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Influence of ginger (*Zingiber officinale*) on histology, blood profile and internal organ characteristics of broilers

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Abstract

A study using ninety-nine day old Marshal Broiler chicks was conducted to investigate the effect of ginger root meal on the histology, blood profile and internal organ characteristics of broilers. The birds were randomly assigned to three dietary treatments replicated three times in a completely Randomized Design. Each dietary treatment consisted of 33 birds per treatment with 11 birds per replicate. Ginger root meals were supplemented at 0%, 1.5% and 3.0% representing Diet 1, Diet 2 and Diet 3 respectively. At the end of the experiment, three broilers from each replicate were sampled, slaughtered, its internal organs, tissues of the heart, liver, kidney and small intestine were collected and processed for histopathology. Blood samples for hematology and serum biochemistry were collected, analyzed and recorded. Data collected on different parameters were subjected to Analysis of Variance. Results showed that no significant differences (P>0.05) were observed on all the internal organs and on the hematological parameters. There were significant differences (P<0.05) on the serum biochemistry. The histopathology of the internal organs showed that addition of ginger root meal above 1.5% in poultry diets could be detrimental to some internal organs.

Keywords: *Blood profile, Broilers, Ginger, Hematology, Histopathology, Organ morphology.*

Description of Problem

Nutritional strategies aimed at reducing cost of animal production have led to high accumulation of fat in broiler carcass. Diets that have high cholesterol and saturated fatty acids from animal products are known to contribute to unhealthy plasma lipid levels leading to increased plasma cholesterol, triglyceride and low density lipoprotein (LDL) cholesterol [1]. Elevated blood cholesterol and triglyceride are associated with increased risk of cardiovascular disease [2]. The efficiency of growth and blood profiles tends to remain uniform throughout the developing stage of an animal but may be significantly altered by such factors as physiology, nutrition, climate, drugs, hormones, age, chemicals and environment [3, 4, 5, 6, 7, 8].

Delayed growth and underdevelopment of internal organs are some of the major constraint to efficient poultry production. Secondly, increasing cases of runts in poultry production is a challenge. This can be seen in the prevalence of runts in most poultry farms and in other sectors of livestock production enterprise. To achieve the desired purpose of increased protein intake in human, there is a great need to improve the productivity of farm animals. This requires that the internal organs of these farm animals must undergo full growth and development. The use of plant products to enhance growth and development of the internal organs and

blood profile of livestock cannot be over-emphasized. This is due to its lesser side effects, low cost and easy availability of these plant products. As a result, organic and plant products are continually being harnessed and scrutinized for their beneficial properties. Among these substances, herbal products have received increased attention and many have shown significant results [9, 5]. One of such products is ginger (*Zingiber officinale).*

Zingiber officinale is a perennial flowering plant widely known as ginger. It belongs to the family *Zingiberacae* whose rhizome serves as the storage organ. Ginger contains more than 140 phytochemicals as well as volatile oils, vitamins and minerals [10]. Ginger rhizome is known to lower blood cholesterol level in man. It has medicinal, anti-inflammatory, antimicrobial properties, speeds up digestion and widely used as preservatives, spice or condiment and for many other medicinal purposes in many homes [11, 12].

Although the beneficial effects of ginger have been exploited in human nutrition, little research has been conducted on its activity on the anatomy, physiology, growth and development of farm animal species. If the biological properties of ginger are proved to enhance growth and blood profile of broilers in this study without exhibiting deleterious effects on the physiological characteristics of birds, its potential as growth promoting supplement in poultry diets will impact positively on animal production. Therefore, it becomes justifiable to investigate the effects of ginger on the histology, blood profile and on the internal organ characteristics of broilers as well as its effects on the overall performance of broilers.

Materials and Methods

Location of experimental site

This research was conducted in the Poultry Unit of the Teaching and Research Farm of the College of Animal Science and Animal Production, Micheal Okpara University of Agriculture, Umudike, Abia State, Nigeria. Umudike is located in Abia state, Nigeria; at latitude $05^{0}29^{1}$ North and longitude $07^{0}31^{1}$ East; and at an altitude of 122 meters above sea level. It lies within the tropical rainforest zone of South-Eastern Nigeria. The location is characterized by average annual rainfall of 2,177mm in 148-155 rain days. The average ambient temperature is 25.5^{0}C with minimum and maximum temperature of 22^{0}C and 29^{0}C respectively. Relative humidity ranged from 57-91% [13].

Collection and preparation of ginger root meal

Fresh ginger rhizome was purchased fresh from Ubani market, in Umuahia, Abia State, Nigeria. It was cleaned and washed in running tap water to remove adhering debris. It was later cut into small sizes of about 1 cm, after which they were air-dried under room temperature. It was ground to coarse powder using a mechanical blender (CF-158 Hammer Muhle 2,2 Kw 380 V-cissonius). The ground sample was used in formulating the experimental diets. The compositions of the experimental diets are presented in Table 1.

Table 1: Compositions of the experimental diets (%)

Ingredients	Diet 1	Diet 2	Diet 3
Maize	47.30	47.30	47.30
Soya bean meal	28.30	28.30	28.30
Palm kernel cake	17.70	17.70	17.70
Fish meal	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00
Common salt	0.25	0.25	0.25
Lysine	0.10	0.10	0.10
Methionine	0.10	0.10	0.10
Premix	0.25	0.25	0.25
Total	100.0	100.0	100.0
Ginger Root %	0	1.5	3.0
Calculated Crude protein %	21.0	21.0	21.0
Calculated Energy (kcal/kg)	2840.0	2840.0	2840.0

Premix composition (per kg of diet): vitamin A, 12,500 IU; vitamin D3, 2500 IU; vitamin E, 50.00mg; vitamin K3, 2.50mg; vitamin B1, 3.00mg; vitamin B2, 6.00mg; vitamin B6, 6.00mg; niacin, 40mg; calcium pantothenate, 10mg; biotin, 0.08mg; vitamin B12, 0.25mg; folic acid, 1.00mg; chlorine chloride,300mg; manganese, 100mg; iron, 50mg; zinc, 45mg; copper, 2.00mg; iodine, 1.55mg; cobalt, 0.25mg; selenium, 0.10mg; antioxidant, 200mg.

Experimental design, birds and management

One hundred and fifty (150) day-old Marshal broiler chicks were purchased from a reputable hatchery in Ibadan, Oyo State, Nigeria. Two weeks pre-experimental period were used to acclimatize the broiler chicks to the experimental procedures. Thereafter, Ninety-nine (99) 2weeks old broilers were selected and randomly assigned to three treatments replicated three times with 11 birds per replicate in a completely randomized design feeding trial that lasted 56 days. They were managed in deep litter pens throughout the experimental period and were fed concentrate diets with water supplied *ad libitum*. Routine management practices were also carried out appropriately. The 3 treatments consisting of 0%, 1.5%, and 3.0% ginger root meal supplemented diets, designated Diet 1, Diet 2 and Diet 3, respectively. Diet1 served as the control. The experimental model is as follows:

$Y_{ij} = U + T_i + e_{ij}$

Where Y_{ij} = individual observation on the broiler characteristics.

μ = overall mean

T_i = treatment effect

e_{ij} = random error assumed to be independently, identically and normally distributed with zero means and constant variances.

Data collection

Initial and final body weights of the broilers were measured on arrival to the poultry Farm and at the end of the experiment respectively. Subsequently, body weights and other growth performance parameter were taken at weekly interval throughout the study. All weight measurements were done using electronic weighing scale (OHAUS Champ II). Weight gain was calculated from the difference between the final weight and initial weight. At the end of the 8 weeks experiment, 3 birds sampled from each replicate were slaughtered; its internal organs were collected, measured and recorded.

Hematology

Three (3) blood samples from each replicate were collected from the broiler birds for hematological examination. A 5-ml syringe fitted with a sterile needle was used to collect about 2 ml of blood and quickly transferred to Ethylene Diamine Tetraacetic Acid (EDTA) sample bottles. The EDTA sample bottles were shaken gently to prevent clotting. The following hematological indices were determined: Packed cell volume, Hemoglobin, Red Blood Cell, White Blood Cell, Mean Cell Volume, Mean Cell Hemoglobin and Mean Cell Hemoglobin Concentration. Packed cell volume (PCV) was determined by the micro-hematocrit method as described by [14]. Hemoglobin (Hb) concentration was determined using a spectrophotometer through the cyanomethaemoglobin method as described by [15]. Red blood cell (RBC) and white blood cell (WBC) counts were determined using Neubauer hemocytometer method as described by [16]. Mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were calculated according to [16] and [17]

Serum Biochemistry

Three (3) blood samples from each replicate were collected for serum biochemistry from the broiler birds and transferred into sample bottles without anti-coagulant. About 2ml of blood collected was allowed to clot for 30 min, after which it was centrifuged at 3000 revolutions per minutes for 10 min in order to separate the serum from the clot. After the centrifugation, the serum was carefully collected and transferred into a clean sample bottle and the blood chemistry tests were performed thereafter. The following blood chemistry indices were determined: Cholesterol, Triglyceride, Blood Urea, Total protein, Albumin, Globulin, Glucose, Total bilirubin, Serum Creatinine, High Density Lipoprotein, Aspartate amino transferase (AST) and Alanine amino transferase (ALT). The blood for serum biochemical parameters were collected and analyzed colorimetrically and spectrophoto-meterically as described by [18, 19 and 20]. The blood for Hematology and Serum biochemistry were analyzed at the College of Veterinary Medicine, Michael Okpara University of Agriculture, Umudike.

Histological study

At the end of the 8 weeks experiment, three (3) broilers sampled from each replicate were slaughtered. The tissues of the heart, liver, kidney and small intestine were collected and processed for histopathology. The tissue was embedded, dehydrated in an alcoholic solution of different concentrations. Clearing and impregnation was done using xylene and paraffin wax respectively. The tissue was cut (Sectioned) using a microtome (Rotary Kepee Model KD 202A), stained with hematoxylin and eosin; and examined using a light microscope of different magnification according to the procedure described by [21, 22] and [23] for histological studies. The slides were observed for histological indicators to observe for possible degenerative changes on the tissue structure using a microscope connected to a computer system. A photo-micrographic software - Phoenix Micro Image Analysis (2003) version 1.33 was used to project the slides on the computer for clear assessment. The slides were subsequently captured and printed for interpretation at the Physiology Laboratory

of the College of Animal Science and Animal Production, Michael Okpara University of Agriculture, Umudike.

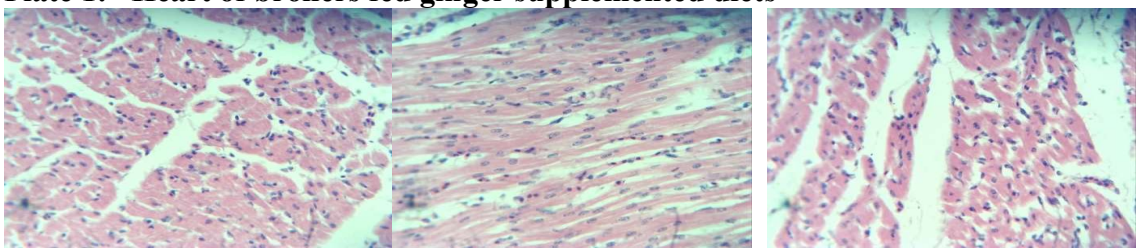
Statistical analysis

Data collected on different parameters were subjected to ANOVA in accordance with the methods of Steel *et al.* [24]. Significant means were separated according to Duncan's Multiple Range Test [25].

Results and Discussion

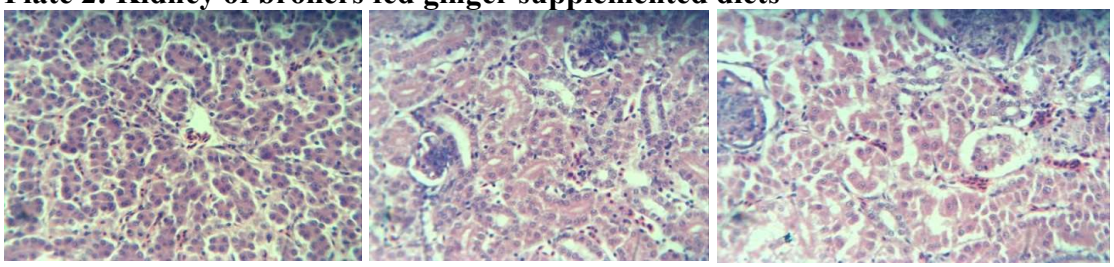
The Histopathology of the hearts, kidneys, liver and the intestines of broilers fed ginger supplemented diets are shown in Plates 1, 2, 3 and 4 respectively.

Plate 1: Heart of broilers fed ginger supplemented diets



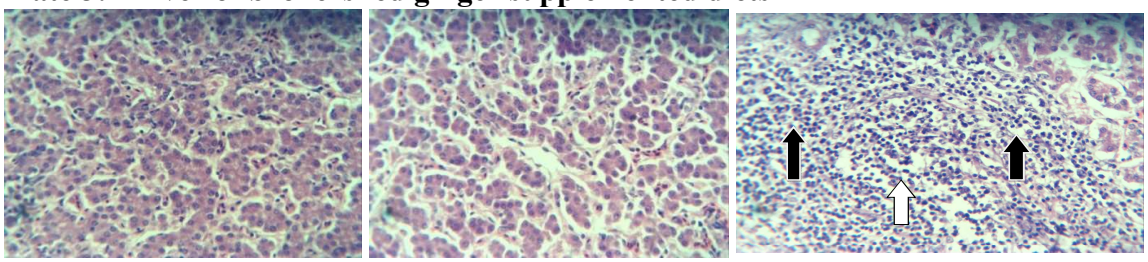
Normal heart muscle (Diet 1) **Normal heart muscles (Diet 2)** **Normal heart muscles (Diet 3)**

Plate 2: Kidney of broilers fed ginger supplemented diets



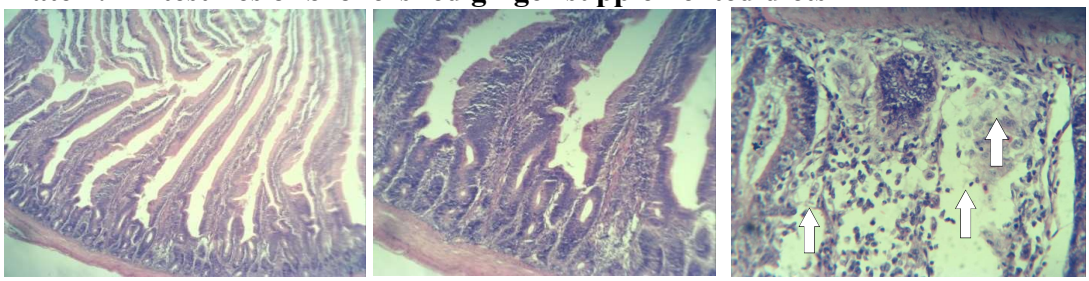
Normal kidney (Diet 1) **Normal kidney (Diet 2)** **Normal kidney (Diet 3)**

Plate 3: Liver of broilers fed ginger supplemented diets



Normal hepatocytes (Diet 1) **Normal hepatocytes (Diet 2)** **Mild inflammation and necrosis of hepatocytes, Massive infiltration of mononuclear cells - white arrows, with mild fibrosis – black arrow, (Diet 3).**

Plate 4: Intestines of broilers fed ginger supplemented diets



Normal intestine (Diet 1) **Normal intestine (Diet 1)** **Mild necrosis of the intestinal villi –arrows (Diet 3)**

The histopathology of the hearts and kidneys of broilers in Diets 1, 2 and 3 (0%, 1.5% and 3.0% ginger root meal supplementation) as shown in Plate 1and 2 shows that the hearts and kidneys of all the animals were normal. There was no necrosis or any damage observed on the heart. All the cells, tissues and cardiac muscle fibers are all normal. The podocytes, distal tubules and the vascular poles of the kidneys of broilers fed 1.5% and 3.0% ginger supplemented diets are normal when compared to the control (Diet 1). The levels of the ginger root meal supplementation in the diets did not have any detrimental effects on the anatomy, histology and on general functioning of the hearts and kidneys.

These observations are in line with the research by [26, 27] who affirmed that excessive inclusion of ginger might not induce any significant alteration in the histology of the kidney and heart.

Moreover, the histopathology examination of the liver of the 1.5% ginger root meal supplementation (Plate 3) indicates that the livers are all normal when compared with that of the 0% ginger supplementation. The hepatocytes, kuffer cells, the sinosoids, recticulin fibers, hepatic venules and portal tracts are all normal. This means that the supplementation/inclusion of ginger root meal at levels up to 1.5% in poultry diets will not have any detrimental effects on the anatomy, histology and on the normal functioning of the liver.

Conversely, a closer examination of the histopathology of the liver of the 3.0% ginger root meal supplementation (Plate 3 Diet 3) indicate that there were necrosis of the liver compared to that of the control diets (Plate 3 Diet 1). From these observations, it could be deduced that inclusion/supplementation of ginger root meal above 1.5% in poultry diets could have adverse effects on the liver and should be avoided. These findings suggest that excessive consumption of ginger could be harmful to the liver. These observations are in line with [28] and [29] who observed that the excessive consumption of ginger could cause hepatic necrosis.

Furthermore, the histopa-thology of the small intestines (Plate 4) shows that the intestines of Diet 2 are all normal compared to that of the control (Diet 1). The villi, microvilli and the epithelial cells of the intestines of broilers of 1.5% ginger root meal supplementations are all normal. The supplementation of ginger root meal at levels up to 1.5% did not have any detrimental effect on the anatomy, histology and normal functioning of the intestines.

Moreover, further examination of the

histopathology of the intestines of the 3.0% ginger root meal supplementation (Plate 4 Diet 3) showed that there were erosion and necrosis of the intestinal villi and microvilli accompanied with mild degeneration and necrosis of the epithelial cells. The erosion and necrosis of the intestinal villi may have resulted in reduced absorption surface of the intestine, thus limiting nutrient absorption and utilization. Thus, ginger at high level of inclusion/ supplementation may damage the villi, microvilli and the epithelia cells of the intestine. From these observations, it could be inferred that inclusion/ supplementation of ginger at 3.0% and above in poultry diets could have adverse effects on the villi, microvilli, epithelia cells and on the nutrient absorption of an animal.

The results of ginger root meal supplemented diet on the relative organ weight of the broilers are presented in Table 2.

Table 2: Relative organ weight of boilers fed ginger root meal supplemented diets.

Parameters (%)	Diet 1 (0%)	Diet 2 (1.5%)	Diet 3 (3.0%)	SEM	Sig.
Liver	2.110	2.150	2.793	0.163	NS
Kidney	0.273	0.297	0.410	0.035	NS
Lungs	0.610	0.670	0.680	0.042	NS
Intestine	5.857	6.113	8.050	0.398	NS
Gizzard	2.087	1.897	1.763	0.108	NS
Heart	0.320	0.387	0.380	0.023	NS
Crop	0.213	0.300	0.320	0.188	NS
Spleen	0.207	0.123	0.160	0.024	NS

[a,b]: Means with different superscripts along rows are significantly different (P<0.05). NS=Non-significant difference (P>0.05). SEM = standard error of treatment means.

From Table 2, all the relative organ weight of the broilers studied were statistically similar, and no significant differences (P>0.05). This means that the levels of ginger root meal supplementation in the diets did not adversely affect the development and performance of these internal organs. This observation collaborated with [30] and [31] who reported no detrimental effects of ginger powder on the internal organs of broilers.

The results of ginger root meal supplemented diet on hemato-logical parameters of the broilers are presented in Table 3.

Table 3: Physiological response of ginger root meal supplementation on the hematological parameters of broilers

Parameters	Diet 1 (0%)	Diet 2 (1.5%)	Diet 3 (3.0%)	SEM	Sig.
Packed cell volume (%)	31.330	29.330	32.000	1.073	NS
Hemoglobin (g/dl)	8.333	8.067	9.333	0.334	NS
White blood cell ($x10^3mm^3$)	20.651	17.877	17.269	1.689	NS
Red blood cell ($x10^6mm^3$)	5.633	5.273	5.750	0.193	NS
MCV (fl)	55.620	55.627	55.654	0.015	NS
MCH (pg)	26.598	27.516	29.228	0.551	NS
MCHC (%)	26.597	27.516	29.232	0.552	NS

[a,b]: Means with different superscripts along rows are significantly different (P<0.05). NS=Non-significant difference (P>0.05). SEM = standard error of treatment means.

The Packed Cell Volume, Hemoglobin Concentration, White Blood Cell count, Mean Cell Volume (MCV), Mean Corpuscular Hemoglobin (MCH) and Corpuscular Hemoglobin Concen-tration (MCHC) of birds fed 0% ginger root meal supplementation (control) were statistically similar (P>0.05) to that of the broilers fed 1.5% and 3.0% ginger supplementations. The supplemen-tation of ginger root meal in the diets did not have any detrimental effects on the hematological parameters of the broilers. And this collaborated with [2, 30] and [32] that reported no detrimental effects of ginger on the hematological parameters.

The results of ginger root meal supplemented diet on the serum biochemistry of broilers are presented in Table 4.

Table 4: Physiological response of ginger root meal supplementation on Serum biochemistry of the broilers

Parameters	Diet 1 (0%)	Diet 2 (1.5%)	Diet 3 (3.0%)	SEM	Sig.
Cholesterol (mg/dl)	137.033[a]	129.665[b]	125.093[c]	1.792	*
Triglyceride (mg/dl)	138.877[a]	130.097[b]	122.767[c]	2.384	*
Urea (mg/dl)	47.437	48.693	46.263	0.789	NS
Total protein (g/dl)	7.423	6.953	7.107	0.111	NS
Albumin (g/dl)	2.400	2.513	2.433	0.404	NS
Globulin (g/dl)	5.023	4.443	4.587	0.122	NS
Glucose (mg/dl)	54.803[a]	45.177[b]	41.190[c]	2.034	*
Bilirubin (mg/dl)	0.547	0.553	0.603	0.016	NS
Creatinine (mg/dl)	1.430	1.500	1.450	0.034	NS
HDL (mg/dl)	25.200	52.040	25.440	0.427	NS
AST (µl)	36.250	35.330	39.070	1.160	NS
ALT (µl)	34.000	34.670	37.330	1.780	NS

[a,b]: Means with different superscripts along rows are significantly different (P<0.05). NS=Non-significant difference (P>0.05). SEM = standard error of treatment means.

The Urea, Total Protein, Albumin, Globulin, Bilirubin, Creatinine, High Density Lipoprotein (HDL), Aspartate amino transferase (AST) and Alanine amino transferase (ALT) of the 1.5% and 3.0% ginger root meal supplementations were statistically similar to the control diet (Diet 1). This means that the levels of ginger root meal supplementation in the diets did not have detrimental effects on the serum biochemistry stated above, since they are still within the normal range of the biochemical parameters.

Furthermore, significant decreases (P<0.05) were observed in Glucose, Triglycerol, and Cholesterol levels of the ginger root meal supplemented diets compared to control. The results obtained in this study agree with the reports of [2, 33, 34 and 32]. This is inferred that ginger root meal at 1.5% and 3.0% supplementation was able to reduce the level of fat and cholesterol in the blood. Therefore, the ability of ginger root meal to lower the level of fats, triglycerol and cholesterol levels in the blood of these

broiler birds may find useful application in improving the cardiovascular health in humans. Ginger root meal can be effective and beneficial in regulating excessive fat deposition in the blood, serum triglycerol and cholesterol level in humans and animals. Based on these observations, ginger can be considered a supplementary herbal therapy on obese patients for prevention, control or treatment of obesity.

Conclusion and Applications

1. The histopathology examination of the internal organs showed that supplementation of ginger root meal above 1.5% in poultry diets could be detrimental to broilers.
2. The supplementation of ginger root meal at 1.5% and 3.0% did not have any detrimental effects on the hematology, internal organs characteristics and on some of the serum biochemical parameters of the broiler birds.
3. However, ginger supplemen-tations significantly reduced the Serum triglyceride, glucose and cholesterol levels of the chickens. This implies that ginger can be used in regulating excess blood sugar, triglyceride and cholesterol level both in human and animal.
4. These results also suggest that ginger can be reasonably included in broiler diets without adversely affecting the histology, blood profile and the internal organs.

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