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Productive Performance and Immune Response of Two Broiler Breeds to Dietary Moringa Supplementation

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ABSTRACT

Antibiotic growth promoters were widely used to improve broiler performance however with the increased problems associated with its use such as their residues and subsequent resistance to bacteria has caused them to replace antibiotics for herbs and plant extract alternatives (phytogenics). One hundred and fifty Cobb500 chicks and 150 Ross 308 chicks were distributed from two to six weeks of age into three treatments (50 birds/ treatment) which included 2% *Moringa oleifera* supplemented ration (M 2%), 3% *Moringa oleifera* supplemented ration (M 3%) and control treatment for both breeds, moreover, chicks of each treatment were distributed into five replicates (10 birds/replicate). Ross breed achieved significantly higher (P<0.05) body weight, weight gain, feed intake, feed conversion ratio, carcass weight and breast muscle weight compared to Cobb breed. Moreover Ross breed responded better to dietary *Moringa oleifera* supplementation than Cobb. Firstly M(3%) was decreasing body weight and weight gain than M(2%) however with time the opposite occurred with carcass cuts and internal organs weights were not affected significantly (P<0.05) with dietary *Moringa oleifera* supplementation. Ross 308 breed showed an increase in HI titer against Newcastle disease virus than Cobb 500 breed. Finally we concluded that the Ross breed respond better to dietary *Moringa oleifera* supplementation. However, more future researches are required to study the response of different broiler breeds to different dietary Moringa levels.

Key words: *Moringa oleifera*, Breed, Performance, immunity and Newcastle disease virus

INTRODUCTION

A lot of feed additives are being used in the poultry industry to maximize growth performance of broilers. Use of in-feed-antibiotics leads to residues in meat and eggs, increases the cost of production and develops microbial resistance to different antibiotics. However inhabit usage of Antibiotic Growth Promoters (AGPs) from poultry feed may affect their production performance and encourage regenerated pathogens leading to diseases and economic losses in farms (Yang et al., 2009)

Moringa is a genus from the plant family called Moringaceae. This genus comprises of 13 species and grow in tropical and subtropical climates (Yang, et al., 2006). All parts of the *Moringa oleifera* tree has beneficial properties. It is a multipurpose tree, various parts of which are used as feed stuff. Moringa contains high antioxidants and anti-inflammatory compounds (Yang, et al., 2006). Nutrient composition of *Moringa oleifera* leaves indicates a rich nutrient profile of important minerals, a good source of protein and amino acids, vitamins, ß -carotene and various phenolics with multiple feed additive purposes (Moyo et al., 2011).

Juniar et al. (2008) found that the inclusion of Moringa oleifera leaf meal at amounts up to 10% did not produce significant (P> 0.05) effects on feed consumption, body weight, feed conversion ratio and carcass weight in broiler chickens. Many researchers have reported a major effect of the genotype on live weight (Ojedapo et al., 2008; Razuki et al., 2011), feed conversion, carcass composition (Marcato et al., 2006; Nikolova and Pavlovski, 2009), carcass weight (Rondelli et al., 2003), and abdominal fat (Barbato, 1992; Fontana et al., 1993). However, the question now is if the various broiler breeds will response differentially to Moringa supplementation?

Muhammd et al. (2016) observed that Moringa oleifera leaf meal may replace dietary soya beans meal up to 15%, with optimum level of 5% in growing Japanese quails, its effect on growth performance, immune function, and ileum microflora in broilers was studied by Yang et al. (2007) and they found a significant enhancement of duodenum traits, and enhancements of the immune system in broilers were observed.

Thus the objective of this study is to investigate the effect of inclusion different levels of dietary *Moringa oleifera* leaves on productive performance, carcass characters, blood antioxidants and immune response of two broiler breeds from 2 to 6 weeks age.

MATERIALS AND METHODS

Birds and experimental design

This work was applied in experimental poultry unit, faculty of veterinary medicine, Damanhour University, Egypt within August and November 2015. 150 Cobb500 chicks and 150 Ross 308 chicks were obtained from Arab poultry breeders company Ommat. The chicks of each strain were distributed into three treatments (50 birds/ treatment) which included 2% Moringa supplemented ration (M 2%), 3% Moringa supplemented ration (M 3%) and control treatment, moreover chicks of each treatment were distributed into five replicates (10 birds/replicate). Chicks were brooded under gas brooder supplied 33°C at the first week reduced 3°C per week till reaching 24°C. Light was supplied for 24 hours during the first 48 hours of life then lighting duration was reduced to 18 hours per day. Chicks were fed with starter ration (23% Crude Protein (CP) during first two weeks without the addition of Moringa. the Experiment was initiated at two weeks of age where chicks were fed on grower ration from two weeks till six weeks of age after the addition of moringa to treated groups at level of 2% and 3%. All chicks were vaccinated with HB1+H120 at eight days of age, Infectious Bursal Disease (IBD) at 12 days and La Sota at 18 days of age and all vaccines were applied through drinking water after following all precautions.

Moringa source and preparation

Moringa leaves used in this experiment were obtained as a powder product from the farm of Moringa friends at Sadat city, Menfoia, Egypt, then it was added to ration from two weeks till 6 weeks of age at two concentration 2% and 3%. The proximate analysis of Moringa leaves showed in the following table 1.

Table 1. Chemical composition (%) of Moringa leaves

	P %	Ca %	Ash %	EE %	Cp %	DM %
According to AOAC 2005	0.77	2.10	12.3	11.7	7.25	89.6

DM= Dry matter; Cp= Crude protein; Ca=calcium; P=phosphorus

Performance traits

Body weight: body weight measured to most exact gram weekly from two weeks till six weeks of age using sensitive scale.

Weight gain= W2 – W1 where W1 = is the weight at any week and W2 = the weight at the next week.

Feed intake/ bird/ week

Water intake/ bird/ week

Mortality/treatment/week

Feed Conversion Ratio was estimated according to Lambert et al. (1936).

$$FCR = \frac{\text{feed intake (g)/bird/week}}{\text{weight gain (g)/bird/week}}$$

Carcass traits

At six weeks of age three birds per replicate were slaughtered after starvation for 12 hours with continued water supply (Sadek et al., 2014). The birds were weighed before being slaughtered then weighing again after evisceration to calculate dressing percentage. Abdominal fat (including fat around gizzard) and internal organs (including intestine, liver, gizzard and heart) were weighed to the nearest gram using sensitive scale (0.0000). Carcasses were divided and the weight of thigh, shoulder and left breast were measured.

Chemical analysis

Blood samples were collected from the wing vein at the end of experiment (42 days), serum were separated through centrifugation at 3000 rpm for 15 minutes and preserved in a deep freezer at (-20°C) until the time of analysis.

Haemagglutination inhibition test

Newcastle Disease Virus (NDV) antigen, la Sota strain, was used to test serum samples collected at 35 days of age (10 samples per each group) for antibody titers against NDV as described by Allan et al. (1978). Here the Haemagglutination Inhibition (HI) titer was expressed as the reciprocal of the highest dilution that causes inhibition of agglutination and Gometric Man Titer (GMT) was calculated.

Lactobacillus count was done using Rogosa agar as a selective medium used for the isolation of lactobacilli and the typical colonies appeared after 48 hours of incubation at 37°C in 5% CO2. According to Rogosa et al. (1951) approximately 100 mg of intestinal digesta were collected three times after the end of essential oil treatment at 3, 7 and 14 days and mixed each time with 900µL of sterile saline solution (0.9% NaCl) and homogenized three minutes using a homogenizer. Each digesta homogenate was serially diluted from initial 10-1 to 10-9 and subsequently plated on selective agar media (Rogosa agar) and incubated anaerobically at 37°C for 48h for *Lactobacillus* count.

Ethical approval

This study was carried out in strict accordance with the recommendations in the guide for the care and use of laboratory animals of the national institutes of health. The protocol was approved by the committee on the ethics of animal experiments of Alexandria university, Egypt (Permit Number: 18261).

Statistical analysis

Body weight data were analyzed using a two way analysis of co-variance for initial body weight data (two weeks body weight) as there is a significant difference of initial weight between the two breeds, however other productive and carcass traits absolute weight data were analyzed using the two way analysis of variance by SAS (2002), Proc GLM (P<0.05).

RESULTS AND DISCUSSION

Effect of breed and *Moringa oleifera* leaves supplementation and their interaction on broiler performance are shown in table 2. Concerning the effect of breed, there are significant increases (P<0.05) in body weight and weight gain of Ross breed than Cobb allover experimental period (2172.89 g vs. 1784.86 g). Hascik et al. (2010) found that the Ross 308 chicks responded most positively to the feed commercially manufactured compound feed as compared with hybrid Cobb500 and Hubbard JV also, they were the most adaptable in the current farming environment.

Cobb chicken showed significant reduced body weight and body weight gain when fed on different levels of *Moringa oleifera* as opposed to unsupplemented groups. In contrast to Ross broiler which showed higher body weight and weight gain with Moringa supplemented groups when compared with the control group. However, the differences were not significant. Rashid et al. (2012) found that Ross strain got the highest significant (p<0.05) live body weight gain in comparison with Cobb and Hubbard strains under heat stress and different dietary protein level. These results may be referring to higher ability of Ross breed on acclimatization and adaptation on the new environmental condition or dietary composition than the Cobb breed.

Table 2. Effect of breed, Moringa supplementation and their interactions on weekly body weights of broilers from two to six weeks

Item		Week2	Week3	Week4	Week5	Week6
Breed						
	Cobb	451.25±5.44^{b}	691.7±8.51^{b}	1061.82±14.16^{b}	1454.64±21.6^{b}	1784.86±27.56^{b}
	Ross	483.11±5.02^{a}	756.67±8.23^{a}	1204.71±13.72^{a}	1761.73±20.71^{a}	2172.89±25.25^{a}
Moringa (%)						
	M(2%)	474.35±6.87	733.56±10.42^{a}	1128.69±17.4^{ab}	1600.6±26.39	1921.19±33.4
	M(3%)	470.97±5.96	702.11±9.57^{b}	1099.96±15.85^{b}	1592.59±24.39	1990.86±31.1
	Control	461.14±7.1	736.89±9.82^{a}	1171.15±16.45^{a}	1631.37±24.76	2024.56±29.96
Breed*Moringa (%)						
Cobb	M(2%)	445±8.93	692.13±16.13	1059.13±26.71^{c}	1440.74±39.92^{bc}	1709.86±51.8^{c}
Cobb	M(3%)	463.62±5.7	671.57±13.37	997.53±22.58^{c}	1389.17±35.69^{c}	1741.74±44.7^{c}
Cobb	Control	444.52±11.78	711.41±13.63	1128.79±22.55^{b}	1534.01±34.2^{b}	1902.99±43.52^{b}
Ross	M(2%)	497.83±7.86	774.99±13.69	1198.25±23.03^{a}	1760.46±35.49^{a}	2132.53±43.86^{a}
Ross	M(3%)	477.42±9.98	732.65±13.92	1202.38±22.65^{a}	1796.01±33.93^{a}	2239.99±43.79^{a}
Ross	Control	475.86±7.71	762.38±14.34	1213.5±24.26^{a}	1728.73±36.25^{a}	2146.14±41.52^{a}

Means within the same column under the same category carry different superscripts are significant (P<0.05)

There is no significant difference in the final body weight of different groups fed diets supplemented with different levels of *Moringa oleifera* leaves (2%, 3% and 0%). These results are in agreement with Onunkwo and George, (2015) who found that there was no significant difference (P >0.05) in growth performance parameter in broiler chickens when fed graded levels (0%, 5.0%, 7.5% and 10%) of *Moringa oleifera* leaves meal for seven weeks (49 days. There is no significant difference in feed intake between different experimental groups. Chicken fed with diets containing *Moringa oleifera* leaves at level 3% showed significant increase in FCR at age 28 and 45 day when compared with those fed basal diets. But those of group fed diets supplemented with *Moringa oleifera* leaves at level 2% showed insignificant difference in FCR when compared with the control group all over experimental period (P<0.05).

These results are agree with those of Nkukwanaa et al. (2014) who found that no significant differences were observed in feed intake between treatments during periods from 0 to 35 d, FCR was the highest (P<0.05) in birds supplemented with *Moringa oleifera* leaf meal. However FCR1 from 2-3 weeks was lower on Ross breed than Cobb breed which mean higher weight gain acquired with feed intake in Ross breed however, the opposite occurred with FCR4 from 5-6 weeks where Cobb breed recorded significantly (P<0.05) lower FCR than Ross breed (table 3) which ensures our previous interpretation about the prolonged time required until the adaptation of Cobb breed to the new environmental conditions. Ross breed recorded significantly higher (P<0.05) feed intake than Cobb breed all over the experiment (table 4). Similar results were obtained with Rashid et al. (2012) who recorded significantly (P<0.05) higher feed intake and feed conversion ratio for Ross breed compared with Cobb one.

From our results we may be to conclude that Ross breed adapted more rapidly on new environmental condition than Cobb breed. Regard to water intake it was found that chicken which fed on diets supplemented with *Moringa oleifera* leaf meal drink significantly (P<0.05) more water than the control group table 4. This may be due to leaf meals are generally bitter in taste (Onunkwo and George, 2015), so, the inclusion of *Moringa oleifera* leaves in the diets could have resulted in increase water intake to overcome the bitter taste of the broiler diets.

Table 5 showed the impact of *Moringa oleifera* leaf meal at different levels (2, 3 and 0%) on carcass characters and dressing percentage. There were no significant differences in dressing percentage and other carcass characteristics of different experimental groups (table 5).

Table 3. Effect of breed, Moringa supplementation and their interactions on weight gain and feed conversion ratios of broilers from two to six weeks

Items		WG1	WG2	WG3	WG4	FCR1	FCR2	FCR3	FCR4
Breed									
Cobb		234.58±8.5 5[b]	385.13±12.69[b]	479.03±20.25[b]	392.07±15.07[b]	2.87±0.15[a]	2.19±0.07	2.01±0.08	1.63±0.1[b]
Ross		293.13±9.38[a]	500.17±14.23[a]	615.65±19.73[a]	452.77±14.85[a]	2.3±0.17[b]	2.23±0.07	2.05±0.08	2.21±0.09[a]
Moringa(%)									
M(2%)		270.33±11.62	445±17.51	526.16±24.44	407.68±19.64	2.57±0.21	2.08±0.09[b]	2.21±0.1	1.9±0.13a[b]
M(3%)		243.11±10.81	417.72±16.41	556.4±25.36	417.68±18.12	2.7±0.19	2.39±0.09a	1.95±0.1	2.14±0.11[a]
Control		278.13±10.52	465.24±15.56	559.46±23.62	441.90±17.12	2.47±0.19	2.15±0.08b	1.94±0.09	1.73±0.11[b]
Breed*Moringa(%)									
Cobb	M(2%)	233.75±16.63	390±22.92	440.24±34.96	329.54±27.78[c]	3.02±0.30	2.1±0.12	2.21±0.14	1.72±0.19
	M(3%)	208.97±13.81	348.4±22.46	479.47±36.75	440.00±26.60[ab]	3.04±0.25	2.35±0.12	1.97±0.15	1.8±0.16
	Control	261.03±13.81	417±20.5	517.39±33.4	406.66±23.79[b]	2.53±0.25	2.12±0.11	1.86±0.13	1.37±0.16
Ross	M(2%)	306.9±16.23	500±26.47	612.09±34.16	485.82±27.78[a]	2.13±0.29	2.07±0.14	2.2±0.14	2.08±0.19
	M(3%)	277.3±16.63	487.1±23.94	633.33±34.96	395.36±24.63[bc]	2.35±0.3	2.44±0.12	1.93±0.14	2.48±0.15
	Control	295.23±15.86	513.5±23.42	601.52±33.4	477.14±24.63[a]	2.41±0.28	2.19±0.12	2.01±0.13	2.08±0.14

Means within the same column under the same category carry different subscript are significant (P<0.05); WG1= weight gain from 2-3weeks; WG2= weight gain from 3-4weeks; WG3= weight gain from 4-5weeks and WG4= weight gain from 5-6weeks. FCR1=feed conversion from 2-3weeks; FCR2=feed conversion from 3-4weeks; FCR3=feed conversion from4-5weeks and FCR4=feed conversion from 5-6weeks

Table 4. Effect of breed, Moringa, week and their interactions on weekly feed intake, water intake and mortality of broilers during two to six weeks

Level		Feed/bird/week	Water/bird/week	Mortality (%)
Breed				
	Cobb	714.17±45.1[b]	1386.67±123.82[b]	1.5±0.4[a]
	Ross	973.33±63.75[a]	1981.67±155.42[a]	0.33±0.19[b]
Treatment				
	Moringa (2%)	825±94.79	1843.75±212.85[a]	1.13±0.48
	Moringa (3%)	876.25±77.9	1716.25±183.31[a]	0.88±0.44
	Control	830±79.31	1492.5±207.53[b]	0.75±0.41
Week				
	Week3	600±22.36[a]	1031.67±73.73[c]	0±0[b]
	Week4	918.33±66.2[b]	1788.33±149.56[b]	0.33±0.28[b]
	Week5	1043.33±73.29[a]	2156.67±184.84[a]	1.67±0.56[a]
	Week6	813.33±94.15[c]	1760±222.38[b]	1.67±0.49[a]
Moringa * Breed				
Moringa(2%)	Cobb	672.5±81.07	1555±197.08	1.5±0.87
	Ross	977.5±140.91	2132.5±342.04	0.75±0.48
Moringa(3%)	Cobb	772.5±74.2	1512.5±238.24	1.75±0.63
	Ross	980±125.03	1920±269.04	0±0
Control	Cobb	697.5±92.14	1092.5±171.68	1.25±0.75
	Ross	962.5±95.69	1892.5±254.64	0.25±0.25
Week * Breed				
Week3	Cobb	556.67±6.67	900±97.13[f]	0±0
	Ross	643.33±24.04	1163.33±20.28[ef]	0±0
Week4	Cobb	776.67±23.33	1480±116.76[d]	0.67±0.67
	Ross	1060±36.06	2096.67±56.08[bc]	0±0
Week5	Cobb	893.33±14.53	1830±167.03[c]	2.67±0.33
	Ross	1193.33±64.38	2483.33±190.29[a]	0.67±0.67
Week6	Cobb	630±100	1336.67±253[de]	2.67±0.33
	Ross	996.67±26.67	2183.33±63.6[b]	0.67±0.33

Means within the same column under the same category carry different subscript are significant (P<0.05); Feed/bird/week= feed intake per bird per week; Water/bird/week= water intake per bird per week

Table 5. Effect of breed, Moringa supplementation, and their interactions on carcass weight, dressing, thigh, breast and shoulder weights traits of broilers at 42 days

Item		Carcass Weight	Dressing (%)	Thigh	Breast	Shoulder
Breed						
	Cobb	1348.06±54.89[b]	0.76±0.007	311.89±24.38	269.44±17.33[b]	76.11±3.2
	Ross	1561.11±51.15[a]	0.74±0.004	365.44±15.59	319.44±21.27[a]	87.22±4.26
Moringa (%)						
	M(2%)	1440.83±108.98	0.76±0.009	338.17±24.77	304.17±39.25	83.33±6.28
	M(3%)	1396.25±60.51	0.75±0.009	320±21.17	275.83±17.48	80±6.06
	Control	1526.67±54.99	0.75±0.006	357.50±23.57	303.33±15.2	81.67±3.07
Breed*Moringa (%)						
Cobb	M(2%)	1221.67±25.87	0.77±0.018	286.67±3.33	233.33±13.33[c]	73.33±3.33
	M(3%)	1307.5±86.64	0.77±0.007	290±15.28	245±20.21[c]	73.33±7.26
	Control	1515±72.34	0.75±0.012	385.66±25.66	330±15.28[ab]	81.67±6.01
Ross	M(2%)	1660±103.32	0.76±0.004	389.67±20.09	375±50.08[a]	93.33±9.28
	M(3%)	1485±54.08	0.73±0.008	350±33.29	306.67±13.02[abc]	86.67±9.28
	Control	1538.33±98.76	0.74±0.003	356.67±30.87	276.67±14.53[bc]	81.67±3.33

Means within the same column under the same category carry different subscript are significant (P<0.05); M(2%)= moringa oleifera 2%; M(3%)= moringa oleifera 3%

Table 6. Effect of breed, Moringa supplementation, and their interactions on internal organs weight of broilers at 42 days

Item		Gizzard	Abdominal fat	Intestine	Liver	Heart
Breed						
	Cobb	30.56±1.45[b]	24.67±5.02	88.11±5.87[b]	38.11±1.4[b]	8.89±0.59
	Ross	35.33±1.29[a]	19.89±1.61	107.56±4.64[a]	49.67±3.23[a]	10.33±0.55
Moringa (%)						
	M(2%)	33±2.5	26±7.4	91.33±8.69	45.17±4.78	9.17±1.14
	M(3%)	33.67±1.31	18.33±2.01	93.83±6.3	39.83±2.36	9.83±0.65
	Control	32.17±2.07	22.5±2.32	108.33±6.51	46.67±4.01	9.83±0.31
Breed*Moringa (%)						
Cobb	M(2%)	29±1.73	35.67±13.38	73.33±4.41	36.67±1.45	7.33±0.33
	M(3%)	31.67±1.76	18.33±4.41	87.67±10.11	36±3	9.33±1.33
	Control	31±4.16	20±3.51	103.33±8.21	41.67±1.67	10±0.58
Ross	M(2%)	37±3.51	16.33±1.2	109.33±5.81	53.67±6.33	11±1.73
	M(3%)	35.67±1.2	18.33±0.88	100±7.64	43.67±2.03	10.33±0.33
	Control	33.33±1.67	25±2.89	113.33±10.93	51.67±7.26	9.67±0.33

Means within the same column under the same category carry different subscript are significant (P<0.05); M(2%)= moringa oleifera 2%; M(3%)= moringa oleifera 3%

Table 7. Newcastle disease virus HI titers for the collected blood samples from both breeds (Cobb 500 and Ross 308) at 42 days of age

Chickens Groups	**Geometric mean (GM) of HI titers (Log 2)**	
	Cobb	Ross
Moringa (2%)	3.2	3.5
Moringa (3%)	3.6	4
Control	2.9	3

Table 8. *Lactobacillus* Count of intestinal samples from both breeds (Cobb 500 and Ross 308) at 42 days of age

Chickens Groups	***Lactobacillus* count**	
	Cobb	Ross
Moringa (2%)	3×10^5	8×10^6
Moringa (3%)	25×10^5	1×10^7
Control	4×10^4	3×10^4

Regarding the breed effect, Ross 308 showed significant increase (P<0.05) in carcass weight and breast muscle weight compared to Cobb 500 (table 4) which may be attributed to higher final body weight of Ross than Cobb breed. Moreover, gizzard, liver and intestine weights were significantly (P<0.05) higher with Ross compared to Cobb breed this may be resulted from significantly (P<0.05) higher feed intake of Ross than Cobb breed which increased gizzard, intestine and liver weights.

The effect of *Moringa oleifera* on immune response, indicated that Ross 308 breed showed an increased immunity against NDV than Cobb 500 breed (table 6) and these data were a confirmation to Eze et al. (2013) who reported that *Moringa oleifera* extract increased ND HI titer in the vaccinated and un-vaccinated chicken groups with NDV vaccines.

The observed data indicated the better weight gain and FCR in Ross 308 chickens as it has a significant increase in *Lactobacillus* count inducing better feed digestion, absorption, increased digestive enzymes as well as reducing the bad effect of harmful bacteria in the intestinal tract. Also, Yang et al. (2007) indicated the positive effect of *Moringa oleifera* (3% dried leaves) on enhancement of duodenum traits, increased concentrations of total globulin, γ-globulin and IgA, lymphocyte ratio, reduced *E. coli* and increased *Lactobacillus* counts in ileum improving the whole immune responses and improved intestinal health of broilers which helped in increasing the production of digestive secretions and nutrient absorption, reduced pathogenic stress in the gut, exert antioxidant properties and reinforce the animal's immune status, which help to explain the enhanced performance in poultry.

CONCLUSION

Ross breed responded better to dietary Moringa supplementation than Cobb. Also, Ross breed achieved significantly higher (P<0.05) body weight, weight gain, feed intake, FCR, carcass weight and breast muscle weight compared to Cobb breed. Ross 308 breed showed an increase in HI titer against NDV than Cobb 500 breed.

Competing interests

The authors declare that they have no competing interests.

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