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EFFECT OF NATURAL PLANT; GUINEA HEN WEED (*Petiveria alliacea*) PARTS ON GROWTH AND CARCASS INDICES OF FINISHING BROILER CHICKENS

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ABSTRACT
A 56- day feeding trial was carried out to evaluate the effect of feeding guinea hen weed (*Petriveria alliacea*) leaf and root meals as phytobiotics on growth, carcass, haematological and serum indices of finishing broiler birds using 192 day old chicks. Eight treatment groups were arranged in a 2 × 4 factorial arrangements of 2 plant parts; *Petiveria* leaf meal (PLM) and *Petiveria* root meal (PRM) at 4 levels (0mg/kg, 500mg/kg, 1000mg/kg and 1500mg/kg). Each group was replicated three times with 8 birds per replicate. The results of the main and interaction effects revealed that for all growth parameters measured, only mortality was significantly affected ($p<0.05$) with variation across the dietary treatments. Broiler chickens on control diet showed elevated ($p<0.05$) mortality percentage when compared with other levels when either PLM or PRM was fed. An improved ($p<0.05$) dressing, drumstick and breast percentages were observed in broiler chickens on PLM compared to their counterparts on diet containing PRM. Different levels of inclusion of *Petiveria* plant parts revealed ($p<0.05$) effects on dressing percentages which were linearly improved for birds on control diet. Broiler chickens fed diet containing 1500 ppm showed highest ($p<0.05$) drumstick and liver values compare to other treatments. Amidst other varying inclusion levels, abdominal fat was observed to be reduced ($p<0.05$) in 500ppm fed birds. Engagement of PLM and PRM at different levels showed significant ($p<0.05$) interaction effects on relative weight of wings, drumstick and thigh. Reduced ($p<0.05$) wings were obtained in broiler chickens fed 1000 and 1500 ppm in comparison to other dietary treatments with drumstick poorer in broiler chickens fed with diet containing 1000ppm of PRM. The study concluded that feeding of guinea hen weed as phytobiotic additive elicited improved carcass variables in finishing broiler chickens.

Keyword: Guinea hen weed, finishing broiler, growth, carcass

Introduction

A variety of synthetic feed additives including drugs and antibiotics are used in poultry feeds to maximize the efficiency of production, product quality and to control diseases (Bedford 2000; Whitehead 2002). The use of antibiotics as antimicrobial growth promoters (AGPs) has been widely practiced in animal production and its benefits in improving weight gain and feed efficiency of broiler chickens are well established (Butaye *et al*., 2003). Although, the modes of action of growth promoters are not fully understood, the main effects are thought to be mediated via the gut associated bacteria (Gaskins *et al*. 2002). The use of AGP, however, can result in the development of drug resistant bacteria (Alexander *et al*., 2008) which may infect humans via the food chain and thus it is a public health concern (Torres *et al.*, 2000; Bekele and Ashenafi, 2010). The use of probiotics, prebiotics, organic acids, herbs and plant extracts (phytobiotics), as alternatives to antibiotic feed additives in diets for monogastric animals has been explored (Bedford, 2000; Wenk, 2003). Leaf meals of some tropical legumes and browse plants are rich in nutrients like vitamins, minerals and carotenoids (Vohra *et al*, 1972; Udedibie, 1987; Udedibie and Opara, 1996). Phytobiotics are plant–derived compounds and natural bioactive compounds that can be incorporated into diets in order to enhance the performance and well–being of animals. The beneficial multifunction aspects of most phytobiotics are derived from their specific bio-active components. Phytochemical components are responsible for both pharmacological and toxic activities in plants (Margret and Vickery, 1997), and it is generally

described as primary and secondary plant compounds (Wald, 2003). Guinea hen weed (*Petiveria alliacea)* is from the order- *Caryophyllales* and family- *Phytolaccaceae*. Studies have been carried out on the plant to ascertain its activity or potential use. Seokwon *et al.* (2005) carried out a study to determine the antibacterial and antifugal activitives of *Petiveria alliacea* and results showed that its sulfine, thiosulfinates, stilbenes, benzaldehyde etc containing compound exibit antimicrobial activity. Rossi *et al.* (1993) and Quaros *et al.* (1999) reported that mice administered *Petiveria alliacea* extract showed increased immunity against monocytogenic infection and stimulated immune cell production. The present study therefore, was designed to evaluate the effect of guinea hen weed on performance, carcass, haematological and serum indices of finishing broiler chickens.

Materials and Methods

Experimental site and test ingredient

This experiment was carried out at the Teaching and Research Farm, Federal University of Agriculture, Abeokuta, Ogun State. The area lies on latitude $7^0$10'N and longitude 3^0 2'E. It is 76m above sea level. The climate is tropical humid with a mean annual rainfall of 1037mm, 34.7^0C temperature and relative humidity of 82%. (Google earth, 2017).The plant *Petiveria alliacea* was uprooted completely; the leaves and the roots were cut off from the stalk separately, chopped into bits, washed to remove debris. The leaves and roots were spread separately on polyethene bags, the leaves were air dried under a shade (29±2^o C) without altering the greenish colour of the leaf and the roots were sundried (≤ 90% DM) for 14 days until they became crispy and easy to break. Both were milled (1mm sieve) into powdered form using a laboratory mill and stored separately in air tight containers at room temperature till the time of use: as *Petiveria* leaf meal (PLM) and *Petiveria* root meal (PRM).

Experimental birds and dietary treatments

A total of 192 day-old broiler chicks of commercial strain (ANAK 2000) were purchased from a reputable commercial hatchery in Abeokuta. The birds were alloted to eight treatment groups of 24 birds each. Each treatment group was further divided into three replicate groups of eight birds each in a 2 × 4 factorial arrangements of; 2 plant parts (leaf and root) and 4 inclusion levels of PLM and PRM (0 ppm, 500 ppm, 1000 ppm and 1500 ppm) and reared for 56-days Tables 1 and 2.

Data Collection

Proximate analysis of the test ingredients and experimental diets was carried out according to the methods of AOAC (2005). Feed intake was recorded daily, the birds were weighed weekly and feed conversion ratio computed accordingly. Mortality rate was calculated and expressed in percentage (%). At the end of the 8th week, three birds per replicate (whose weights were representatives of the mean weight of birds in the replicate) were selected, starved overnight for 12 hours to empty GIT for cleaners operation, thereafter they were weighed, slaughtered, de-feathered and eviscerated following standard commercial procedures (Jensen, 1984). The weight of the cut parts and internal organs were weighed and expressed as percentages of live weight.

Statistical Analysis

Data obtained in this experiment were laid out in a 2×4 factorial arrangement, subjected to Analysis of Variance (Steel and Torrie, 1980). Level of probability was expressed at 5% and significant means seperated using Duncan multiple range test (Duncan, 1955). Polynomial contrast (linear and quadratic) was applied to determine the effect of inclusion levels of *Petiveria* leaf and root meals (PLM; PRM).

Results and Discussion

The results of the main effect of *Petiveria* plant parts and levels of inclusion on the performance characteristics of finishing broiler chickens are as shown on Tables 3. Inclusion of PLM and PRM reflected no significant ($p>0.05$) effects on growth performance indices. Meanwhile, graded levels of inclusion produced significant ($p<0.001$) effect on mortality % with birds on control diet having higher value than treated birds. The interaction effects of *Petiveria* plant parts and levels of inclusion on the performance characteristics of finishing broiler chickens are presented in Table 4. The results revealed that for all parameters measured, only mortality was significantly affected ($p<0.05$) with variation across the dietary treatments. Broiler chickens on control diet showed elevated mortality percentage when compared with other levels when either PLM or PRM was fed. The lack of significant effects observed in performance indices as a result of plant parts and graded levels of inclusion contradicts the findings of Alcicek *et al.* (2004); Ademola *et al.* (2009) and Javed *et al.* (2009). They stated that carcass characteristic improved in broilers fed with different levels of powder or aqueous extract of ginger. Also not in accordance with Safa and Tazi, (2014) who concluded that *Moringa* leaf meal improved feed intake of broiler chickens. It nevertheless, agrees with the findings of Calislar *et al.* (2009) who found that phytogenic additives containing extracts from *Origanum vulgare* ssp had no effect on the body weight, body weight gain, or mortality in broiler chicks. Meanwhile, the mortalities observed in this study may not be attributed to the dietary treatments as birds in control

diet were equally affected, it could be that the environment the experiment was carried out might have been endemic.

Carcass characteristics of finishing broiler chickens fed diets containing PLM and PRM

Tables 5 and 6 shows the main and interactive effect of *Petiveria* plant parts and level of inclusion on the carcass characteristics and relative organ weights of finishing broiler chickens. Back, breast, kidney and colon were significantly ($p<0.05$) influenced by the *Petiveria* plant parts. An improved dressing %, per cent drumstick and breast were observed in broiler chickens on PLM compared to their counterparts on diet containing PRM. In the meantime an appreciable relative weight of head, shanks, wings and thigh meat were obtained in birds fed with diet containing PRM. Different levels of inclusion of *Petiveria* plant parts revealed linear and quadratic effects on dressing percentage which were linearly ($p<0.01$) improved for birds on control diet compared to treated birds. Relative weights of liver were linearly influenced and improved in birds fed graded levels of test ingredient. Broiler chickens fed with diet containing 1500ppm showed highest ($p<0.05$) drumstick and liver values compare to other treatments. Amidst other varying inclusion levels, abdominal fat was observed to be reduced in 500ppm fed birds. Engagement of PLM and PRM at different levels showed significant ($p<0.05$) interaction effects on relative weight of wings, drumstick and thigh. Reduced ($p<0.05$) wings were obtained in broiler chickens fed 1000 and 1500ppm in comparison to other dietary treatments. Drumstick was poorer in broiler chickens fed with diet containing 1000ppm of PRM. Positive influence of PLM plant part on dressed weight and dressing percentage was observed in this study. This result disagrees with Pourali *et al.* (2010) who reported that broiler carcass yield was not affected by phytobiotics; ginger and garlic, when fed to broiler birds. The reported higher dressed weight and percentage values the control birds had over the treated birds might be due to different level of inclusion fed were in consonance with the reports of Adedeji (2013) and Castellini *et al.* (2002) that conventionally fed poultry birds were better in live weight, dressing percentage and dressed weight compared with treated birds. Meanwhile, carcass yield is an indication of the quality and utilization of the ration (Bamgbose and Niba 1998). The similar values recorded for relative organ weights; empty gizzard and spleen could be attributed to response of the birds to each diet Svihus (2011). Drumstick, one of the most economically important portion of carcass composition and also the greatest edible portion of meat in broilers (Smith and Teeter, 1992; Fanimo *et al.*, 1996) was greatly favoured by phytobiotic additives at 500 and 1000mg/kg respectively. The positive influence of *Petiveria* plant parts on gizzard could be related to the biological function of these additives which enhance immune response (Mahfouz and El-Dakhakhny, 1960 and El-Ghamry, 2004). The reduced abdominal fat observed as results of plant parts and different inclusion levels of the additives agrees with the findings of Ghaedi *et al*. (2013) who opined that the use of black pepper extract in broiler reduced significantly abdominal fat percentage. This could be due to the synergetic effect of the anti- nutrient in the diet to reduce fat content as reported by Agarwal (1996) and Sharma *et al*. (1996). The authors opined that phytogenic feed additives possess lipid lowering effects. The lower spleen values observed in phytobiotic treated birds contradicts the findings of Esonu (2006) who recorded higher spleen weight when neem leaf meal was included in the diets of broiler.

Conclusion

The study concluded that feeding of guinea hen weed as phytobiotic additive elicited improved carcass variables in finishing broiler chickens.

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Table 1: Percentage (%) Composition of Broiler Starter Diets (0-4weeks)

	PLM (ppm)				**PRM (ppm)**			
Ingredient	**0**	**500**	**1000**	**1500**	**0**	**500**	**1000**	**1500**
Maize	52.00	52.00	52.00	52.00	52.00	52.00	52.00	52.00
Wheat Offal	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30
SBM	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
PKC	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
GNC	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
FM (72%)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Bone meal	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Oyster shell	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.0
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
PLM	-	+	++	+++	-	-	-	-
PRM	-	-	-	-	-	+	++	+++
Total	100	100	100	100	100	100	100	100
Calculated Analysis								
ME (Kcal/Kg)	2920.30	2920.30	2920.30	2920.30	2920.30	2920.30	2920.30	2920.30
Crude Protein %	22.90	22.90	22.90	22.90	22.90	22.90	22.90	22.90
Crude Fibre%	3.39	3.39	3.39	3.39	3.39	3.39	3.39	3.39
Fat%	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95
Calcium%	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53
Phosphorus%	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51

*Vitamin Mineral premix provided (per kg of diet): Vit A 11500IU, Vit D3 1600IU, Riboflavin 9.9mg, Biotin 0.25mg, Pantothenic acid 11.0mg, Vitamin K 3.0mg, Vit B2 2.5mg, Vit B6 0.3mg, VitB12 8.0mg, Nicotininc acid 8.0mg, Iron 5.0mg, Manganase 10.mg, Zinc 4.5mg, Cobalt 0.02mg, Selenium 0.01.

Table 2: Percentage (%) Composition of Broiler Finisher Diets (4-8weeks)

	PLM (ppm)				PRM (ppm)			
Ingredient	**0**	**500**	**1000**	**1500**	**0**	**500**		**1500**
Maize	56.00	56.00	56.00	56.00	56.00	56.00	56.0	56.00
Wheat Offal	8.30	8.30	8.30	8.30	8.30	8.30	8.30	8.30
SBM	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
PKC	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
GNC	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
FM (72%)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Bone meal	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Oyster shell	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
PLM	-	+	++	+++	-	-	-	-
PRM	-	-	-	-	-	+	++	+++
Total	100	100	100	100	100	100	100	100
Calculated Analysis								
ME (Kcal/Kg)	2933.20	2933.20	2933.20	2933.20	2933.20	2933.20	2933.20	2933.20
Crude Protein%	20.74	20.74	20.74	20.74	20.74	20.74	20.74	20.74
Crude Fibre%	3.41	3.41	3.41	3.41	3.41	3.41	4.41	4.41
Fat%	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Calcium%	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52
Phosphorus	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

*Vitamin Mineral premix provided (per kg of diet): Vit A 11500IU, Vit D3 1600IU, Riboflavin 9.9mg, Biotin 0.25mg, Pantothenic acid 11.0mg, Vitamin K 3.0mg, Vit B2 2.5mg, Vit B6 0.3mg, VitB12 8.0mg, Nicotininc acid 8.0mg, Iron 5.0mg, Manganase 10.mg, Zinc 4.5mg, Cobalt 0.02mg, Selenium 0.01m

Table 3: Main effect of *Petiveria* plant parts and level of inclusion on the performance characteristics of finishing broiler chickens

	Plant parts				Levels of inclusion (ppm)					P- Value	
Measurements	**PLM**	**PRM**	**SEM**	**P -Value**	**0**	**500**	**1000**	**1500**	**SEM**	**L**	**Q**
Initial weight	43.72	43.69	0.022	0.515	43.70	43.71	43.68	43.74	0.031	0.448	0.499
Final live weight (g/bird)	2089.00	1845.00	70.556	0.149	1973.00	2054.00	1873.00	1967.00	99.782	0.663	0.948
Total weight gain (g/bird)	1437.45	1197.99	74.233	0.177	1335.31	1415.23	1216.70	1302.63	104.982	0.537	0.977
Daily weight gain (g/bird/day)	51.33	42.78	2.721	0.452	47.68	50.54	43.45	46.52	3.848	0.689	0.630
Feed intake (g/bird/day)	83.06	77.37	2.278	0.096	86.08	80.88	75.07	78.83	3.222	0.071	0.180
Feed conversion ratio	1.61	1.81	0.098	0.675	1.81	1.60	1.73	1.69	0.139	0.369	0.750
Mortality (%)	15.75	15.45	1.26	3.109	23.09^{a}	11.11^{b}	10.31^{b}	14.97^{ab}	4.397	0.428	0.038

^{ab} Means on the same row with different superscripts are significantly different ($p<0.05$)

Table 4: Interaction effect of *Petiveria* and level of inclusion (ppm) on the performance characteristics of finishing broiler chickens

Measurements	**PLM**				**PRM**					
	0	**500**	**1000**	**1500**	**0**	**500**	**1000**	**1500**	**SEM**	**P-Value**
Initial weight (g/bird)	43.73	43.76	43.67	43.73	43.72	43.65	43.70	43.75	0.055	0.515
Final live weight (g/bird)	2204.44	2108.30	2056.90	1987.70	2204.40	2000.00	1689.30	1947.20	53.725	0.222
Total weight gain (g/bird)	1551.67	1410.53	1395.00	1393.95	1552.65	1420.24	1038.61	1212.20	55.889	0.288
Daily weight gain (g/bird/day)	55.41	50.37	49.82	49.78	55.45	50.72	37.09	43.29	1.917	0.230
Feed intake (g/bird/day)	91.11	83.21	81.97	75.97	91.09	78.55	68.17	81.70	1.784	0.071
Feed conversion ratio	1.64	1.65	1.62	1.53	1.64	1.55	1.83	1.88	0.067	0.425
Mortality (%)	20.95^{a}	5.55^{c}	5.55^{c}	13.00^{b}	25.80^{a}	16.66^{ab}	15.07^{b}	15.00^{b}	2.274	0.025

^{ac} Means on the same row with different superscripts are significantly different ($p<0.05$)

Table 5: Main effect of *Petiveria* plant parts and level of inclusion on the carcass characteristics and relative organ weights of finishing broiler chickens

	Plant parts				Levels of inclusion (ppm)					P-Value	
Measurements	**PLM**	**PRM**	**SEM**	**P- Value**	**0**	**500**	**1000**	**1500**	**SEM**	**L**	**Q**
Live weight (g)	1600.00	1550.00	29.432	0.209	1600.00	1575.00	1625.00	1500.00	41.623	0.195	0.244
Plucked weight (g)	1475.00	1438.00	38.776	0.306	1525.00	1425.00	1500.00	1375.00	54.837	0.143	0.822
Dressed weight (g)	1319.00^{a}	1262.00^{b}	25.710	0.009	1400.00^{a}	1225.00^{b}	1312.00^{ab}	1225.00^{b}	36.359	0.014	0.244
Dressing percentage	82.43^{a}	81.41^{b}	0.565	0.000	87.50^{a}	77.78^{b}	80.74^{ab}	81.67^{ab}	0.799	0.001	0.000
Cut-off parts (% live weight)											
Shanks	3.60^{a}	5.41^{b}	0.70	0.015	3.70	6.71	3.60	4.02	0.99	0.647	0.156
Head	0.23^{b}	0.30^{a}	0.01	0.024	0.22	0.24	0.30	0.25	0.01	0.175	0.761
Back	20.70	15.30	1.20	0.119	19.63	18.70	16.70	16.80	1.67	0.975	0.437
Wings	7.31^{b}	8.13^{a}	0.20	0.022	7.52	8.13	7.51	7.72	0.30	0.965	0.438
Drumstick	9.43^{a}	8.30^{b}	0.30	0.008	9.30^{a}	8.90^{a}	7.64^{b}	9.60^{a}	0.40	0.829	0.010
Thighs	8.43^{b}	9.34^{a}	0.21	0.006	8.92	9.64	8.33	8.64	0.30	0.537	0.585
Breast	20.98	16.94	1.30	0.499	19.50	19.01	19.95	17.44	1.83	0.537	0.557
Neck	3.91	4.51	0.20	0.106	4.34	4.21	3.73	4.60	0.30	0.875	0.098
Organs and abdominal fat (% live weight)											
Kidney	0.21	0.23	0.02	0.151	0.20	0.20	0.20	0.30	0.01	0.085	0.084
Liver	2.67	2.21	0.20	0.165	2.10^{b}	2.31^{ab}	2.35^{ab}	3.03^{a}	0.30	0.022	0.440
Heart	0.43^{a}	0.40^{b}	0.03	0.025	0.50	0.50	0.40	0.40	0.50	0.089	0.976
Empty gizzard	2.94^{a}	2.52^{b}	0.12	0.008	2.10^{b}	3.10^{a}	2.90^{a}	2.89^{a}	0.20	0.007	0.010
Lungs	0.60	0.60	0.03	0.050	0.70^{a}	0.63^{ab}	0.53^{b}	0.50^{c}	0.04	0.002	0.912
Abdominal fat	1.33^{a}	0.90^{b}	0.13	0.029	1.50^{a}	0.63^{b}	1.10^{ab}	1.30^{a}	0.20	0.790	0.007
Spleen	0.14^{a}	0.10^{b}	0.01	0.000	0.22^{a}	0.20^{a}	0.10^{b}	0.12^{b}	0.01	0.000	0.259
Small intestine	2.84	2.53	0.24	0.154	3.60	2.23	2.50	2.50	0.35	0.056	0.063
Large intestine	2.00	2.20	0.13	0.050	2.80	1.72	2.14	1.80	0.20	0.046	0.069
Ceacal	1.71	1.41	0.20	0.281	1.33	1.70	1.51	1.73	0.25	0.357	0.831

[ac] Means on the same row with different superscripts are significantly different ($p<0.05$).

Table 6: Interaction effect of *Petiveria* plant part and levels of inclusion (ppm) on the carcass characteristics and relative organ weights of finishing broiler chickens

	PLM				PRM					
Measurements	**0**	**500**	**1000**	**1500**	**0**	**500**	**1000**	**1500**	**SEM**	**P-Value**
Live weight (g)	1800.00^{a}	1500.00^{bc}	1650.00^{ab}	1550.00^{bc}	1750.00^{a}	1650.00^{ab}	1600.00^{b}	1450.00^{c}	21.910	0.013
Plucked weight (g)	1750.00^{a}	1300.00^{c}	1550.00^{ab}	1400.00^{b}	1600.00^{a}	1500.00^{ab}	1450.00^{b}	1300.00^{c}	28.122	0.006
Dressed weight (g)	1600.00^{a}	1200.00^{b}	1325.00^{b}	1250.00^{b}	1550.00^{a}	1250.00^{b}	1300.00^{b}	1200.00^{b}	23.157	0.007
Dressing percentage	88.89^{a}	80.00^{b}	80.30^{b}	80.65^{b}	88.57^{a}	75.76^{c}	81.25^{b}	82.75^{b}	312	0.000
Cut-off parts (% live weight)										
Shanks	3.31^{b}	3.80^{b}	3.60^{b}	3.63^{b}	4.01^{b}	9.70^{a}	3.60^{b}	4.41^{b}	0.077	0.075
Head	0.21^{b}	0.30^{a}	0.23^{b}	0.22^{b}	0.23^{b}	0.22^{b}	0.30^{a}	0.30^{a}	0.006	0.024
Neck	3.70	4.30	3.70	4.02	4.97	4.15	3.81	5.01	0.155	0.106
Back	23.80	21.04	18.60	19.20	15.44	16.44	14.80	14.01	1.108	0.119
Wings	8.50^{a}	8.10^{ab}	7.40^{b}	7.40^{b}	8.60^{a}	8.21^{ab}	7.70^{ab}	8.01^{ab}	0.145	0.022
Drumsticks	9.64^{a}	9.40^{a}	9.13^{a}	9.60^{a}	8.96^{a}	8.42^{a}	6.20^{b}	9.60^{a}	0.293	0.008
Thighs	10.00^{a}	9.30^{ab}	8.60^{b}	8.01^{bc}	10.10^{a}	9.98^{a}	8.10^{bc}	9.22^{ab}	0.207	0.006
Breast	20.30	21.50	22.02	20.02	18.70	16.53	17.90	14.70	0.987	0.499
Organs and abdominal fat (% live weight)										
Kidney	0.15	0.20	0.20	0.30	0.21	0.13	0.14	0.22	0.013	0.151
Liver	2.13	2.44	2.60	3.52	1.99	2.20	2.14	2.54	0.027	0.165
Heart	0.64^{a}	0.54^{ab}	0.50^{ab}	0.40^{b}	0.64^{a}	0.40^{b}	0.32^{c}	0.40^{b}	0.090	0.025
Empty gizzard	2.34^{b}	3.10^{ab}	3.30^{a}	3.01^{ab}	2.30^{b}	3.01^{ab}	2.50^{b}	2.80^{ab}	0.127	0.008
Lungs	0.70	0.63	0.60	0.50	0.63	0.63	0.50	0.53	0.027	0.050
Abdominal fat	1.80^{a}	0.61^{c}	1.24^{b}	1.70^{ab}	1.80^{a}	0.70^{c}	0.90^{bc}	0.91^{bc}	0.121	0.029
Spleen	0.21^{ab}	0.20^{a}	0.10^{b}	0.20^{a}	0.21^{ab}	0.20^{a}	0.10^{b}	0.05^{c}	0.011	0.000
Small intestine	4.03^{a}	2.20^{b}	2.83^{ab}	2.30^{b}	3.20^{a}	2.30^{b}	2.10^{c}	2.63^{ab}	0.145	0.010
Large intestine	3.34^{a}	1.90^{bc}	2.30^{ab}	1.80^{bc}	3.22^{a}	1.55^{c}	2.02^{b}	1.81^{bc}	0.045	0.154
Caecal	1.40	2.14	1.90	1.40	1.30	1.20	1.12	2.10	0.010s	0.281

^{ae} Means on the same row with different superscripts are significantly different ($p<0.05$)