

Response of two strains of broiler chickens to feeding trough shapes

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Abstract

This study determined the effect of feeding trough shapes on the growth performance, carcass characteristics and cost benefit analysis of 180 broiler chickens of two strains (90 birds each of Marshal and Hubbard strains) subjected to circular, rectangular and square-shaped feeding troughs with a surface area of 900 cm^2 each. The broiler chicks were brooded for two weeks and thereafter allotted into six treatment groups of 30 chicks each, consisting of 3 replicates of 10 chicks per replicate. Daily weight gains were recorded and at the 8^{th} week, 3 broiler chickens that were of average weights for each replicate were used for carcass evaluation. Data were analysed using PRO GLM at 5% level of significance. Results showed that feeding trough shapes significantly ($P< 0.05$) influenced the final weight, feed intake and feed conversion ratio. Birds on circular feeding trough recorded the best feed conversion ratio (2.98±0.03). The feeding trough shape and strain did not significantly ($P>0.05$) affect the cut-up parts and organs measured. In the interaction between strain and feeding trough, the dressing percentage was significantly ($P<0.05$) affected, but did not follow any trend. Marshal strain on square feeding trough recorded significantly ($P<0.05$) lowest production cost (N539.25) while Hubbard strain on circular feeder had the highest cost of N605.46. It was concluded that, in terms of cost of production, the square and rectangular-shaped feeding troughs could be adopted.

Keywords: feeding troughs, broilers, feed intake, feed conversion ratio, carcass, cost benefit.

Introduction

The efficient production of poultry meat from broiler chickens has evolved through the development of specific stocks by intense selection for the growth of the birds up to market weight. This has been done through selection based on phenotypic expressions such as selection of superior individuals employing a classical approach. Many years of selection resulted in enormous advances in chicken characteristics, associated with yield and adaptation (vanHorne, 2007). The live weight of broiler chicken is the best examples of the progress achieved throughout years of selection and breeding. However, the continual increase in growth efficiency of the modern broiler has allowed the cost of production today to remain at a similar level to that of the 1950s. Apart from the genetic potentials of chickens, various factors in the bird's environment such as temperature and other elements of modified environment among which is the feeder shape affect its well being and its level of productivity. Hence, the performance of the modern broiler chickens is predicated upon ration type; its quality and quantity which are a function of proper management. In this vein, Sogunle

et al. (2009) emphasized that quality and quantity feeding is an essential aspect of broiler farming which has a high dependence of body weight on feed intake. The interaction between these factors and the genetic potential of the chicken had been reported to govern performance (Weaver *et al.*, 1991). The experiment therefore sought to determine the effect of feeding trough shapes on the performance and carcass characteristics of broiler chickens.

Materials and Methods

Site of the experiment

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm Directorate, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria. This area is situated in the rainforest vegetation zone of South-western Nigeria on Latitude 7°13′49.46′′N, Longitude 3° 26′ 11.98′′ E and altitude of 98m above sea level. The climate is humid with a mean annual rainfall of 1003mm annual mean temperature and humidity ranges from 31.9 to 34.7^{0}C and 79.7 to 90.1%, respectively (Federal University of Agriculture, Abeokuta Meteorological Centre).

Experimental birds and their management

A total of 180 day-old broiler chicks from two strains (90 birds each of Marshal MY and Hubbard strains, respectively) was procured from a reputable commercial hatchery in Ogun State. The chicks were brooded together for the first two weeks and managed intensively on deep litter. The birds had free access to feed and water *ad libitum.* The birds were fed commercially prepared feed ration.

Experimental design and animal allotment

After two weeks brooding, the chicks were randomly divided into 6 treatments of 30 birds each. These birds were sub-divided on strain and feeding trough basis into three replicates of 10 birds each. The experiment was a 2 x 3 factorial arrangement comprising 2 strains (Marshal MY and Hubbard) and 3 feeding trough shapes (circular, square and rectangular).

The three different shapes of locally fabricated metal feeding troughs such as circular (commercially available), rectangular and square with a surface area of 900 m^2 each were used for feeding the birds for 6 weeks. The square feeder had a dimension of 30 x 30 cm with curved-in plate of 2cm to prevent feed wastage, while the rectangular feeder had a length, of 45cm and width, 20cm with curved-in plate of 2cm to prevent wastage.

Data collection

Data were collected daily on weight gain and feed intake, while feed conversion ratio was calculated. Also, the prevailing market prices for the ingredients were used in estimating the cost benefits of using the feeding troughs of different shapes in broiler production. The total cost (N), total cost per weight gain (N/g), feed cost/bird/day (N) and feed cost per weight gain (N/g) were estimated at N158.70 equivalent to 1$.

Carcass evaluation

At the end of the 8th week, 3 birds which were of average weight for each replicate were used for carcass evaluation. They were slaughtered, bled, plucked and eviscerated. The live weight, plucked weight and dressed weight were taken. Also, cut-up parts (head, neck, wings, breast, thighs, drumstick, back and shank), organs and offals (gizzard, liver, lungs, heart, kidney, crop, proventriculus, small intestine and large intestine) were weighed as criteria for the measurement of carcass performance. All weights were taken using Mettler® top-loading sensitive scale and

expressed as percentage of the live weight.

Statistical design and analysis

The experimental layout was a 2 x 3 factorial composed of 2 strains of broiler chickens with each subjected to 3 feeding troughs and replicated three times. All data collected were analysed using PRO GLM at 5 % level of significance and significantly different means were separated using Duncan's Multiple Range Test as contained in SAS (2003) package.

Results

Effects of strain and feeding trough shapes on performance of Broiler chickens

Table 1 shows the main effect of strain and feeding trough shapes on performance of broiler chickens. Feeding trough shapes significantly (P< 0.05) influenced the final weight, feed intake and feed conversion ratio of broiler chickens, while the weight gain was not significantly (P>0.05) affected by the feeding trough shapes. The circular feeding trough recorded the highest (P>0.05) weight gain (38.67±0.18) with corresponding lowest feed intake (115.02±0.71) and the best feed conversion ratio (2.98±0.03). The result obtained showed significant (P<0.05) effect of strain on the total cost and total cost/weight gain with the highest total production cost of N601.35 recorded in Hubbard strain, while Marshal recorded N543.64 cost/weight gain. The total cost of production, feed cost and feed cost/weight gain were significantly (P<0.05) influenced by the feeding trough with the highest total cost of N577.11 recorded in the square feeders. The highest value (N8.17) for feed cost was recorded in birds that used rectangular feeders, while those that used circular shaped feeders had the lowest feed cost and feed cost/weight gain of N8.05 and N0.20, respectively.

In Fig 1, the weekly growth of Marshal strain of broiler chickens on different feeding trough shapes showed that at the 1st and 2nd weeks, there was a decline in weight gain of the birds on the rectangular shape.

Table 1: Main effect of strain and feeding trough shape on growth performance and cost-benefits of broiler chickens

	Strain		Feeding trough shape		
Parameter	Marshal	Hubbard	Circular	Square	Rectangular
Initial weight (g/bird/day)	360.0±0.03	380.0±0.01	380.0±0.01	370.0±0.02	360.0±0.04
Final weight (g/bird/day)	1960.0 ±0.03	1960.0±0.02	2000.0±0.02^{a}	1920.0±0.03^{b}	1950.0±0.03^{a}
Weight gain (g/bird/day)	38.09±0.63	37.49±0.58	38.67±0.58	36.91±0.77	37.79±0.75
Feed intake (g)	116.47±0.21	115.63±0.54	115.02±0.71^{b}	116.41±0.14^{a}	116.74±0.21^{a}
Feed conversion ratio	3.06±0.05	3.09±0.05	2.98±0.03^{b}	3.16±0.07^{a}	3.09±0.06^{ab}
*Total cost (₦)	543.64± 11.20^{b}	601.35± 12.73^{a}	577.66±12.52^{a}	567.11±12.53^{c}	572.73±13.82^{b}
Total cost/weight gain	14.30±0.40^{b}	16.07±0.41^{a}	14.97±0.48	15.40±0.48	15.18±0.47
Feed cost (₦)	8.15±0.01	8.09±0.00	8.05±0.05^{b}	8.15±0.01^{a}	8.17±0.01^{a}
Feed cost/weight gain	0.21±0.02	0.22±0.01	0.20±0.00^{b}	0.22±0.00^{a}	0.21±0.00^{ab}

$^{a, b}$ Means in the same row by factor with different superscripts differ significantly (P < 0.05)

*Total cost = Cost of day-old chicks + Cost of feed + Cost of feeding trough ₦158.70 = 1$

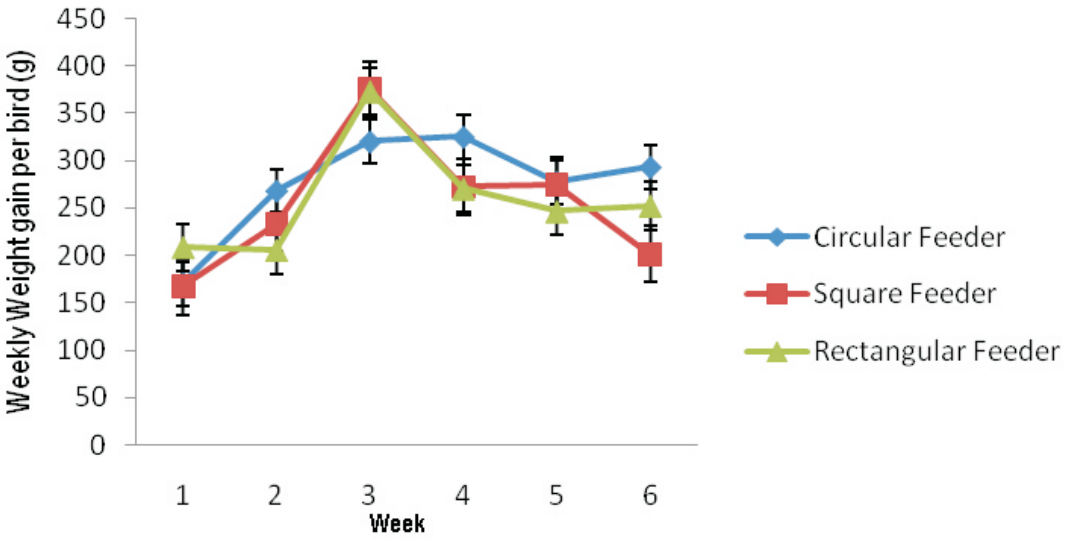

Fig. 1: Weekly Growth of Marshal strain of Broiler Chicken on different feeders

This may be due to the fact that the birds were still passing through adaptation process on this fabricated feeder, whereas birds on conventional (circular) shaped feeders increased slightly in weight gain. However, at the 3rd week of the experiment, the growth of birds on the fabricated feeders (square and rectangular) increased with a weight gain of about 380 g resulting from the ability of the birds to exhibit natural behaviour which enabled them had access to all the nutrients in the feeds, whereas the weight gain of birds on the conventional (circular) feeder declined at this week and then increased at weeks 5 and 6. The weekly weight gain of Hubbard broiler chicken fed using three feeder shapes is shown in Fig. 2. The weight gain of birds on the circular feeder the third week, after which there was a continuous decrease up to the point of termination of the study. The birds on the square feeder had a continuous increase in weight gain up to the third week, before there was a gradual decrease in weight gain till the last week. In the first two weeks, there was a sharp increase in weight gain of birds fed using the rectangular feeder shape, but dropped in the following week, thereby giving an irregular gain in weight for birds on the rectangular feeding trough.

The effect of interaction between strain and feeding trough shapes on growth performance and cost-benefits of broiler chickens is presented in Table 2. The feed intake revealed a significant ($P<0.05$) decreased in the amount of feed consumed with Hubbard strain recording the lowest value of 113.82g in circular-shaped feeding trough, while Marshal strain on rectangular-shaped feeding trough having the highest value of 117.02g. The total cost was significantly ($P<0.05$) different with Hubbard strain on circular feeder had the highest production cost of N605.46, followed by those on rectangular (N603.64) and the least cost of N594.96 for those on square feeder. The Marshal strain had the least cost of production with those

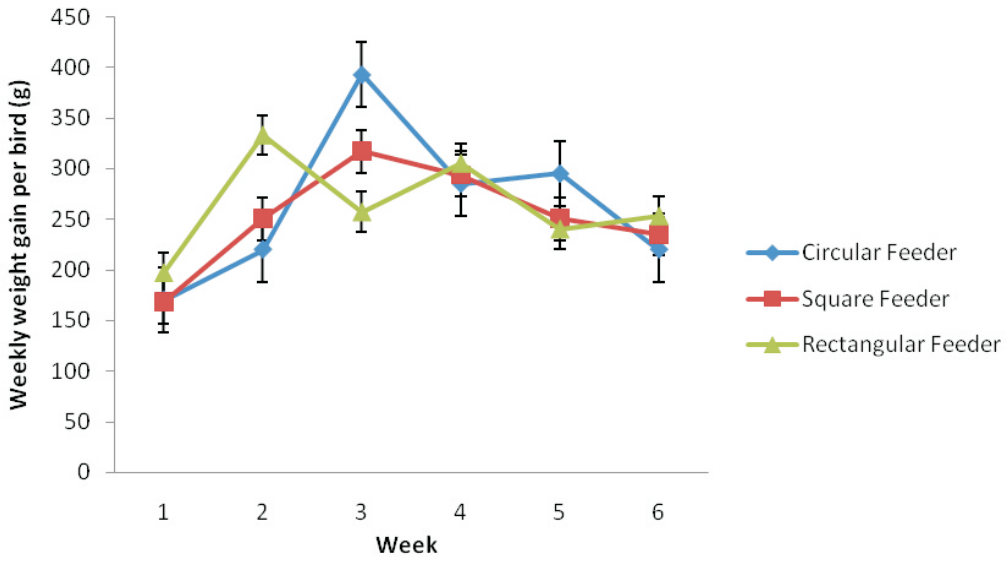

Fig. 2: Weekly growth of Hubbard Strain of Broiler Chicken on different Feeders

on square feeder recording N539.25. However, the total cost/weight gain was also significant (P<0.05) between strains, but not significant (P>0.05) across the treatments. Likewise, the feed cost showed (P<0.05) differences within strains, Hubbard strain on circular feeder had the lowest feed cost of N796.00, while Marshal strain on rectangular feeder had the highest value of N8.19. The feed cost/weight gain showed no significant (P>0.05) difference among the strains and between treatments.

Effects of strain and feeding trough shapes on the carcass characteristics of broiler chickens

In Table 3, the relative weight of the heart was significantly (P< 0.05) influenced by the main effect of strain with Hubbard strain having the highest value of 6.63 % and Marshal strain with 4.42 %. Similarly, the relative weight of the neck was significantly (P< 0.05) affected by the feeding through shapes. Broilers on circular feeder had the lowest value (5.35 %), while birds on square and rectangular feeders had 6.32 and 6.40 %, respectively. The dressing percentage of the strains of birds did not show any significant P>0.05) different as the Marshal strain had a value of 72.81 % and Hubbard strain had 73.16 %. There was no significant (P>0.05) difference in the live weight values of both strains and amongst birds with respect to feeding trough shapes. Likewise, strain had no significant (P>0.05) influence on cut-up parts such as: wing, shank, thigh, drum-stick, keel, neck and back as well as the relative organ weights of the liver, gizzard, large intestine and small intestine. The feeding trough shapes also did not significantly (P>0.05) influenced the values obtained in the cut-up parts and organs. In the interaction effect between

Table 2: Effect of interaction between strain and feeding trough shapes on growth performance and cost-benefits of broiler chickens

Strain	Marshal			Hubbard		
Parameter	**Circular**	**Square**	**Rectangular**	**Circular**	**Square**	**Rectangular**
Initial weight (g/bird/day)	360.0±0.02	360.0±0.02	370.0±0.04	410.0±0.05	380.0±0.01	360.0±0.02
Final weight (g/bird/day)	2020.0±0.03	1920.0±0.03	1950.0±0.06	1990.0±0.02	1930.0±0.06	1940.0±0.03
Weight gain (g/bird/day)	39.44±0.89	36.98±0.56	37.86±1.44	37.90±0.55	36.83±1.63	37.74±0.84
Feed intake (g)	116.21±0.47^{a}	116.18±0.11^{a}	117.02±0.26^{a}	113.82±0.95^{b}	116.63±0.17^{a}	116.45±0.28^{a}
Feed conversion ratio	2.95±0.07	3.14±0.05	3.10±0.11	3.00±0.02	3.18±0.15	3.09±0.06
*Total cost (₦)	549.85±1.43^{c}	539.25±0.35^{d}	541.83±0.79^{d}	605.46±2.93^{a}	594.96±2.93^{b}	603.64±0.53^{a}
Total cost/weight gain	13.95±0.32^{b}	14.58±0.21^{b}	14.35±0.52^{b}	15.98±0.15^{a}	16.21±0.65^{a}	16.01±0.33^{a}
Feed cost (₦)	8.13±0.03^{a}	8.13±0.00^{a}	8.19±0.01^{a}	7.96±0.06^{b}	8.16±0.01^{a}	8.15±0.01^{a}
Feed cost/weight gain	0.20±0.00	0.21±0.00	0.21±0.00	0.21±0.00	0.22±0.01	0.21±0.00

$^{a, b}$: means in the same row by factor with different superscripts differ significantly ($P < 0.05$)

*Total cost = Cost of day-old chicks + Cost of feed + Cost of feeding trough

₦158.70 = 1$

Table 3: Main effect of strain and feeding trough shapes on the carcass of broiler chickens

	Strain		Feeding trough shapes		
Parameters	Marshal	Hubbard	Circular	Square	Rectangular
Live weight (g)	1903.33±57.95	1877.78±68.65	1833.3±63.81	1833.3±65.40	2005.00±84.80
Dressing percentage	72.81±2.13	73.16±2.31	70.03±1.23	71.61±3.12	77.31±2.58
Cut-up parts (%)					
Wing	9.97±0.35	9.91±0.54	9.76±0.45	10.12±0.80	9.94±0.34
Shank	4.46±0.19	4.46±0.19	4.27±0.28	4.55±0.16	4.83±0.20
Thigh	11.66±0.40	11.14±0.55	10.57±0.60	11.82±0.70	11.82±0.31
Drum stick	10.60±0.39	10.35±0.52	10.02±0.51	10.28±0.71	11.13±0.35
Keel	18.69±0.66	17.01±1.04	19.28±1.45	16.57±1.02	17.72±0.44
Neck	6.35±0.29	5.69±0.29	5.35±0.38^{b}	6.32±0.34^{a}	6.40±0.25^{a}
Breast	15.87±0.69	15.37±0.51	16.33±0.42	16.27±0.29	16.36±0.35
Back	13.47±0.59	12.71±0.69	13.08±0.81	13.09±0.99	13.11±0.66
Organs (%)					
Heart	4.42±0.04^{b}	6.63±0.60^{a}	3.68±1.50	3.51±1.32	3.40±1.51
Liver	1.70±0.09	1.68±0.13	1.81±0.10	1.72±0.11	1.55±0.17
Gizzard	2.99±0.11	2.94±0.19	2.75±0.19	3.12±0.20	3.03±0.15
Intestine (cm)					
Large intestine	10.83±0.85	10.17±0.56	10.68±0.95	11.40±0.96	9.42±0.57
Small intestine	162.61±5.75	153.39±4.69	150.03±7.23	161.13±6.59	162.83±5.46

$^{a, b, c}$: means in the same row by factor with different superscripts differ significantly ($P < 0.05$)

strain and feeding trough shapes on carcass values of broiler chickens (Table 4), the dressing percentage, shank, neck, heart, gizzard and large intestine were significantly ($P<0.05$) influenced by the effect of interaction between strain and feeding trough shape with dressing percentage of 76.57, 72.90 and 68.99 % for Marshal strain that used square, rectangular and circular feeding troughs, respectively. Hubbard strain that used the rectangular feeders had the highest value of 81.72 %, followed by 71.10 % for the circular and 66.66 % for those that used the square feeders. Also, Hubbard strain that used the rectangular feeders recorded the highest value of 5.08 % for shank and Marshal strain on circular feeder recorded the lowest value of 4.01 % for shank.

Discussion

In this study, strains did not influence the growth performance characteristics of the experimental birds. This corroborates the findings of Abdullah *et al.* (2010) who reported similar live body weights for both Hubbard and Lohman birds at days 14 and 28. Also, Goliomytis *et al.* (2003) and Korver *et al.* (2004) reported no significant differences for final body weight at 42 days of age between commercial broiler strains. The non-significant effect of the feeder shapes on the weight gain might be attributed to the fact that feeder shapes do not affect uniformity of body weight as well as other performance characteristics of broiler as stated by Leksrisompong (2010) that feeder space is not a

Table 4: Effect of interaction between strain and feeding trough shapes on carcass of broiler chickens

Strains	Marshal			Hubbard		
Feeding trough shapes	Circular	Square	Rectangular	Circular	Square	Rectangular
Live weight (g)	1850.00±104.08	1850.00±50.00	2010.00±135.77	1816.70±96.14	1816.70±136.42	2000.00±132.28
Dressing (%)	68.99±2.11^{bc}	76.57±4.84^{ab}	72.90±3.51^{bc}	71.10±1.41^{bc}	66.66±0.92^{c}	81.72±1.23^{a}
Cut-up parts (%)						
Wing	9.87±0.69	10.43±0.63	9.61±0.64	9.66±0.74	9.80±1.64	10.28±0.26
Shank	4.01±0.29^{b}	4.78±0.26^{ab}	4.59±0.34^{ab}	4.53±0.50^{ab}	4.32±0.06^{ab}	5.08±0.19^{a}
Thigh	10.87±0.55	12.70±0.80	11.42±0.32	10.27±1.18	10.94±1.00	12.22±0.46
Drum stick	10.13±0.60	10.78±0.89	10.89±0.72	9.91±0.96	9.78±1.20	11.37±0.15
Keel	19.59±1.54	18.15±1.31	18.33±0.70	18.97±2.83	14.98±1.00	17.10±0.29
Neck	5.90±0.41^{ab}	6.57±0.72^{a}	6.59±0.40^{a}	4.81±0.50^{b}	6.10±0.08^{ab}	6.21±0.33^{ab}
Breast	15.60±0.86	16.06±0.72	14.93±0.77	14.97±0.72	14.01±1.27	15.81±1.27
Back	13.51±0.49	14.73±1.05	12.18±1.09	12.65±1.68	11.45±1.06	14.05±0.35
Organs (%)						
Heart	4.33±0.03^{b}	4.45±0.09^{b}	4.50±0.06^{b}	7.03±0.05^{a}	6.57±0.28^{a}	6.30±1.73^{a}
Liver	1.71±0.18	1.65±0.19	1.75±0.16	1.92±0.09	1.78±0.14	1.35±0.27
Gizzard	3.06±0.16^{ab}	2.87±0.24^{ab}	3.07±0.22^{ab}	2.45±0.24^{b}	3.38±0.25^{a}	3.00±0.25^{ab}
Intestine (cm)						
Large intestine	12.70±0.06^{a}	10.97±1.98^{ab}	8.83±1.01^{b}	8.67±0.66^{b}	11.83±0.72^{ab}	10.00±0.50^{ab}
Small intestine	156.57±10.97	162.10±12.46	169.17±9.01	143.50±9.92	160.17±7.80	156.50±5.25

$^{a, b, c}$: means in the same row by factor with different superscripts differ significantly ($P < 0.05$)

contributing factor to the weight gain of broiler chickens. However, in this study, feeder shape had significant effect on feed intake and feed conversion ratio with birds that used the square and rectangular feeder shapes having greater values than those on the circular feeder shape. This study however was in contrast to the report of Nakawe (1981) that broiler performance was not significantly affected by trough or hanging tube type feeders with feeder space allowance ranging from 2, 2.54 and 2.74cm per bird. The feeder shapes had a marked effect on feed intake of Hubbard strain with those on circular feeder having the lowest feed intake of 113.82g compared to Marshal which supported the findings of Sogunle *et al.* (2009) that Marshal strain had a higher feed intake compared to Hubbard strain. Marshal strain can be considered to be better in terms of total cost per weight gain and total cost, as it has low cost of production compared to Hubbard strain since the performance and carcass characteristics of both strains are comparable. It was evident that, though much was spent on feeding for birds in the square feeder shape, but there was still reduction in the total cost of production. This makes square feeder shape to be better in terms of production cost.

Strains and feeder trough shaped showed no effect on the live weight of the birds across the treatment. This contradicted the findings of Karima and Fathy (2005) who reported that there are differences in live body weight between breeds or strains and that the proportion of meat in valuable parts of the carcass was influenced by slaughter weight. Similarly, the present report was in contrast to the reports by Sogunle *et al.* (2014) that feeding trough shapes influenced the weight changes in cockerel chickens. In the carcass cut-up parts, the strain only affected the heart out of all the parameters measured with Hubbard strain having a higher value of 6.63±0.60 % than Marshal (MY) which recorded 4.42± 0.04 %. Hence, Hubbard could be considered better in terms of this important organ as reported in the findings of Famimo *et al.* (1996). The dressing percentage of the strain ranging from 72.81 ± 2.13 % (Marshal) to 73.16± 2.31 % disagreed with the findings of Anonymous (1983) who reported a New York dressing percentage of between 75 and 95 % for broiler chickens, but agreed with the dressing percentage of 77.31 ± 2.58 % obtained for birds on the rectangular feeder. In addition, findings in this study for dressing percentage contradicted the report of Sogunle *et al.* (2009) who recorded a dressing percentage of 81.09 % for Hubbard feed different commercial feeds.

Conclusion

It could be concluded that:

1. The differences in the feed intake showed that the fabricated feeders (square and rectangular-shaped) allow for easy access to feed.
2. The cost of production using square and rectangular feeding troughs was lower than using conventional feeders with square having the least production cost.

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