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Moringa Oleifera Leaves in Broiler Diets: Effect on Chicken Performance and Health

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Abstract
Moringa products have a wide range of applications in agricultural, industrial and pharmaceutical processes. Moringa leaves have a relatively high crude protein content which varies from 25% to 32%. A high proportion of this protein is potentially available for digestion due to a high proportion of pepsin soluble nitrogen (82-91 %) and low proportion (1-2%) of acid detergent insoluble protein.Determination of chemical composition was evaluated in Moringa Leaves then Five iso-nitrogenous and iso-caloric experimental broiler diets were formulated as MOL0%, MOL5%, MOL10%, MOL15% and MOL20%, respectively and supplemented to broilers (10 chicks in each concentration) for 42 day. After 42nd day, chemical analysis of lipid profile(triglycerides, total cholesterol, HDL, LDL and vLDL), and haematological analysis(Hb, RBC, PCV, MCV, MCHC, Plt, MPV, PCT, PDW, WBC, LYM, MON, GRA) were recorded. Also tissue sampling from Bursa, Spleen, and Thymus were collected and preserved in 10 % formalin for histopathological examination. The obtained values were statistically analysed by one way analysis of variance (ANOVA) The chemical composition was determined in *Moringa oleifera* leaves, were ash, crude fiber, crude lipids, crude protein, total sugars, reducing sugar and non-reducing sugars. The highest effect of supplementation of *moringa oleifera* poultry diets on body weight of broiler, were 2293, 2318 and 2391gm, of treatments (10, 15 and 20% of MOL), respectively. Also, the more effective treatment were 20% of MOL of blood biochemical, lipid profile (triglycerides, total cholesterol, HDL, LDL and vLDL) and haematological parameters (HB, RBCs, Plt and WBCs), comparing with normal diets, histopathology of Bursa, Thymus, and Spleen showed improvement and hyperactivity in 15% and 20% MOL. Therefore, it is recommended to add *Moringa oleifera* at 15% and 20% in broiler diets to improve performance and health.
Keywords: Broiler, Diets, Performance, Moringa

INTRODUCTION

Medicinal plants having various phytochemicals and bioactive components such as trace metal ions, vitamins, alkaloids, carotenoids, polyphenols, fats, carbohydrates, and proteins are involved in enhancing long-term health benefits. **Sravanthi and Rao (2014).**

Moringa oleifera commonly known as (family: Moringaceae) horse radish tree or drumstick tree is both nutritional and medicinal with some useful minerals, vitamins, amino acids. Almost all the parts of this plant: root, bark, gum, leaf, fruit, Leaves, seed and seed oil have been used for various ailments in the indigenous medicine of South Asia, including the treatment of inflammation and infectious diseases along with cardiovascular, gastrointestinal, hematological and hepatorenal disorders.

Administration of *Moringa oleifera* leaf extract inhibited the growth of pathogenic gram positive and gram negative bacteria and antioxidant activity. **Sreelatha and Padma(2009).** There has been an increased interest in the utilization of the *M. oleifera*, in improving of ruminants farming and poultry performances. **(AbouSekken, 2015).** The growing popularity of the use of *Moringa oleifera* as a feed additive in poultry nutrition necessitates through investigation into its nutritional value, as well its impact on haematological parameters as a measure of both nutritional and medicinal benefits of the leaves in broiler chicks.

Moringa oleifera leaves incorporated into maize meal poultry feed led to better growth performance of the chicks and a significant increase in the serum level of biochemical minerals compared to the maize meal feed alone. Several studies have reported that the use of *Moringa oleifera* leaves as feed supplements in livestock, the optimal concentration of *Moringa oleifera* leaves as a nutritional supplement has not yet been determined and there are only limited reports on the bioactive constituents of *Moringa oleifera* leaves and their impact on meat antioxidant status **Hassan *et al.*, (2016).**

The objective of this study was to examine the effect of various levels of *Moringa oleifera* leaves meal as a new source of antioxidant on productive and physiological parameters of broiler chicks under heat stress condition.

MATERIALS AND METHODS

Moringa Plant

Leaves sample were air dried in the shade and ground into a fine powder. Leaves were kindly obtained from Agricultural Research Center, Giza, Egypt.

Chemical composition of investigated Leaves:

Determination of moisture content: Moisture content was determined according to the method described by **AOAC (2000).** A known weight of air dried Leaves (2g) was dried at 105°C in an air drying oven to a constant weight. Percentage of moisture content was calculated**.**

Determination of ash content: Ash content was determined according to **AOAC (2000),** as follow: Exactly 2g of air dried Leaves ere placed in a silica crucible and ignited at 600ºC in a muffle furnace till a constant weight, the percentage of ash content was calculated.

Determination of crude fiber content: Crude fiber is a mixed material and defined as the sum of lignin and polysaccharide contents which not digested by dilute acid and alkali. Crude fiber was estimated according to the method described by **AOAC (2000).** A known weight of the air dried Leaves (2g) was mixed with 0.5g asbestos, then 200ml of sulphuric acid (1.25%v/v H2SO4), were added. The mixture was boiled under reflex for 30 minutes, followed by filtration through Gooch crucible. The residue was boiled again with aqueous sodium hydroxide solution (200ml, 1.25%w/v NAOH) for 30 minutes, then filtration was repeated in the same manner. Finally the residue was washed with hot water followed by diethyl ether and dried at 110ºC to constant weight. The content of Gooch crucible was then ignited in the muffle furnace at 600ºC to a constant weight. Fiber content was calculated by subtraction of ash content from the weight of digested sample. Percentage of crude fiber content was then calculated.

Determination of crude protein content: Crude protein content was determined by the official Kjeldahl method described in **AOAC (2000),** as follow: A known weight of air dried Leaves (0.5g) was digested with 8ml. of concentrated sulphuric acid in Kjeldahl flask in the presence of (2.14g) digestion mixture [1kg potassium sulphate and 60g of mercuric oxide (red)]. After digestion the solution was treated with 10ml. of 40% sodium hydroxide solution. The liberated NH_3 was received into 10ml. of 1% boric acid in the presence of 2 drops of Tachero indicator (1.25g methyl red+0.32g methylene blue in one litre of 90% ethanol). The received ammonia was titrated with 0.01N sulphuric acid. The percentage of total nitrogen was estimated and the crude protein content was calculated by using 5.25 as a factor of protein. Erian *et al.,* (1994).

Determination of crude lipid: Crude lipid of air dried Leaves were determined according to **AOAC (2000).** A known weight of air dried Leaves (2g) was extracted in soxhlet apparatus using n-hexane as a solvent for 24 hours. Then the solvent was removed and percentage of crude lipid was calculated.

Determination of soluble carbohydrate content: The carbohydrate contents were determined with a slightly modified phenol–sulphuric acid method according to **Masuko *et al.*, (2005).** The colour reaction was initiated by mixing 50µml of crude polysaccharide solution with 150µml of concentrated sulphuric acid, followed immediately with 30µml of 5% phenol, and the reaction mixture was kept at 90C for 5 min. After cooling to room temperature, the absorbance of the mixture was measured at 490 nm, using a Spekol 11 (Carl Zeiss-Jena) spectrophotometer. The total carbohydrate content was calculated with D-glucose as standard.

Determination of reducing sugar: The reducing sugar was determined by the modified method of **Miller., (1959).** Briefly, 0.5 ml of 1% 3,5-dinitrosalicylic acid (DNS) was added to an aliquot of sample (20–500 µml), and the volume adjusted to 5 ml with distilled water. After shaking, the mixture was heated in boiling water for 5 min and cooled to room temperature; 2.5 ml of distilled water were added to the mixture. The absorbance was measured at 540 nm, using a Spekol 11 (Carl Zeiss-Jena) spectrophotometer. And the total reducing sugar was calculated with D-glucose as a standard reducing sugar.

Calculation of Non-reducing sugars: Insoluble sugars were calculated according to the following equation: Nonreducing % = Total sugars % - reducing sugars %

Experimental animals:

Fifty healthy broiler chicks weighing 38-40gm were obtained from Science Academy of Experimental Researches, Mansora, Egypt. Chicks were housed in a battery system and each of the replicate of two birds was put in a separate cages and left in a good environmental conditions for acclimatization.

Experimental protocol:

Five iso-nitrogenous and iso-caloric experimental broiler diets were formulated and designated as MOL 0%, MOL 5%, MOL 10%, MOL 15% and MOL 20%, respectively **Zanu et al., (2011).** Five experimental groups were classified with 10 chicks in each as following;

Group1: 10 broiler chicks fed normal diets without *Moringa* (0% MOL *Moringa*).
Group2: 10 broiler chicks fed normal diets + 5% *Moringa* (5% MOL *Moringa*).
Group3: 10 broiler chicks fed normal diets + 10% *Moringa* (10% MOL *Moringa*).
Group 4: 10 broiler chicks fed normal diets+ 15% *Moringa* (15% MOL *Moringa*).
Group 5: 10 broiler chicks fed normal diets+ 20% *Moringa* (20% MOL *Moringa*).

After one week of acclimatization, the five experimental diets were randomly assigned and fed to the chicks *ad libitum* for a total of six weeks (42 days).

Body weight

From each group 10 Broiler were weighted individually at the start of the experiment and after 14 day post supplementation (corresponding 42thday) and consumed diets were recorded for calculation of weight gain and feed conversion rate. **Allam *et al.*, (2016).**

Blood samples

Samples were collected from the eye canthus by heparinized tubes after 42 days from the beginning of the experiment. Then, each blood sample was divided into two portions. First portion was centrifugation to obtain the blood serum. Serum samples were kept at refrigerator under freezing conditions for determination of the lipid profile (Triglycerides, total cholesterol, HDL-c, LDL-c and VLDL-c). Second portion was treated with 10% of ethylene diamine tetracetic acid (EDTA) with a good shaking to determine complete blood count (CBC) as a haematological analysis.

Chemical analysis of blood:

Lipid profile (triglycerides, total cholesterol, HDL, LDL and vLDL) were determined by enzymatic colorimetric method of **Richmond (1973)** described in a commercial kits by Human (Germany).

Haematological analysis (Hb, RBC, PCV, MCV, MCHC, Plt, MPV, PCT, PDW, WBC, LYM, MON, GRA) were through using apparatus namely ABX Micros 60 which a fully automated Haematological analyzer from Sysmex Corporation International Company according to **Nakul *et al.*, (2003).**

Histological observations:

Representative tissue samples from Bursa, spleen, and thymus from all the experimental groups were taken after the end of the experiment (six week) to study the histological changes associated with the different diets. Samples were fixed in a 10% formalin-saline solution before preparing the histological sections using paraffin method technique. All sections were dehydrated in ascending grades of ethanol, cleared in xylene and then embedded in paraffin wax. Transverse sections (4-5 microns, thickness) were taken, mounted on glass slides and stained with haemotoxyline and eosin (H and E) stains. All sections were microscopically examined **Bancroft *et al.*, 2012**.

Statistical analysis

Statistical analyses of all experimental data were done using the statistical software package **(CoStat, 2005).** All comparisons were first subjected to one way analysis of variance (ANOVA) and significant differences between treatment means were determined using Duncan's multiple range test at $P<0.05$ as the level of the significance (**Duncan, 1955)**.

RESULTS and DISCUSION

Chemical composition of investigated leaves:

As showed in table (1) the percentages of moisture content for air dried investigated leaves was 9.35% for *Moringa oleifera.* These result were in accordance with those obtained by **Peter and Philip (2014),** who found that The moisture content for raw sample (9.97± 0.09%) was significantly higher when compared with the defatted (9.40±0.10%). Also, our findings coincided with those obtained by **Sodamade *et al.*, (2013),** who found that the percentage of moisture was 9.00% for *Moringa oleifera* leaves. While, the results were lower than those reported by **Nadeem et al., (2013),** who stated that percentage of moisture was 13.92% for *Moringa oleifera leaves*.

Table (1) Chemical composition of investigated Leaves:-

Plant Leaves Extract	Moisture %	Ash %	Fiber %	Protein %	Lipid %	Total sugars %	Reducing sugars %	Non reducing sugars %
Moringa oleifera	**9.35**	**5.89**	**17.41**	**25.37**	**2.44**	**39.02**	**13.62**	**21.40**

Furthermore, ash, crude fiber, crude lipids, crude protein, total sugars, reducing sugar and non-reducing sugars were determined in *Moringa oleifera leaves*. All results were calculated as (g/100g dry weight) and recorded in table (1).

Data in table (1) showed that *M. oleifera leaves* have the percentage values for ash, crude fiber, crude lipids, crude protein, total sugars, reducing sugar and non-reducing sugars, which were 5.89, 17.41, 25.37, 2.44, 39.02, 13.62 and 21.40%, respectively.

Previous data were in agreement with those reported by **Sodamade *et al.*, (2013),** who found that the percentage values for ash, crude fat, and total carbohydrate which were 6.00, 2.43 and 38.21g/100g on dry weight basis for *Moringa oleifera leaves*. While, not in the same line with those others for crude fiber and crude

protein were 5.43 and 39.13%, respectively.

The results of *Moringa oleifera* leaves for Ash, Fiber and Protein were 5.89, 17.41 and 25.37% based on dry weight, respectively. These findings were in the same line with those reported by **EL-MASSRY *et al.*, (2013),** who found that ash, fiber and protein were 7.92, 18.67 and 26.79% based on dry weight, respectively. While, found that carbohydrates content was 35.90%. also, **Mukunzi *et al.*, (2011),** who found that ash, fat and protein 13.44, 3.48 and 25.26%, respectively. The presence of some phytochemicals like saponins and flavonoids explained the medicinal action of the plant encountered in its therapeutic uses.

Effect of Supplementation of *Moringa Oleifera* Poultry Diets on Body Weight of Broiler.

Data in table (2) revealed that the most effective of Supplementation of *M. Oleifera* Poultry Diets on Body Weight of Broiler, were 612, 1733 and 2391gm, of treatment (20% MOL), after 14, 28 and 42days, respectively. Followed by the effect of Supplementation of *M. Oleifera* Poultry Diets on Body Weight of Broiler, were 608, 1718 and 2318gm, of treatment (15% MOL), after 14, 28 and 42days, respectively. While, the effect of Supplementation of *M. Oleifera* Poultry Diets at treatment of (5 and 10%), on Body Weight of Broiler, were 2133 and 2141gm, after 42days, respectively.

Table (2), Effect of *Moringa Olefera* on Body Weight of Broilers.

Groups	Number of Birds	Average body weight		
		Days 1-14	Days 14-28	Days 28-42
Group 1	10	$460^{c}\pm0.00$	$1522^{c}\pm23.76$	$2133^{a}\pm23.16$
Group 2	10	$580^{b}\pm01.21$	$1651^{b}\pm12.01$	$2141^{a}\pm83.11$
Group 3	10	$595^{b}\pm21.99$	$1702^{a}\pm29.75$	$2293^{a}\pm63.06$
Group 4	10	$608^{a}\pm05.44$	$1718^{a}\pm00.38$	$2318^{a}\pm00.42$
Group 5	10	$612^{a}\pm08.71$	$1733^{a}\pm27.19$	$2391^{a}\pm02.28$
LSD=0.05	5.65			

Group 1: Level of dietary of poultry (0% MOL), Group 2: Level of dietary of poultry (5% MOL), Group 3: Level of dietary of poultry (10% MOL), Groups 4: Level of dietary of poultry (15% MOL), Group 5: Level of dietary of poultry (20% MOL), respectively.

Obtained data were agreed with those by **David et al., (2012)** who found that the effect of dietary supplemental herbal preparations on growth performance of broiler chicks from 0-42 day, was 2744gm, at treatment 0.05% of *Moringa* fruit powder. **Gakuya et al., (2014).** Who found the Average total feed intake per replicate (kg), of treatment (0, 1.25, 2.5, 5, 7.5 and 10%) *Moringa Oleifera*, were 2.213, 2. 457, 2.089, 2.436, 2.099 and 2.164kg, after 28days, respectively.

Hassan et al., (2016). who found that the Effect of Different Levels of *Moringa oleifera* Leaves Meal on body weight of Broiler Chicks, were 1307, 1408, 1488 and 1543gm, of treatment MOLM (0, 0.1, 0.2 and 0.3%),after 35days, respectively.

Effect of Supplementation of *Moringa Oleifera* Poultry Diets on lipid profile:

Effect on total cholesterol and triglycerides:

From tables (3), it could be noticed that t-cholesterol decreased with increasing the treatment of Supplementation of *M. Oleifera* Poultry Diets percentage 20%, was 161.44mg/dl While, the decreased Supplementation of *M. Oleifera* Poultry Diets at treatment percentage 5, 10 and 15%, which were 199.73, 182.52 and 172.49mg/dl, respectively. Compared with normal dietary of poultry was, 207.04mg/dl.

From tables (3), it could be observed that triglycerides increased by decreasing the treatment of Supplementation of *M. Oleifera* Poultry Diets percentage 20%, was 385.19mg/dl While, the increased of Supplementation of *M. Oleifera* Poultry Diets at treatment percentage 5, 10 and 15%, which were 356.12, 371.15 and 379.17mg/dl, respectively. Compared with normal dietary of poultry was, 348.14mg/dl.

Effect on HDL, LDL and vLDL-cholesterol:

Data in table (3), showed that treatment of Supplementation of *M. Oleifera* Poultry Diets led to a gradual increase of serum HDL. Raising both of treatment of the experiment caused an increase in serum HDL, which reached 95.79mg/dl, of Supplementation of *M. Oleifera* Poultry Diets percentage 20%, While, the increased of Supplementation of *M. Oleifera* Poultry Diets at treatment percentage 5, 10 and 15%, which reached 87.04, 81.92 and 86.83mg/dl, respectively. Compared with normal dietary of poultry was, 91.40mg/dl.

The data in table (3), showed similar which effect on serum LDL. Raising both of treatment of the experiment caused an decreased in serum LDL, which reached 79.13mg/dl, of Supplementation of *M. Oleifera* Poultry Diets percentage 20%, While, the decreased of Supplementation of *M. Oleifera* Poultry Diets at treatment percentage 5, 10 and 15%, which reached 92.23, 87.28 and 83.21mg/dl, respectively. Compared with normal dietary of poultry was, 103.13mg/dl.

Data for vLDL values as a result of treatment of Supplementation of *M. Oleifera* Poultry Diets, decreased from 86.53mg/dl of normal dietary of poultry to 84.30, 80.45 and 78.50mg/dl, at treatment 5, 10 and 15 *M. Oleifera* Poultry Diets, respectively. While, the effect of *M. Oleifera* Poultry Diets at treatment 20% decreased

to 83.55mg/dl.

Obtained data were agreed with those by **(AbouSekken, 2015).** who found that The effects of feeding different levels of Moringa oleifera leaves meal (MLM) at treatment percentage 5% on Total Cholesterol, HDL and LDL, which were 189.81, 95.38 and 88.74mg/dl, respectively. While, the effects of feeding different levels of *Moringa oleifera* leaves meal (MLM) at treatment percentage 10% on Total Cholesterol, HDL and LDL, which were 190.60, 89.22 and 98.22mg/dl, respectively.

Zanu et al., (2011). they said that Effect of *Moringa oleifera* leaves meal MLM at treatment percentage 5% on Total cholesterol, Triglyceride, HDL, LDL and VLDL, which were 2.73, 0.51, 2.04, 0.43 and 0.20mmol/l, respectively. While, at treatment percentage 10%, which were 2.52, 1.20, 1.92, 0.03 and 0.50mmol/l respectively. Also, at treatment percentage 15%, which were 2.49, 1.17, 1.83, 0.13 and 0.53mmol/l, respectively Compared with Level of dietary 0%, which were 3.04, 1.14, 2.40, 0.13 and 0.53mmol/l, respectively.

Table (3) Effect of *Moringa oleifera* leaveson lipid profile in poultry diets.

Groups	T-Cholesterol (mg/dl)	Triglycerides (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	vLDL (mg/dl)
Group 1	207.04±0.19	348.14±0.14	91.40±0.10	103.13±0.03	86.53±0.03
Group 2	199.73±0.44	356.12±0.02	87.04±0.32	92.23±0.13	84.30±0.00
Group 3	182.52±0.27	371.15±0.17	81.92±0.30	87.28±0.03	80.45±0.07
Group 4	177.49±0.17	379.17±0.32	86.83±0.33	83.21±0.03	78.50±0.17
Group 5	161.44±0.22	385.19±0.12	95.79±0.47	79.13±0.03	83.55±0.04
LSD=0.05	2.43	4.25	2.67	2.36	1.44

Effect of Supplementation of *Moringa Oleifera* Poultry Diets on haematological parameters:

The complete blood count (CBC) was used as a broad screening test to check such disorders as anemia, infection and many other diseases. It is actually a panel of tests that examines different parts of the blood, which play an important role in metabolism and important indicators of health in both human and animals **(Bain *et al.*, 2006).** The complete blood count (CBC) includes the following tests:

Effect on HB, RBCs, PCV, MCV and MCHC:

Data in table (4), conveyed that the haemoglobin level (Hb), in normal dietary of poultry, was 9.59g/dl and decreased to 8.89 and 8.72g/dl, at treatment 5 and 10% *Moringa oleifera* leaves in dietary of poultry. While, the effect of supplementation *Moringa oleifera* leaves attribution 15 and 20% in dietary of poultry increasing haemoglobin level to 9.15 and 9.73g/dl, respectively.

From the same table, it was clear that the total red blood cells (RBCs) were reduced from 3.78×10^6/µl for normal dietary of poultry to reach 3.32, 3.41 and 3.52×10^6/µl after treatment percentage 5, 10 and 15% *Moringa oleifera* leaves in dietary of poultry. Whereas, the increased of red blood cells, was 3.99×10^6/µl at treatment 20% *Moringa oleifera* leaves.

The same table showed that the total packed cell volume (PCV) of normal dietary of poultry, was 31.74% which decreased to 29.91, 30.34 and 30.78% after treatment percentage 5, 10 and 15% *Moringa oleifera* leaves in dietary of poultry. While, the increased of total packed cell volume, was 31.79% at treatment 20% *Moringa oleifera* leaves.

Previous data revealed that the total mean corpuscular volume (MCV) of normal dietary of poultry, was 42.96µm^3 which increased to 43.94, 44.83, 46.18 and 49.77µm^3 after treatment percentage 5, 10, 15 and 20% *Moringa oleifera* leaves in dietary of poultry.

On the other hand, table (4) declare that the total mean corpuscular hemoglobin concentration (MCHC) was reduced from 34.12g/dl for normal dietary of poultry to 29.29 and 33.92% after treatment percentage 5 and 10% *Moringa oleifera* leaves in dietary of poultry. While, the increased of total mean corpuscular hemoglobin concentration, which were 35.89 and 36.86%, respectively at treatment percentage 15 and 20% *Moringa oleifera* leaves.

Table (4) Effect of *Moringa oleifera* leaves on haematological parameters, were HB (g/dl) RBCs (106/µl), PCV (%), MCV (µm3) and MCHC (g/dl) in poultry diets.

Groups	Hb (g/dl)	RBCs (10^6/µl)	PCV (%)	MCV(µm^3)	MCHC (g/dl)
Group 1	9.59 ± 0.23	3.78 ± 0.29	31.74 ± 1.49	42.96 ± 0.11	34.12 ± 0.59
Group 2	8.89 ± 0.29	3.32 ± 0.20	29.91 ± 0.84	43.94 ± 0.08	29.29 ± 0.17
Group 3	8.72 ± 0.43	3.41 ± 0.77	30.34 ± 0.49	44.83 ± 0.47	33.92 ± 0.57
Group 4	9.15 ± 0.47	3.52 ± 0.86	30.78 ± 1.16	46.18 ± 0.45	35.89 ± 0.36
Group 5	9.73 ± 0.91	3.99 ± 0.67	31.79 ± 0.63	49.77 ± 0.41	36.86 ± 0.25
LSD=0.05	2.28	3.09	1.13	1.43	5.79

Effect on Plt, MPV, PCT and PDW:

Data in table (5), clear that the platelet blood (Plt) level in normal dietary of poultry, was 1277×10^3/µl and decreased to 1155 and 1263×10^3/µl, at treatment percentage 5 and 10% *Moringa oleifera* leaves in dietary of

poultry. While, the effect of supplementation *Moringa oleifera* leaves attribution 15 and 20% in dietary of poultry increasing of platelet blood to 1281 and 1298×10^3/µl, respectively.

The table showed that the mean platelet volume (MPV) was reduced from 9.0µm^3 for normal dietary of poultry to reach 8.7 and 8.9µm^3 after treatment percentage 5 and 10% *Moringa oleifera* leaves in dietary of poultry. Though, the effect of supplementation *Moringa oleifera* leaves attribution 15 and 20% in dietary of poultry on (MPV) increased to 9.1 and 9.2µm^3, respectively.

The same table showed that the platelets hematocrit value (PCT) in normal dietary of poultry was 7.4 which reduced to 4.2% after treatment percentage 5 and 10% *Moringa oleifera* leaves in dietary of poultry. While, the effect of supplementation *Moringa oleifera* leaves attribution 5, 10 and 20% in dietary of poultry on (PCT) increased to 7.4, 7.4 and 7.5%, respectively.

On the other hand, table (5) declare that the total platelet distribution width (PDW) of normal dietary of poultry was 10.7%, which reduced to 10.4 and 10.5% after treatment percentage 5 and 10% *Moringa oleifera* leaves in dietary of poultry. As well, the effect of supplementation *Moringa oleifera* leaves attribution 15 and 20% in dietary of poultry on (PCT) increased to 10.7 and 10.8%, respectively.

Table (5) Effect of *Moringa oleifera* leaves on haematological parameters, were Plt (103/µl), MPV(µm3), PCT(%) and PDW(%) in poultry diets.

Groups	Plt (10^3/ µl)	MPV (µm^3)	PCT (%)	PDW (%)
Group 1	1277 ± 93.31	9.0 ± 0.23	7.4 ± 0.08	10.7 ± 0.44
Group 2	1155 ± 17.55	8.7 ± 0.36	7.2 ± 0.02	10.4 ± 0.13
Group 3	1263 ± 16.29	8.9 ± 0.24	7.4 ± 0.04	10.5± 0.36
Group 4	1281 ± 77.09	9.1 ± 0.33	7.4 ± 0.16	10.7 ± 0.65
Group 5	1298 ± 90.88	9.2 ± 0.97	7.5 ± 0.06	10.8 ± 0.89
LSD=0.05	1.57	2.83	2.62	1.21

Effect on WBCs, Lym, Mono and GRA:

Data in table (6) cleared that white blood cells (WBCs) level in normal dietary of poultry, was 12.24×10^3/µl and increased to 12.25, 21.37, 12.48 and 12.57×10^3/µl, at treatment percentage 5, 10, 15 and 20% *Moringa oleifera* leaves in dietary of poultry.

From table (6), it was informed that the level of Lymphocytes (Lym) decreased from 5.66×µm^3 for normal dietary of poultry to reach 5.51, 5.42 and 5.55×10^3/µl after treatment percentage 5, 10 and 15% *Moringa oleifera* leaves in dietary of poultry. Conversely, the effect of supplementation *Moringa oleifera* leaves attribution 20% in dietary of poultry on (Lym) increased to 5.67×10^3/µl, respectively.

Previous data revealed that the Monocytes (Mono) values of normal dietary of poultry was 0.45% which lowered to 0.42 and 0.43% for treatment percentage 5 and 10% *Moringa oleifera* leaves in dietary of poultry. Whereas, the effect of supplementation *Moringa oleifera* leaves attribution 15 and 20% in dietary of poultry on (Mono) which increased to 0.45 and 0.46%, respectively.

On the other hand table (6) declared that the Granulocytes (GRA) of normal dietary of poultry, was 38.5%. While, the effect of supplementation *Moringa oleifera* leaves attribution 5, 10, 15 and 20% in dietary of poultry on (GRA) which were 38.0, 38.2, 38.4 and 35.7%, respectively.

Table (6) Effect of *Moringa oleifera* leaves on haematological parameters, were WBCs(10^3/µl), Lym(10^3/µl), Mono(%) and GRA(%) in poultry diets.

Groups	WBCs (10^3/µl)	Lym (10^3/µl)	Mono (%)	GRA (%)
Group 1	12.24 ± 0.21	5.66 ± 0.29	0.45 ± 0.01	38.5 ± 0.15
Group 2	12.25 ± 0.27	5.51 ± 0.01	0.42 ± 0.03	38.0 ± 0.41
Group 3	12.37 ± 0.52	5.42 ± 0.20	0.43 ± 0.01	38.2 ± 0.17
Group 4	12.48 ±0.43	5.55 ± 0.31	0.45 ± 0.75	38.4 ± 0.41
Group 5	12.57 ± 0.34	5.67± 0.07	0.46 ± 0.45	38.7 ± 0.29
LSD=0.05	1.17	1.06	1.01	1.13

This finding was in the same line with **Sajid et al., (2015),** who described that effect of herbal medicine supplementations on haematological variables haemoglobin, RBCs, WBCs and PCV of broilers supplemented with Arsilvon super which were 9.73(g/dl), 2.05(10^6/µl), 15073(10^3/µl), 30.37%, respectively. Compared with of control broilers supplemented, which were 9.63(g/dl), 2.44(10^6/µl), 12926(10^3/µl), 30.20%, respectively.

Obtained data were agreed with those reported by **Allam et al., (2016).** who found that effect of moringa olefera in blood picture (RBCs, HB, PCV and WBCs, which were 3.95(10^6/µl), 14.23g/dl, 37.22% and 13.13(U/L), respectively. Compared with of control broilers supplemented, which were 3.35(10^6/µl), 13.24g/dl, 34.28% and 11.31(U/L), respectively.

Achieved data were arranged with those described by **Olugbemi et al., (2010.)** who found that Effect of treatment on haematological parameters, (PCV, RBC, HB, WBCs, Lymphocytes, Monocytes and Neutrophil), which were 30.14%, 2.21(10^6/µl), 8.10%, 13.00x10^3/µL, 56.14%, 8.43% and 30%, respectively. Compared with

of control broilers supplemented, which were 30.82%, 2.03×10^6/µl, 8.01%, $12.45x10^3$/µL, 57.00%, 6.71% and 31.71%, respectively.

Zanu et al., (2011). they said that effect of *Moringa oleifera* leaves meal (MLM) at treatment percentage 5% on blood variables (WBCs, RBCs, HGB, HCT, MCV, MCH, MCHC, LYM and GRAN), which were $12.52x10^3$/µL, $3.18x10^6$/µL, 14.60g/dl, 37.10%, 124.09fl, 45.86pg, 39.33g/dl, 41.43% and 2.87%, respectively. While, at the treatment percentage 10%, which were $12.65x10^3$/µL, $3.08x10^6$/µL, 13.73g/dl, 35.13%, 123.88fl, 44.07pg, 38.70g/dl, 49.53% and 3.73%, respectively. Also, at the treatment percentage 15%, which were $12.76x10^3$/µL, $3.43x10^6$/µL, 14.83g/dl, 37.93%, 124.43fl, 43.17pg, 39.33g/dl, 68.33% and 7.87%, respectively. Compared with level of dietary (0%MLM), which were $12.87x10^3$/µL, $3.06x10^6$/µL, 14.16g/dl, 36.30%, 123.60fl, 46.30pg, 39.03g/dl, 73.73% and 5.17%, respectively.

Histopathological Findings

Bursa of Fabricious

Microscopic examination after 42 days revealed; scanty lymphoid follicles in groups (1&2&3) while showed improvement and normal active lymphoid follicles in groups (4&5), Figure 1(a&b).

Spleen

Microscopic examination after 42 day of age, showed Atrophied follicles in groups (1&2&3) while revealed normal white pulp and red pulp in groups (4&5), Figure 1(c&d).

Thymus

Microscopic examination after 42 day of age, revealed Scanty cortical lymphoid cells in groups (1&2&3) while showed normal thymic cortex and medulla in groups (4&5), Figure 1(e&f).

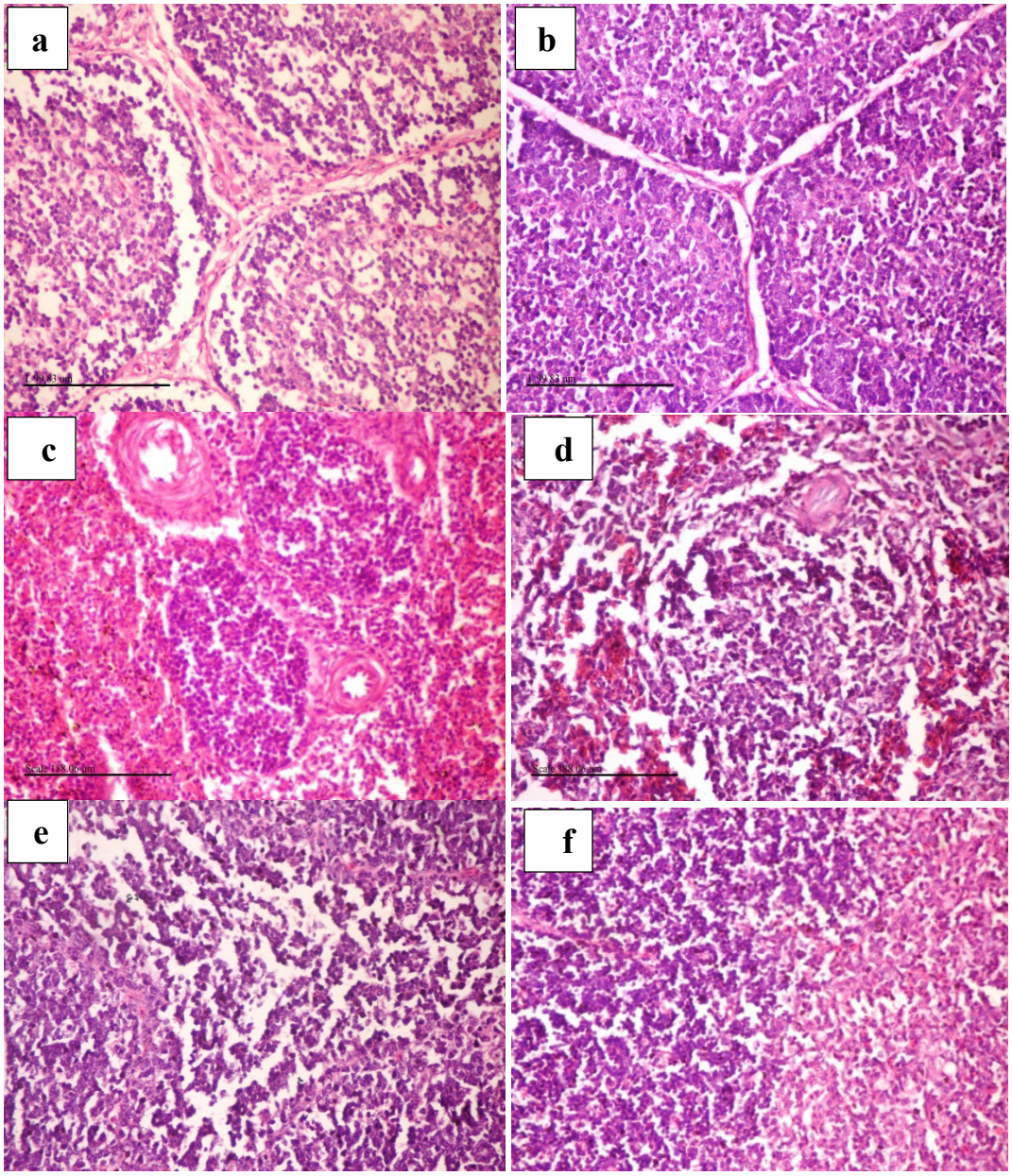

Figure (1) showing;

a- Bursa from groups 1,2,3 showing scanty lymphoid follicles (H&E X 400)
b- Bursa from group 4,5 showing normal active lymphoid follicles (H&E X 400)
c- Spleen from groups 1,2,3 showing atrophied lymphoid follicles (H&E X 400)
d- Spleen from groups 4,5 showing normal lymphoid follicles (H&E X 400)
e- Thymus from groups 1,2,3 showing Scanty cortical lymphoid cells (H&E X 400)
f- Thymus from groups 4,5 showing normal cortex and medulla (H&E X 400)

Conclusion

The effect of supplementation *Moringa oleifera* leaves attribution 15 and 20% in dietary of poultry increasing body weight and blood biochemical of broilers. While the effect of supplementation *Moringa oleifera* leaves attribution 5 and 10% in poultry of broilers not noticeable on body weight and blood biochemical of broilers.

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