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# Physicochemical and blood profile of broilers fed finisher diet supplemented with onion skin extract

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***Target Audience**: Animal Scientists, Poultry farmers, Veterinarians*

## Abstract

*The use of growth promoters like antibiotics has been a major challenge in poultry industries because of resistance of microorganisms and carcass residue which affect the final consumer of poultry products. Plant extracts rich in antimicrobials and antioxidants have been documented to be substitute to growth promoters in poultry industries. Therefore, a four-week study was carried out to determine the effect of Onion Skin Extract (OSE) on the physicochemical and blood parameters of broiler chickens. One-hundred and sixty-eight four-week old Marshal broiler chicks were allotted in completely randomized design to four dietary treatments of T1 (control), T2 (100mg/kg OSE), T3 (200mg/kg OSE) and T4 (300mg/kg OSE). Each treatment was replicated six times with seven birds per replicate. Blood was collected from three birds per replicate before slaughtering for physicochemical evaluation of the carcass. Total cholesterol was lower (P < 0.05) in birds fed supplemented 300mgOSE/kg of feed compared with other treatments. Treatments T3 and T4 were statistically similar (P.>0.05) but significantly differed (P<0.05) from treatments T1 and T2 with respect to Packed cell volume. Haemoglobin, Eosinophils and Monocytes were not significantly affected by OSE supplementation. Oxidative rancidity was lower (P < 0.05) in broilers fed diets supplemented with OSE. Water holding capacity, pH and abdominal fat were not affected (P > 0.05) by OSE supplementation. It can be concluded that onion skin extract at 300mg/kg of feed reduced oxidative rancidity and did not negatively affect broiler blood parameters.*

***Keywords:** Blood profile, broilers, oxidative rancidity, onion skin extract, cholesterol*

## Description of Problem

One of the key players in ensuring global food security and meeting people's daily protein requirements is poultry (1). To maintain the health of the chickens, intensive vaccination and medication are practiced which leave some residues in broiler meat. In order to avoid this risk, alternative methods including organic and phytochemical supplements are added to the poultry meal. Extract from plants like Rosemary, Propolis and Moringa have been supplemented in broiler feed with an improvement in the health status and meat quality of broiler chickens (2,3,4). These extracts contain antioxidants that have been proven to be effective like synthetic ones.

Antioxidants are a class of chemicals that are added to meat and other products to extend shelf-life (5,6,7). Due to worries about the safety of synthetic antioxidants, the usage of natural antioxidants has been growing over the last few years (8,9). Several natural plant extracts with high potential antioxidant activity are incorporated into meat and meat products to improve shelf-life (5,10,11).

Onions are among the plants with potential phytochemical compounds that have been proven to improve the health status of broiler chickens. The skin is rich in different pharmacologically active compounds known for antioxidant, antiviral, antimicrobial, and antifungal properties (12,

13). Onion has so many valuable medicinal applications because of the nutrients, vitamins, minerals, and organic compounds contained in them, including the presence of sulfuric compounds and quercetin (14, 15). Onions also contain mineral components like calcium, magnesium, sodium, potassium, selenium, and phosphorus, and they are a good source of vitamin C, vitamin B6, and dietary fibre (16-18). The dietary onion extract is known to enhance the immunoglobulin level and the antioxidant activity of meat (19). The acid and base pH, water retention ability during and before cooking, acceptability of meat, and meat flavour-enhanced after herb extract mixture were included in the feed (20).Therefore, this study was designed to determine the effect of onion skin extract on the physicochemical and blood parameters of broiler chickens.

## Materials and methods

### *Location of the study*

The study was carried out at the Teaching and Research Farm, University of Ibadan, Ibadan.

### *Extraction Procedure*

Onion Skins were gotten from the market, sun-dried until a constant weight was reached and milled. Three litres of 80% methanol were used to soak 90grams of the onion skin for 24 hours. The methanol extract was filtered through 0.2µm and solvent (methanol) was removed by rotary evaporation (Labo-Rota C-311, Resona Technics, Switzerland) for 1h at 55 °C and stored.

### *Animal and experimental design*

A total of 168 one-day old Marshal male broiler chicks were procured from a commercial hatchery. The chicks were raised on commercial broiler starter diet for 4 weeks. They were weighed and randomly assigned after 4 weeks to four experimental diets viz; T1-Basal diet (Control), T2, T3 and T4 with 100, 200 and 300mg of Onion Skin Extract (OSE) per kilogram of feed respectively. Experimental treatments contained 42 birds, 6 replicates per treatment and 7 birds per replicate. Feed and water were given *ad-libitum*. The formulated control finisher diets contain approximately 20% crude protein, 4% crude fibre and 3100ME kcal/kg. At the end of the experiment (4 weeks), blood samples were collected from three birds which were randomly selected per replicate, tagged, weighed and slaughtered by cutting the jugular vein. The carcasses were defeathered, eviscerated and stored in a deep freezer until required analysis.

### *Haematological indices*

Samples of complete blood were collected from three broilers per replicate. Blood samples were obtained from the jugular vein using evacuated tubes containing EDTA. The haemocytometer method was used to determine the red blood cell (RBC) and white blood cell (WBC) counts using the Natt-Herrick solution. Haematocrit (Hct) or Packed Cell Volume (PCV) and Haemoglobin (Hb) values were measured by microhaematocrit and Sahli's methods (21) respectively. The percentages of peripheral blood leukocytes were determined using blood smears stained by the May Grunwald-Giemsa stain (21). All parameters were taken in triplicate of each sample.

### *Serum Biochemistry*

The blood was collected using plain bottle and allowed to clot, and then the serum was separated immediately by centrifugation at 10,000 revolutions for 10 minutes. Total protein was estimated by the burette reaction (22); and the Alanine Transaminase (ALT) and Aspartate Transaminase (AST) were determined colorimetrically using reagent kits (Randox

Lab., Ltd., Co. Antrim, UK). Sodium oxalate fluoride was used for glucose preservation. The blood glucose was determined by enzymatic colourimetric test (GOD-PAP method) Quimica Clinica Aplicada, S.A. Kit.

***Physico-chemical Parameters***

*pH*

Meats from each replicate (10g) were homogenized in 90 mL of distilled water. The pH of homogenized samples were measured in triplicate using a glass pH meter.

*Analysis of oxidative rancidity*

This was measured according to the techniques outlined by (23). Sample (10g) was ground using mortar and pestle and thereafter 25ml distilled water and 20% Trichloroacetic Acid (TCA) were added. The mixture was thoroughly homogenized for 2 minutes and then filtered using Whatman filter paper (No 1). The filtrate was mixed with an equal volume of 0.02M Thiobarturitic Acid (TBA) and inoculates at 100$^{o}$C for 35 minutes. It was cooled for 10mins. Solution absorbance was measured using a UV-VIS spectrophotometer at 532nm.

*Colour*

Colour (L*, a*, b* values) of meat samples was determined using a Konica Minolta Chroma Meter CR-400 (Sensing, Japan). All measurements were taken in triplicate for each sample and means were recorded.

*Percentage of cooking loss*

Meat samples (approx. 50g) were taken from the breast muscle of each carcass and boiled to an internal temperature of 72ºC. The weight of the cooked meat was taken to obtain the cooking loss.

Percentage cooking loss was calculated as:

$$\frac{\text{Weight of meat sample before cooking} - \text{weight of meat sample after cooking}}{\text{Weight of meat sample before cooking}} \times 100$$

**Results and discussion**

***Serum biochemical indices***

The treatments supplemented with OSE had lower LDL ($P < 0.05$) compared with the control (49.23 mg/dL) group. This could be a result of allicin and its derivative compounds found in onion (24). By reducing hepatic cholesterol biosynthesis (25), Onions may exert their hypolipidemic effect. Lipid lowering effect of polyphenols can best be explained by (26) studies where gene expression of fat transportation and metabolic enzymes like carnitine palmitoyltransferase I (CPT-I), acyl CoA oxidase 1 (ACOX1) and peroxisome proliferator-activated receptor- α (PPAR α) in liver adipose and abdominal tissues is much enhanced by tea polyphenols. (27) observed similar lipid catabolic enzyme regulation in body tissues, resulting in reduced serum triglycerides, LDL and total cholesterol. OSE reduced cholesterol and triglycerides due to active biomolecules having flavonoids and other polyphenols. Blood serum protein, under the influence of internal and external influences, represents the state of an organism and the changes that happen to it. Birds fed diets with 100mg and 200mg OSE/kg of feed had a significant increase in total protein compared with other treatments. The increase inserum total protein and globulin concentration can be attributed to polyphenols in onion skin which have antioxidant properties that elevate the immune response of chickens (28). However, a reduction in total protein was observed in birds fed 300mg/kg OSE. This might be due to the toxic effect of onion. A similar observation was reported by (29) who observed a reduction in total protein and globulin values in the plasma of broiler chicks fed dietary supplementation of natural antioxidants.

***Haematological parameters***

Among the haematological indices,

only haemoglobin, eosinophils and monocytes were not significantly affected. Haematological examination contributes significantly to the detection of certain changes in the health status of birds, which may not be apparent at the time of physical examination, but which undoubtedly affect the fitness of birds (30). Blood physiology is affected by OSE supplementation. The PCV of the experimental birds ranged between 22.67 – 28.33 %

**Table 1: Effects of dietary supplementation of onion skin extract on selected serum biochemical indices of broiler chickens**

| Parameters | T1 | T2 | T3 | T4 | SEM | p-value |
|---|---|---|---|---|---|---|
| ALT ( i.u/L) | 35.00$^{b}$ | 42.00$^{a}$ | 28.33$^{d}$ | 31.33$^{c}$ | 0.90 | 0.034 |
| AST ( i.u/L) X $10^{-2}$ | 1.82 | 1.99 | 1.86 | 1.89 | 0.31 | 0.065 |
| Albumin (g/dL) | 1.75 | 1.93 | 1.55 | 1.55 | 0.04 | 0.025 |
| Total protein (g/dL) | 5.67$^{ab}$ | 6.50$^{a}$ | 6.25$^{a}$ | 5.00$^{b}$ | 0.20 | 0.032 |
| ALP (mg/dL) | 90.30$^{b}$ | 99.00$^{ab}$ | 109.00$^{a}$ | 112.33$^{a}$ | 2.60 | 0.012 |
| T. Chol(mg/dL) | 103.23$^{a}$ | 100.26$^{b}$ | 99.56$^{b}$ | 95.05$^{c}$ | 1.32 | 0.031 |
| Trig(mg/dL) | 27.33 | 29.49 | 31.21 | 32.22 | 0.54 | 0.345 |
| LDL(mg/dL) | 49.23$^{b}$ | 44.78$^{b}$ | 40.07$^{b}$ | 33.41$^{c}$ | 0.65 | 0.034 |
| HDL(mg/dL) | 48.55$^{b}$ | 49.55$^{b}$ | 53.25$^{a}$ | 55.20$^{a}$ | 0.87 | 0.021 |
| VLDL | 5.47$^{c}$ | 5.90$^{b}$ | 6.24$^{a}$ | 6.44$^{a}$ | 1.29 | 0.035 |

$^{abc}$ Means within a row with different superscripts differs significantly (P < 0.05); ALT: Alanine Aminotransferase; AST: Aspartate Aminotransferase; ALP; Alkaline phosphatase; T. Chol: Total cholesterol; Trig: Triglyceride; LDL: Low Density lipoprotein; VLDL: Very low density lipoprotein;HDL: High Density lipoprotein; SEM= Standard Error of mean; T1 -Basal diet; T2 – Basal diet +100mg OSE/kg of feed; T3 – Basal diet + 200mg OSE/kg of feed; T4 – Basal Diet + 300mg OSE/kg of feed

RBC were within the range of 2.05 – 3.42 ($10^{6}$/ $mm^{3}$) and falls within the range reported by (32). Broiler chickens fed 200mg OSE/kg of feed had the highest value compared with other treatments which indicates the favourable effect of OSE on hematopoiesis. However, RBC

**Table 2:** Haematological indices of broiler chickens fed graded levels of onion skin extract

| Parameters | Treatments | | | | | |
|---|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | SEM | p-value |
| PCV (mL%) | 23.33$^{b}$ | 22.67$^{b}$ | 28.33$^{a}$ | 26.00$^{a}$ | 0.66 | 0.024 |
| Haemoglobin (g/dL) | 11.82 | 11.99 | 11.86 | 11.89 | 0.31 | 0.543 |
| Globulin (mg/dL) | 4.00$^{ab}$ | 4.60$^{a}$ | 4.63$^{a}$ | 3.47$^{b}$ | 1.22 | 0.042 |
| RBC ($10^{6}$/$mm^{3}$) | 2.12$^{c}$ | 2.05$^{c}$ | 3.42$^{a}$ | 2.38$^{bc}$ | 0.16 | 0.013 |
| WBC ($10^{3}$/$mm^{3}$) | 5.67$^{b}$ | 6.50$^{a}$ | 6.25$^{a}$ | 5.00$^{b}$ | 0.20 | 0.032 |
| MCV (pl) | 110.05$^{a}$ | 110.59$^{a}$ | 82.84$^{c}$ | 109.24$^{a}$ | 0.54 | 0.027 |
| MCH (pg) | 55.75$^{a}$ | 58.49$^{a}$ | 34.68$^{c}$ | 49.96$^{a}$ | 0.52 | 0.038 |
| MCHC (%) | 50.66$^{a}$ | 52.89$^{a}$ | 41.86$^{c}$ | 45.73$^{b}$ | 0.49 | 0.029 |
| Lymphocytes ($10^{3}$/$mm^{3}$) | 69.00$^{a}$ | 69.67$^{a}$ | 69.67$^{a}$ | 64.00$^{b}$ | 0.74 | 0.027 |
| Eosinophils ($10^{3}$/$mm^{3}$) | 0.43 | 0.37 | 0.23 | 0.23 | 0.40 | 0.234 |
| Monocytes ($10^{3}$/$mm^{3}$) | 0.17 | 0.30 | 0.30 | 0.20 | 0.58 | 0.432 |

$^{abc}$ Means within a row with different superscripts differs significantly (P < 0.05); RBC= Red blood cell; PCV=Packed cell volume; WBC= White blood cell; MCV = Mean Corpuscular Volume; MCHC=Mean Corpuscular Haemoglobin Concentration; MCH= Mean Corpuscular Heamoglobin, SEM= Standard Error of Mean; T1 - Basal diet; T2 – Basal diet +100mg OSE/kg of feed; T3 – Basal diet + 200mg OSE/kg of feed; T4 – Basal Diet + 300mg OSE/kg of feed reduced as the dietary inclusion of OSE increased to 300mg/kg. Onion is very rich in quercetin that has the ability to chelate metals. Quercetin has several sites where metal chelation occurs. They can be polymerized where there are several chelating metal sites. The copolymerization of the flavonoids and iron could be responsible for the low level of RBC as the dietary inclusion of OSE increased.

Haemoglobin (Hb) values ranged from 11.62 – 11.99g/dL which was higher than 9.70 - 11.00g/dL obtained by (33) and this was in line with the report of (32). Supplementation of broiler diet with OSE affects MCH, MCV, RBC and lymphocytes significantly, contrary to the report of (34) when spices and sweet violet extracts were used to replace antibiotics and antioxidants in broiler feed. MCH values ranged from 39.79 – 58.49pg and significant differences were observed. These values were lower than the report of (32), who reported 23 – 47pg for avian species. MCV was significant ($p < 0.05$) and the values were within the range recommended (90 – 140fL) by (35) indicating a normocytic condition of the birds. There was no significant difference in the MCHC values. The values of MCHC of the broilers ranged from 41.86 – 50.66g/dL which is higher than the range of 30.20 – 36.2g/dL reported by (36). The range for the lymphocytes of the experimental broiler chickens was 64.00 – 69.67% and this agrees with 58.10 – 71.70% reported by (37). The range values obtained for eosinophils was 0.23 – 0.47($10^3$/$mm^3$) which was within the range reported by (38). The increase in the blood content of PCV, Hb, and RBC of birds fed the test ingredients is an indicator of improved oxygen-carrying capacity of the cells, which has resulted in improved nutritional availability for birds, thereby affecting their well-being.

*Physicochemical properties and colour*

Results from this study revealed that the higher the inclusion level of OSE in broiler diet, the lower the quantity of Malondialdehyde (MDA) in the meat. Oxidative rancidity of broiler chickens fed 200mg (0.23MDA/g) and 300mg (0.16MDA/g) were not significantly different. This might be due to the phenolic compounds present in onion skin which could act as antioxidants.

**Table 3: Effects of dietary supplementation of onion skin extract on physicochemical properties**

| Parameters | Treatments | | | | | |
|---|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | SEM | p-value |
| Oxidative rancidity | 0.35$^{a}$ | 0.27$^{a}$ | 0.23$^{b}$ | 0.16$^{b}$ | 0.13 | 0.023 |
| pH | 5.80 | 5.79 | 5.79 | 5.74 | 0.11 | 0.142 |
| WHC (%) | 55.64 | 60.75 | 62.89 | 59.56 | 0.17 | 0.213 |
| Cooking loss (%) | 25.18$^{b}$ | 27.13$^{ab}$ | 28.68$^{a}$ | 29.50$^{a}$ | 0.55 | 0.028 |
| Colour | | | | | | |
| Lightness (L*) | 54.16$^{b}$ | 53.86$^{b}$ | 61.38$^{a}$ | 55.35$^{ab}$ | 1.16 | 0.035 |
| Redness (a*) | 4.26 | 6.05 | 4.48 | 3.89 | 0.43 | 0.321 |
| Yellowness (b*) | 9.00$^{ab}$ | 7.76$^{b}$ | 9.82$^{a}$ | 8.18$^{b}$ | 0.25 | 0.026 |

$^{ab}$Means within a row with different superscripts differs significantly ($P < 0.05$; SEM: Standard Error mean; WHC: water holding capacity; Basal diet; T2 – Basal diet +100mg OSE/kg of feed; T3 – Basal diet + 200mg OSE/kg of feed; T4 – Basal Diet + 300mg OSE/kg of feed

**pH**

The pH value of meat is an essential factor that affects the quality of meat as it is a direct indicator of the accumulation of meat acid that affects the colour of meat and drip loss. (39). Controlling the pH reduction is important during meat processing since lower pH causes more water losses (40); leading to economic losses. Supplementation of OSE did not affect the pH ($p < 0.05$) of

broiler chickens. The result of this study agreed with (41) who found no significant difference in pH when the dietary natural extract was supplemented in broiler chickens.

**Water Holding Capacity**

Water holding capacity (WHC) is known to be one of the major quality characteristics of fresh meat, as it affects some major characteristics of cooked meat such as potential drip loss, technological quality, appearance and sensory properties. Water holding capacity ranged between 40.13 to 60.77% during storage. WHC was not influenced by OSE. A similar result was reported by (42).

**Cooking loss**

The cooking loss in this study ranged between 25.18 to 29.50%. Cooking loss was significantly affected by the supplementation of broiler diets with OSE. The higher the inclusion of OSE, the higher the cooking loss in the meat. The weight of meat lost during cooking is mainly water, even though small amounts of water-soluble proteins and lipids could be lost. As fat is an insulator, meat with a higher fat content will slow down heat transfer during cooking. When heat transfer is not as rapid or severe, meat proteins do not denature to a great extent and less moisture is lost during cooking. Thus, the treatment with higher abdominal fat content seems to have a lower cooking loss. On the contrary, (43) reported no significant difference in cooking loss when broilers were fed dietary medicinal herb extract mixture.

**Colour**

The colour of meat is considered to be related to the degree of oxidation in meat (44). In this study, dietary inclusion of OSE significantly affects the lightness of the broiler meat with 200mg OSE/kg of feed having the highest value. This result agreed with (45) who reported a higher value of L* when onion-garlic was supplemented in broiler diets. Redness (a*) was not significantly affected by OSE supplementation. This is in line with (46) who reported no effect of dietary onion on meat colour. Studies have shown that meat redness (a*) is influenced by a number of factors, including sex. The non-significant effect of OSE on broiler redness in this study might be due to the use of same sex (male) for this experiment. The findings of this study showed a higher b* value for breast meat of birds treated with 200mg OSE/kg feed which is consistent with (47) who treated broilers with a dietary oregano extract. It has been hypothesized (48) that some free radicals produced during lipid oxidation act directly on the pigment with regard to the meat colour, resulting in its oxidation or damaging the reduction systems of the pigment.

The higher value of b* component in broiler supplemented with 200mg OSE/kg of feed can be related to the action of the antioxidant to block the propagation of free radicals, preserving the pigments and giving a yellower colour. In addition, (49) reported that meat colour is altered by dietary supplementation of natural antioxidants, presumably by reducing haemoglobin oxidation and activating mechanisms that modify the distribution of pigments in animal tissues.

**Conclusion and Application**

1. The inclusion of onion skin extract at 300mg/kg of feed reduced low density lipoprotein, total cholesterol and increase high density lipoprotein in the broiler at the finisher phase.
2. Results from this study revealed that the inclusion of onion skin extract at 300mg/kg of feedin broiler diet

reduced oxidative rancidity of broiler meat.

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