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EFFECT OF *MORINGA OLEIFERA* SUPPLEMENTATION ON THE REPRODUCTIVE PERFORMANCE IN BARKI EWES

By

Ghattas, T. A.[1], Ghada. H. Abdel Rahman Hassan[2]

Biology of Reproduction Department

Animal Reproduction Research Institute (ARRI), Al Haram, Giza, Egypt.

ABSTRACT

This study was designed to evaluate the effect of *Moringa oleifera* (MO) tree leaves supplementation on growth and reproductive performance of growing ewes in Egypt.

Twelve ewes with average initial weight 25.57 ± 4 .62 kg were randomly divided into two groups (6 females each). Group 1 served as the control group, and these animals only feed without any supplementation. In addition to the natural pasture, Group 2 received 10 g of *M. oleifera* dried leaf meal. For 45 day the animals in both groups subjected to close observation for 6 months to compared between the control and supplemented group,WBC, lymphocytes, monocytes, neutrophils, total protein, globulin,total antioxidants, progesterone, palmitic, oleic, linoleic acid was differed ($P<0.05$) significantly in the supplemented group than the control one. Also, the overall body weight gain and the final body weight of the ewes were significantly differed between two groups. All reproductive efficiency parameters measured such as birth rate, twinning rate were significantly ($p< 0.05$) higher in supplemented ewes compared to the control. Body weights at birth of the offspring in supplemented ewes were, however, significantly ($p>0.05$) affected by supplementation. We concluded that the *Moringa oleifera* tree leaves can be used as supplementation to improve the growth and reproductive performance with no harmful effects on their health.

INTRODUCTION

Moringa oleifera leaves may have the possibility to improve nutritional status, growth performance, and producing healthier of ruminants when used as part of their diets **(Tingting Zhang *et al*., 2019 and Yusuf *et al.*, 2018).**

In recent years, interest in *Moringa* leaves as a supplement to animal diets has received care including its effects on the health and commercial performance of goats, sheep and cows. However, little information is available concerning the effect of adding the *Moringa oleifera* leaves on the diets of animals **(Kholif *et al.*,2015),** then added that feeding a *Moringa* leaf preparation to goats modified fatty acid profile positively.

In Egyptian farm animal's production systems, the most important restraint the presence of limitations in both quantity and quality of feed ingredients **(Azzaz *et al.*, 2015).** Usually, the Egyptian farmers feed their goats and ewes with low-quality berseem hay and agriculture by products, which are low in protein content, high in crude fibre and have short supply of vitamins and minerals contents, which leads to low digestibility and reduced voluntary feed intake. *Moringa oleifera* Lamarck is a South Asian tree grows near the Himalaya Mountains but has spread overall the world. Its leaves are rich in carotene and ascorbic acid with a good profile of amino acids, vitamins A,B, C, Ca, Fe and P **Mendieta-Araica, (2011),** reported that *Moringa oleifera* leaves have beneficial effects include anti-inflammatory action, antioxidant, antimicrobial, antitumor activities and inhibition of platelets aggregation.

Moreover *M. oleifera* leaves contained polyphenolic compounds. **(Azzaz *et al.*, 2016).**

In India *Moringa* is a slender, evergreen tree originated, but has spread to other regions of the world. It is one of the fastest growing trees in the world with high biomass yield, high crude protein and a balance of other nutrients in the leaves.Then added that *Moringa* can develop well in any region where the soil is not soft and watery. Its culture as human food and livestock feed in the Southern states has not been popular because information on the feeding value is scarce**,** *Moringa oleifera* tree leaves could be used as supplementation to improve the growth and reproductive performance with no harmful effects on their health **(Asaolu *et al.*, 2010).** *Moringa* has been introduced to Egypt over the last few years and is grown on in a various land use patterns **(Abd El Baky and El Baroty, 2013).**

MATERIAL AND METHODS

I. Animals and study site: The present study was performed on the experimental farm of Animal Reproduction Research Institute (ARRI). Twelve clinically healthy Barki ewes, their age ranged from 15-18 months were selected randomly from the flock and used in the present experiment. All ewes were healthy and clinically free from external and internal parasites.

Animals housed in semi open pens under natural day light and temperature. According to standard farming practice of ARRI, the animals were fed twice a day and had free access to drinking water and mineral blocks. Initial weights of the animals were taken at the beginning of the trial and weekly subsequently. Weight of the experimental ewe lambs was ranged from 29-31kg.

They were fed with good-quality Egyptian clover, berseem (alfa alfa) every day and were offered a standard total mixed ration according to **NRC (2007).**

II. Animal groups and treatment protocols:

Before the start of the experiment, the samples of *Moringa oleifera* leaves were analyzed, weighted and oven- dried at 105^{0}C 24 hours, then ground to pass through a 2 mm sieve in animal reproduction research institute (ARRI). Ewes were examined by ultrasound scanner (200 pie Medical Co - Netherlands - Holland), to confirm that ewes were non-pregnant.

The animals were weighted before the commencement of the feeding regimen; ewes were randomly assigned to two equal groups (6 each). The control group (1) fed on the basal diet without any supplementation while, group (2) fed on basal diet supplemented with *Moringa* supplementation (*Moringa* level 10.0 g/animal/ day for 45 days) in its station according to the method of **Ben Salem and Makkar (2009)** in sheep and **Kruti *et al.*, (2015)** in calves**.**

Proximate composition (%) of *Moringa oleifera*:

Nutrients	As fed basis %	As dry matter basis%
Dry matter	90.51	100
Moisture	9.49	-
Crude protein	23.44	25.9
NDF	31.29	34.58
ADF	13.45	14.86
Hemicellulose	17.85	19.72
Cellulose	9.50	10.50
Lignine	3.95	4.36
Ash	12.99	14.36
NFC	17.69	19.55
Ether extract	5.08	5.61
TDNix	58.44	64.57
DE(Mcal/kg)	2.75	3.04
ME(Mcal/kg)	2.37	2.62
NEI(Mcal/kg)	1.32	1.46

Two blood samples were taken from each ewe through jugular vein puncture every two weeks during the first experimental period (45 day). The first blood sample was anticoagulated by dipotassium salt of ethylene diamine tetra- acetic acid (EDTA) and was used for evaluation of the hemogram. The second blood sample was collected in a clean centrifuge tube and was allowed to clot, then centrifuged at 3000 rpm for 10 minutes for serum separation. The clear non-hemolyzed supernatant serum was harvested for biochemical studies.

Two intact rams were introduced to the flock to allow natural mating only for 30 min in each time. Pregnancy was diagnosed and fetal numbers were determined by mean of trans rectal sonar or Ultrasonography. Each lamb had weighted, and fertility data were collected throughout the study.

III. Hematological studies:

Erythrocytic cell counts and total leukocytic counts were done using an improved Neubauer hemocytometer. Packed cell volume (PCV %) was estimated by the microhematocrit technique. Hemoglobin concentration was determined calorimetrically using the cyanmethemoglobin method **Feldman *et al.*, (2000).**

IV. Biochemical assay:

Serum Total antioxidant capacity level (TAC) was measured according to **Cortassa *et al.*, (2004).**

Serum fatty acids: Gas chromatography analysis of *Moringa*: According to a previously described method **(AOAC., 2001)**, the fatty acid composition of *Moringa* seed oils was determined and assayed by gas chromatography (GC) 5890 Hawellete packared series II equipped with a flame ionization detector.

Progesterone hormone: Serum was assayed for progesterone hormone; by direct enzyme linked immunoassay (ELISA) according to **Maxey *et al*., (1992).**

V. Reproductive performance throughout the experimental period: One month after the natural matingconception rates of animals of the two groups were checked by ultrasonography using a real time B-mode (Veston, Kontron France).

Fertility was monitored in terms of conception rate **(Ozyurtlz *et al.*, 2011)**.

Pregnancy rate = number of pregnant ewes / numbers of mated ewes x 100.

Twinning rate = number of pregnant ewes bearing twins/number of mated ewes x 100.

Lambing rate = number of lambing ewes / numbers of mated ewes x 100.

Statistical analysis:

All data were subjected to statistical analysis according to **Sendecor and Cochran (1982).** Student "t" test and least significant differences were carried out to test differences between treatments using a computer program "COSTAT".

RESULTS

Results of hemogram of ewes in control and treated groups are illustrated in (Table 1). The total red cell counts, hemoglobin concentration and packed cell volume in the control and supplemented group revealed insignificant changes.

Concerning the mean values of total leukocytic, lymphocytes, monocytes and neutrophils counts were high significant changes ($P < 0.05$) in 30 day and 45-day post treatment of experimental period in supplemented group compared with control.

Table(1): Values of hemogram (RBCs count,Hb,PCV,TLC ($x10^3/\mu l$,Lymphocytes, Monocytes, Neutrophils, Eosinophils and Basophils) of experimental groups (mean ± SD).

Parameters \ Experimental period	Pretreatment		15 day post treatment		30 day post treatment		45 day post treatment	
	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II
RBCs(x106/µL)	10.98 ± 0.39^a	10.41 ± 0.33^a	9.79 ± 0.61^a	10.11 ± 0.27^a	10.06 ± 0.33^a	11.00 ± 0.94^a	11.34 ± 0.28^a	11.86 ± 0.66^a
Hb (g/dl)	10.41 ± 0.35^a	10.50 ± 0.34^a	9.33 ± 0.31^a	10.88 ± 0.15^a	10.32 ± 0.34^a	10.40 ± 0.40^a	9.66 ± 0.26^a	10.69 ± 0.48^a
P C V (%)	33.44 ± 2.06^a	36.21 ± 1.52^a	34.11 ± 0.30^a	35.12 ± 0.31^a	35.31 ± 1.52^a	36.50 ± 1.77^a	36.88 ± 1.01^a	36.99 ± 1.04^a
TLC($x10^3/\mu l$)	9.78 ± 0.06^a	9.64 ± 0.08^a	8.91 ± 0.03^a	9.39 ± 0.05^a	8.73 ± 0.02^a	14.41 ± 0.01^b	9.24 ± 0.09^a	13.75 ± 0.07^b
Lymphocytes (%)	59.3 ± 0.02^a	58.3 ± 0.03^a	56.53 ± 1.60^a	60.4 ± 0.01^a	56.07 ± 0.51^a	71.20 ± 0.03^b	57.52 ± 1.61^a	73.20 ± 0.02^b
Monocytes (%)	11.9 ± 0.09^a	12.3 ± 0.04^a	11.4 ± 0.09^a	12.5 ± 0.04^a	11.8 ± 0.09^a	14.5 ± 0.03^b	11.2 ± 0.09^a	14.8 ± 0.01^b
Neutrophils (%)	9.2 ± 0.01^a	11.3 ± 0.01^a	9.7 ± 0.05^a	11.9 ± 0.02^a	9.3 ± 0.03^a	13.2 ± 0.05^b	9.9 ± 0.01^a	13.9 ± 0.06^b
Eosinophils (%)	1.0 ± 0.05^a	1.3 ± 0.01^a	1.0 ± 0.07^a	1.2 ± 0.01^a	1.0 ± 0.04^a	1.5 ± 0.01^a	1.0 ± 0.05^a	1.2 ± 0.03^a
Basophils (%)	1.0 ± 0.01^a	1.0 ± 0.01^a	1.0 ± 0.08^a	1.0 ± 0.01^a	1.0 ± 0.06^a	1.1 ± 0.01^a	1.0 ± 0.01^a	1.1 ± 0.05^a

Group (1): represents the control group.

Group (2): represents the *Moringa* supplemented group.

Means with different superscripts within a row are significantly different at p<0.05.

Assay of serum biochemical parameters of ewes in control and treated groups are illustrated in (Table 2).

In the period of experiment the total protein, globulins,total antioxidants and progesterone was high significant changes (P< 0.05) after 30- and 45-day post treatment.

Table (2): Values of biochemical parameters (total protein, albumin, globulin, total antioxidants and progesterone of experimental groups (mean ± SD).

Experimental period / Parameters	Pretreatment		15-day post treatment		30-day post treatment		45-day post treatment	
	Group I	**Group II**	**Group I**	**Group II**	**Group I**	**Group II**	**Group I**	**Group II**
Total protein(g/dl)	**6.16 [a]**	**5.83 [a]**	**6.33 [a]**	**5.92 [a]**	**6.17 [a]**	**6.84[b]**	**6.33 [a]**	**6.95 [b]**
Albumin (g/dl)	**3.18 [a]**	**2.98 [a]**	**3.2 [a]**	**2.95 [a]**	**3.17 [a]**	**3.35 [a]**	**3.17 [a]**	**3.32 [a]**
Globulin (g/dl)	**2.98 [a]**	**2.85 [a]**	**3.13 [a]**	**2.97 [a]**	**3.01 [a]**	**3.49 [b]**	**3.17 [a]**	**3.63[b]**
TAC (mmol /L)	**0.42 [a]**	**0.45 [a]**	**0.048 [a]**	**0.44[a]**	**0.5 [a]**	**0.83 [b]**	**0.53 [a]**	**0.86 [b]**
Progesterone (ng/ml	**0.43 [a]**	**0.42 [a]**	**0.50 [a]**	**0.48 [a]**	**0.57 [a]**	**0.75 [b]**	**0.68 [a]**	**0.83 [b]**

Group (1): represents the control group

Group (2): represents the *Moringa* supplemented on diet group

Means with different superscripts within a row are significantly different at p<0.05.

Mean values of serum free fatty acids of ewes in control and treated groups are illustrated in table (3). Values of fatty acids were highly significant in palmitic, oleic acid and linolenic acid in 5th and 7th week of experiment.

Table (3): Values of free fatty acids of experimental groups (mean ± SD).

Experimental period / g/100g FA	Pretreatment		15-day post treatment		30-day post treatment		45-day post treatment	
	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II
Palmitic acid	**27.4[a]**	**26.1 [a]**	**27.3 [a]**	**26.2 [a]**	**26.8 [a]**	**23.7[b]**	**26.4 [a]**	**22.6[b]**
Oleic acid	**24.9 [a]**	**25.3 [a]**	**24.8 [a]**	**24.3 [a]**	**25.2 [a]**	**28.8 [b]**	**26.2 [a]**	**29.1 [b]**
Linoleic acid	**0.56 [a]**	**0.60 [a]**	**0.57 [a]**	**0.61[a]**	**0.58 [a]**	**0.87 [b]**	**0.57 [a]**	**0.89 [b]**
Stearic acid	**16.35[a]**	**14.49[a]**	**13,91[a]**	**16.22[a]**	**16.91[a]**	**17.65[a]**	**15.88[a]**	**17.22[a]**
Linolenic acid	**0.32[a]**	**0.30[a]**	**0.34[a]**	**0.31[a]**	**0.33[a]**	**0.32[a]**	**0.31[a]**	**0.33[a]**
Arachidic acid	**0.85 [a]**	**0.86 [a]**	**0.84 [a]**	**0.87 [a]**	**0.84 [a]**	**0.98 [b]**	**0.87 [a]**	**0.95[b]**
Behenic acid	**0.43 [a]**	**0/48 [a]**	**0.44 [a]**	**0.48 [a]**	**0.45 [a]**	**0.47 [a]**	**0.45 [a]**	**0.49 [a]**

Group (1): represents the control group.

Group (2): represents the *Moringa* supplemented on diet group.

Means with different superscripts within a row are significantly different at p<0.05.

The initial body weight was not insignificant changes while final body weight of ewes was highly significant changes (P< 0.05) of experimental period. The total weight gain was increased significant changes in group II than group I as in (Table 4). The pregnancy rate and birth rate were significant increase in group II than in group I (100.00% vs 90.00%), (100.00 %vs 83.33 %) respectively. The single lambing rate was significantly higher in group II than the group I (87.50% vs 33. 33%). The twinning rate was significantly higher in group II than in group I (33.33% vs 0 %).

Table (4): The effect of *Moringa* on the reproductive performance of ewes of experimental groups (mean ± SD).

Items	Group I n=6	Group II n=6
Initial body weight kg)	**30.07± 0.12[a]**	**29.60± 0. 01[a]**
Final body weight (kg)	**34.01±0.01 [a]**	**38.9±0.09 [b]**
Total weight gain (kg)	**3.94± 0.03[a]**	**9.30± 0.05[b]**
Pregnancy rate (%)	**90% [a]**	**100% [b]**
Lambing rate (%)	**83.33 % [a]**	**100 % [b]**
Birth weight (kg)	**2.50 [a]**	**3.03 [a]**
Twining rate (%)	**0% [a]**	**33.33 % [b]**

Group (1): represents the control group.

Group (2): represents the *Moringa* supplemented on diet group.

Means with different superscripts within a row are significantly different at p<0.05.

DISCUSSION

Moringa oleifera is one of the replacement forage protein and energy sources. It likens well in nutrient composition, especially crude protein,*Moringa oleifera* supplementation has been reported to progress the growth performance of ruminants when supplemented as fresh fodder, hay, or as part of a concentrate diet. However, the results of this study are in agreement with **(Kholif *et al*., 2016; Jiwuba *et al*., 2016)**. The higher values in the group supplemented with MO show that MO could provide towards better livestock performance in designate of bodyweight changes **(Nouman *et al*., 2014)** as it contains an appreciable level of essential nutrients.

The RBCs and Hb values recorded for the sheep in this study were non-significant changes and within the normal values as in reported by **Daramola *et al.* (2005)** for same breed.

The present results show that hence the animals were not anaemic and the diets supported good health status of the sheep.

Packed cell volume values obtained for all treatment groups were within normal range for sheep which is an indication that, the treatment diets were nourishing and non-toxic and influenced adequate blood supply. PCV is used as an index of toxicity and its composition varies with breeds **(JIWUBA *et al.*,2016).Aikhuomobhogbeand Orheruata (2006)** observed that low PCV results in anaemia. This is attributed with reduced oxygen carrying-capacity of blood, increased pulse rate and consequently heart failure.

High significant WBCs count in 5th and 7th week of experiment. These results are agreement with **(Ahamefule *et al.*, 2005)** mentioned that high WBC is usually associated with microbial infection or the presence of foreign body or antigen in the circulating medium.

Daramola *et al*. (2005) reported that,the normal values of WBC obtained in this study suggested well developed immune system of the sheep. These results possibly high spot the ethno-veterinary possession of *Moringa oleifera* as reported by **Fahey (2005)**.

Increase serum total protein values in the treated groups (MO) in 5th and 7th week may be due to the improvement of rumen environment after MO supplementation which led to enhance dietary protein digestion and microbial protein synthesis, total protein and globulin levels determined in this study were significantly increased ($P < 0.05$) in ewes of group II compared to group I and these values are generally induced by the quality and quantity of protein intake **(Research Animal Resource., 2009).** In previous studies **(Melillo, 2007)** the observations of albumin and globulin fall within the range of reference values reported for healthy rabbits**.**

Interestingly, natural antioxidants present in food of plant origin such as *Moringa oleifera* are valuable tools in gain and keep good health **(Kholif *et al.*, 2015).**Then added that, the immune regulatory function of *Moringa* was demonstrated through increased blood protein levels and globulins in the supplemented groups, while blood serum antioxidant activity.

The immune system is one of the first body functions to be influence by an impaired nutritional status.The antioxidant activity is important in help the immunity of ewes through the elimination of excess reactive oxygen molecules (pro-oxidants) that may harm their immune functions and adequate nutrition is an important regulator of immune function and can frequently tip the balance between health and disease **(NRC, 2007).**

The total antioxidant capacity (TAC) was higher in serum of ewes fed MO than control. *Moringa oleifera* leaves are elegant in nutrients such as protein, fatty acid, mineral and vitamins and have potentials to be used as a feed additive with multiple purposes **(Moyo *et al.*, 2013).** The use of *Moringa* leaf as a protein source has several advantages which include: the ability to be yield several times per growing season; small difference in the intake of both fresh or dried *Moringa* leaves and ability to store its dried leaf for longer periods without amelioration in nutritive value **(Mendieta-Araica *et al.*, 2011).** On the other hand, *Moringa* *oleifera* is one of the plants that contain natural antioxidants which act as antioxidant, antimalarial, cardiac stimulant and has antibacterial and antifungal activities **(Farooq *et al.*, 2007).** Additionally, the antioxidant properties of *Moringa* leaves can be activate antioxidant enzymes, inhibit oxidases and discard free radicals, **(Luqmans *et al.*, 2012).**

Increase in blood serum oestradiol in ewes and agreement with **Zachut *et al.* (2011)** reported in dairy cows supplemented with fatty acids, compared with a control group. Then added that Plasma levels of oestradiol reported in this study could be attributed to an increase in ovarian steroidogenesis or possibly to decrease in steroid catabolism in the liver. A greater oestradiol concentration in plasma when cows were fed low and high levels of polyunsaturated fatty acids compared with the control group. Concentrations of oestradiol in blood were positively related to oestrus length, the diameter of the preovulatory follicle, and pregnancy rate in cows **(Perry *et al.* 2014).**

In addition, several studies **(Moraes *et al*., 2013)** have observed that protein level in the diet do not change the frequency of natural or synchronized estrus in ewes, but it can increase the progesterone levels. This information is consistent with our results, demonstrating that an increase in the protein level in diet for ewes maintained in adequate body condition did not show any significantly effect on number of animals in estrus, but may affect the moment of estrus manifestation.

Steroids are one of the causes of increased body and sexual organ weight and an increase in these parameters could be regarded as a biological indicator for effectiveness of the plant extract in improving the genesis of steroidal hormones **(Narra *et al*., 2019).**

The significant alteration of fatty acid profile after MO supplementation in this study could be attributed to high concentrations of fatty acids generally and unsaturated fatty acids especially in *M. oleifera* leaves. In this affect, **(Olaofe *et al.*, 2013)** reported that total unsaturated fatty acids (TUFA) of *M. oleifera* leaves represent 42% of its total fat.

Moringa contains more dietary polyunsaturated fatty acids than the saturated fatty acids.

A higher content of PUFA and lower amount of SFA is desirable **(Hoffman and Wilklund, 2006),** as such, its inclusion in the diet is recommended as it blocks the occurrence of diseases thereby promoting good health. **Wood *et al.*, (2008)** recommended more consumption of linolenic acid, which promote the endogenous synthesis of long chain fatty acids. Polyunsaturated fatty acids are important for human and animal health. They are of interest because they are precursors of long chain PUFA, which are viewed as important bioregulators of many cellular processes **(Khotimchenko, 2005).** They are linked to the development and functionality of the immune system. Consumers have preference of food low in saturated fatty acids (SFA) because they are associated with an increased risk of cardio-vascular diseases and some cancers **(Griffin, 2008; Alfaia *et al.*, 2009).**

The improvement in body weight with *Moringa oleifera* leaf meal supplement group is in agreement with results reported by **Ahaotu *et al.* (2013)**. The significant dry matter intake obtained in the diet containing 15% MOLM may be due to its higher protein quality, greater palatability and higher protein content of the diet. This is in line with the result obtained by **Aye and Adegun (2013)** suggested that, the diet high in protein content increases intake.

Replacement of alfalfa with *M. oleifera* had a positive effect on average daily gain in lambs fed MOD than that control group, milk yield, composition and quality of ewes and goats and growth performance of lambs **(Elfadil *et al.*, 2017).** Ewes fed supplemented by *M. oleifera* resulted in increased weight gain, Similarly, **Bebeker and Abdalbagi (2015)** fed goats with *M. oleifera* leaves and observed that moderate levels of supplementation resulted in rapid growth performance and could sustain and improve livestock productivity.

The marked elevation in weight gain by the animals fed the experimental diets may be attributed to *Moringa oleifera* leaf meal due to its high nutrient profile and palatability.

The superior weight gains exhibited by animals may also be attributed to the high feed intake and feed utilization of the animals on diet, since voluntary feed intake of an animal is directly related to the body weight changes. The superior feed efficiency of diets over the other diets is a reflection of the observed higher feed utilization and indeed higher growth rates of does fed the respective diets mentioned by **Ukanwoko *et al*. (2013)**

The positive effect resulting from *M. oleifera* supplementation was due to the high protein contents. Several studies **(Moyo *et al.*, 2016)** have reported improvements in growth performance of goats fed diets containing *M. oleifera* leaves. Increasing levels of *M. oleifera* resulted in increased weight gain, suggesting that a higher beneficial effect was achieved. Similarly, **Bebeker and Abdalbagi (2015)** fed goats with three different levels of *M. oleifera* leaves and observed that moderate levels of supplementation resulted in rapid growth performance and could sustain and improve livestock productivity. Concerning reproductive performance, the higher birth rate observed in goats *M. oleifera* leaf meals may have resulted from the use of these supplements in animal feed. Supplementary feed rich in energy and protein has a significant positive effect on reproduction in general and ovulation rate in particular **(Blache *et al.*, 2008).** Previous studies reported increased ovulation rates and the incidence of twins **(Rhind, 1992)** in does feed high protein diets. The lower birth weight and weaning weight observed in the control group may be due to the effect of poor-quality feeding. According to **Deminicis *et al.* (2009),** insufficient energy supply is considered to be the primary obstacle in the production of small ruminants, resulting in reduced growth and reproductive performances. However, offspring born to goats feed *M. oleifera* leaves had high survival rates. This result may have been influenced by the presence of compounds with therapeutic properties in *M. oleifera* leaves **(Bebeker and Abdalbagi, 2015),** in addition to the positive effects of supplementation on the does.

Birth weight and weaning weight did not vary significantly among treatments, but kids born from supplemented does had relatively heavier weights compared to those from the control group. Heavier birth weight and weaning weight of kids may have resulted from heavier weights of does at kidding and milking phase, therefore reflecting a positive effect of supplementation. Similar results were observed in other studies conducted for goats under different production systems **(Bushara and Abu Nikhaila, 2011).**

CONCLUSION

In conclusion, the data derived from nutrient characterization of *Moringa* are clear indications that, the plant leaves are rich in nutrients and has potential to be used as a feed additive with multiple purposes. These include serving as a protein, fatty acid and antioxidants resource for ewes feed formulations. High nutritional content found in the dried leaves are important nutritional indicators of the usefulness of the plant as a likely feed resource. Drying the leaves assists to concentrate the nutrients, facilitate conservation and consumption, as such, it can be used during the time when feed is scarce or can be transported to areas where it is not cultivated. It can be used to improve health and nutrition in Egypt.

REFFERENCES

Abd El Baky, H.H., El-Baroty, G.S. (2013): Characterization of Egyptian *Moringa* peregrine seed oil and its bioactivities. Int. J. Manag. Sci. Bus. Res. l2, 89-108.

Ahaotu EO, Ezeafulukwe CF. and Ayo-Enwerem CM and Ekenyem BU. (2013): Effects of Enzyme Fortified Raw *Moringa* Seed (*Moringa oleifera*) Waste Diets on Nutrient Utilization and Haematological Parameters of Broilers Inter J. Appl Sci Engr 1:25-30.

Aikhuomobhogbe PU and Orheruata AM. (2006): Hematology and blood biochemical indices of West African Dwarf goats vaccinated against pestes des petit ruminants (PPR). Afr J. Biotech. 5:743-748.

Alfaia CPM, Alves SP, Martins SIV, Costa ASH, Fontes CMGA, Lemos JPC, Bessa JB, Prates JAM. (2009): Effect of the feeding system on intramuscular fatty acids and conjugated linoleic acid isomers of beef cattle, with emphasis on their nutritional value and discriminatory ability. Food Chem., 114: 939-946.

AOAC. (2001): Official Methods of Analysis. 16th Edn, the Association of Official Analytical Chemists, Washington, DC., USA

Asaolu V.O, Odeyinka S.M, Akinbamijo O.O, Sodeinde F.G. (2010): Effects of *Moringa* and bamboo leaves on groundnut hayutilization by West African Dwarf goats. Livestock Research for Rural Development 22 (1).

Aye PA and Adegun MK. (2013): Chemical composition and some functional properties of *Moringa*, Leucaena and Gliricidia leaf meals Agric. Biol. J. N. Am 4:71-77.

Azzaz, H.H., H.A. Aziz, E.S.A. Farahat and H.A. Murad (2015): Impact of microbial feed supplements on the productive performance of lactating Nubian goats. Global Vet., 14: 567-575.

Azzaz, H.H., H.A. Murad, A.M. Kholif, T.A. Morsy, A.M. Mansour and H.M. El-Sayed (2016): *Moringa oleifera* and Echinacea purpurea as Supplements for Rhamani Lactating Ewe's Diets and Their Effect on Rumen Characteristics, Nutrients Digestibility, Blood Parameters, Milk Production, Composition and its Fatty Acid Profile DOI: 10.3923/ajava. 684.692 ISSN 1683-9919.

Azzaz, H.H., H.A. Murad, A.M. Kholif, T.A. Morsy, A.M. Mansour and H.M. El-Sayed (2016): Increasing nutrients bioavailability by using fibrolytic enzymes in dairy buffaloes feeding. J. Biol. Sci., 13: 234-241.

Bebeker EA, Abdalbagi YMA. (2015): Effect of Feeding Different Levels of *Moringa oleifera* leaves on performance, haematological, biochemical and some physiological parameters of Sudan Nubian goats. Online J Anim Feed Res, 2: 50-61.

Ben Salem H, Makkar HPS. (2009): Defatted *Moringa oleifera* seed meal as a feed additive for sheep. Animal Feed Science and Technology; 150 (1-2) 27-33.

Bushara I, Abu Nikahaila AMA. (2011): Productive and reproductive of Taggar female kids as affected by concentrate rations under dryland farming in western Sudan. Egyptian J. Anim Prod, 47: 151-160.

Cortassa, S., Aon, M.A., Waston, R.L.,Rourke, B. (2004): A mitochondrial oscillator dependent on reactive oxygen species. Biopysic. J, 87: 2060 -2073.

Daramola JO, Adeloye AA, Fatoba TA, Soladoye AO. (2005): Haematological and Biochemical parameters of WAD goats Liv. Res. R. Dev. 17:45-56.

Deminicis BB, Do Carmo Araújo SA, Jardim JG. (2009): Maneio nutrição e alimentação de ovinos e caprinos: visão geral e análise econômica. A Lavoura, 29-34.

Dumas, B.T. and H.G. Biggs (1972): Standard Methods of Clinical Chemistry Academic Press, New York, and pp: 175.

Fahey JW. *Moringa oleifera* (2005): A Review of the Medical Evidence for Its Nutritional, Therapeutic, and Prophylactic Properties Part 1. Trees for Life Journal a forum on beneficial trees and plants 1:1-5.

Farooq, A.; Sajid, L.; Muhammad, A.; and Anwarul-Hassan G. (2007): *Moringa oleifera:* a food plant with multiple medicinal uses. Phototherapy Res., 21: 17–25.

Feldman, J.G. and Jain, N.C. (2000): ″Schalm′s Vetrinary Hematology″, 5th ed., Lea and Febiger, Philadlphia, USA.

Griffin B.A. (2008): How relevant is the ratio of dietary n-6 to n-3 polyunsaturated fatty acids to cardiovascular disease risk? Evidence from the OPTILIP study. Curr. Opin. Lipidol, 19: 57-62.

Henery, R. J. (1968): “Clinical Chemistry Principles and Techniques”. Harper and Row, New York, P.,185.

Hoffman LC and Wiklund E. (2006): Game and vension-meat for the modern consumers. Meat Sci., 74: 197-208.in dairy cows and the e_ects on hormonal and behavioral patterns around estrus. Reproduction 141:833-840.

Jiwuba, P.C., Ahamefule, F.O., Okechukwu, O.S. and Ikwunze, K. (2016): Feed intake, body weight changes and haematology of West African dwarf goats fed dietary levels of *Moringa oleifera* leaf meal. Agricultura 13(1-2), 71-77.

Kholif, A.E., Morsy T.A., G.A. Gouda, U.Y. Anele and M.L. Galyean (2016): Effect of feeding diets with processed *Moringa oleifera* meal as protein source in lactating Anglo-Nubian goats. Anim. Feed Sci. Technol., 217: 45-55.

Kholif, A.E., Gouda, G.A., Morsy, T.A., Salem, A.Z.M., Lopez, S. and Kholif, A.M. (2015): *Moringa oleifera* Leaf Meal as a Protein Source in Lactating Goat's Diets: Feed Intake, Digestibility, Ruminal Fermentation, Milk Yield and Composition, and Its Fatty Acids Profile. Small Ruminant Research, 129, 129-137. https://doi.org/10.1016/j.smallrumres.2015.05.007.

Khotimchenko SV. (2005): Lipids from the marine alga *Gracilaria verruscosa*, Chem. Nat. Compd., 41 (3): 285-288.

Kruti Debnath Mandal1, M. R. Das1, M. Pati1, P. D. Pati2, A. R. Gupta1, R. C. Patra1 and S. K. Senapati1(2015): Effect of *Moringa oleifera* on hematological parameters of calves reared in industrial fluorotic area Veterinary World, EISSN: 2231-0916

Luqmans, S.; Srivastava, S.; Kumar, R.; Maurya, A. K.; and Chanda, D. (2012): Experimental assessment of *Moringa oleifera* leaf and fruit for its antistress, antioxidant, and scavenging potential using in vitro and in vivo assays. Evidence-Based Complementary and Alternative Medicine, Article ID 519084, 12 pages.

Maxey, K.M., Maddipati, K.R., and Birkmeier ([1992): Interference in enzyme immunoassay. J. Clin. Immunoassay 15, 116-120.

Melillo, A. (2007): Rabbit Clinical Pathology. Journal of Exotic Pet Medicine, 16, 135-145.

Mendieta-Araica B, Sprndly E, Reyes-Snchez N. and Sprndly R. (2011): Feeding *Moringa oleifera* fresh or ensiled to dairy cows-effects on milk yield and milk flavor. *Trop Anim Health Prod* 43:1039-1047.

Mendieta-Araica, B. (2011): *Moringa oleifera* as an alternative fodder for dairy cows in Nicaragua. Ph.D. University of Agricultural Sciences, Uppsala, Sweden.

Moyo, B.,Oyedemi, S.,Masika, P.J. and Muchenje,V. (2013): Polyphenolic Content and Antioxidant Properties of *Moringa oleifera* Leaf Extracts and Enzymatic Activity of Liver from Goats Supplemented with *Moringa oleifera* Leaves/Sunflower Seed Cake. Meat Science, 91, 441-447.

Narra Venkatesh 1, Kopuri Gayathri Devi1, Gunji Venkateswarlu 2, and Akula Murali Sri Sudhakar 3 (2019): Effect of Hydroalcoholic Extract of *Moringa oleifera* Leaves on Fertility Hormone and Sperm Quality of Male Albino Rats. World Journal of Current Medical and Pharmaceutical Research.

Nouman,W., Basra, S.M.A., Siddiqui, M.T., Yasmeen, A., Gull, T. and Alcayde, M.A.C. (2014): Potential of *Moringa oleifera* L. as livestock fodder crop: A review. Turk. J. Agric. For. 38 (1), 1-14.

NRC. (2007): Nutrient Requirements of small Ruminants: Sheep-Goat-Cervids and New World Camelids, 7th ed. National Academy Press, Washington DC, USA. PP: 221-229.

Olaofe, O., E.I. Adeyeye and S. Ojugbo (2013): Comparative study of proximate, amino acids and fatty acids of *Moringa oleifera* tree. Elixir Applied Chem., 54: 12543-12554.

Ozyurtlu, N.;Ay Serhan, S.; Kucukaslan, I.; Gungor O. and Aslan, S. (2011): Effect of subsequent two short-term, short-term, and long-term progestagen treatments on fertility of Awassi ewes out of the breeding season. Ankara Univ. Vet. Fak. Derg. 58,105-109.

RAR. (Research Animal Resource (2009): Reference Values for Laboratory Animals: Normal Haemotological Values. RAR Websites, RAR, University of Minnesota.

Snedecor, G.W. and Cochran, W.G. (1982): Statistical methods. 7th Edition, the Iowa State University Press, Iowa.