Effect of *Moringa Peregrine* Seeds on Productive Performance and Hemato-Biochemical Parameters of Growing Rabbits

Ibrahim, N.H.; Morsy, A.S. and Ashgan, M.E.

Animal and Poultry Physiology Department, Desert Research Center
alisaber_drc@yahoo.cdom

Abstract: The present study was carried out in South Sinai Research Station, located at Ras Suder that belongs to the Desert Research Center, Ministry of Agriculture and Land Reclamation, Egypt. This study was carried out to investigate the effect of addition graded levels of *Moringa peregrine* seeds meal (MPS) on the productive performance, haematology and plasma biochemical parameters of growing California rabbits. A total number of 36 weaned rabbits (35 days old and body weight of 609.86 ± 14.96 g) were used in this study and randomly divided into three equal treatments (12 rabbits of each) and gavage with 0 (Tr1, control), 2 (Tr2) and 4 (Tr3) g *Moringa peregrine* seeds /kg diet. Productive performance and hemato-biochemical parameters were measured. Results showed that rabbits fed diets supplemented with 4 g MPS /kg diet recorded 10.1 % higher ($P<0.05$) in final live body weight than that of the control group. Live body weight change and daily weight gain were significantly increased in the rabbits of Tr2 (2 g MPS/kg diet) by 11.7 % and in Tr3 (4 g MPS/kg diet) by 14.3 % as compared to control group (Tr1). Daily feed intake was increased ($P<0.05$) in the rabbits of Tr2 by 6 g and insignificantly increased in Tr3 by about 3 g as compared to control group. However, rabbits of Tr3 were improved feed conversion and decreased cost of feeding by 8.7 % and 0.72 L.E., respectively as compared to control group. Growth performance index was increased ($P<0.05$) in the Tr3 by 20.6 % and insignificantly increased in the rabbits of Tr2 by 11.6 % as compared to control group. The results showed that red blood cells count, hemoglobin concentration and mean corpuscular hemoglobin concentration increased ($P < 0.05$) in the rabbits of Tr2 and Tr3 than that of control group. However, hematocrit and mean corpuscular volume were decreased ($P<0.05$) in the rabbits of Tr2 and Tr3 than that of control group. White blood cells were significantly higher in the rabbits of Tr3 by 42.37 % as compared to control group. Results showed that albumin, glucose, cholesterol, LDL, HDL, triglycerides, total lipids, urea, aspartic transaminase and GGT concentrations were decreased ($P < 0.05$) in the rabbits of Tr3 (4 g MPS/kg diet) as compared to rabbits of control group. Meanwhile, globulin level was significantly increased in rabbits Tr3 by 20.50 % as compared to control group. No significant differences in total protein, creatinine and alanine transaminase levels were observed between treatments. **It can be concluded that,** *Moringa peregrine* seeds (MPS) can be used at level 2 or 4 g/ kg diet to enhance productive performance and hemato-biochemical parameters of growing rabbits.

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1. Introduction

In many tropical and subtropical countries, various parts of moringa (leaves, fruits, immature pods, flowers and seeds) are incorporated into the traditional food of humans (Siddhuraju and Becker, 2003 and Anhwange *et al*., 2004). Leaves of the moringa tree are the preferred part for use in animal diets as leaf meal. Researchers were conducted to study the effect of this leaf meal on the growth performance of layer chicks (Melesse *et al*., 2011), on the productive performance of laying hens (Kakengi *et al*., 2007 and Abou-Elezz *et al*., 2011), on broilers' performance (Juniar *et al*., 2008 and Olugbemi *et al*., 2010), and on the growth, carcass, and blood indices of weaner rabbits (Nuhu, 2010). The effect of moringa seeds was also examined by researchers (Abbas and Ahmed, 2012).

Recently, there has been interest in the utilization of moringa (*Moringa oleifera, Moringa peregrine*) commonly called horse radish tree or drum stick tree, as potential inexpensive protein source for livestock feeding) Sarwatt *et al*., 2002(. It is rich in carotene, ascorbic acid, iron and in the two amino acids generally deficient in other feeds i.e methionine and cystine (Makkar and Becker, 1996). So, the moringa tree has gained popularity as a nutrition power plant that can feed the needy and save lives. Its leaves are an excellent source of vitamin A (four times the amount in carrots), vitamin C (seven times the amount in oranges), vitamin B, calcium (four times the amount in milk), protein (twice the amount in milk), and potassium (three times the amount in bananas). In addition, moringa contains specific plant pigments with demonstrated potent antioxidant properties such as the

carotenoids - lutein, alpha-carotene and beta-carotene, xanthins, and chlorophyll; other phytochemicals with known powerful antioxidant ability – kaempferol, quercetin, rutin and caffeoylquinic acids; powerful antioxidant vitamins - C, E, and A and essential micronutrients with antioxidant activity - selenium and zinc (Fuglie, 1999). The protective antioxidant compounds are located in organelles, subcellular compartments or the extracellular space, enabling maximum cellular protection to occur.

The antioxidant system of the living cell includes three major levels of defense. The first level is based on the activity of superoxide dismutase (SOD), glutathione peroxidase (GSH-Px) and catalase which, together with metal-binding proteins, are responsible for prevention of free radical formation and keep this process under control. The second level of antioxidant defense is based on chain-breaking antioxidants (vitamins E, C, carotenoids, etc.) and is responsible for restriction of chain formation and propagation. The third level of defense is based on the activity of specific enzymes, responsible for repairing or removal of damaged molecules from the cell (Surai, 2002).

The use of moringa in the present study fits in the strategy of increasing immunity responses of rabbits that is reflections on improving physiological and productive performance. Therefore, this study was carried out to investigate the effect of addition graded levels of *Moringa peregrine* seeds meal on the productive, haematology and plasma biochemical parameters of growing rabbits.

2. Materials And Methods

The field work was carried out in South Sinai Research Station, Desert Research Center, Ministry of Agriculture and Land Reclamation located at Ras Suder, South Sinai, Egypt. The study was started in October 2012 till December 2012 (the experiment extended for 3 months). California rabbits used in this study to investigate the effect of moringa as additive supplement on physiological responses of growing rabbits. A total number of 36 weaned rabbits (35 days old and body weight of 609.86 ± 14.96 g) were used in this study and randomly divided into three equal groups (12 rabbits of each) and gavage with 0 (control, Tr1), 2 (Tr2) and 4 (Tr3) g *Moringa peregrine* seeds /kg diet. Each group was sub-divided into four equal replicates (3 rabbits each). Rabbits were individually housed in standard dimensions wired metallic cages. The rabbits were fed, *ad-libitum*, a commercial concentrate pelleted diet (Table 1).

Table (1): Composition and proximate chemical analysis of diets.

	Levels of moringa seeds		
Ingradient	**0 % (Tr1, control)**	**0.2 % (Tr2)**	**0.4 % (Tr3)**
Corn	11.5	11	11
Soybean meal (44 % CP)	16.8	16.8	16.7
Wheat bran	28.5	28.5	28.5
Clover hay	31.7	32	32
Barley	6.5	6.5	6.4
Moringa seeds	-	0.2	0.4
Molass	3	3	3
Limestone	1.3	1.3	1.3
Salt	0.3	0.3	0.3
Premix*	0.3	0.3	0.3
DL-methionin	0.1	0.1	0.1
Total	100	100	100
DE kcal.	2608	2603	2604
CP%	18.02	18.08	18.11
CF%	13.01	13.09	13.08
EE%	2.30	2.37	2.44

*Supplying each kg diet = Vit. A 12000 IU, Vit. D3 2000 IU, Vit. E 10 mg, Vit. K3 2 gm, Vit. B1 1000 mg, Vit. B2 5 mg, Vit. B6 1.5 mg, Vit. B12 10 mg, Niacin 30 mg, Pantotheni acid 10 mg, Folic acid 1 mg, Choine 250 mg, Biotin 50 mg, Copper 5 mg, Manganese 60 mg, Zinc 50 mg, Iron 30 mg, Iodine 0.3 mg Selenium 0.1 mg and Cobalt 0.1 mg.

Individual body weight was recorded at 6th week (initial body weight) and 14th week (final body weight) of age. Live body weight changes, daily weight gain, feed intake and feed conversion were calculated at 6-14 weeks of age. Feed conversion was calculated as g feed / g gain. Cost of feeding for producing 1 kg live weight of rabbit was calculated as feed conversion (6-14 weeks) × price of 1 kg feed (L.E. 3.00). Growth performance index was calculated as body weight at 14 weeks of age / feed conversion at 6-14 weeks of age × 100.

Blood samples were taken from the marginal ear vein into tubes containing EDTA as anticoagulant (10 rabbits/treatment were randomly chosen during the mild and end of experiment). Hemoglobin concentration, hematocrit (%), red blood cells count

and white blood cells count were examined immediately and the rest of the blood was centrifuged for 15 minutes at 3000 rpm to collect plasma before being stored at -20 ^{o}C until analysis.

Red blood cells (RBC's) and white blood cells (WBC's) were counted using hemocytometer. Hemoglobin concentration (Hb) was determined colorimetrically in fresh blood samples using ready-made kits (Diamond Diagnostics, Egypt). Hematocrit (Ht %) was estimated using microhematocrit tubes by Wintrobe methods**.** Mean corpuscular volume in femto liter (MCV), mean cell hemoglobin concentration % (MCHC) and mean cell hemoglobin in pg (MCH) were calculated from the following equations:

MCV= (Ht×10)/RBC's; MCH= (Hb×10)/RBC's; MCHC= (Hb×100)/Ht (%).

Plasma total protein, albumin, glucose, total cholesterol, low density lipoprotein (LDL), high density lipoprotein (HDL), triglycerides, urea, creatinine, alanine transaminase (ALT), aspartate transaminase (AST) and glutamyle transferase (GGT) were determined by the colorimetric methods with commercial kits. Value of globulin was calculated by subtracting the value of albumin from the value of total protein. Albumin/globulin ratio (A/G) was calculated according to results of albumin and globulin.

Statistical analysis was carried out using General Linear Model (GLM) procedures by SAS (2004) using simple one way analysis of variance.

Duncan's New Multiple Range Test (Duncan, 1955) separated differences among treatment means.

3. Results and Discussions

1. Productive performance

Productive performances of rabbits were significantly improved with increasing the levels of *Moringa peregrine* seeds (MPS) in the diet (Table 2). Rabbits fed diets supplemented with 4 g MPS /kg diet recorded 10.1 % higher (P<0.05) in final live body weight than that of the control group. Live body weight change and daily weight gain were significantly increased in the rabbits of Tr2 by 11.7 % and in Tr3 by 14.3 % as compared to control group. Daily feed intake was increased (P<0.05) in the rabbits of Tr2 by 6 g and insignificantly increased in Tr3 by about 3 g as compared to control group. However, rabbits of Tr3 were improved feed conversion and decreased cost of feeding by 8.7 % and 0.72 L.E., respectively as compared to control group. Finally, growth performance index was increased (P<0.05) in the Tr3 (4 g MPS /kg diet) by 20.6 % and insignificantly increased in the rabbits of Tr2 (2 g MPS /kg diet) by 11.6 % as compared to control group.

Table (2): Productive performance of growing rabbits as affected by moringa seeds supplementation

Traits	Levels of moringa seeds (g/kg diet)			±SE
	0 g (Tr1, control)	2 g (Tr2)	4 g (Tr3)	
Initial live body weight(g)	610.00	610.41	609.16	24.53
Final live body weight (g)	2089.16^{b}	2263.33^{ab}	2300.00^{a}	69.81
Live body weight change (g)	1479.16^{b}	1652.92^{a}	1690.84^{a}	63.97
Daily weight gain (g)	26.41^{b}	29.51^{a}	30.19^{a}	1.14
Daily feed intake (g)	72.82^{b}	78.82^{a}	75.97^{ab}	1.71
Feed conversion	2.75^{a}	2.67^{ab}	2.51^{b}	0.11
CFP (L.E.)	8.25^{a}	8.01^{ab}	7.53^{b}	0.30
Growth performance index	75.96^{b}	84.76^{ab}	91.63^{a}	6.09

CFP=cost of feeding for producing 1 kg live weight

a, b Means bearing different superscripts within the same row are significantly different (P<0.05).

This improvement in productive performance may be due to the increase in feed intake and the improvement in nutrients digestibility of diets. Also, this positive effect may be attributed to the biological function of MPS that have been essential for growth. This could explain the better weight performance of rabbits fed the diet containing MPS. Indeed, the seeds of moringa are rich in minerals such as iron, vitamins A, B, C and E and especially protein with eight essential amino acids (Odeyinka *et al*., 2008, Faye *et al*., 2011 and Dougnon et al., 2012). The author attributed the improvement of rabbit growth to the higher level of vitamin A in moringa, as reported by Grubben and Denton (2004). And/or moringa seed contains natural substances that can promote health and alleviate illness. Moreover, moringa was used as antimicrobial agent (Caceres *et al.,* 1990).

Additionally, the results of this study indicated that moringa *seeds* having medicinal effect in alleviating some health problems associated with nutritional status and its positive effect on productive performances of rabbits (Mahajan *et al.*, 2007).

2. Hematological parameters

The results of hematological parameters in rabbits are shown in Table (3). The results show that red blood cells count, hemoglobin concentration and mean corpuscular hemoglobin concentration increased (P < 0.05) in the rabbits fed 2 g (35.77, 35.90 and 62.98 %, respectively) and fed 4 g (13.82, 14.09 and 33.58 %, respectively) MPS / kg diet as compared to control

group. However, hematocrit % and mean corpuscular volume were decreased (P<0.05) in the rabbits fed 2 g (14.93 and 35.35 %, respectively) and fed 4 g (14.93 and 25.02 %, respectively) than that of control group. This decrease in MCV of rabbits fed different levels of moringa seeds occurred in spite of increase in RBC's and decrease in Ht %. This might indicate an responses efficiency of rabbits fed moringa seeds by increasing surface ratio compared with volume unit so that rapid diffusion of oxygen (Alessandro et al., 2011). White blood cells were significantly higher in the rabbits supplemented with 4 g MPS by 42.37 % as compared to control group.

Table (3): Hematological traits of growing rabbits as affected by moringa seeds supplementation

Traits	Levels of moringa seeds (g/kg diet)			±SE
	0 g (Tr1, control)	2 g (Tr2)	4 g (Tr3)	
RBC's ($\times10^6$/ml^3)	3.69^c	5.01^a	4.20^b	0.13
WBC's ($\times10^3$/ml^3)	5.90^b	6.06^b	8.40^a	0.49
Hb (g/dl)	9.22^c	12.53^a	10.52^b	0.34
Ht (%)	36.83^a	31.33^b	31.33^b	0.92
MCV (fl)	100.07^a	64.69^c	75.03^b	3.09
MCH (pg)	24.97	25.04	25.00	0.40
MCHC (%)	25.10^c	41.16^a	33.53^b	1.87

RBC's, red blood cells; WBC's, white blood cells; Hb, hemoglobin; Ht, hematocrit; MCV, Mean corpuscular volume; MCH, Mean corpuscular hemoglobin; MCHC, Mean corpuscular hemoglobin concentration.
a, b, c Means bearing different superscripts within the same row are significantly different (P<0.05).

The increase in the hemoglobin concentration of rabbits might be due to the fact that MPS is rich in amino acids, vitamins and minerals particularly iron (Subadra *et al.*, 1997 and Faye *et al*., 2011). Jabeen *et al*. (2008) mentioned that the antimicrobial properties of the *Moringa oleifera* seed extracts may be due to lipophilic compounds. These compounds may attach to the cytoplasmic membrane. The authors also suggested that extracts of *Moringa oleifera* seeds may contain antibiotic metabolites, such as carboxylic acid, 2,4-diacetyl phloroglucinol, and cell wall-degrading enzymes and chitinases. The antioxidant effect of *Moringa oleifera* leaf extract and fruit was explained by Luqman *et al*. (2012), who noticed that it was due to the presence of polyphenols, tannins, anthocyanin, glycosides, and thiocarbamates, which remove free radicals, activate antioxidant enzymes, and inhibit oxidases. And/or this increase in RBC's, WBC's and hemoglobin may indicate the role of MPS as contain strong antioxidants such as vitamin C in preventing reduction of oxygen consumption in rabbits through its action on the thyroid gland or protects leukocytes from auto-oxidation (Anderson, 1981; Jaffe, 1984 and Morsy, 2007).

3. Biochemical parameters

Table (4): Biochemical traits of growing rabbits as affected by moringa seeds supplementation

Traits	Levels of moringa seeds (g/kg diet)			±SE
	0 g (Tr1, control)	2 g (Tr 2)	4 g (Tr 3)	
Total protein (g/dl)	4.83	5.19	5.08	0.13
Albumin (g/dl)	2.44^a	2.53^a	2.19^b	0.06
Globulin (g/dl)	2.39^b	2.66^{ab}	2.88^a	0.14
Glucose (mg/dl)	119.40^a	108.85^b	99.14^c	3.54
Cholesterol (mg/dl)	32.42^a	26.15^{ab}	19.25^b	4.19
LDL (mg/dl)	4.33^a	2.01^b	2.22^b	0.33
HDL (mg/dl)	28.17^a	24.14^a	16.31^b	4.18
Triglycerides (mg/dl)	73.36^a	55.71^b	44.06^c	4.01
Total lipids (mg/dl)	343.76^a	171.34^b	218.84^b	30.87
Urea (mg/dl)	45.94^a	41.92^{ab}	38.60^b	1.58
Creatinine (mg/dl)	0.67	0.62	0.71	0.04
ALT (I.U./L)	18.25	17.02	16.29	1.08
AST (I.U./L)	32.16^a	26.42^{ab}	21.38^b	3.40
GGT (I.U./L)	218.06^a	187.82^{ab}	140.60^b	36.17

a, b, c Means bearing different superscripts within the same row are significantly different (P<0.05).
LDL, low density lipoprotein; HDL, high density lipoprotein; ALT, alanine transaminase; AST, aspartic transaminase; GGT, glutamyle transferase

Results of Table (4) show that albumin, glucose, cholesterol, LDL, HDL, triglycerides, total lipids, urea, aspartic transaminase and GGT concentrations were decreased (P < 0.05) in the rabbits fed 4 g MPS by

10.24, 16.96, 40.62, 48.72, 42.10, 39.94, 36.33, 15.97, 33.51 and 35.52 %, respectively as compared to rabbits of control group. On the other hand, the values of glucose, LDL, triglycerides and total lipids were decreased (P<0.05) in the rabbits of Tr2 by 8.83, 53.57, 24.05 and 50.15 %, respectively as compared to control group. However, globulin level was significantly increased in rabbits Tr3 by 20.50 % as compared to control group. No significant differences in total protein, creatinine and alanine transaminase levels were observed between treatments.

This decrease in glucose level of rabbits treated with 2 g and 4 g MPS/kg diet is in agreement with the findings of Jaiswal *et al.* (2009), who reported that blood glucose level decreased after administration of *Moringa oleifera* aqueous leaf extract to rats. This may suggest that MPS may have an insulin-like effect on peripheral tissues either by promoting glucose uptake and metabolism or by inhibiting gluconeogenesis. It is likely that the MPS has some effect of increasing the tissue utilization of glucose (Jabeen *et al*., 2008 and Luqman *et al*., 2012) by inhibiting hepatic gluconeogenesis or absorption of glucose into the muscles and adipose tissues (Desta *et al*., 2011 and Kamanyi *et al*., 1994). Similarly, this decrease in blood cholesterol level is in agreement with the study reported for *Moringa oleifera* leaf extract that showed hypocholesterolemic activity (Ghasi *et al*., 2000 and Pari and Kumar, 2002). It was reported that the mechanism of cholesterol reduction is thought to be through the lowering of plasma concentrations of LDL by B-sitosterol, the bioactive phytoconstituent isolated from *Moringa oleifera* (Ghasi *et al*., 2000, Saluja *et al*., 1978 and Kane and Malloy, 1982). Therefore bsitosterol or a similar constituent in the MPS may be responsible for this effect as well. The non-significant (P>0.05) effect of MPS on creatinine and alanine aminotransferase and/or significant decrease of MPS (Tr3) on urea, aspartic aminotransferase and glotamyle transferase (GGT) is an indication that the fed rabbits with MPS have no untoward effect on the health status of the rabbits (Teshome *et al*., 2001) and/or this might be an indication of the non-toxic action of MPS on the body metabolism of the rabbits.

***In conclusion*,** the result of this study showed that *Moringa peregrine* seeds (MPS) can be used at level 2 or 4 g/ kg diet to enhance productive performance and this was indicated in this study by its positive effect on some blood parameters and growth performance index of the growing California rabbits.

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