EFFECTS OF TWO HOUSING SYSTEMS ON PERFORMANCE CHARACTERISTICS HAEMATOLOGICAL AND SERUM BIOCHEMICAL INDICES OF GROWING PULLETS

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ABSTRACT
Effects of two housing systems on performance characteristics haematological and serum biochemical indices of growing pullets were undertaken. Bovan nera pullets (n=576) at weeks 12 weighing 1.06 ± 0.01-1.08 ± 0.03kg were divided into two equal portions of 288 pullets each into conventional Battery Cage System (BCS) and Deep Litter System (DLS). Pullets were randomly allotted to the same dietary treatment in a completely randomised design. The experimental diets and water were offered to birds ad libitum. Birds were weighed prior to allotment to dietary treatments. The weight and feed consumption of pullets were taken weekly. The conversion ratio, feed cost/gain and percentage mortality were determined. At week 14, blood samples were collected to evaluated haematological and serum biochemical indices using standard procedures. Two-way analysis of variance (ANOVA) using the General Linear Model procedure of SAS Institute Inc. (2012) and significant means separated by Duncan Multiple Range option of the same software was employed to analysed data. The feed intakes (kg/bird/day) obtained for pullets in DLS and BCS were 0.10±0.06 and 0.08±0.08 with gains of 0.01±0.07 and 0.01±0.03 kg/bird/day respectively. Performance characteristics of growing pullets was not affected (p>0.05) by housing systems Haematological and serum biochemical indices of birds were within the normal physiologically healthy chickens. Two housing systems did not affect (p>0.05) haematological and serum biochemical indices except albumin; albumin/globulin ratio, and phosphorous. Empirically, it can be concluded that housing systems affect albumin, albumin/globulin ratio, and phosphorous as serum indices.
Keywords: Battery cage, deep litter, haematological indices, serum biochemical indices, pullets

INTRODUCTION

Poultry proteins play a significant role in human nutrition. Good quality egg productions and maintenance of healthy laying stock require the supply of inputs such as quality pullet chicks, housing system, nutrition and effective husbandry management. Commercial egg production in Nigeria is dominated by exotic strains of chickens developed and evaluated in the temperate region in optimal housing system and nutrition. The performance of poultry strains however remains low in Nigeria due to sub-optimal housing systems and nutrition. In developing countries, farmers house more birds in deep litter systems (DLS) than in battery cage system (BCS) (Badubi and Ravindran, 2004). Approximately 90% of laying birds are housed in BCS for commercial egg production (Awoniyi, 2003). The BCS provides increase spatial density of birds; easy control of microclimate; simplified waste disposal; reduction of labour costs; and easy supervision of individual birds for high production level and health status (Banga-Mboko *et al*., 2010). In Nigeria, the DLS is still used by some poultry farmers for commercial egg production because of its advantage of low-cost input. Housing systems affect performance of birds in the tropics when intensively stocked when there is no regards for regulation of microclimatic condition (Obidi *et al*., 2008). Reported study (Mmereole *et al.*, 2007) indicated that variations existed in performance of birds in different housing systems. Blood parameters are affected by the quality and quantity feed, feed toxicity and environmental condition in the housing system (Roberts *et al*., 2003). Haematological and serum biochemical indices are useful clinical and diagnostic indicators for evaluating health status in animals. This study was carried out to investigate effects of two housing systems on the performance characteristics and haematological and serum biochemical indices of growing pullets.

MATERIALS AND METHODS

The experiment was carried out at the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria. A total of 576 Bovan nera pullets were randomly allotted to two housing systems of 288 pullets per treatment. Each treatment was a triplicate of eight birds per replicate. Birds (n=288) were each raised on conventional BCS and a partitioned DLS house respectively. Each cage measured 50 x 45 x 40cm^3 and accommodated 4 pullets. The DLS was partitioned into 36 smaller pens with an average floor area of 3.32 m^2 to accommodate 8 pullets per pen. An isocaloric and isonitrogenous growers' diet was formulated and fed to birds. The composition of the experimental growers' diet is shown in Table 1.

Table 1: Gross composition of experimental growers' diet

Ingredients	Level of inclusion (%)
Maize	54.89
Soybean meal	7.98
Groundnut cake	7.98
Palm kernel cake	13.97
Wheat bran	9.98
Bone meal	2.00
Oyster shell	2.00
Salt	0.30
Methionine	0.15
Lysine	0.10
Grower premix	0.15
Biotronic	0.30
Mycofix	0.10
Ronozyme G2G	0.02
Ronozyme P	0.02
Avatec	0.06
Total	100.00
Calculated nutrient values	
ME (kcal/kg)	2,781.38
Crude protein (%)	16.18
Crude fibre (%)	4.84
Fat (%)	4.70
Calcium (%)	1.58
Phosphorus (%)	0.82
Lysine	0.77
Methionine + cysteine	0.69

Birds were weighed prior to allotment to dietary treatments. The feed consumption per replicate was obtained by subtracting the leftover from the quantity of feed offered to the pullets. Pullets in each replicate were weighed individually and the mean live weights of pullets in each replicate were used to determine the live weight gains. Live weight gain was determined by subtracting initial from the final live weight. Feed conversion ratio was obtained by dividing feed intake (kg) by the weight gain (kg). Feed cost/gain and percentage mortality were also determined. Routine medication, vaccination and husbandry practices were administered on them. The feeding period lasted 12 weeks within which the pullets were given feed and water *ad libitum*. The design of the experiment was a completely randomized design. At week 14, 6 pullets per housing system were randomly selected and blood collected using 5ml syringes via the jugular vein. Blood samples for haematological study were collected drained into heparinized bottles. Blood samples for determination serum biochemical parameters determination was drained into plain vacationer tubes without Ethyl Diamine Tetra-Acetate powder (EDTA) for separation. Blood samples were centrifuged; serum separated out, decanted and kept deep frozen for analysis. Packed Cell volume (PCV) was determined using micro-haematocrit method (Schalm *et al*., 1975). Haemoglobin (Hb) concentration was measured spectrophotometrically by the method of cyanomet haemoglobin (Schalm *et al*., 1975). Red blood cell (RBC) and White Blood Cell (WBC) were estimated using haemocytometer (Aiollo, 1998). Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) were estimated by calculation from Hb, PCV and RBC by the formula according to Jaime and Hewlett (2008). White Cell Differential counts (WCDC) e.g. Eosinophil, Monocytes, Platelet, Lymphocytes, Basophile and Heterocyst were estimated by blood staining techniques.

Total protein (TP) was determined using Biuret method. Albumin was determined by the method of Bromo cresol green (BG). The globulin was obtained by subtracting the quantity of albumin from the total protein. Blood cholesterol determination was as described by Dacia and Lewis (1991). Triglycerides, Very Low Density Lipoprotein (VLDL), Low Density Lipoprotein (LDL) and High Density Lipoprotein (HDL) were estimated by the methods described by Gowenlock *et al.* (1988). Aspartate amino Transferase (AST) Alkaline amino Transferase (ALT) and Alkaline Phosphatase (ALP) activities were determined by spectrophotometry method as described by Hodder and Rej (1983). Urea concentration was determined as described by Toro and Ackermann (1975). Minerals [Calcium (Ca) and Phosphorus (P)] in digests were determined using Atomic Absorption Spectrophotometer (AAS) by the method according to AOAC (2000).

Statistical analysis
Data were subjected to a two-way analysis of variance (ANOVA) at $\alpha_{0.05}$ using the General Linear Model procedure of SAS Institute Inc. (2012) and significant means were separated by Duncan multiple range option of the same software.

Results and Discussion
Similar values of feed intake ($p>0.05$) 0.10±0.06 and 0.08±0.08 kg/bird/day were obtained for pullets in the DLS and BCS to gain 0.01±0.07 and 0.01±0.03 kg/bird/day respectively. Effect of two housing systems on the performance characteristics of pullets is shown in Table 2. The two housing systems did not have any significant effect ($p>0.05$) on the performance parameters of pullets.

Table 2: Performance characteristics of pullets in two housing systems

Parameters	DLS	BCS
Initial body weight/bird (kg) at week 13	1.06 ± 0.01	1.08 ± 0.03
Final body weight/bird (kg) at week 16	1.34 ± 0.01	1.32 ± 0.04
Live weight gain (kg)/bird/day	0.01±0.07	0.01 ± 0.03
Feed intake (kg)/bird/day	0.10 ± 0.06	0.08 ± 0.08
Feed conversion ratio	10.00± 0.02	8.00± 0.03
Mortality (%)	0.00	0.00

DLS-Deep Litter System, BCS-Battery Cage System

Feed intake of pullets in BCS was comparable with reported values by Oguntunji and Salako (2012).
In Table 3, all haematological values were within the physiological normal range for chickens as documented by Ikhinioya *et al*. (2000). Effect of two housing systems on all haematological indices of growing pullets were not significant ($p>0.05$)

Table 3: Haematological indices of growing pullets in two housing systems

Haematological indices	**DLS**	**BCS**
Hb (g/100ml)	7.17±0.82	7.15±0.59
PCV (%)	21.50±2.43	21.50±1.76
RBC (10^6IU)	3.66±0.31	3.56±0.43
MCV (fl)	58.74±0.95	60.39±0.28
MCH (pg)	19.59±014	20.08±0.25
MCHC (g/dL)	33.35±0.82	33.26±0.59
WBC (10^3IU)	21.28±2.44	19.03±4.31
Lymphocytes (%)	68.83±4.36	66.00±5.62
Heterocyst (%)	24.83±5.12	28.33±6.12
Monocytes (%)	3.00±0.63	3.00±0.63
Eosinophil (%)	3.17±1.60	3.17±1.60
Basophil (%)	0.17±041	0.33±0.52
Platelets x 10^5	2.42±7.81	2.12±8.50

DLS-Deep Litter System, BCS-Battery Cage System, Hb-Haemoglobin, RBC-Red blood cells, WBC-White blood cells, PCV-Pack Cell Volume, MCV-Mean Corpuscular Volume, MCH-Mean Corpuscular Haemoglobin, MCHC-Mean Corpuscular Haemoglobin Concentration

Table 4 shows effect of two housing systems on the serum biochemical indices of growing pullets. Housing systems did not affect ($p>0.05$) serum biochemical indices aside AL, AL/GL and P of the growing pullets. The values obtained for all the serum biochemical indices were within the normal physiologically healthy chickens.
The AL and AL/GL values (3.38±0.36 g/dL and 3.05±0.32) of pullets in the DLS was higher ($p<0.05$) than 2.70±0.21 g/dL and1.74±0.47 respectively of those in the BCS. Changes in nutritional status and environment due to housing system affect serum AL values than GL (Ross & Vogel, 1978). The lower serum AL values of pullets in BCS portrays signs of poor health and performance in animals. Higher serum AL values of pullets in DLS indicates stronger immune response to disease infection in an environment. In agreement with the report of Ikhimioya *et al*. (2000), pullets with higher serum AL have greater potential for blood clotting and prevention of haemorrhage. There were significant differences ($p<0.05$) in serum phosphorous values (mg/dL) of pullets from both housing systems. The DLS serum phosphorous values recorded was 1.61±0.28 higher ($p<0.05$) compared with 1.20±0.11 for those in the BCS. The difference ($p<0.05$) serum phosphorous was attributed to animals' activity and exercise by Dhandu and Angel (2003). Significantly higher ($p<0.05$) phosphorous in the serum of pullets in DLS could be a reflection of greater activities of movement and exercises that require expenditure of

energy produce through series of biological pathway involving phosphate in adenosine triphosphate (ATP) as energy storage form in the body.

Table 4: Serum biochemical indices of growing pullets in two housing systems

Serum biochemical indices	DLS±SD	BCS±SD
TP (g/dL)	4.24±0.35	4.08±0.60
AL (g/dL)	3.38±0.36[a]	2.70±0.21[b]
GL (g/dL)	1.11±0.29	1.55±0.74
AL/GL ratio	3.05±0.32[a]	1.74±0.47[b]
TC (g/dL)	114.63±21.08	97.48±15.23
TG (g/dL)	111.30±76.77	68.01±34.84
LDL (mg/dL)	62.60±9.25	53.87±15.35
VLDL (mg/dL)	22.26±15.35	13.60±6.97
HDL (mg/dL)	101.54±12.75	92.05±12.31
UN_2 (mg/dL)	3.62±2.45	4.20±0.51
UA (mg/dL)	3.92±2.04	2.79±1.57
AST (IU/L)	81.64±16.26	86.54±24.51
ALT (IU/L)	3.41±4.25	1.76±0.40
ALP (IU/L)	459.77±31.98	452.18±21.78
Ca (mg/dL)	8.97±3.07	9.68±2.38
P (mg/dL)	1.61±0.28[a]	1.20±0.11[b]

[ab]Means with different superscripts within the same row are significantly different (P<0.05)

DLS-Deep Litter System, BCS-Battery Cage System, TP-Total protein; AL-Albumin; GL-Globulin; TC-Total Cholesterol; TG-Triglycerides; LDL-Low Density Lipoprotein, VLDL-Very Low Density Lipoprotein, HDL-High Density Lipoprotein, UN_2-Urea N_2, UA-Uric Acid, AST-Aspartate amino Transferase, ALT-Alkaline amino Transferase, ALP-Alkaline Phosphatase; Ca-Calcium; P-Phosphorous; SD-Standard Deviation

CONCLUSION

The findings of this study revealed that performance characteristics, haematological and serum biochemical indices of growing pullets between 13 to 16 weeks of age were not affected by housing systems.

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