THE EFFECT OF *MORINGA OLEIFERA* LEAVES AS A FEED ADDITIVE ON GROWTH PERFORMANCE, CARCASS CHARACTERISTICS, BLOOD PARAMETERS AND ECONOMICAL EFFICIENCY IN MULARD DUCKS

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SUMMARY

A total number of 150 unsexed seven day old Mulard ducks were randomly classified into three equal groups of 5 replicates (10 ducklings each). The 1st group received the basal diet and served as control group (G1). The other two groups (G2 and G3) received the basal diet supplemented with *Moringa oleifera* as feed additive at the level of 1 and 2%, respectively till age 10 wks. The results showed that dietary *Moringa oleifera* leaves (MOL) at 1% significantly increased the final body weight by 9.5%, the daily body weight gain by 9.4% and the daily feed intake by 6.14%, respectively compared to the control group. *Moringa oleifera* at 2% significantly decreased the final body weight by 6.7%, the body weight gain by 7.0% and the feed conversion ratio by 7.9%, while showed significant increase in liver weight by 1.6%, the gizzard weight by 13.2%, the giblet weight by 7.5%, the edible parts by 6.4% and the non edible parts by 13.3%, respectively compared to the control group. Feeding MOL at 1% significantly increased the total protein by 13.7%, the albumin by 20.5% and the globulin by 7.4% respectively, compared to the control group. Dietary MOL at 1 and 2% MOL significantly decreased the cholesterol level by 39 and 25%, the triglycerides by 41.3 and 16%, the total lipids by 23.5 and 19.6% as well as decreased the alkaline phosphatase activity by 64.2 and 28.1%, the AST by 31.3 and 41.5% and the renal creatinine by 23.5 and 19.6% respectively, compared to the control group as well as the ALT significantly ($P<0.05$) decreased by 35.8 with 1% MOL while increased by 18.2% with 2% MOL. It could be concluded that 1% of MOL levels was better results than 2% level.

Keywords*: Mulard ducks, Moringa oleifera L, growth performance, carcass characteristics and blood parameters.*

INTRODUCTION

The global poultry industry is exposed to many obstacles, the high prices of feed ingredients is the most important (Abbas, 2013), therefore it is necessary not only to find a cheap sources of protein or energy, but also to search the high feed additives in medicinal value or high quality in protein, energy and vitamins as an attempt to dismantle some of those obstacles especially in the developing countries. *Moringa oleifera Lam*., belonging to the Moringaceae family is being investigated for its high nutritional value, fast growth and utilization as a livestock fodder crop (Nouman *et al*., 2013) and for its health multipurpose (Worku, 2016). *Moringa oleifera Lam*., contains 30.3% crude protein included 19 amino acids (Moyo *et al*., 2011), 2273–2978 kcal/kg dry matter metabolisable energy (Olugbemi *et al*., 2010), vitamins (A, B, C, and E), 0.6–11.2% minerals (Mbora *et al*., 2004), 1.28-4.96% lipids (Mehta *et al*., 2003), 30.97-46.78% fiber (Dalia *et al*., 2009) and high level of flavonoids as antioxidants (Vongsak *et al*. 2013) that used in treating malnutrition, fever, headaches, nerve pain, and diabetes (Ndong *et al*., 2007). *Moringa oleifera Lam*., is characterized by high medicinal value provides a rich and rare combination of zeatin, quercetin, sitosterol, caffeoylquinic acid and kaempferol (Upadhyay *et al*., 2015). *Moringa oleifera Lam* improved nutrition, boosted food security, fostered rural development support sustainable land care, and foraged for livestock (Makkar *et al*., 2007). *Moringa oleifera Lam* is expected to serve as good bio-resource for generating a readily available herbal formulation that might be equally potent and cost effective than the conventional synthetic drugs (Mittal *et al*., 2003) and therefore it's considered the *miracle tree* and God's gift to human (Mbikay 2012). Our theoretical hypothesis, the high nutritional value of MOL may be able to overcome the high prices of feed components and improve the growth performance. The objective of this study is to study the effect of 1 and 2% levels of MOL as a

nutritional supplement on growth performance, carcass characteristics and some blood parameters of growing Mulard ducks.

MATERIALS AND METHODS

Experimental Animals and Feeds

This experiment was carried in Nubaria Research and Production Station, National Research Centre. A total number of 150 Mulard ducks, 7 days old (commercial strains resulting from cross breeding between male Muscovy ducks and female Pekin ducks) were used with an average body weight of 222.5 ±1.2 g. Ducks were randomly assigned to three equal experimental groups, each containing 5 replicate pens with 10 birds per each. *Moringa oleifera Lam*., MOL (Moringaceae family) used in this work is a grinding dried leaves as feed additive. The experimental groups were classified as follow: The 1st group received the basal diet and served as control group (G1). The other two groups (G2 and G3) received the basal diet supplemented with *Moringa oleifera L* as feed additive at the level of 1 or 2%, respectively till age 10 wks during the growth period (63 days). Basal starter (1-4 wks.) and finisher (5-9 wks.) diets were formulated to cover the nutrient requirements of ducks according to NRC (1994) and calculated analysis are shown in (Table 1). Drinking and feeders were supplied for each pen and offered *ad libitum*. Ducks of all pens were kept under the same managemental conditions and were grouped weighed and feed consumption per pen was recorded bi-weekly during the experimental period.

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

Ingredient	Starter % (0-4 wks)	Finisher % (5-10 wks)
Yellow corn	63.85	72.0
Soybean meal (44%)	25.80	21.2
Broiler protein concentrates* (52%)	10.00	5.0
Di calcium phosphate	00.35	1.0
Limestone	-	0.45
Vit. and Min.premix**	-	0.15
DL.Methionine	-	0.05
Salt	-	0.15
Total	100	100
Calculated analysis		
Crude protein %	22	18
ME (Kcal/ kg)	2900	3000
Lysine	1.14	0.91
Methionine%	0.44	0.40
Calcium	0.96	0.73
Av.phosphorus	0.48	0.40

** Broiler concentrate 52% crud protein supplied the following of the diet(kg) Vit A, 12000 IU, Vit D3 2000 IU, Vit E 10mg, Vit K 2mg, Vit B11 mg, Vit B2 4mg, Petothenic acid 10 mg, Folc acid 1mg, Niacin 20MG, Vit B6 1.5 mg, Vit B12 0.01mg, Biotin 0.05 mg, Choline Chloride 500mg, Fe 3mg, Ze 1.1mg, Min 55mg, Cu 5mg, Se 1mg.*

** * Each 3kg of the Vit and Min premix manufactured by Agri-Vit. Company, Egypt contains: Vitamin A 10 MIU, Vit D2 MIU, Vit E 10g, Vit k 2g, Tiamine 1g, Riboflavin 5g, Pyridoxine 1.5g, Niacin 30g, Vit.B12 10mg, Pantothenic acid 10g, Folic acid 1.5g, Biotin 50mg, Choline chloride 250g,Manganese 60g, Zinc 50g, Iron 30g, Copper 10g, Iodine 1g, Selenium 0.10g, Cobalt 0.10g and carrier CaCO3 to 3000g.*

Biochemical blood analysis

At the end of the experiments, three ducks from each group were slaughtered after fasting overnight (10 hrs). Blood was collected in heparinized test tubes and centrifuged immediately for 10 min. at 3000 rpm and obtained plasma was rapidly frozen until biochemical analysis. Plasma samples were analyzed to detect the activities of kidney function through blood level of creatinine and liver function through alkaline phosphatase, aspartase aminotransferases and alanineaminotransferases (ALT & AST) concentration. Total protein, albumin and globuline were estimated by subtracting the difference between them. Total lipids, triglyceride and cholesterol were also determined. Specific diagnostic kits (Bio Meriex, France) were used according to the recommendations mentioned by Bogin and Keller (1987).

Carcass characteristics measurements

Three representative ducks from each treatment were randomly chosen and fasted for 12 hours before slaughtering according to Blasco *et al.* (1993), to determine the carcass measurements. The non edible and edible offal's include head, gizzard, liver, spleen, heart, and kidneys were removed, then individually weighed and calculated as percentages of carcass relatively to live body weight.

Statistical analysis

Collected data were subjected to statistical analysis as one way analysis of variance using the general linear model procedure of SPSS (1998). Duncan's Multiple Range Test (1955) was used to separate means when the dietary treatment effect was significant according to Duncan (1955).

Economical efficiency

The economical efficiency of the experimental diets were calculated according to the local market price of ingredients and duck live body weight as following: Net revenue = total revenue-total feed cost. Economical efficiency (%) = (net revenue/ total feed cost) x 100

RESULTS AND DISCUSSION

Growth Performance

Supplementation of MOL at 1% significantly (P<0.05) increased the final body weight by 9.5%, the daily body weight gain by 9.4% and the daily feed intake by 6.14%, respectively compared to the control group (Table 2). These results may be due to the highest antioxidant content and high nutritional value of MOL (Karthivashan *et al*., 2013), its rich protein source (Kakengi *et al*., 2007), protein absorption improvement effects (Wei Lu *et al*., 2016) or to its antibiotic effect (Ologhobo *et al*., 2014). Similar results showed that feeding MOL leaves improved the growth performance of goats in an almost similar way, which indicates that MO, could be used as an alternative protein supplement for goats (Moyo *et al*., 2012), for rabbits (Safwat *et al*., 2014) and for chickens (Donkor *et al*., 2013). Supplementation of MOL at 2% level significantly (P<0.05) decreased the final body weight by 6.7%, the body weight gain by 7.0%, the daily body weight gain by 7.0% and the feed conversion ratio by 7.9% compared to the control group (Table 2). These results confirm that MOL had a significant increase effect on body weight in a dose-dependent manner (Oyagbemi *et al*., 2013), which may be due to the rich fairly unique group of glucosinolates and isothiocyanates compounds in MOL (Khalafalla *et al*., 2010), or to the benzylamine metabolize content in MOL that has insulin-mimicking action and lipolysis inhibition (Iffiú-Soltész *et al*., 2010), or to the lower fat accumulation and body mass (Waterman *et al*., 2015), or to the cardiac toxicity induced by the effect of N, α-L-rhamnopyranosyl vincosamide in MOL (Cheraghi *et al*., 2017). Similar results in Rhode Island Red hen showed that fresh MOL had lower values of body weight, egg laying rate, egg weight and egg mass, and recorded better feed conversion ratio (Abou-Elezz *et al*., 2012) and in mice and rats (Kumbhare *et al*., 2012).

Table (2): Growth performance as affected by different levels of dietary *Moringa oleifera.*

Item	Control	*Moringa oleifera Lam*	
		1%	2%
Initial body weight g	225.6 ±0.93 a	222.0±1.1 b	220.0±1.5 b
Final body weight g	3910±34.6 b	4280±53 a	3750±12.5 c
Body gain g	3684±16.3 b	4058±0.11 a	3530±0.26 c
Daily body gain g	58.5±0.33 b	64.4.±0.41 a	56.0±0.27 c
Total feed intake g	12928±96 b	13721±92.6 a	12995±38.2 b
Daily feed intake g	205.2±0.27 b	217.8±0.69 a	206.3±0.66 b
F.C.R ratio	3.51±0.02 b	3.38±0.02 b	3.68±0.02 a

a, b, Means within each row in each parameter which have different superscripts differ significantly (P<0.05).

Carcass Characteristics

Supplementation of MOL as feed additive at 2% significantly (P<0.05) increased the Liver weight by 1.6%, and the gizzard weight by 13.2%, the giblet weight by 7.5%, edible parts by 6.4% and non edible

parts by 13.3%, respectively compared to the control group (Table 3). These results may be due to the ability of MOL in regeneration of damaged hepatocytes and pancreatic β cells via its antioxidant properties (Abd El Latif *et al*., 2014), or to exert their effects by inhibiting rate-limiting steps in liver gluconeogenesis resulting in increase in insulin signaling and sensitivity (Waterman *et al*., 2015). Similar results showed that the hot carcass weight and the dressing percentage were significantly higher for MOL treatment (Moyo *et al.,* 2012).

Table (3): Carcass characteristics as affected by different levels of dietary *Moringa oleifera.*

Item	Control	Moringa oleifera Lam	
		1%	2%
Carcass weight / Live weight %[1]	71.6±0.35 a	71.0±0.28 a	69.3±0.37 b
Liver weight %	3.89±0.06 b	2.81±0.02 c	4.40±0.06 a
Gizzard weight %	3.72± 0.02b	3.33± 0.04c	4.21± 0.08a
Heart weight %	1.35±0.01 a	1.09±0.01 b	1.02±0.01 c
Giblet weight %	8.96±0.07 b	7.22±0.08 c	9.63±0.14 a
Edible %	8.95±0.07 b	7.19±0.08 c	9.53±0.12 a
Non edible %	30.8±0.6 b	33.6±0.5 a	34.9±0.7 a

a, b,c,d, Means within each row in each parameter which have different superscripts differ significantly (P<0.05).

*1-Carcass %: Weighed and calculated as a percent of live body weight. * Giblets include (head, gizzard, liver, spleen, heart, sex organs and kidneys). Organs %: Weighed and calculated on the basis of the proportion to 100 grams of carcass.*

Blood biochemical Analysis

Supplementation of MOL at 1% significantly (P<0.05) increased the total protein by 13.7%, the albumin by 20.5% and the globulin by 7.4%, respectively compared to the control group (Table 4). Supplementation MOL at 1% may promote feed utilization as reflected by increased feed intake and final body weight in growing ducks. Increased feed utilization may also increase hepatic protein synthesis and subsequently blood protein level as was confirmed in the present results. Meanwhile, supplementation MOL at 2% had a depressive effect on feed intake, daily gain, feed conversion and blood protein which may be due to the toxic substances present in MOL under relatively higher concentration. Also, these

Table (4): biochemical blood parameters as affected by different levels of dietary *Moringa oleifera.*

Item	Control	*Moringa oleifera Lam*	
		1%	2%
Total protein g/dl	6.00±0.12 b	6.82±0.22 a	5.97±0.09 b
Albumin g/dl	2.88±0.01 b	3.47±0.13 a	3.04±0.04 b
Globulin g/dl	3.10±0.12 b	3.36±0.18 a	2.92±0.07 b
A/G ratio	0.92±0.05	1.04±0.26	1.04±8.01
Cholesterol mg/dl	138.6±4.44 a	84.5±5.94 c	104.1±8.01 b
Triglycerides mg/dl	168.4±7.75 a	111.3±6.14 c	141.4±7.64 b
Total lipids mg/dl	628.6±26.1 a	509.4±10.1 b	511.0±52.6 b
Creatinie mg/dl	0.51±0.04 b	0.39±0.03 c	0.41±0.03 a
Alkaline phosphatase Iu/dl	40.5±6.63 a	14.5±3.93 c	29.1±3.5 b
AST L / Iu/L	51.3±5.51 a	35.2±4.8 b	30.0±1.29 c
ALT L / Iu/L	30.7±4.62 b	19.7±2.59 c	36.3±4.62 a

a, b, Means within each row in each parameter which have different superscripts differ significantly (P<0.05).

results may be due to the enhanced humoral immune response induced by the rich several phytoconstituents in MOL (Aja *et al*., 2014) as shown in rats by (Sharma *et al*., 2013), or may be due to the abundance of calcium and vitamin A present in MOL (Leone *et al*., 2015) as shown in hen egg albumen and Haugh unit by (Wei Lu *et al*., 2016) as well as may be due to the decreasing of protein glycation and protein oxidation as reflected by polyphenols presence in MOL (Al-Malki and El Rabey 2015). Supplementation MOL at 1 and 2% significantly (P<0.05) decreased the cholesterol level by 39

and 25%, the triglycerides by 41.3 and 16% and the total lipids by 23.5 and 19.6%, respectively compared to the control group (Table 4). These results may be due to the reducing oxidative stress and advanced glycation thereby maintaining lipid homeostasis (Sangkitikomol *et al*., 2014), or may be due to less inflammation and lower hepatic stellate cells involved in the progression of liver fibrosis (Leone *et al*., 2016). Other results showed that MOL has hypocholesterolemic activity (Ghasi *et al*., 2000). Similar results showed that MOL increase the excretion of rabbit's faecal cholesterol and possesses a hypolipidemic effect (Mehta *et al*., 2003). With regard to the hepatic function, dietary MOL at 1 and 2% % significantly ($P<0.05$) decreased the alkaline phosphatase activity by 64.2 and 28.1%, the AST by 31.3 and 41.5% as well as ALT significantly ($P<0.05$) decreased by 35.8 with 1% MOL while increased by 18.2% with 2% MOL, respectively compared to the control group (Table 4). These results may be due to the effective role of MOL of ameliorated liver fibrosis and reduces liver damage as shown in rats (Hamza, 2010) or may be due to the crucial role of MOL in liver folate metabolism and expresses almost all the genes related to folate metabolism and homeostasis (Saini *et al.*, 2015). Similar results showed higher aspartate aminotransferase activity concentration in laying hens by using MOL (Wei Lu *et al*., 2016). With regard to the renal function, supplementation MOL at 1 and 2% % level significantly ($P<0.05$) reduced the creatinine by 23.5 and 19.6%, respectively compared to the control group (Table 4). This result may be due to that MOL has ability in reducing the elevated urinary oxalate by the antioxidant enzymes effect in the kidneys as reported in male rats by Al-Malki and El Rabey (2015) Similar results showed lower uric acid concentration in laying hens by using MOL (Wei Lu *et al*., 2016).

Economical efficiency

The economical efficiency of MOL dietary treatments is presented in Table (5). The profitability of using MOL as a feed additive depends upon the price of tested diets and the growth performance rate of ducks fed these diets. Supplementation MOL as a feed additive at 1% and 2% achieve superiority in profitability estimated by 18.6 and 9.3 L.E. compared with 27.1 LE / duck in the control group. These results explain the lower profitability for the MOL treatments which attributed to the high price of one kg MOL and the high level 2%.

Table (5): Economic efficiency as affected by different levels of dietary *Moringa oleifera.*

Item	Control	*Moringa oleifera Lam*	
		1%	2%
Marketing weight, Kg	3.910	4.280	3.750
Feed consumed as it is / duck, kg	12.928	13.721	12.995
Costing 1Kg feed + additive (LE)1	8.00	9.00	10.00
Feed cost, (LE)	103.4	123.5	116.9
Management / duck, (LE)2	1.5	1.5	1.5
Costing of 7 days age chick, (LE)	12	12	12
Total cost, (LE)3	116.9	137	130.4
Total revenue, (LE)4	148.6	162.6	142.5
Net revenue	31.7	25.5	12.1
Economical efficiency5	27.1	18.6	9.3
Relative economic efficiency6	100	68.6	34.1

1 Based on prices of year 2017. 2 Include medication, vaccines, sanitation and workers/duck 1.5 LE.

3 Include the feed cost of experimental duck 4 Body weight x price of one kg at selling which was 38LE.5 net revenue per unit of total cost. 6 Assuming that the relative economic efficiency of control diet equal 100. LE: Egyptians pound (local money).

CONCLUSIONS AND RECOMMENDATION

Future researches should be conducted at the levels below 1% to avoid exposure to toxic substances as glucosinolates and isothiocyanates compounds and to the high price of *Moringa oleifera L* leaves that induced the increasing of feed consumed cost by one or two thousands LE per ton at the two levels (1 and 2%). Using of MOL at 1% achieved significant increased in the final body weight, the body weight gain in comparison with the unfavorable results at the 2% of MOL.

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تأثير اضافة أوراق المورينجا كمضاف غذائى على مظاهر النمو، خواص الذبيحة، صفات الدم والكفاءة الاقتصادية فى البط المولار

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يهدف هذا البحث الى دراسة اضافة أوراق المورينجا كنبات عالى القيمة الغذائية على الأداء الانتاجى وصفات الذبيحة وكذلك قياسات الدم والجدوى الاقتصادية للبط المولار. استخدم في هذه الدراسة عدد 150 بطة مولار عمر سبعة أيام تم تقسيمها عشوائيا إلى ثلاث مجموعات متساوية كل مجموعة منها خمس مكررات (كل منها 10 بطات). تم تغذية المجموعة الأولى على العليقة الأساسية واستخدمت كمجموعة مقارنة، أما المجموعتان الثانية والثالثة تم اضافة أوراق المورينجا للعليقة الأساسية بنسبة 1% و 2% على التوالى وذلك حتى عمر عشرة أسابيع. أوضحت النتائج أن إضافة أوراق المورينجا للعليقة الأساسية بمقدار 1% تسبب في زيادة معنوية لوزن الجسم النهائي بنسبة 9,5% ولمعدل النمو اليومي بمقدار 9,4% ولمعدل الغذاء المأكول يومياً بمقدار 6,14% على التوالي قياسا بمجموعة المقارنة. ولقد أوضحت النتائج أن إضافة أوراق المورينجا بنسبة 2% تسبب في نقص معنوي لوزن الجسم النهائي بمقدار 6,7% ولمعدل الزيادة اليومية للوزن بمقدار 7% ولكفاءة التحويل الغذائي بنسبة 7,9% بينما في نفس الوقت تسببت في زيادة معنوية لوزن الكبد بمقدار 1,6% ولوزن القانصة بنسبة 13,2 ولوزن الأجزاء المأكولة من الذبيحة بنسبة 7,5% والغير مأكول بنسبة 13,3% على التوالي قياسا بمجموعة المقارنة. كما أوضحت النتائج أيضا أن إضافة 1% من أوراق المورينجا تسبب في زيادة معنوية لبروتين بلازما الدم بنسبة 13,7% وللألبيومين بنسبة 20,5% والجلوبيولين بنسبة 7,4% على التوالي قياسا بمجموعة المقارنة. بينما أوضحت النتائج أن إضافة أوراق المورينجا بنسبة 1, 2% تسببت في نقص معنوي لمستوى كوليسترول الدم بنسبة 39، 25% وللجلسريدات الثلاثية بنسبة 41,3 و 16%وللدهون الكلية بنسبة 23,5 و 19,6% وكذلك لنقص في نشاط انزيم الفوسفايز القاعدي بنسبة 64,2 و 28,1% و كذلك لنقص فى الأسبارتيت أمينو ترانسفيريز بنسبة 31.3% و41.5% كما حدث نقص معنوى فى نشاط انزيم اللآنين أمينو ترانسفيريز عند اضافة مستوى 1% من أوراق المورينجا بنسبة 35.8% ولكن عند اضافة مستوى 2% حدثت زيادة معنوية قدرها 18.2% . كما انخفضت نسبة الكرياتنين بنسبة 23,5%، 19,6% على التوالي قياسا بمجموعة المقارنة. توصى هذة الدراسة باستخدام أوراق المورينجا بنسبة 1% وكذلك توصى بدراسة مستويات أقل من ذلك لتجنب كلاً من سمية نبات المورينجا وسعره المرتفع حيث أن الدراسة أوضحت أن مستوى 1% من المورينجا كان أفضل من مستوى 2%.