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Effect of Weather Parameters on Adaptability and Performance of Broiler Chicken reared during the Dry Season of North Central Nigeria

Akinlade, O. O.✉, Okusanya, P. O.
Agricultural Technology Department, The Federal Polytechnic Ilaro, Nigeria.
✉**olamilekan.akinlade@federalpolyilaro.edu.ng**

Abstract
Effect of weather parameters on strains of broiler chicken reared during the dry season of north central Nigeria was carried out to determine the adaptability and performance of the birds. 120-day-old chicks consisting of 30 Arbor Acre (T1), Marshal (T2), Anak (T3) and Cobb (T4) were used for this study, and it lasted for six weeks. Data on the temperature, feed intake and growth performance were recorded. The highest temperature of 42.00 ºC was recorded in the sixth week, and 38.8 ºC was the least temperature which was observed in the second week. The study revealed that there was no observed significant difference in the feed intake from the 1st week to the 6 th week. A sharp decrease in weight gain across the treatment was observed in 6th week when the temperature was at 42.00 ºC. At week 5 when the relative humidity was 79-51 % RH, the feed intake of T4 was reduced compared to T3, but T4 has the highest weight gain at this period which shows that it better utilizes the feed. It can be concluded that T4 was well adapted to temperature and relative humidity variations having the highest weight gain and feed conversion values.

***Keywords**:* Boiler, dry season, north central, relative humidity, weight gain

INTRODUCTION

Poultry birds are domestic Duck, Fowl, Ostrich, Turkey, Goose among others which are important economically to man. Their products contribute to human food in many ways especially, as source of protein (Demeke, 2004). At the beginning of the year 2000 all through to 2010, a great increase in broiler meat production was recorded in Africa, which is as high as 4.5 % each year, Oceania 3.7 %, Europe recorded an average of 3.9 %, and Americas 3.5 % (Govindarajan, Palanisam, AbdulRazak, Intan & Sharida, 2015). Increase in the consumption of broiler was favoured mainly because it is easily processed, cheap, and high nutrient values. It is high in protein value and readily available fats, has tendered fine fibre and its cholesterol level is low (Grabowski & Kijowski, 2004) The role poultry production plays in the economy of developing countries which Nigeria is one cannot be over emphasize, especially, broilers production, which is one of the highest producers of quality and nutritious animal protein to meet the protein requirement her populace (Apata & Ojo, 2000). Yang & Jiang (2005) said fowl rearing occupies the second position in terms of quantity, pork has the highest figure of about 29% of meat produced from farm and this is on continuous increase yearly (Mckay, Hung, Chinnan & Philips, 2001). Amos, (2006) reported that nutritionists and agriculturists have nodded the poultry industry of Nigeria as a quick means of alleviating the protein deficiency ravaging the country.

Broilers chicken are homoeothermic animals that live comfortably only in a relatively narrow zone of thermo neutrality (Shini, Kaiser, Shini, & Bryden, 2008). Menquesha, (2011), reported that changes in atmospheric condition is antagonistic to poultry production; its effect cut across the globe. The resultant consequence of these conditions is evident in nutritional quality of feeds i.e. mould build up, reduced production in-terms of products gotten, loss of volatile nutrients at high temperature, increase in disease susceptibility and disease carriers or vectors, reduction in water available for drinking, and making it extremely difficult for birds to survive (Spore, 2008). Adesoji, Farinde, and Ajayi (2006) stated that the greatest effect of weather as seen in Sub - Saharan Africa where animal production contributes forty percent (40%) of agricultural Gross Domestic Product (GDP) and support the well-being of billions of the world's poor by gainfully employing about 1.3 billion people (Food and Agricultural Organization (FAO), 2007).

Production of fast growing broiler chicken in molecular genetics results into modern species of broiler chicken which are easily affected by environmental stress which has great contribution from temperature. (Deeb & Cahaner, 2002). Genetic divergence exists between these broiler brands due to the quality of parent stock, breeding efficiency and variation in the pedigree from which the brands may have originated (Deeb & Lamont, 2002). Gwaza, Noah, & Wamagi (2013) reported that the expected genetic differences are also expected to be translated into difference in the performance of the broiler brands (feed consumption, body weight gain, feed conversion, target market weight the entire management needs as well as production cost) under humid conditions. This variation is also expected to be translated into difference in the performance of the broiler brands ((feed consumption, body weight gain, feed conversion, target market weight the entire management needs as well as production cost) under diverse environmental condition (Gwaza, Terzungwe & Egahi, 2011).

Lin et al. (2005) stated in his research that the response of broilers to humidity at varying ambient temperatures triggers heat redistribution within the system of day old chick up one week of age. Relative humidity is vital in the broiler chickens' performance; feed intake, feed conversion and subsequent weight gain are controlled by it (Yahav, 2000). Temperatures significantly influence the survivability and performance of the poultry. According to Indian Council of Agricultural Research (ICAR), (2010), as temperature increased to 34 ^{o}C and above, the birds experience heat stress which result into mortality in meat type chickens by 8.4%, the feed consumption of the chickens decreases from 108.3g/bird/day at 31.6 ^{o}C to 68.9 g/bird/day at 37.9 ^{o}C, the egg production also decreased by 6.4% as compared to their standard egg production. Razuki, Mukhils and Hamad (2007) reported that Broiler brands are expected to differ in their reaction to these effects which also affects their inputs needs, management challenges, cost of production and the expected revenues of the enterprise in relation to the effects of these variation in environmental conditions. These in turn will determine the choice of a broiler brand and efficiency of the enterprise since broiler brands differed in their genotypes. In addition, the magnitude of their genotype environmental covariance and interaction effects determining their efficiency would also vary in any production environment.

Thus, it is important to know the extent of these effects. Many studies have been conducted to evaluate the effect of the thermal environment on birds' growth performance (Leenstra, 1992; Yoon, Kenneth & Washburn, 1995); Abu-Dieyeh, (2006), still more studies are necessary to examine the adaptability of different strains to high temperature and relative humidity variations. Sandercock, Hunter, Nute, Mitchell, and Hocking, (2001) reported that keeping the environment conducive is a major factor to consider in improving broiler welfare, this can be through good ventilation, favourable humidity and temperature including other climatic/weather parameters.

In Nigeria, farmers target different festive periods like Easter, Christmas and other Muslim festival to command attractive market price because of the short cycle of production of broiler chicken. The Easter celebration which falls most at times at the fourth month of the year (April), broilers are reared from January/February to March/April which falls in dry season in the guinea savanna of Nigeria (Saliu, Audu & Okolo, 2013). This research therefore looks at the effect of weather parameters on adaptability and performance of four strains of broiler chicken reared during the dry season of north central Nigeria.

MATERIALS AND METHOD

The research was carried out at the Poultry partition of Animal Production Department, School of Agriculture and Agricultural Technology, Federal University of Technology, Teaching and Research Farm, situated at Gidan Kwano, Minna, Niger State, Nigeria. Minna experiences two seasons which are the dry and wet season i.e November to March and March to October respectively. It's altitude is 75 m above the sea level, it has a land area of about 6784 km^2 and lies between latitude 9037' north and longitude 6033' east. The mean annual rainfall is

1300 mm take from an exceptionally long record of 50years. Temperature rarely falls below 22 ^{o}Cthe peak being 40oc (February and March) and 35 ^{0}C (November and December) (Adama, Ogunbajo & Mambo, 2007). It is located in the guinea savannah or north central zone of Nigeria.

Source of the experimental birds

Four different strains of broiler day old chicks totaling one hundred and twenty (120) consisting of Anak, Marshal, Abor-acre and Cobbs were used for the experiment. The birds were purchased from a commercial hatchery outside Minna

Experimental design and management

The birds were reared intensively throughout the period of the experiment. (6 weeks). Before the birds arrived, the house was prepared according to the procedure of (Asaniyan, Agbede, and Laseinde , 2007). The drinkers and feeders were positioned; coal pot was used as a source of heat. On the arrival of the chicks, glucose and multivitamins was administered in their water as an anti-stress and to initiate fed intake. Water and feed was given ad-libitum. The birds were fed on a premium commercially prepared feed. Their house was divided into 12 pens to accommodate the four treatments and each treatment was replicated thrice with ten birds each, which T1 was arbor acre breeds, T2 was Marshal Breed, T3 was Anak breed and T4 was Cobb breed. The birds were randomly and equally allotted into four treatments in a completely randomized design (CRD) experiment. Thirty birds were allotted to each treatment and replicate thrice having 10 birds each. The birds were brooded for four (4) weeks. Routine managements which include washing of Drinkers, Feeders, provision of clean water and feed, weighing of left over and checking of sick birds. Vaccination against major disease (IBD, NCD) and other medications were strictly adhered to.

Parameters measured

Feed intake

The feed intake was measured daily for birds in each treatment and quantity consumed per day were obtained by subtracting the quantity left over from the quantity fed. Weekly record of average feed consumption per bird was also obtained for each treatment by dividing the total quantity of feed consumed by the number of birds in each treatment.

Water intake

The daily water intake for birds in each replicate was obtained by subtracting the quantity left over from the quantity given. A correction factor was taken into consideration by keeping an equal amount of water given to the birds outside the pen to determine the evaporative losses. Weekly average water consumption record per treatment was obtained for each treatment by dividing cumulative water intake of the treatment by the number of birds in each treatment

Body weight gain

The average weekly body weight gain was gotten by measuring the initial body weight of the birds using a weighing balance (Camry® - 20 kg), then, subtracting it form the average weekly body weight. This was repeated for subsequent weeks throughout the experiment where the previous weeks' weight gain serves as the initial weight gain for the new week. Body weight gain=Final body weight- Initial body weight

Feed conversion ratio (FCR)

This was calculated using the total body weight gain and feed consumed by the birds in their different treatments.

FCR=Total average feed intake/Total body weight gain

Weather Data

Weekly average weather parameter which covers the period of experiment (6 weeks) was collected at the Federal University of Technology, Minna meteorological station, School of Agriculture and Agricultural Technology Teaching and Research farm and used for the experiment.

Statistical Analysis

All data collected at the end of the experiment was subjected to analysis of variance (ANOVA) and General Linear Model (GLM) procedure of Statistical Analysis System (SAS), (2000), Duncan Multiple Range Test was used to separate the mean where there are statistical significant ($p<0.05$) differences.

RESULTS DISCUSSIONS

Average weekly temperature

Table 1 shows the average weekly values of temperature and relative humidity. Temperature was lowest at week 2 with a range of 24.21-38.80ºC and highest at week 6 with a range of 27.14 – 42.00 ºC. Relative humidity was also lowest at week 2 (36 %, 29 %) and highest at week 5 (79 %, 50 %)

Table 1: Average weekly temperature and relative humidity (RH) values

	Temperature (ºC)		Relative humidity (%)	
Week	Minimum	Maximum	**morning**	**evening (**mean**)**
1	27.02	39.71	45	31
2	24.21	38.80	36	29
3	26.35	39.85	51	39
4	25.00	41.00	55	34
5	26.28	40.14	79	51
6	27.14	42.00	73	50

Table 2: Average Water intake, Feed intake, Weight gain and Feed conversion ratio of the Broiler strains.

Parameters	T1	T2	T3	T4	SEM	LOS
Water intake (ml)	9724.2^{c}	11548.3^{b}	12698.7^{b}	14527.6^{a}	558.22	*
Feed intake (g)	4492.2^{a}	4436.0^{a}	4714.3^{a}	4509.8^{a}	47.89	
Weight gain (g)	1238.9^{c}	1244.7^{c}	1461.1^{b}	1631.6^{a}	50.30	*
FCR	3.61^{c}	3.58^{c}	3.23^{b}	2.7^{a}	0.11	*

T1: Arbor Acre
T2: Marshal
T3: Anak
T4: Cobb
SEM: standard mean of error
a – c levels or otherwise: Means with different superscript are significantly different (p<0.05)
LOS: Level of significance

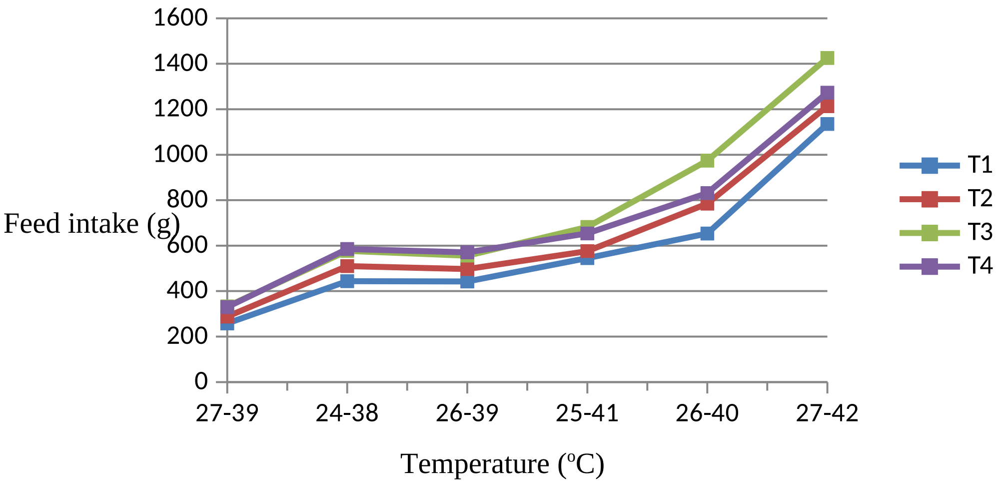

Figure 1: Line graph of Temperature against feed intake

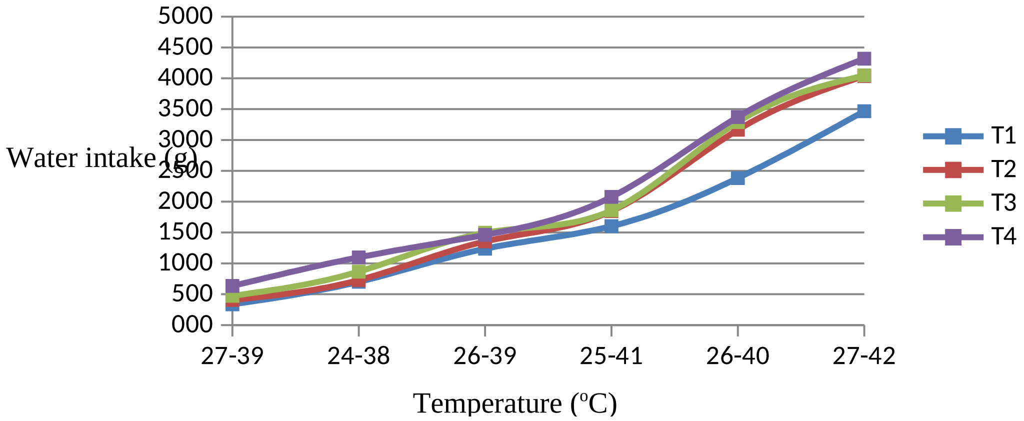

Figure 2: Line graph of Temperature against Water intake.

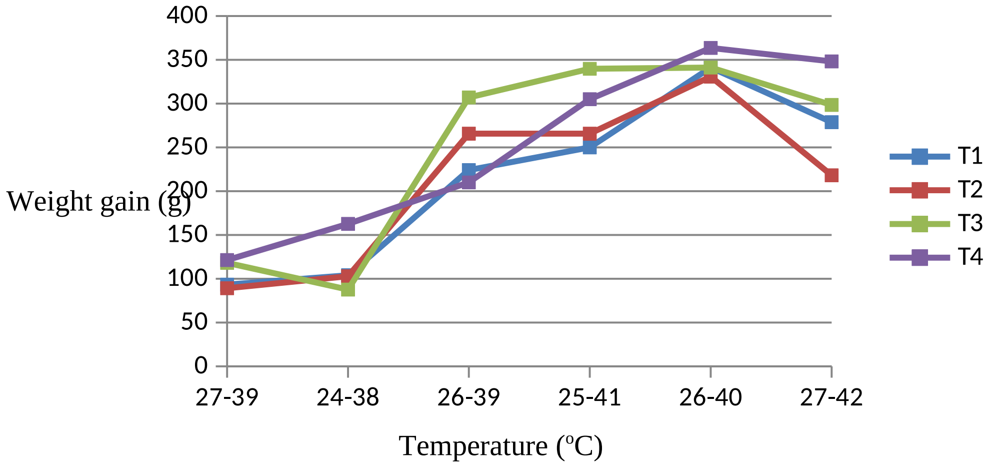

Figure 3: Line graph of Temperature against weight gain

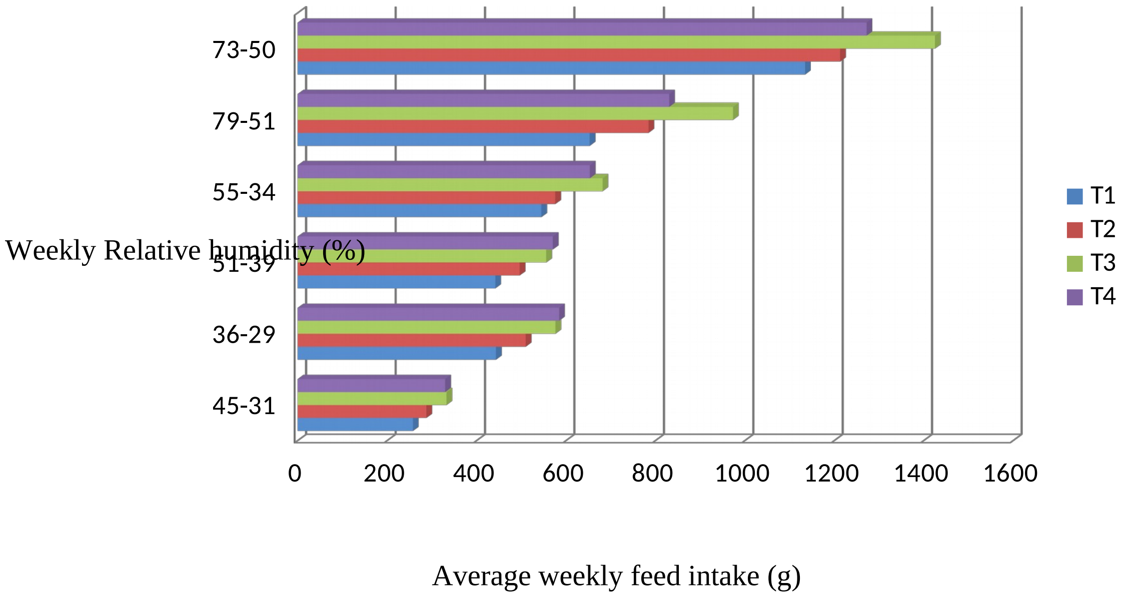

Figure 4: Bar chart of Relative humidity and feed intake

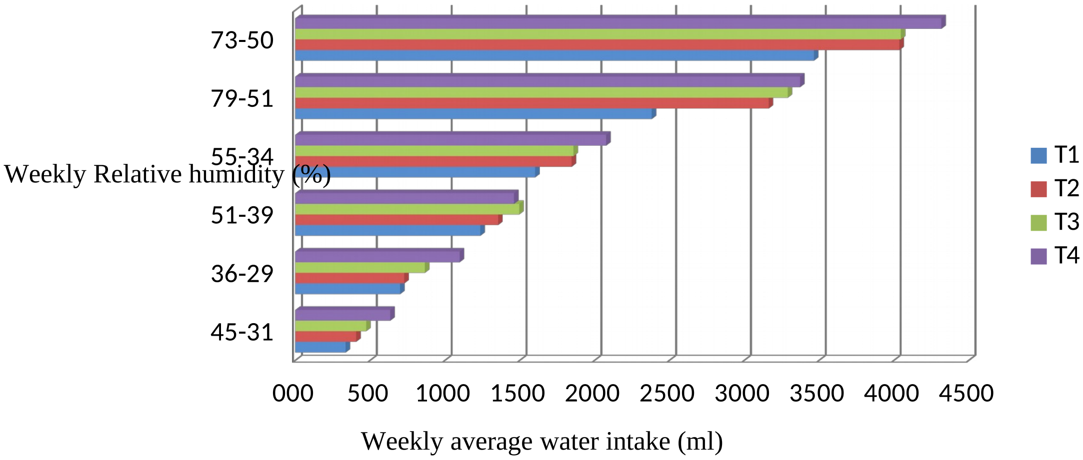

Figure 5: Bar chart of Relative humidity and water intake.

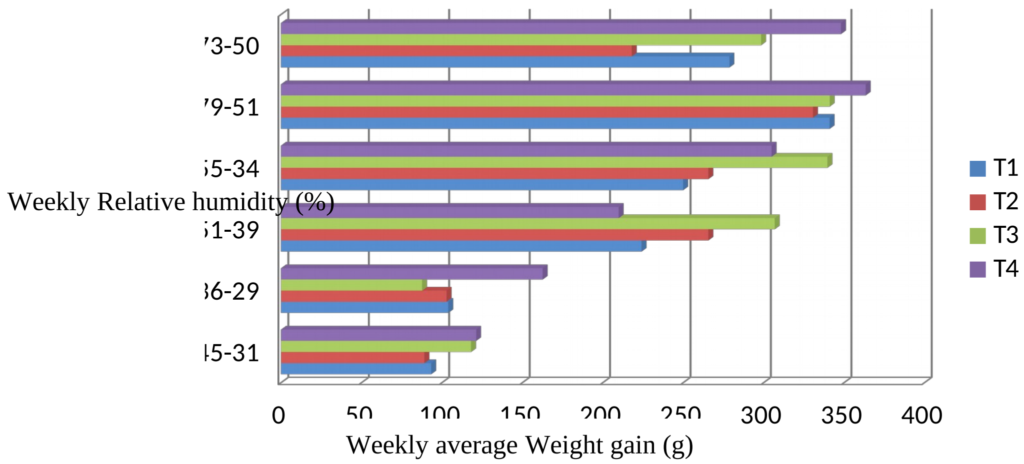

Figure 6: Bar chart of Relative humidity and weight gain.

Discussion

Table 2 shows the average water and feed intake, weight gain and feed conversion ratio of the treatments. The water intake of the treatment was significantly difference (P<0.05) with Cobb strain having the highest value. There was an increase in feed intake across the treatments but not significantly different form each other, this is attributed to the temperature increases across the week of the study. This is in line with the research work of Balogun et al (2013) where they reported that water intake increases as the temperature increases. Cobb strain at the conclusion of the experiment has the highest weight of 1631.67g and better converts the feed to flesh as it has the lowest value of 2.70 of feed conversion ratio and it is significantly different from other treatment this may be because of their genetic superiority. This work corroborate with the findings of Reddish and Lilburn, (2004) and Dairo et al., (2009) that Ross strain had higher body weight than other strains used. The authors attributed the outcome of their work to the genetic superiority of Ross over other strains.

Figure 1, 2 and 3 shows the relationship between weekly temperature variation on feed intake, water intake and weight gain of the experimental birds. The feed intake increases throughout the period of experiment, the same trend was observed for water intake. This is in tandem with the report of Joseph et al., (2012) that feed and water intake of broiler has a positive correlation with their age. The effect of temperature on the weight gain of the birds is shown in Figure 3, there was increase in the weight gain of the birds across the treatment up to the 5 th week of the experiment (except for treatment 2, whose growth was flattened at week 3 and 4) but a sharp decrease was seen at the 6 th week when the temperature range was at the highest (27.14 - 42.00ºC). This outcome corroborates the findings of Joseph et al., (2012) that broiler chicken performance significantly declined as the temperature increased above the nominal body temperature for broilers (41°C). However, Cobb strain did not response negatively to high temperature as expected. It had the highest weight gain. This may be because of their genetic superiority. This corroborates with the study of Huwaida et al. (2011) which revealed that Cobb strain was not significantly affected by season unlike in Hubbard and Ross strains which are affected by season.

Shown in Figures 4, 5 and 6 is the relationship between water intake, feed intake and weight gain and the average weekly relative humidity. The lowest and highest values of relative humidity was seen at weeks 2 and 5 respectively, Cobb strain has the highest values for feed intake, water intake at week 2 (36-29% RH) and also utilizes the feed as it has the highest weight gain at this period, at week 5 when the relative humidity was 79-51 % RH, the feed intake of Cobb strain was reduced compared to T3, but

Cobb strain has the highest weight gain at the period which shows that it better utilizes the feed. This agrees with the work of Winn and Godfrey (1967) as sited in Yahav, (2000) where they reported that higher humidity seem to favor better growth and feed conversion of broiler chicken.

CONCLUSION

From this experiment, it can therefore be concluded that variation in temperature and relative humidity, affects the feed intake and growth performance of broiler. But Cobb strain amidst high temperature and relative humidity variations performs best as has the highest weight gain.

This study reveals that Cobb strain genetic merits enable it to adapt to high temperature variation and therefore it is most suitable for rearing in the tropics.

Recommendations

It is recommended that Cobb strain of broiler can be conveniently reared during the dry season especially (January-March) of the Northern Nigeria or guinea savanna without much stress. Nevertheless, measures to control th environmental temperature and relative humidity should be made available if other strain are to be reared in this region. Further research should be done to compare Cobb broilers with other strains of broiler like Ross and Hubbard.

REFERENCES

Abu-Dieyeh, Z.H. M., (2006). Effect of high ambient temperature per se on growth performance of broilers. *International Journal Poultry Science*, 5, 19-21.

Adama, T. Z., Ogunbajo, S. A, & Mambo, M., (2007). Feed intake, growth performance and nutrient digestibility of broiler chick fed diets containing varying levels of sorghum dried brewers' grain. *International Journal Poultry Science*, 6 (8), 592-598

Adesoji, S.A, Farinde, A.J., & Ajayi, A.O. (2006). Determinants of training needs of fadama farmers in Osun State of Nigerian and implications for extension workers. *Journal of Applied Sciences*, 6(15), 3082-3088.

Amos, T. T. (2006). Analysis of Backyard Poultry Production in Ondo State, Nigeria. *International Journal of Poultry Science*, *5*(3), 247-250.

Apata, D.F & Ojo, U. (2000). Efficiency of the Trichoderma viride enzymes complex in broiler starter fed cowpea testa based diet. In: Ukachukwu, S. N.; Ibeauchi, J.A., Ibe, S.N.; Ezekwe, A.G. And Abasiekong, S.F. (Eds). Animal Production in the new millennium: Challenges and Options of Proceeding 25th Annual *Nigeria Society of Animal Production Conference*. Page 132–134.

Asaniyan E. K., Agbede J. O., & Laseinde E. A. O. (2007). Impact assessment of different litter depth on the performance of broiler chicken raised on sand and wood shavings litters. *World Journal of Zoology*, 2(2), 67-72.

Balogun, A. A., Akinseye, F. M., & Agbede, J. O. (2013). Water and feed consumption in broiler birds during a typical hot weather condition in Akure, Ondo State, Nigeria. *International Journal of Biological and Chemical Science*, *7*(3), 1119-1125.

Cobb broilers management guide 2012 edition, cob-vantress.com: page 9-21.

Dairo, F. A. S, Oluwasola T. A, Adesehinwa A. O. K & Oluyemi, J. A. (2009). Variation of energy and protein content on the performance and carcass values of broiler chickens. In J. A. Akinlade (Ed.), *Global economic recession and the challenges to livestock production in Nigeria*. Proceeding of the 14th Annual Conference of Animal Science Association of Nigeria, Lautech,14:(pp. 452-4), Ogbomosho, Nigeria.

Deeb, N., & Lamont S J (2002). Genetic architecture of growth and body composition in unique chicken populations. *Journal of Hereditary*, *93*(2), 107-18.

Deeb, N., & Cahaner, A. (2002). Genotype-by-environment interaction with broiler genotypes differing in growth rate. 3. Growth rate and water consumption of broiler progeny from weight-selected versus non-selected parents under normal and high ambient temperatures. *Poultry Science*, *81*, 293–301.

Demeke, S., (2004). Egg production and performance of local and White Leghorn hens under intensive and rural household conditions in Ethiopia. *Livestock Research for Rural Development 16*, Art 9. www.lrrd.org/lrrd16/2/deme1602.htm

Elijah, O. A., & Adedapo, A. (2006). The effect of climate on poultry productivity in Ilorin Kwara State, Nigeria. *International Journal of Poultry Science, 5*(11), 1061-1068.

Food and Agricultural Organization (FAO) (2007). Production Year Book. FAO Statistics Series 156. FAO Rome, I. (1984). Nutrient Requirement of Poultry. 9th Edition. National Research Council, Washington.

Govindarajan K., Palanisamy A., AbdulRazak A., Intan S. I., & Sharida, F. (2015). Competing Role of Bioactive Constituents in Moringa oleifera Extract and Conventional Nutrition Feed on the Performance of Cobb 500 Broilers. *BioMedical Research International*. https://doi.org/10.1155/2015/970398

Grabowski, T., & Kijowski, J., (2004) *Meat and poultry products – technologies, hygiene, quality*. Ed. WNT, Warszawa (in Polish).

Gwaza, D. S, Noah, E T, & Wamagi, T. I. (2013). Discriminant Analysis of Morphological Traits in Selected Population of the Tiv Local Chicken Ecotype in the Derived Guinea Savannah of Nigeria. *Journal of Agricultural Veterinary Science, 3*(6), 60-64.

Gwaza, D. S. Terzungwe, A, & Egahi, O. J (2011). Interaction of year's age of bird and pen effects on hen –day lay of layer breeds and their adaptation in the derived southern guinea savannah of Nigeria. Extreme Life, Biospeology and Astrobiology. *International Journal of Bioflux Society, 3*(2), 77-82.

Huwaida, E. E. M., Ali, O. H. A. Mohamed, E. A.A. &. Yousif, I. A. (2011). Effect of season and dietary protein level on immune response of three exotic broiler strains in Sudan. *Journal of Animal Feed Resources, 3*(1), 31-35.

Dare/India Council of Agricultural Research (ICAR). 2010-11 annual Report Pp 13.www.icar.org.in/content/dareicar-annual-report-2010-2011

Joseph `L. Purswell, William A. Dozier III, Hammed A. Olanrewaju, Jeremaiah D. Davis, Hongwei Xin, & Richard, S. G. (2012). Effect of temperature-humidity index on live performance in broiler chickens grown from 49 to 63 days of age. Agricultural and Biosystems Engineering Conference Proceedings and Presentations. http://lib.dr.iastate.edu/howtocite.html.

Leenstra, F., (1992). Effects of low, normal and high temperature on slaughter yield of broilers from lines selected for high weight gain, favorable feed conversion and high or low fat content. *Poultry Science, 7,*1994-2006.

Lin H., Zhang H. F., Jiao H. C., Zhao T., Sui S. J., Zhang Z. Y., Buyse J., & Decuypere., E. (2005). Thermoregulation responses of broiler chickens to humidity at different ambient temperatures I. One Week of Age. *Poultry Science, 84*, 1166–1172

Mckay W., Hung, K.H, Chinnan Y-C, & Philips, R.D (2001). Akara making characteristics of five U.S varieties of cowpea (Vigna Unguiculata). *Journal of Food Quality,* 24, 53-65

Menquesha, M. (2011). Climate change and the performance of rearing poultry for the demand of protein foods. *Asian Journal Poultry Science, 5*, 135-143.

Razuki W. M, Mukhils S. A, & Hamad, R. F (2007). Performance of three commercial Broiler strains reared under hot and thermoneutral conditions. *Iraqi Journal of Agriculture, 12,* 92-103.

Reddish J.M, & Lilburn, M.S. (2004). A comparison of growth and development pattern in diverse genotype of broiler 1. Male broiler growth. *Poultry Science, 83,* 1067-71.

Saliu, O.J., Audu, S.I. & Okolo (2013). Analysis of the adoption of recommended feed for broiler production in Kogi State, Nigeria. International *Journal of Agriculture and Rural Development, 16*(2), 1509-1520

Sandercock, D. A., Hunter, R. R. Nute, G. R. Mitchell, M. A. & Hocking, P. M. (2001). Acute heat stress-induced alterations in blood acid-base status and skeletal muscle membrane integrity in broiler chickens at two ages: Implications for meat quality. *Poultry Science, 80*, 418–425.

Shini S, Kaiser P, Shini A, & Bryden, W. L. (2008). Biological response of chickens (Gallus gallus domesticus) induced by corticosterone and a bacterial endotoxin. *Comparative Biochemistry and Physiology*

Part B: Biochemistry Molecular and Biology Journal. 149, 324-333.

Spore Magazine. (2008). Climate variation: Pests and diseases (pp. 5-6). Spore Magazine, August Special Issue:CTA.

Statistical Analysis System, Version 9.2, SAS. Institute Inc., Carry N.C. USA. 2009

Winn, P.N., & Godfrey, E.F (1967). The effect of humidity on growth and feed conversion of broiler chickens. I*nternational Journal of Biometeorol 11*, 39–50. https://doi.org/10.1007/BF01424274

Yahav Shlomo (2000). Relative humidity at moderate ambient temperatures: Its effect on male broiler chickens and turkeys. British Poultry Science. 41. 94-100. 10.1080/00071660086475.

Yang, C.X. & Jiang, C.L. (2005). N-3 Fatty acid metabolism and effects of alpha-linolenic acid on enriching N-3 FA eggs. *Journal of China Agriculture University*, 95, 117-122.

Yoon, O., Kenneth, W. & Washburn, (1995). Effects of environment on growth, efficiency of feed utilization, carcass fatness and their association. *Poultry Science, 74*, 285-296.