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Research Article
Effect of *Moringa oleifera* Leaf Meal on Growth Performance and Blood Parameters of Egg Type Chicken During Juvenile Growth

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Abstract

Background and Objective: Medicinal plants are currently used as alternative to antibiotics growth promoters. However, their positive effect on livestock growth performance, particularly on poultry, depends on the rearing conditions and the birds' lines. This study investigated the effect of different levels of *Moringa oleifera* leave meal (MOLM) on performance and serum biochemical parameters of egg-type chicken from one day old to 8 weeks of age. **Methodology:** A total of 450 days old chicken were randomly assigned to three treatment groups (M0, M1 and M3), 150 birds per treatment group and were respectively fed with diets containing 0, 1 and 3% of *Moringa* leaf. During experimental period, feed intake, body weight and feed conversion ratio were recorded weekly. At 5 weeks of age, 12 birds per group were slaughtered to collect blood, gizzard, pancreas, heart and liver. Blood serum concentrations in total protein, albumin, uric acid, calcium, magnesium and iron were also determined. **Results:** Results showed similarity between feed intake, liver relative weight while significant differences ($p<0.05$) between treated groups and the control one were observed on body weight, daily weight gain, feed conversion ratio and gizzard relative weight. In addition, total protein, albumin, calcium, magnesium and iron levels were significantly increased ($p<0.05$) in chickens fed MOLM as compared to control. The results also indicate that chickens of control diet group had higher blood uric acid level ($p<0.05$). However, no significant difference in phosphorus concentration was found between groups. **Conclusion:** During juvenile growth, MOLM did not affect feed intake, liver relative weight and phosphorus level. The leaves affect body weight, daily weight gain, feed conversion ratio and gizzard relative weight. Significantly differences were observed on total protein, albumin, calcium, iron and magnesium levels.

Key words: Blood parameters, chickens, metabolites, growth performance, *Moringa oleifera* leaf meal

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The increase in cost of animal feeds and the ban of antibiotic growth promoters utilization in poultry industry have lead researchers to focus their attention on non-conventional feedstuffs[1,2]. According to these authors, the use of plants as animal feedstuffs might contribute in reduction in feed cost, increase the production and farmer's profitability. Thus, herbs, spices and various plants extracts naturally used by human because of their nutritional value and medicinal effect have been studied to evaluate their contribution to poultry health and feeding[3-5]. To achieve this goal, Mmereole[5] investigated the effects of *Cymbopogon citratus* leaf meal on growth performances of broiler chickens and showed that lemon grass (*Cymbopogon citratus*) leaf meal can be considered as a viable alternative to antibiotics growth promoters. Other studies have pointed out poultry production improvement when they were fed with *Azadirachta indica*[6], *Tephrosia bractereolata*[7] and *Gliricidia sepium*[8]. *Moringa oleifera* is also another promising leaf meal in livestock feeding. In many tropical and subtropical countries, all parts of *Moringa oleifera* tree are edible and have been incorporated into human's traditional food[9,10]. But its leaves are the preferred part used in animal feeding as leaf meal because of its high content in vitamins, minerals and proteins[11]. *Moringa oleifera* contains also some bioactive molecules which reduce the activity of pathogenic bacteria[12] and improve the digestibility of other foods helping chickens to attain their genetic potential. Several researches have showed *Moringa* leaf meal effects on broiler's weight gain, feed conversion ratio and body weight[13-15], on egg production[16-18]. However, there is a paucity of research regarding the effects of *Moringa oleifera* leaf meal on the blood parameters of chicken during their starter period. It is well know that evaluation of blood parameters allows for identification of metabolic alteration due to many endo-and exogenous factors such as genotype, age, season and diets. Many medicinal plants used as food supplements have been involved in pathological manifestations such as liver lesions and tumors, lung and kidney disease[19]. In this regard, it is necessary to investigate the effect of *Moringa oleifera* leaf meal on chicken's blood biochemical profiles during their starter period. The objective of this study was to examine the effect of *Moringa oleifera* leaf meal on growth performance and biochemical parameters of egg-type chicks up to 8 weeks of age.

MATERIALS AND METHODS

Experimental design: The study was carried out at the Centre d'Excellence Regional sur les Sciences Aviaires (CERSA), University of Lome (Togo). During 8 weeks, 1 day-old chicks ISA brown (layer-type) were fed with three types of diets containing *Moringa oleifera* leaves. Leaves were collected from farmer's field in Togoville (Vo district in Togo) and dried under air conditioning system and hand-crushed before using. Four hundred and fifty days old ISA brown chicks (layer-type) were randomly assigned into three groups (M0, M1, M3) with 3 replications of 50 chicks in each treatment group. They were fed basal diet supplemented with *Moringa oleifera* leaves meal (MOLM) at the levels of 0, 1 and 3%, respectively. Each diet was formulated to fit crude protein (CP) and metabolisable energy (ME) (Table 1).

Data collection

Production parameters: The amount of feed offered and refused per pen was recorded daily. The amount of feed consumed was determined as the difference between feed offered and remaining feed. Birds were weighed each week individually and pen average was calculated. Body weight change was calculated as the difference between the final and initial body weight. Average daily body gain was calculated as body weight change divided by the number of experimental days. These data were used to determine feed conversion ratio by dividing feed intake by body weight gain.

Table 1: Gross composition of experimental diets (%)

	Groups		
Feed stuffs	M0	M1	M3
Maize	56	55.9	55.32
Wheat bran	11	11.3	11.66
Fish meal	8	7.5	7.12
Soya seed	20	19.3	17.9
Concentrate	4	4	4
Oyster shell	1	1	1
Moringa leaf	0	1	3
Total	100	100	100
Calculated analysis			
EM (kcal kg^{-1})	2962.50	2956.00	2942.81
CP (%)	20.11	19.88	19.58
Calcium (%)	0.97	0.95	0.93
Available phosphorus (%)	0.05	0.05	0.05
Sodium (%)	0.35	0.34	0.34
Lysine total (%)	1.09	1.06	1.01
Methionine total (%)	0.48	0.47	0.46
CF (%)	4.99	4.97	4.89

CP: Crude protein, ME: Metabolizable energy, CF: Crude fibre

Internal organs weight: At 5 weeks of age, 4 randomly selected birds from each replication were weighed and slaughtered. After slaughtering, the birds were de-feathered and eviscerated. The gizzard, heart, pancreas and liver were weighed. The organ weights were used to determine their proportion of body weight.

Bio-chemical analysis: On the average, 4 mL of blood samples for serum biochemical test were obtained from the same birds by inserting a sterile needle into the wing vein of the birds before slaughtering. All blood collection tubes were kept on ice in cool containers. The blood was allowed to coagulate and was centrifuged at 3000 rpm for 10 min to obtain serum which was stored in a freezer at -20°C for analyses. Commercial diagnostic Kits were used for determination of levels of total protein (997180), uric acid (30390), albumin (CNQ), calcium inorganic (BXCO292A), phosphorus (3-245), magnesium (CNQ:EB) and iron (CNQ-Gw) by using Technicon RA 1000 Auto-biochemical analyzer (Instruments Corporation, Tarrytown, New York, USA). Concentration of the biochemical constituents was calculated according to the manufacturer instructions.

Statistical analysis: A commercial scientific 2D graphics and statistics software GraphPad Prism published by GraphPad Software, Inc., a privately held California (USA) corporation[20] was used to analyze the data. One-way ANOVA model was used to compare the effect of *Moringa oleifera* on feed intake, body weight, feed conversion ratio, internal organs weight and biochemical parameters. If the overall F-value was statistically significant ($p<0.05$), further comparisons among groups were made according to Tuckey's test.

RESULTS

Productive performance

Body weight, feed intake and feed conversion ratio: Body weight, day weight gain, feed intake and feed conversion ratio according to treatments are summarized in Table 2. Overall, chicks weights increased with age. Birds fed with *Moringa* leaf were significantly heavier than those fed with the basal diet at 8 weeks of age ($p<0.05$). In addition, final body weight of chicks fed diet containing 3% of leaf was significantly higher than the final weights of chicks fed diet containing 1% of leaf ($p<0. 05$). The same trend was observed with daily weight gain. About feed intake, values were comparable between M0, M1 and M3. On the contrary, feed conversion ratio was significantly different between the three groups and was in the following order: M3<M1<M0 ($p<0.05$).

Table 2: Effect of different levels of dietary *Moringa oleifera* leaves meal (MOLM) on body weight gain, feed intake and feed conversion ratio at 8 weeks of age

	Groups		
Parameters	M0	M1	M3
Initial live body weight (g)	33.28±0.51	33.26±0.89	33.27±0.56
Final live body weight (g)	497.89±6.22^{c}	543.20±4.97^{b}	563.66±5.88^{a}
Daily feed intake (g)	31.25±7.39^{a}	31.18±7.27^{a}	30.13±7.97^{a}
Daily weight gain (g)	8.28±0.12^{c}	9.08±0.24^{b}	9.45±0.43^{a}
Feed conversion ratio	3.76±0.18^{a}	3.41±0.21^{b}	3.17±0.14^{c}

^{a,bc}Means in the same row with different superscripts are significantly different ($p<0.05$)

Table 3: Effect of different levels of dietary *Moringa oleifera* leaves meal (MOLM) on relative weight (% body weight) of some internal organs of laying chickens at 5 weeks of age

	Groups		
Parameters	M0	M1	M3
Gizzard	5.83±0.13^{b}	6.37±0.17^{a}	6.39±0.22^{a}
Liver	2.84±0.08	2.83±0.05	2.82±0.03
Heart	0.59±0.01^{a}	0.54±0.02^{b}	0.52±0.02^{b}
Pancreas	0.56±0.01^{b}	0.59±0.02^{a}	0.56±0.03^{b}

^{a,b,c}Means in the same row with different superscripts are significantly different ($p<0.05$)

Table 4: Effect of different levels of dietary *Moringa oleifera* leaves meal (MOLM) on bio-chemical parameters at 5 weeks of age

	Groups		
Parameters	M0	M1	M3
Total protein (g L^{-1})	25.70±0.58^{b}	35.93±1.31^{a}	36.70±1.03^{a}
Albumin (g L^{-1})	8.10±0.48^{b}	9.61±0.92^{a}	10.15±0.64^{a}
Uric acid (mg dL^{-1})	7.56±0.58^{a}	6.06±1.24^{b}	5.68±0.15^{b}
Calcium (mg L^{-1})	65.33±4.53^{b}	81.16±4.16^{a}	85.33±1.62^{a}
Magnesium (mg L^{-1})	19.57±0.49^{b}	20.83±0.88^{a}	21.03±0.88^{a}
Iron (mg L^{-1})	1.20±0.07^{b}	1.38±0.09^{a}	1.35±0.20^{a}
Phosphorus (mg dL^{-1})	5.71±0.71	5.59±0.53	5.65±0.43

^{a,b,c}Means bearing different superscripts within the same row are significantly different

Organ relative weights: Table 3 showed organ relative weights of liver, gizzard, heart and pancreas in function of diet treatments. Liver relative weights were similar while gizzard relative weight of groups M1 and M3 were higher than those of the control group ($p<0.05$). The chicks in M1 had the highest ($p<0.05$) pancreas relative weights than M0 and M3 while heart relative weights was higher ($p<0.05$) in M0 than M1 and M3 whose values were comparable.

Blood serum bio-chemical parameters: The effect of different treatments on the serum biochemical parameters are shown in Table 4. Results show that total protein and albumin levels were significantly increased ($p<0.05$) in chickens fed MOLM as compared to control. The same trend was observed with calcium, magnesium and iron concentrations while phosphorus concentrations were comparable between the

three groups. In contrast, uric acid concentration was significantly lower in the birds offered Moringa than those in the control group.

DISCUSSION

In this study, although feed intake was comparable among the three groups, serum and production parameters were significantly affected. This similarity between feed intakes agrees with the results of Teteh *et al.*[18,21] and Sanchez *et al.*[22], who have showed that *Moringa oleifera* leaves did not contain any factors that could limit feed consumption. Though feed intakes were similar in the current study, feed conversion ratio was significantly low in birds fed with *Moringa oleifera* leaves ($p<0.05$). This better growth performance was also observed by Melesse *et al.*[23] with Red Island Rhode fed diet containing up to 6% of *Moringa stenopetala* leaf meal, Hassan *et al.*[24] with broiler fed diet supplemented with 0.1, 0.2 and 0.3% MOLM. Results of Makkar and Becker[25] revealed that *Moringa oleifera* leaves are rich in minerals, vitamins and especially protein with eight essential amino acids. Thus, the improvement of chicken growth may be attributed to those essential nutrients contained in *Moringa* leaves. Moreover, the growth performance of chicks can be linked to the high digestibility of this leaf as showed by Teteh *et al.*[21]. The high weight of gizzard can be due to its increased muscular activity to grind the high amount of fibers in diets of M1 and M3. It has been shown that pH of a well-developed gizzard content decreased by a magnitude of between 0.2 and 1.2 units[26]. Thus, birds fed with MOLM would have the beneficial effects of a reduced pH which inhibits pathogenic microflora growth in the digestive tract and improves gastric digestion.

Generally, total plasma proteins are parameters used to estimate avian body condition. It plays numerous roles such as: Maintenance of colloid osmotic pressure, transport of minerals and hormones, rapid substitute for indispensable amino acids, assuring glucose through gluconeogenesis, forming enzymes and immune system in the organism. According to Yaman *et al.*[27], albumin is one of the main plasma proteins which serve as source of amino acids for synthesis of tissue proteins in the period of quick somatic growth of birds. The content of protein in the blood serum in present study experiment showed significant increase ($p<0.05$) in birds fed MOLM. Also, the serum albumin level demonstrated an increasing tendency and the highest ($p<0.05$) content of this protein fraction was detected in the group fed MOLM. Similar results were obtained by Tesfaye *et al.*[28], who found that 5 and 10% MOLM improved broilers serum total protein. The relatively greater total plasma protein and albumin content in birds receiving dietary MOLM may be due to contraction intensity and retention time of voluminous gizzard which improve the degradation of feed nutrients in the leaf meal by pepsin and hydrochloric acid. Because of increased needs of synthesis and intensive somatic growth, the liver of birds received MOLM increases the synthesis of total proteins and albumin which results in the increasing of their live body weight at 8th week of age. In birds, uric acid is the major nitrogenous waste product. Any change in protein catabolism is mainly reflected in serum uric acid concentration. Age and diet may influence the concentration of blood uric acid in birds but high values for uric acid may represent kidney disease[29]. In the present study, uric acid was significantly reduced in birds fed MOLM. This implies that MOLM did not reduce the efficiency of kidney function or this might be an indication of the non-toxic action of MOLM on the body metabolism of the birds. Minerals are essential for animal growth and they are involved in many physiological, digestive and biosynthetic processes within the body. Magnesium is involved in the metabolism as a catalyst of a wide array of enzymes. Iron is an essential constituent of haemoglobin, myoglobin and cytochrome enzymes and calcium is mainly needed for the ossification of bones, regulation of muscle activity and catalization of enzyme and hormone systems while phosphorus is an important constituent of nucleic acids and phospholipids[30]. In the current study, the highest concentration content of iron, calcium and magnesium was observed in the birds fed MOLM while phosphorus level was similar within treatments. *Moringa oleifera* has been reported to be a very good indigenous source of iron, potassium, calcium, phosphorus, magnesium, vitamins and phenolic compounds[31]. Higher values of mineral in chickens fed MOLM indicate greater potential for digestive and biosynthetic function and a better state of growth.

CONCLUSION

It can be concluded that MOLM incorporation up to 3% in chick's diet has no effect on feed intake, liver relative weight and phosphorus level. Although, its incorporation has effect on body weight, daily weight gain, feed conversion ratio and gizzard relative weight. The MOLM incorporation also had a positive effect on total protein, albumin, calcium, iron and magnesium levels. Therefore, MOLM can be used by farmers to enhance bird's performance. Further studies are required to observe the dose dependent effect of MOLM on global gene expression profiling in chicken liver.

SIGNIFICANCE STATEMENT

This study discovers the possibility to enhance total protein, calcium, iron and magnesium level by using *Moringa oleifera* leaves meal that can be beneficial for chickens growth and health status. This study will help the researchers to uncover the critical areas of the increasing price of conventional ingredients that many researchers were not able to explore. Thus, a new theory on reducing production cost by using available feed ingredients may be arrived at.

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