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Carcass Characteristics and Organoleptic Properties of Organically Raised Broiler Chickens

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Abstract
The influence of carcass characteristics and organoleptic properties of organically raised broiler chickens were investigated in a twelve-week feeding and management trial. Conventional birds (control) group A and organically raised birds (groups B, C and D from which organic millet, sorghum and wheat have been excluded from their diets respectively). 180 day-old Ross broiler chicks were randomly distributed into (4) experimental diets in a completely randomized design (CRD). Each treatment group was replicated into three with 15 birds per replicate. Organic birds were allowed a three hour foraging daily on experimental quadrants. At the end of 8th week, meats from 108 chickens (27 birds) from each treatment were slaughtered for assessment of carcass characteristics and organoleptic properties. The results indicated that the different dietary treatments have effect on carcass characteristics and organoleptic properties. Conventional birds shows highest values for live weight, breast, thigh weights and as expected organoleptic properties while organic broilers demonstrated higher values for organ weights. It was concluded that organic broilers seems to be a possible alternative to the conventional methods since the carcass traits and the organoleptics properties of broiler chickens fed organically had been established and feed must not be 100% organic diets with consideration of crude protein and energy requirement of broilers to meet up with the demand of consumer towards organic meat. Therefore, further research is needed to explore the best broiler chickens that will show more response to organic feed in derived savanna environment of Nigeria.
Keywords: Organic farming, primal cut, visceral organs and organoleptic properties, ross broilers**.**

INTRODUCTION

Organic livestock farming has set itself the goal of establishing environmentally friendly production, sustaining animals in good health, realizing high animal welfare standards, and producing products of high quality. By striving for these goals, organic livestock farming meets the demands of an increasing number of consumers who are critical of conventional production methods (Sundrum, 2001). The quality attributes of food products, including poultry meat, have been attracting an increasing interest in recent years. Modern consumers are often aware of the relationship between meat quality and safety and animal welfare (Hermansen, 2003; Grunert *et al*., 2004), and many of them believe that organic food products have superior sensory properties and report that they "taste better" (Latter-Dubois, 2000).

Many chicken genotypes require a longer fattening period and are well adapted to outdoor farming conditions (Fanatico *et al*., 2005, 2006). One of the most successful specialty poultry production systems in Europe is the French Label Rouge program, which requires outdoor access. The program meets consumer expectations of organic poultry production, and is regarded as providing branded low-fat meat products with exceptional flavor characteristics, highly appreciated by connoisseurs (Lewis *et al*., 1997; Castellini *et al*., 2002c; Gordon and Charles, 2002). In Nigeria, non-certified chickens are available for pasture-based poultry production, such as in Poland with a good example of a free-range rearing program is "organically raised chickens of Podlasie".

Poultry meat quality is affected by the genotype, diet, age at slaughter and motor activity of birds, and their adaptation for outdoor production (Ojedapo *et al*., 2008; 2009). Organoleptic characteristics or properties are the trait that influence the consumer to regularly purchase and eat meat. Nutritional value concerns the chemical composition of the meat and its suitability for human consumption. Although, many factors can influence meat quality, this research work is only concerned with the nutritional and eating qualities of meat, particularly organically raised broilers. It attempts to examine the possibilities for nutritional manipulation of these characteristics in the animal and to establish their likely value to both the consumer and the producer (Uchewa, 2013). Therefore, the variation in poultry meat quality between alternative production systems can be not largely assessed in this part of the country. With this in consideration, the objective of the present study was to compare the carcass characteristics and organoleptic properties of organically raised broiler chickens in this environment.

MATERIALS AND METHODS

Site of Research

The research was carried out at the poultry unit of the Teaching and Research Farm Ladoke Akintola University of Technology, Ogbomoso, Oyo State. Ogbomoso is located in a derived savannah region of Nigeria (Amao *et al*., 2013).

Collection and preparation of test ingredients

The conventional feeds were purchased at a reputable feed mill (Segfun) in Ogbomoso. The organic feed ingredients such as maize, soybean, wheat and sorghum were sourced for In Ogbomoso and it's environ. Feed ingredients for organic diet were processed in various ways as to reduce the anti-nutritional factors to the barest minimum. After processing in various ways for the removal of anti-nutrients, the test ingredients were milled and mixed in a local milling house (where household foodstuff are milled) to prevent contamination or mixing with conventional foods.

The experimental diets were supplemented with known weights of leafy vegetable like *Amaranthus esculentus*, (succulent Amaranths), *Talinum triagularae* (water leaf), *Cellocia esculentus*_(green) as source of vitamins and minerals.

*Preparation of experimental diets***.**

Four experimental diets were formulated. Diet A was the control with the conventional feed while diets B, C, D are organic feed with exclusion of millet, sorghum and wheat respectively.

The diets were in two phases (the starter phase and the finisher phase). The percentage composition of experimental diets for both starter and finisher phase are shown in tables 1 and 2.

Experimental birds and their management

One hundred and eighty (180) unsexed day old broiler chicks of Ross breed were sourced from Ajanla farm, Lagos-Ibadan express ways, Oyo state, were used for this experiment. The birds were raised on deep litter but the treatment groups were allowed a period of three hours on the experiment range quadrants beside the poultry house when the birds were two weeks old. The pasture quadrants contained young succulent vegetables which include *Cellossia spp* (green), *Talinum triangulare* (waterleaf) and *Amaranthus esculentus* (amaranth). Prior to the arrival of the bird, the poultry house was scrubbed thoroughly with hot water and a solution of water and Neem tree extract (*Azardiracta indica*) was used to sprinkle the house as a disinfectant. This prevents microbial as well as insect encroachment. After this was done, the house was left for three days to dry off. Also, feeding troughs and drinkers were thoroughly washed with water and neem tree extract and later sun-dried.

On arrival of the birds, the control groups were administered clean water and retardants and glucose, while the treatment groups were given only water. The birds were later taught how to eat from their trays by dipping their beaks in feed and water. The experimental birds were randomly allotted to four dietary treatments with three replicates per treatment in a completely randomized design (CRD). Fifteen birds were allotted to each replicates making forty five birds per treatment. The experiment lasted eight weeks.

Drinkers were washed daily and fresh water was served *ad libitum*. Wood shavings whose chemical contents have been reduced using activated charcoal method was used in the pens of groups B, C and D while unprocessed wood shavings were used for birds in group A (control group). Feacal droppings and wood shavings were removed from feeding and drinking troughs before fresh feeds were served. Litters were changed when due and dead birds were removed first thing in the morning.

Vaccination and medication were given to the birds on the control as at when due. For the organic group of birds, the daily water administered to them was mixed with extracts of neem tree and garlic. On occasions when there is morbidity, the sick birds were isolated and treated with conventional medications and they were not returned to the flock. Water leaf, neem tree, Amaranths, Experimental site with forages, organic birds while feed, Conventional birds at 8 weeks and Organic birds at 8 weeks represent plates I, II, III, IV, V, VI and VII respectively.

Carcass analysis

At 8^{th} week, 27 birds from each treatment, totaling 108 broiler chickens were randomly selected, tagged and fasted for 12-18 hours and later taken to the laboratory for slaughtering and further analysis. Data were then collected for live weight (g), defeathered (%), Dressed weight (g), breast (g), drumstick (g), back (g), thigh (g) and wings (g) (primal cut); liver (g), kidney (g) whole gizzard (g), empty gizzard (g), GIT (g), heart (g) and lung (g) (viscera organs).

Organoleptic properties

Sample for palatability were obtained from the breast, thigh and wings of the birds. Meat preparation was done using a wet cooking method. The samples were wrapped in impervious polythene pouches which could be destroyed by cooking process. In the process. The meat samples were cooked in boiling water for 20 minutes using water bath and no spices was added to the meat. The meat was then served to 10 member panels comprising mainly of students and staffs of Ladoke Akintola University of Technology Ogbomoso. The trained panelists evaluated the samples for colour flavour, juiciness, tenderness and general acceptability, the assessment

was based on 9 point hedonic scale. The score was arranged in a descending order, the maximum score was given to extremely like condition while the lowest score 1 was for the poorest condition.

Proximate analysis

The proximate analyses of experimental diets (Table 3) were determined by the AOAC (1990) method. Bomb calorimeter was used to determine the gross energy (G.E) value of experimental diets. Metabolizable energy (ME) was calculated with the formula:

ME (kcal/Kg) = 37 x %CP + 81 x %fat + 35.5 x %NFE

Statistical analysis

Data collected were subjected to one way analysis of variance (ANOVA) using SAS (2003), while the means were separated using Duncan multiple range test.

RESULTS AND DISCUSSION

Carcass Characteristics

There were significant differences ($P < 0.05$) in the live weight (g) of the birds at 8weeks from the carcass characteristics of broiler chickens shown in the table 4. Control group (A) has highest live weight (g) more than the other groups, followed by group D. It was observed that there were no significant differences ($P > 0.05$) for the parameters measured for defeathered (%) and dressed weight (g) at 8weeks.The result for the primal cut as shown in table 5 showed a significantly ($P < 0.05$) higher values for control group (A) in breast. This was however closely followed by group D. The lowest values were however observed in group C and D. The thigh of broiler chickens on control group (A) and group C has highest ($P < 0.05$) values and this was closely followed by group D. The head of the birds showed that group B and group C has the highest significant ($P < 0.05$) values compared to other groups and followed closely by group D. There were no significant differences ($P >0.05$) between the drumstick, wing, neck, back and shank across the treatments. This result is in line with that obtained by Ekeudo *et al*., (2005) who studied the chemical composition of broiler chickens sold in south Africa's trade and they reported lower values for thigh, humidity, equal values for the breast, higher values regarding the fat and protein in the breast and thigh, and equal values regarding the ashes content in both cuts when compared to this study and with values in the united state Department of Agriculture (USDA, 1999). The significant differences recorded in the carcass quality of the experimental birds in all the parameters measured could be as a result of organically feed as compared to the conventional feeds given to the control broilers. The results for all carcass characteristics for organically fed broilers shows lower net live weight, defeathered percent, dressed weight and all primal cut were consistent with values obtained for other organic chickens (Castelline *et al*., 2002).

The result for the organ weight as shown in table 6 revealed a significantly ($P < 0.05$) highest value for birds on diet B in liver, closely followed by group C. The kidney of broiler chickens in the experiment showed no significant differences and range between 0.57 – 0.66. It was also observed that birds on group C has the highest value ($P < 0.05$) in whole gizzard than the other groups and followed closely by group B but there was no significant difference ($P > 0.05$) between the group D and the control (A). The empty gizzard of the birds shown that group D had highest significant difference ($P < 0.05$) while the GIT on group B shows the highest significant differences ($p<0.05$) value followed by group C. The heart of birds on diet C had the highest ($P < 0.05$) value, however closely followed by group D. It was however, indicated that there is no significant different between the control group (A) and group B. The lung of chickens on group C and group D had the highest ($P < 0.05$) values, closely followed by control group (A) with lowest value was observed in group B with lowest value of 0.54. Thus, the present results was compactable with the results obtained for broilers visceral organs in the study of (Ojedapo *et al*., 2008, 2009) for control diet birds and organic birds (Castelline *et al*., 2002).

The result of organoleptics properties of broiler chickens of organic group fed with convectional feed was as shown in table 7. The colour of the bird is moderately acceptable, group B is slightly acceptable, group C is slightly acceptable and that of group D is slightly acceptable. The flavor of birds in control group (A), group B and D are slightly acceptable, while group C is intermediate. The juiciness of the birds in control group (A) is slightly acceptable, group B is intermediate, group C is also intermediate and that of group D is moderately acceptable. The tenderness of the birds in all the groups of birds is intermediate. The general acceptability of the birds in control group (A) is moderately acceptability, group B is moderately acceptability, group C is slightly acceptability and that of group D is slightly acceptable. The variation in organoleptics properties of broiler chickens of organic group fed with convectional feed were in agreement with certain authors claim that the free-range production system improves the eating quality of poultry meat (Lewis *et al.,* 1997; Fanatico *et al.,* 2007), but their results concern the meat of slow-growing chicken that are reared much longer than fast-growing birds but this was disagreed with the finding of Gregory (1998); Wang *et al.,* (2009) that free-range management of broiler chickens has no effect on quality traits of their meat.

CONCLUSION

The findings of the study indicate that broiler rearing by organic system seems to be a possible alternative to the conventional methods since the carcass traits and the organoleptics properties of broiler chickens fed organically had been established and feed must not be 100% organic diets with consideration of crude protein and energy requirement of broilers to meet up with the demand of consumer towards organic meat. Therefore, further research is needed to explore the best broiler chickens that will show more response to organic feed in Nigeria environment.

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Table 1.Composition of Experimental Diets (Broiler Starter Mash)

Ingredients	Group A(kg)	Group B(kg)	Group C(kg)	Group D(kg)
Conventional maize	48.07	-	-	-
Organic wheat	-	14.01	14.99	-
Organic sorghum	-	14.01	-	13.99
Organic millet	-	-	14.99	13.99
Wheat offal	7.5	7.5	7.5	7.5
Full fat SBM	-	43.02	40.08	43.08
Commercial SBM	40.30	-	-	-
local fishmeal	-	2.50	2.50	2.50
palm oil	-	2.0	2.0	2.0
oyster shell	1.2	2.7	2.7	2.7
bonemeal	2.0	-	-	-
vit/min premix	0.25	-	-	-
methionione	0.18	-	-	-
lysine	0.25	-	-	-
Water leaf	-	2.50	2.50	2.50
Total	100	100	100	100
Calculated analysis				
ME kcal/kg	2872.67	3002.45	3019.00	3067.6
CP (%)	23.04	27.24	26.74	24.67
Crude fiber	3.75	3.9	4.01	4.00
Fat %	3.59	5.03	4.91	4.90

TABLE 2. Composition of experimental diets (broiler finisher mash)

Ingredients.	Group A	Group B	Group C	Group D
Conventional maize	45.00	-	-	-
Organic wheat	-	14.01	14.99	-
Organic sorghum	-	14.01	-	13.99
Organic millet	-	-	14.99	13.99
Wheat offal	10.00	7.5	7.5	7.5
Full fat SBM	-	43.02	41.08	43.08
Commercial SBM	18.25	-	-	-
Palm kernel cake	23.00			
local fishmeal	-	2.50	2.50	2.50
palm oil	-	2.0	2.0	2.0
oyster shell	1.2	2.7	2.7	2.7
bonemeal	1.50	-	-	-
vit/min premix	0.25	-	-	-
methionione	0.25	-	-	-
lysine	0.25	-	-	-
salt	0.30	0.25	0.25	02.5
Total	100	100	100	100
Calculated analysis				
ME kcal/kg	2712.67	3002.45	3019.00	3067.6
CP (%)	17.39	27.24	26.74	24.67
Crude fiber	5.16	3.90	4.01	4.00
Fat %	4.04	5.03	4.91	4.90

TABLE 3: Proximate Composition of Experimental Diets(%)

PARAMETER	CONTROL	X-MILLET	Y-SORGHUM	Z-WHEAT
Moisture	9.48	9.52	8.03	9.62
Crude protein	10.50	8.75	7.26	7.08
Crude fibre	9.80	6.02	4.11	8.23
Ether extractives	22.08	21.45	20.65	20.71
Ash	9.45	11.35	9.58	8.05

TABLE 4. Carcass characteristics of Broilers fed with organic feeds and vegetables

PARAMETER	A	B	C	D	SEM
LIVE WEIGHT$_{(g)}$	1516.67^{a}	322.57^{c}	320.00^{c}	498.33^{b}	104.62
DEFEATHERED$_{(\%)}$	81.33	76.59	82.71	81.33	1.43
DRESSED WEIGHT	50.51	50.86	50.49	49.93	4.09

^{abc} Mean with different superscript on the same row are significantly different ($p<0.05$)
(A): Conventionally Fed and Raised Birds, (B): Organically raised birds' diet minus Millet, (C): Organically raised birds' diet minus Sorghum, (D): Organically raised birds' diet minus Wheat.

TABLE 5. Primal cut and external offal weight of broilers fed with organic feeds and vegetables

	A	B	C	D	SEM
BREAST	16.37^{a}	9.27^{b}	10.32^{b}	11.14^{b}	0.70
THIGH	9.63^{a}	7.17^{b}	9.23^{a}	6.27^{ab}	0.35
DRUMSTICK	9.41	7.64	8.74	8.03	0.31
WING	9.47	7.54	8.34	8.28	0.29
NECK	3.79	3.93	3.70	2.76	0.20
BACK	13.36	10.33	13.24	12.82	42.56
SHANK	4.60	4.96	5.42	4.79	0.17
HEAD	2.93^{c}	5.19^{a}	5.72^{a}	4.15^{b}	0.26

^{abc} Mean with different superscript on the same row are significantly different ($P < 0.05$)
(A): Conventionally Fed and Raised Birds, (B): Organically raised birds' diet minus Millet, (C): Organically raised birds' diet minus Sorghum, (D): Organically raised birds' diet minus Wheat.

TABLE 6. Organs weight of broilers fed with organic feeds and vegetables

Organs	A	B	C	D	SEM
LIVER	2.43^{b}	3.55^{a}	3.15^{ab}	2.72^{b}	0.18
KIDNEY	0.65	0.61	0.57	0.66	0.04
WHOLE GIZZARD	4.15^{b}	5.09^{ab}	6.04^{a}	4.15^{b}	0.24
EMPTY GIZZARD	2.59^{ab}	2.96^{ab}	3.38^{a}	2.49^{b}	0.15
GIT	6.39^{c}	18.08^{a}	11.79^{b}	9.05^{cb}	1.02
HEART	0.46^{b}	0.45^{b}	0.68^{a}	0.52^{ab}	0.03
LUNG	0.66^{ab}	0.54^{b}	0.74^{a}	0.50^{a}	0.03

^{abc} mean with different superscript on the same row are significantly different ($P < 0.05$)
(A): Conventionally Fed and Raised Birds, (B): Organically raised birds' diet minus Millet, (C): Organically raised birds' diet minus Sorghum, (D): Organically raised birds' diet minus Wheat.

TABLE 7. Organoleptic properties of broilers fed with organic feeds and vegetables.

PARAMETER	A	B	C	D
Colour	6.6	5.8	6.0	6.4
Flavor	5.8	5.6	5.2	6.0
Juiciness	5.6	4.8	5.4	6.8
Tenderness	5.0	4.6	5.4	5.4
Gen. Acceptability	7.2	6.6	6.0	5.6
Physical properties				
Cooking loss	30.25	25.30	28.58	32.50
WHC	69.75	74.70	71.42	67.50

(A): Conventionally Fed and Raised Birds, (B): Organically raised birds' diet minus Millet, (C): Organically raised birds' diet minus Sorghum, (D): Organically raised birds' diet minus Wheat.

Plate I

Plate II

Plate III

Plate IV

Plate V

Plate VI

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