

Serum Biochemistry and Sensory Evaluation of Broiler Chicken Fed *Cymbopogon citratus* Leaf Meal

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Abstract The study was conducted to investigate the effect of feeding graded levels of *Cymbopogon citratus* leaf meal (CcLM) at 0,0.01,0.1, and 0.2 % respectively on the sensory and biochemical parameters of 120 broiler chickens. The diet was isocaloric and isonitrogenous and the study lasted for 56 days after which data on organoleptic and biochemical parameters were collected and evaluated using a completely randomized design. Results showed that the serum glucose level, aspartate aminotransferase (AST), alanine aminotransferase (ALT) and total protein (TP) were significant ($p < 0.05$). Serum evaluation was done using nine panelists. Bite of different portions of broiler meat samples weighing 10g were served at room temperature. Responses from the panelist were obtained using the hedonic scale of ranking. Results showed that broilers raised with diet D (0.2 % CcLM) did not adversely influenced colour, texture, odour and acceptability for consumers. The study revealed that inclusion of CcLM in broiler chicken diet, does not have any deleterious effect on the serum biochemistry and organoleptic parameters of broiler chicken.

Keywords: serum biochemistry, broiler chicken, *Cymbopogon citratus*

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1. Introduction

Food is a basic need and the agricultural sector continues to play a significant role in Nigeria's economy in terms of feeding and employment [1]. For the developing countries as a whole, the ratio of undernourished people in the world population is about 12.9 per cent [2]. Poultry meat is a rich source of high quality protein, minerals and vitamins [3]. The production interval is much shorter compared to other livestock [1]. One of the major challenges of chicken production in Nigeria is low quality of ingredients used in the formulation of feeds and high cost of feeding [4]. In most developing countries, the use of leaves, seeds, fruits, barks and root of some plants to improve the performance of farm animals is common [5]. *Cymbopogon citratus* is a plant of importance because of its rich composition of phytochemicals like tannins, flavonoids and phenols [6]. Traditionally, tea made from *Cymbopogon citratus* leaves are popular in South America, Asia and West Africa for its antiseptic, antifever, antidyspeptic, carminative, anti-inflammatory, febrifuge, analgesic, spasmolytic, antipyretic, diuretic and stomachic agent [7,8,9,10,11]. This study evaluates the serum biochemical indices and sensory parameters of broiler chicken fed with graded levels of *Cymbopogon citratus* leaf meal inclusions in their diet.

1.1. Experimental Site

The experiment was carried out at the Poultry and Livestock Teaching and Research farm, Babcock University, Ilishan-Remo Ogun State, Nigeria. Babcock University is located in the rain forest vegetation zone of Nigeria. It lies within latitude 6° 54'N and 7° 28'N of the Equator and longitude 3° 42'E and 4°15'E of the Greenwich Meridian. The average annual rainfall is 1500mm with altitude of about 300 meters above sea level; while the mean annual temperature is about 27°C.

1.2. Experimental Material

Cymbopogon citratus seedling was identified and authenticated at Department of Botany, University of Ibadan with voucher number, UIH22565, Ibadan, Oyo state Nigeria and the seedlings were grown in the field, harvested and dried indoors.

1.3. Experimental Design

A total of 120 broiler (Arbor Acre strains) randomly allotted to 4 treatment groups A, B, C and D of three replicates per treatment was used in this study after obtaining an ethical clearance from Babcock University Health Research Ethics Committee, BUHREC281/15. Brooding lasted for

4 weeks with the introduction of graded levels of the leaf meal in starter feed at week 2, then graded levels of leaf meal in finisher diet was continued till week 8. The composition of the diets is as shown in Table 1 and Table 2.

Diet A = Control diet- the usual broiler feed without leaf meal.

Diet B = Control diet + 0.01% of *Cymbopogon citratus* leaf meal (CcLM)

Diet C = Control diet + 0.1% of *Cymbopogon citratus* leaf meal (CcLM)

Diet D = Control diet + 0.2% of *Cymbopogon citratus* leaf meal (CcLM)

All the treatments diets A-D had three replicates of ten (10) birds each totaling one hundred and twenty (120) birds.

1.4. Leaf Meal Preparation

The fresh leaves of *Cymbopogon citratus* were harvested. Preference was given to mature leaves which were directly exposed to sunlight throughout the day. Harvesting was done between the hours of 016 and 017 when the plants must have completed their light stage of photosynthetic process for the day. The quantity of leaves needed was air dried at an average room temperature of 27°C for seven days and further oven dried to constant weight at 40°C for ten hours and then milled with a hammer mill sieve of 0.02mm diameter [12], to obtain a fine powdery meal stored at 4°C in the fridge until ready for use.

Table 1. Composition (%) of Broiler Starter Experimental diet

Ingredients	Diet A	B plus 0.01% of Cc	C plus 0.1% of Cc	D plus 0.2% of Cc
Maize	55.00	55.00	55.00	55.00
GNC	20.00	20.00	20.00	20.00
SBM	14.30	14.30	14.30	14.30
Fish meal (72%cp)	3.00	3.00	3.00	3.00
Wheat offal	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00
DCP	2.00	2.00	2.00	2.00
PKC	2.00	2.00	2.00	2.00
Common Salt	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10
Premix	0.25	0.25	0.25	0.25
Total	100	100	100	100
Crude protein	23.08	23.08	23.08	23.08
Metabolizable energy (kcal/kg)	2960	2960	2960	2960
Ether extract	4.41	4.41	4.41	4.41
Crude Fibre	3.85	3.85	3.85	3.85

GNC = Groundnuts cake
 PKC = Palm kernel cake
 DCP = Dicalcium phosphate
 SBM = Soybean Meal.

Table 2. Composition (%) of Broiler Finisher Experimental diet

Ingredients	Diet A	B plus 0.01% of Cc	C plus 0.1% of Cc	D plus 0.2% of Cc
Maize	59.00	59.00	59.00	59.00
GNC	17.00	17.00	17.00	17.00
SBM	8.00	8.00	8.00	8.00
Fish meal (72%cp)	1.00	1.00	1.00	1.00
Wheat offal	5.30	5.30	5.30	5.30
Limestone	1.50	1.50	1.50	1.50
DCP	2.00	2.00	2.00	2.00
PKC	5.50	5.50	5.50	5.50
Common Salt	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10
Premix	0.25	0.25	0.25	0.25
Total	100	100	100	100
Crude protein	19.52	19.52	19.52	19.52
Metabolizable energy (kcal/kg)	2998	2998	2998	2998
Ether extract	4.42	4.42	4.42	4.42
Crude Fibre	3.72	3.72	3.72	3.72

GNC = Groundnuts cake
 PKC = Palm kernel cake
 DCP = Dicalcium phosphate
 SBM = Soybean Meal.

The composition of the diets is shown in Table 1 for starter and Table 2 for finisher. Proximate composition of the experimental diets was run according to AOAC [13]. All animals were housed under identical conditions of temperature and humidity. Clean water and feed were readily available to birds *ad-libitum*, while vaccination and medication were done as and when due.

1.5. Collection of Data

Serum Biochemical analysis: Blood samples were allowed to clot and centrifuged at 1500rpm for 20 minutes to separate the sera. The sera were stored at -20°C for the analyses of serum glucose, total protein, albumin, creatinine, cholesterol, aspartate aminotransferase (AST) and alanine amino transferase (ALT). Sigma assay kits (Sigma Co. St. Louis, Missouri, USA) was used in the analysis.

1.6. Sensory Evaluation

The sensory assessment were determined through meat preparation which was done using a wet cooking method after samples had been obtained from the breast, thigh, wing and drumstick of the birds. The samples were cooked for ten minutes in 500mls of water with 3 grams of common salt in an aluminum pot without any spices added. The meat was served to 9 member trained panelists, comprising staff and students of School of Agriculture and Industrial Technology, Babcock University Nigeria. The panelists evaluated the colour, texture, odour, taste and overall acceptability of the bite portions.

1.7. Statistical Analysis

Data obtained were subjected to analysis of variance

(ANOVA) in a completely randomized design [14] and significant ($P < 0.05$) means were compared using Duncan's Multiple Range Test (DMRT) obtained in the same statistical package.

2. Result

Serum Biochemical Indices

There were significant decrease ($p < 0.05$) in the serum glucose levels of the broiler diets. Diet of 0.01% *Cymbopogon citratus* with 58.87mg/dl serum glucose level was the lowest when compared with all groups studied. Decrease was not directly proportional with increased concentration of *Cymbopogon citratus* at 0.1% and 0.2%. The activities of aspartate aminotransferase (AST) in the treatment groups were significantly ($p < 0.05$) decreased when compared with the control and showed no significant ($p > 0.05$) decrease between the treatment groups. The enzyme activity of alanine aminotransferase (ALT) was significantly ($p < 0.05$) decreased in treatment groups of 0.01% and 0.1% leaf meal. There were significant differences ($p < 0.05$) among the treatment groups. There was a significant decrease ($p < 0.05$) of the total protein (TP) in the treatment group of 0.2% leaf meal and this group was significantly different ($p < 0.05$) from other treatment groups. There was also significant decrease ($p < 0.05$) in the albumin level in the treatment groups when compared to the control. Treatment 0.2% *Cymbopogon citratus* had the lowest value. There were significant increase ($p < 0.05$) in the cholesterol level of the serum in the treatment groups. There was a significant decrease in the creatinine levels of the serum of 0.01% leaf meal.

Table 3. Serum Biochemistry of Broiler Chicken Fed *Cymbopogon citratus* Leaf Meals

Parameters	Diet A	B plus 0.01% of Cc	C plus 0.1% of Cc	D plus 0.2% of Cc	SEM	STDValues
GLUC (mg/dl)	84.54 ^a	58.87 ^c	75.98 ^b	73.59 ^b	1.81	152-182
AST (I.U./l)	90.27 ^a	83.00 ^b	85.00 ^b	84.00 ^b	1.71	88-208
ALT (I.U./l)	6.08 ^b	4.43 ^d	5.67 ^c	6.29 ^{ab}	0.65	9.5-37.2
TP(I.U./l)	3.16 ^a	2.91 ^{ab}	3.30 ^a	2.15 ^b	0.34	5.2-7
ALB(g/dl)	2.04 ^{ab}	1.52 ^c	1.39 ^d	1.38 ^d	0.39	2.1-3.0
CHOL(mg/dl)	19.33 ^c	22.30 ^{ab}	21.59 ^b	21.70 ^{ab}	0.97	52-148
CRT(mg/dl)	0.81 ^b	0.78 ^c	0.92 ^{ab}	0.84 ^b	0.94	0.9-1.85

a,b,c: Means on the same row with the same superscript are not significantly different ($p > 0.05$)

keys: GLUC – Glucose, AST-Aspartate Aimo Transferase, ALT – Alanine Aimo Transferase, TP – Total Protein, ALB – Albumin, CHOL – Cholesterol, CRT – Creatinine.

Table 4. Sensory Evaluation of Broiler Chicken Fed *Cymbopogon citratus*

Parameters	Diet A	B plus 0.01% of Cc	C plus 0.1% of Cc	D plus 0.2% of Cc	SEM
Colour	7.9	7.3	7.8	8.0	0.34
Texture	7.6	7.1	6.2	7.9	0.42
Odour	7.8	6.8	7.5	8.1	0.42
Taste	7.3	7.2	7.3	7.4	0.41
Overall Acceptability	7.6 ^{ab}	7.0 ^{ab}	7.0 ^{ab}	8.0 ^a	0.37

a,b,c: Means on the same row with the same superscript are not significantly different ($P > 0.05$).

SEM=Standard Error of Mean

This was determined by using hedonic scale 1-9 (1=dislike extremely, 2=dislike very much, 3= dislike moderately, 4= dislike slightly, 5=neither like nor dislike, 6= slightly like, 7=like moderately, 8= like very much, 9= like extremely).

3. Discussion

The significant ($p < 0.05$) reduction of serum glucose level in all the treatment groups suggests that *Cymbopogon citratus* leaf meal has hypoglycemic potential. This could be facilitated by the presence of hypoglycemic compounds like flavonoids and alkaloids present in the leaf meal [10,15,16]. This observation agrees with the reports of Shah *et al.*, [17]. The decrease was below the standard value and was not further reduced by increased percentage of *Cymbopogon citratus* in the diet.

The mean serum hepatic enzymes of broiler as influenced by dietary inclusion of *Cymbopogon citratus* revealed lower enzyme activities among the treatment diets. The low levels of biochemical marker enzymes like alanine aminotransferase (ALT) and aspartate aminotransferase (AST) in birds administered with the above plant leaf meals might be due to reduced leakage of the enzymes in the liver cells as values were significantly ($p < 0.05$) lower compared with the control diet A. This further suggests that the leaf meal could repair hepatic injury or restore the cellular permeability which can be caused by cytotoxic and mutagenic compounds. This therefore agrees with the reports of Tiwari *et al.*, [18] and Bidinotto *et al.*, [19] that *Cymbopogon citratus* has cytoprotective effect due to its phenolic compounds.

The blood total protein level showed significant ($p < 0.05$) decrease in group D. The values obtained in this study is below the range of serum protein (5.00-7.00g/dl) reported by Anon [20] and 4.55g/dl to 6.46g/dl reported by Udoyong [21]. This observation suggests that the protein level in the diets was sufficient to sustain or support the normal protein levels in the blood. It should be noted that the diets were isonitrogenous. The above result corroborated for albumin levels which also significantly ($p < 0.05$) decreased when compared with the control diet A.

Blood cholesterol level showed no significant ($p > 0.05$) difference among the treatments though there were decreases between group B and C with increase in per cent age inclusion. When compared to the control diet, significant increase was however observed. The values obtained were lower than the standard serum values of 52-148mg/dl [20]. This suggests that the presence of antihypertensive compounds such as flavonoids and alkaloids present in *Cymbopogon citratus* has reduced serum cholesterol thereby preventing cardiovascular disease.

Serum creatinine revealed no significant ($p > 0.05$) difference and there were variations among the diets with regard to the normal range. The values were within the range which showed that there were no muscle wastage and no relative loss in weight of the birds. This is in agreement with the reports of Ogbuewu *et al.*, [22].

The values obtained for colour showed that the highest value, 8.0, was obtained from birds raised in group D, which has the highest concentration of the leaf meal. The results for texture, odour and acceptability which are 7.9, 8.1 and 8.0 respectively. It was observed that, treatment D had the highest hedonic score when compared to among the treatment groups and with the control.

4. Conclusion

The significant decrease in the levels of biochemical marker enzymes like ALT and AST in *Cymbopogon citratus* leaf meal fed broilers might be due to decreased leakage of the enzymes in liver cells. This suggests that the CcLM could repair hepatic injury and/or restore cellular permeability, thus reducing liver toxicity and preventing enzymes leakage into the blood circulation. From the above results, it was concluded that inclusion of CcLM to broiler diet enhanced the hepatoprotective, hypoglycaemic and anti-necrotic effects on the broilers without adversely affecting the organoleptic properties of the broiler meat.

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