Influence of housing types and sex on the growth performance, haematological and serum biochemical parameter of broiler chickens

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Abstract

This experiment was carried out to determine the effects of housing types and sex on growth and blood parameters of Arbor Acre broiler chickens. Three hundred (300) chicks, at two weeks of age were divided into two groups (male and female) each containing 150 birds. Each group was randomly sub-divided into two housing systems (deep litter and deep litter with run) consisting of three replicates with 25 birds per replicate and were fed ad libitum. Data collected were subjected to one-way analysis of variance in a 2 x 2 factorial arrangement. The housing type had no significant effect on the growth parameters measured. However, weight gain, feed intake and protein intake were influenced ($p < 0.05$) by sex. The effect of interaction between housing type and sex on the growth performances showed that male in the two housing systems had better ($p < 0.05$) performances than female. However, the female chickens in deep litter performed better ($p < 0.05$) than their female counterpart in deep litter with run. Haematological and biochemical parameters were not influenced by the main effect of housing type and sex. The interaction effect between the housing types and sex on the haematological and serum biochemical parameters had effect ($p < 0.05$) only on basophil and aspartate transferase. It was concluded that Arbor acre male broiler chickens can be raised on any of the housing types while female should be raised only on deep litter for better performance.

Keywords: Housing, sex, broiler, growth performance, haematology

Introduction

The livestock species are raised under different management system. The system of management defined the extent in which birds are exposed to sunlight or ultraviolet rays and it also describes the housing pattern. The challenge which continually faces broiler production is the provision of suitably designed house to provide optimum environment for maximum growth and production (Andrew and Mcpherson, 1993). The provision of appropriate good quality housing is still the most basic requirement for successful poultry production in spite of provision of specially formulated feeds, vitamin supplements, antibiotics, vaccines and other aids to intensive poultry production.

Studies have shown that intensive management system of poultry causes stress and also behavioural and physiological problems with negative effects on the health and productivity of birds (Hall, 2001; McLean *et al.*, 2002; Bessei, 2005). Therefore, there is need to adopt technology to improve the wellbeing of birds in such a management system or to avoid the use of the system. It has been reported that provision of outdoor areas to birds has a favourable effect on their welfare as it allows them to express their natural behaviours such as moving, scratching, pecking, foraging and eating (Mahboub *et al.*, 2004; Tuytens *et al.*, 2005). Bestman and Wagenaar (2003) and Nicol *et al.* (2003) reported that the use of free range by birds

Housing types and sex on the growth of broiler chickens

not only boosts their immunity but helps to reduce stress experienced during rearing. The recent challenge to find a suitable housing system for rearing birds to enhance growth performance and productivity in the poultry industry spurred the conduct of this experiment. This work was carried to determine the effect of housing types and sex on the growth performances, haematological and serum biochemical parameter of Arbor acre broiler chickens.

Materials and methods

Experiment Site:

The experiment was carried out at the poultry unit of the Directorate of University Farm of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria. The area lies on latitude 7° 10' N and longitude 3° 2' E, it received a mean precipitation of 1037mm per annual an average temperature of 34.7°C and an average relative humidity of 82%

throughout the year (Google Earth, 2014).

Experimental Design:

A total number of three hundred (300), two weeks old broiler chicks of Arbor Acres strain were purchased and sexed. The birds were divided into two groups (male and female) each containing 150 birds after the first two (2) weeks of brooding. Each group was randomly sub divided into two housing systems (deep litter and deep litter with *run*) a run is an extension outside the pen in which bird can move out to exercise its natural behaviour. Each group consisting of three replicates with 25 birds per replicate were given experimental diets at *ad libitum* and water. The study was carried out for 6 weeks (3-8 weeks old). Vaccination schedule and medication for chicks were strictly adhered to. Broiler starter diet was formulated and given at starter phase (15th – 28th day) and broiler finisher diet at the finisher phase (29 – 56 days). The compositions of the diets are shown in the Table 1.

Table 1: Compositions (%) of experimental diets

Ingredient	Starter	Finisher
Maize	41.50	47.50
Soybean	22.00	10.00
Wheat offal	13.00	20.00
Groundnut	16.00	15.00
Fishmeal	2.50	2.00
Bone meal	3.00	3.00
Oyster shell	1.00	1.00
Vit/mineral premix	0.25	0.25
Salt	0.25	0.25
Methionine	0.25	0.25
Lysine	0.25	0.25
Total	100.00	100.00
Calculated Analysis		
Crude protein	22.23	20.18
Energy (Mj/Kg)	11.85	12.29

Data Collection:

Data on growth performance (feed intake, body weight, feed conversion ratio and mortality) of each group were recorded weekly. Blood analyses were carried out on

8th week of the experiment.

Collection of Blood Samples:

The blood was collected at 42nd day of the experiment. Blood samples were collected from the wing vein from one bird per

replicate into tubes containing Ethylene Diamine Tetra Acetate (EDTA) to determined haematological parameters (packed cell volume, white blood cell, Haemoglobin, Red blood cell, Neutrophil, lymphocyte, Eosinophil, Basophil, monocytes and conjugated billirubin) while another 3ml were collected in to bottles without anti-coagulant to determine some serum biochemical parameters (Ca^{++} , Na^{++} , Bicarbonate, Glucose, cholesterol, Total protein, Albumin, Globulin, Total billirubi, Conjugated billirubi, Serum glutamic pyruvic transminase, serum glutamic oxaloacetic transaminase, and Alkaline phosphate.

Statistical Analysis

The data were analyzed using the Randomized Complete Block Design (RCBD) of ANOVA according to SAS (2000). Significant ($P<0.05$) different means were separated using Duncan multiple ranged test of the software.

Results and Discussion

Table 2 shows the effects of housing type and sex on growth performance of broiler chickens. The result showed that housing type had no significant ($P>0.05$) effect on all the growth parameters measured. The similarity in the performances of broiler chickens in the two housing systems could be as a result of the quality of the systems and that they provided adequate comfort for the birds as it can also be seen that the mortality is within normal range. Bell and Weaver (2001) found that housing conditions of poultry birds play very important role and poultry parent stock should be provided the conditions that ensure optimum performance of the birds. Many researchers had found out that improvement in the housing system results in improved welfare health of the birds (Lewis and Morris, 2006; Ahlers *et al.*, 2009).

Table 2: Main effect of housing types and sex on growth performance of broiler chickens

Parameters	Housing type		Sex	
	Deep litter with run	Deep litter	Female	Male
Initial weight (g)	334.67±9.09	342.04±14.83	333.37±11.14	343.33±12.30
Final weight (g)	2050.33±200.51	2140.60±2050.3	1966.21±109.53 ^b	2224.73±74.41 ^a
Weight gain (g)	1715.67±203.24	1798.57±103.03	1632.84±113.86 ^b	1881.39±77.54 ^a
Weight gain per day (g)	40.85±4.84	42.82±2.43	38.88±2.71 ^b	44.80±1.85 ^a
Total feed intake(kg)	4.77±0.27	4.91±0.49	4.54±0.70 ^b	5.14±0.33 ^a
Feed intake per day (g)	113.69±6.33	116.85±11.75	108.17±1.61 ^b	122.37±7.78 ^a
FCR	2.80±0.19	2.73±0.16	2.79±0.19	2.73±0.16
Protein intake (g/day)	23.87±1.33	24.54±2.47	22.72±0.33 ^b	25.70±1.63 ^a
Protein efficiency	1.71±0.11	1.75±0.10	1.71±0.11	1.75±0.10
Mortality (%)	4.67±4.68	1.33±2.07	4.67±4.68	1.33±2.07

^{ab} Mean in the same row with different superscripts are significant ($P<0.05$).

However, the effect of sex on growth performance was reflected ($p<0.05$) in final weight gain, weight gain per day, feed intake and protein intake. The male birds were significantly ($p<0.05$) heavier (2224.73g/day) than their female counterpart which recorded 1966.21g/day at the end of the experiment. The average total weight gain of male birds was

1881.39g while that of the female was 1632.84g, the weight gain of the birds per day were 44.80 and 38.88g/day for the male and female, respectively. The feed intake per day of the male birds increased significantly ($p<0.05$) than the females. The feed intake pattern of male and female broiler chicken obtained agreed with the report of Laseinde and Oluyemi (1996).

Housing types and sex on the growth of broiler chickens

The authors also reported that male birds grow faster and weigh heavier than the females under various rearing conditions. This could be attributed to the higher activity of the males than the females. Fischer (1985) reported that male birds are behaviourally more active than the females; hence consumed more feeds and gain weight faster than the females. The result of the interaction between housing type and sex on growth performances of broiler chickens (3-8weeks) is shown on Table 3. The result showed that interaction between housing types and sex has significant ($p<0.05$) effect on all the parameters except mortality. Interaction across the treatments showed that male in the housing system had better performances than female. However, the female chickens in deep litter performed better ($p<0.05$) than their female counterpart in deep litter with *run*. The male birds on deep litter and deep litter with *run* recorded highest final weight ($p<0.05$) of 2231.90 and 2217.56g which were heavier than the female on deep litter and deep litter

with *run* 2049.31 and 1883.11g, respectively. It also reflected that weight gain per day of female bird reared on deep litter with *run* recorded the least value of 36.85g. The protein intake and protein efficiency ratio were also influenced ($p<0.05$) by the effect of interaction. Female birds managed on deep litter had increased values of final weight and weight compared to their counterpart in deep litter with *run*. This could be due to the energy dispersed by the latter as they move freely on *run*, these finding agreed with the observation of Castellini *et al.* (2008) who reported that outdoor activities reduces growth rate and influenced mortality rate than birds managed on deep litter. However, mortality was not influenced in the present study. The insignificant value mortality in the present study negated the report of Santos *et al.* (2012) that housing type had significant effect on mortality. The variation could be due to the differences in the housing type used in these studies.

Table 3: Effect of interaction between the housing systems and sex on growth performance of broiler chickens (3-8 weeks)

Parameter	Female		Male	
	Deep litter	Deep litter with run	Deep litter	Deep litter with run
Initial weight(g)	331.41±13.9 ^b	335.33±10.26 ^{ab}	352.67±4.16 ^a	334.00±10.00 ^{ab}
Final weight(g)	2049.31±21.08 ^b	1883.11±93.99 ^c	2231.90±76.83 ^a	2217.56±88.23 ^a
Weight gain(g)	1717.90±30.35 ^b	1547.77±98.91 ^c	1879.23±78.09 ^a	1883.56±94.44 ^a
Weight per day(g)	40.90±0.72 ^b	36.85±2.35 ^c	44.74±1.86 ^a	44.85±2.25 ^a
Feed intake(kg)	4.54±0.03 ^b	4.55±0.10 ^b	5.28±0.44 ^a	4.10±0.12 ^a
Feed per day(g)	107.99±0.61 ^b	108.34±2.45 ^b	125.71±10.46 ^a	119.03±2.91 ^a
Feed conversion ratio	2.64±0.06 ^b	2.95±0.13 ^a	2.81±0.19 ^{ab}	2.66±0.09 ^b
Protein intake (g/day)	22.68±0.12 ^b	22.75±0.51 ^b	26.40±2.19 ^a	24.10±0.61 ^a
Protein efficient ratio	1.80±0.04 ^a	1.62±0.7 ^b	1.70±0.12 ^{ab}	1.79±0.60 ^a
Mortality (%)	2.67±2.31	6.67±6.11	0.00±0.00	2.67±2.31

^{abc} Mean in the same row with different superscripts are significant ($p<0.05$).

The effect of housing type and sex on haematological and serum biochemical parameters is represented in Table 4. The result showed that all the parameters measured were not influenced ($p>0.05$) by

housing type or sex. The PCV values ranged from 33.25 to 33.75% in the two housing types. Birds on deep litter recorded $2.50 \times 10^{12}/L$ and $11.70 \times 10^9/L$ for Red blood cell and White blood cell while their counterpart

on deep litter with *run* recorded 2.68 x 10¹²/L and 11.95 x 10⁹/L, respectively.

Table 4: The main effect of housing type and sex on of haematological and serum biochemical parameters

Parameters	Housing type		Sex	
	Deep litter	Deep litter with <i>run</i>	Female	Male
PCV (%)	33.25±4.11	33.75±5.25	32.75±3.40	34.25±6.68
Haemoglobin (g/dl)	10.78±1.38	10.88±1.45	10.73±0.93	10.93±1.77
RBC (X10 ¹² /L)	2.50±0.51	2.68±0.43	2.55±0.26	2.63±0.62
WBC (X10 ⁹ /L)	11.70±1.37	11.95±1.98	11.40±1.13	12.25±2.02
Heterophil (%)	35.50±5.45	37.00±4.69	34.75±6.40	37.75±2.50
Lymphocyte (%)	63.50±4.93	62.75±4.35	64.25±5.62	62.00±2.94
Eosinophil (%)	0.25±0.00	0.50±0.00	0.00±0.00	0.25±0.50
Basophil (%)	0.50±0.00	0.58±0.00	0.50±0.58	0.00±0.00
Monocyte (%)	0.25±0.50	0.25±0.50	0.50±0.58	0.00±0.00
Total protein (g/dl)	7.20±0.41	6.83±0.83	7.10±0.68	6.93±0.68
Albumin (g/dl)	3.40±0.37	3.75±0.64	3.83±0.59	3.33±0.33
Aspartate transferase (iu/L)	69.00±7.44	72.5±13.72	75.50±12.12	66.00±6.68
Alanine transferase (iu/L)	27.75±2.99	28.25±6.13	25.50±3.87	30.50±3.87
Glucose (Mg/dl)	118.5±16.44	114.25±15.63	109.50±17.84	123.25±9.07
Cholesterol (Mg/dl)	70.25±20.25	76.00±16.37	77.00±19.88	69.25±16.26
Bicarbonate	15.40±3.38	14.73±2.57	15.65±2.13	14.48±3.59
Calcium(Mg/dl)	10.75±1.57	10.18±0.57	10.10±1.14	10.83±1.17
Sodium	143.5±11.12	143.75±3.77	143.00±7.78	144.25±8.66
Total bilirubin	0.15±0.04	0.12±0.02	0.14±0.20	0.13±0.50
Conjugated billirubin	0.12±0.40	0.07±0.02	0.88±0.04	0.09±0.04
Globulin	3.80±0.74	3.08±0.83	3.28±1.13	3.60±0.50
Alanine transferase (ALT)	30.75±2.5	32.75±4.90	33.50±4.51	30.00±2.16

^{abc} Mean in the same row with different superscripts are significant (p<0.05).

Table 5 showed that the effect of interaction between housing type and sex on the haematological and serum biochemical parameters of broiler chicken had no significant (p>0.05) effect in all the parameters measured except basophil and Aspartate transferase. It was shown that only the female birds on deep litter had basophil. The result of aspartate transferase (AST) showed that female on deep litter with *run* had the least value of 61.50 while the highest value (83.50) was recorded from male on deep litter with *run*. The effect of housing type on haematology variables can

be best known through understanding of haematological concept, however all the haematology parameters of housing type fall within the normal range for chickens. Haematology is a scientific study of the natural functions and diseases of the blood on the other hand, those factors in the blood are usually determined in order to assess the degree of health of the animal. The blood parameters obtained in this study shows that the birds' health status was not adversely affected by the housing systems. The values of PCV and RBC also showed that the birds were not anaemic since the two indices are

Housing types and sex on the growth of broiler chickens

good indicators of the blood volume and oxygen carrying capacity. The immune response of the birds was not negatively affected by the housing system as observed in the values of the WBC which were normal. The non-significant effect of housing in the values of blood parameters was in line with the founding of Alabi *et al.* (2015) who reported that the haematological values of the laying hens were not influenced by the housing. The similarities in the haematological parameters also agreed with the findings of Olaniyi *et al.* (2012) in cockerel chickens reared on deep litter and free range systems. Even though, the effect of sex was insignificant on both haematological and serum biochemical indices, this contradicted the result of Sharmin and Myenuddin (2004). The difference in the

observation may be attributed to the level of significance because the authors subjected their data to 99% ($p < 0.01$) while in the present study it was at 95%. It could also be that the birds were of the same age, reared for short period of eight weeks and managed under the same environment (season and feed). The insignificant effect of housing type on blood parameters could be due to similar conditions of husbandry system under which the bird were kept. The result was in agreement with the report of Addass *et al.* (2012) who worked on management system on some haematological parameters of intensively and semi-intensively kept chickens. The study showed that the housing types did not impose significant effect on growth performance and blood (haematological and serum biochemical) parameters of broiler chickens.

Table 5: Effect of interaction between housing type and sex on the haematological and serum biochemical parameter of broiler chickens

Para meter	Deep litter		Deep litter with run	
	Female	Male	Female	Male
PCV (%)	33.50±0.71	33.00±7.07	35.50±6.36	32.00±5.66
HB (g/dl)	11.00±0.28	10.55±2.33	11.30±1.83	10.45±1.49
RBC ($\times 10^{12}/L$)	2.60±0.14	2.40±0.83	2.85±0.49	2.50±0.42
WBC ($\times 10^9/L$)	11.55±0.35	11.85±2.33	12.65±2.47	11.25±1.91
Heterophil (%)	32.00±5.65	39.00±2.83	36.50±2.12	37.50±7.78
Lymphocyte (%)	66.50±4.95	60.5±3.54	63.50±2.12	62.00±7.07
Eosinophils (%)	0.00±0.00	0.50±0.71	0.00±0.00	0.00±0.00
Basophil (%)	1.00±0.00 ^a	0.00±0.00 ^b	0.00±0.00 ^b	0.00±0.00 ^b
Monocyte (%)	0.50±0.70	0.00±0.00	0.00±0.00	0.50±0.71
Total protein(g/dl)	7.15±0.49	7.25±0.50	6.60±0.85	7.05±1.11
Albumin (g/dl)	3.45±0.64	3.35±0.70	33.00±4.24	4.20±0.28
Aspartate transferase (iu/L)	67.50±12.02 ^{ab}	70.50±3.54 ^{ab}	61.50±6.36 ^b	83.50±6.36 ^a
Alanine transferase (iu/L)	27.50±4.49	28.00±1.41	33.00±4.24	23.50±2.12
glucose (Mg/dl)	118.00±25.46	199.00±12.75	127.50±3.53	101.00±4.24
cholesterol (Mg/dl)	79.00±29.70	61.50±6.36	77.00±22.63	75.00±16.97
Bicarbonate (Mmol/l)	146.00±2.40	16.20±5.09	12.75±0.92	16.70±1.84
Calcium (Mg/dl)	10.05±1.91	11.45±1.34	10.20±0.85	10.15±0.50
Sodium	145±12.72	142.00±14.14	146.50±2.12	141.00±2.83
Total bilirubin	0.15±0.02	0.15±0.07	0.11±0.01	0.13±0.04
Conjugated bilirubin	0.11±0.05	0.11±0.60	0.08±0.01	0.07±0.03
Globulin	3.70±1.13	3.90±0.57	3.30±0.28	2.85±1.34
Alanine transferase (ALT)	31.00±4.24	30.50±0.71	29.5±3.54	36.00±4.24

^{ab} Means in the same row with different superscript are significant ($p < 0.05$)

Conclusion

The male broiler chicken of arbor acre strain can be raised on any of the two housing type without any difference in their performance while their female counterpart should be raised on deep litter for optimum performance.

Acknowledgements

The authors acknowledged the contribution of Miss J. A. Adegbite, the laboratory technologist of the Department of Animal Production and Health, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.

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Received: 7th February, 2017

Accepted: 21st June, 2017