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Serum biochemistry and sensory evaluation of broiler chicken fed *Andrographis paniculata* leaf meal

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ABSTRACT

The study was conducted to investigate the effect of feeding graded levels of *Andrographis paniculata* leaf meal (APLM) at 0, 0.01, 0.1 and 0.2% on the sensory and biochemical parameters of 120 Abor-acre broiler chickens. The diet was isocaloric and iso-nitrogenous. The study was conducted for a period of 56 days. Data on organoleptic and biochemical parameters were collected and evaluated using randomized design. The results obtained show that glucose level, aspartate aminotransferase (AST), alanine aminotransferase (ALT), total protein (TP), cholesterol (CHO), albumin (Alb) and creatinine (CRT) were significant ($p<0.05$). Sensory evaluation was done using 9 panelists. Bite of different portions of broiler meat samples weighing 10 g were served at room temperature. Responses from the panelists were obtained using the hedonic scale of ranking. The results of the panelists' evaluations suggest that inclusion of APLM to broiler diet enhanced the hepatoprotective, hypoglycaemic and anti-necrotic effects on the broilers without adversely affecting the organoleptic properties of the broiler meat.

INTRODUCTION

Agriculture accounts for about 35% of the gross domestic product (GDP), out of which livestock farming sub-sector accounts for about 10% (Adeyemo and Onikoyi, 2012). This is because it plays a vital role in providing the basic need of man-food (Nchuchuwe and Adejuwon, 2012). Poultry production out-numbers other types of livestock in Nigeria and are found throughout the country wherever there is human settlement (Kryger et al., 2010). Its products-meat and -egg are rich sources of high quality protein, minerals and vitamins (Atteh, 2004). There has been a steady increase in the demand for poultry products in Nigeria due to increase in population, urbanization, export drive and improved standard of living (Sinovec and Rosanović, 2006). The challenges of poultry quality feed and medication have necessitated the use of antibiotics, coccidiostats, arsenicals and mycotoxin binders in meat producing animals to improve yield. This practice has resulted to higher cost of poultry products and development of drug resistant strains of microorganisms (Adedeji et al., 2014). There is therefore the need for cheaper and locally available substitutes. *Andrographis paniculata,* an ubiquitous and easy to cultivate plant, has been reported to have hepatoprotective (Dwivedi et al., 1987; Trivedi and Rawal, 1998; Bhattacharyya et al., 2003; Mathivanan and Kalairasi, 2007; Dhiman et al., 2012; Mathivanan and Edwin, 2012), anti-lipoperoxidative (Mathivanan and Kalairasi, 2007; Mathivanan and Edwin, 2012), anti-inflammatory (Thiyagarajan et al., 2011) and anti-parasitic properties (lala et al., 2003). This is due to its rich bioactive compounds like andrographolide, 14-deoxy-11-oxoandrographolide, neoandrographolide and andrographiside (Mohamed, 2010; Liu et al., 2007; Balachandram and Govindarajan, 2005). *A. paniculata* is

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Table 1. Composition (%) of broiler starter experimental diet.

Ingredients	A control	B feed with 0.01% APLM	C feed with 0.1% APLM	D feed with 0.2% APLM
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 fiber	3.85	3.83	3.83	3.83

GNC, Groundnuts cake; **PKC,** palm kernel cake; **DCP,** dicalcium phosphate; **SBM,** soya bean meal.

one of the highly used potential medicinal plants in the world (Hossain et al., 2014). This study was conducted to assess the effects of *A. paniculata* leaf meal inclusion on the serum biochemical indices and sensory parameters of broiler chickens.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Poultry and Livestock Teaching and Research farm, Babcock University, Ilara-Remo Ogun State, Nigeria.

Experimental material

A. paniculata seedlings were obtained from Cocoa Research Institute of Nigeria, Oluyole LGA, Ibadan, Oyo State, Nigeria and authenticated at Department of Botany, University of Ibadan with voucher number, UIH22564. The seedlings were grown in the field, harvested and dried indoors.

Experimental design

A total of 120 broiler (Arbor Acre strains) randomly allotted to four 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 four 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 up to week 8. The composition of the diets is as shown in Tables 1 and 2.

Diet A: Control; standard broiler feed without leaf meal.
Diet B: Standard broiler feed + 0.01% of APLM
Diet C: Standard broiler feed + 0.1% of APLM
Diet D: Standard broiler feed + 0.2% of APLM

All the treatments diets A-D had three replicates of 10 birds each totaling 120 birds. Experimental diets were offered *ad libitum* and birds had free access to clean water throughout the 56 days study period.

Leaf meal preparation

The fresh leaves of *A. paniculata* were harvested. Preference was given to mature leaves which were directly exposed to sunlight throughout the day. Harvesting was done between the hours of 16 and 17 h; 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

Table 2. Composition (%) of broiler finisher experimental diet.

Ingredients	A control	B feed with 0.01% APLM	C feed with 0.1 % APLM	D feed with 0.2 % APLM
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 Fiber	3.72	3.72	3.72	3.72

GNC, Groundnuts cake; **PKC,** palm kernel cake; **DCP,** dicalcium phosphate; **SBM,** soya bean meal.

dried to constant weight at 40°C for 10 h and then milled with a hammer mill sieve of 0.02 mm diameter (Makanjuola, 1984), to obtain a fine powdery dust stored at 4°C in the fridge until ready for use.

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 (1990).

Collection of data

On day 56, two birds per replicate were selected and bled through the jugular vein, 2 ml each, into two ethylenediaminetetraacetic acid (EDTA) free sample bottles for serum biochemistry assay. Bite portions of the breast, thigh, wing and drumstick were collected for organoleptic properties.

Serum biochemical analysis

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

Sensory evaluation

The sensory assessment was determined through tissue 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 10 min in 500 mls of water with 3 g of common salt in an aluminum pot without any spices added. The meat was served to trained 9-member panel, comprising staff and students of the Food Laboratory of Department of Nutrition and Dietetics, Babcock University. The panelist evaluated the colour, texture, odour, taste and overall acceptability of the bite portions.

Statistical analysis

Data obtained were subjected to analysis of variance (ANOVA) in a completely randomized design (SAS, 2003). $P<0.05$ was considered statistically significant and means were compared using Duncan's Multiple Range Test (DMRT), (1995) from the same statistical package.

RESULTS

Serum biochemical indices

The values for the serum biochemical indices are presented in Table 3. The serum glucose level was significantly ($P<0.05$) lower in B (61.88 mg/l) than in D (70.88 mg/l). No significant difference ($P>0.05$) was

Table 3. Serum biochemistry of broiler chicken fed APLM.

Parameters	A control	B feed with 0.01% APLM	C feed with 0.1% APLM	D feed with 0.2% APLM	SEM	STD values
GLUC (mg/dl)	84.54^{a}	61.88^{d}	83.51^{a}	70.88^{c}	1.81	152-82
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}	5.68^{c}	6.45^{ab}	6.73^{a}	0.65	9.5-7.2
TP (I.U./l)	3.16^{a}	2.68^{ab}	2.25^{b}	3.30^{a}	0.34	5.2-7.0
ALB (g/dl)	2.04^{ab}	1.62^{c}	1.70^{b}	2.33^{a}	0.39	2.1-3.0
CHOL (mg/dl)	19.33^{c}	23.40^{a}	19.33^{c}	22.56^{ab}	0.97	52-148
CRT (mg/dl)	0.81^{b}	0.92^{ab}	0.89^{b}	0.90^{ab}	0.94	0.9-.85

a, b and c, Means on the same row with the same superscript are not significantly different (p>0.05).
GLUC, Glucose; **AST,** aspartate amino transferase; **ALT,** alanine amino transferase; **TP,** total protein; **ALB,** albumin; **CHOL,** cholesterol; **CRT,** creatinine.

observed at C (83.51 mg/l). The serum cholesterol was significantly (P<0.05) higher in B (23.40 mg/l) and D (22.56 mg/l) when compared with the control, A (19.33 mg/l). The serum AST level was significantly (P<0.05) lower across all the treatments: B, C and D with values of 83.00, 85.00, and 84.00 I.U/L, respectively when compared with the control, A (90.27I.U/L). The serum ALT level was significantly (P<0.05) lower in B (5.8 I.U/L) while C and D exhibited higher activities of 6.45 and 6.73 I.U/L, respectively. The serum total protein decreased significantly (P<0.05) at C (2.25 I.U/L), while B was 2.68 I.U/L and D the highest (3.30 I.U/L), though not significant (P>0.05) when compared to the control, A 3.16 I.U/L. In albumin however, B (1.62 g/dl) was significantly (P<0.05) decreased followed by C (1.70g/dl) and there was no observable statistical difference (P>0.05) in serum creatinine level.

DISCUSSION

Andrographolide, which is abundant in *A. paniculata* (Mohamed, 2010; Dhiman et al., 2012), enhances the surface uptake of glucose by adipose tissues and inhibit glucose absorption from intestine and glucose production from the liver resulting into decreased serum glucose level (Rammohan, 2009). The significant decrease in glucose level observed in the treatments groups compared with the control are in agreement with the above findings.

The activities of AST and ALT were significantly (P<0.05) decreased in the treatment groups when compared with the control. This is in agreement with the reports of Dwivedi et al. (1987), Trivedi and Rawal (1998), Bhattacharyya et al. (2003), Mathivanan and Kalairasi (2007), Dhiman et al. (2012) and Mathivanan and Edwin (2012) on birds. The reduced levels of AST and ALT activities in broilers administered with *A. paniculata* leaf meal could be attributed to decreased leakage of the enzymes in the liver cells, since the values of hepatic enzymes were below the control and standard ranges, which reflected the hepatoprotective role of APLM on broiler birds.

There was an increase in the total protein and albumin in the serum of broiler fed the 0.2% *A. paniculata* leaf meal (Diet C) compared with the control. Trivedi and Rawal (1998) also reported an increased serum and albumin levels of benzene hexachloride (BHC) treated albino mice treated with *A. paniculata.* It also agrees with Mathivanan and Edwin (2012) that observed higher levels of serum protein and albumin in broilers fed with *A. paniculata* when it was compared with standard antibiotics, virginiamycin. This suggests that the protein level in the diet was sufficient to sustain the normal protein levels having fed all groups with isonitrigenous ration.

Serum cholesterol level varied significantly (P<0.05) in comparison to the control group. This disagrees with the results of Eugine and Manavalan (2011) who reported that feeding APLM to swiss albino mice did not alter the serum total cholesterol. Similar observations were made by Dwivedi et al. (1987), Zhang and Tan (2000) and Govindarajan (2011).

Whenever there is wasting of muscle in birds and relative weight loss, serum creatinine level increases (Ogbuewu et al., 2010). There was no significant (P>0.05) difference in the treatment groups when compared with the control diet A. This suggests that there was no necrosis of the muscle.

Sensory evaluation

The highest hedonic ranks for colour, texture, odour, taste and acceptability with values of 7.7, 7.4, 7.4, 7.4, and 7.7, respectively were very much liked Table 4. From the above results, the hedonic scale ranking where all parameters chosen by the panelist were above 7.0, which

Table 4. Sensory evaluation of broiler chicken fed with APLM.

Parameters	A control	B feed with 0.01% APLM	C feed with 0.1% APLM	D feed with 0.2% APLM	SEM
Colour	7.9	7.6	7.3	7.7	0.34
Texture	7.6	7.3	7.4	7.3	0.42
Odour	7.8	7.4	7.0	7.4	0.42
Taste	7.3	7.4	6.8	7.3	0.41
Overall acceptability	7.6^{ab}	7.7^{ab}	6.6^{b}	7.3^{ab}	0.37

a, b and 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).

equals 'like moderately' suggests that sensory evaluation method may be adequate to ascertain the true nature of the parameters under consideration. It is also worthy to note that the taste of the meat did not reflect the original taste of the leaf meal, which is very bitter, thus the popular name "King of bitters". Hence, the inclusion of the *A. paniculata* leaf meals did not affect the sensory qualities of the meat negatively. Ajaya et al. (2004) and Mathivanan et al. (2006) also reported that inclusion of *A. paniculata* did not affect the sensory properties of the broiler meat negatively. Similarly, Nagalakshmi et al. (1996) reported that another bitter product (neem kernel cake) inclusion in broiler diet did not impart any outward taste in pressure cooked broiler meat.

Conclusion

The significant decrease in the levels of biochemical marker enzymes like ALT and AST in *A. paniculata* leaf meal fed broilers might be due to decreased leakage of the enzymes in liver cells. This suggests that the APLM could repair hepatic injury and/or restore the cellular permeability, thus reducing the effect on liver toxicity and preventing enzymes leakage into the blood circulation. From the above results, it was concluded that inclusion of APLM to broiler diet enhanced the hepatoprotective, hypoglycaemic and anti-necrotic effects on the broilers without adversely affecting the organoleptic properties of the broiler meat up to 0.2% APLM inclusion.

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