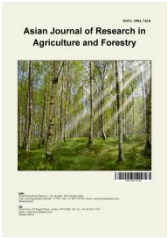

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Evaluation of Carcass, Growth Performance, Hematological and Biochemical Parameters of Broiler Chickens Fed Additive of Onion Bulb Peel Powder

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The study evaluated the effect of the powder of onion bulb peel waste (*Allium cepa*) as feed additives on growth performance, blood profile and carcass features of broiler chickens. A total of 150-day old Arbo acre strains of broiler chicks were randomly allocated into five treatments group with 30 birds in each treatment with three replicates of 10 birds each. The birds were reared on the

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floor of a pen partitioned into experimental units. The study was conducted in two phases; starter phase (0-28 day) and finisher phase (28-56 day). A basal experimental diet was formulated for the broiler chickens and varying levels of onion bulb peel powder was added as a supplement at 0mg/kg (control), 25mg/kg, 50mg/kg, 75mg/kg and 100mg/kg in diets 1, 2, 3, 4 and 5 respectively. Feed and water were provided ad libitum. The results obtained in this study revealed that there was significant difference ($p<0.05$) in feed intake, body weight, daily weight gain, feed conversion ratio, hematological and bio-chemical parameters, carcass weight, non-carcass weight, percentage of carcass cut-part relative to the dressed weight and percentage non carcass relative to live weight between treatment diets. Onion bulb peel powder at 100mg/kg enhanced growth performance, reduced total blood cholesterol, triglyceride and low-density lipoprotein, increased the high-density lipoprotein cholesterol and improved carcass yield of the birds. Since the feeding of onion bulb peel powder up to 100mg/kg as feed additives did not constitute nutritional disorder or any adverse effect on heamatological parameters of broiler chickens, it can be concluded that onion bulb peel powder at this level of inclusion is good for broiler chicken production.

Keywords: Abdominal fat; additives; haemoglobin; lymphocyte; onion bulb peel; proventiculus; triglyceride.

1. INTRODUCTION

Evaluation of the effects of powder of onion bulb peel waste which are usually available as by-products of onion during harvest, sorting, peeling, transportation and marketing on broiler chicken performance is crucial in understanding the potential benefits or drawbacks of using this additive in poultry feed. By analyzing factors such as growth performance, carcass characteristics, and physiological parameters, researchers can determine the impact of the extract on overall chicken health and productivity. Examining these outcomes helps to paint a comprehensive picture of how broiler chickens respond to the additive, guiding future decisions on its incorporation into feed formulations. Through careful evaluation, potential benefits such as improved growth rates or enhanced nutrient absorption can be identified, while any negative impacts on performance can be mitigated. Therefore, conducting a thorough assessment of the effects of onion bulb peel powder extract on broiler chicken performance is essential for making informed decisions regarding its use in the poultry industry

Onion bulb tunics are the outer peels generated from onion. It is one of the major wastes generated from agro-industry which contributes largely towards environmental pollution largely due to indiscriminate disposal of the by-products, by vendors, food processors and households. Onion is a bulbous plant widely grown in almost all parts of the world [1]. Onion is majorly grown among the Hausa tribes of the Northern region in Nigeria as a result of the favourable climatic condition of the Northern Nigeria. Onion plant contains compounds such as cycloallicin, flavonoids, phenolic acids and sterols that possessed antibacterial, anti-inflammatory, antiviral, antioxidants, and hypoglycemic properties [2,3]. Onion has been used as a vegetable for dish garnishing, spices and herbal or medicinal purposes which qualify its use as natural sources of feed additives in poultry production without a possibility of causing nutritional disorder.

Feed additives play a weighty role in the improvement of feed efficiency and animal performance [4]. Little or no information is available on the utilization of onion bulb peel waste in poultry nutrition. Therefore, the design of this study is to investigate the effect of the powder of onion bulb peel wastes, as feed additive in broiler chicken nutrition on growth performance, blood profile and carcass traits.

2. MATERIALS AND METHODS

2.1 Experimental Site

The study was conducted at the Poultry Unit of the Teaching and Research Farm, Ekiti State University, Ado-Ekiti, Nigeria. It is located between latitude 07^{o} 31^{1} 15^{11} N and longitude 05^{o} 13^{1} 17^{11} E with a temperature range of 21^{o}C to 28^{o}C situated in the humid zone of Nigeria. It is characterized with a tropical climate and a bimodal rainfall distribution [5].

2.2 Preparation of Test Ingredients

Dry onion bulb peels (outer part), a by-product from edible onion bulbs, were collected from Central Hausas Vegetable Market in Ikere Ekiti, Ekiti State, Nigeria. Onion bulb peels were

collected, sorted, cleaned, oven-dried at 50^0C to retain the bioactive compounds, milled and stored in a paper bag prior use. Preliminary studies on the shelf-life of onion bulb peel powder shows that the powder can keep for two weeks with sealed paper bag and three months with polythene bag. Other ingredients used for the composition of experimental basal diets were procured from a reputable feed mill within Ado-Ekiti, Ekiti State, Nigeria.

2.2.1 Experimental feed composition

The fundamental nutrition (Table 1) was prepared according to the nourishment requisite [6] for broilers. Experimental diets were comprised with treatment 1 (control diets, fundamental only), treatment 2- fundamental nutrition + 25mg/kg onion bulb peel powder, treatment 3- fundamental nutrition + 50mg/kg onion bulb peel powder, treatment 4 - fundamental nutrition + 75mg/kg onion bulb peel powder and treatment 5- fundamental nutrition + 100mg/kg onion bulb peel powder.

2.3 Management of Birds and Experimental Procedure

One hundred-and fifty-day-old Arbo Acres strain broiler chicks were procured from a reputable source and 30 chicks were casually apportioned to each treatment in a Completely Randomized Design. Ten (10) birds of three replicate in each treatment diet were allotted. The experiment was monitored for 0-4 weeks and 5-8 weeks for the starter phase and finisher phase respectively. The chicks were brooded in their separate units; drugs and vaccination were administered accordingly. The chicks were reared on the floor covered with litter during the starter phase from 0-4 weeks, for the evaluation of growth performance only and continued to the finisher phase from 5-8 weeks for growth performance, blood profile and carcass evaluation. Feeding trial lasted for a period of 8 weeks, feed and portable water were provided *ad-libitum*.

2.4 Growth Performance

The initial and final body weights were taken to determine body weight gained. Feed intake was determined by taking away the weight of the left-over feed from weight of the daily feed provided. The feed conversion ratio was evaluated by dividing the amount of feed intake by average weight of one chicken.

2.5 Hematological and Bio-chemical Parameters at the 7th Week of the Study

Three birds were randomly selected from the replicate, blood samples were collected through the wing vein by the use of 5ml sterile syringes into EDTA tubes containing Ethylenediamine tetraacetic acid (anti-coagulant) for hematological analysis according to the procedure of Onyishi *et al*. [7] for packed cell volume, red blood cell count, hemoglobin count, red blood cell indices (mean corpuscular haemoglobin concentration (MCHC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH)), white blood cell and white blood cell differential count of neutrophil, lymphocytes, basophil, eosinophil and monocytes. Hematocrit (PCV) was estimated by using micro hematocrit reader after the blood-filled capillary tube to 75% of its length and sealed with plasticine was centrifuged at 10,000RPM for five minutes [8]. Haemoglobin concentration (Hb) was determined by the cyanmethemoglobin method [9]. Red blood cells, white blood cells and other blood cells indices were estimated by using automatic blood analyser [10,11]. Also, blood samples were collected into plain tubes (without anti-coagulant) for serum analysis (total cholesterol, triglycerides, high-density lipoprotein, low-density lipoprotein) by use of commercial enzyme analysis reagent kit [12].

2.6 Carcass Preparation and Carcass Characteristics

At the end of 8th week of feeding trial, three birds from each dietary treatment were randomly selected, weighed to obtain live weight, immobilized, killed, scalded at temperature of 65^oC, eviscerated, washed, drained and chilled overnight at temperature of 7^oC. All internal organs separated and weighed separately. Dressed weight and dressing percentage were calculated by dividing dressed weight by live weight multiplied by 100. Carcass was dissected into standard cut-parts, weight determined and percentage carcass-cut parts were evaluated relative to dressed weight. Dressing percentage was evaluated by dividing eviscerated weight by live weight. Percentage internal organ weight was calculated relative to live weight to enhance probable prediction of the weight of internal organs from live weight.

Table 1. Experimental feed composition (g/100g)

Ingredients	Starter (1d-4th week)	Finisher (5th – 8th week)
Maize	40.0	45.0
Soybean meal	25.0	10.0
Brewer's dried grain	15.25	25.25
Palm kernel cake	15.0	17.0
Palm oil	2.0	5.0
Bone meal	1.0	1.0
DCP	1.0	1.0
Salt	0.25	0.25
Premix	0.25	0.25
Methionine	0.15	0.15
Lysine	0.10	0.10
Total	100	100
Calculated:		
Crude protein (%)	22.08	18.66
Metabolizable energy (kcal/kg)	2930	3119.79

2.7 Statistical Analysis

Statistical analysis was carried out using IBM SPSS Statistics 20, One-way ANOVA Post Hoc Multiple Comparisons of Ryan-Einot-Gabriel-Welsch F' test at 0.05 significance level [13].

3. RESULTS

The effect of feeding diets containing varying levels of the powder extract of onion bulb peel waste as a feed additive on performance parameters of broiler chicken at 4th and 8th week is presented in Table 2a and 2b respectively. At the end of 4th week (starter phase) of the feeding trial, the final body weight in diet 3 fed chicks was significantly higher ($p<0.05$) than control and other diets. Average daily feed intake and total feed intake were significantly higher ($p<0.05$) in both diets 1 and 5 while diets 2,3 and 4 had similar values of 24.74±1.33g and 695.3±38.5g respectively. The total feed intake value (722.2g) was statistically similar in diets 1 (control) and 5 fed chicks. Daily weight gain per chick in diet 4 had the highest value (13.65±0.55g) and the lowest value (13.42±1.34g) was recorded in diet 2 fed chicks. Body weight gain was significantly higher ($p<0.05$) in diet 4 than control and test diets. Feed conversion ratio at 4th week was similar in diet 3 and diet 4 fed chicks.

Table 2a. Performance of broiler chickens fed additive powder of onion bulb peel waste for 4 weeks during starter phase

Performance parameters	Experimental group				
	Diet 1 (control)	Diet 2	Diet 3	Diet 4	Diet 5
Initial body weight at 0 week (g)	$27.61±1.43^{c}$	$27.4±1.43^{d}$	$28.5±1.18^{b}$	$28.5±0.97^{b}$	$28.6±1.08^{a}$
Final body weight at 4th week (g)	$402.1±7.3^{c}$	$403.4±25.6^{c}$	$409.85±18.5^{a}$	$410.8±15.7^{a}$	$407.0±20.0^{b}$
Daily weight gain (g)	$13.53±0.43^{c}$	$13.42±1.34^{e}$	$13.62±0.57^{b}$	$13.65±0.55^{a}$	$13.52±0.72^{d}$
Body weight gain at 4th week (g)	$374.47±8.18^{d}$	$381.43±33.6^{b}$	$381.35±16.4^{b}$	382.27±15.4a	$378.44±20.1^{c}$
Average daily feed intake (ADFI) (g)	$25.62±2.09^{a}$	$24.74±1.33^{b}$	$24.74±1.33^{b}$	$24.74±1.33^{b}$	$25.62±2.09^{a}$
Total feed intake (g)	$722.2±63.7^{a}$	$695.3±38.5^{b}$	$695.3±38.5^{b}$	$695.3±38.5^{b}$	$722.2±63.7^{a}$
Feed conversion ratio (FCR)	$1.93±0.20^{a}$	$1.84±0.19^{c}$	$1.83±0.14^{d}$	$1.83±0.15^{d}$	$1.92±0.22^{b}$

ADFI: average daily feed intake, FCR: feed conversion ratio, Identical alphabets in horizontal arrangement are not significantly different (P>0.05), Diet 1 (control/ basal); diet 2 (basal +25mg/kg onion bulb peel powder); diet 3 (basal +50mg/kg onion bulb peel powder); diet 4(basal +75mg/kg onion bulb peel powder); diet 5 (basal +100mg/kg onion bulb peel powder)

Table 2b. Performance of broiler chickens fed additive powder of onion bulb peel powder from 5-8th weeks after starter phase

Performance parameters	Experimental group				
	Diet 1 (control)	Diet 2	Diet 3	Diet 4	Diet 5
Initial body weight at 5th week (g)	1130.4±72.4^{c}	1186.6±69.8^{a}	1124.9±90.2^{d}	1095.2±75.7^{e}	1178.5±86.3^{b}
Final body weight at 8th week (g)	2170±293.4^{a}	2128.9±111.2^{c}	2011.0±115.9^{e}	2013.6±167.1^{d}	2157.0±256.8^{b}
Daily weight gain (g)	35.01±8.44^{a}	33.48±3.39^{c}	31.65±6.16^{d}	33.51±5.05^{c}	34.95±10.7^{b}
Body weight gain at 8th week (g)	980.2±236.4^{d}	937.3±94.9^{e}	986.1±316.8^{c}	1044.8±331.6^{b}	1178.6±453.6^{a}
Average daily feed intake (DFI) (g)	83.51±7.5^{d}	83.16±7.76^{e}	83.6±7.21^{c}	83.96±7.46^{b}	84.6±7.1^{a}
Total feed intake (g)	2338.3±210.0^{d}	2328.4±217.3^{e}	2341.2±201.8^{c}	2351.8±208.9^{b}	2371.1±200.6^{a}
Feed conversion ratio (FCR)	2.48±0.55^{c}	2.51±0.45^{b}	2.55±0.65^{a}	2.40±0.57^{d}	2.24±0.67^{e}

ADFI: average daily feed intake, FCR: feed conversion ratio, Identical alphabets in horizontal arrangement are not significantly different (P>0.05), Diet 1 (control/ basa); diet 2 (basal +25mg/kg onion bulb peel powder); diet 3 (basal +50mg/kg onion bulb peel powder); diet 4(basal +75mg/kg onion bulb peel powder); diet 5 (basal +100mg/kg onion bulb peel powder)

Table 3. Hematological studies of Broiler chicken fed additive powder of onion bulb peel powder for eight weeks

Parameters	0 (Control)	25mg/kg	50mg/kg	75mg/kg	100mg/kg
PCV (%)	28.0±0.00a	27.7±0.58b	27.7±0.58 b	28.0±1.00 a	27.0±3.61c
RBC(x1012/L)	4.50±0.52b	4.27±0.31d	3.87±0.06 e	4.33±0.42 c	4.90±1.85 a
Hb (g/dl)	8.70±0.35d	8.73±0.15c	8.40±0.35e	8.93±0.35b	9.13±0.78a
MCHC(g/dl)	31.1±1.27d	31.6±0.78c	30.4±1.67e	31.9±0.20b	34.0±2.62a
MCV (fl)	63.0±6.93d	67.0±0.00b	71.7±2.52a	65.0±7.55c	58.7±15.0e
MCH(pg/cell)	19.7±2.83e	20.6±1.20c	21.7±0.58a	20.8±2.41b	20.5±7.07d
WBC(x 10^{9}/L)	8.20±4.16b	6.07±0.31e	8.17±6.96c	6.27±2.34d	9.47±2.08a
Neutrophil(%)	56.7±15.0b	42.7±3.06d	40.7±22.3e	50.7±1.15c	64.7±11.7a
Lymphocycte(%)	36.0±13.9c	44.0±1.16a	34.7±9.24d	42.7±2.31b	32.7±9.02e
Monocyte(%)	5.33±1.16d	6.33±1.53b	6.00±0.00c	6.67±1.16a	6.00±0.00c
Eosinophil(%)	2.00±0.00 a	0.00±0.00c	0.67±1.16b	2.00±3.46a	2.00±0.00a
Basophil(%)	0.00±0.00b	0.00±0.00b	0.67±1.16a	0.00±0.00b	0.00±0.00b

Identical alphabets in horizontal arrangement are not significantly different (P>0.05), PCV- pack cell volume, RBC- red blood cell, Hb- haemoglobin , MCHC- mean corpuscular haemoglobin concentration, MCV- mean corpuscular volume , MCH- mean corpuscular heamoglobin, WBC-white blood cells Diet 1 (control/ basal); diet 2 (basal +25mg/kg onion bulb peel powder); diet 3 (basal +50mg/kg onion bulb peel powder); diet 4(basal +75mg/kg onion bulb peel powder); diet 5 (basal +100mg/kg onion bulb peel powder)

Table 4. Blood cholesterol of Broiler chicken fed additive powder of onion bulb peel powder for eight weeks

Parameters	0 (Control)	25mg/kg	50mg/kg	75mg/kg	100mg/kg
TC (mg/dl)	124.3±17.9^{a}	107.1±7.75^{c}	107.0±17.4^{c}	107.0±27.5^{c}	112.0±11.80^{b}
TG (mg/dl)	88.6±15.3^{b}	88.6±0.06^{b}	59.0±33.5^{d}	79.7±0.00^{c}	100.4±5.14^{a}
HDL (mg/dl)	72.2±8.89^{c}	77.2±0.17^{b}	72.2±25.2^{c}	70.9±15.6^{d}	78.6±2.25^{a}
LDL (mg/dl)	32.2±8.89^{a}	11.6±0.00^{e}	21.9±2.52^{c}	29.7±4.45^{b}	18.1±4.45^{d}

Identical alphabets in horizontal arrangement are not significantly different (P>0.05). TC- total cholesterol, TG-triglycerides, high-density lipoprotein- HDL, low-density lipoprotein-LDL. Diet 1 (control/ basal); diet 2 (basal +25mg/kg onion bulb peel powder); diet 3 (basal +50mg/kg onion bulb peel powder); diet 4(basal +75mg/kg onion bulb peel powder); diet 5 (basal +100mg/kg onion bulb peel powder)

The performance in birds at the end of 8th week feeding for finisher phase showed that average daily feed intake, total feed intake, daily weight gain and body weight gain varied significantly ($p<0.05$) between control (diet 1) and test diets. Average feed intake and total feed intake were higher ($p<0.05$) in diet 5 fed birds than diets 1, 2, 3 and 4. Feed conversion ratio was significantly ($p<0.05$) lower in diet 5 fed broiler chickens.

The effect of feeding onion bulb peel powder (OBPP) diet on hematological parameters of

broiler chickens at 5 weeks is presented in Table 3. The packed cell volume (PCV) of birds fed control diet (diet 1) and diet 4 (75mg/kg OBPP) were significantly higher ($p<0.05$) than diets 2, 3 and 5 fed chicks. Red blood cell (RBC), heamoglobin count (Hb), mean corpuscular heamaglobin concentration (MCHC), white blood cell and neutrophil in diet 5 fed chickens were significantly higher ($p<0.05$) than diets 1, 2, 3 and 4 fed chickens. The mean corpuscular volume (MCV), mean concentration heamaglobin and basophil in diet 3 (50mg/kg OBPP) fed chickens had the highest percentage lymphocyte value (44%) while the lowest value of 32.7% was observed in diet 5 fed chickens. Monocytes in diet 5 was significantly lower ($p<0.05$) than diets 1, 2, 3 and 4. Eosinophil was statistically similar in diets 1, 4 and 5 but significantly differ ($p<0.05$) in diet 3 chickens.

The effects of the diets on serum biochemistry of broiler chickens are presented in Table 3. At the end of 8th week of feeding trial the study revealed that the total cholesterol level in diets 2, 3, and 4 were significantly lower ($p<0.05$) than chickens fed diets 1 and 2. Triglycerides (TG) and low-density lipoprotein (LDL) were significantly ($p<0.05$) lower in diet 5 than diets 1, 2, 3, and 4 fed chickens. High density lipoprotein cholesterol was significantly ($p<0.05$) higher in diet 5 fed chickens than control (diet 1) and other diets fed chickens.

The result of the effect of feeding broilers chickens with varying levels of onion bulb peel powder (OBPP) as feed additives on carcass characteristics are presented in Table 5a and 5b). The live weight (2308g) was highest in diet 2 fed birds while the lowest live weight (2128.7g) was observed in diet 3 fed chickens. There was significant difference ($p<0.05$) between dietary treatments in weight of cut- carcass and percentage weight carcass. The weight of non-carcass traits and percent weight of non-carcass traits relative to live weight of broiler chickens fed the experimental diets are presented in Table 6a and 6b. There were substantial differences in all the non-carcass traits among broilers fed dietary treatments.

Table 5a. Carcass characteristics of broiler chickens fed additive powder of onion bulb peel powder for eight weeks

Parameters(g)	0 (Control)	25mg/kg	50mg/kg	75mg/kg	100mg/kg
Live weight	2155.3±245.4^{d}	2308±61.8^{a}	2128.7±94.6^{e}	2195.7±137.8^{c}	2196.7±64.7^{b}
Evisc. wt	1548.3±220.0^{c}	1625.0±91.7^{a}	1446.0±49.9^{e}	1572.0±105.0^{b}	1540.3±52.3^{d}
*D.P (%)	71.7±2.18^{b}	71.9±3.29^{c}	69.7±1.56^{d}	71.6±1.89 ^{b}	70.12±0.33^{c}
Breast	476.7±89.5^{c}	531.0±91.7^{a}	434.0±47.5^{e}	505.3±30.4^{b}	474.3±14.2^{d}
Drum stick	227.3±8.33^{d}	236.7±12.5^{b}	219.0±6.56^{e}	34.0±40.1^{c}	239.0±11.4^{a}
Thigh	206.3±44.8^{e}	249.3±6.51^{a}	218.3±1.15^{d}	225.7±11.0^{c}	233.7±11.7^{b}
Wing	153.3±36.7^{e}	187.00±11.3^{a}	165.7±22.9^{c}	169.7±18.5^{b}	158.3±7.23^{d}
Rib	159.3±8.40^{a}	116.0±4.00^{d}	135.3±35.6^{b}	126.7±7.77^{c}	134.7±21.4^{b}
Neck	122.0±32.5^{d}	122.3±18.6^{d}	135.3±35.6^{a}	126.7±7.77^{c}	134.7±2.14^{b}
Back	157.3±13.6^{a}	140.0±5.00^{c}	133.3±18.5^{d}	150.7±42.1^{b}	132.0±8.54^{e}
Shanks	98.7±9.61^{c}	103.0±16.8^{b}	96.7±13.5^{d}	96.0±18.1^{e}	108.0±5.29^{a}
Head	57.0±5.0^{e}	68.0±3.46^{b}	60.7±4.73^{c}	71.7±6.80^{a}	59.7±0.58^{d}

**D.P- dressing percentage, Evisc.wt- Eviscerated weight, Identical alphabets in horizontal arrangement are not significantly different (P>0.05). Diet 1 (control/basal); diet 2 (basal +25mg/kg onion bulb peel powder); diet 3 (basal +50mg/kg onion bulb peel powder); diet 4(basal +75mg/kg onion bulb peel powder); diet 5 (basal +100mg/kg onion bulb peel powder)*

Table 5b. Percentage primal cuts relatives to eviscerated weight of broiler chicken fed additive powder of onion bulb peel powder for eight weeks

Parameters (%)	0 (Control)	25mg/kg	50mg/kg	75mg/kg	100mg/kg
Breast	30.7±1.70^{d}	32.7±6.8^{a}	30.2±2.33^{e}	31.9±1.02^{b}	30.8±1.6^{c}
Drum stick	14.8±1.70^{b}	14.5±0.67^{c}	14.5±1.10^{c}	14.8±1.57^{b}	15.5±1.06^{a}
Thigh	13.2±1.25^{e}	15.3±0.99^{a}	14.7±0.71^{c}	14.4±1.00^{d}	15.2±0.55^{b}
Wing	9.82±1.33^{d}	11.5±1.21^{a}	11.1±1.06^{a}	10.8±0.47^{b}	10.3±0.70^{c}
Rib	10.5±2.08^{a}	7.12±0.56^{e}	9.11±2.21^{b}	8.10±0.98^{d}	8.77±1.56^{c}
Neck	7.79±1.10^{c}	7.46±0.77^{d}	7.99±0.48^{a}	7.93±0.99^{b}	7.98±0.27^{a}
Back	10.2±0.93^{a}	8.24±0.43^{e}	9.01±1.43^{c}	9.53±2.23^{b}	8.59±0.85^{d}
Shank	6.48±1.20^{c}	6.39±1.33^{d}	6.71±1.16^{b}	6.09±0.84e	7.01±0.27a
Head	3.71±0.41^{d}	4.18±0.05^{b}	4.20±0.46^{b}	4.56±0.32^{a}	3.88±0.10^{c}

Identical alphabets in horizontal arrangement are not significantly different (P>0.05). Diet 1 (control/ basal); diet 2 (basal +25mg/kg onion bulb peel powder); diet 3 (basal +50mg/kg onion bulb peel powder); diet 4(basal +75mg/kg onion bulb peel powder); diet 5 (basal +100mg/kg onion bulb peel powder)

Table 6a. Weight of non –carcass traits of broiler chickens fed additive powder of onion bulb peel powder for eight weeks

Parameters (g)	0 (Control)	25mg/kg	50mg/kg	75mg/kg	100mg/kg
Heart	47.7±1.53^{e}	63.0±11.5^{a}	55.3±3.05^{d}	58.0±11.0^{c}	59.0±4.58^{b}
Gizzard	10.3±3.22^{a}	11.7±0.58^{c}	10.3±1.16^{b}	11.3±2.31^{d}	9.67±0.58^{e}
Liver	41.7±14.2^{b}	44.0±2.00^{a}	38.0±2.65^{c}	35.0±1.00^{d}	34.7±4.16^{e}
Proventiculus	6.67±1.16^{e}	10.0±1.00^{a}	8.00±1.00^{d}	8.67±0.58^{b}	8.00±1.00^{c}
Spleen	2.10±0.50^{d}	2.31±0.81^{b}	2.27±0.24^{c}	1.89±0.19^{e}	2.48±0.14^{a}
Abdominal fat	31.7±2.08^{a}	18.7±4.16^{c}	15.7±2.08^{d}	21.3±3.06^{b}	14.0±3.46^{e}

Identical alphabets in horizontal arrangement are not significantly different ((P>0.05). Diet 1 (control/ basal); diet 2 (basal +25mg/kg onion bulb peel powder); diet 3 (basal +50mg/kg onion bulb peel powder); diet 4(basal +75mg/kg onion bulb peel powder); diet 5 (basal +100mg/kg onion bulb peel powder)

Table 6b. Percentage weight of non –carcass traits relative to live weight of broiler chicken fed additive powder of onion bulb peel powder for eight weeks

Parameters (%)	0 (Control)	25mg/kg	50mg/kg	75mg/kg	100mg/kg
Gizzard	3.13±0.52^{e}	3.86±0.56^{a}	3.83±0.18^{c}	3.67±0.50^{d}	3.84±0.41^{b}
Heart	0.66±0.12^{d}	0.72±0.05^{b}	0.71±0.06^{c}	0.73±0.18^{a}	0.63±0.06^{e}
Liver	2.65±0.57^{b}	2.70±0.29^{a}	2.63±0.10^{c}	2.23±0.09^{d}	2.25±0.20^{d}
Proventiculus	0.43±0.05^{d}	0.62±0.04^{a}	0.55±0.06^{b}	0.55±0.04^{b}	0.52±0.06^{c}
Spleen	0.13±0.02^{d}	0.14±0.06^{c}	0.15±0.02^{b}	0.12±0.02^{e}	0.16±0.01^{a}
Abdominal fat	2.08±0.33^{a}	1.15±0.24^{c}	1.09±0.19^{d}	1.37±0.28^{b}	0.91±0.21^{e}

Identical alphabets in horizontal arrangement are not significantly different ((P>0.05). Diet 1 (control/ basal); diet 2 (basal +25mg/kg onion bulb peel powder); diet 3 (basal +50mg/kg onion bulb peel powder); diet 4(basal +75mg/kg onion bulb peel powder); diet 5 (basal +100mg/kg onion bulb peel powder)

4. DISCUSSION

This study investigated the effect of the powder of onion bulb peel (Allium cepa) powder as feed additives on growth performance, blood profile and carcass traits of broiler chickens. While some previous research has highlighted the potential benefits of using plant-based extracts as dietary additives for poultry, [14,15,16] the specific impact of onion bulb peel powder on the parameters evaluated in this study remains less explored. Our findings suggest that the inclusion of onion bulb peel powder enhanced improvements in carcass yield, growth performance, and certain hematological and biochemical parameters as positive changes were observed which suggests that the powder has potential health benefits on the chickens. [17,18]. This impact on hematological and biochemical parameters could be linked to the bioavailability of nutrients facilitated by the powder of onion bulb peel. Also, the inclusion of the extract in the broiler feed led to body weight gain and feed efficiency compared to the control group [19]. These findings support the use of onion bulb peel powder as a potential additive in broiler diets to enhance performance and overall health.

Possible mechanisms underlying the effects observed in broiler chickens fed additive of onion bulb peel powder could be attributed to the bioactive compounds present in the powder. Onion bulb peel powder is known to contain high levels of phenolic compounds such as quercetin, kaempferol, and myricetin, which possess antioxidant and anti-inflammatory properties [20, 21]. These compounds may have contributed to the improvement in growth performance and carcass characteristics of the broiler chickens by enhancing their immune function and reducing oxidative stress. Furthermore, the onion peel powder might have influenced the gut microbiota composition, leading to better nutrient absorption and utilization [22,23]. Overall, the bioactive components in the onion bulb peel powder appear to have multifaceted effects on the physiological processes of the broiler chickens, ultimately resulting in the observed benefits.

Performance of birds at both 4th and 8th weeks of feeding and at 100mg/kg of onion bulb peel powder (OBPP) inclusion, positively influenced feed intake, body weight gain and feed conversion ratio. The feeding of lower concentration of onion bulb peel powder (OBPP) improves performance of birds, a contradiction to the report of Malematja et al. [24] who reported the feeding of lower concentration of onion bulb tunic powder did not improve performance of birds and that changes of improvement were only

observed at higher dosage of onion extract. Also, the result of growth performance was in accordance with Goodarzi et al. [25] in birds fed onion supplemented diets. The results of feed conversion ratio (FCR) obtained in this study aligns with Goodarzi et al. [26]. The increase in the feed intake in birds may be due to aromatic nature of onion which may have stimulated appetite in the birds to consume more feed as compared with control. Feeding onion bulb peel powder (OBPP) at levels of 50mg and 75mg were effectively utilized in birds at 4th week while the inclusion of 100mg onion bulb peel powder (OBPP) in the diet contributed immensely to feed utilization at 8th week. Age of animals may be responsible as feed utilization comes with growth and maturity also onion peel powder may also have improved the bi-gut-health of the birds thus facilitating proper digestion and absorption of nutrients in the birds [27,28]. Onion peel extracts have been reported for its hyperglycemia and hypoglycemia potentials which stimulates center for feed intake and satiety [25,29].

The results obtained in this study signify that the PCV values of broilers fed with varied levels of onion bulb peel powder (OBPP) as an additive were closer to the value of 28.8% as reported by Kokore *et al*. [30] The value of red blood cells (RBC) in diets 3 fed chickens corresponds with those reported by Oguntoye et al. [31]. The inclusion of onion bulb peel powder (OBPP) at 100mg/kg enhanced better PCV in broiler chickens at 8th weeks. This is important to animal health as PCV values are significant indicators of health and disease in poultry birds, and they provide insights into the birds' adaptability to environmental conditions [32]. Low packed cell volume (PCV) has been reported as indication of anaemic and immunosuppression conditions in chickens [33,34].

Haemoglobin and red blood cell values obtained in the study are within normal reference values for chicken [35,36]. Mean corpuscular haemoglobin concentration (MCHC), mean corpuscular volume (MCV) and mean corpuscular heamoglobin (MCH) values varied among treatments but are within reference for haematological values for chickens [37]. The results of white blood cell (WBC) did not follow a specific pattern with respect to an increment in onion bulb peel powder inclusion in the diets. The study revealed that the values of WBC obtained were within reference values even though there were variations among treatment groups [38]. Lymphocytes in the study were below 50% an indication that the diets did not constitute stress or threat in the broiler chickens [39]. Several factors such as diseases, age, sex, nutrition, strain and environmental factors could influence variations of hematological parameters [40,41].

The reduction in total cholesterol (TC), triglycerides (TG), low density lipoprotein cholesterol (LDL) and increase in the high-density lipoprotein (HDL) concentration in broiler chickens at 8th weeks old complies with the submission of Goodarzi et al. [25] that dietary feeding of onion influenced higher HDL and lowered TG in broiler chicken. It has also been reported that dietary onion decreases serum cholesterol level in broiler chicken [42].

The decrease in the abdominal fat and improvement in the carcass and non-carcass yield as concentration of onion bulb peel powder increases reveals that onion bulb peel powder may contain bio active compounds that enhance breakdown of abdominal fat and increase in carcass weight [43,44].

5. CONCLUSION

In summary, the key findings of the study on the effects of onion bulb peel powder on broiler chicken performance indicate a significant improvement in growth performance, carcass characteristics, and hematological parameters. The inclusion of the additive onion bulb peel powder in the diet led to enhanced body weight gain, feed efficiency, and dressing percentage. These results suggest that the use of onion bulb peel powder can be a promising natural additive to enhance broiler chicken performance.

6. RECOMMENDATION

Inclusion of onion bulb peel powder (OBPP) up to 100mg is therefore recommended as it enhanced dressing percentage, carcass yield and reduced abdominal fat considerably in birds.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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