Impact of *Moringa oleifera* Leaves on Camel Calves' Growth Rates

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ABSTRACT

This study was conducted at the Camel Studies and Production Development Center (CSPDC) in the North-Western Coastal Zone of Egypt, which is a part of the Agriculture Research Center (ARC) and Animal Production Research Institute (APRI). Twelve growing camels' calves with an average body weight of 182.5 kg at age 12-14 months were used for 120 days to evaluate the impact of feeding Moringa oleifera leaves (MOL) as additive feeds on the growth rate of camel calves and some blood constituents. The calves were divided into three groups (4 animals per group); the first group (G1): set as the control, without introducing any additives, the second (G2) dried leaves of MOL were added (50g /d/ animal) to calves ration and the third group (G3): 100 gram of MOL were added. A Complete Randomized Design (CRD) was used to statistically analyze data. The results showed that, Moringa oleifera leaves had no significant effect (≥0.05) on average daily gain or total weight gain while, the highest average daily body gain during the experimental period was achieved in (G3) 341.7 gram, followed by 327.75 g/day for animals in (G2), then 312.5 for animals in (G1). The monthly growth gain (kg/month) for camel calves in (G1) is continuing in gradual growth with a slight reduction in the second month. On the other hand, G2 is continuing in growth with a slight decline in the second month, while, camel calves in addition to (G3) are continuing to increase with a slight decline in the fourth month with no significant differences (≥0.05). Significant effects on blood parameters were obtained in G3 total protein (≥0.05) when moringa increased in ratio (100g) while, there were no significant differences (≥0.05) among groups in blood constituents (albumin, ALT and AST). Our results revealed that Moringa leaves can be used as feed additives for enhancing camel calves' growth, Moringa can be used economically and successfully if it is available in the surrounding area or at an acceptable price.

Keywords: Moringa olifera; Additive feeds; Weight gain; camel calves

INTRODUCTION

Traditional feed resources such as (grains, cereals, legumes,.) for animal production are rare and very expensive in some parts of the world. So, searching for different feeding sources for animals is very necessary. The animal raised for both meat and milk production is the Egyptian Maghrebi camel. It grows at a very moderate rate and is of modest size. During the first year of an intensive raising regime, its body weight might increase by 300–1000 g/d (Wardeh, 2004).

Camel can eat different types of feed, which are suitable and available in their environment. Increasing interest in Moringa and its benefits inspires farmers to use it in the camel diet to evaluate its impact on camel growth. Moringa olifera is fast fast-growing, drought-resistant tree of the family Moringaceae, native to Noththern India (Velez-Gavilane,2019).

Moringa is said to be a good source of nutrients, which are essential for development and growth. In order to improve ruminant performance, including growth and milk yield, without adversely affecting animal health, Moringa can be used as green fodder either alone or in combination with other crops or concentrated feeds. It also grows readily in the field, has good coppicing ability, and has a good potential for large amounts of animal forage. Because of their high digestible protein content and well-balanced amino acid composition, Moringa leaves are the primary component that ruminant nutritionists are interested in as a source of protein (Yusuf et al., 2016 and Babiker et al., 2017).

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Moringa leaves, provide a rich source of minerals. It contains four times more calcium and twice as much digestible protein compared with milk. So we can use it as a calcium and protein source. Kasolo et al., 2010 reported that Moringa leaves are abundant in essential minerals (potassium, zinc, magnesium, iron, and copper)

Moringa olive leaves can be used as a feed additive to improve livestock performance and feed efficiency or as a replacement or supplement for traditional crops to obtain more economically sustainable, environmentally friendly and safer production (Shih et al., 2011and Saini et al., 2014).

Ruminal methane emissions are greatly reduced when cattle and other ruminants are fed Moringa oleifera leaves or seeds, which may help farmers transition to climate-friendly practices.

MATERIALS AND METHODS

1- Animals and Management

The study was carried out at Camel Studies and Production Development Center which belongs to the Animal Production Research Institute (APRI), Agriculture Research Center (ARC) in Matrouh Governorate. Twelve growing Magrabi camel calves 12- 14 months old with an average 182.5 kg body weight (BW) for 120 days were used. The camel calves were divided into three groups, the first group (G1) served as control group fed basal ration consists of 1.5 kg concentrated feed mixture (CFM) and 1.5 kg of berseem hay and 1.5 kg rice straw without any additive whereas, the other two groups were fed the basal ration with adding (MOL) Moringa olifera, where in the second group (G2) MOL was added 50 g/h/ day and, the third group (G3) was add 100 g/h/ day.

The rations were offered to the experimental animals daily at 8:00 am and 4:00 pm. The chemical composition of the used feed stuffs is shown in Table (1). The offered rations consist of berseem hay, rice straw and complete feed mixture (CFM: consisted of 25% yellow corn, 25% wheat bran,20% barley, 9% cottonseed peeled, 3% molasses, 2% limestone and 1% salt). Free fresh water was provided. The average daily gain (ADG, g/head/d) and total body growth (TBG, kg) were calculated. Every two weeks prior to morning feeding, changes in body weight (BW) were individually documented using a computerized platform called Balance. The average daily gain (ADG) for each animal was determined by dividing the difference between the final body weight (FBW) and the beginning body weight (IBW) by the time in days.

Table (1). Chemical composition of the experimental feedstuffs on a dry matter basis (%).

Item	DM	OM	CP	CF	EE	NFE	Ash
Moringa oleifera	91.70	85.3	22.6	25.9	7.5	29.3	14.7
Berseem Hay	92.89	92.43	11.3	30.50	3.20	47.43	7.57
Rice Straw	89.00	85.00	3.5	44.35	1.67	35.48	15
CFM	90.89	89.34	12.9	13.00	3.6	59.84	10.22

DM: Dry matter, OM: Organic matter, CP: Crude protein, CF: Crude fiber, EE: Ether extract, NFE: Nitrogen free extract

2- Blood Samples and Analysis

Blood samples were collected from the jugular vein into a clean glass tube coated with heparin as an anticoagulant, and then centrifuged for 20 min at 3000 rpm to obtain plasma then stored at -20 C° for later analysis. Colorimetric methods were adapted for the analysis of Total protein(TP), Albumin (Alb) Commercial kits (Biodiagnostic made in Egypt) were used to determine total protein according to Gornal *et al*. (1949), albumin, according to Doumas *et al*. (1971) and Globulin concentrations were obtained by subtraction the value of albumin from the corresponding value of total protein. Alanine aminotransferase (ALT) and activity of Aspartate aminotransferase (AST) were determined by the method of Young. (1990).

3- Statistical Analysis

We used the General analysis of linear model procedure (SAS,2010) for statistical analysis of the studied traits during the growth trial experiment using the following model: $Y_{ij} = \mu + T_i + e_{ij}$

Y_{ij} = observed parameter

μ = overall mean

T_i = effect of treatment

E_{ij} + experimental error

Significant differences among means were detected using Duncan's multiple-range test (Duncan, 1955).

RESULTS

The duration of the experiment lasted 120 days. The initial body weights were nearly similar in all groups, (G1), (G2) and (G3) (183.31, 181.6 and 182.63kg, respectively. The final body weights at the end of the experiment were 220.8, 221.9 and 223.6 kg respectively. Finally, the highest total gain (kg) at the end of the study period was 41 kg in (G3) and the least was 37.5 kg in (G1).

The daily feed intake is represented in Table (2) according to the allowance of the Animal Production Research Institute (APRI).

Monthly growth (kg) of Maghrabi camel calves was represented in Table (3). Observing the pattern of growth in (G1) during the experimental period the growth of camel calves is gradually raised with a slight decline in the second month. On the other hand, the growth of camel calves in (G2) continues to rise gradually with a slight decline in the second month while in (G3) the growth rate continues to rise with a decline in the fourth month. Also, results found that total monthly growth (kg) and total weight gain were higher in (G3) than in the other groups with no significant differences.

The average daily gain for camel calves provided with 100g MOL/day (G3) had better performance during the first 3 months of the experiment compared to G1 and G2. While G2and G3 had nearly the same ADG in the fourth month of treatment (Figure .1)

Table (2). Change in live body weight and daily feed intake of the experimental animals

Item	G1	G2	G3
Duration	120	120	120
Initial body weight (kg)	183.3	181.6	182.6
Final body weight(kg)	220.8	221.9	223.6
Total weight gain (kg)	37.5	39.33	41
Daily feed intake (kg)	4.5	4.5	4.5

According to the allowance of Animal Production Research Institute Daily feed intake (1.5 kg CFM+1.5 kg berseem hay +1.5 kg rice straw)

Blood analysis and biochemical parameters are very important indices for several metabolic processes, which may vary among animal species due to age, sex physiological status, nutrition and environmental conditions.

Table (3). Monthly weight gain, total weight gain and average daily gain during experimental period.

Parameter	(G1)	(G2)	(G3)
-Total Growth			
In the first month(kg)	9.36	9.33	9.43
In the second	9.13	9.00	10.23
month(kg)	9.46	10.33	10.66
In the third month	9.53	10.66	10.36
In the fourth month	37.5	39.33	41
(kg)	312.5	327.75	341.7
- Total weight gain(kg)			
- Average daily gain (g)			

Table (4) Biochemical parameters of camel calves during the experimental period

Parameter	G1	G2	G3	SE
Total protein(g/dl)	6.39[b]	6.52[b]	6.66[a]	±0.18
Albumin (g/dl)	4.72	4.81	4.96	±0.69
AST(IU/l)	47.9	49.23	46.86	±3.82
ALT(IU/l)	11.35	11.33	11.57	±0.81

(AST) Aspartate aminotransferase, (ALT) Alanine aminotransferase, Values with different letters have a significant difference.

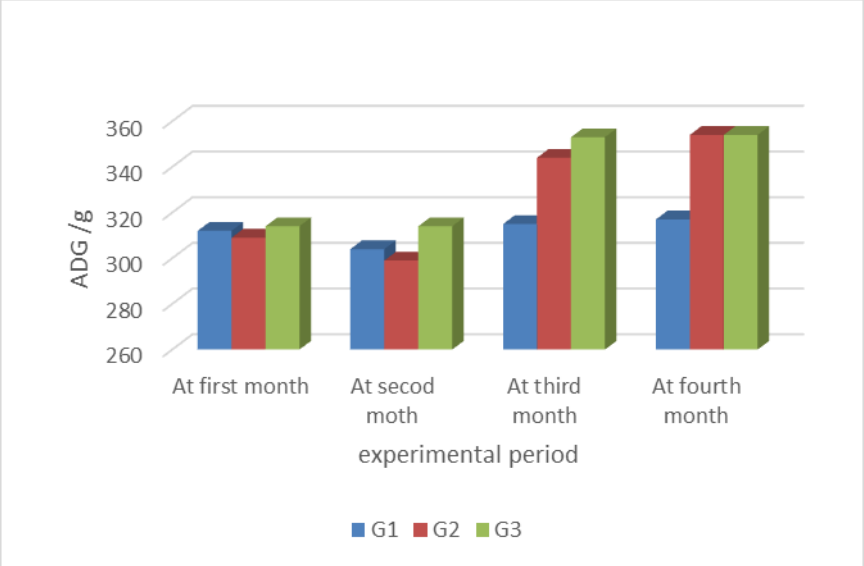

Figure (1) Average daily gain for camel calves during the experimental period.

Results of blood parameters represented in Table (3) revealed that total protein and albumin are higher in G3 with significant differences (≥0.05) in total protein. However, values of total protein and albumin are within normal ranges as reference 6.3 to 8.3 g/100 ml and 2.5 and 4.5 g/dl respectively, (Bernard and Mohammed 2018). AST and ALT are in the normal range with no significant differences. According to the results, we can conclude that Moringa had no adverse effect on blood protein and liver function.

DISCUSSION

The monthly growth and average daily gain in G3 during the experiment period are relatively higher than other groups. These findings could be attributed to high crude protein (CP) and higher digestibility of dry matter of Moringa which reflects higher growth and weight (Fadiyimu, 2010). These results were confirmed by Ebrahiem *et al*. (2020), who stated that there was a higher daily gain observed for the animal group that fed on Moringa than for those that fed on other additives with no significant differences. Also, Ahmad *et al* (2017) found that total body weight gain and average daily gain in buffalo calves were significantly higher in groups fed 5,10,15% dry Moringa in the control group or the group that fed on 20% Moringa.

Average daily gain is higher in G3 than other groups during the experimental period, which could be due to Moringa enhancing the ruminal efficiency of dietary nutrients use and reducing methane production (Sottan, 2014). Also, Moringa leaves have an antioxidant activity which is good for optimal microbial growth with the consequence of better microbial protein synthesis (Soltan.,2017). These results agree with Ebrahiem *et a.l* (2020), who found that the daily weight gain of camel calves fed Moringa olifera was raised up from 229.1±0.22 to 395.8±0.28 g and the average daily up ADG was 589.2±0.58 g/day in the first three months of the experiment but declined to 303.5 ± 0.28 and 266.7±0.23 g/d for daily weight gain and average daily weight gain in the next two months of the experiment. The beneficial nutritional composition of M.O., which delivers proteins along with bioactive substances including alkaloids, flavonoids, phenolics, glucosinolates, carotenoids, sterols,

saponins, phenolic acids, tannins, and isothiocyanates, may be the cause of this performance boost. (Jürgen and Abdulkarim, 2023).

In blood parameters assessment, total protein tested in the present study for G1, G2 and G3 were 6.39, 6.53 and 6.6 g/ dl respectively. The total protein blood parameter in camels' blood ranges between 6.3 to 8.3 g/100 ml reported by Bernard and Mohammed (2018) This finding agrees with the results of our experiment. In camel, serum albumin concentration varies between 2.5 and 4.5 g/dl Bernard and Mohammed (2018), obtained results that are in the normal range. Ahmad *et al.* (2017) found that significant difference in albumin concentration when Moringa was fed to buffalo calves. According to Kholif(2018). Moringa supplement 75%of berseem clover can increase feed utilization and increase serum total protein and albumin when fed to Nubian goat and decrease Cholesterol and Triglycerides.

In camel serum ىmean values of Aspartate aminotransferase (AST) activity range from 37 to 131 U/l (Bernard and Mohammed., 2018) and Alanine aminotransferase (ALT), activity varies from 6 to 25 U/l (Bernard and Mohammed., 2018). Results indicated that no adverse effects of adding moringa as a feed additive on animal blood parameters and animal health

CONCLUSION

Our study concluded that Moringa leaves can be used as an effective additive to enhance the growth of camel calves. Our results indicate that adding 100 g/day to their diet leads to improvements in growth rate and average daily gain. Additionally, analysis of blood parameters confirmed that this supplementation does not negatively affect the animals' health, making it a good growth promoter if it is available at good prices.

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الملخص العربي

تاثير استخدام اوراق المورينجا على معدلات نمو حيران الابل

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تم إجراء التجربة بمركز دراسات وتربية الابل في محافظه مطروح التابعه لمعهد بحوث الإنتاج الحيواني - مركز البحوث الزراعية تم استخدام اثني عشر من حيران الإبل النامية بمتوسط عمر من (12-14) شهرلدراسة تأثير إضافة أوراق المورينجا علي معدل نمو حيران الإبل وبعض مكونات الدم واستمرت التجربه 120 يوم. تم تقسيم الحيران إلى ثلاث مجموعات متساوية (4 حيوانات لكل مجموعة)؛ المجموعة الأولى كنترول (بدون اي إضافات) والمجموعه الثانية تم إضافة اوراق المورينجا(50جرام/ اليوم/ الحيوان) والمجموعه الثالثة تم إضافة اوراق مورينجا (100جرم/ اليوم/ الحيوان) الي العلائق المقدمة للحيوانات تم تحليل البيانات إحصائياً وفقاً للتصميم العشوائي الكامل. وكشفت النتائج المستخلصة أن أعلى متوسط للنموالبومي في الوزن خلال فترة التجربة تحقق في المجموعه الثالثة بمعدل 341.7 جرام، تلاها 327.75 جرام/يوم للمجموعه الثانية تليها المجموعه الاولي 312.5 جرام. بملاحظه النمو نجد ان النمو الشهري للحيران بالنسبة للمجموعه الاولي يستمر معدل النمو في الزيادة تدريجيا خلال التجربة مع الانخفاض نسبيا في الشهر الثاني وبالنسبه المجموعه الثانية يستمر معدلات النمو في الزيادة مع انخفاض طفيف في الشهر الثاني بالنسبه للمجموعه الثالثه يرتفع تدريجيا و انخفض قليلاً في الشهرالرابع . اظهرت نتائج مقاييس الدم انه لاتوجد فروق معنويه في كل من الابيومين و ALTو AST بينما توجد فروق معنويه($0.05\geq$)في البروتين الكلي وكانت القيم مرتفعه في المجموعه الثالثة وكشفت نتائج التجربة أن استخدام اوراق المورينجا كاضافه غذائيًة جيدًا لتعزيز نمو حيران الإبل النامية، إذا كانت متاحة في المنطقة المحيطة أو بسعر مقبول.

الكلمات الدالة: اوراق المورينجا، حيران الابل، معدل نمو