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Evaluation of serum lipid profile and sensory properties of spent layers fed diets supplemented with curry, mint and pawpaw leaves powder

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***Target Audience:** Poultry farmers. food scientist, meat scientists and researchers.*

Abstract

Serum lipid profile and sensory properties of spent layers fed diets supplemented with curry, mint and pawpaw leaves including the phytochemicals in the leaves were evaluated. Spent layers numbering 210 were randomly allocated to seven broiler finisher diet (BFD); containing no supplement, 2 kg pawpaw leaf powder (PLP), 2 kg curry leaf powder (CLP), 2 kg mint leaf powder (MLP), 1 kg CLP + 1 kg PLP, 1 kg MLP + 1 kg PLP and 1 kg CLP +1 kg MLP levels for T_1, T_2, T_3, T_4, T_5, T_6 and T_7 respectively in a Completely Randomized Design (CRD) technique. The study was based on one week adaptation period and forth night feeding exposure to the supplement compositions. Serum lipid profile and sensory properties of meat were evaluated. The results revealed that supplementation of 2 kg of CLP and MLP in BFD fed to spent layers significantly reduce serum lipid profile components as compared to control except HDL. Results also indicated that supplementation of 2 kg of MLP in the BFD fed to spent layers significantly enhanced meat aroma and supplementation of 2 kg PLP significantly enhanced tenderness as compared to the control. The study concluded that supplementation of 2 kg CLP, MLP and PLP respectively, enhanced the serum lipid profile quality and sensory properties quality. On these bases, CLP, MLP and PLP could be included in diet of spent layer to improve the meat and serum lipid profile qualities.

***Key words:** Serum, Lipid profile, Sensory properties and Spent layer meat.*

Description of Problem

Poultry meat is a valuable alternative to red meat, especially in regions where under-nutrition or low-income earners are increasing (1). This has led to an increase in poultry production worldwide which led to the development of new ready- to- eat poultry products with effects for meat quality, as an important economic factor in the poultry industry (2). This quality attributes affect marketing and conservation while nutritional quality influences the consumer decisions (3,4). Excessive expansion of egg production has resulted in the abundance of spent layers (5). Meat from spent layer is usually very tough and chewy, non-juicy and low in fat (6,7). Due to the unacceptable toughness of the meat, which is one of the most important determinant of eating quality and suitability of meat by consumers (8). The use of spent layer for meat has long been a problem for the poultry industry (9).

Attempts to improve spent layer meat quality by improving tenderness through post-slaughter processes are not only costly and labor intensive, but also require large storage area and longer storage time. The processes are, therefore, impractical and not economically feasible (9). Nevertheless, according to (10), spent layers have remained a good source of meat for most Nigerians and sale of the spent layers at the end of the laying cycle is one important source of income to the poultry farmer. However, meat value is very essential in maintaining consumer health. These, therefore, have created the need to look for better alternatives that enhance the quality of spent layer meat without having negative impacts on the consumers.

Moreover, people are becoming more concerned in healthily produced poultry products because of the negative health consequences of using the hazardous inorganic substances in the production of meat and their products. According to (11) and (12), the use of natural preservatives to improve the quality of meat and their products is a promising technology. Many herbs, plants, fruits and vegetable extracts or powders have been found to have antioxidant and tenderizing properties. Among the tested natural substances in poultry nutrition were leaf meal of Basil (*Ocimum basilicum*), Curry (*Murraya koenigii*), Spear mint (*Mentha spicata*), Pawpaw (*Carica papaya*), etc. (13,14,15,16,17). The present study set to evaluate serum lipid profile and sensory properties of spent layers fed diets supplemented with curry, mint and pawpaw leaves powder.

Materials and Methods

Experimental location

The trial was conducted at the Poultry Production Unit of Sokoto State Veterinary Centre, located at Aliyu Jedo Road, in Sokoto Metropolis. Sokoto State is within the savannah agro-ecological zone located on longitude 5014’51.1872”E and latitude 1300’21.1428” N at an altitude of 350 m above the sea level. The rainy season starts in mid-May to early June and reaches peak in August. Dry season starts in mid-October and ends in late May. The hottest period is March to May while the coldest period is December to February, characterized by dry harmattan winds (18). Sokoto State Veterinary Centre has an average annual temperature of 30.26^{o}C with average rainfall of 650 mm and average annual humidity of 48.54% (18,19).

Sources of test ingredients and other feedstuffs

The test ingredients (curry, mint and pawpaw leaves) were sourced from the Sokoto main vegetable market (Ramin Kura) within Sokoto metropolis. The plant specimens were identified by a botanist in the Botany unit (Department of Biological Sciences), Usmanu Danfodiyo University, Sokoto (UDUS). Already processed feedstuffs for compounding diet (maize, groundnut cake, blood meal, bone meal, wheat offal, salt, limestone, methionine, lysine and premix) were sourced from the Feed-mill section of the Sokoto Technology Incubation Centre (STIC), Sokoto. TIC), Sokoto.

Experimental chickens and management

The 210 spent layer chickens of ISA Brown strain at 115 weeks old were purchased from the Labana Farms Limited, Aliero, in Aliero Local Government Area of Kebbi State. On arrival, the birds were fed broiler finisher diet (BFD) and presented drinking water containing anti-stress (glucose), to relieve them from journey stress. An adaptation time of seven days was observed for the birds to adjust to their new environment. They were afterward randomly distributed by means of Completely Randomized Design (CRD) to seven treatments and fed for 14 days. The treatments consisted of single BFD containing no supplement as T_1, BFD + 2 kg pawpaw leaf powder (PLP) as T_2, BFD + 2 kg curry leaf powder (CLP) as T_3, BFD + 2 kg mint leaf powder (MLP) as T_4, BFD + 1 kg CLP + 1 kg PLP as T_5, BFD + 1 kg MLP + 1 kg PLP as T_6 and BFD + 1 kg CLP + 1 kg MLP as T_7.

Table1: Gross and chemical compositions of experimental diets

	Treatment Diets						
Ingredients (%)	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Maize	56.00	56.00	56.00	56.00	56.00	56.00	56.00
Wheat offal	22.50	22.50	22.50	22.50	22.50	22.50	22.50
Groundnut cake	15.50	15.50	15.50	15.50	15.50	15.50	15.50
Blood meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Salt	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Premix	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
CLP	0.00	0.00	2.00	0.00	1.00	0.00	1.00
MLP	0.00	0.00	0.00	2.00	0.00	1.00	1.00
PLP	0.00	2.00	0.00	0.00	1.00	1.00	0.00
Calculated Chemical Composition							
ME(Kcal/kg)	2900.00	2920.49	2912.87	2913.75	2916.68	2917.12	2913.31
CP (%)	20.00	20.64	20.50	20.48	20.57	20.56	20.49
CF (%)	4.87	4.93	4.91	4.90	4.92	4.91	4.91
EE (%)	4.10	4.12	4.12	4.11	4.12	4.11	4.12

CLP- Curry leaf powder, MLP- Mint leaf powder, PLP- Pawpaw leaf powder, ME- Metabolisable energy, CP- Crude protein, CF- crude fibre, EE – ether extract.

Trial plan

Two hundred and ten (210) spent layer birds were alienated into seven groups of 30 birds each and allocated to the seven dietary treatments. Each treatment group was divided into three replicates with 10 birds per replicate.

Sample collection

At the end of trial, three birds were randomly selected using balloting method from each treatment for blood sample collection of serum lipid profile assay and meats were collected for sensory evaluation.

Phytochemical assay

The curry, mint and pawpaw leaves used for this experiment were air-dried and then oven-dried at temperature of 50°C to obtain moisture content of 10% as recommended by (20). Phytochemical compounds were analysed according to the procedure described by (21, 22, 23).

Determination of serum lipid profile

Serum lipid profile determination was conducted in the Biochemistry laboratory, Department of Biochemistry, Usmanu Danfodiyo University, Sokoto. Serum lipid profile were analysed with Spectrophotomer (model: AE-350, By ERMA INC) using Randox Cholesterol Kit Enzymatic End point method according to the procedure described by Bhagavan (24). Sensory evaluation was carried out in the Department Animal Science Laboratory using descriptive test sensory panels, which constituted of both undergraduate and postgraduate students of various Departments in the Usmanu Danfodiyo University, Sokoto, Nigeria according to the methods described by (25). Meat from breast and thigh parts for each treatment were cut, packed in polyethylene bags and placed in boiling water (100°C) for 25 minutes. The cooked meat samples were placed in separate coded disposable plates and presented to the panelists for evaluation. The panelists were trained on the criteria for the sensory evaluation of meat and also instructed to use water for cleansing mouth between samples to reduce impact between samples. Each panelist was asked to evaluate the aroma, tenderness, colour and overall acceptability of the meat samples. A nine-point hedonic scale was used to score each of these attributes; 1= extremely dislike, 2 = to 9, like extremely.

Data analysis

The data collected were subjected to one-way Analysis of Variance (ANOVA). Significant difference observed among treatment means ($P<0.05$) were separated by Duncan's Multiple Range Test (DMRT) using SPSS version 21.0 2012, IBM USA.

Results and Discussion

Phytochemical analysis of test ingredients

The results for phytochemical analyses are presented in Table 2. The results showed that the following active substances are present in the test ingredients; alkaloids, flavonoids, cardiac glycosides, phenols, saponins, tannins and terpenoids. These active substances were found in varying amounts in different ingredient and some are not detected in others. CLP contains higher amount of cardiac glycosides (0.60 mg/kg) and flavonoids (1.04 mg/kg) compared to MLP and PLP. MLP contains higher amount of tannins (1.60 mg/kg) and terpenoids (0.34 mg/kg) compared to CLP and PLP while PLP contains higher amount of alkaloids (0.80 mg/kg) compared to CLP and MLP.

Table 2: Proportions (mg/kg) of phytochemical components

Components	Ingredient		
	CLP	MLP	PLP
Alkaloids	0.75	0.34	0.80
Cardiac glycosides	0.60	0.45	0.54
Flavonoids	1.04	0.67	0.93
Phenols	0.09	-	-
Saponins	-	0.52	-
Tannins	0.075	1.60	-
Terpenoids	0.024	0.34	-

- = Not detected
CLP- Curry leaf powder
MLP - Mint leaf powder
PLP- Pawpaw leaf powder

Several studies conducted by (26,27,17,28) affirm the presence of bioactive substances in CLP, MLP and PLP. However, these herbs possess different concentrations of these bioactive compounds which could be due to varietal difference of the plants. The phytochemical analysis result of CLP is in line with the work of (17) and (28) who reported the phytochemical screening of curry (*Murraya koenigii L.*) revealed the presence of cardiac glycosides, flavonoids, tannins and terpenoids. Similarly, the following active substances; flavonoids, saponins, tannins and terpenoids were confirmed in MLP by (27). (26) also reported the presences alkaloids (carpain, carpasemine), cardiac glycosides and flavonoids present in pawpaw leaves.

Serum lipid profile assay

Serum lipid components results are presented in Table 3. The treatments differ significantly ($p<0.05$) in all lipid components except high density lipoprotein (HDL). The control birds had higher ($P<0.05$) total cholesterol (TC) compared with birds in treatments 3, 4 and 7 but similar with other treatments. The birds on control diet had significantly higher ($P<0.05$) low density lipoprotein (LDL) concentration than birds in all other treatments. Treatment 1 birds had higher ($P<0.05$) triglyceride (TAG) than other treatments except treatment 2 birds.

Table 3: Serum lipid components (mg/dl) according to treatments

Treatments	Lipid profile components			
	TC	HDL	LDL	TAG
1	204.33^{a}	37.00	136.67^{a}	202.00^{a}
2	194.33^{ab}	44.00	117.00^{b}	191.67^{ab}
3	189.33^{b}	44.33	109.67^{b}	182.33^{bc}
4	191.67^{b}	44.00	112.33^{b}	177.33^{bc}
5	193.67^{ab}	42.00	110.00^{b}	184.33^{b}
6	193.00^{ab}	44.00	115.00^{b}	172.00^{c}
7	188.33^{b}	44.00	113.33^{b}	181.00^{bc}
SEM	3.44	3.32	3.15	4.43

abc = means bearing different superscripts within the same column differ ($P<0.05$)
SEM = Standard Error of Mean
TC = total cholesterol
HDL= high density lipoprotein
LDL= low density lipoprotein
TAG = triglyceride
No supplement as T_1, BFD + 2 kg pawpaw leaf powder (PLP) as T_2, BFD + 2 kg curry leaf powder (CLP) as T_3, BFD + 2 kg mint leaf powder (MLP) as T_4, BFD + 1 kg CLP + 1 kg PLP as T_5, BFD + 1 kg MLP + 1 kg PLP as T_6 and BFD + 1 kg CLP + 1 kg MLP as T_7.

The control birds had higher total cholesterol than the birds fed supplements; it implies that the supplements had secondary metabolites that affect the enzymes which stimulate lessening synthesis or increases tissue absorption of TC in the serum. Flavonoids a constituent of the test ingredients was reported to cause decline in cholesterol levels by (29) and (30). The serum LDL was higher for birds on control diet than all other treatments birds. This suggests that these supplements had secondary metabolites that affect the enzymes which stimulate decline synthesis or increased tissue absorption of LDL. (31) reported that flavonoids was responsible for decreased low density lipoprotein in serum. Triglyceride concentration was lower for birds on supplemental diets than the control. This may not be unconnected to the supplements in the diets. This suggests that the bioactive substances in the test ingredient either reduces the synthesis from fat in feed or reduces the synthesis of triglyceride in the liver. The lower values obtained of 188.33, 109.67, 37 mg/dl for TC, LDL and HDL in this study are lower than the values of 2.46, 1.70 and 0.44 mg/dl^{-1} acquired by (32) who evaluated alfalfa flavonoids on performance, meat quality and gene expression of broiler chicken. The variation could be attributed to differences of test ingredients, breeds and age of the birds and location of the studies. The findings of this study are in line with the report of (32) who reported flavonoids in the diet of broiler decreases the TC, LDL and HDL level in the serum of birds.

Sensory evaluation of spent layer meat

The results of sensory evaluation were presented in Table 4.There were significant (P<0.05) differences in aroma and tenderness among the treatment means. The meat aroma scores of treatments 4, 6 and 7 were higher (P<0.05) than the scores of treatments 1 and 3, but similar with treatments 2 and 5 meat. Treatment 2 meat had significantly higher scores than all other treatments meat for tenderness.

Table 4: Sensory evaluation of spent layer meat according to treatments

Treatment	Aroma	Tenderness	Colour	Acceptability
1	4.70^{c}	2.63^{d}	7.37	7.56
2	4.89^{bc}	5.89^{a}	7.59	7.33
3	5.52^{abc}	4.59^{b}	7.11	7.33
4	6.33^{a}	4.74^{b}	7.41	7.74
5	5.70^{ab}	4.37^{b}	6.89	7.11
6	5.93^{a}	3.44^{c}	7.29	7.41
7	6.26^{a}	3.15^{cd}	6.78	7.07
SEM	0.29	0.26	0.27	0.24

abcd= means bearing different superscripts within the same column differ (P<0.05)
SEM= Standard Error of Mean
No supplement as T_1, BFD + 2 kg pawpaw leaf powder (PLP) as T_2, BFD + 2 kg curry leaf powder (CLP) as T_3, BFD + 2 kg mint leaf powder (MLP) as T_4, BFD + 1 kg CLP + 1 kg PLP as T_5, BFD + 1 kg MLP + 1 kg PLP as T_6 and BFD + 1 kg CLP + 1 kg MLP as T_7.

The high rating scores for aroma of meat obtained in treatment 4 might be due to effects secondary metabolites present in the supplement. Terpenoids are widely used directly as flavoring compounds in food industries (33). The finding of this study agrees with work by (7) who concluded that dietary supplementation of 2% papaya leave meal in spent layers for a few days before slaughter, improved meat quality in terms of meat flavour or aroma. The high rating scores for tenderness of meat observed in treatment 2 could be as results of supplementation of PLP in the diet, known to contain tendering agent papain. (9) reported that application of pawpaw leaves marinades one hour before cooking was enough for meat tenderization. The findings of this study support report by (7) who maintained that supplementation of 2% pawpaw leave meal (PLM) with vitamin D_3 and the combination in spent layer diet two weeks before slaughter improves the meat of spent layer meat tenderness.

Conclusion and Applications

1. It was concluded that supplementation of 2 kg CLP significantly reduced TC and LDL, while the combination of

layers.
2. Dietary supplementation of 2% MLP and PLP in spent layer diet significantly enhanced aroma and tenderness of spent layer meat respectively.

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