EFFECTS OF STOCKING DENSITY AND SEASON ON THE GROWTH PERFORMANCE AND WELFARE OF BROILER CHICKENS IN IBADAN, NIGERIA.

T. I. ADEMULEGUN[1], G. O. ADEYEMO[2] AND A. E. SALAKO[2]
[1]*Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria*
[2]*Department of Animal Science, University of Ibadan, Ibadan, Oyo State, Nigeria.*
Correspondence: tadext4@gmail.com

ABSTRACT
The study was carried out to investigate the effects of season and stocking density on the growth performance and welfare of broiler chickens in Ibadan, Nigeria. In a seven-week feeding trial, a total of 96 one-week old Arbor Acre broiler chickens were randomly distributed to three stocking densities (birds/m^2) of 10, 12, and 14 at the rate of 32 birds per stocking density (SD) during each season; Late Wet (LWS) and Late Dry (LDS). Total Feed Intake (TFI, g), Final Live Weight (FLW, g), Feed Conversion Rate(FCR), Live weight/m^2(LW/m^2), Normal Gait Score(NGS,%), Survival Rate(SR %), Heterophil: Lymphocyte(H:L) ratio, were assessed. Data were subjected to statistics analysis (ANOVA at $\alpha_{0.05}$). Birds raised during LWS had higher TFI (4756.60) than LDS birds, while SD had no effect on TFI. Birds on SD of 14 birds/m^2 had lower FLW. The FCR was lower during LDS and on SD 10 and 12birds/ m^2. The LW/m^2 was higher in birds on SD 14birds/m^2. The LWS had higher NGS and lower H:L ratio. Season and SD had no effect on SR. The NGS and H: L were not affected by SD. Broiler chickens could be raised at stocking density of 14birds/m^2 during either of the seasons.
Keywords: Season, stocking density, performance, welfare.

INTRODUCTION
The physical environment of farm animals inside livestock buildings is determined by hygrothermal variables, such as temperature, humidity, air quality and stocking density (Schauberger *et al.*, 2000). They play an important role for improving the performance and welfare of the animals (Garcimartin *et al.*, 2007). Animal welfare is defined as the physical and physiological state of an animal as regard to its attempt to cope with the environment (Edward, 2004). The combination of high ambient temperature(AT) and relative humidity (RH), as obtained in the humid tropics, continues to cause major environmental distress in poultry, reduces production efficiency, increase endogenous heat production and overloads the birds' thermo-regulatory mechanism (Ajakaye *et al.*, 2010). In broiler production, stocking density is very important welfare factor. Trend of decrease of the growth rate in broilers registered in high stocking densities, as well as parameters of production performance, present significant indicator of welfare (Dozier *et al.*, 2005). Changes in the physical environment and the development of more productive genotypes called for constant research into the effects of the physical environment on the performance and welfare of the animals.

MATERIALS AND METHODS
The experiment was conducted at the poultry unit of the teaching and research farm, University of Ibadan, Ibadan, Nigeria. The periods of the experiment were; August to November [Late wet season (LWS)} with temperature(AT) and relative humidity(RH) ranges of 22.10^0 C - 32.20^0 and 55-95% respectively and February to April [Late dry season (LDS)] with AT range of 23.10-36.70^{0}C and RH of 30-95%. In each of the season, 96 one-week old Arbor acre commercial broiler chickens were randomly distributed into the three stocking densities (10, 12, and 14birds/ m^2) with 0.05m^2 per bird for drinkers and feeders. Birds were distributed at 8birds in 4 replicates per stocking density (SD). They were fed broiler starter diet with 23.03% crude protein and 3196kcal/ kg ME and finisher diet containg 20.11% crude protein and 3231kcal/kg ME. The Birds were housed in an open sided house. Thermo hygrometers were placed at strategic points in the house to monitor temperature and relative humidity. Vaccination and medication were administered as recommended by the

hatchery operator. Feed and water were supplied *ad libitum*. Records of feed intake and birds' weight were taken weekly, while mortality record was taken daily. The experiment lasted for seven weeks. The welfare status was determined by measuring the following parameters:

Gait Score: This measures the walking ability of the birds. It was assessed by subjectively assigned; 0= normal gait; 1= abnormal gait; 2= lameness (Dozier *et al*., 2005).The scoring was done per pen by three individuals observation.

Survival Rate: This was determined from daily mortality record.

Heterophil: Lymphocyte (H: L) Ratio: This was determined from the microscopically counted leucocytes (WBC) by dividing the percentage of heterophil with the percentage of lymphocytes.

Serum Glucose: was determined according to Slot (1965) and **Cholesterol** by the method of Roschlan *et al*. (1974).

Statistical Analysis

Data generated during the two seasons were subjected to analysis of variance using General Linear Model (GLM) of SAS software 9.2(SAS 2008). Significantly different means were separated using Duncan Multiple Range (DMR) test, with level of significance set at $p < 0.05$.

RESULTS AND DISCUSSION

Table 1 shows the growth performance of broiler chickens as influenced by season and stocking density. There was no significant difference in the final live weight (FLW) of the birds between the seasons (P> 0.05). The FLW of birds on SD 14 birds/m^2 was lower (p<0.05) than that of birds on SD 10 birds/m2 and 12 birds/m^2 that were similar. The total feed intake (TFI) was significantly higher during late wet season (LWS) than late dry season (LDS), however SD had no effect on TFI. The FCR was better during LDS and on stocking densities 10 and 12 birds/m^2. The lower feed intake during LDS was in agreement with the observation of Abu-Dieyeh (2006) , and it's due to the fact that high ambient temperature causes hyperthermia in the body, which reduces the activity of the appetite centre in the medulla oblongata and animals react by reducing physical activity and spend less time eating (Laszlo *et al*., 2011). The non-significant difference of TFI among the SD was due to the sumptuous feeding and drinking spaces provided in all the stocking densities. The reduced activity associated with higher ambient temperature (Collin *et al*., 2001), contrary to the aggressiveness during lower temperature must have contributed to the productive utilization of feed and nutrient intake for growth by birds during LDS. The lower FLW observed in birds on SD 14 birds/m^2 must have been due to the inability of the birds to liberate enough heat for optimum growth. The LW/m^2 increased linearly with each increase in stocking density. Late wet season (LWS) had higher (91.77%) normal gait score (NGS) and lower Heterophil: Lymphocyte ratio (H:L) than LDS (Table 2). Serum glucose and cholesterol levels were also higher during LWS (P<0.05). Birds on SD 14 birds/m^2 had lower serum glucose and cholesterol than birds on 10 birds/m^2. Survival rate (SR) was not affected by season or stocking density. Additionally, SD had no significant effect on H:L ratio, NGS and SR. The lower NGS during LDS is a consequence of the reduced exercise of the legs, since broilers subjected to high environmental temperatures rest more and reduce their physical activity in order to lower heat production (Collin *et al*., 2001). The higher H:L during LDS is in consonance with the observed increase in H:L during summer by Huwaida *et al*., (2013). The lower serum glucose and cholesterol levels were in agreement with the observation of Ogah *et al*. (2014) and must have been due to increase in energy expenditure associated with respiratory muscular activity due to panting.

CONCLUSION:

The seasonal climatic elements in Nigeria are stressful. From physiological and welfare aspects, stocking density of up to 14 birds/m^2 with 0.05m^2 for feeders and drinkers per bird did not represent cause of stress at average ambient temperatures of 27.79°C to 29.62°C and relative humidity of 70.82% to 75.12%.

REFERENCES

Abu- Dieyeh, Z. H.M; (2006). Effect of high temperature per se on growth performance of broilers. Int. J. Poult. Sci., 5(1): 19-21. http//www.pjbs.org/ijps/fin489.pdf.

Ajakiaye, J.J., Perez- Bello, A., Cuesta- Mazorra, M., Garcia- Diaz, J.R., Mollineda- Trujillo A.

(2010). Effects of vitamin C and E dietary supplementation on erythrocyte parameters of layer chickens reared in high ambient temperature and humidity. *Brazilian Journal of Poultry Science*. V12/ n, 3/ 205-209.

Collin, A., Van Milgen, J., Dubois, S.and Noblet, J. (2001). Effect on high temperature feeding behaviour and heat production in group housed young pigs. *British Journal of Nutrition* Vol. 86:63-70 ISSN: 0007– 1145.

Dozier, W.A., Thaxton, J.P., Branton, S.L., Morgan, G.W., Miles, D.M., Roush, W.B., Lott, B.D. and Vizzier-Thaxton, Y. (2005). Stocking density effect on growth performance and processing yield Of Heavy Broilers. *Poultry Science* 84: 1332-1338

Edward, D.J. (2004). The role of Veterinarian in animal welfare: a global perspective. Proceeding of the global conference in animal welfare and OIE initiative. Paris, 23-25 February, 2004 pp.37-49.

Garcimartin, M.A., Ovejero, I., Sanche, E. and Sanchez-Giron, V. (2007). Application of the sensible heat balance to determine the temperature tolerance of commercial Poultry housing. *World's Poultry Science Journal* Vol.63: 575-584.

Huwalda, E.E., Malik, O.H.A., Mohamed, E.A.A. and Yousif, I.A. (2013). Effect of season and dietary Protein level on immune response of three exotic broiler strains in Sudan. Online *Journal of Animal Feed Resources* 3(1):31-35.

Laszlo, B., Veronika, H. and Martin, W.A.V. (2011). Impacts of climate change on animal production and quality of animal food products. Climate change. Socio -economic effects, Dr Houshan kheradmand (Ed.), ISBN: 978-953-307-411-5, In Tech, 165-190

Schauberger, G., Piringer, M.and Petz, E. (2000). Steady- state balance model to calculate the indoor climate of livestock buildings demonstrated for finishing pigs. *International Journal of Biometeorology* 43:154-162.

Table 1 Effects of Season and Stocking Density on Growth Performance of Broiler Chicken

Main Effects	FLW (g/bird)	TFI (g/bird)	WG (g/bird)	FCR	LW/m² (kg)
Season					
LWS	2210.97	4756.60^a	2169.47	2.16^b	25.57
LDS	2225.72	4568.50^b	2186.89	2.06^a	25.11
SEM	13.00	24.91	13.01	0.01	0.34
SD(bird/m²)					
10	2241.17^a	4680.79	2201.01^a	2.10^a	21.68^c
12	2253.25^a	4695.05	2213.09^a	2.09^a	25.76^b
14	2157.11^b	4608.81	2116.94	2.14^b	28.86^a
SEM	13.00	24.91	13.01	0.01	0.34
Interraction					
Season x SD					
P-value	0.03	NS	0.03	0.02	NS

a,b,c,d: Means on the same column with different superscripts are significantly different($p<0.05$).
LDS: Late Dry Season; LWS: Late Wet Season. SEM: Standard Error of Mean, SD: Stocking Density; FCR: Feed Efficiency Ratio; FLW- Final Live Weight; TFI- Total Feed Intake; WG- Weight Gain; NS- Not significant ($P>0.05$)

Table 2 Effects of Season and Stocking density on some Welfare Parameters of Broiler Chickens

Main Effect	NGS (%)	SR (%)	H:L	CHOL (mg/dl)	GLU (g/dl)
Season					
LDS	80.70b	94.97	0.72a	87.71b	139.91b
LWS	91.77a	96.35	0.31	147.82a	160.81
SEM	0.94	0.63	0.03	3.37	2.96
SD(bird/m^2)					
10	85.09	96.00	0.53	119.47a	162.97a
12	87.85	95.31	0.52	122.60a	146.91b
14	85.78	95.65	0.63	111.36b	141.11b
SEM	0.94	0.63	0.03	3.37	2.96
Interraction					
Season x SD					
P-value	**NS**	**NS**	**NS**	**NS**	**0.0029**

a,b,c,: Means on the same column with different superscripts are significantly different($p<0.05$). SEM: Standard Error of Mean, SD: Stocking Density; SR: Survival Rate; H:L: Heterophil:Lymphocyte ratio; NGS: Normal Gait Score; CHOL-Cholesterol; GLU- Glucose;LWS- Late Wet Season; LDS-Late Dry Season; NS- Not significant ($P>0.05$)