the dairy farms is high milk price and demand. Therefore, the economic analysis was performed to check the recurring expenditure incurred to rear buffalo calves upto six months of age by replacing Moringa leaves in different proportions. Information on calf growth and cost of calf rearing is important for the successful raising of calves as replacement stock.

Conclusions

Moringa leaves have a very high biological value and considerable potential for adoption as feed for ruminant fodder resource. Moringa leaves are inexpensive, easily available and unconventional source of energy. *Moringa oleifera* plants are readily available in Madhya Pradesh. On the basis of the findings of the present experiment, Upto 15 per cent concentrate mixture replacement can be done with *Moringa oleifera* leaf meal to improve the body weight gain, feed intake and protein intake of Murrah buffalo calves. *Moringa oleifera* leaf meal can replace upto 15 per cent of calf starter and concentrate mixture to achieve better body weight gain and improve economic efficiency of Murrah buffalo calf rearing.

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References

1. Abbas TE. The use of *Moringa oleifera* in poultry diets. Turkish Journal of Veterinary and Animal Sciences. 2013; 37:492-496.
2. Ahmad AE, Ibrahim AAS, Ebtehag IMAE, Mohamed SA, Hassan MS. Effect of feeding dry *Moringa oleifera* leaves on the performance of suckling buffalo calves. Asian Journal of Animal Science, 2017; 11:32-39.
3. Anderson KL, Nagaraja TG, Morrill JL, Avery TB, Galitzer SJ, Boyer JE. Ruminal microbial development in conventionally or early-weaned calves. Journal of Animal Science. 1987; 64(4):1215.
4. Anjorin TS, Ikokoh P, Okolo S. Mineral composition of *Moringa oleifera* leaves, pods and seeds from two regions in Abuja, Nigeria. International Journal Agriculture and Biology. 2010; 12:431-434.
5. Anwar F, Bhanger MI. Analytical characterization of *Moringa oleifera* seed oil grown in temperate regions of Pakistan. Journal of Agricultural and Food Chemistry, 2005; 51:6558-6563.
6. Aslam M, Anwar F, Nadeem R, Rashid U, Kazi TG, Nadeem M. Mineral composition of *Moringa oleifera* leaves and pods from different regions of Punjab, Pakistan. Asian Journal of Plant Sciences. 2005; 4:417-421.
7. BAHS. Basic Animal Husbandry, 2017, Statistics. http://dahd.nic.in/Division/statistics/animal-husbandry-statistics-division.
8. Chimonyo M, Kusina NT, Hamudikuwanda H, Nyoni O. Reproductive performance and body weight changes in draught cows in a smallholder semi-arid farming area of Zimbabwe. Tropical Animal Health and Production. 2000; 32(6):405-415.
9. Deshmukh P. Antibacterial and immunomodulatory activity of *Moringa oleifera* in albino rats. M.V.Sc. thesis (Department of Veterinary Pharmacology and Toxicology), Nanaji Deshmukh Veterinary Science University, Jabalpur, M.P. India, 2014.
10. Dubey DK, Dora J, Kumar A, Kumar GR. A multipurpose tree moringa oleifera. International Journal of Pharmaceutical and Chemical Sciences. 2013; 2(1):415-421.
11. El-Badawi AY, Omer HAA, Abedo AA, Yacout MHM. Response of growing New Zealand white rabbits to rations supplemented with different levels of *Moringa oleifera* dry leaves. Global Veterinaria. 2014; 12:573-582.
12. Fahey JW, Zalcmann AT, Talalay P. The chemical diversity and distribution of glucosinolates and isothiocyanates among plants. Phytochemistry. 2001; 56:5-51.
13. Kertz AF, Barton BA, Reutzel LF. Relative efficiencies of wither height and body weight increase from birth until first calving in Holstein cattle. Journal of Dairy Science. 1998; 81:1479-1482.
14. McDonald P, Edwards RA, Greenhalgh JFD, Morgan CA. Animal Nutrition, 5th Edn., Wiley, New York, 1995, 418-433.
15. Moran JB. Factors affecting high mortality rates of dairy replacement calves and heifers in the tropics and strategies for their reduction. Asian Australasian Journal of Animal Science. 2011; 24(9):1318-1328.

16. NRC. Nutrient requirements of dairy cattle. 7th Rev. Edn. National Academy Science., Washington, DC, 2001, 214-233.
17. Oduro I, Ellis WG, Oswsu D. Nutritional potential of two leafy Vegetabale: Moringa oleifera and Ipomea batata leaves, Scientific Research and Essays. 2008; 3:57-60.
18. Ogbe AO, John PA. Proximate study, mineral and anti-nutrient composition of *Moringa oleifera* leaves harvested from lafia Nigeria potential in poultry nutrition and health. Journal of Microbiology Biotechnology and Food Science. 2012; 1(3):296-308.
19. Ojiako EN. Phytochemical analysis and antimicrobial screening of *Moringa oleifera* leaves extract. The International Journal of Engineering and Science. 2014; 3(3):32-35.
20. Portugaliza HP, Fernandez TJ. Growth performance of Cobb broilers given varying concentrations of malunggay (*Moringa oleifera*) aqueous leaf extract. Journal of Animal and Feed Research. 2012; 2(6):465-469.
21. Pradhan BC. Valuation of haematological and biochemical parameters of goats of central Odisha environment fed on natural grazing land of Odisha. The Pharma Innovation Journal. 2016; 5(5):83-90.
22. Sarwatt SV, Milangha MS, Lekule FP, Madalla N. *Moringa oleifera* and cottonseed cake as supplements for smallholder dairy cows fed Napier grass. Livestock Research for Rural Development, 2004, 16(6).