

Meat quality, serum and meat lipid profiles of broiler chicken fed *Persea americana*, *Jatropha tanjorensis* and *Ocimum basilicum* leaves extract via drinking water

Ubong Sunday Udoudo*, Joseph Sylvester Ekpo, Idorenyin Meme Sam and Loveday Samuel Okon

Department of Animal Science, Faculty of Agriculture, Akwa Ibom State University, Obio Akpa Campus, Oruk Anam Local Government Area, Akwa Ibom State, Nigeria.

*Corresponding author. Email: ubongudoudo207@gmail.com

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ABSTRACT: Meat quality, serum, and meat lipid profiles of broiler chicken fed *Persea americana*, *Jatropha tanjorensis*, and *Ocimum basilicum* leaves extracts via drinking water were assessed. One hundred and twenty (120) broiler chickens at the finisher phase were divided into four groups. Each group comprised thirty birds and was replicated three times, with ten (10) birds per replicate in a completely randomised design. Birds were randomly assigned to normal drinking water (T₁), *Persea americana* leaf extract (PALE, T₂), *Jatropha tanjorensis* leaf extract (JTLE, T₃) and *Ocimum basilicum* leaf extract (OBLE, T₄), measured at 100ml/L via drinking water. All the birds were fed with a basal diet, and the experiment lasted for 28 days. Data collected on serum and meat lipid profiles were total cholesterol, high-density lipoprotein, low-density lipoprotein, triglycerides and very low-density lipoprotein. The physicochemical parameters of meat measured were chilling loss, cold shortening, thermal shortening, cooking yield and cooking loss. Sensory properties of meat were evaluated. The data obtained were subjected to one-way analysis of variance. Results showed that serum lipid profile showed significant ($p < 0.05$) reduction in total cholesterol, and low-density lipoprotein, triglycerides and very low-density lipoprotein for T₂, T₃ and T₄ compared to T₁. In contrast, a significant ($p < 0.05$) increase in high-density lipoprotein was obtained for T₂, followed by T₃ and T₄, while T₁ decreased. A similar trend occurred in the meat lipid profile as HDL increased while LDL, VLDL, and TG decreased in T₂, T₃, and T₄ compared to T₁. Physicochemical parameters of T₂, T₃ and T₄ showed significant ($p < 0.05$) reduction in cold shortening, thermal shortening and cooking, while increasing cooking yield of broiler meat. There were significant ($p < 0.05$) increases in flavour, juiciness, tenderness, and acceptability in T₄, T₃ and T₂ than in T₁. It was concluded that the use of PALE, JTLE and OBLE improved meat quality and reduced bad cholesterol in broiler meat.

Keywords: Broiler meat processing, leaf extracts, lipid profiles, physicochemical properties.

INTRODUCTION

Consumption of chicken has dominated other meats; this growing demand is driven by population growth and rising individual consumption (FAO, 2023). Ukpanah *et al.* (2024) opined that high demand for poultry meat is attracted by its high-quality protein and low level of fat, with a desirable fatty acid profile. However, consumers being conscious of their health would continue to demand

wholesome and healthy meat and its products (Sanwo *et al.* 2019). Ekpo *et al.* (2018) highlighted those characteristics such as conformation of the carcass, thickness of internal fat, colour, texture and firmness of the bones, level of marbling, flank streaking and degree of leanness are used to assess quality and assign grades. Micha *et al.* (2010) reported that negative perception of

meat and meat products is exacerbated by the amount of fat in the meat, saturated fatty acids, cholesterol and sodium, precursors of cardiovascular diseases. Soladoye *et al.* (2015) pointed out that various techniques employed in meat processing are aimed at promoting oxidative reactions via oxygen exposure (size reduction or high oxygen atmosphere packaging), increased temperatures (i.e. cooking), or incorporation of pre-oxidant ingredients like sodium chloride. According to De Cesare *et al.* (2022), processing involves taking the meat in its raw form and turning it into another product that is marketable, safe for consumption and attractive to consumers.

Factors such as sex, breed, age, nutrition and management have been reported to influence changes in meat quality, as well as impact the incidence and severity of muscle myopathies (Sam *et al.*, 2019; Kuttappan *et al.*, 2012). The presence of high unsaturated fatty acids has been reported to cause high sensitivity of poultry meat to oxidative stress (Min *et al.*, 2008; Sanwo *et al.*, 2019). Ekpo *et al.* (2018) pointed out that meat quality, more specifically, eating qualities from a consumer standpoint, can involve many aspects, including appearance, juiciness, flavour, and texture. These factors are affected by pH, colour, water holding capacity, tenderness and cooking loss and can ultimately determine the acceptability of a product (Barbut 1997; Fletcher, 2002). Due to these factors, it is important to understand how antioxidants are affecting meat quality over time so that the industry can optimise yields while limiting the amounts of downgrades due to these quality issues. Therefore, this study seeks to assess the meat quality and lipid profile of broiler chickens fed various leaf extracts via drinking water.

MATERIALS AND METHODS

location of the study

The experiment was conducted at the Teaching and Research Farm and Animal Science Laboratory, Akwa Ibom State University, Obio Akpa Campus, Oruk Anam Local Government Area, Akwa Ibom State, Nigeria. The area lies between latitude 5° 17'N and longitude 7° 21'E and 7° 58'E with annual rainfall of 3500 – 5000 mm, temperature range of 24 – 26°C and relative humidity range of 60 – 90% (AKSU-MET, 2021).

Management of experimental birds

A total of one hundred and twenty (120) broiler chickens at the finisher phase were divided into four groups. Each group consisted of thirty birds and was replicated three times, with ten (10) birds per replicate in a completely randomised design. Birds were randomly assigned to normal drinking water (T₁), *Persea americana* leaf extract

(T₂), *Jatropha tanjorensis* leaf extract (T₃) and *Ocimum basilicum* leaf extract (T₄), measured at 100 ml/L via drinking water. All the birds were fed with basal diets, and the experiment lasted for 28 days.

Sources and processing of test materials

Fresh leaves of *Persea Americana* (Avocado), *Jatropha tanjorensis* (Hospital is too far) and *Ocimum basilicum* (African curry) were harvested from the plant and washed with water to remove traces of dust. The leaves were ground in a mill. The leaf extract was obtained by soaking the ground leaves in clean water for 24 hours at 37°C. The obtained solution was filtered and used. The quantity of the filtrate measured to be 100 ml/litre of drinking water for *Persea Americana* leaf extract (PALE), *Jatropha tanjorensis* leaf extract (JTLE) and *Ocimum basilicum* leaf extract (OBLE), designated as T₂, T₃ and T₄, respectively, while T₁, untreated clean water, served as the control.

Meat lipid analysis

A sample of 5 g from the thigh muscle of each of the three replicates was collected for the determination of the meat lipid profile and carried out according to the method described by Folch *et al.* (1957).

Determination of serum lipid profile

A sample of 5 ml of blood was collected from twenty-four (24) birds, six birds per treatment, into plain vacutainer (without anticoagulants) at slaughtering. The sample was centrifuged at 3000 rpm for 15 minutes. The serum was used to determine lipid profile based on the method described by Baker *et al.* (1998). Parameters studied were total cholesterol (TC), high-density lipoprotein (HDL), low-density lipoprotein (LDL), triglyceride (TG) and very low-density lipoprotein (VLDL). TC, TG and HDL were determined using commercial kits, while LDL was determined using the formula described by Friedewald *et al.* (1972).

Physicochemical analysis

Cooking loss: 100g of meat samples were taken from the breast part of two birds per replicate of each treatment. The meats were weighed, wrapped individually in cellophane and cooked at 80°C for 20 minutes (Okon *et al.*, 2023a). The losses were determined as follows:

Cooking loss (%) = $\frac{\text{weight of sample before cooking} - \text{weight after cooking}}{\text{weight of sample before cooking}} \times 100$

Cold shortening: The left wings of the birds were used for cold shortening. This part was measured in centimetres using a ruler before and after chilling to have the cold shortening.

Chilling Loss: The breast meat was used for chilling loss. The meat samples were chilled for 24 hours to differentiate between the warm carcass weight and the chilled weight.

Thermal shortening: The right wing of the birds was used for thermal shortening. The length of the meat was measured in centimetres using a ruler before putting it in a heat-resistant polythene bag and immersing it in boiling water of about 80°C. It was allowed to cool for 20 minutes and reweighed after to have thermal shortening.

Sensory evaluation

Meat samples were presented to a 9-man trained panelist to evaluate for colour, flavor, juiciness, tenderness and overall acceptability using a 9-point Hedonic scale (1=extremely dislike; 2= dislike very much; 3= moderately dislike; 4= dislike slightly; 5= intermediate; 6= like slightly; 7= like moderately; 8= like very much; 9= like extremely) described by Ekpo and Okon (2024).

Experimental design

The data collected were subjected to one-way analysis of variance (ANOVA) using SPSS. The significant differences between means were separated using the Duncan Multiple Range Test of the same package.

RESULTS AND DISCUSSION

Physico-chemical parameters of broiler meat, as presented in Table 1, indicated that chilling loss for T₁ (4.00), T₂ (3.80), T₃ (6.50) and T₄ (6.00) were not significantly ($p>0.05$) influenced by leaf extracts. However, cold shortening (6.50T₁, 3.40T₂, 4.67T₃ and 5.50T₄) and thermal shortening (6.10T₁, 4.20T₂, 4.80T₃ and 4.67T₄) were significantly ($p<0.05$) higher in T₁ compared to treatment groups. Cooking yield was significantly ($p<0.05$) higher in T₂ (72.50), T₄ (72.00) and T₃ (71.50) compared to T₁(69.50). Conversely, cooking loss was significantly ($p<0.05$) higher for T₁ (31.50) compared to T₃ (29.50), T₄ (28.00) and T₂ (27.50). This implies that antioxidants present in the treatments reduced cooking loss and improved the cooking yield obtained. It could also increase water-holding capacity by preserving of cellular structure of meat, which minimises water leakage. Antioxidants in broilers have been shown to enhance water holding capacity (WHC) by stabilising physiological membranes

and protecting protein and lipid from oxidative damage (Mudalal *et al.*, 2014). This helps stabilise cellular structure, minimise water leakage, resulting in higher water holding capacity, which is otherwise reduced thermal cooking loss obtained. Additionally, the cooking method adopted might have also affected the meat yield. The meat yield obtained in this study disagreed with the earlier work of Sanwo *et al.* (2019) for broiler fed turmeric powder and cayenne pepper powder as antioxidants. Alugwu *et al.* (2022) claimed that the higher the temperature, the greater the cooking losses due to losses in moisture. Obuz *et al.* (2003) noted that cooking at a lower temperature yields a tender product. Alugwu *et al.* (2022) further reported that a reduction in cooking yield is associated with cooking temperature and time. Singh *et al.* (2015) observed that cooking yield and cooking loss were mostly affected by different cooking methods. Apart from antioxidants, some macro minerals such as potassium, sodium and calcium present in T₂, T₃ and T₄ might have played significant roles by increasing protein solubility, especially myofibrilla protein, thereby improving water binding and water holding capacity of meat. This is reflected in the reduced cooking loss, thermal shortening and higher cooking yield obtained in treatment diets. According to Offer and Trinick (1983) and Huff-Lonergan and Lonergan (2005), adequate calcium and potassium regulate muscle pH decline, which in turn improves meat texture and water holding capacity, resulting in higher cooking yield.

The serum lipid profile of broiler presented in Table 2 indicated that total cholesterol (111.40 T₁, 107.47 T₂, 98.87 T₃, and 88.47 T₄) showed significant ($p<0.05$) reduction in value in treatments 2, 3 and 4 compared to control, T₁. The same trend was observed for low-density lipoprotein, triglyceride and very low-density lipoprotein. However, high-density lipoprotein increased in 70.67T₂, 69.00T₃ and 62.67T₄ compared to the T₁ control. The drastic reduction in bad cholesterol, low-density lipoprotein in T₂, T₃ and T₄, suggested that antioxidants present in the leaf extracts might have reduced oxidative stress, which usually accumulates fat and cholesterol, thereby resulting in a drastic reduction of cholesterol. Besides, the presence of saponin in the extracts must have contributed to the reduced cholesterol level in the blood. Ebe *et al.* (2019) opined that saponins lower blood cholesterol levels by blocking excess cholesterol from reabsorption into the blood, and the non-sugar component of saponin is associated with antioxidant potential. Ekpo and Okon (2024) noted that antioxidants in plant leaves help protect against the oxidation of fatty acids. The results of the present study were in line with reports from Madhupriya *et al.* (2020) and Fatma *et al.* (2011), who observed a reduction in the levels of total cholesterol for broiler fed triphala leaf meal. Similar results were found by Sujatha *et al.* (2019) and Yahya *et al.* (2014) in birds fed polyherbal feed supplement and ginger root, respectively.

Table 1. Physico-chemical parameters of processed broiler meat.

Parameters	Treatments				SEM
	T ₁	T ₂	T ₃	T ₄	
Chilling loss (%)	4.00	3.80	3.25	3.20	0.58
Cold shortening (cm)	6.50 ^a	3.40 ^c	4.67 ^{bc}	5.50 ^b	0.33
Thermal shortening (cm)	6.50 ^a	4.20 ^c	4.80 ^b	4.67 ^b	0.21
Cooking yield (%)	69.50 ^b	72.50 ^a	71.50 ^{ab}	72.00 ^a	0.49
Cooking loss (%)	30.50 ^a	27.50 ^d	29.50 ^b	28.00 ^c	0.60

T₁ = control; T₂ = broiler+ *Persea americana*; T₃ = broiler + *Jatropha tanjorensis*; T₄ = broiler + *Ocimum basilicum*; SEM=standard error of mean.

Table 2. Serum lipid profile of broiler chicken.

Parameters (mg/dL)	Treatments				SEM
	T ₁	T ₂	T ₃	T ₄	
Total cholesterol	111.40 ^a	107.47 ^{ab}	98.87 ^b	88.47 ^c	13.58
HDL	59.00 ^b	70.67 ^a	69.00 ^a	62.67 ^{ab}	4.84
LDL	42.00 ^a	27.33 ^{ab}	20.50 ^b	21.67 ^b	3.58
Triglyceride	52.01 ^a	47.33 ^b	46.83 ^b	20.66 ^c	11.43
VLDL	10.40 ^a	9.47 ^b	9.37 ^b	4.13 ^c	2.29

^{abc} means on the same row bearing different superscripts are significantly different ($p < 0.05$); HDL = high density lipoprotein; LDL = low density lipoprotein; VLDL = very low-density lipoprotein; T₁ = control; T₂ = broiler + *Persea americana*; T₃ = broiler + *Jatropha tanjorensis*; T₄ = broiler + *Ocimum basilicum*; SEM = standard error of mean.

Table 3. Lipid profile of broiler meat.

Parameters (mg/dL)	Treatments				SEM
	T ₁	T ₂	T ₃	T ₄	
TC	50.04 ^a	45.81 ^c	49.10 ^b	49.92 ^b	0.04
HDL	21.22 ^c	25.12 ^a	23.69 ^b	23.99 ^b	0.54
LDL	23.22 ^a	16.52 ^c	20.33 ^b	20.70 ^b	0.09
TG	28.00 ^a	20.83 ^c	25.44 ^b	26.19 ^b	0.61
VLDL	5.60 ^a	4.17 ^c	5.08 ^b	5.23 ^b	0.03

^{abc} means on the same row bearing different superscripts are significantly different ($p < 0.05$); TC=total cholesterol; HDL=high density lipoprotein; LDL=low density lipoprotein; TG=triglyceride; VLDL= very low-density lipoprotein; T₁=control; T₂= broiler+ *Persea americana*; T₃ = broiler + *Jatropha tanjorensis*; T₄ = broiler + *Ocimum basilicum*; SEM = standard error of mean.

The results of the meat lipid profile presented in Table 3 showed significantly ($p < 0.05$) higher concentration of TC, LDL, TG and VLDL in T₁ than in T₂, T₃ and T₄. This suggests the hypocholesterolemic potential of the leaf extracts. This result was in agreement with the findings of Madhupriya *et al.* (2020) and Okon *et al.* (2023b), who observed a reduction in total cholesterol concentration in broiler breast meat fed varying levels of triphala and *Monodora myristica*, respectively. Similarly, the hypoglycemic potential of bioactive compounds helped reduce triglyceride levels and blocked the buildup of fat in the tissue. The differences observed in lipid profile may be due to the antioxidative potency of each of the leaf

extracts. The findings of this study are in agreement with the studies of Okon *et al.* (2023a), Ekpo and Okon (2023) and Madhupriya *et al.* (2020) on rabbit, pig and broiler chicken fed spice, avocado seed meal and *Jatropha tanjorensis*, respectively. A similar result was reported by Okon *et al.* (2024), who observed an increase in HDL and a reduction in LDL in broiler meat breaded with various coating materials.

Sensory evaluation of processed broiler meat, as presented in Table 4, indicated that leaf extract significantly ($p < 0.05$) affected all the sensory parameters of broiler meat. Flavour, juiciness, tenderness, colour and overall acceptability scores were significantly ($p < 0.05$)

Table 4. Sensory evaluation of processed broiler meat.

Parameters	Treatments				SEM
	T ₁	T ₂	T ₃	T ₄	
Flavour	6.10 ^c	6.60 ^{bc}	7.30 ^{ab}	8.00 ^a	0.21
Juiciness	5.90 ^b	7.30 ^a	7.20 ^a	7.60 ^a	0.17
Tenderness	6.80 ^b	7.80 ^a	8.40 ^a	8.40 ^a	0.16
Colour	6.80 ^{ab}	6.10 ^b	6.90 ^{ab}	7.10 ^a	0.15
Acceptability	6.20 ^c	7.00 ^b	7.40 ^{ab}	7.90 ^a	0.15

^{abc} means on the same row bearing different superscripts are significantly different ($p < 0.05$); T₁ = control; T₂ = *Persea americana* extract; T₃ = *Jatropha tanjorensis* extract; T₄ = *Ocimum basilicum* extract; SEM = standard error of mean.

affected. Flavour ranked highest in T₄ and T₃ than other treatment groups. The increase may be attributed to the high flavonoid content in *Ocimum* and *Jatropha* leaf extracts. Antioxidants, particularly polyphenols present, could have significantly improved meat flavour by reducing oxidative reaction and formation of volatile compounds that can lead to off-flavours and off-colours.

The improvement in colour observed in T₂, T₃, and T₄ could also be attributed to the antioxidants present in these treatments. Suman and Joseph (2013) had earlier reported that supplementing livestock feed with antioxidants or inclusion of antioxidants into fresh meat reduced lipid and oxymyoglobin oxidation, thereby enhancing the fresh meat colour stability. Colour is one of the important quality traits, and myoglobin is the major heme protein responsible for the meat colour. This also affects meat perception and preference by consumers. Juiciness and tenderness scores were significantly ($p < 0.05$) increased in meat fed test diets compared to the control. The result of the study disagrees with the findings of Ekpo and Okon (2023), who reported a reduction in tenderness of pork fed *Jatropha tanjorensis*. However, the finding corroborated with the findings of Ekpo and Okon (2024) for pork fed processed avocado seed. Okon *et al.* (2023b) asserted that tenderness and juiciness of meat are positively correlated, noting that the level of tenderness determines the extent to which juiciness is achieved. The overall acceptability was significantly ($p < 0.05$) higher in the treatment groups than in the control. This indicated that meat from treatment groups was higher in flavonoids and phenols, which improved juiciness and tenderness by maintaining the structural integrity of proteins.

Conclusion

Based on the results of this study, it is deduced that feeding broiler chickens with *Persea americana*, *Jatropha tanjorensis*, and *Ocimum basilicum* leaves extracts via drinking water increased high-density lipoprotein while reducing total cholesterol, low-density lipoprotein, very

low-density lipoprotein and triglyceride in both serum and meat lipid. It increased the cooking yield of meat while reducing cooking loss, cold loss and thermal loss. Improved sensory traits (flavour, juiciness, tenderness and colour) of broiler meat.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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