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ADDITION OF *MORINGA OLEIFERA* LEAVES POWDER AND MEDIUM CHAIN FATTY ACIDS IN THE DIETS AND THEIR EFFECT ON PRODUCTIVE PERFORMANCE OF BROILER CHICKENS

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SUMMARY

A total number of 300 one-day old unsexed Cobb broiler chickens were initially fed a control diet for six days, then were into ten treatments, each treatment contained three replicates of ten birds. The objectives were to determine the effects of single or combined supplementation of *Moringa olivera* leaf meal (MOL) and medium chain fatty acids (MCFAs) to broiler diets on productive performance. The experimental treatments were as follows: 1-Chicks were fed the control diet (D_1), 2-D_1 + 0.5g MOL/kg diet, 3-D_1+ 0.6g MOL/kg diet, 4- D_1+ 0.7 g MOL/kg diet, 5-D_1+ 0.8g MOL/kg diet, 6- D_1+ 1 g aromabiotic /kg diet, 7-D_1+ 1g aromabiotic/kg diet + 0.5g MOL/kg diet, 8- D_1+ 1g aromabiotic/kg diet + 0.6g MOL/kg diet, 9- D_1+ 1g aromabiotic /kg diet + 0.7g MOL/kg diet, and 10-D_1+ 1g aromabiotic/kg diet + 0.8g MOL/kg diet. Results obtained could be summarized in the following: Chicks fed combined supplementation of 0.08% MOL +0.1% MCFAs had significantly higher live body weight at 38 day of age and body weight gain during the period from 7-38 days as compared with the control or other treatments. Also, these birds had the best significantly values of feed conversion ratio, crude protein conversion, caloric conversion ratio and higher growth rate, performance index, economical and relative efficiency during the period from 7 to 38 days compared with the control. No significant differences were noticed in slaughter parameters and immune organs% as affected by the treated groups in comparison with the control. Chicks fed diets supplemented with 0.08% MOL+ 0.1% MCFAs or 0.07% MOL+ 0.1% MCFAs had significantly higher values of white blood cells, lymphocyte (L) and H/L ratio (lower value of heterophils (H)). The level of serum aspartate aminotransferase and total cholesterol had decreased significantly in chicks fed diets supplemented with MOL plus MCFAs compared with the birds fed control or some MOL diets. The highest values (significant) of total count, *lactobacillus* count and immune response to Newcastle disease were recorded for chicks fed diet supplemented with 0.08% MOL +0.1% MCFAs. *E.coli* counts were reduced significantly by feeding all treated diets compared with the control.

Keywords: *Feed additives, Moringa oleifera leaf meal, aromabiotic, probiotics and broiler.*

INTRODUCTION

Poultry production in Egypt has become one of the biggest agriculture industries and its improvement is a major goal of broiler producers. Feed is a major component affecting net return from the poultry enterprise. Various strategies like feed supplements and additives are being used to ensure more net return and to minimize expenditure on feed. A poultry industry challenge is to exploit the use of specific dietary supplements to boost the production and growth performance of poultry (Chand *et al*., 2014).

Use of chemical feed additives as growth promoters has criticism due to adverse effects on consumers and there is increasing demand for organic meat and eggs. In view of this, herbal and plant derivatives would be a valuable alternative to promote growth and health in poultry as there is no residual toxicity. Alternatives for substituting these traditional growth promoters have been evaluated and probiotics feeding have been the area of interest. A number of alternative products, such as probiotics, prebiotics, organic acids, essential oils, and oligosaccharides, are the subject of research to enhance the health of human and growth performance of broilers.

The limited studies on the effects and usage of the moringa leaves as feed ingredient are breakthroughs towards extensive investigation of its possibilities and viability as a feed source. *Moringa oleifera* is known for long time as an important nutritional supplement with a variety of medicinal properties. *Moringa oleifera* leaf is rich in vitamins (especially vitamin A), amino acids (AA), energy, crude protein (CP), low levels of tannins, trypsin and amylase inhibitors (Makkar and Becker, 1997). Also, Makkar and Becker (1997) reported that MOL is rich in carotenoids, ascorbic acid and iron. The CP content of Moringa ranges from 71.2 to 391.7 g/kg and varies across the plant parts with the seeds having the highest CP content followed by flowers, leaves, whole plant, stems and pods.

According to Moyo *et al.* (2011), there is quite a lot of literature on the nutritional value of *Moringa oleifera* leaf meal (MOL) with varying nutritional content. *Moringa oleifera* has been reported to posses several nutrients, including: calcium, magnesium, potassium, iron, vit. A, and vit. C and a CP content that varies from 16 to 40% (Rweyemamu, 2006). The essential nutrient contents of moringa leaves/twigs such as vit. A and B, calcium, iron, copper, sulfur and protein and its ability to absorb and neutralize toxic elements in food could justify its significance in developing the plant as one of the major local feed stuffs (Lannaon, 2007).

Moringa oleifera leaves contain polyphenol, simple sugar, tannins, vitamins, rhamnose, carotenoids, phytates, phenolic acids, flavonoids, alkaloids, isothiocyanates, saponins, oxalates and glucosinolates triterpenoid (Augustin *et al*., 2011). *Moringa oleifera* leaf contains 8.13g/kg of vit. A (Ferreira, 2008), 6.66.8 mg/100 g of β-carotene (Kidmos *et al.,* 2006). β-carotene is more concentrated in the dried leaves, 17.6 to 39.6 mg/100 g of dry weight (Moyo *et al.,* 2011).

Moringa oleifera has also been reported to exhibit other diverse activities. Aqueous leaf extracts regulate thyroid hormone and can be used to treat hyperthyroidism and exhibit an antioxidant effect (Tahiliani and Kar, 2000). Moringa is a potential plant that could be used to enhance immune response and to improve intestinal health of broiler chicken (Yang *et al.,* 2006). As per FAO (1996) there are numerous uses of *Moringa oleifera* as medicine. The pan-tropical cultivation and easy propagation of moringa tree justify more intensive research into its biological and economic possibilities particularly as useful feed ingredients and medicine.

Among a variety of candidates for the replacement of antibiotic growth promoters, organic acids (OAs) are promising alternatives (Mroz, 2005). Medium-chain fatty acids (MCFAs) are another type of acids that could be considered as antibiotic replaces.

Medium chain fatty acids are namely caproic, caprylic, or capric acid and are digested and absorbed faster than long-chain fatty acids and may be very useful when the digestion, absorption, or transport of dietary fat is defective (Del Alamo *et al.,* 2007). Medium chain fatty acids have been shown to be good alternatives for nutritional antibiotics in piglets, due to their high antibacterial activity, and they enter the cell un-dissociated (Dierick *et al.,* 2002). Once in the cell, the MCFAs dissociates followed by a drop in pH and results in the inactivation of the bacterial cell. The MCFAs inhibits the production of lipases by the bacteria (Dierick *et al.*, 2002). As lipases are needed to allow the bacteria to attach to the intestinal wall, this process will be prohibited and the bacteria will be washed out (Dierick *et al.,* 2002). Furthermore, the antibacterial potency of MCFAs is believed to exceed that of short chain fatty acids, SCFAs (Hermans *et al.*, 2010).

Considering the above statements, one experiment was conducted to study the effects of single or combined supplementation of *Moringa olivera* leaf meal and MCFAs to broiler diets on growth performance, mortality rate, some carcass parameters, bacterial count, intestinal pH, blood serum

MATERIALS AND METHODS

The experimental work of the present study was carried out at El-Azab Poultry Research Station, Fayoum, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Dokki, Egypt, to determine the effects of MOL and their combination with MSFAs (aromabiotic) to broiler diets on growth performance, some carcass parameters, bacteria enumeration, intestinal pH, blood serum parameters, Immune parameters and economical efficiency during the period from February to April

2016. Chemical analyses were performed in the laboratories of the Animal Production Research Institute, Agricultural Research Center according to the procedures outlined by A.O.A.C. (2016).

A total number of 300 one-day old unsexed Cobb broiler chickens were initially fed a control diet for six days. At seven days of age, chicks were individually weighed to the nearest gram, wing-banded and randomly allotted to the dietary treatments (ten treatments, 30 birds each), each treatment contained three replicates of ten birds.

The experimental treatments were as follows:1-Chicks were fed the control diet (T_1), 2-D_1 + 0.5g MOL /kg diet, 3-D_1+0.6g MOL/kg diet, 4-D_1+ 0.7g MOL /kg diet, 5-D_1 + 0.8g MOL/kg diet, 6-D_1+1g aromabiotic/kg diet, 7-D_1+1g aromabiotic/kg diet+ 0.5g MOL/kg diet, 8-D_1 +1 g aromabiotic /kg diet+ 0.6g MOL/kg diet , 9-D_1 + 1 g aromabiotic /kg diet+ 0.7g MOL kg diet, and 10-D_1+1 g aromabiotic /kg diet+ 0.8g MOL/kg diet.

The dried MOL used in the present study was obtained from the Egyptian scientific association for moringa (register no 4297/2012), National Research Centre, Egypt. Prodused by vitamax coumpany and contains 60 % MCFA (C6, C8, C10) on a support of silicium dioxide. A carefully balanced mix of medium chain fatty acids (MCFA); C6, Caproic Acid, C8, Caprylic Acid, C10, Capric Acid.

Chicks were raised in electrically heated batteries with raised wire mesh floors and had a free access to the feed and fresh water from nipple drinkers (2nipples/cage) throughout the experiment. Light was provided for 23 houre/day. Batteries were placed into a room provided with continuous fans for ventilation. The chicks were fed starter diet from 7 to 14 days of age, grower diet from 15 to 21 days, and finisher diet from 22 days to the end of the experiment at 38 days of age.

The experimental diet was supplemented with minerals and vitamins mixture and DL-methionine and L-Lysine HCl to cover the recommended requirements according to the Cobb catalog recommendations and were formulated to be iso-caloric and iso-nitrogenous. The composition and calculated analysis of the experimental diet are shown in Table (1).

Birds were individually weighed to the nearest gram at 7, 15, 22 and 38 days of age in the early morning before receiving any feed and water. At the same time, feed consumption was recorded and body weigh gain (BWG), feed conversion ratio (FCR), crude protein conversion (CPC), caloric conversion ratio (CCR) and growth rate (GR) (g feed/g gain) were calculated. Performance index (PI) was calculated according to the equation described by North (1981) as follows: PI = (live body weight (LBW), Kg/FC) x100. The vaccination program adopted by recommended requirements according to standard commercial guidelines.

Accumulative mortality rate was obtained by adding the number of dead birds during the experiment divided by the total number of chicks at the beginning of the experimental period (mortality% was within normal limits and not related to treatments studied).

At the end of the experiments (38 days of age), slaughter tests were performed using 48 chicks (16 treatments x three replicate). The birds were on feed withdrawal overnight (approximately 12 h), then individually weighed to the nearest gram, and slaughtered by severing the jugular vein. After four minutes bleeding time, each bird was dipped in a water bath for two minutes, and feathers were removed. After the removal of head, carcasses were manually eviscerated, and then their weights were obtained. The eviscerated weights included the front part with wings and hind part.

Carcass% = (carcass weight/LBW) x100.

Immune organs (spleen, bursa and thymus glands), viscera (gizzard (empty), liver and heart) were individually weighed and calculated in relation to LBW. The abdominal fat was removed from the parts around the viscera and gizzard and was weighed to the nearest gram. Dressing percentage was calculated as follows: Dressing%= ((carcass weight+giblets)/LBW) x100.

At the time of slaughter test, 3 samples of ileum content for each treatment were taken. Total microflora of ileum content was enumerated. The pH of intestinal contents was directly determined by pH-meter.

At the end of the experimental period (38 days), individual blood samples were taken from 3 birds of each treatment during the slaughter. The blood samples were collected into dry clean centrifuge tubes and centrifuged at 3000 rpm for 20 minutes. The clear serum samples were carefully drawn and transferred to dry, clean, small glass bottles, and stored at–20Ċ in a deep freezer until the time of chemical determinations. The biochemical characteristics of blood were determined colorimetrically using commercial kits.

Table (1): Composition and analyses of the control (starter, grower and finisher) diets.

Item%	Starter (7-14 days)	Grower (15-21days)	Finisher (22-38 days)
Yellow corn, ground	64.37	70.4	74.22
Soybean meal (44%CP)	23.08	16.78	12.3
Corn gluten meal (60%CP)	8.56	9.0	10.0
Dicalcium phosphate	1.8	1.7	1.5
Calcium carbonate	0.9	0.85	0.8
Vit. and Min. premix*	0.3	0.3	0.3
Sodium chloride	0.3	0.3	0.3
DL–Methionine	0.24	0.2	0.15
L-Lysine Hcl	0.45	0.47	0.43
Total	100.0	100.0	100.0
Calculated analysis%**:			
Crude protein (CP)	21.50	19.5	18.5
Crude fat	2.84	3.03	3.17
Crude fiber	3.00	3.00	3.00
Calcium	0.90	0.84	0.76
Available phosphorus	0.45	0.42	0.38
Potassium	0.68	0.57	0.50
Methionine	0.50	0.48	0.50
Methionine+Cystine	0.98	0.89	0.82
Lysine	1.32	1.19	1.05
Arginine	1.13	0.96	0.85
Threonine	0.59	0.49	0.43
Valine	0.73	0.62	0.54
ME, Kcal./Kg	3008.0	3086.0	3167.0

* *Each 3.0 kg of premix supplies one ton of the diet with: Vit. A, 12000000 I.U; Vit. D_3, 2000000 I.U.; Vit. E, 40g; Vit. K_3, 4g; Vit. B_1, 3g; Vit. B_2, 6g; Vit.B_6, 4g; Vit.B_{12}, 30mg; Niacin, 30gm; Biotin, 80mg; Folic acid, 1.5g; Pantothinic acid, 12g; Zn, 70g; Mn, 70g; Fe, 40g; Cu, 10g; I, 1.5g; Co, 250mg; Se, 200mg; Choline, 350g and complete to 3.0 Kg by calcium carbonate.*

***According to NRC, 1994.*

To determine the economical efficiency for meat production, the amount of feed consumed during the entire experimental period was obtained and multiplied by the price of one Kg of each experimental diet which was estimated based upon local current prices at the experimental time. Statistical analysis of results was performed using the General Linear Models (GLM) procedure of the SPSS software **(SPSS, 2007),** according to the follow general model:

$$Y_{ij}= \mu+T_i+e_{ij}$$

Where:

Y_{ij}: observed value, μ: overall mean, T_i: treatment effect (i: 1 to 10., e_{ij}: random error.
Treatment means indicating significant differences ($P\leq0.01$ and $P\leq0.05$) were tested using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Effects of single or combined supplementation of MOL and MCFAs to broiler diets on productive performance of Cobb broiler chicks are presented in Table (2).

Chicks fed combined supplementation of 0.08% MOL + 0.1% MCFAs had higher significantly LBW (2079.67g), BWG (1934.10g), PI (40.08) and the best FC, CPC and CCR as compared with the control or other treatments (Table 2). While those fed experimental diet represents the control without additives recorded lower values. Generally, there was a significant positive response obtained by feeding 0.08% MOL+ 0.1% MCFAs over that of the control and single supplementation of MCFAs on productive performance during the period from 7 to 38 days. No significant differences in FI were found between chicks fed single or combined supplementation of MOL and MCFAs and the control during the experimental period studied.

In this respect, Cave (1982) found that addition of 30 g/kg (3%) of MCFAs containing caprylic (C_8:0), capric (C_{10}:0), and lauric (C_{12}:0) acid groups significantly increased BWG in chicks. Also, the improved BWG confirmed that the antimicrobial activity of MCFAs helped diminished intestinal infection pressure and improved intestinal morphology, resulting in better digestive and absorptive capacities. Dove (1993) showed that dietary inclusion of 5% MCFAs (weight basis) provided the greatest increase in BWG.

The responses observed in present study partially agree with those reported by Teteh *et al.* (2013) and EL. Moustafa *et al.* (2015). They showed that birds fed on MOL powder at difrent levels gained significantly higher BWG than birds fed the control diet. This improve in BWG could be partly attributed to high digestibility of moringa leaves, which could improve absorption of nutrients (EL. Moustafa *et al.*, 2015).

Table (2): Effects of single or combined supplementation of *Moringa oleifera* leaf meal (MOL) and medium chain fatty acids (MCFAs) to broiler diets on productive performance.

Item	LBW[1], g	BWG[2], g	FI[3], g	FC[4]	CPC[5]	CCR[6]	GR[7]	PI[8]
Control (C)	1885.63^{d}	1739.00^{d}	3291.60	1.89^{a}	0.38^{a}	5.84^{a}	1.71^{c}	33.17^{d}
C +0.05% MOL	1950.33^{cd}	1803.97^{cd}	3261.00	1.81^{ab}	0.36^{ab}	5.58^{ab}	1.72^{bc}	35.12^{cd}
C +0.06 % MOL	1968.33^{bcd}	1822.20^{bcd}	3249.13	1.78^{abc}	0.35^{abc}	5.51^{abc}	1.72^{abc}	36.49^{abcd}
C +0.07% MOL	1983.33^{abcd}	1836.90^{abcd}	3261.30	1.78^{abc}	0.35^{abc}	5.48^{abc}	1.73^{abc}	36.60^{abcd}
C +0.08 % MOL	1993.33^{abc}	1847.03^{abc}	3303.17	1.79^{abc}	0.35^{abc}	5.52^{abc}	1.73^{ab}	36.12^{bcd}
C+0.1% MCFAs	1945.67^{cd}	1799.80^{cd}	3232.80	1.80^{ab}	0.36^{ab}	5.55^{ab}	1.72^{bc}	36.07^{bcd}
C +0.05% MOL +0.1% MCFAs	2023.67^{abc}	1876.87^{abc}	3328.33	1.77^{abc}	0.35^{abc}	5.48^{abc}	1.73^{ab}	36.99^{abc}
C +0.06% MOL +0.1% MCFAs	2039.67^{abc}	1894.10^{abc}	3260.40	1.73^{bc}	0.34^{bc}	5.32^{bc}	1.73^{ab}	38.10^{abc}
C +0.07% MOL +0.1% MCFAs	2071.33^{ab}	1925.97^{ab}	3278.27	1.70^{bc}	0.34^{bc}	5.25^{bc}	1.74^{a}	39.24^{ab}
C +0.08 % MOL +0.1% MCFAs	2079.67^{a}	1934.10^{a}	3259.20	1.67^{c}	0.33^{c}	5.15^{c}	1.74^{a}	40.08^{a}
±SEM[9]	9.927	9.990	15.212	0.012	0.002	0.036	0.001	0.357
P value	0.007	0.007	0.949	0.027	0.027	0.027	0.010	0.017

$^{a–d}$ Means in a column with different superscripts differ significantly ($P \leq 0.05$). [1]live body weight, [2]body weight gain, [3] feed intake, [4]feed conversion, [5]crude protein conversion, [6]caloric conversion ratio, [7]growth rate, [8]performance index , [9] Pooled SEM

Makanjuola *et al.* (2014) indicated that adding MOL 0.2, 0.4 and 0.6% MOL to the diets lasted 28 days, had no adverse effect on final LBW and BWG in broiler chicken.

Accordingly, Adil *et al.* (2011) showed that, supplementation of 0.3% acidifier improved BWG and FCR in slow growth type chickens. This may be partially attributed to the lowering of the pH of the digestive organ which led to better digestion, absorption and utilization of nutrients (Dhama *et al.*, 2008) and modified intestinal microflora and helped to improve bird's performance; health statue as well as reduced the microbial use of nutrients (Snyder and Wostmann, 1987). The lowering of the pH optimized the activity of proteases and beneficial bacteria and enhanced FC by broiler birds. Results from more recent research in broiler chickens are not uniformly in agreement with our research. For example, Khatibjoo *et al.* (2018) reported that broilers fed diet containing MCFAs had worst FCR. Along with this similar results, Adil *et al.* (2011) found supplementation of 0.2% or 0.3% acidifier had no effect on FI than those without acidifier.

The present result agree with Paguia *et al.* (2014) who studied the influence of MOL basal diet (control), 0.1%, 0.2%, 0.3%, 0.4% on growth performance of broilers and found no effect on average cumulative feed consumption. Effect of MOL leads to improve FCR ratio in 0.2, 0.4 and 0.6% MOL groups compared to control group and recorded best FCR in birds fed on 0.2% MOL and at the interval of 15-28, 29-42 and 7-42 days of age with Japanese quail chicks received 0.4 and 0.6% MOL were significantly higher in feed consumption as compared to control and 0.2% MOL (EL. Moustafa *et al.*, 2015). This may be attributed to birds fed MOL based diets adequately utilized the nutrients they consumed. The results coincided with the finding of Ebenebe *et al.* (2012) who reported that, chicks fed on MOL diets performed significantly better than the birds of control group in term of higher BWG and better FCR. This observation could be generally traced to increasing fiber content of the diet which may have impaired nutrient digestibility and absorption (Onu, 2010). It could also be attributed to the CP content or palatability of the control feed which enhances its acceptability and utilization.

Abdel-Raheem *et al.* (2012), reported that probiotic and synbiotic supplemented broilers recorded the higher final LBW, LBWG, FCR.

The results of the present findings disagree with the reports of Mandal *et al.* (2014) and Paguia *et al.* (2014). They reported that no significant difference was observed for FCR of the broiler chickens basal diet with four levels of MOL powder which might be due to high level of powder in diets. Teteh *et al.* (2013) revealed that using MOL at 1 and 2% did not influence FI and FCR. However, Makanjuola *et al.* (2014) observed no effect on FCR when broilers were fed 0.2, 0.4 and 0.6% MOL.

Slaughter parameters:

Effects of single or combined supplementation of MOL and MCFAs to broiler diets on some slaughter parameters as a percentage of LBW at 38 days of age is presented in Table (3). The results indicated no significant differences due to supplementation of MOL and MCFAs on some slaughter parameters.

Table (3): Effects of single or combined supplementation of *Moringa oleifera* leaf meal (MOL) and medium chain fatty acids (MCFAs) to broiler diets on some slaughter parameters%.

Item	Liver	Gizzard	Heart	Abdominal fat	Half breast	Half rear	Carcass weight after evisceration	Dressing	Immune organ		
									Bursa	Thymus	Spleen
Control (C)	2.75	2.64	0.58	1.11	53.71	46.29	71.18	77.28	0.11	0.41	0.12
C+0.05% MOL	2.89	2.67	0.55	1.11	53.91	46.09	63.69	69.94	0.15	0.48	0.15
C+0.06% MOL	3.08	2.24	0.49	0.97	53.82	46.18	64.93	70.91	0.15	0.48	0.17
C+0.07% MOL	2.53	2.45	0.57	1.07	55.90	44.10	64.86	70.57	0.14	0.47	0.17
C+0.08% MOL	2.62	2.25	0.53	0.85	53.78	46.22	64.47	70.03	0.13	0.49	0.17
C+0.1%MCFAs	2.84	2.47	0.52	0.93	55.18	44.82	67.01	72.98	0.16	0.50	0.13
C+0.05%MOL +0.1% MCFAs	2.88	2.45	0.49	0.98	53.46	46.55	61.50	67.49	0.15	0.48	0.17
C +0.06% MOL +0.1% MCFAs	2.85	2.3	0.54	1.00	54.78	45.22	65.96	71.85	0.14	0.52	0.16
C+0.07% MOL +0.1% MCFAs	2.83	2.58	0.53	0.98	54.29	45.71	65.79	71.90	0.18	0.57	0.17
C+0.08 % MOL +0.1% MCFAs	2.80	2.38	0.56	0.90	56.81	43.19	65.37	71.26	0.16	0.54	0.15
±SEM[1]	0.035	0.032	0.014	0.032	1.50	1.50	2.17	2.27	0.004	0.011	0.005
P value	0.108	0.070	0.895	0.696	0.831	0.831	0.286	0.326	0.053	0.154	0.236

[1] *Pooled SEM*

Concerning the treatment effect on abdominal fat%, chicks fed diets supplemented with 0.05% MOL or the control showed higher values (1.11%), while, chicks fed 0.08% MOL or 0.08% MOL+ 0.1% MCFAs showed lower values (0.85 and 0.90%, respectively) and the differences were insignificant (Table 3). These results indicate that there were no statistically significant differences in some carcass quality between the control and trial groups in other parameters which is similar to the findings of Khatibjoo *et al.*

(2018). In this respect, Aderinola *et al.* (2013) observed that the proportion of abdominal fat decreased as the inclusion level of MOL increased.

The relative weight of liver, abdominal fat and spleen was significantly reduced with increased dietary level of MOL in ration as compared to control group (Kumar *et al.*, 2018). These findings were similar to those reported by others who suggested that dietary Medium-chain triglyceride decreased the abdominal fat percentage in broiler chickens (Chiang *et al.*, 1990).

Ologhobo *et al.* (2014) concluded that, feeding MOL at 0.2, 0.4 and 0.6% levels had no negative influence on the carcass quality but rather improved the breast and drumstick of broiler chicks. Aderinola *et al.* (2013) found that the organ proportions obtained show that there were significant differences among liver, kidney, spleen and gizzard. The dietary supplementation of MOL did not significantly affect the relative weights of dressing, breast, thigh, liver, heart, giblets and total edible parts. On the other hand, abdominal fat was significantly decreased by increasing levels of MOL. Also, gizzard significantly decreased by using all levels of MOL compared to control group (EL. Moustafa *et al.*, 2015).

The result of the carcass characteristics in this study is similar to the finding of Nuhu (2010) who reported that there were no significant differences among treatments for carcass characteristic for weaner rabbits fed MOL.

Numerically, birds fed diets supplemented with 0.07% MOL+ 0.1% MCFAs had the highest value of thymus (0.57%) compared with other treated groups (0.47-0.54%) and the control (0.41%). Bursa percentage ranged from 0.13 to 0.18% for chicks fed diets supplemented with 0.08% MOL and 0.07% MOL+ 0.1% MCFAs, respectively, while the control group reflected the lowest value (0.11%) but the differences were insignificant. This important production of the immune cells may be due to antioxidxwrant activities of some components of moringa leaves like vit. C and E (Rocha *et al.*, 2010) and phenols especially flavonoids (Diallo *et al.*, 2009) and to the capacity of plants polysaccharides to modulate the immune system (Dong *et al*., 2007).

In this regard, measurement of immune organ weight is a common method to evaluate the immune status of chickens (Heckert *et al.*, 2002). Development of these organs is also considered to be crucial for optimal lymphocyte synthesis (Glick, 1977). The inclusion of dietary MCFAs increased the relative weight of the bursa of Fabricius in broilers compared with the control treatment (Begum *et al.*, 2015).

Our findings are partly congruent with that of EL. Moustafa *et al.* (2015) who reported significantly increased of bursa relative weight by dietary all levels of MOL compared to control group. Also, the same author explained that 0.2% MOL significantly improved the percentage of thymus compared to the control and other treatments and 0.2, 0.4 or 0.6% MOL improved the percentage of spleen without significant differences compared to the control. The results are in agreement with those reported Teteh *et al.* (2013) who found that relative organ weights of spleen, burse and thymus of birds fed control were smaller than those of groups fed 1 and 2% MOL. This result is also supported by Olugbemi *et al.* (2010) who reported that MOL had a beneficial effect on the immune responses and improve intestinal health of broilers.

Blood parameters:

Results presented in Tables (4 and 5) show the effects of single or combined supplementation of MOL and MCFAs to broiler diets on some blood parameters. The results indicated no significant differences due to supplementation of MOL and MCFAs except, white blood cells, heterophils (H), lymphocyte (L) and H/L ratio which were significantly affected. Chicks fed diets supplemented with 0.08% MOL+ 0.1% MCFAs or 0.07% MOL+ 0.1% MCFAs had higher value of white blood cells, lymphocyte and H/L ratio (lower value of heterophils), while, those fed the control diet had lower values of white blood cells, lymphocyte and H/L ratio (higher values of heterophils), as shown in Table (4). Also, the level of serum AST and total cholesterol had decreased significantly ($P \leq 0.05$) in chicks fed diets supplemented with MOL plus MCFAs compared with the birds fed control or some MOL diets. The absence of significant differences among MOL plus MCFAs treatment diets in plasma AST in the present study may reflect normal liver function of the birds fed diets containing MOL plus MCFAs (Table 5).

Table (4): Effects of single or combined supplementation of *Moringa oleifera* leaf meal (MOL) and medium chain fatty acids (MCFAs) to broiler diets on some blood parameters.

Item	Hemoglobin (g/dL)	RBC[1] ($10^6/mm^3$)	Blood index				WBC[6] ($10^3/mm^3$)	Differential count%				H/L ratio
			HCT[2] %	MCV[3] (μ^2)	MCH[4] (µµg)	MCHC[5] %		H[7]	L[8]	Mo.[9]	Eo.[10]	
Control(C)	11.93	3.02	27.82	92.34	39.67	42.91	28.00^{c}	18.67^{a}	70.00^{b}	5.00	6.33	0.27^{a}
C+0.05%MOL	12.07	3.15	28.57	90.64	38.36	42.37	28.41^{c}	18.00^{ab}	70.33^{b}	5.00	6.67	0.26^{a}
C+0.06%MOL	11.57	3.14	27.35	87.33	36.83	42.51	29.18^{c}	18.00^{ab}	70.33^{b}	4.00	7.67	0.26^{a}
C+0.07%MOL	11.97	3.16	27.40	86.73	37.93	43.71	33.35^{a}	17.33^{abc}	72.33^{b}	4.67	5.67	0.24^{bc}
C+0.08%MOL	12.33	3.10	26.54	85.69	39.80	46.49	32.14^{ab}	16.33^{bc}	72.33^{b}	4.33	7.00	0.23^{bc}
C+0.1%MCFAs	11.30	3.03	26.13	86.32	37.32	43.30	30.17^{bc}	16.00^{cd}	71.67^{b}	5.00	7.33	0.22^{bc}
C +0.05% MOL +0.1% MCFAs	11.50	3.18	29.33	92.24	36.14	39.19	28.45^{c}	15.67^{cd}	73.00^{b}	4.67	6.67	0.21^{bcd}
C +0.06% MOL +0.1% MCFAs	11.60	3.00	27.93	93.09	38.98	41.87	33.11^{a}	16.00^{cd}	73.00^{b}	4.33	6.67	0.22^{bc}
C +0.07% MOL +0.1% MCFAs	11.73	3.05	26.61	87.36	38.53	29.60	33.62^{a}	15.67^{cd}	76.00^{a}	4.33	4.00	0.21^{cd}
C+0.08 % MOL +0.1% MCFAs	12.40	3.18	27.66	87.21	39.02	45.00	34.22^{a}	14.33^{d}	76.33^{a}	4.67	4.67	0.19^{d}
±SEM[11]	0.141	0.026	0.276	0.749	0.538	1.624	0.244	0.183	0.283	0.082	0.298	0.003
P value	0.734	0.669	0.335	0.235	0.856	0.601	0.000	0.001	0.000	0.136	0.207	0.000

[a–d] Means in a column with different superscripts differ significantly ($P \leq 0.05$). [1]Red blood cells, [2] Hematocrit, [3] Mean corpuscular volume, [4] Mean corpuscular hemoglobin, [5] Mean corpuscular hemoglobin concentration, [6] White blood cells, [7] Heterophils, [8] Lymphocyte, [9] Monocytes, [10] Eosinophiles, [11] Pooled SEM.

The result was in line with Madubuike and Ekenyem (2006) who recorded no difference (P>0.05) in the haematocrit (PCV) values among treatments. Haematocrit is an index of toxicity level of the blood or suggest the presence of a toxic factor which has adverse effect on blood formation or caused reduction in the percentage of red blood cells compared to the liquid component of blood (Oyawoye and Ogunkunle, 1998). The values obtained in present study were within the normal range of described by Animashahun *et al.* (2006). Church *et al*. (1984) indicating that though there is presence of a toxic factor, but still all the treatment groups had nutritional adequacy, since values did not indicate mal-or under nutrition. This confirms that the inclusion of MOL on broiler diet had little effect on the relative quantity of blood cells as compared with the total volume of blood (Health and Olusanya, 1985).

Also, these results are in harmony with those obtained by Begum *et al.* (2015) who reported that no significant differences were observed in total protein or RBCs with supplementation of MCFAs, while, had higher WBCs compared with the control group. Moreover, broilers fed the MCFAs diet exhibited increased lymphocyte counts compared with the control diets. In this regard, Makanjuola *et al.* (2014) found that 0.2%, 0.4% and 0.6 MOL did not influence the serum total protein, albumin, globulin and AST. But ALT significant decrease was observed in the birds on diet 0.4 %.

Table (5): Effects of single or combined supplementation of Moringa oleifera leaf meal (MOL) and medium chain fatty acids (MCFAs) to broiler diets on plasma parameters and lipids profiles.

Item	Total protein g/dL	Albumin (A) g/dL	Globulin (G) g/ dL	A/G	ALT[1] (U/L)	AST[2] (U/L)	Lipids profiles (mg/dl) Total lipids	Tri-glycerides	Total cholesterol
Control (C)	2.93	1.30	1.63	0.79	27.67	159.33[a]	376.33	93.00	180.67[a]
C +0.05% MOL	3.43	1.43	2.00	0.69	27.00	158.67[a]	349.00	84.00	173.33[ab]
C +0.06 % MOL	3.27	1.37	1.90	0.72	26.33	157.00[a]	324.00	81.67	178.33[ab]
C +0.07% MOL	3.30	1.13	2.17	0.53	25.00	153.67[a]	348.33	86.33	165.67[bc]
C +0.08 % MOL	3.20	1.13	2.07	0.56	25.00	154.33[a]	335.00	87.33	167.33[abc]
C +0.1% MCFAs	3.43	1.30	2.13	0.63	24.00	138.00[b]	326.00	87.67	157.67[c]
C+0.05%MOL +0.1% MCFAs	3.37	1.40	1.97	0.69	27.00	137.00[b]	332.33	78.67	156.67[c]
C+0.06%MOL +0.1% MCFAs	3.37	1.17	2.20	0.53	24.67	137.33[b]	345.00	76.00	157.00[c]
C+0.07%MOL +0.1% MCFAs	3.50	1.27	2.23	0.56	23.00	137.67[b]	338.00	75.67	156.33[c]
C+0.08%MOL +0.1% MCFAs	3.57	1.27	2.30	0.55	22.33	135.33[b]	340.67	75.00	156.33[c]
±SEM[3]	0.057	0.036	0.042	0.021	0.393	1.4	3.932	1.429	1.407
P value	0.481	0.568	0.068	0.090	0.085	0.001	0.234	0.123	0.002

[a–c] Means in a column with different superscripts differ significantly (P≤0.05). [1]Alanine aminotransferase, [2]Aspartate aminotransferase, [3]Pooled SEM

In this respect, EL. Moustafa *et al.* (2015) indicated that plasma AST and ALT decreased with all levels of MOL. Since liver is reported to contain enzymes like ALT and AST, it releases these enzymes to the blood when damaged (Kaplan *et al.,* 2003). Although the decrease in ALT activity observed in birds on diet contained 0.4% and 0.6% MOL could suggest that MOL has properties that can enhance liver health. Also, EL. Moustafa *et al.* (2015) found that HDL fraction was increased and LDL fraction was decreased in all treatments compared to control group. The same author stated that total protein was significantly increased in group 0.2 and 0.4% MOL as compared to those treated with 0.6% MOL or control group. He also showed that total protein and globulin were increased with all levels of MOL compared to control group, while, A/G ratio in all dietary treatments appeared to be decreased. Moreover, Dey and De (2013) found that 0.25 or 0.40% MOL in broiler diets was significant reduced in total cholesterol, TG, LDL-cholesterol and increase in HDL-cholesterol in MOL supplemented birds.

The study observed a significant (P≤0.001) difference in the WBCs parameters among treatments. This observation shows that the principal function of phagocytes, which is to defend against invading microorganisms by ingesting and destroying them, thus contributing to cellular inflammatory processes, was enhanced (Adedapo *et al.,* 2012) which may account for its antibacterial activity (Fahey, 2005). Thus enhancing the health condition of the experimental birds which was in line with Du *et al. (*2007) who reported that dietary supplementation of MOL may increase immune ability of broilers. This was confirmed as no mortality was recorded in treatments diets. The low cholesterol content observed in the birds with treatments diets would have been as a result of the hypocholesterolemic properties (Olugbemi *et al*., 2010) of MOL included in the diets. Aderinola *et al.* (2013) found that the proportion of abdominal fat decreased (P≤0.05) as the inclusion level of MOL increased, this could probably be attributed to the hypocholesterolemic property of the MOL (Olugbemi *et al.,* 2010).

Intestinal microflora:

Results presented in Table (6) show the effects of single or combined supplementation of MOL and MCFAs to broiler diets on intestinal pH, bacterial count and immune response to AI and ND. There are significant differences due to supplementation of MOL and MCFAs on intestinal pH. Chicks fed the control diet were recorded significantly higher pH (6.54) than the other treated groups (5.88-6.24). The lowest values were obtained for chicks fed diets supplemented with 0.08% MOL +0.1% MCFAs and 0.07% MOL +0.1% MCFAs (5.88 and 5.94, respectively). In this respect, Isaac *et al.* (2013) demonstrated the role of MCFAs in control of infection and maintenance of health and integrity of digestive tract was examined in broilers and other animals. Fatty acids are generally inhibitory to microorganisms, but different fatty acids have different minimum inhibitory concentrations, depending on the type of fatty acid, type of microorganism and environmental pH. Low pH increases the concentration of dissociated SCFAs, which in that conformation, can pass into the bacterial cells where the intercellular pH is higher. Medium-chain fatty acids produce a strong antibacterial effect due to the anionic part of the molecule, but how much effect is due to change of the bacterial pH and how much is due to influence on the metabolic level of the bacteria is not yet known (Isaac *et al.,* 2013). The anionic part of fatty acids changes the physico-chemical characteristics of the digestive tract environment in which the microorganisms exist and influences the expression of microorganism and host genes.

Table (6): Effects of single or combined supplementation of Moringa oleifera leaf meal (MOL) and medium chain fatty acids (MCFAs) to broiler diets on bacterial count and immune response to Newcastle disease (ND) and avian influenza (AI).

Item	Intestinal	Bacterial count			Titration against	
	pH	Total count	*E.coli* 10*4	*lactobacillus*	ND	AI
Control (C)	6.54[a]	10.66[f]	4.65[a]	5.03[e]	7.33[b]	7.00
C +0.05% MOL	6.24[b]	10.68[f]	4.10[bc]	5.39[d]	7.67[b]	7.33
C +0.06 % MOL	6.12[bcd]	10.80[de]	4.17[bc]	5.49[d]	7.67[b]	8.00
C +0.07% MOL	6.13[bc]	10.75[ef]	4.22[b]	5.40[d]	7.67[b]	7.33
C +0.08 % MOL	6.18[bc]	10.91[cd]	4.06[bcd]	5.42[d]	8.00[ab]	8.00
C +0.1% MCFAs	6.10[bcd]	10.95[c]	4.00[cde]	5.65[c]	7.67[b]	7.33
C +0.05% MOL +0.1% MCFAs	6.05[cde]	10.73[ef]	3.85[ef]	5.68[bc]	9.00[a]	7.67
C +0.06% MOL +0.1% MCFAs	6.01[cde]	11.13[b]	3.88[def]	5.68[bc]	7.33[b]	8.33
C +0.07% MOL +0.1% MCFAs	5.94[de]	11.22[ab]	3.84[ef]	5.76[b]	8.33[ab]	8.67
C +0.08 % MOL +0.1% MCFAs	5.88e	11.30[a]	3.77[f]	5.91[a]	9.00[a]	8.67
±SEM[1]	0.018	0.012	0.019	0.011	0.105	0.133
P value	0.000	0.000	0.000	0.000	0.010	0.098

[a–f] *Means in a column with different superscripts differ significantly (P≤0.05).* [1] *Pooled SEM*

The results obtained from bacterial count (Table 6) were significantly differed when fed treated diets compared with the control. The highest values of total count were obtained for chicks fed diets supplemented with 0.08% MOL +0.1% MCFAs (11.30) than 0.05% MOL (10.68) and the control (10.66). *E.coli* counts were reduced significantly by feeding treated diets (single or combined supplementation of MOL and MCFAs) compared with the control. The lowest values were obtained for chicks fed diets supplemented with combined MOL and MCFAs (3.77-3.88) than the control (4.65), followed by chicks fed diet supplemented with MOL or MCFAs in alone form (4.00-4.22). Chicks fed 0.08% MOL+ 0.1% MCFAs showed the highest *lactobacillus* count (5.91), while the lowest values observed in chicks fed MOL alone (5.39-5.49) and the control (5.03), with significant differences.

The response observed in present study partially agree with those reported by Yang *et al.* (2006) who demonstrated that MOL are potential plant material to improve intestinal health of broilers. And other studies showed that MOL juice can be particularly effective against the *Pseudononas aeruginosa* bacterium, which can cause diseases in both animals and humans. A compound called pterygospermin from MOL plant has the antibacterial effect against a variety of microbes (Fahey, 2005). Also, in this regard Gaia (2005) indicated that moringa is concentrated in nutrients and reduce the activity of pathogenic bacteria and moulds and improves the digestibility of other feeds, thus helping chickens to express their natural genetic potential. The beneficial effect are attributed to the supplementation of dry moringa leave because it contain phytogenic compounds have attracted a lot of attention for their potential role as alternatives to AGP and also these compounds have shown some positive effects (antimicrobial, antioxidant and regulator of the gut flora) in poultry production. As some previous data Yang *et al.* (2006) indicated the positive effect of 3% MOL on enhancement of duodenum traits, reduced *E. coli* and increased *Lactobacillus* counts in ileum improving the intestinal health of broilers which helped in increasing the production of digestive secretions and nutrient absorption.

It has been proven that MCFAs decreases the number of intracellular lymphocytes in epithelium cells of the digestive tract (Isaac *et al.,* 2013). Additionally, the anticoccidial properties of MCFAs have by studying high quality coconut oil (enhanced virgin coconut oil – EVCO) that contains MCFAs and their proper monoglycerides been proven (Price *et al.,* 2013 and Luckstadt and Mellor, 2011). These materials also inhibited growth of both Gram-positive and Gram-negative bacteria and the *yeast, Candida albicans.* Previously, aromabiotic was shown to be effective against a wide range of opportunistic microorganisms, including *E. coli* (Khosravinia, 2015), *Salmonella* (Van Immerseel *et al.,* 2004), *Campylobacter* and *Clostridia* (Hermans *et al.,* 2011) which are more harmful to broiler performance in stressful conditions. On other hand Begum *et al.* (2015) found that *E. coli* counts were reduced with MCFAs diet (6.62 log^{10} cfu/g) when compared with the control diet.

Concerning the treatment effect on immune response values of ND (Table 6), there are significant differences due to supplementation of MOL and MCFAs on ND values. Chicks fed diet supplemented with 0.08% MOL +0.1% MCFAs and 0.05% MOL +0.1% MCFAs had the highest immune response value of ND (9.00). The lowest value was obtained for chicks fed diets supplemented with 0.06% MOL +0.1% MCFAs and the control (7.33). Data revealed that there were no significant differences of immune response values of AI among treatment groups. According to Eze *et al.* (2013) MOL extract increased ND, H1 titers in the vaccinated chicken groups with ND vaccines.

Economic efficiency (EEf):

Results of EEf values during the period from 7 to 38 days of age are summarized in (Table 7). There are considerable cost saving with using the inclusion of 0.08% MOL+ 0.1% MCFAs compared to others treatment and the control group. Differences in economic and relative efficiency values showed that diet contained 0.08% MOL+ 0.1% MCFAs had the best values of economical and relative efficiency values being 1.76 and 109.78%, respectively compared with the control group, followed by those fed experimental diets containing 0.07% MOL+ 0.1% MCFAs being 1.74 and 108.74%, followed by those fed experimental diets containing 0.06% MOL+ 0.1% MCFAs (1.73 and 107.7%), while the lowest one was recorded for the birds fed control diet (1.61 and 100%). The relative efficiency varied between 100% to 109.78%, which is of minor importance relative to other factors of production.

Table (7): Effects of single or combined supplementation of *Moringaoleifera*leaf meal (MOL) and medium chain fatty acids (MCFAs) to broiler diets on economical efficiency (EEf).

Item	Treatment (T)									
	T1*	T2	T3	T4	T5	T6	T7	T8	T9	T10
a_1	0.3897	0.3773	0.4040	0.3957	0.3857	0.3987	0.3893	0.3957	0.3993	0.3917
b_1	389.20	396.70	398.20	399.70	401.20	396.20	403.70	405.20	406.70	408.20
a_1 x b_1=c_1	151.66	149.69	160.87	158.15	154.73	157.95	157.17	160.33	162.41	159.88
a_2	0.5627	0.4970	0.5081	0.5424	0.5545	0.4941	0.5923	0.5161	0.5186	0.5175
b_2	381.20	388.70	390.20	391.70	393.20	388.20	395.70	397.20	398.70	400.20
a_2 x b_2=c_2	214.50	193.18	198.27	212.47	218.03	191.82	234.38	204.98	206.77	207.12
a_3	1.1576	1.1947	1.1800	1.1322	1.1907	1.1493	1.1487	1.1257	1.1880	1.1683
b_3	369.50	377.00	378.50	380.00	381.50	376.50	384.00	385.50	387.00	388.50
a_3 x b_3=c_3	427.72	450.39	446.63	430.24	454.24	432.72	441.09	433.95	459.76	453.90
a_4	1.1817	1.1920	1.1570	1.1910	1.1723	1.1907	1.1980	1.2230	1.1723	1.1817
b_4	369.50	377.00	378.50	380.00	381.50	376.50	384.00	385.50	387.00	388.50
a_4 x b_4=c_4	436.63	449.38	437.92	452.58	447.24	448.29	460.03	471.47	453.69	459.08
(c_1+c_2+c_3+c_4)=c_{total}	1230.5	1242.6	1243.7	1253.4	1274.2	1230.8	1292.7	1270.7	1282.6	1280.0
D	1.8856	1.9503	1.9683	1.9833	1.9933	1.9457	2.0237	2.0397	2.0713	2.0797
E	1700.0	1700.0	1700.0	1700.0	1700.0	1700.0	1700.0	1700.0	1700.0	1700.0
d x e=f	3205.6	3315.6	3346.2	3371.7	3388.7	3307.6	3440.2	3467.4	3521.3	3535.4
f- c_{total} =g	1975.1	2072.9	2102.5	2118.2	2114.4	2076.9	2147.6	2196.7	2238.6	2255.5
Economical efficiency (g/ c_{total})	1.6051	1.6681	1.6905	1.6899	1.6593	1.6874	1.6613	1.7287	1.7454	1.7621
Relative efficiency (r)	100.00	103.93	105.32	105.29	103.38	105.13	103.50	107.70	108.74	109.78

a_1, a_2, $a_3$and a_4 ....average feed intake (Kg/bird) during the periods of starter, grower, finisher 1 and finisher 2, respectively.
b_1, b_2, b_3 and b_4 …… price / Kg feed (P.T.) during the periods of starter, grower, finisher 1 and finisher 2, respectively (based on average local market price of diets during the experimental time).
c_1, c_2, $c_3$and c_4 …. feed cost (P.T.) during the periods of starter, grower, finisher 1 and finisher 2, respectively.
Total feed cost (P.T.) = c_{total} = (c_1+c_2+c_3+c_4)
Average LBW (Kg/ bird) d
Price / Kg live weight (P.T.) e…….(according to the local market price at the experimental time).
Total revenue (P.T.) = d x e = f
Net revenue (P.T.) = f - c_{total} =g
Economical efficiency = (g / c_{total}) ……………..(net revenue per unit feed cost).
Relative efficiency r….(assuming that economical efficiency of the control group (1) equals 100).
** T1 (Control (C)), T2 (C +0.05% MOL), T3 (C +0.06 % MOL), T4 (C +0.07% MOL), T5 (C +0.08% MOL), T6 (C +0.1% MCFAs), T7 (C +0.05% MOL +0.1% MCFAs), T8 (C +0.06% MOL +0.1% MCFAs), T9 (C +0.07% MOL +0.1% MCFAs) and T10 (C +0.08 % MOL +0.1% MCFAs).*

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إضافة مسحوق أوراق المورنجا اوليفيرا والأحماض الدهنية متوسطة السلسلة في العلائق وتأثيرها على الأداء الإنتاجي لبداري التسمين

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استخدم عدد ٣٠٠ كتكوت وزعت بالتساوي إلى ١٠ معاملات بكل معاملة على ٣ مكررات بكل مكرر ١٠ طيور.وتهدف هذه التجربة إلى دراسة تأثير إضافة مسحوق أوراق المورنجا اوليفيرا والأحماض الدهنيه متوسطة السلسلة بصوره فرديه او خليط منهم في علائق بداري التسمين على الاداء الإنتاجي. وكانت المعاملات التجربيه كما يلي:

١-عليقة الكنترول

٢-عليقة الكنترول+ ٠,٥ جم مسحوق أوراق المورنجا/ كجم عليقه.

٣-عليقة الكنترول+٠,٦جم مسحوق أوراق المورنجا/ كجم عليقه.

٤-عليقة الكنترول+ ٠,٧جم مسحوق أوراق المورنجا/ كجم عليقه.

٥- عليقة الكنترول+ ٠,٨جم مسحوق أوراق المورنجا/ كجم عليقه.

٦- عليقة الكنترول+ ١ جم اروماببيوتك/ كجم عليقه.

٧- عليقة الكنترول+١ جم اروماببيوتك + ٠,٥جم مسحوق أوراق المورنجا/ كجم عليقه.

٨- عليقة الكنترول+١ جم اروماببيوتك + ٠,٦جم مسحوق أوراق المورنجا/ كجم عليقه.

٩- عليقة الكنترول+١ جم اروماببيوتك + ٠,٧جم مسحوق أوراق المورنجا/ كجم عليقه.

١٠- عليقة الكنترول+١ جم اروماببيوتك + ٠,٨جم مسحوق أوراق المورنجا/ كجم عليقه.

وتم تلخيص النتائج المتحصل عليها كما يلي:الكتاكيت المغذاه على علائق تحتوي خليط من ٠,٨جم مسحوق أوراق المورنجا+ ٠,١% أحماض دهنية متوسطة السلسلة كانت أعلى معنويا في وزن الجسم الحي عند عمر ٣٨ يوم ومعدل الزيادة في وزن الجسم خلال الفترة من ٧-٣٨ يوم مقارنة بالكنترول او العلائق التجريبية الأخرى. أيضا هذه الطيور كانت الأفضل معنويا في معامل التحويل الغذائي وكفاءة تحويل البروتين والطاقة وأعلى في معدل النمو والأداء الإنتاجي والكفاءة اقتصادية خلال الفترة من ٧-٣٨ يوم مقارنة بالكنترول. لا توجد فروق معنويه مسجلة في البرسا، الثيموس والطحال % نتيجة تأثير المجموعات التجريبية مقارنة مع الكنترول. الكتاكيت المغذاه علي علائق تحتوي خليط من ٠,٨جم مسحوق أوراق المورنجا+ ٠,١% أحماض دهنية متوسطة السلسلة او ٠,٧جم مسحوق أوراق المورنجا+ ٠,١% أحماض دهنية متوسطة السلسلة كانت أعلى معنويا في قيم خلايا الدم البيضاء، الليمفوسايتس، معدل H/L (قيمه اقل في الهيتيروفيلس). أيضا مستوى السيرم من AST والكوليستيرول الكلي انخفضت معنويا في الكتاكيت المغذاه على العلائق المحتوية مخلوط مسحوق أوراق المورنجا والأحماض الدهنية متوسطة السلسلة مقارنة بالتي غذيت على الكنترول وبعض علائق المورنجا. القيم الأعلى معنويا في العد الكلي وعد اللاكتوباسللس وتترات النيوكاسيل المناعية سجلت في الكتاكيت المغذاة على خليط من ٠,٨جم مسحوق أوراق المورنجا+ ٠,١% أحماض دهنية متوسطة السلسلة. عد الايشريشيا كولاي كان اقل معنويا بالتغذية على كل العلائق التجريبية مقارنة بالكنترول.