Research Article

Potential of *Moringa oleifera* Leaf Meal as Partially Replacement of Cotton Seed Cake in Diet of *Nili-Ravi* Buffaloes in Semi-Arid Areas

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Abstract | This experiment was conducted to evaluate the potential of *Moringa Oleifera* leaf meal (MOLM) as partially replacement of the cotton-seed cake (CSC) in lactating *Nili-Ravi* buffaloes. On the basis of nearly similar lactation stage and body weight, sixteen individually confined buffaloes were randomly blocked and allotted to four different dietary treatments. MOLM in proportion to CSC was supplemented along with maize silage as basal diet. Four dietary treatments having MOLM were 0.0, 0.71, 1.42 and 2.16 Kg DM/day used as replacement for CSC containing 2.16, 1.42, 0.71 and 0.0 Kg DM CSC/day. Overall the apparent digestibility coefficients of dry matter (DM) and organic matter (OM) were non-significant (P>0.05) whereas digestibility of NDF was significantly increased (P<0.05) in treatment MLM4. When compared among treatments, the value of crude protein (CP) digestibility coefficient was high (P<0.05) in treatment MLM4 as compared to MLM1. Similar trend was also observed in case NDF among treatments. Daily milk yield and 4 % FCM has increased (P<0.05) in buffaloes fed treatment MLM3 and MLM4 as compared to other treatments. While there was no significant (P>0.05) difference of percentage of fat, protein, lactose, ash, total solids and solid not fat observed among all treatments. However, on the basis of total yield per buffalo in a day, an increasing (P<0.05) trend was observed in increase of milk protein and lactose contents. Moreover, a significant difference was observed in milk protein between treatment MLM1 and MLM4. This study indicated that CSC can be substituted completely with MOLM however a combination of MOLM and CSC improved milk yield than either protein source fed alone in lactating *Nili-Ravi* buffaloes in Pakistan.

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Introduction

In the southern semi-arid areas of Punjab, due to low rainfall and water shortage, the available fodder for ruminants is poor in quality and quantity. This low quality fodder leads to deficiencies in protein and energy in lactating animals (Mannetje't, 1984). During drought and water scarcity period, matured and dry pastures have shortage of crude protein and energy contents (Sarwatt et al., 2004). This worsen situation severely effect on the milk production in buffaloes. Due to decline in milk production, mostly smallhold-

ers and nomadic livestock holders are affected. So supplementation of protein is required with balance of other available nutrients to enhance the performance as well production of the buffaloes.

Among farmers, the popular source of protein which is widely used to buffaloes is Cotton seed cake. The excessive utilization of cotton seed cake and its expanding export to gulf countries has increased its prices in the local markets. Moreover its few varieties contains gossypol, an anti-nutritional factors which is detrimental for animal health (Adegun et al., 2013). So there is need to explore other non-conventional protein rich forage trees which can supplement protein in the animals in the scarcity periods of the year.

Moringa oleifera is a drought resistant tree which is widely grown in South Asia, Pakistan and India which is traditionally used as vegetable or livestock fodder (Odee, 1998). It is a fast growing plant which grows well in all sorts of soil. It continues to grow even in water scarcity periods (Becker, 1995). The leaves of this plant are high in contents of crude protein, essential vitamins and minerals (Makkar and Becker, 1997).

Various studies have been conducted to utilize *Moringa oleifera* as source of supplementation to ruminants but the use of *Moringa oleifera* leaf meal (MOLM) as an alternative of cotton seed cake as an ingredient of concentrate in *Nili-Ravi* buffaloes in the semi-arid zone of the Punjab has not conducted so far. So the objective of this study was to evaluate the potential of *Moringa oleifera* leaf meal as partially replacement of cotton seed cake in diet of *Nili-Ravi* buffaloes in semi-arid areas of Pakistan.

Materials and Methods

Experimental animals and management

On the basis of nearly similar lactation stage and body weight, twelve individually confined buffaloes were used for this experiment at White Gold Dairy Farm. They were placed in blocks depending on parity level. The buffaloes were confined in well ventilated stalls with *adlib* supply of water. Before the start of experiment all the buffaloes were equally treated for dewormer Nilzan Plus (Oxyclozanide BP (vet),Levamisole Hydrochloride BP (vet) ,Cobalt Sulphat-ICI,Pakistan) and Ecotraz Plus Pour On (Amitraz 1.5% + deltamethrin 0.5% + piperonyl butoxide 3%- Orient Animal Health) for internal and external parasites respectively were applied according to the manufacturer's instructions. Buffaloes were vaccinated against FMD two weeks before the start of the experiment.

Feeding management of buffaloes

During the fodder scarcity period in summer, leaves of *Moringa Oleifera* and soft stems were harvested using a machete before flowering stage. The harvested material was chopped into smaller pieces of about 2 cm with an electric chopping machine and was dried in the shade to reduce its moisture upto 20% dry matter contents. After drying the material, it was milled by hammer mill and passed through 1mm screen. After milling it was packed into sacks and were stored in the warehouse with complete ventilation. Cotton seed cake was purchased from a local cotton seed oil expeller plant. Mineral mixture was used by Pakistan Agricultural Research Council (PARC) recommended (Milk booster-PARC Islamabad). Fresh maize at milky grain stage was harvested using mechanical harvester from the plots of White Gold Dairy Farm and were chopped into 2cm length by electric chopper and packed into silo pits to prepare maize silage. First 2 weeks were adaption to treatments phase while in following 3 weeks, production as well as digestibility parameters were recorded.

Measurement of nutrients digestibility

Daily weight of the fodder offered and refused by all the buffaloes was recorded. From the conventional method of difference net daily fodder intake was determined. The Dry matter of the fodder was conducted as described by Undersander et al. (1993).

For the measurement of the digestibility by total collection method, 4 buffaloes were randomly selected for digestibility estimation at the end of feeding trail. Initially for 3 days these buffaloes were adapted for fecal collection. In following next 7 days fecal samples were collected by total collection method. At every morning, weight of the total collected feces was recorded while 5% fecal sample was taken. Placed in air tight plastic bags and kept in refrigerator at -20°C. At the last day all the fecal samples of individual buffaloes were thoroughly mixed and pooled up to make single sample for the chemical analysis of DM,CP and NDF.

Chemical analysis

The collected samples of fodder and feces were ana-

lyzed for dry matter (DM), Organic matter (OM), neutral detergent fiber (NDF), acid detergent fiber (ADF), crude protein (CP) and ash contents. Samples of feed and feces were dried at 60°C for 48 h in the oven and got constant weight. After it the material was passed through 1mm sieve. Ash was determined by keeping the samples at 550°C for 8 h in the special electric furnace. DM and OM in the feed and fecal samples were assessed by procedure proposed by Goering and Van Soest (1990). Nitrogen (N) was determined by mi micro Kjeldahl method (Kass and Rodriguez, 1993) while crude protein was calculated from nitrogen contents in the samples (CP = N x 6.25) according to the official methods of AOAC (1990). Coefficients of apparent digestibility for DM, OM, CP and NDF were calculated by the differences of the amount of nutrients between offered feed and recovered in the feces. In the milk samples milk protein was determined by formaldehyde titration (6.38×N) as suggested by Scott (1986). Babcock method (Pereira, 1988) was used to determine the fat contents in the milk samples whereas lactose contents were analyzed by USA made auto analyzer.

Data analysis

The experimental design used was 4x4 latin square with four replicates. Data from dry matter intake, apparent digestibility coefficients, milk production and milk composition were analysed using the general linear model (GLM) of the Statistical Analysis System. Duncan's multiple range test was used to separate treatment means (SAS 2002).

Results

Ingredient proportion and chemical composition of feeds

Proportion of the ingredients used in the experimental diets for lactating buffaloes is presented in Table 1. The four treatments have similar feed ingredients except two which are cotton seed cake (CSC) and *Moringa oleifera* leaf meal (MOLM) at various proportions, as MOLM to replace CSC (Table 1). The mean chemical composition of the five feed ingredients have indicated (Table 2) there is clear difference of the contents of the crude protein level among these ingredients. CP contents were high in MOLM as compared to other feed ingredients. Composition of the intake nutrients of the treatments are represented in Table 3, indicate that similar contents of DM, OM and ADF were present in four treatments.

Table 1: *Proportion of the ingredients in the experimental diets*

Ingredients proportion Kg DM/day	Treatments			
	MLM1	MLM2	MLM3	MLM4
MOLM	0.00	0.71	1.42	2.16
CSC	2.16	1.42	0.71	0.00
Maize Silage	……Ad-libitum……			
Wheat bran	2.94	2.94	2.94	2.94
Cane molasses	0.72	0.72	0.72	0.72
Mineral Mixture	0.180	0.180	0.180	0.180

MOLM= *Moringa Oleifera leaf meal;* **CSC**= *Cotton seed cake*

Table 2: *Chemical composition of individual feed ingredients*

Chemical composition (g/KgDM)	Experimental Feed				
	CSC	MOLM	Maize	W. Bran	Molasses
DM	901	890	880	890	743
CP	190	267	95.1	155	30.4
NDF	563	305	468.5	425	4.0
ADF	171	230	258.1	155	2.0
Ash	15.1	138	64.6	6.30	133

DM = *Dry matter;* **NDF**= *Neutral detergent fiber;* **OM** = *Organic matter;* **ADF** = *Acid detergent fiber;* **CP** = *Crude protein*

Table 3: *Nutrients Intake composition of the treatments*

Nutrient content Kg DM	Treatments			
	MLM1	MLM2	MLM3	MLM4
DM	14.799	14.765	14.758	14.777
OM	13.847	13.727	13.632	13.560
CP	1.673	1.721	1.776	1.839
NDF	9.647	9.449	9.268	9.096
ADF	5.309	5.347	5.389	5.439
ASH	0.9514	1.038	1.125	1.216

DM = *Dry matter;* **NDF**= *Neutral detergent fiber;* **OM** = *Organic matter;* **ADF** = *Acid detergent fiber;* **CP** = *Crude protein*

Digestibility of the nutrients

Overall the apparent digestibility coefficients of dry matter (DM) organic matter (OM) and crude protein (CP) were non-significant (P>0.05) whereas digestibility of NDF was significantly increased (P<0.05) in treatment MLM4 (Table 4). When compared among treatments, the value of digestibility coefficient was high (P<0.05) in treatment MLM4 as compared to MLM1. Similar trend was also observed in case NDF among treatments.

Milk production and composition

Daily milk yield and 4 % FCM has increased (P<0.05)

in buffaloes fed treatment MLM3 and MLM4 as compared to other treatments (Table 5). While there was no significant (P>0.05) difference of percentage of fat, protein, lactose, ash, total solids and solid not fat observed among all treatments. However, on the basis of total yield per buffalo in a day, an increasing (P<0.05) trend was observed in increase of milk protein and lactose contents. Moreover, a significant difference was observed in milk protein between treatment MLM1 and MLM4.

Table 4: *Apparent Digestibility Coefficients of the different treatments*

Parameters	Diets				Significance
	MLM1	MLM2	MLM3	MLM4	
Apparent Digestibility Coefficients (%)					
DM	70[a]	72[a]	73[a]	70[a]	(P>0.05)
OM	72[a]	73[a]	74[a]	72[a]	(P>0.05)
CP	74[a]	76[a]	79[a]	81[b]	(P>0.05)
NDF	69[a]	72[a]	74[a]	80[b]	(P<0.05)

[a,b]Means within same row sharing different superscripts differ significantly (P < 0.05)

Table 5: *Milk production and composition of the different treatments*

Milk yield and constituents Kg/day	Treatments				Significance
	MLM1	MLM2	MLM3	MLM4	
Milk yield	10.8[a]	11.4[b]	11.8[b]	11.9[b]	(P<0.05)
4 % FCM	12.42[a]	12.93[a]	13.57[b]	13.32[b]	(P<0.05)
Fat	0.54	0.55	0.59	0.57	(P>0.05)
Protein	0.36[a]	0.38[a]	0.41[b]	0.42[b]	(P<0.05)
Lactose	0.39[a]	0.41[a]	0.44[b]	0.46[b]	(P<0.05)
Milk composition %					
Fat	5.0	4.9	5.0	4.8	(P>0.05)
Protein	3.4	3.4	3.5	3.6	(P>0.05)
Lactose	3.7	3.6	3.8	3.9	(P>0.05)
Ash	0.8	0.80	0.81	0.82	(P>0.05)
Total Solids	12.9	12.7	13.11	13.12	(P>0.05)
Solid Not Fat	7.9	7.8	8.11	8.32	(P>0.05)

[a,b]Means within same row sharing different superscripts differ significantly (P < 0.05); 4% FCM= 4 % Fat corrected milk

Discussion

The maize silage had low CP and high fiber contents, which is characteristics consistent for most cereal crop. The CP content of the maize silages in the present study was within the range of the minimum level of 9.5% required for optimum rumen function (Van Soest, 1994). During this experiment the cotton seed cake contained cottonseed hulls as a result of poor processing during de hulling. It had caused a diluting effect on the crude protein contents in cotton seed cake. The contents of crude protein in the MOLM was similar to that reported by Makkar and Becker (1997) (264 and 270 g/kg DM, respectively) and Sutherland et al. (1996).

The increase in nutrients intake of DM, OM and CP in the treatments containing *Moringa Oleifera* leaf meal (MOLM) as a part of diet was due to increase in CP and low NDF contents in the *Moringa Oleifera* as compared to cotton seed cake (CSC). The similar finding was reported by Reyes et al. (2006) when 2kg and 3kg *Moringa Oleifera* respectively was offered to cows with basal diet B. brizantha hay. However, there was no significant difference of digestibility coefficients of DM, OM and CP among all treatments. A significant increase of digestibility coefficient of NDF was observed in the treatment MLM4 having maximum inclusion of *Moringa Oleifera* leaf meal (MOLM) with replacement of cotton seed cake. This phenomenon occurred due to the fact that *Moringa oleifera* has low contents of NDF 305g/Kg as compared to 563 g/Kg in CSC and 468 g/Kg respectively. Same results were observed by Reyes et al 2006 when 2kg and 3kg *Moringa Oleifera* respectively was offered to cows with basal diet *B. brizantha* hay.

From Table 4 it is obvious that Milk yield has increased in the treatments which were fed *Moringa Oleifera* leaf meal as part of concentrate. Similar results were recorded by Sarwatt et al. (2004). According to Sarwatt et al. (2004) partial replacement of CSC with MOLM has improved the milk yield indicated that Moringa has positive effect on rumen environment with more microbial output and also *Moringa* has good rumen by pass characteristics.

There was no changes in milk composition including fat, protein, lactose, ash, total solids and solid not fat. However total yield of protein and lactose contents per day were high in treatments fed higher quantities of MOLM. This response is due to increase in milk yield in treatment MLM3 and MLM4 also yielded more protein and lactose contents in Kg/ day. Overall increase in milk protein contents also explained by Sporndly (1989) who reported that increase in dietary CP had increased milk protein yield. Similar results were supported by DePeters and Cant (1992) who

demonstrated that milk protein was increased 4% to 10% in milk as compared to control diet when cows were fed diet containing CP 180 g /kg DM.

Conclusions

In the semi-arid zones in the South Asia, *Moringa oleifera* leaf meal as an alternative source of crude protein can completely substitute cottonseed cake however a combination of MOLM and CSC improved milk yield than either protein source fed alone in lactating *Nili-Ravi* buffaloes in Pakistan.

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