

EFFECT OF FEEDING CONCENTRATE MIXTURES CONTAINING VARYING LEVELS OF DRIED MORINGA (*Moringa oleifera*) LEAVES ON THE DIGESTIBILITY OF NUTRIENTS IN MURRAH BUFFALO HEIFERS

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ABSTRACT

A feeding trial was conducted on fifteen Murrah buffalo heifers divided into three groups fed with varying levels of dried moringa (*Moringa oleifera*) leaves incorporated at 0, 10, and 20 per cent in the concentrate mixture (20 per cent CP and 68 per cent TDN) for the treatments T1 (control), T2, and T3 respectively for the evaluation of digestibility of nutrients. *Ad libitum* green grass was provided. The digestibility coefficient of nutrients remained similar ($P>0.05$) except for CP, which was significantly lower ($P<0.05$) in buffalo heifers fed T3 compared to those fed T1 and T2. The present study revealed that moringa leaves can be effectively incorporate at 10 per cent in the concentrate mixture of buffalo heifers.

Keywords: Murrah buffalo heifers, dried moringa leaves, digestibility of nutrients

INTRODUCTION

Moringa trees are widely distributed in India, and the dried leaves of this plant can be incorporated as an ingredient in concentrate feed. It is a drought resistant tree fodder, can tolerate dry seasons lasting up to six months and can be cultivated in hot, humid, tropical and subtropical regions. Being perennial in nature, it can be harvested several times in the same growing season (Sanchez *et al.*, 2006). Moringa leaves have high nutritional value and an impressive range of medicinal uses such as therapeutic and prophylactic properties (Anwar *et al.*, 2007). They are abundant in energy, amino acids (methionine, cysteine, arginine, aspartic acid, glutamic acid), fatty acids (oleic acid, linoleic acid, linolenic acid and palmitic acid) polyphenols, ascorbic acid, α -tocopherol, β -carotene, (Arabshahi-D *et al.*, 2007; Sanchez-Machado *et al.*, 2010), and various minerals such as Ca, K, Fe, Zn

and vitamins (Gupta *et al.*, 1989). Moringa leaves are found to be a potential source of natural antioxidants, flavonoids and phytoestrogens (Djais *et al.*, 2019).

Various studies have been done in dairy cattle incorporating moringa leaves in feed at different levels of inclusion. Sultana *et al.* (2021) reported no significant difference in digestibility of nutrients of Red Chittagong bulls fed with moringa leaves and twigs in concentrate mixture at 0, 25 and 50 per cent. In buffaloes, studies related to concentrate feed incorporating dried moringa leaves are minimal. So the present study was planned to formulate concentrate feed containing dried moringa leaves for Murrah buffalo heifers and compare their nutrient digestibility to those fed on conventional feed and with the hypothesis that the digestibility of nutrients in control ration and experimental ration will be similar.

MATERIALS AND METHODS

Fifteen Murrah buffalo heifers were selected from the buffalo farm of University Livestock Farm and Fodder Research and Development Scheme, Mannuthy for the experiment. All the animals were housed in a barn with sufficient ventilation and light. The barn was clean and dry with facilities for individual feeding and watering. The body weight of the experimental animals were taken and randomly allotted to three

dietary treatments of five animals each using completely randomised design. The average body weight of experimental animals was 310 kg. All experimental animals were dewormed before the start of the experiment.

Three dietary treatments *Viz.* T1, T2 and T3 containing concentrate mixture (20 per cent CP and 68 per cent TDN) were provided to experimental buffalo heifers and all dietary treatments were made to be isocaloric and isonitrogenous. The ingredients used in basal diet were maize, rice polish, de-oiled rice bran, corn gluten fibre, de-oiled coconut oil cake, alfalfa pellets, dried moringa leaves, calcite, mineral mixture and salt. Dried moringa leaves was incorporated at 0, 10 and 20 per cent in the concentrate mixture for treatments T1 (control), T2 and T3 respectively. They were kept under identical environmental and management conditions prevailing in the farm and were fed as per ICAR (2013) feeding standards throughout the experimental period of 120 days. Green grass (Hybrid Napier) and water were offered *ad libitum* to all experimental buffalo heifers. The moringa leaves for this experiment was purchased from Sree Shiva and Co. in Madurai, Tamil Nadu, India.

A digestibility trial of five days duration towards the end of the experiment by total collection method was conducted in

all the experimental animals. Representative samples of concentrate feed and grass were taken during the digestion trial and stored for chemical analysis. The balance of the feed and grass samples if any, were also collected from individual animals and their moisture content was determined every day during the collection period. The dung voided by each animal was collected quantitatively uncontaminated with urine, feed residue or dirt as and when they are voided in individual containers, on a continuous 24 hour basis during the digestion trial. The entire quantity of dung voided by each individual animal during the previous 24 hours was weighed separately at 9 A.M every day and representative samples at the rate of ten per cent of the total quantity were taken after mixing thoroughly and stored in airtight double lined polythene bags. The samples collected in each day were stored in deep freezer at -20°C. At the end of the collection period, the stored

faecal samples were pooled and used for chemical analysis. Based on the data on the digestion trial, the digestibility coefficient of nutrients in the ration was estimated.

Using the software Statistical Product and Service Solutions (SPSS) version 24.0, data collected on various parameters throughout the experiment were statistically analysed in accordance with (Snedecor and Cochran, 2014) by the analysis of variance (ANOVA) approach.

RESULTS AND DISCUSSION

The data on ingredient composition of the experimental rations and data on digestibility coefficient of nutrients of buffalo heifers maintained on three experimental rations are given in Table 1 and 2 respectively.

Statistical analysis of the data revealed that, dry matter (DM), ether extract (EE), crude fibre (CF), nitrogen

Table 1. Ingredient composition of the experimental rations offered to buffalo heifers maintained on three dietary treatments

Ingredient	Per cent composition		
	T1	T2	T3
Maize	37	36	33
Rice polish	4	4	4.5
De-oiled rice bran	9	12.25	14
Corn gluten fibre	11.75	10	12
De-oiled Coconut oil cake	23	13	3
Alfalfa pellets	12.25	12.25	11.5
Dried moringa leaves	0	10	20
Calcite	1.5	1	0.5
Mineral mixture	1	1	1
Salt	0.5	0.5	0.5
Total	100	100	100

Table 2. Digestibility coefficient¹ of nutrients of buffalo heifers maintained on three experimental rations, %

Parameters	T1	T2	T3	p-value
Dry matter	64.89±0.96	66.17±0.84	64.31±0.93	0.371 ^{ns}
Crude protein	66.69 ^a ±0.82	66.87 ^a ±0.96	61.78 ^b ±1.10	0.004*
Ether extract	80.83±0.86	83.89±0.98	81.62±0.83	0.08 ^{ns}
Crude fibre	63.08±1.27	67.03±0.59	64.01±1.46	0.081 ^{ns}
Nitrogen free extract	69.39±0.93	71.04±0.89	69.78±0.88	0.426 ^{ns}
Neutral detergent fibre	65.37±0.77	68.55±0.62	67.06±1.15	0.072 ^{ns}
Acid detergent fibre	56.42±1.21	59.21±0.75	57.90±1.88	0.351 ^{ns}

¹Mean values are based on five replicates; ns-non significant at P> 0.05

*Means bearing different superscripts within a row differ significantly at P<0.05

free extract (NFE), neutral detergent fibre (NDF), and acid detergent fibre (ADF) digestibility were similar (P>0.05) between the three treatment groups whereas the digestibility of crude protein (CP) was significantly lower (P<0.05) for T3 when compared with T1 and T2.

Dry Matter

The average DM digestibility of the experimental rations fed to the buffalo heifers fed dietary treatments T1, T2 and T3 were 64.89±0.96, 66.17±0.84 and 64.31±0.93 per cent, respectively. Statistical analysis of the data revealed no significant difference (P>0.05) in DM digestibility between the three treatments.

Imran *et al.* (2016a), observed that lactating Nili Ravi buffaloes fed *Moringa oleifera* hay (MOH) diet at 3 per cent DM of bodyweight had significantly higher DM digestibility (68.6 percent) than *Medicago sativa* (MSH) at 3 per cent DM of bodyweight fed buffaloes (60.4 percent),

and the values being comparable to that obtained in present study. The values of DM digestibility were in agreement with the Abdel-Raheem and Hassan (2021) who observed values of 66.42 and 62.03 in buffalo calves fed with moringa leaf meal (MLM) at 15 per cent and 20 per cent respectively replacing soya bean meal (SBM) by 50 and 75 per cent in the concentrate mixture.

Imran *et al.* (2016b) did not observe any effect on DM digestibility in Nili Ravi buffaloes when fed with rations containing MLM at 0.0, 0.71, 1.42 and 2.16 Kg DM/day as replacement for cotton seed cake (CSC) at levels of 2.16, 1.42, 0.71 and 0.0 Kg DM/day and obtained DM digestibility of 70, 72, 73 and 70 per cent respectively, the values being higher compared to present study.

Similar trends to that obtained in the present study were stated by Kholif *et al.* (2015) who observed no significant difference in DM digestibility of goats fed

diets containing 10 and 20 percent MLM replacing sesame meal as a protein source.

Crude Protein

The average CP digestibility of the experimental rations fed to the buffalo heifers in treatments T1, T2 and T3 were 66.69 ± 0.82 , 66.87 ± 0.96 and 61.78 ± 1.10 per cent, respectively. Statistical analysis of the data revealed that the buffalo heifers fed with T1 and T2 ration had significantly higher ($P < 0.05$) CP digestibility than animals fed T3.

Likewise, Elaidy *et al.* (2017) also observed that buffalo calves offered with 0, 5, 10, 15 and 20 per cent moringa leaves containing concentrate ration had CP digestibility of 61.63, 73.76, 77.70, 73.89, and 61.55, respectively. Digestibility of CP was significantly higher in 5, 10 and 15 per cent fed groups, and comparable values to the present study were observed in the 0 and 20 per cent moringa incorporated groups. Similarly, Abdel-Raheem and Hassan (2021) concluded that in buffalo calves, the inclusion of MLM at 15 per cent and 20 per cent replacing SBM by 50 and 75 per cent in the concentrate mixture respectively had significantly reduced CP digestibility (per cent) of 60.91 and 57.73 as compared that of control diet (66.06) and the values observed were almost in agreement with the present study.

Imran *et al.* (2016a) observed that lactating Nili Ravi buffaloes fed MOH diet at 3 per cent DM of bodyweight and MSH diet at 3 per cent DM of bodyweight had CP digestibility of 80.00 and 69.10 and the values were higher than that observed in present study. Similarly, Imran *et al.* (2016b) found that Nili Ravi buffaloes fed rations containing MLM at 0.0, 0.71, 1.42, and 2.16 Kg DM/day as a replacement for CSC containing 2.16, 1.42, 0.71, and 0.0 Kg DM/day had CP digestibility of 74, 76, 79, and 81 per cent respectively, the values being higher compared to those obtained in the present study.

Similar trends were also reported (Kholif *et al.*, 2015) in goats fed MLM as a protein source. Low CP digestibility at 20 per cent MLM incorporation was observed compared to an MLM-free diet and the study concluded that the lower digestibility of 20 per cent MLM incorporated diet was due to the higher tannins and phenolic compound concentrations in MLM, which binds protein, reducing the availability of CP for digestion.

Crude Fibre

The average CF digestibility of the experimental rations fed to the buffalo heifers in treatments T1, T2 and T3 were 63.08 ± 1.27 , 67.03 ± 0.59 and 64.01 ± 1.46 per cent, respectively. The statistical analysis of the data revealed that there was

no significant difference ($P>0.05$) in CF digestibility of buffalo heifers fed three experimental rations.

Similar to the present study Abdel-Raheem and Hassan (2021) observed that buffalo calves fed with concentrate incorporated with MLM at 15 per cent and 20 per cent, replacing SBM by 50 and 75 per cent respectively, had CF digestibility of 64.57 and 59.22 per cent. On the contrary lower values for CF digestibility were observed by Elaidy *et al.* (2017) in buffalo calves offered with 0, 5, 10, 15, and 20 per cent moringa leaves containing concentrate ration the values being 36.10, 45.66, 48.98, 49.82, and 42.62 respectively in which 0 and 20 per cent moringa leaves fed group had significantly lower digestibility.

Ether Extract

The average EE digestibility of the experimental rations fed to the buffalo heifers in treatments T1, T2 and T3 were 80.83 ± 0.86 , 83.89 ± 0.98 and 81.62 ± 0.83 per cent, respectively and the values were similar ($P>0.05$).

Higher EE digestibility values were observed by Imran *et al.* (2016a) in lactating Nili Ravi buffaloes fed with a MOH diet (88.4 per cent) at 3 per cent DM of bodyweight. In agreement with present study Elaidy *et al.* (2017) observed that there was no significant difference between

the EE digestibility values of 84.48 and 83.90 per cent in buffalo calves offered 0 and 20 per cent moringa leaf incorporated concentrate mixture. Abdel-Raheem and Hassan (2021) concluded that in buffalo calves, the inclusion of MLM at 15 per cent and 20 per cent, replacing SBM by 50 and 75 per cent in the concentrate mixture respectively, had EE digestibility of 62.32 and 61.79, the values being lower than those obtained in present study.

Kholif *et al.* (2015) reported that goats fed dried moringa leaves had no effect on EE digestibility at 0, 10, 15 and 20 per cent incorporation in concentrate mixtures.

Nitrogen Free Extract

The average NFE digestibility of the experimental rations fed to the buffalo heifers in treatments T1, T2 and T3 were 69.39 ± 0.93 , 71.04 ± 0.89 and 69.78 ± 0.88 per cent, respectively. Statistical analysis of the data revealed that no significant difference ($P>0.05$) in NFE digestibility between three treatments.

The NFE digestibility values were comparable to Elaidy *et al.* (2017), who fed buffalo calves 0, 5, 10, 15, and 20 per cent moringa leaves containing concentrate ration (64.20, 75.01, 76.69, 74.30, 65.25, respectively), and the observed NFE digestibility coefficients were significantly

higher in the 5, 10, and 15 per cent fed groups, and comparable values were observed in the 0 and 20 per cent moringa incorporated groups. Abdel-Raheem and Hassan (2021) concluded that in buffalo calves, the inclusion of MLM at 15 per cent and 20 per cent, replacing SBM by 50 and 75 per cent in the concentrate mixture and control feed had NFE digestibility of 56.90, 55.11 and 58.21 which were lower compared to values obtained in the present study.

Neutral Detergent Fibre

The average NDF digestibility of the experimental rations fed to the buffalo heifers in treatments T1, T2 and T3 were 65.37 ± 0.77 , 68.55 ± 0.62 and 67.06 ± 1.15 per cent, respectively and the values did not differ significantly ($P > 0.05$).

Imran *et al.* (2016a) observed that the NDF digestibility of lactating Nili Ravi buffaloes fed MOH diet and MSH diet each at 3 per cent DM of bodyweight had NDF digestibility of 79.5 per cent the values being higher than those obtained in the present study. Imran *et al.* (2016b) found that Nili Ravi buffaloes fed with ration containing MLM at 0.0, 0.71, 1.42 and 2.16 Kg DM/day substituting CSC at levels of 2.16, 1.42, 0.71 and 0.0 Kg DM/day had a NDF digestibility coefficient of 69, 72, 74, and 80 per cent respectively, which were similar ($P > 0.05$) except for the

group fed moringa at highest level.

Similarly, Kholif *et al.* (2015) observed no significant difference in NDF digestibility between goats fed with 0, 10, and 20 per cent moringa incorporated concentrate mixture. However, goats fed MLM at 15 per cent of diet as a protein source had improved NDF digestibility when compared to the MLM devoid diet.

Acid Detergent Fibre

The average acid detergent fibre (ADF) digestibility of the experimental rations fed to the buffalo heifers in treatments T1, T2 and T3 were 56.42 ± 1.21 , 59.21 ± 0.75 and 57.90 ± 1.88 per cent, respectively and the values did not differ significantly ($P > 0.05$).

Similar ADF digestibility values of 61.8, 58.9, 58.2, and 57.3 were observed by Thao *et al.* (2015), who offered *Eucalyptus camaldulensis* leaf meal at 0, 40, 80, and 120 grams/head/day to swamp buffaloes along with a basal diet containing *ad libitum* rice straw and concentrate feed. Imran *et al.* (2016a) observed that ADF digestibility of lactating Nili Ravi buffaloes fed with MOH diet at 3 per cent DM of bodyweight was significantly higher (77.1) than those fed MSH (67.8) at 3 per cent DM of bodyweight and the digestibility values were higher compared to that observed in present study.

In agreement with the present study, Kholif *et al.* (2015) observed that there was no significant difference in ADF digestibility of goats fed with 0, 10 and 20 per cent moringa in rations, whereas MLM at 15 per cent as a protein source had improved digestibility of ADF as compared to MLM devoid diet.

CONCLUSION

On summarising the results, it could be concluded that dried moringa leaves can be incorporated at 10 per cent in the rations of buffalo heifers. The digestibility of nutrients remains unchanged at 20 per cent incorporation except for the CP digestibility.

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