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Research Article

Effect of *Moringa* Leaf Pellets as an Additional Feed Component on Milk Yield of Lactating Cows

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Received: April 04, 2020; **Published:** June 22, 2020

Abstract

Scarcity of good fodder for ruminant animals can be addressed by using fodder trees and shrub forages that are locally available and easily manageable. A study was conducted to evaluate the effect of *Moringa* leaf pellets as an additional feed component on the milk yield of eight lactating cows. A basal diet with Bermuda grass and concentrate feed was tested against the same diet where the Bermuda grass was partially replaced by *Moringa* leaf pellets on weight basis for four weeks. The milk yield was recorded twice a day and a sample of 100 ml from each milking was collected and analysed for organoleptic characteristics. The mean daily milk yield was significantly higher when cows were fed *Moringa* leaf pellets and the group fed with *Moringa* leaf pellets showed consistent milk yield throughout the collection period compared to the other group. The organoleptic characteristics like colour, smell and taste of the milk were not significantly different between the diets. It has been evident from the study that *Moringa* leaf pellets fed at half of the forage requirement can significantly improve milk yields of dairy cattle fed a basal diet of Bermuda grass and concentrate without affecting the organoleptic characteristics of milk and thus has the potential to emerge as a good supplement in arid regions.

Keywords: *Moringa Leaf Pellets; Cows; Milk*

Introduction

Scarcity of good quality fodder is one of the most crucial problems faced by the farmers of the arid region. A potential strategy for increasing the quality and availability of feeds for ruminant animals may be using fodder trees and shrub forages [1]. Most trees and shrubs are easily propagated and do not require high management inputs (fertilizer, pesticides, etc.) or advanced technology [2]. However, largely due to the presence of anti-nutritional compounds such as mimosine, cyanogenic glycosides, condensed tannins and alkaloids, the use of forage trees and shrubs has been limited and ad libitum feeding of these forages is rarely used in livestock feeding [3,4].

One of these potential tree forages is *Moringa* (*Moringa oleifera* Lamarck (synonym: *Moringa pterygosperma* Gaertner), commonly referred to as the drumstick tree, which grows throughout the tropics. There are several positive attributes to *Moringa* as an animal feed. *Moringa* grows in all types of soil, from acid to alkaline [5] and at altitudes from sea level to 1800m. It is drought tolerant and will grow even during the 6 months of the dry season [2]. It produces high leaf mass within a short period, and being perennial in nature, it can be harvested several times in the same growing season [3,4]; *Moringa* leaves are characterized by high Crude Protein (CP) content, adequate amino acid profile, high level of Iron, Vitamins A, B, and C [3,6,7] and high amounts of polyphenols resulting in elevated antioxidative activity [8]. Moreover, *Moringa* leaves can be fed fresh or dried and after drying can be stored for long periods without deterioration in nutritive value [9].

Due to this recent interest in *Moringa*, feeding trials using fresh *Moringa* have been performed with many types of animals such as pigs, goats and Creole cows [2,10,11]. Feeding fresh *Moringa* is convenient but there is a large variation in production over the year. Therefore, *Moringa* leaf meal (MLM) is an interesting product as it can be produced during periods of high yields and later used for feeding during the dry season when high quality feed resources are scarce [3].

Rocha and Mendieta [12] fed dairy cows with *Hyparrhenia rufa* grass and sorghum straw supplemented with different levels of *Moringa* leaves, *Moringa* was readily accepted by the animals and did not seem to have any toxic effect or contain any factors limiting intake. Supplementation with *Moringa* leaves at a level of 0.3% of Body Weight resulted in a higher milk yield than for the control treatment, which was grazing only. Sarwatt., *et al*. [13] found that when cotton seed cake was substituted by *Moringa* leaf meal at levels of 10, 20 or 30% of Dry Matter, milk yield was significantly increased.

However, the number of dairy cow experiments with *Moringa* leaf meal is limited [13] and it would be fruitful to study the potential of *Moringa* leaf meal as a feed supplement for milk production.

Objective of the Study

Therefore, the objective of this study was to evaluate how feeding *Moringa* leaf pellets compares to Bermuda grass regarding milk yield and organoleptic characteristics.

Materials and Methods

Location

The experiment was conducted at the farm of The Royal family, Fujairah, United Arab Emirates located at 2508 48.4'' N and 5619 06.2'' E.

Experimental design and management

A basal diet with Bermuda grass and concentrate feed was tested against the same diet where the Bermuda grass was partially replaced by *Moringa* leaf pellets on weight basis. The experimental period consisted of four weeks of data collection with regard to milk yield.

Eight dairy cows from the farm herd in their second lactation were used in the trial. The animals were loose confined in well ventilated stalls. Before the start of the experiment the cows were injected with vitamin A (625000 IU), vitamin D3 (125000 IU) and vitamin E (125 IU), treated against internal and external parasites and vaccinated against the prevalent diseases. Water was provided *ad libitum* and the cows had access to commercial mineral supplement with Ca, P, Mg and trace elements.

The feed allotment was planned to meet the nutritional recommendations of the region. For the control group 60% of the expected dry matter intake was given as roughages in the form of Bermuda grass and 40% in the form of commercial concentrate feed (Milk maker Plus - Agrivita tm). The trial group was fed with Bermuda grass and commercially available *Moringa* leaf pellets in equal quantities along with the same amount of concentrate feed. Roughages were offered individually in separate feed troughs twice a day. The concentrates were fed individually before milking at 05.00h and 17.00h.

The cows were milked twice a day and at each milking the yield was weighed and recorded. From each milking a sample of 100 ml was collected and refrigerated at 4°C. The samples were pooled per week during the data collection period and analysed for organoleptic characteristics.

Statistical analysis

The difference in milk yield of the two groups was analysed using a two-sample t test using Minitab statistical software version 18.0 (Minitab, 1998).

Results

The lactation performance data of cows fed with the two treatments is presented in table 1 and 2. The milk yield ranged between 28.064 to 40.7 kg in the group fed with *Moringa* leaf pellets and between 20.976 to 33.4 kg in the group fed with Bermuda grass alone.

Day	Daily Milk Yield	
	***Moringa* Fed (4 cows)**	**Bermuda grass fed (4 cows)**
0	32.698	27.208
1	30.128	27.794
2	28.064	20.976
3	29.344	21.396
4	29.816	21.22
5	32.238	23.78
6	33.438	26.438
7	33.468	26.246
8	33.948	25.468
9	34.258	26.99
10	34.444	28.794
11	34.663	28.525
12	33.918	28.522
13	35.378	28.568
14	35.134	29.832
15	35.59	28.14
16	34.204	24.64
17	34.59	27.899
18	34.294	23.974
19	34.056	22.376
20	40.7	31.7
21	37.7	26.7
22	38.9	28.9
23	38	33.4
24	36.3	32.4
25	36.5	30
26	37.7	32.8
27	35.1	25.1
28	34.8	25.1
29	37.7	26.6

Table 1: *Daily milk yield of cows fed with Moringa leaf pellets and Bermuda grass alone.*

Days	Increase or Decrease in milk yield $Day_{(n+1)} - Day_{(n)}$	
	***Moringa* Fed**	**Bermuda Fed**
1	-2.57	0.586
2	-4.634	-6.232
3	-3.354	-5.812
4	-2.88	-5.988
5	-0.46	-3.428
6	0.74	-0.77
7	0.77	-0.962
8	1.25	-1.74
9	1.56	-0.218
10	1.746	1.586
11	1.965	1.317
12	1.22	1.314
13	2.68	1.36
14	2.436	2.624
15	2.892	0.932
16	1.506	-2.568
17	1.892	0.691
18	1.596	-3.234
19	1.358	-4.832
20	8.002	4.492
21	5.002	-0.508
22	6.202	1.692
23	5.302	6.192
24	3.602	5.192
25	3.802	2.792
26	5.002	5.592
27	2.402	-2.108
28	2.102	-2.108
29	5.002	-0.608

Table 2: *Difference in milk yield of cows fed with Moringa leaf pellets and Bermuda grass alone.*

The mean daily milk yield was significantly (P 0.05) higher when cows were fed *Moringa* leaf pellets compared with the other treatment. The group fed with *Moringa* leaf pellets showed consistent milk yield throughout the collection period (Figure 1) in actual terms and the fluctuation in milk yield was found to be less in terms of difference in yield (Figure 2).

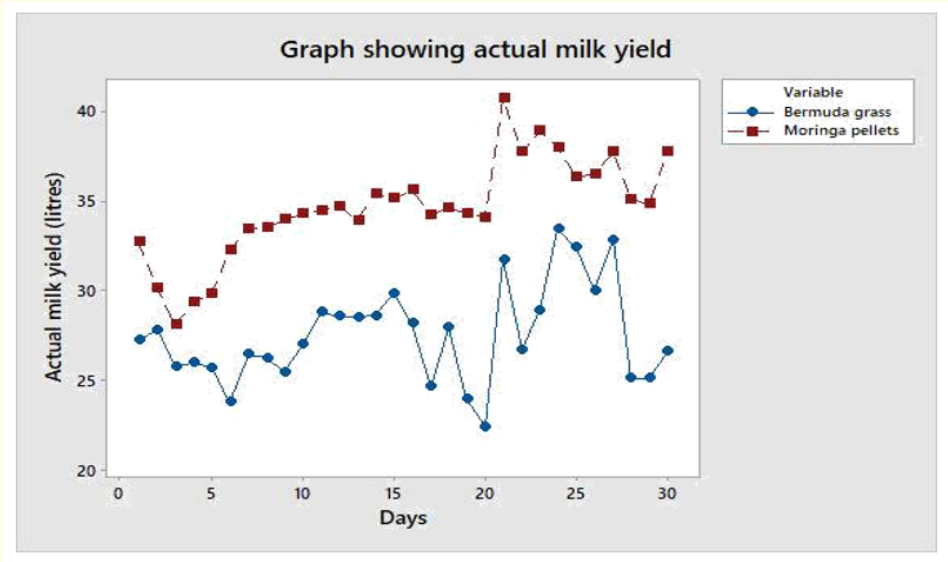

Figure 1: *Graph showing actual milk yield of cows fed with Bermuda grass and Moringa leaves.*

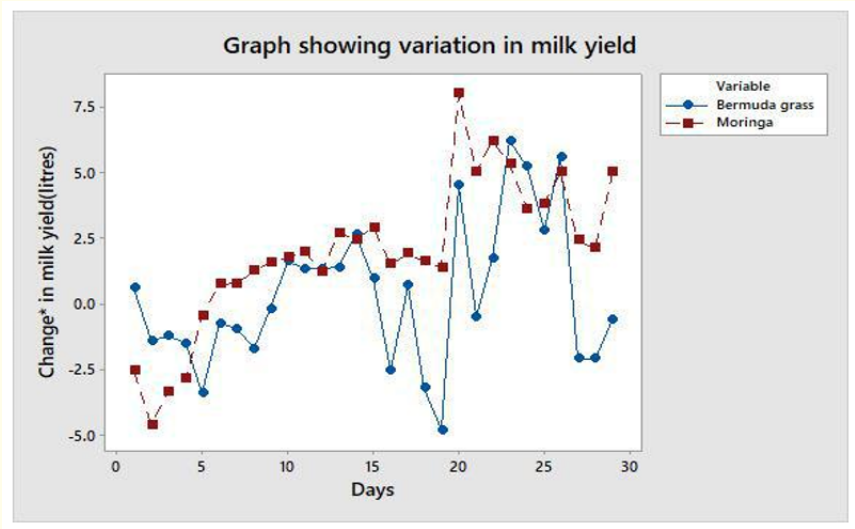

Figure 2: *Graph showing variation in daily milk yield.*

**Change due to other environmental factors- The major one being atmospheric temperature.*

The organoleptic characteristics like colour, smell and taste of the milk were not significantly different between the diets.

Discussion

Milk production was higher in the *Moringa* leaf pellet supplemented cows than those offered Bermuda grass alone. A similar observation was reported by Reyes-Sanchez., *et al*. [2] wherein milk yield was increased in dairy cows by 58% and 65% when fed supplement of 2 and 3 kg dried MO leaves per day, respectively, as substitute for local forage.

Rocha and Mendieta [12] found that cows supplemented with *Moringa* at a level of 0.3% of BW had 13% higher milk production than cows fed a basal diet of *H. rufa* grass and Sorghum vulgare straw. In another experiment, dried MO leaf meal substituted 430, 730 and 1000 g/kg of cotton seed cake in concentrated mixtures while significantly increasing milk yield [3]. Yielding a contrasting result, Mendieta-Araica., *et al*. [4] tested the effect of feeding low yielding dairy cows with diets based mainly on fresh and ensiled *Moringa* foliage along with molasses and elephant grass. The differences among the three groups in milk yield (13.6 - 13.9 kg/d) and milk composition were not significant. Sultana., *et al*. [7] found higher milk and ECM yields in lactating goats fed dried *Moringa* leaves as substitute for sesame meal or concentrates in the diet.

Khalel., *et al*. [14] used *M. oleifera* as a supplement feedstuff (20% and 40% inclusion level) in comparison with *Trifolium alexandrinum* forage (40% inclusion level) evaluating the milk yield and composition during lactation. They reported that cows fed with the *M. oleifera* supplemented diets had significantly higher ($P < 0.05$) milk yield with 25% and 16% daily yield increase compared to those fed with *Trifolium alexandrinum* hay. In a recent study, Cohen-Zinder., *et al.* [15] reported a significantly higher ($P < 0.05$) milk yield, milk fat and milk energy composition for cows that were fed a diet formulated with *M. oleifera* leaf (44 g/kg DM substitution rate) compared to the control diet formulated with wheat hay.

The increase in milk yield has been attributed to different reasons by several authors. According to Sarwatt., *et al*. [13] *Moringa* improved the milk yield due to a positive effect on the rumen environment, leading to increased rumen microbial output, and that the protein in *Moringa* also has good rumen bypass characteristics. Kholif., *et al*. [16] reported that when *Moringa* leaf is a protein source in diet, it increases feed intake, enhances nutrient digestibility and ruminal fermentation, leading to an increase in the milk yield and improvement of the milk fatty acid profile in goats.

The use of *Moringa oleifera* as a fodder plant to improve livestock production can be attributed to the rich presence of minerals in the plant [17] which are crucial for increased weight gain, milk yield and milk quality in ruminant animals [3]. The high increase in the yield and quality of milk of goats and ewes fed with *M. oleifera* leaf when compared to those fed with *Alfalfa* hay was attributed to the rich presence of micro nutrients including phosphorus, calcium, potassium and magnesium [18].

In a different view, Moyo., *et al*. [19] attributed the presence of high anti-oxidant properties of *M. oleifera* leaf to be responsible for improved productivity of livestock. The high anti-oxidative activity of the *Moringa* is due to the high phenolic components of the *Moringa* leaves [8,15] which were shown to have beneficial effects in productive ruminants [15,20]. Moderate concentrations of soluble phenolics and tannins in the diet (20 - 40 g/kg DM) improved production efficiency of ruminants, without increasing Dry Matter intake, as manifested by increased wool growth, body weight gain, milk yield and ovulation rate [21]. In another study, a low level of soluble phenolics addition supplied from pomegranate pulp to cows' TMR, resulted in improved milk yield compared with a control TMR. This advantage was attributed to 25% inhibition of in vitro methane production by ruminal methanogenic bacteria in the cows fed soluble phenolics [22]. Reduction of methanogenesis by phenolics in the rumen might save energy which otherwise is wasted as methane gas, resulting in improved production efficiency in lactating ruminants as demonstrated previously [15,21,22].

The properties like increased rumen microbial output, good rumen bypass characteristics of *Moringa* protein, the rich presence of minerals in the plant and the presence of high anti-oxidant properties of *Moringa* leaf would have collectively contributed to the increase in milk yield recorded in this study.

According to Judkins and Keener [23] milk produced under normal conditions has a slightly sweet taste and aromatic smell. The sweet taste comes from lactose and the aromatic smell mainly from fat. Both taste and smell are affected by the environment and the feeding. The effects on taste, smell and colour appear when the cow consumes forages with strong taste or pigments and intense smell. Taste and smell are absorbed at level of the lung or gastro-intestinal tract and pass to the milk across the circulatory systems [24].

There is a common opinion among farmers that dairy cows fed fresh *Moringa* will produce milk with a bad taste or smell. Makkar and Becker [25] attribute this bitter taste in fresh *Moringa* to alkaloids, saponins and glucosinolates.

The results of milk sensory analysis (taste, smell and colour) in cows supplemented with *Moringa* showed that feeding *Moringa* did not affect milk organoleptic characteristics and there was no difference between treatments. Since the cows were milked 14h after feeding *Moringa* any effects on taste, smell or colour could probably not be expected [2].

Mendieta-Araica., *et al*. [3] reported no evidence of quality problems for any of the treatments.

The values for taste, smell and colour were all typical, with no significant differences among treatments.

The alkaloids and saponins which cause the bitter taste in fresh *Moringa* might have disappeared in the process of drying and preparation of leaf pellets [26,27].

Conclusion

Moringa leaf pellets fed at half of the forage requirement can significantly improve milk yields of dairy cattle fed a basal diet of Bermuda grass and concentrate without affecting the organoleptic characteristics of milk and thus has the potential to emerge as a good supplement in arid regions.

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