

# Performance, health status and cost implications of Raising Broiler chickens under different housing Systems

Adegbenro, Muiyiwa; Sulaimon, Eniola Hamid; Faluyi, Oyetayo Bolanle, Adepo, Temitayo Oluranti and Igbasan, Francis Adegbaye

Division of Animal Production and Management, Department of Animal Production & Health, The Federal University of Technology, Akure, Nigeria.

Corresponding Author: Adegbenro, M.

**Abstract**— This study investigated the performance and cost implication of raising broiler chickens under different housing systems. Three (3) different rearing systems namely; deep litter, colony cage and fold unit housing systems were used for this study. A total number of one hundred and thirty (130), four (4) weeks old Abor-acre strain of broiler chickens were procured out of which, one hundred and twenty (120) were randomly distributed into three (3) treatments of four (4) replicates, ten (10) started chicks per replicates in a Completely Randomized Design and the weight of each replicate was balanced ( $\pm 1g$ ). The birds were fed formulated broiler finisher diets and water *ad-libitum* throughout the experimental period. At the end of the experimental period, the birds were starved overnight and weighed in the morning. Two (2) birds per replicates were slaughtered and blood collected for haematological studies. Carcass and organ parameters were recorded, while cost analysis was done using excel. Data collected were subjected to analysis of variance using SPSS version 17 package. Results from the study revealed highest final weight, highest weight gain, highest eviscerated weight, lowest feed intake ( $2388.00 \pm 1.44g$ ,  $1716.25 \pm 0.32g$ ,  $1890.00 \pm 27.00g$ ,  $3475.75 \pm 36.57g$ , respectively) and best feed conversion ratio ( $2.03 \pm 0.07$ ) were recorded in birds on fold unit system. All the organs measured were significantly ( $P < 0.05$ ) influenced by the treatments except heart. Erythrocyte sedimentation rate (ESR), packed cell volume (PCV), haemoglobin (Hb), mean cell haemoglobin concentration (MCHC) were not significantly ( $P > 0.05$ ) influenced by the housing systems. Among all the bacteria isolated; *Streptococcus faecalis*, *Salmonella* spp., *Enterobacter aerogenes* and *Serratia marcescens* were significantly ( $P < 0.05$ ) influenced by the housing systems. The cost evaluation of this study indicated beneficial effect of using colony and fold unit systems. Lowest total cost of production (₦1481.67) was recorded in fold unit system while highest total cost of production (₦1754.95) was recorded in deep litter system. Highest live weight (2.44kg), highest total sales price (₦2196.00) and highest net profit (₦714.00) were recorded in bird raised under fold unit. From the total cost of production, live weight, total sales price and net profit, it could be concluded that bird raised under fold unit performed well and better and such housing system (fold unit) could be adopted by backyard/small scale broiler chicken farmers as alternative to conventional deep litter system.

**Keywords**— Production, cost, broiler chickens, housing systems, blood, bacteria.

## I. INTRODUCTION

With the present economic situation in Nigeria and considering the rate at which an average Nigerian tends to raise chickens (broilers and cockerels) during Christmas and New year festivals in their compounds call for need to look for ways to encourage these backyard farmers in order to reduce the cost of poultry production and management

with a view to encouraging livestock farmers to produce more animal proteins for the populace without compromising the quality of meat obtained from these animals. There is the need to develop more convenient, easily adoptable housing systems which are safer and cost effective for these backyard poultry farmers. Apart from the major argument about the welfare of poultry managed

and housed intensively, there is evidence that compromised welfare is usually associated with a reduction in productivity (Jones *et al.*, 2005; Julian, 2005). Cost of conventional buildings; battery cages, deep litter system is now a great challenge as cost of building materials is going up on daily basis in Nigeria due to growing inflation and exchange rates, there is therefore the need for cheaper housing systems. An attractive hypothesis to consider is that put forward recently by (Dawkins *et al.*, 2004), which suggests that “chicken welfare is influenced more by housing conditions”. This hypothesis therefore, should be expected to account also for the use of cages in the production of broiler chickens. Hence, the question that arises is how performance responses (growth characteristics and carcass quality) of broilers are related to different housing systems. Thus, this study seeks to investigate alternative ways of rearing broiler chickens for backyard/small scale broiler chicken farmers in order to increase production of animal protein (meat) via reducing the cost of building construction by adopting simple housing systems.

## II. MATERIALS AND METHODS

**Experimental Site:** The experiment was carried out at Oluade Farms, Ilara Mokin (latitude 7°18'N and longitude 5°10'E), Ifedore Local Government, Ondo State, Nigeria. Ilara Mokin falls within rainfall zone of the humid tropics which is characterized by hot and humid climate. The mean annual rainfall is 1500mm and the rain period is bimodal with a short break in august. The altitude is about 350.52m above sea level, the mean annual humidity is 75% and temperature is 27°C (Oyinloye, 2013).

**Pen Construction:** Three (3) different rearing systems namely; deep litter housing system, colony housing system and fold unit housing system were used for this study. The deep litter system was constructed to a standard using the following materials; iron sheets, wood, wire mesh, nails, cement and blocks, while the colony cage and fold unit systems were constructed with; iron sheets, wood, wire mesh and nails and the colony cage and fold unit systems were placed under natural shades mainly plantain/banana and palm trees to provide natural cover.

**Experimental Diet:** One basal broiler finisher diet was formulated at the Nutrition Laboratory of the Department of Animal Production and Health, Federal University of Technology, Akure Nigeria, to meet the requirement of swine (NRC, 1994). The gross composition of the finisher diet is presented on Table 1.

Table 1: Gross Composition of Broiler Finisher Diet (g/100g)

Ingredients	
Maize	54.00
Wheat offal	5.80
Soyabean meal	21.00
Groundnut cake	12.00
Lysine	0.10
Methionine	0.10
Dicalcium phosphate	1.50
Limestone	2.00
Premix	0.25
Salt	0.25
Vegetable oil	3.00
<b>Total</b>	<b>100.00</b>
<b>Calculated analysis:</b>	
Crude protein (%)	19.70
Metabolizable energy (Kcal/kg)	3030.24
Calcium (%)	1.11
Phosphorus (%)	0.50
Lysine (%)	0.10
Methionine (%)	0.40
<i>*Contained vitamins A (8,500,000 IU); D3 (1,500,000 IU); E (10,000mg); K3 (1,500mg); B1 (1,600mg); B2 (4,000mg); B6 (1,500mg); B12 (10mg); Niacin (20,000mg); Pantothenic acid (5,000mg); Folic acid (500mg); Biotin H2 (750mg); Choline chloride (175,000mg); Cobalt (200mg); Copper (3,000mg); Iodine (1,000mg); Iron (20,000mg); Manganese (40,000mg); Selenium (200mg); Zinc (30,000mg); and Antioxidant (1,250mg) per 2.5kg</i>	

**Experimental Layout and Birds Arrangement:** A total number of one hundred and thirty (130) started broiler chicks were procured from a vendor in Akure, Ondo State, Nigeria out of which one hundred and twenty (120) were used for this study. The started broiler chicks were divided into three (3) groups namely; deep litter, colony cage and fold unit. Each system had forty (40) started broiler chicks and each system was replicated four times (4) with ten (10) started broiler chicks per replicate in a Completely Randomized Design and the weight of each replicate was balanced ( $\pm 1g$ ). The chicks were fed *ad-libitum* on the same finisher diet throughout the experimental period (28 days), while fresh and clean water was also provided daily

throughout the experimental period. The deep litter system was covered with wood shavings as bedding materials while the colony cage and fold unit systems were not covered by any concrete or beddings but had only grasses and others plants available within the pens and environment. The colony cage system remained permanent throughout the experimental period, while fold unit system was moved on weekly basis (i.e rotational farming type) within the farm to give access to fresh vegetables and also allow the used portion to rest for some period. The Weekly feed intake and weight changes were recorded and from these two (2) parameters, feed conversion ratio was calculated.

**Slaughtering of birds:** At the end of the experimental period, birds were kept of feed for 12 hours so as to empty their crop to prevent carcass contamination. Two (2) birds were randomly selected per replicate for the purpose of determining the carcass characteristics. Slaughtering was done by severing the jugular vein, after stunning. The birds were bled and were scalded and defeathered. Thereafter, the dressed and eviscerated weights were expressed as a percentage of the live weight. The following organs were weighed; liver, heart, lungs, pancreas, proventriculus, spleen, gizzard and were expressed in g/kg body weight.

**Blood collection:** At the end of the experimental period, the birds were starved overnight and two (2) birds were randomly selected per replicate. The birds were stunned, slaughtered by severing the jugular vein, for collection of blood used for the haematological and serum indices studies. For haematology, blood samples were collected into sterilized bottles containing Ethylene Diamine Tetra-acetic Acid (EDTA) and the following blood parameters were determined; erythrocyte sedimentation rates (ESR), packed cell volume (PCV), haemoglobin concentration (Hb), red blood cell (RBC), absolute haemoglobin and differential white blood count.

**Bacteria load:** Swab was inserted into the cloaca to get the fecal sample to obtain sample from the experimental birds to determine the bacteria load. The media (Nutrient Agar)

used was prepared from commercially dehydrated products and reconstituted according to the manufacturer's directives, sterilized and allowed to cool. 1ml each of the serially diluted fecal sample was dropped at the centre of a Petri-dish followed by pouring of the nutrient agar using the pour plate method as described by Mumtaz *et al.* (1986). It was allowed to solidify for some minutes and then incubated at 37 °C for 24 hours. The colonies that emerged were counted and calculation for the colony forming units were expressed as log cfu/ml using the formula as described by Rukayya *et al.* (2016). The bacterial colonies that developed on the nutrient agar plates were sub-cultured by streaking on freshly prepared nutrient agar plates and MacConkey agar plates until pure colonies were obtained according to the conventional procedure as highlighted by (Fawole and Oso, 2001).

**Statistical Analyses:** All data collected were subjected to analysis of variance (ANOVA) using SPSS Version 17 Package and where significant differences exist, Duncan Multiple Range Test (DMRT) of the same package was used to separate the means.

### III. RESULTS

**Growth performance:** The influence of the three housing systems on the growth performance of broiler chickens indicated that all parameters measured except the initial weight were significantly ( $P < 0.05$ ) influenced by the housing systems (Table 2). Highest final weight ( $2388.00 \pm 1.44$ g), highest weight gain ( $1726.75 \pm 0.32$ g), lowest feed intake ( $3475.75 \pm 36.57$ g) and best feed conversion ratio ( $2.01 \pm 0.07$ ) were recorded in birds reared under the fold unit housing system while, lowest final weight ( $2305.00 \pm 2.96$ g), lowest weight gain ( $1638.75 \pm 3.66$ g), highest feed intake ( $3609.75 \pm 14.29$ g) and highest feed conversion ratio ( $2.20 \pm 0.06$ g) were recorded in birds under the deep litter system. In all, the weight gain and feed intake values followed a particular trend.

Table 2: Growth performance of broiler chickens reared under three different housing systems

Parameters	Deep litter	Colony cage	Fold unit
Initial weight (g)	$666.25 \pm 1.01$	$662.50 \pm 0.87$	$661.75 \pm 1.76$
Final weight (g)	$2305.00 \pm 2.96^b$	$2307.50 \pm 3.50^b$	$2388.00 \pm 1.44^a$
Weight Gain(g)	$1638.75 \pm 3.66^c$	$1645.00 \pm 3.06^b$	$1726.75 \pm 0.32^a$
Feed Intake(g)	$3609.75 \pm 14.29^a$	$3480.75 \pm 12.25^b$	$3475.75 \pm 36.57^b$
Feed Conversion Ratio	$2.20 \pm 0.06^b$	$2.11 \pm 0.05^a$	$2.01 \pm 0.07^a$

\*Means without identical superscripts in the same horizontal row are significantly different ( $P < 0.05$ )

**Relative organ weights:** The relative organ weights of broiler chickens reared under three different housing systems are presented in Table 3. Among all the relative organs measured, only the heart was not significantly ( $P>0.05$ ) influenced by the housing systems. Highest gizzard ( $17.78\pm 7.89\text{g/kg}$  body weight), highest lungs ( $5.48\pm 0.18\text{g/kg}$  body weight) and highest proventriculus ( $4.81\pm 0.38\text{g/kg}$  body weight) were observed in birds reared under the deep litter system while lowest gizzard ( $14.31\pm 1.85\text{g/kg}$  body weight), lowest lungs ( $4.46\pm 0.63\text{g/kg}$  body weight) and lowest proventriculus ( $3.41\pm 0.23\text{g/kg}$  body weight) were observed in birds

reared under the colony housing system. Highest pancreas ( $2.71\pm 0.20\text{g/kg}$  body weight) and highest spleen ( $2.09\pm 0.36\text{g/kg}$  body weight) were recorded in birds reared under the fold unit housing system while the lowest pancreas ( $2.40\pm 0.09\text{g/kg}$  body weight) and lowest spleen ( $1.00\pm 0.24\text{g/kg}$  body weight) were recorded in birds reared under the colony housing system. Numerically, highest heart ( $4.69\pm 0.63\text{g/kg}$  body weight) was observed in birds reared under the deep litter system while lowest heart ( $3.94\pm 0.70\text{g/kg}$  body weight) was recorded in birds reared under the colony housing system.

Table 3: Relative organ weight (g/kg Body Weight) of broiler chickens raised under three different housing systems.

Parameters	Deep litter	Colony cage	Fold unit
Dressed Weight (%)	$92.66 \pm 1.06$	$95.96 \pm 1.00$	$91.45 \pm 0.52$
Eviscerated Weight (%)	$77.81 \pm 1.41$	$78.47 \pm 1.19$	$77.46 \pm 0.56$
Liver (g/kg Body Weight)	$17.39 \pm 3.34^a$	$14.94 \pm 0.70^b$	$17.83 \pm 2.30^a$
Heart (g/kg Body Weight)	$4.69 \pm 0.63$	$3.94 \pm 0.70$	$4.03 \pm 0.94$
Gizzard (g/kg Body Weight)	$17.78 \pm 7.89^a$	$14.31 \pm 1.85^b$	$16.55 \pm 2.47^{ab}$
Lungs (g/kg Body Weight)	$5.48 \pm 0.18^a$	$4.46 \pm 0.63^b$	$5.03 \pm 0.80^{ab}$
Pancreas (g/kg Body Weight)	$2.69 \pm 0.44^{ab}$	$2.40 \pm 0.09^b$	$2.71 \pm 0.20^a$
Proventriculus (g/kg Body Weight)	$4.81 \pm 0.38^a$	$3.41 \pm 0.23^c$	$4.05 \pm 0.32^b$
Spleen (g/kg Body Weight)	$1.14 \pm 0.21^b$	$1.00 \pm 0.24^b$	$2.09 \pm 0.36^a$

\*Means without identical superscripts in the same horizontal row are significantly different ( $P<0.05$ )

**Haematological indices:** The haematological indices of broiler chickens reared under the three different housing systems are presented in Table 4. Among all the parameters measured, Red blood cell, Mean corpuscular haemoglobin, Mean corpuscular volume, Lymphocytes, Heterophils and Monocytes were significantly ( $P<0.05$ ) influenced by the housing systems. Highest Red blood cell ( $2.02\pm 0.17\times 10^6/\text{mm}^3$ ), highest Mean corpuscular haemoglobin ( $49.1\pm 0.17\text{pg}$  of Hb), highest Mean corpuscular volume ( $146\pm 0.05\mu^3$ ) and highest Lymphocytes ( $60.75\pm 0.49\%$ ) were recorded in birds reared under colony housing system while, lowest Mean corpuscular haemoglobin ( $45.0\pm 0.08\text{pg}$  of Hb), lowest Mean corpuscular volume ( $137\pm 0.03\mu^3$ ) were recorded in birds reared under the conventional deep litter housing system and lowest Red blood cell ( $1.20\pm 0.11\times 10^6/\text{mm}^3$ ),

and lowest Lymphocytes ( $57.00\pm 2.35\%$ ) were recorded in birds reared under the fold unit housing system. Highest Erythrocyte sedimentation rate ( $2.75\pm 0.25\text{mm/hr}$ ) was recorded in bird reared under the conventional deep litter housing system while lowest Erythrocyte sedimentation rate ( $2.25\pm 0.49\text{mm/hr}$ ) was recorded in bird reared under the fold unit housing system. Highest Packed cell volume ( $28.75\pm 1.03\%$ ) was recorded in bird reared under the colony housing system while lowest Packed cell volume ( $27.25\pm 0.63\%$ ) was recorded in bird reared under the fold unit housing system. Highest Mean cell haemoglobin concentration ( $33.61\pm 0.23\%$ ) was recorded in bird reared under the fold unit housing system while lowest Mean cell haemoglobin concentration ( $32.64\pm 0.37\%$ ) was recorded in bird reared under the colony housing system.

Table 4: Haematological indices of broiler chickens raised under different housing system

Parameters	Deep litter	Colony cage	Fold unit
Erythrocyte sedimentation rate (mm/hr)	2.75 ± 0.25	2.50 ± 0.29	2.25 ± 0.49
Packed cell volume (%)	27.55 ± 0.49	28.75 ± 1.03	27.25 ± 0.63
Red blood cell (x10 <sup>6</sup> /mm <sup>3</sup> )	1.99 ± 0.04 <sup>a</sup>	2.02 ± 0.17 <sup>a</sup>	1.20 ± 0.11 <sup>b</sup>
Haemoglobin (g/100ml)	9.25 ± 0.09	9.58 ± 0.34	9.35 ± 0.21
Mean cell haemoglobin concentration (%)	33.36 ± 0.22	32.64 ± 0.37	33.61 ± 0.23
Mean corpuscular haemoglobin (pg of Hb)	45.0 ± 0.08 <sup>b</sup>	49.1 ± 0.17 <sup>a</sup>	48.4 ± 0.15 <sup>a</sup>
Mean corpuscular volume (μ <sup>3</sup> )	137 ± 0.03 <sup>b</sup>	146 ± 0.05 <sup>a</sup>	141 ± 0.05 <sup>ab</sup>
Lymphocytes (%)	58.75 ± 0.63 <sup>b</sup>	60.75 ± 0.49 <sup>a</sup>	57.00 ± 2.35 <sup>b</sup>
Heterophils (%)	25.75 ± 0.48 <sup>a</sup>	23.25 ± 0.49 <sup>b</sup>	24.50 ± 0.87 <sup>ab</sup>
Monocytes (%)	10.75 ± 0.48 <sup>b</sup>	11.25 ± 0.63 <sup>b</sup>	12.75 ± 0.25 <sup>a</sup>
Basophils (%)	0.88 ± 0.13	0.65 ± 0.22	0.75 ± 0.14
Eosinophil (%)	2.25 ± 0.48	2.75 ± 0.25	2.25 ± 0.25

\*Means without identical superscripts in the same horizontal row are significantly different (P<0.05)

**Bacteria load:** Figure 1 shows the total bacteria load of birds reared under the three housing systems. From the figure, bird reared under colony housing system had the highest bacteria load count (108×10<sup>6</sup>CFU), this is due to the fact that the cages were stationary during the

experimental period, followed by bird reared under fold unit housing system with total bacterial value (102×10<sup>6</sup>CFU) and the lowest total bacterial load count (98×10<sup>6</sup>CFU) was observed in bird reared under the conventional deep litter housing system.

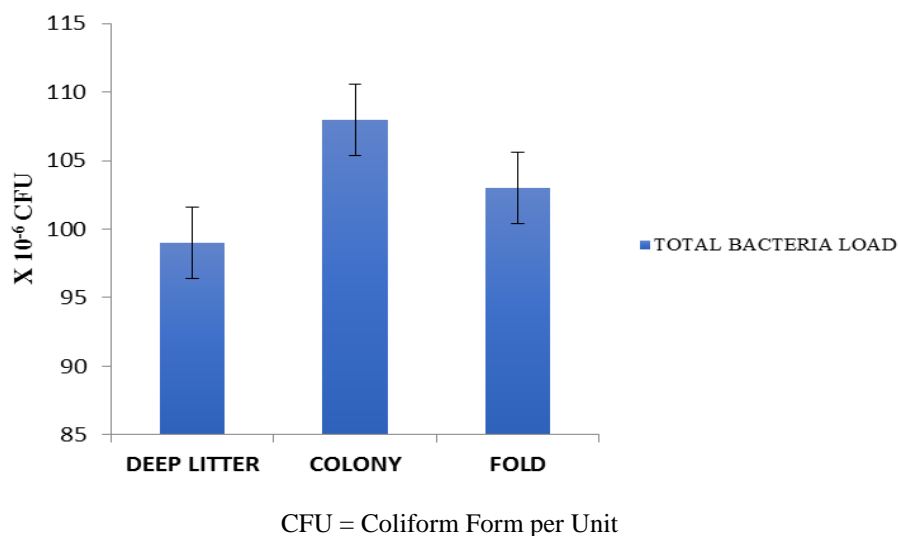


Fig.1: Total bacteria load of started broiler chicks raised under three different housing systems

**Economic analysis:** The economic analysis of started broiler chicks reared under three different housing systems. From the table only the cost of started chick (₹700) was the same across the treatments. The cost of feed consumed, cost of drugs and cost of construction varied with regard to the housing system thereby leading to different values of cost of production. Highest cost of

feed consumed (534.28₹/bird), highest cost of drugs (180₹/bird), highest cost of construction (340.67₹/bird) and highest total cost of production (1754.95₹/bird) were observed in birds reared under the conventional deep litter housing system while lowest cost of feed consumed (509.00₹/bird), lowest cost of drugs (130₹/bird), lowest cost of construction (136.67₹/bird) and lowest total cost



of production (1475.65N/bird) were observed in birds reared under the fold unit housing system. Highest total sales price (2196.00N/bird) and highest net profit (720.35N/bird) were recorded in birds reared under the fold unit housing system while lowest total sales price

(2115.00N/bird) was observed in bird reared under the colony housing system and lowest net profit (405.05N/bird) was recorded in bird reared under the conventional deep litter housing system (Table 5).

Table 5: Economic analysis of started broiler chick reared under three different housing systems

Parameters	Deep litter	Colony cage	Fold unit
Cost of started chicks	700.00	700.00	700.00
Cost of feed consumed (N/bird)	534.28	515.00	509.00
Cost of drugs (N/bird)	180.00	150.00	130.00
Cost of construction (N/bird)	340.67	150.00	136.67
Total cost of production(N/bird)	1754.95	1515.00	1475.65
Live weight(kg)	2.40	2.35	2.44
Selling price/kg	900.00	900.00	900.00
Total sales price(N/bird)	2160.00	2115.00	2196.00
Net profit (N/bird)	405.05	600.00	720.35

\*As at the time of this study 25 kg bag of broiler finisher was sold at N3700

#### IV. DISCUSSION

The floorless housing systems used in this present study was designed for small-scale/backyard poultry farmers. Small groups (10 - 50 birds), controlled stocking rates and effective protection from predators make the system very suitable for small scale or backyard poultry farmers. The final weight according to production systems was in ascending order i.e from treatments deep litter – fold unit which was not in agreement with the report of Bunyamin *et al.*, (2011) who reported that the average body weight of conventional bird was higher than organic control group. The results also contradicted the observations of Castellini *et al.*, (2002) who reported that outdoor organic treatments reduced growth rate when compared to conventional system. The highest feed consumed in bird reared under the deep litter housing system was compatible with findings of Bunyamin *et al.*, (2011) who reported that the highest cumulative feed intake of the deep litter system as compared with birds on outdoor systems. Also from the results of this study on feed intake, birds on colony and fold unit housing systems consumed less when compared with those in deep litter housing system. This may also be as a result of birds access to other forages within their range/pen which they also consumed and birds on deep litter housing system do not have access to such forages which makes them to concentrate mainly on given feed thereby leading to high feed intake. Also, birds on colony and fold unit housing systems consume herbs, roots, stems, leaves and

invertebrates; practicing poultry with green matter can reduce the supplementation of dietary vitamins and minerals, support gut fill and can be used as enrichment device Sossidou *et al.* (2015). The result obtained in this study shows that the birds on the three housing systems have the ability to turn feed to body mass. Quality of product output for the system is fixed by a predetermined amount of kilogram carcass of live weight of broiler chickens from shed by a commercial producer (Warren and Emmert, 2000). Dressed weight and eviscerated weight of birds were not significantly different across the three housing systems and these agreed with Castellini *et al.* (2002) reports which stated dressing percentages were similar in both systems.

Haematological indices i.e Red blood cell, white blood cell, packed cell volume and haemoglobin concentration has been found useful in disease prognosis according to Togun and Oseni, (2005). The packed cell volume recorded in this study ranged between 27.23 – 28.75% and this falls within the normal range of 25 – 75% for chickens as reported by Akinmutimi (2004) and Ahamefule *et al.* (2006). Packed cell volume below normal range is an indication of anaemia. The haemoglobin concentration values recorded in this study fell within the reference values of 8.23 to 11.30 g/dl, reported for healthy broiler chickens (Olukomaiya *et al.*, 2014). There was no significant difference in the red blood cell and erythrocyte sedimentation rate of birds under the three housing systems. The heterophils which

are granulocytes of the white blood cell fell within the reference values of 10.00 to 53.60% and 0.00 to 15.00%, respectively for healthy domestic chickens (Riddell 2011). The lymphocyte is granulocytes of the white blood cell fell within the reference values of 47.2 to 85.0% (Riddell 2011) for healthy domestic chickens. The basophils obtained in this study agree with the values of 0.00 to 3.33% (Olukomaiya *et al.* 2014). The basophil values obtained suggest that there was no condition of prolonged stress. Basophils are responsible for the elaboration of histamines and heparin in circulating blood (Afolabi *et al.* 2011). The non-significant effect of different housing systems on haematological parameters of broiler chickens could be due to similar conditions of animal husbandry system used for raising the birds (Addass *et al.* 2012). The housing systems used produced no significant difference in relation to haemoglobin concentration values. This corroborates the finding of Addass *et al.* (2012) who observed same results in relation to haemoglobin concentration of the chickens that were studied. All mean values of red blood cell counts, packed cell volume and haemoglobin concentration did not differ significantly among management systems which corroborate the finding of Nyaulingo (2013).

The presence of *Staphylococcus aureus* may be due to staphylococcus from environmental factors. *Micrococcus lutes* is a gram positive spore forming bacteria and heat resistant (David, 2005). Soil, humans and birds are reportedly considered as reservoirs of most of all these organisms (Fitzgerald *et al.*, 2001, Bannerman and Peacock, 2007). *Enterobacter aerogenes*, an opportunist bacterium was present in colony housing system, there are rare reports of the bacteria causing any diseases in healthy animals, *Serratia marcescens* was also present in fold unit housing system, and this also is no cause for concern as it leads to no disease in healthy animals.

The absence of *Enterobacteriaceae* family in the fold unit housing system may be associated with antibacterial activity of phytogenic plant they consumed (Bankova *et al.*, 2007). It is noteworthy that few studies exist that have assessed the correlation of bacterial population in the gastro intestinal tract (GIT) with blood parameters of broiler chickens under different management systems. The present study has confirmed the heterogeneity of bacterial population (gram positive and gram negative) in the GIT of broiler chickens as documented by Gong *et al.* (2002). The diversity of bacterial distribution may probably be due to the interactions of host's tissues/cells and gut microbiota. The bacterial load did not show any significant effect on the three housing systems.

The total cost of production was highest in the conventional deep litter housing system and lowest in the fold unit housing system and this led to bird reared under the fold unit housing system recording the highest net profit over the bird reared under the conventional deep litter housing system and this simply means that backyard farmers using the fold unit housing systems will have more cash than farmers using the conventional housing system.

## V. CONCLUSION

Based on the findings, an inference could, thus, be drawn from the present study that broilers reared on floorless pastured pen exhibited better growth performance with optimum feed intake leading to best feed conversion ratio as compared to those reared under deep litter housing system. The summarized results presented here support the view that there is a promising potential for backyard farmers especially those rearing broiler chickens for Christmas and New Year festival periods. Weekly movement of the fold unit pens do not support coccidiosis outbreak.

## ACKNOWLEDGEMENT

The authors are grateful to the Managing Director of Oluade Farms, Ilara Mokin, Ondo state, Nigeria for making some facilities available for this study.

## REFERENCES

- [1] ADDASS, P.A., D.L. DAVID, A. EDWARD, K.E. ZIRA and A. MIDAU (2012). "Effect of Age, Sex and Management System on Some Haematological Parameters of Intensively and Semi-Intensively kept Chicken in Mubi, Adamawa State, Nigeria." *Iranian Journal of Applied Animal Science* 2(3): 277-282.
- [2] AFOLABI, K.D., A.O. AKINSOYINU, A.R.O. ABDULLAH, R. OLAJIDE and S.B. AKINLEYE (2011). "Haematological Parameters of the Nigerian Local Grower Chickens Fed Varying Dietary Levels of Palm Kernel Cake". *Poljoprivreda* 17(1): 74-78.
- [3] AKINMUTIMI, A.H. (2004). Evaluation of sword bean (*Canavalia gladiata*) as alternative feed resources for goat production. PhD Thesis. Michael Okpara University of Agriculture, Umudike, Nigeria.
- [4] BANKOVA, V., M. POPOVA and B. TRUSHEVA (2007). "Plant Origin of Propolis: Latest Developments and Importance for Research and Medical Use". In *Apicultura – De la stiinta la agribusiness si apiterapie* edited by Margitas, L.A. and D. Dezmirean, 40-46. Cluj Napoca: Editura Academic Press.

- [5] BANNERMAN, T.L. and PEACOCK, S.J. (2007) Staphylococcus, Micrococcus, and Other Catalase-Positive Cocci. In: Murray, P.R., Baron, E.J., Jorgensen, J.H., Landry, M.L. and Pfaller, M.A., Eds., Manual of Clinical Microbiology, ASM Press, Washington DC, 390-404.
- [6] CASTELLINI, C., MUGNAI, C. and DAL BOSCO, A. (2002) Effect of organic production system on broiler carcass and meat quality. *Meat Sci.* 60:219–225. doi: 10.1016/S0309-1740(01)00124-3
- [7] DAVID O. A. (2005). Meat and milk hygiene. Farm Coe press, University of Ibadan.
- [8] DAWKINS, M. S., DONNELLY C. A., and JONES, T. A. (2004). Chicken welfare is influenced more by housing conditions than by stocking density. *Nature* 427, 342-344.
- [9] FAWOLE, M. O. and OSO, B. A. (2001). Laboratory Manual of Microbiology. Rev. ed. Ibadan: Spectrum Books.
- [10] FITZGERALD J. R., STURDEVANT D. E., MACKIE S. M., GILL S. R. and MUSSER J. M. (2001): Evolutionary genomics of *Staphylococcus aureus*: insights into the origin of methicillin-resistant strains and the toxic shock syndrome epidemic. *Proc Natl Acad Sci U S A.* 98(15):8821-6.
- [11] GONG, J., R.J. FORSTER, H. YU, J.R. CHAMBERS, R. WHEATCROFT, P.M. SABOUR and S. CHEN. (2002). “Molecular Analysis of Bacterial Populations in the Ileum of Broiler Chickens and Comparison with Bacteria in the Cecum”. *FEMS Microbiology Ecology* 41:171-179.
- [12] JONES, T. A., DONNELLY, C. A. and DAWKINS, M.S. (2005). Environmental and management factors affecting the welfare of chickens on commercial farms in the United Kingdom and Denmark stocked at five densities. *Poult. Sci.*, 84, 1155-1165.
- [13] JULIAN, R.J. (2005). Production and growth related disorders and other metabolic diseases of poultry - a review. *Veterinary journal.* 169, 350-369.
- [14] MAXWELL, M. H., G. W. ROBERTSON, S. SPENCE and C. C. MCCORQUODALE (1990). “Comparison of Haematological Values in Restricted and *Ad libitum* Fed Domestic Fowls: White Blood Cells and Thrombocytes.” *British Poultry Science* 31:399-405.
- [15] MUMTAZ, B., ZAFAR, A. and ABDUL, B. (1986). Quantitative and qualitative microbial load determination from meat samples effected by time and temperature. *Journal of Pakistan Medical Association.* pp. 90-93.
- [16] Nutrient requirements of poultry (1994). Ninth revised edition, Board on Agriculture. *National Academy press, Washington, D. C*
- [17] NYAULINGO, J. M. (2013). “Effect of Different Management Systems on Haematological Parameters in Layer Chicken.” MSc. Dissertation, Sokoine University of Agriculture, Morogoro, Tanzania. pp. 29-35.
- [18] OLUKOMAIYA, O. O., O. A. ADEYEMI, O. M. SOGUNLE, M. O. ABIOJA, P. O. IWUCHUKWU and U.P., EMUVEYAN (2014). “Effects of Feed Restriction and Ascorbic Acid Supplementation on Haematological Parameters of Marshall Broiler Chickens.” *Indian Journal of Innovations and Developments* 3(2): 18-22.
- [19] OYINLOYE, M. A. (2013). Monitoring spatial growth of educational institution using GIS: A focus on Federal University of Technology Akure, Nigeria. *American Journal of Humanities and Social Sciences*, 1(3): 163-173.
- [20] RIDDELL, C. (2011). “Comparative Anatomy, Histology and Physiology of the Chicken.” Department of Pathology, Western College of Veterinary Medicine, University of Saskatchewan, Saskatoon, Saskatchewan, Canada S7N 0W0. pp.37. [http://cal.vet.upenn.edu/projects/poultry/Syllabus/page37\\_44.htm](http://cal.vet.upenn.edu/projects/poultry/Syllabus/page37_44.htm)
- [21] RUKAYYA, H. M, ZAINAB, J. A, CLEMENT, A. Y, MUSA, B. B, and ADEDAYA, M. R. (2016). Assessment of Bacteria associated with ready-to-eat food sold at Federal University of Dutse, Jigawa State. Nigeria International Journal of Current Research in Bioscience and Plant Biology 3(4): 5-14.
- [22] SOSSIDOU, E. N., DAL BOSCO A., CASTELLINI C. and GRASHORN, M. A. (2015). Effects of pasture management on poultry welfare and meat quality in organic poultry production systems. *World's Poultry Science Journal.* Vol. 71: 375 – 384
- [23] TOGUN, V.A and OSENI, B.S.A. (2005). Effect of low level inclusion of biscuit dust in broiler finisher diet on pre-pubertal growth and some haematological parameters on unsexed broilers. *Res. Comm. Anim. Sci.* 25(1): 22 - 24.
- [24] WARREN, W. A. and EMMERT, J. L. (2000). Efficacy of phase-feeding in supporting growth performance of broiler chicks during the starter and finisher phases. *Poultry Science* 79: 764 – 770