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Effect of Different Organic Feed Ingredients on Growth Performance, Haematological Charactersistics and Serum Parameters of Broiler Chickens

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Abstract: Growth performance, haematological characteristics and serum parameters of organically raised broiler chickens were determined in a twelve-week feeding and management trial. Conventional birds (control) and organically raised birds (groups X, Y and Z from which organic millet, sorghum and wheat have been excluded from their diets respectively) were produced in a 2 x 4 factorial arrangement of a completely randomized design (CRD) experiment. One hundred and eighty days old broiler chicks of Ross breed were randomly allocated to four dietary and management treatments in triplicates of 15 birds per replicate. The conventional birds were raised on deep litters, vaccinated, given mediations and were fed premixes along with the *ad libitum* diet supply. Organic birds were allowed a three hour foraging daily on experimental quadrants, although they were also raised on deep litter system. Data collated were taken at both the 8^{th} and 12^{th} weeks. Results of growth performance, haematological characteristics and serum parameters were significantly different ($p<0.05$) at both 8^{th} and 12^{th} weeks, except for haemoglobin and total protein. It was demonstrated that diet, days of slaughter and management practices had significant effects on the growth, haematology and serum parameters of organic broiler chickens. It was concluded that in derived savannah zone Nigeria, safe organic broiler chickens can be produced with diets of CP value of 24.67 - 27.24% and metabolizable energy of between 3002.45-30067.63 kcal/kg, if allowed outdoor access, forages and exclusion of vaccines and synthetic medications.

Key words: Organic broilers % Growth performance % Haematology and serum characteristics

INTRODUCTION

The world's population is predicted to increase each year by 70-80 million in third world and developing countries, [1] and projected population in 2000 shows an increase from 6.1 billion to 7.9 billion in 2025. The human population of the sub-Saharan Africa will be about one billion by the year 2020 [2]. The increase economy of many developing countries improves the demand for animal products, especially meat as a source of protein and chicken continues to be the least expensive meat in most of these countries. In fact hardly there will be any community without either domestic or exotic chickens. The broiler industry is therefore ideally suited to meet this expected increased demand for animal protein with improved efficiency of production [1].

To meet this calls for the need to improve agricultural production by engaging in not only the utilization of crops but also animal husbandry to provide food for man. Livestock are an important component of farming systems in sub-Saharan region of Africa [2], rearing poultry either subsistent or commercially represent more than 80% poultry production in Africa [3] and it appear to have rapid growth in population [4]. Nigeria as a country expended about 8 million US dollars on the import of poultry meat in 2005 [5] thus showing a wider gap between the production and consumption of animal protein with per capita consumption below 2% per person per day, as against recommendation by Food and Agricultural Organization [6] to be the minimum requirement for the growth and development of the body [7, 8] and this is far below 67g per day recommended by World Health Organization. This means that the demand for protein of animal origin is greater than its supply, possibly because of increased human population. Despite all the available natural and artificial resources the high demand for animal industries in developing industries has not been met.

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Animal protein has failed to meet the increasing demand and make full use of its potential [9].

Organic livestock or Organic farming is a method of raising crops and livestock that excludes the use pesticides, fertilizers, growth enhancers, genetically modified organisms, (GMOs), antibiotics and growth hormones. Organic farming is a holistic system designed to optimize the productivities and fitness of diverse communities within the agro-system, including soil organisms, plants, livestock and people. The principal goal of organic farming is to develop enterprises that are sustainable and harmonious with the environment. The general targets of organic production according to the Canadian standards (2006) are protection of the environment, minimize soil degradation, optimize biological productivity, promote a sound state of health, prepare attentive care that promotes the health and meet the behavioural needs of livestock, maintain the organic integrity and vital qualities of the product at all stages of production [10].

Animals to be certified organic must be allowed access to pasture for most of their lives. Movable forms of housing which do not restrict animal movement are the best form required for organic livestock farming. Antibiotics and other synthetic medications are only allowed in situations of disease incidence which has surpassed the economic threshold level. The use of naturally occurring active ingredients of veterinary importance in roots and herbs is recommended and animals are allowed to combat diseases with the farm's high level of hygiene and their natural antibodies [11]. Organic farming presents many challenges, some products are more challenging than others; however, nearly every agricultural products can be processed organically. Organic agricultural products are fast becoming a household name. Benefits derived from organic agricultural products include reduction of toxic load, keeping chemical out of the air, water soil and our bodies, eliminates off farm pollution [11], protects the future generations [12], contributes to the building of healthy soil and organic promotes biodiversity. Organic products taste better and possess truer flavours, it also affords the final consumers to really understand and appreciate what agriculture is [13].

The solution to the problem of animal protein shortage lies in the production of fast maturing livestock animals like poultry, with the utilization of cheap and locally available but safe feedstuffs in order to produce them at affordable prices. Over the years, the demand for a cheap, fast and affordable source of protein has skyrocketed (due to incessant population surge) and higher pressure was placed on poultry products expansion. The introduction of organically raised meat products was due to the ailments contacted form consuming conventionally raised animal products. A recent research also proved an imbalance between the omega 6 and omega 3 essential fatty acids in conventionally produced meat and eggs [14]. Therefore this research work has been designed to evaluate the effect of different organic feed ingredient on growth performance, haematological characteristics and serum parameters of broiler chickens.

MATERIALS AND METHODS

Site of Experiment: The research was carried out at the poultry unit of the Teaching and Research Farm, Ladoke Akintola University of Technology Ogbomoso which is located at derived savannah region of Nigeria.

Collection and Preparation of Test Ingredients: The conventional (control) feeds were purchased at a reputable feed mill in Ogbomoso. The organic food ingredients such as maize and millet were sourced for in Akufo, Oyo state, interior area of southwest while soybean, wheat offal and sorghum were got from Mokwa, Niger state, north central Nigeria. Feed ingredients for organic diet were processed in various ways to reduce the anti-nutritional factors to the barest minimum. For example, soybean was toasted before milling to reduce the content of trypsin inhibitors, lactins, saponins, raffinose and stachyoses. After processing in various ways for the removal of anti-nutrients, the experimental diets were milled and mixed in a local milling house (where household foodstuffs are milled) to prevent contamination or mixing with conventional foods. The experimental diets were supplemented with known weights of adequately rinsed fresh leafy vegetable like *Amaranthus esculentus*, (succulent Amaranths), *Talinum triagularae* (water leaf) and *Cellocia esculentus* (green) as sources of vitamins and minerals.

Preparation on Arrival of the Birds: On arrival, the control groups were supply with clean, cool water mixed with anti-stress and glucose, while the treatment groups were given only water and the birds were trained how to eat and drink from their trays by dipping their beaks in feed and water. The experimental birds were randomly allotted to a 2 x 4 factorial arrangement of a completely

randomized design (CRD). Fifteen birds were allotted to each replicates making forty five birds per treatment. The experiment lasted eight weeks.

Routing Care of the Birds: Drinkers were washed daily and fresh water was served *ad libitum*. Wood shavings Feacal droppings and wood shavings were removed from feeding and drinking troughs before fresh feeds were served. Litters were changed when due. Vaccination and medication were given to the birds on the control as at when due. For the organic group of birds, the daily water administered to them was mixed with extracts of neem tree and garlic. On occasions when there is morbidity, the sick birds were isolated and treated with conventional medications and they were not returned to the flock.

Feed Intake and Weight Gain: Feed given to both organic groups and control groups were weighed before serving and the remnants in the feeders were also weighed daily. The difference was recorded as the feed intake per day. The initial weights were taken at the commencement of the experiment. Subsequently, birds were weighed weekly and their weights were recorded accordingly until the twelfth week when the experiment was terminated.

Blood Analysis: Blood samples were taken at eighth and twelfth week respectively from six birds per treatment, two from each replicate, by severing the jugular vein. Blood meant for haematological analysis were collected into bottles containing ethylene diamine tetra-acetic acid (EDTA) which serves as anti-coagulant, to prevent blood clotting. Blood meant for serum analysis were collected in bottles without EDTA. The samples were subjected to Laboratory analysis to determine haematological parameters which includes packed cell volume (PCV), Haemoglobin (Hb), Red Blood Cells (RBC) count and White Blood Cell (WBC) count. Haematological parameters (packed cell volume, red blood cell count, white blood cells, haemoglobin and lymphocytes) were determined as outlined by Schalm *et al.* [15]. The serum biochemical assay was carried out using standard chemical procedures: Total serum by Golgberg refractometer, Albumin by Bromocresol green (BCG) method, Urea Nitrogen [16], Alkaline phosphatase by spectrophotometric method [17].

Laboratory Analysis: The proximate analyses of experimental diets were determined by the AOAC [18] method and Bomb calorimeter was used to determine the gross energy (GE) value of experimental diets.

Statistical Analysis: Data collected were subjected to one way analysis of variance (ANOVA) using SAS (2000), while the means were separated using Duncan multiple range test. The experimental birds were randomly allotted to a 2 x 4 factorial arrangement of a completely randomized design (CRD).

RESULTS AND DISCUSSION

Feed conversion ratio (FCR) was significantly different ($p<0.05$) at the 8th week. The birds in group X (organic diet minus millet) had the highest value of (3.41), group Y (organic diet minus sorghum) had 3.24 and birds fed with diet Z (organic diet minus wheat) had 2.54. The control diet had the least FCR (1.95) and by implication had the best FCR at the 8th week as they required only 1.95g of feed to gain 1g of body weight, which is economically better than the other groups. Great numbers of literatures have ascertained the effect of feed quality (nutritional components and absence / presence of anti-nutritional factors) and management systems on feed conversion ration of broiler birds [19, 20] Results from this study indicated that feed conversion ratio (FCR) of conventional birds were better than that of organically fed birds at the 8th week. The reason may be due to conditioning in the physiology of organic birds to the fed diets and, the outdoor access which increased their activities and probably reduced their body weight gain. The lower feed intake recorded both at the 8th and 12th weeks was due to the fact that organic birds consumed forages (asides formulated feed) and these forages contain flavonoids and carotenoids which are antioxidants and prevents excessive fat let-down.

Diets has been established to have a measurable effect on blood components and latter in turn are widely used in nutritional evaluation [21]. These claims were supported by the study as all the heamatological parameters (except WBC, at 12th week and lymphocytes at 8th week) were significantly different. Packed cell volume was significantly different in all groups of birds and it falls within range value recommended by Mitruka and Rawnsley [22] except for group Y birds with overall PCV value of 23.95 as opposed to Mitruka and Rawnsley [22] which reported a range of between 24.90-45.20%. This signifies that organically raised broiler chickens' PCV is within range as stipulated by specialists. The lower PCV of organic birds might imply high level of blood dilution.

Table 1: Formulation of experimental diets (Broiler Starter Mash).

Ingredient	Control	X	Y	Z
Conventional maize	48.07	-	-	-
Organic wheat	-	14.01	14.99	-
Organic sorghum	-	14.01	-	13.99
Organic millet	-	-	14.99	14.99
Wheat offal	7.5	7.50	7.50	7.50
Full fat soya	-	43.02	43.02	43.02
Commercial SBM	40.03	-	-	-
Local fish meal	2.50	2.50	2.50	2.50
Palm oil	-	2.00	2.00	2.00
Oyster shell	1.20	2.70	2.70	2.70
Bone meal	2.00	-	-	-
Vitamin premix	0.25	-	-	-
Methionine	.18	-	-	-
Lysine	0.25	-	-	-
Salt	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated Nutrients				
Metabolizable Energy (kcal/kg)	2872.67	3002.45	3019.00	3067.60
Crude protein (%)	23.04	27.24	26.74	24.67
Crude fibre (%)	3.75	3.90	4.01	4.00
Fibre (%)	3.59	5.03	4.91	4.90

Table 2: Formulation of experimental diets (Broiler Finisher Mash).

Ingredient	Control	X	Y	Z
Conventional maize	48.07	-	-	-
Organic wheat	-	14.01	14.99	-
Organic sorghum	-	14.01	-	13.99
Organic millet	-	-	14.99	14.99
Wheat offal	7.50	7.50	7.50	7.50
Full fat soya	-	43.02	43.02	43.02
Commercial SBM	40.03	-	-	-
Local fish meal	2.50	2.50	2.50	2.50
Vegetable oil	-	2.00	2.00	2.00
Oyster shell	1.2	2.7	2.7	2.7
Bone meal	2.00	-	-	-
Vitamin premix	0.25	-	-	-
Methionine	.18	-	-	-
Lysine	0.25	-	-	-
Salt	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated Nutrients				
Metabolizable Energy (kcal/kg)	2872.67	3002.45	3019.00	3067.60
Crude protein (%)	23.04	27.24	26.74	24.67
Crude fibre (%)	3.75	3.90	4.01	4.00
Fibre (%)	3.59	5.03	4.91	4.90

Table 3: Effect of organic treatment on growth performance of birds at 8th and 12th week.

Parameters	8TH WEEK				12th WEEK				
	Cont	X	Y	Z	Cont	X	Y	Z	SEM
TFI(g/bird/day)	58.15^{a}	24.16^{a}	18.35^{a}	14.42^{d}	86.44^{a}	30.13^{b}	24.51^{c}	17.25^{d}	1.82
TWG(g/bird/day)	29.80^{a}	7.09^{b}	3.24^{b}	2.56^{c}	32.46^{a}	10.94^{c}	12.07^{b}	10.50^{c}	1.08
FCR	1.95^{d}	3.41^{a}	3.24^{b}	2.54^{c}	2.46^{b}	2.75^{a}	2.03^{c}	1.64^{d}	0.12

abc: Means with different superscripts within same row are significantly different ($p<0.05$) TFI= total feed intake, TWG= total weight gain, FCR = feed conversion ratio, Cont= Control: conventionally fed and raised birds X: Organically raised birds' diet minus millet, Y: Organically raised birds' diet minus sorghum Z: Organically raised birds' diet minus wheat, SEM = standard error of mean.

Table 4: Main effects of diet on the haematological parameters of organically raised broiler chickens.

Parameters	Control	X	Y	Z	SEM
PVC (%)	28.80[a]	26.80[b]	23.95[c]	25.80[b]	0.38
Hb (g/dl)	10.80	11.90	10.37	11.93	0.28
RBC (x106ml)	2.89[a]	2.81[a]	2.30[c]	2.70[b]	0.81
WBC (x106ml)	1.12[c]	1.31[a]	1.25[b]	1.31[a]	0.28
Lymphocytes (%)	75.60[a]	59.55[b]	54.47[b]	61.55[b]	0.35
MCH	37.37[b]	42.34[a]	45.09[a]	44.19[a]	2.49
MCV	99.65[a]	95.35[b]	104.13[a]	95.56[a]	4.64
MCHC	37.50[b]	44.40[ab]	43.30[ab]	46.24[a]	1.87

abc: Means with different superscripts within same row are significantly different ($p<0.05$) X: Organically raised birds' diet minus millet, Y: Organically raised birds' diet minus sorghum Z: Organically raised birds' diet minus wheat.

Table 5: Main effect of age of on the haematological parameters of oganically raised broiler chickens.

Parameters	8th week	12th week	SEM
PVC (%)	23.18[b]	28.43[a]	0.57
Hb (g/dl)	9.47[b]	12.53[a]	0.34
RBC (x106ml)	3.33[a]	1.58[b]	0.21
WBC (x106ml)	7.60[b]	2.43[a]	0.08
Lymphocytes (%)	38.76[b]	86.68[a]	0.45
MCH	28.44[b]	79.30[a]	1.49
MCV	69.61[b]	79.94	6.02
MCHC	40.85[b]	44.07[a]	2.17

abc: Means with different superscripts within same row are significantly different ($p<0.05$), X: Organically raised birds' diet minus millet, Y: Organically raised birds' diet minus sorghum Z: Organically raised birds' diet minus wheat.

Table 6: Main effects of diets on serum parameters of organically raised broiler chickens.

Parameters	Control	X	Y	Z	SEM
SGOT (iu/l)	372.16[b]	381.30[b]	417.00[a]	358.80[b]	2.14
Alk. Phos	80.72[a]	75.25[b]	81.83[b]	74.70[b]	0.31
Albumin (g/dl)	4.91[a]	4.39[b]	4.39[b]	4.51[ab]	0.24
Total Protein (g/dl)	8.88	8.69	8.66	8.89	0.51
Globulin	3.97[b]	4.30[a]	4.27[a]	4.38[a]	0.23
Cholesterol	81.81[b]	82.24[ab]	80.76[b]	86.41[a]	0.47
Urea	27.87[a]	28.86[a]	27.87[a]	25.21[b]	0.55
CaH	11.88[a]	11.47[b]	11.14[c]	11.52[b]	0.56

abc: Means with different superscripts within same row are significantly different ($p<0.05$), X: Organically raised birds' diet minus millet, Y: Organically raised birds' diet minus sorghum Z: Organically raised birds' diet minus wheat.

Table 7: Main effects of age on serum parameters of organically raised brioler chickens

Parameters	8th week	12th week	SEM
SGOT (iu/l)	375.13[b]	384.52[a]	1.13
Alk. Phos	76.76[b]	79.49[a]	0.51
Albumin (g/dl)	3.57[b]	5.53[a]	0.31
Total Protein (g/dl)	5.40[b]	7.60[a]	0.35
Globulin	4.13[b]	4.38[a]	0.21
Cholesterol	80.32[b]	85.28[a]	0.45
Urea	26.38[b]	28.58[a]	0.35
CaH	10.08[b]	11.90[a]	0.51

Normal Hb value ranges between 8.7-9.3g/dl [23]. For this study, at the 8th week, only the control group had values that fall within this range (8.10). But at the 12th week, the organic groups had higher values. This means that organically raised depressive metabolism in their first 8 weeks of life and their body reconditioned (which may be due to consumption of forages, neem plant and other natural ethno-veterinary plants) in order to meet up with demands from increased activities (outdoor access).

RBC counts were found to be within normal range according to Mitruka and Rawnsley [22]. However, there was less significant difference between conventional birds and organic birds. At the first 8 weeks, the organic birds had lower RBC counts. This can be due to the presence of some anti-nutritional compounds present in

the forages being used as supplements. But at the 12th week, their physiologies adjusted (probably due to body defensive mechanisms and presumably higher accumulation of degradative microorganisms in their gastrointestinal tract) and they had more RBC counts than their conventional counterparts. This supports the claims of Berg, [24]. However, Ernest and Ringer, [25] reported that decrease in RBC count is associated with the low quality feed and protein deficiency.

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