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Research Article
Effect of Feeding Dry *Moringa oleifera* Leaves on the Performance of Suckling Buffalo Calves

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Abstract
Objective: This study aimed to evaluate the effect of feeding different levels of dry *Moringa oleifera* leaves (DMOL) on nutrient digestibility, some blood constituents and performance of suckling buffalo calves. **Materials and Methods:** Thirty newborn buffalo calves were used in feeding trial through suckling period. Calves were suckled buffalo milk and fed calf starter and berseem hay *ad libitum* as control ration, while in the other tested rations 5, 10, 15 and 20% of calf starter was replaced by DMOL for R2, R3, R4 and R5, respectively. **Results:** Data indicated that, DMOL contained 28.00% Crude Protein (CP), 6.23% Ether Extract (EE), 15.39% Crude Fiber (CF), 41.95% NFE and 8.43% ash (on DM basis). Nutrient digestibility, nutritive values, weight gain, feed conversion and economic efficiency of tested ration were significantly ($p<0.05$) increased with increasing the level of DMOL in the rations up to 15% and decreased afterwards at 20% level, which was nearly similar to control ration. There were insignificant differences in blood total protein, globulin, creatinine and alanine aminotransferase (ALT) among experimental rations. While, values of albumin, urea and aspartate aminotransferase (AST) were significantly ($p<0.05$) different among tested rations. **Conclusion:** Results of the present study concluded that replacing up to 15% of calf starter by DMOL improved growth performance of suckling buffalo calves, if compared with replacing 20% and control group.

Key words: Dry *Moringa oleifera* leaves, suckling buffalo calves, growth performance, nutrient digestibility, blood parameters

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The need to introduce cheap and readily available alternative feedstuffs to support livestock development has become imperative[1]. 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[2,3].

Leaf meals not only consider a good source of protein but also give some necessary vitamins, minerals, various phenolic and oxycarotenoids etc.[4]*. Moringa oleifera* is one of animal feeds and its leaves are the preferred part could be used for feeding animals as leaf meal. Many researchers investigated the effect of *Moringa* leaves on productive performance of dairy cows[5], sheep and goats performance[6,7] on the growth and carcass characteristics of rabbits[8,9] on broilers and laying hens productive performance[10,11].

Moringa oleifera is a highly valued plant, distributed in most of the tropics and subtropics countries under Egyptian condition[9] reported that dry *Moringa oleifera* leaves contained: 31.68% CP, 6.41% CF, 8.78% EE, 38.25% NFE and 14.88% ash. Also, El-Esawy[5] indicated that the dry leaves of *Moringa* contained 29.73% CP, 10.24% CF, 5.90% EE, 46.01% carbohydrate and 8.12% ash. Moreover, Ca, P, Na, K and Mg content were 3.18, 0.95, 0.32, 1.95 and 0.59%, respectively and containing significant quantities of micro elements (Cu, Fe, Co, Zn and Mn) being 15.00, 0.574, 0.15, 73.00 and 82.00 ppm, respectively. Despite all these results and benefits, no reports in the literatures about using *Moringa oleifera* meal in feeding trials with buffalo calves. So, this study aimed to evaluate the effect of feeding rations containing different levels of dry *Moringa oleifera* leaves on nutrient digestibility, some blood constituents and growth performance of suckling buffalo calves.

MATERIALS AND METHODS

Experimental animals: Thirty newborn buffalo calves used in feeding trial through suckling period (from birth to weaning at 119 days old). Calves removed from their dams after having the colostrum for 3 days. Calves divided into five similar groups (6 calves each, 3 from each sex) according to their LBW.

Feeding procedures: Calves suckled buffalo milk and fed calf starter and berseem hay *ad libitum* as control ration (R1), while in the other tested rations 5 (R2), 10 (R3), 15 (R4) and 20% (R5) of calf starter replaced by dry *Moringa oleifera* leaves (DMOL). All calves were suckled milk according to allowances of APRI[12]. Approximately each calf consumed 385 kg buffalo milk during suckling period (119 days). As well as, artificial rearing system applied for all calves. The daily amount of milk divided into two equal meals at 8.0 am and 4.0 pm until the 13th week of age then given once daily at morning and adjusted weekly according to experiment regime. Calf starter and berseem hay offered for each calf in all tested rations *ad libitum* from the 2nd week of age. Orts were collected before offering the next day feeding and recorded. The fresh water was freely available. Calves weighed biweekly before morning feeding.

Digestibility trials: Five digestibility trials were conducted using 3 male buffalo calves from each group at 12 weeks of age to determine the nutrients digestibility and nutritive values of the experimental rations. Fecal rectum samples were collected for 6 successive days from each calf twice daily with 12 h interval. Acid Insoluble Ash (A1A) was used as natural marker[13]. Total Digestible Nutrients (TDN) and Digestible Crude Protein (DCP) were calculated according to the classic formula of Schneider and Flatt[14].

Chemical analysis: Chemical composition of buffalo milk expressed as protein, fat, lactose, Solids Not Fat (SNF) and Total Solids (TS) was estimated by a Milko Scan, Model 133B. Samples of experimental feedstuffs and feces were composted and representative samples were analyzed according to Van Keulen and Young[15]. Acid Insoluble Ash (A1A) determined in feedstuffs and feces by the methods of AOAC[16].

Blood samples and analysis: Blood samples were taken from the jugular vein of each calf in dry clean glasses tubes using heparine as anticoagulant and then centrifuged for 15 min at 4000 rpm to obtain plasma. Biochemical of blood plasma constituents were determined using commercial kits, total protein and creatinine as described by Tietz[17,18], albumin was determine according to Doumas *et al.*[19], blood plasma urea was determined according to Patton and Crouch[20]. Alanine aminotransferase (ALT) and activity of aspartate aminotransferase (AST) were determined by the methods of Young[21].

Feed conversion and economic study: Feed conversion was calculated and expressed in terms of kg DM, TDN, DCP and Digestible Energy (DE Mcal) required producing 1 kg live body weight. Economic efficiency was calculated as the ratio between the income (price of kilogram body weight gain 40.0 LE kg^{-1}) and cost of feed consumed. It was estimated on the basis of the following prices in Egyptian pounds (LE): Buffalo milk (4.5 LE kg^{-1}), calf starter (3.2 LE kg^{-1}), dry *Moringa oleifera* leaves (12.0 LE kg^{-1}) and berseem hay (1.2 LE kg^{-1}).

Statistical analysis: Data were analyzed using general linear models procedures adapted by SPSS[22] for user guide with one-way ANOVA. Duncan test within SPSS program was done to determine the degree of significant level among means[23].

RESULTS AND DISCUSSION

Chemical composition: Data of chemical analysis of buffalo's milk and experimental feedstuffs and rations in Table 1 and 2 showed that the composition of buffalo milk consumed by suckling calves is within a normal range of the milk composition produced by those buffaloes fed Egyptian traditional rations[24,25]. Results indicated that dry *Moringa oleifera* leaves (DMOL) had higher contents of CP 28%, EE 6.23%, CF 15.39% and ash 8.73% but lower content of NFE (41.95%) compared with calf starter. Oduro *et al.*[26] reported that *Moringa oleifera* leaves contained 27.5% CP, 19.25% CF, 2.23% EE and 42.88% NFE. While Djakalia *et al.*[27] mentioned that DMOL had 24.64, 18.30, 4.77 and 13.34% CP, cellulose, fat and ash, respectively. In the same time, under Egyptian condition higher values of protein content of DMOL (31.68 and 29.73%), respectively were reported by El-Badawi *et al.*[9] and El-Esawy[5].

Digestion coefficients and nutritive values of experimental rations: Nutrients digestibility affected by inclusion DMOL in Table 3. Results indicated that OM, CP, CF, EE and NFE

Table 1: Chemical composition (%) of fresh buffalo milk used for suckling calves

Item	TS (%)	OM (%)	Protein (%)	Fat (%)	Lactose (%)	Ash (%)	SNF (%)
Fresh milk	17.48	16.87	4.39	7.12	5.36	0.61	10.36

Table 2: Chemical composition of experimental ingredients, calf starter and rations

		Chemical composition (Percentage on DM basis)					
Item	DM (%)	OM	CP	EE	CF	NFE	Ash
DMOL	90.80	91.57	28.00	6.23	15.39	41.95	8.43
Berseem Hay (BH)	90.50	89.93	12.90	1.79	28.78	46.46	10.07
1st calf starter (control)	90.60	93.20	16.20	3.25	7.90	65.85	6.80
2nd calf starter contain 5% DMOL	90.61	93.12	16.79	3.40	8.28	64.65	6.88
3rd calf starter contain 10% DMOL	90.69	93.04	17.38	3.55	8.65	63.46	6.96
4th calf starter contain 15% DMOL	90.63	92.96	17.97	3.69	9.03	62.27	7.04
5th calf starter contain 20% DMOL	90.64	92.87	18.56	3.84	9.40	61.07	7.13
Calculated chemical composition of experimental rations (Percentage on DM basis)							
R1	38.27	93.24	18.32	15.09	11.33	48.5	6.76
R2	37.25	93.27	18.67	15.82	11.03	47.75	6.73
R3	37.25	93.27	18.84	15.88	10.67	47.88	6.73
R4	37.39	93.19	19.10	15.90	11.33	46.86	6.81
R5	38.11	93.14	18.90	15.35	12.38	46.51	6.86

DMOL: Dry *Moringa oleifera* leaves, R1: 1st calf starter, R2: 2nd calf starter, R3: 3rd calf starter, R4: 4th calf starter, R5: 5th calf starter

Table 3: Nutrients digestibility and nutritive values

	Experimental rations					
Item	R1	R2	R3	R4	R5	M±SE
Nutrients digestibility (%)						
OM	63.67^{b}	73.04^{a}	75.01^{a}	74.01^{a}	63.63^{b}	1.47
CP	61.63^{b}	73.76^{a}	77.70^{a}	73.89^{a}	61.55^{b}	1.88
EE	84.48^{b}	88.69^{a}	88.64^{a}	88.07^{a}	83.90^{b}	0.85
CF	36.10^{b}	45.66^{a}	48.98^{a}	49.82^{a}	42.62^{ab}	1.61
NFE	64.20^{b}	75.01^{a}	76.69^{a}	74.30^{a}	65.25^{b}	1.54
Nutritive values (%)						
TDN	70.88^{b}	80.45^{a}	81.58^{a}	81.29^{a}	70.74^{b}	1.36
DCP	10.82^{d}	13.22^{b}	13.94^{a}	13.97^{a}	11.38^{c}	0.36
DE (Mcal kg^{-1} DM)	3.13^{b}	3. 55^{a}	3.60^{a}	3.58^{a}	3.12^{b}	0.6

$^{a-d}$Mean in the same row with different superscripts differ significantly at $p<0.05$, DE (Mcal kg^{-1} DM)[31]: TDN×0.04409 digestibility were significantly ($p<0.05$) higher in diets containing 5, 10 and 15% DMOL, comparing with control ration (R1). While all values were comparable to control ration (R1) as the level DMOL increased to 20%. However that of effect was not mention by Aderemi[28], Onu and Otuma[29] and Onu and Aniebo[30].

The same trend was observed with nutritive values as TDN, DCP and DE. It might mentioned that DMOL have some digestion promoting effects from the gradual improvement of OM, CP, CF and NFE digestibilities and nutritive values TDN, DCP and DE values with increasing DMOL levels up to 15%, however, this assumption has not been realized with the highest DMOL supplementation level (20%). These results agreed with El-Badawi *et al.*[9] who indicated that OM, CP and CF digestibilities along with nutritive value as TDN or DCP in rabbits diets were increased ($p<0.05$) with increasing level of *Moringa* up to 0.30% from total ration, while values were nearly comparable to control rations as the level of supplementation increased to 0.45%. Also, nutrients digestibility and nutritive values as TDN and DCP in dairy cows rations increased as DMOL increased up to 40%, while these values were significantly decreased at the level of 60% DMOL[5].

Blood constituents: Results of blood plasma total protein, globulin, createnine and ALT among tested rations in Table 4 indicated that there were insignificant differences. Total protein values of all tested calves nearly similar and within the normal level[32] being 6.8 g dL^{-1}. This may be attributed that all tested rations had nearly similar in CP content that ranged between 18.32 and 19.10% (Table 2). Also, all calves were consumed nearly similar quantity of CP being from 0.308-0.325 kg day^{-1} during the whole suckling period as shown in Table 5. Bush[33] found that a positive correlation between protein content in the diet and plasma protein concentration and mentioned that low level of plasma protein may be due to decrease in the absorbed and synthesized along with the increase in protein losses.

Data of albumin were significantly ($p<0.05$) differences among experimental rations. Average plasma albumin values ranged between 3.00 and 3.47 g dL^{-1} and similar values were recorded with buffalo calves by Abd El-Aal *et al.*[34] being 2.97 and 3.5 g dL^{-1}. Meantime, globulin values ranged between 2.83 and 3.54 with insignificant different as the results of inclusion DMOL in the tested rations. However, inclusion of *Moringa* had no negative effect on globulin concentration.

Data of urea concentrations were insignificant ($p<0.05$) higher among all experimental groups. Similar values of urea concentration in blood of buffalo calves were reported by Al-Metwally[35] and Abd El-Aal[36]. Urea is one of some of non protein nitrogen substance that accumulates in the plasma when renal exertion is reduced. Its level increased in the blood with the high protein diet, intestinal haemorrhage, dehydration, severe haemorrhage, shock, etc. While, blood urea level could be decreased as result of liver failure, low protein diet, anabolic steroids, diabetes insipidus etc.[33]. Concentration of createnine in blood plasma of experimental calves ranged from 0.73-0.92 mg dL^{-1} without significant differences among tested rations. Values of the present study were within the values obtained by Mahmoud[37], who found that creatine concentration ranged between 0.90 and 0.95 mg dL^{-1} with growing rams fed rations contained *Moringa oleifera* stems. The gradually decrease in the levels of blood plasma transaminase enzymes activity as AST with increasing DMOL up to 20%. In this study may be give an indication that these level may be the safe levels can be used when administrating DMOL for suckling buffalo calves. Aspartate aminotransferase and alanine aminotransferase are produced in the liver and are good indicator of damage liver cells but not necessary the severity of the damage[38]. Also, Molander *et al.*[39] mentioned that alanine aminotransferase and aspartate aminotransferase are considered good markers of liver cells activity where increasing level of this enzymes in the blood indicate the tissue activity are destroyed. According

Table 4: Blood plasma parameters of buffalo calves fed experimental rations

	Experimental rations					
Item	R1	R2	R3	R4	R5	M±SE
Total protein (g dL^{-1})	6.30	6.72	6.15	6.27	6.37	0.11
Albumine (g dL^{-1})	3.47^{a}	3.23^{b}	3.12^{bc}	3.15^{b}	2.97^{c}	0.54
Globuline (g dL^{-1})	2.83	3.49	3.03	3.12	3.54	0.90
Urea (mg dL^{-1})	46.67	45.00	46.67	41.33	45.67	2.00
Createnine (mg dL^{-1})	0.85	0.77	0.83	0.73	0.92	0.33
AST (IU L^{-1})	14.33^{a}	16.00^{a}	12.33^{ab}	11.33^{b}	10.33^{b}	0.89
ALT (IU L^{-1})	61.67	55.33	56.67	52.33	51.67	3.51

$^{a-c}$Mean in the same row with different superscripts differ significantly at $p<0.05$, AST: Aspartate aminotransferase, ALT: Alanine aminotransferase

Table 5: Average daily feed intake (kg day^{-1}) of buffalo calves

	Experimental rations					
Item	R1	R2	R3	R4	R5	M±SE
Duration (day)	119.00	119.00	119.00	119.00	119.00	
Average daily feed intake as fed (kg $calf^{-1}$ day^{-1})						
Buffalo milk (kg day^{-1})	3.24	3.24	3.24	3.24	3.24	
Calf starter (kg day^{-1})						
Without DMOL (control)	0.73	--	--	--	--	--
Contained 5% DMOL		0.691				
Contained 10% DMOL			0.742			
Contained 15% DMOL				0.701		
Contained 20% DMOL					0.673	
Berseem hay	0.55	0.50	0.45	0.50	0.60	
Average daily feed intake as DM (kg $calf^{-1}$ day^{-1})						
DM intake	1.73^a	1.65^b	1.65^b	1.65^b	1.72^a	0.14
TDN intake	1.23^b	1.33^a	1.35^a	1.35^a	1.22^b	0.13
DCP intake (DCPI)	0.187^d	0.218^b	0.230^a	0.232^a	0.196^c	0.04
DE intake (Mcal day^{-1})	5.40^b	5.86^a	5.94^a	5.94^a	5.37^b	0.06
CP intake (kg day^{-1} CPI)	0.317	0.308	0.311	0.313	0.325	0.003
CF intake (kg day^{-1} CFI)	0.196	0.182	0.176	0.188	0.213	0.003

a-dMean in the same row with different superscripts differ significantly at $p<0.05$

Table 6: Effect of experimental rations on buffalo calves performance, feed conversion and economic efficiency

	Experimental rations					
Item	R1	R2	R3	R4	R5	M±SE
Duration (day)	119.00	119.00	119.00	119.00	119.00	
Birth weight (kg)	38.10	38.80	38.50	39.20	38.70	0.820
Weaning weight (kg)	99.30^c	108.70^{ab}	109.80^{ab}	110.70^a	102.00^{bc}	2.460
Total body weight gain (kg)	61.30^b	69.90^a	71.30^a	71.50^a	63.70^b	1.160
ADG (kg day^{-1})	0.51^b	0.59^a	0.60^a	0.60^a	0.53^b	0.160
Relative BWG to control	100.00	115.57	117.65	117.65	103.92	
Feed conversion						
kg DMI kg^{-1} gain	3.390^a	2.800^b	2.770^b	2.750^b	3.260^a	0.060
kg TDN kg^{-1} gain	2.400	2.250	2.250	2.240	2.310	0.030
DE Mcal kg^{-1} gain	10.610	9.940	9.920	9.900	10.170	0.130
kg DCP kg^{-1} gain	0.367	0.370	0.387	0.385	0.371	0.005
Economic efficiency						
Feed cost (LE day^{-1})	17.57^d	17.70^{cd}	18.06^{bc}	18.35^{ab}	18.72^a	0.100
Price of daily gain (LE)	20.63^c	23.50^{ab}	24.07^a	24.13^a	21.33^{bc}	0.340
Feed cost kg^{-1} gain	34.27^a	30.27^b	30.34^b	30.44^b	35.28^a	0.560
Economic efficiency	1.17^b	1.33^a	1.33^a	1.32^a	1.14^b	0.210

a-cMean in the same row with different superscripts differ are significantly at $p<0.05$ different

to Maxwell *et al.*[40] revealed that blood parameters are very useful to assess the quality and suitability of feedstuffs used for feeding farm animals.

Feed intake: Data of voluntary feed intake (Table 5) indicated that DMI was significantly ($p<0.05$) lower in DMOL supplemented rations (R2, R3 and R4) than R1 and R5 (0 and 20% DMOL). Meantime TDN, DCP and DE intakes were significantly ($p<0.05$) increased as the DMOL supplementation level up to 15.0%. While, TDN, DCP and DE intake in R5 were nearly comparable to the control group with a significant ($p<0.05$) reduction than those fed R2, R3 and R4. This reduction might be due to the lower digestibility coefficients of all nutrients and nutritive values of R1 and R5 compared with other tested rations (R2, R3 and R4) as shown in Table 3.

Growth performance: Total body weight gain and ADG of buffalo calves fed 5, 10 and 15% DMOL supplemented rations were ($p<0.05$) higher than those fed control (0%) or 20% DMOL rations (Table 6). It was noticeable that R2, R3 and R4 with highest TDN, DCP and DE intakes produced the highest weaning weight, total body weight gain and Average Daily Gain (ADG) while, calves fed control and R5 consumed the lowest intake of TDN, DCP and DE achieved the lowest weaning weight, total weight gain and ADG. The better weaning body weight and weight gain attained by feeding R2, R3 and R4 could be attributed to higher their

TDN, DCP and DE contents and consumed compared with those fed control and R5 rations as shown in Table 3 which were efficient metabolized for growth.

The results of the present study suggested that feeding suckling buffalo calves plus DMOL, at the levels of 5, 10 and 15% could play as natural growth promoter as mentioned by Bose[41] and El-Badawi *et al.*[9], The improvement in body weight gain may be attributed to the rich content of nutrients in DMOL[10,6] and antimicrobial properties of *Moringa*[42]. At the same time certain adverse effect occurred with the highest level of DMOL (20%) may be due to the high content of some phytochemical compounds (phenols, cumarems, alkaloids and tannins) which are naturally occurring at high levels of DMOL. Kakengi *et al.*[43] found that *Moringa oleifera* contain 1.23 g of tannin kg^{-1} leaves. Tannin could be interfering with biological utilization of protein diet and less extent available carbohydrate and lipids[44]. Also, while the depressed of weight gain of calves fed R1 and R5 may be due to the higher CF consumption 0.191 and 0.213 kg day^{-1} $head^{-1}$ compared with other tested rations as shown in Table 5, which may impair nutrients digestion and absorption as mentioned by Aderemi[28], Onu and Otuma[29] and Onu and Aniebo[30].

Using 9% of *Moringa* leaf powder in the Yankasa rams diet was the best results for nitrogen balance, nitrogen retention and haematological parameters[7], while at the higher level 11%, efficiency of protein utilization decreased. The same trend was observed by Fadiyimu *et al.*[45] found that the best nitrogen balance, nitrogen retention and haematological profile of West African Dwarf sheep were recorded at 25% *Moringa* inclusion.

Feed conversion: Results of feed conversion (Table 6) indicated that, calves fed R2, R3 and R4 rations significantly ($p<0.05$) less amount of DM to produce kilogram gain compared to the other groups. This may be due to the superior growth rate of R2, R3 and R4 comparing with control and 5th rations. However, in the present study, the overall values of kg DMI kg^{-1} gain are in accordance with those recorded by many researchers[46,36] found that feed conversion values were ranged between 2.45 and 3.20 kg DMI kg^{-1} gain for suckling buffalo calves. Otherwise, the present values were higher than those obtained by Saleh *et al.*[47] who reported that feed conversion values were ranged between 2.25 and 2.48 kg DMI kg^{-1} gain for suckling buffalo calves. This might be due to the different rearing system and amount of suckled milk along with feeding different quality and quantities of both milk replacers and calf starters. Moreover, values of feed conversion (kilogram feed intake per kilogram gain) expressed as TDN, DCP and DE were nearly similar for all experimental rations without significant differences (Table 6). This may be due to experimental calves were received their recommended nutrient allowances[12] and covered their recommended requirements.

Economic efficiency: The best economic efficiency was recorded with buffalo calves fed R2 (1.33), R3 (1.33) and R4 (1.32), while the significantly ($p<0.05$) lowest values were recorded with calves fed R1 (1.17) and R5 (1.14). On the other hand, the feed cost per kilogram gain of suckling buffalo calf was significantly ($p>0.05$) decreased with increasing the levels of DMOL up to 15%, while at 20% of supplementation the feed cost per kilogram recorded the highest value with highly significant. Such finding are in agreement with El-Esawy[5] who indicated that the relative economic efficiency improved by inclusion of *Moringa* leaves at 20% on the rations of lactating cows, while using *Moringa* leaves at 40 or 60% recorded the worst relative economic efficiency value due to the high price of *Moringa*. Also, Adeniji *et al.*[8] who stated that feed cost per kilogram weight gain was decreased with increasing the inclusion level of *Moringa* leaf meal in rabbit diets. On contrary, the feed cost per kilogram gain of rabbits increased at the level of DMOL up to 0.45% supplementation[9]. However, the differences of feeding cost for diets containing *Moringa* leaves are undoubtedly regarded to common selling prices in different countries.

CONCLUSION

It could be concluded that inclusion of dry *Moringa oleifera* leaves in rations of suckling buffalo calves is highly recommended to improve nutrients digestibilities, nutritive values and growth performance of buffalo calves. The best results were achieved with feeding rations supplemented with 5 -15 % DMOL. However, adverse effects were occurred with 20% *Moringa* leaves supplementation for all measured parameters. More future studies are needed to understand side effects and proper supplementation levels of *Moringa* leaves in the ruminant rations especially growing animals.

SIGNIFICANCE STATEMENT

In Egypt most buffalo calves were slaughted at 60 kg to save buffalo milk for human and avoid calves mortality. So, it is important to using a new plant as *Moringa* leaves in animal's nutrition which consider as a good source of protein, vitamins, minerals, various phenolic and oxycartenoid. It has a positive effect on productive performance and health status for suckling calves. It would encourage Egyptian farmers to raise buffalo calves for meat and milk production which reflect on improvement the national income.

REFERENCES

1. Aye, P.A. and M.K. Adegun, 2013. Chemical composition and some functional properties of *Moringa*, *Leucaena* and *Gliricidia* leaf meals. Agric. Biol. J. North Am., 4: 71-77.
2. Fasuyi, A.O. and O.A. Kehinde, 2009. Effect of cellulase-glucanase-xylanase combination on the nutritive value of *Telfairia occidentalis* leaf meal in broiler diets. J. Cell Anim. Biol., 3: 188-195.
3. Asaolu, V.O., R.T. Binuomote, J.A. Akinlade, O.S. Oyelami and K.O. Kolapo, 2011. Utilization of *Moringa oleifera* fodder combinations with *Leucaena leucocephala* and *Gliricidia sepium* fodders by West African dwarf goats. Int. J. Agric. Res., 6: 607-619.
4. Anwar, F., S. Latif, M. Ashraf and A.H. Gilani, 2007. *Moringa oleifera*: A food plant with multiple medicinal uses. Phytother. Res., 21: 17-25.
5. El-Esawy, S.M.G., 2015. Effect of supplementing different levels of *Moringa oleifera* plant leaves on productive performance of dairy cows. Ph.D. Thesis, Kafrelsheikh University, Egypt.
6. Sarwatt, S.V., M.S. Milang'ha, F.P. Lekule and N. Madalla, 2004. *Moringa oleifera* and cottonseed cake as supplements for smallholder dairy cows fed Napier grass. Livest. Res. Rural Dev., Vol. 16, No. 6.
7. Fayomi, A., A. Ahmed, U. Musa, J.O.S. Shinaba, S.A. Ogedegbe and K. Akanni, 2014. Moringa multi-nutrient blocks: Formulation, production and feeding trial under a tropical environment. Int. J. Sci. Environ. Technol., 3: 67-84.
8. Adeniji, A.A., E.S. Gana, I.C. Chibuogwu and R.U. Onyia, 2010. The feeding value of *Moringa oleifera* for growing rabbits. Proceedings of the 36th Annual Conference of Nigerian Society for Animal Production, March 13-16, 2011, Nigeria, pp: 610-613.
9. El-Badawi, A.Y., H.A.A. Omer, A.A. Abedo and M.H.M. Yacout, 2014. Response of growing New Zealand white rabbits to rations supplemented with different levels of *Moringa oleifera* dry leaves. Global Veterinaria, 12: 573-582.
10. Kakengi, A.M.V., J.T. Kaijage, S.V. Sarwatt, S.K. Mutayoba, M.N. Shem and T. Fujihara, 2007. Effect of *Moringa oleifera* leaf meal as a substitute for sunflower seed meal on performance of laying hens in Tanzania. Livest. Res. Rural Dev., Vol. 19, No. 8.
11. Abbas, T.E., 2013. The use of *Moringa oleifera* in poultry diets. Turk. J. Vet. Anim. Sci., 37: 492-496.
12. APRI., 1997. Animal nutrition scientifically and pracically. Animal Production Research Institute (APRI), Agricultural Research Center, Ministry of Agriculture.
13. McDonald, P., R.A. Edwads, F.D. Greenhalh and C.A. Morgan, 1995. Animal Nutrition. 5th Edn., Prentices Hall, London, UK.
14. Schneider, B.H. and W.P. Flatt, 1975. The Evaluation of Feeds Through Digestibility Experiments. The University of Georgia Press, Athens, Georgia, USA.
15. Van Keulen, J. and B.A. Young, 1977. Evaluation of acid-insoluble ash as a natural marker in ruminant digestibility studies. J. Anim. Sci., 44: 282-287.
16. AOAC., 2012. Official Methods of Analysis. 19th Edn., AOAC International, Gaithersburg, MD., USA.
17. Tietz, N.W., 1986. Text Book of Clinical Chemistry. W.B. Saunders, Philadelphia, ISBN: 9780721688862, pp: 1271-1281.
18. Tietz, N.W., 1990. Clinical Guide to Laboratory Tests. 2nd Edn., WB Saunders, Philadelphia PA., USA., ISBN-13: 978-0721624860, Pages: 957.
19. Doumas, B.T., W.A. Watson and H.G. Biggs, 1971. Albumin standards and the measurement of serum albumin with *Bromcresol green*. Clin. Chem. Acta, 31: 87-96.
20. Patton, C.J. and S.R. Crouch, 1977. Spectrophotometric and kinetics investigation of the Berthelot reaction for the determination of ammonia. Anal. Chem., 49: 464-469.
21. Young, D.S., 1990. Effects of Drugs on Clinical Laboratory Tests. 3rd Edn., AACC Press, Washington, DC., USA., pp: 6-12.
22. SPSS., 2014. Statistical Package for the Social Science. SPSS, Inc., Chicago, Illinois, USA.
23. Duncan, D.B., 1955. Multiple range and multiple F tests. Biometrics, 11: 1-42.
24. Hegazi, S.M., A.A. Bakr, B.I. Agag and M.A. Mousa, 2005. Influence of fat increment in milk replacer on performance of buffalo calves. Egypt. J. Nutr. Feeds, 8: 253-253.
25. Mahmoud, A.E.M. and H.M. Ebeid, 2014. Effect of green forage type on productive performance and milk composition of lactating Egyptian buffalo. Asian J. Anim. Vet. Adv., 9: 27-36.
26. Oduro, I., W.O. Ellis and D. Owusu, 2008. Nutritional potential of two leafy vegetables: *Moringa oleifera* and *Ipomoea batatas* leaves. Sci. Res. Essay, 3: 57-60.
27. Djakalia, B., B.L. Guichard and D. Soumaila, 2011. Effect of *Moringa oleifera* on growth performance and health status of young post-weaning rabbits. Res. J. Poult. Sci., 4: 7-13.
28. Aderemi, F.A., 2003. Effect of enzyme supplemented cassava siviete in cassava based diet on some visceral organs of pullet chicks. Proceedings of the 8th Annual Conference of the Animal Science Society of Nigeria, September 16-18, 2003, Minna, Nigeria, pp: 57-59.
29. Onu, P.N. and M.O. Otuma, 2008. Utilization of heat-treated sheep dropping in the diets of broiler finisher chicks. Int. J. Poult. Sci., 7: 169-173.
30. Onu, P.N. and A.O. Aniebo, 2011. Influence of *Moringa oleifera* leaf meal on the performance and blood chemistry of starter broilers. Int. J. Food Agric. Vet., 1: 38-44.
31. NRC., 1988. Nutrient Requirement of Dairy Cattle. 6th Edn., National Academy Press, Washington DC., USA.

32. Kaneko, J.J., 1989. Clinical Biochemistry of Domestic Animals. 3rd Edn., Academic Press, New York.
33. Bush, B.M., 1991. Interpretation of Laboratory Results for Small Animal Clinicians. Backwell Scientific Publications, London, ISBN: 9780408108492, Pages: 515.
34. Abd El-Aal, A.E., M.A. El-Ashry, A.E. Fekry and K.M. Elwan, 1991. Growth performance, liver and thyroid functions in buffalo calves reared on milk replacers supplemented with hydrogenated oils. Arab J. Nucl. Sci. Applic., 24: 49-60.
35. Al-Metwally, A.A., 1994. Puberty and related phenomena in male Egyptian buffalo calves and its relation to plane of nutration. M.Sc. Thesis, Ain Shams University, Egypt.
36. Abd El-Aal, A.E., 2000. Nutritional studies on raising suckling calves. Ph.D. Thesis, Ain Shams University, Egypt.
37. Mahmoud, A.E.M., 2013. Effect of feeding on *Moringa oleifera* stems on productive performance of growing lambs. Egypt. J. Nutr. Feeds, 16: 281-292.
38. Rej, R., 1989. Aminotransferase in disease. Clin. Lab. Med., 9: 667-687.
39. Molander, D.W., E. Sheppard and M.A. Payne, 1957. Serum transaminase in liver disease. J. Am. Med. Assoc., 163: 1461-1465.
40. Maxwell, M.H., W. Robertson, S. Spener and C.C. Maclorquodale, 1990. Comparsion of haematolgoical parameters in restricted and *ad libitum* fed domestic fowls. Br. Poult. Sci., 31: 407-413.
41. Bose, B., 1980. Enhancement of nodulation of *Vigna-mungo* by ethanolic extract of moringa leaves-a new report. Nat. Acad. Sci. Lett. India, 3: 103-104.
42. Fahey, J.W., A.T. Zalcmann and P. Talalay, 2001. The chemical diversity and distribution of glucosinolates and isothiocyanates among plants. Phytochemistry, 56: 5-51.
43. Kakengi, A.M.V., M.N. Shem, S.V. Sarwatt and T. Fujihara, 2003. Can *Moringa oleifera* be used as a protein supplement to ruminants. Asian-Aust. J. Anim. Sci., 18: 42-47.
44. Esonu, B.O., O.O. Emenalom, A.B.L. Udedibie, U. Herbert, C.F. Ekpor, E.C. Okoli and F.C. Iheukwumere, 2001. Performance and blood chemistry of weaner pigs fed raw Mucuna bean (Velvet bean) meal. Trop. Anim. Prod. Invest., 4: 49-54.
45. Fadiyimu, A.A., J.A. Alokan and A.N. Fajemisin, 2010. Digestibility, nitrogen balance and haematological profile of West African Dwarf sheep fed dietary levels of *Moringa oleifera* as supplement to *Panicum maximum*. J. Am. Sci., 6: 634-643.
46. Helal, F.I.S., E.I.M.A. Ashry, H.S. Soliman and H.M. Aly, 1999. Newly born buffalo calves receiving milk replacers containing different sources and levels of energy density. Incorporating high levels of homogenized margarine in local milk replacers for rearing young buffalo calves. Egypt. J. Nutr. Feeds, 2: 459-471.
47. Saleh, M.S., M.M. Bendary and K.F. Elready, 2006. Raising buffalo calves on cow's milk. J. Agric. Res. Tanta Univ., 32: 794-806.