SLAUGHTERING AGE EFFECTS ON PERFORMANCE, CARCASS AND ORGAN INDICES OF BROILER CHICKENS

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ABSTRACT

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A ten-week experiment was conducted to study the response indices of broiler chickens to slaughtering age effects. One hundred and twenty (120) day-old broiler chicks of Marshall Broiler strain were used. The birds were randomly assigned into four treatments: 6, 8, 10 and 12 weeks raising periods tagged R_6, R_8, R_{10} and R_{12} respectively. Each treatment had three replicates of 10 birds each in a completely randomized design. The birds were fed ad-libitum. The result showed that the weight gain increases as birds advanced in age. The birds on treatments R_{10} and R_6 significantly had the highest (305.47 g per bird per week) and the least (231.78 g per bird per week) weight gain respectively. However, birds' final live weights were significantly different among the treatments except for treatments R_{10} (3100.00 g per bird) and R_{12} (3266.67 g per bird) that were similar. Cost of feed in ₦ g^{-1} body weight gain of birds was significantly different among the treatments but treatments R_6 and R_8 with treatments R_{10} and R_{12} were not significantly different from each other. All the organs weights, except the lung were influenced by the raising periods. The entire carcass indices especially the primal cuts; thigh, drumstick, breast and wing were significantly increased in weight with increased raising periods. Birds under 12 weeks raising period had the highest weight for all the carcass indices. Therefore, weight gain and feed cost supported marketing live broiler chicken at either 8 or 10 weeks. However, broiler chicken slaughtered at12 weeks brings about desirable primal cuts of thigh, drumstick, breast and wing; hence supported marketing broiler chicken as cut parts.

INTRODUCTION

Broiler chickens are specially bred for table meat. They are the fastest growing animal on earth that deposited large mass of muscle within a short period. They are suitable for consumption at tender ages without necessarily mature relative to other chicken types. Modern broiler chicks are able to increase their weight approximately 50 fold within 40 days of hatching (Sklan, 2003). At least 85% of the improvements seen in live performance between 1959 and 2001 can be attributed to selection for body weight gain (BWG), feed conversion ratio(FCR) and breast meat yields (BMY) (Havenstein *et al*., 2003). Broiler production could be the most appropriate means of reducing the animal protein shortfall in developing countries and mitigate the challenge of food security. Relatively low and competitive prices compared to other meats, the absence of cultural or religious obstacles, dietary and nutritional properties are the main factors explaining poultry meat's attractiveness (Valceschini, 2006). Poultry chicken has the potential to meet the demand for animal protein. The need for animal protein cannot be overemphasized as it contains high amounts of essential amino acids needed for normal body growth and function. Poultry meat, as white meat, has comparative advantage over other animal species. White meat generally has low cholesterol content thereby making it more acceptable than red meat, especially to people who are health conscious. Chicken meat has a high content of high-value protein and readily available fats, a low cholesterol content, and it is tender and fine-fibred (Grabowski and Kijowski, 2004).

Modern technology has enhanced large scale production of broiler chickens under intensive, well controlled and well-coordinated production systems. Genetic selection is still leading to improvements in broiler chicken performance and the period it takes to reach market weight is gradually becoming shorter. Hence a large number of broilers are turned out for the table within a very short period of time. Most commercial broilers raised for meat reach table size between 5 - 7 weeks of age (Grabowski and Kijowski, 2004). For some food service industries, chickens are also raised to the age of 4 – 5 weeks and slaughtered (Grabowski and Kijowski, 2004).

At these ages, though they have reached table size, the birds are still young and immature with tender muscle and soft bones. However, personal observation revealed that average Nigerians prefer to eat firm (though not dry) meat. According to Soniran and Okubanjo (2002), many factors influence consumers' decisions when selecting fresh meat products. Some of the important criteria considered include appearance, cost and anticipated eating satisfaction. People see broiler chickens as immature and they anticipate a too soft meat and so they mostly go for spent layers, matured cockerels or matured broilers. There is tendency of incurring more cost on raising broiler chickens up to twelve weeks without any corresponding benefit on weight gain and final live weight (Asaniyan *et al*., 2015). Therefore, to the commercial broiler farmers, raising fast growing strains of broiler chickens beyond eight weeks could be uneconomical. This is because the rate at which feed is being converted to meat (feed conversion ratio) diminishes as the birds advance in age. Organ weights increase as the birds grow older and some of the organs such as liver and gizzard are highly relished. The gizzard in particular is of high economic value in that it is processed separately, frozen and packaged for the market. Carcass and organ weight of broilers as well as meat firmness is affected by age. When chickens are slaughtered at 12 weeks of age and above, they attain body weights of over 3 - 4 kg (Grabowski and Kijowski, 2004). However, cost implication of the attained

weight at the age above 12 weeks could be of concern to broiler farmers. The possibility of increased carcass prime cuts could be an indicator for the profitability of broiler production (Le Bihan-duval *et al.,* 1999). However, factors such as line, sex, age, health, nutrition, body weight, and fattening period before slaughtering influenced these prime cuts (Nikolova and Pavlovski, 2009).This study therefore aimed at comparing the relative performance, carcass and organ indices of broiler chickens differently slaughtered at different weeks.

MATERIAL AND METHODS

Experimental site

The experiment was carried out at the Poultry Unit of Teaching and Research Farm, Joseph Ayo Babalola University, Ikeji Arakeji, Osun State, Nigeria. Ikeji Arakeji is located in the tropical forest zone, in the South Western region of Nigeria with geographical coordinates of latitude 7.4296^{o} and longitude 4.9481^{o} at the altitude 372 meters. The experiment lasted for twelve weeks.

Experimental layout

One hundred and twenty (120) day - old chicks of Marshall Broiler strain were purchased from Zartech Farms Limited, Ibadan, Oyo State, Nigeria. A week before the arrival of the chicks, the experimental pens were thoroughly cleansed and disinfected. The chicks were randomly assigned into four treatments; 6, 8, 10 and 12 weeks raising periods tagged R_6, R_8, R_{10} and R_{12} respectively. Each treatment having three replicates with 10 birds per replicate in a completely randomized design experiment. The birds were brooded and raised in different 12 equal dimensional pens (1m x 1m) throughout the duration of the experiment. The birds were brooded with electricity powered 200 Watts bulbs in each pen to supply heat. Kerosene stoves were kept as heat back-up to supply heat during electricity outage. The birds were fed *ad-libitum* with commercial broiler diets (starter (22% CP and 2900 kcal/Kg ME) and finisher (18% CP and 2900 kcal/Kg ME) and water supplied without restriction. Vaccination and medication schedule on the Joseph Ayo Babalola University Teaching and Research Farm for broiler chicken was strictly observed. Weekly feed consumption and weekly weight of the birds were recorded with averages calculated at the end of each week. The feed intake, weight gain, feed conversion ratio (FCR) and cost of feed/kg body weight were computed. At the end of each treatment trial, two birds were randomly selected per replicate and starved overnight for carcass and organ evaluation. The birds were slaughtered by severing the jugular vein with a sharp knife after stunning as described by National Chicken Council (2013). The carcasses were thoroughly bled, weighed, scalded, defeathered, eviscerated, cut into parts and then weighed. The weighed parts were breast, thigh, drumstick, upper back, lower back, wing, neck, shank, abdominal fat and head. Visceral organs evaluated were liver, kidney, lungs, heart, gizzard, spleen and pancreas.All the carcass characteristics as well as the organs measured were expressed in g/kg body weight.

Statistical analysis

The data obtained from the experiment were subjected to Analysis of Variance and the means were separated by Duncan Multiple Range Test Using SPSS Package 16.0 Version (2011).

RESULTS

Table 1 shows the weekly performance of broiler chickens under the four raising periods of 6,8,10 and 12 weeks. All the performance parameters were significantly ($p<0.05$) different among the treatments. The birds' final live weights varied with age. Birds on treatments R_6 (1433.33 g bird^{-1}) and R_8 (2016.67 g bird^{-1}) were significantly ($p<0.05$) different from one and other while those on treatments R_{10} (3100.00 g bird^{-1}) and R_{12} (3266.67 g bird^{-1}) were not significantly ($p<0.05$) different. Birds on both treatments R_{10} and R_{12} were significantly ($p<0.05$) different from those birds on R_6 and R_8. The feed intake increases with increasing raising period with birds on treatment R_{12} having feed intake value (729.09 g per bird per week) significantly ($p<0.05$) different from other treatments. Birds on treatment pairs: R_6 (436.95 g per bird per week) and R_8 (515.65 g per bird per week), R_8 and R_{10} (659.43 g per bird per week) and R_{10} and R_{12} had their feed intake not significantly ($p>0.05$) different from one and other. The weight gain increases with increasing raising periods up to ten weeks; with declined weight gain (268.45 g per bird per week) at 12 weeks raising period. Birds on treatments R_{10} and R_6 significantly ($p<0.05$) had the highest (305.47 g per bird per week) and the least (231.78 g per bird per week) weight gain respectively. The feed conversion ratio (FCR) values showed that feed utilization declined with increasing raising periods. Birds on treatment R_{12} (2.72) had the highest FCR value that significantly different ($p<0.05$) from the other treatments. However, significant differences were not recorded between R_6 and R_8 also on R_8 and R_{10} showed that the birds under the treatments statistically exhibited similar feed conversion ratio. Cost of feed consumed (₦)/g weight gain was significantly ($p>0.05$) different among the treatments; with birds on treatments R_6 and R_{12} having the least (₦83.00 per bird per week) and highest (₦219.31 per bird per week) cost of feed respectively.

Table 2 presents the results of organ indices of broiler chickens reared under the four raising periods. Except for lung, the raising periods affected the weights of all the organs significantly ($p<0.05$). Gizzard weight increases as birds advanced in age. Except for the gizzard; the weights of all other organs on treatment R_6 (6 weeks raising period) were the highest in magnitude among the treatments (raising periods). Though without a definite trend; the kidney was significantly ($p<0.05$) different among the treatments but treatment R_{10} (4.94g/kg live weight) had

the highest value that was not significantly (P>0.05) different from treatment R_6 (4.20g/kg live weight) while treatment R_8 (3.30g/kg live weight) with the least value was not significantly (p>0.05) different from treatment R_{12} (3.71g/kg live weight).The weight of pancreas was significantly (P<0.05) different among treatments; with treatments R_6 (2.22g/kg live weight) and R_8 (1.96g/kg live weight) significantly different from one another. Though pancreas values for birds on treatments R_{10} (1.53g/kg live weight) and R_{12} (1.34g/kg live weight) were not significantly (p>0.05) different but were significantly (p<0.05) different from both treatments R_6 and R_8.Table 3 presents the results of carcass parameters of broiler chickens reared under the four raising periods.

Table 1: Weekly performance of broiler chicken under four raising periods

	Raising periods				
Parameters	R_6	R_8	R_{10}	R_{12}	SEM
Initial live weight(g/bird)	42.67	43.33	45.33	45.33	0.72
Final live weight (g/bird)	1433.33c	2016.67b	3100.00a	3266.67a	234.95
Feed intake (g/bird/week)	436.95c	515.65bc	659.43ab	729.09a	40.95
Weight gain (g/bird/week)	231.78d	246.67c	305.47a	268.45b	8.56
Feed conversion ratio	1.89c	2.09bc	2.16b	2.72a	0.10
Cost of feed consumed (₦)/g weight gain	83.00d	119.90c	166.30b	219.31a	15.42

a,b,c,d: Means in the same row with different alphabets are significantly (p<0.05) different; SEM = Standard Error of Means. R_6 = Six (6) weeks raising period, R_8 = Eight (8) weeks raising period, R_{10} = Ten (10) weeks raising period and R_{12} = Twelve (12) weeks raising period.

Table 2: Organ indices of broiler chickens reared within four raising periods

Organ Indices	Treatments				
	R_6	R_8	R_{10}	R_{12}	SEM
Live weight (g)	1433.33c	2016.67b	3100.00a	3266.67a	234.95
Gizzard (g/kg LW)	13.97d	15.57c	19.96b	29.08a	1.78
Heart (g/kg LW)	5.44a	4.50b	4.41b	3.72c	0.22
Lung (g/kg LW)	6.91	6.91	6.32	5.46	0.33
Spleen (g/kg LW)	1.11a	0.94b	0.73c	0.78c	0.05
Liver (g/kg LW)	26.69a	25.14a	17.02b	17.00b	1.42
Kidney (g/kg LW)	4.20a	3.30b	4.94a	3.71b	0.19
Pancreas (g/kg LW)	2.22a	1.96b	1.53c	1.34c	0.10

LW = Live weight a,b,c,d: Means in the same row with different alphabets are significantly (P<0.05) different.SEM = Standard Error of Means. R_6 = Six (6) weeks raising period, R_8 = Eight (8) weeks raising period, R_{10} = Ten (10) weeks raising period and R_{12} = Twelve (12) weeks raising period.

Table 3: Carcass parameters of broiler chickens reared within four raising periods

Carcass Parameters	Treatments				SEM
	R_6	R_8	R_{10}	R_{12}	
Live weight (g)	1433.33c	2016.67b	3100.00a	3266.67a	234.98
Dressed Weight (%)	61.56	64.38	67.64	69.83	0.95
Bled Weight (%)	94.12	96.73	93.82	80.88	1.86
Plucked Weight (%)	90.36a	91.67b	90.90c	77.45d	1.77
Eviscerated Weight (%)	73.01d	76.94b	80.39c	81.49a	1.00
Head (g/kg LW)	31.64b	33.04d	38.15c	43.54a	1.41
Neck (g/kg LW)	36.57	36.74	38.84	43.83	0.88
Wing (g/kg LW)	87.77b	102.06d	102.45a	108.55c	2.30
Breast (g/kg LW)	169.97d	183.89c	189.68b	199.14a	3.19
Upper Back (g/kg LW)	56.44d	60.02b	60.33a	64.76c	0.89
Lower Back (g/kg LW)	81.86c	82.02b	82.08b	94.12a	1.58
Thigh (g/kg LW)	89.92d	108.02c	104.96b	110.46a	2.43
Drumstick (g/kg LW)	92.01d	103.10c	109.20b	111.13a	2.25
Belly Fat (g/kg LW)	9.34d	10.13c	18.93b	37.45a	3.41
Shank (g/kg LW)	39.39d	42.30c	45.70b	49.46a	1.14

LW = Live weight a,b,c,d: Means in the same row with different alphabets are significantly (P<0.05) different.SEM = Standard Error of Means. R_6 = Six (6) weeks raising period, R_8 = Eight (8) weeks raising period, R_{10} = Ten (10) weeks raising period and R_{12} = Twelve (12) weeks raising period.

Except for the neck; the entire carcass indices were significantly (p< 0.05) affected by the four raising periods (Treatments R_6-R_{12}). However, the birds on treatment R_{12} (12 weeks raising period) significantly (p<0.05) had the highest weight values for all the carcass indices. The plucked weight was also significantly (p< 0.05) different among the treatments.

DISCUSSION

The results of the final weight and weight gain indicated that age contributes significantly to rate of muscle accretion and development. This particularly favoured the muscularization of gizzard through its capacity for grit actions in feed consumption and digestion. Consequently, increased feed intake is directly proportional to gizzard weight. Body weight according to Chambers (1990) is the most frequently used indicator of growth. This is evident in the progressive final live weight and weight gain of the birds reared in this study. The feed intake was highest for birds reared for twelve weeks though similar to those reared for ten weeks but significantly higher than those reared for six and eight weeks; however, birds reared for six weeks had the least feed intake. This tends to show that feed intake is influenced by age variation; however, the similarities observed between treatments R_6 and R_8, R_8 and R_{10} and R_{10} and R_{12} can be attributed to close age range between the birds. The result outlook of feed conversion ratio could be attributed to the fact that the efficient utilization of feed by broiler chickens diminishes as the birds advance in age. Therefore, closer age difference between a group of broiler chickens raised under the same condition might not bring about significant different in the efficient use of feed as revealed between the birds under treatmentsR_6 and R_8 also R_8 and $R_{10.}$ The cost estimates in terms of cost of feed (₦)/g live weight showed that birds reared for twelve weeks had the highest feed cost though similar to birds reared for ten weeks. However, birds reared six weeks had the least cost compared to others. This contradicted the report of Laseinde *et al.* (2004). Since birds reared for eight weeks had better weight gain than those reared for six weeks at higher cost; for tender meat production, it is therefore better to raise broiler birds for six weeks. Birds reared for ten weeks had better weight gain than those reared for twelve weeks at relatively lower cost. This tends to agree with Poltowicz and Doktor (2012) that highest growth efficiency was obtained when the hybrid broiler chickens were raised to 70 days of age. Also confirm the report of Asaniyan *et al*. (2015) that more cost could be incurred in raising broiler chickens up to twelve weeks without any corresponding benefit on weight gain and final live weight.

Therefore, the better weight gain of birds at ten weeks suggested that birds are better raised for ten weeks for the benefit of meat firmness. The organ indices show that organ development in relation to body weight at early growing stage of broiler chicken seems to be higher in comparison with older age. These organs are early maturing hence they attain full growth at an early stage in life. Consequently, development at older age supports muscle accretion in broiler chicken (Oluyemi and Roberts, 2000).This implies that progressive muscular accretion that favours firm meat formation got to its peak at 12 weeks within the limit of this study (Yisa *et al*., 2013), hence desirable primal cuts could be realized. The total edible meat increased as the live weight increased, with the highest values obtained with birds of 12 weeks age. As the birds grow, the feathers increase in number and in size hence it takes more proportion of the live weight with time. The weights of the wing, chest, upper back, lower back, thigh, drumstick and shank were all significantly different among the treatments. This is an indication of different response of carcass growth to unequal influence of raising periods. Therefore, the result of organ and carcass indices in relationship to relish parts like gizzard, chest, back, thigh and drumstick of broiler chicken tends to support raising broiler chicken up to 12 weeks towards marketing chicken as primal cuts.

CONCLUSION

In conclusion, it is relatively possible to realise tender meat from broiler chickens raised up to either six or eight weeks of age; while broiler firm meat could either be obtained at ten or twelve weeks (at higher cost) of age. However, broiler chicken at twelve weeks age supported primal cuts.

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