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National Animal Production Research Institute
Ahmadu Bello University
P.M.B 1096, Shika-Zaria,
Kaduna State, Nigeria.
Email: japr@napri.gov.ng
Website: http://journals.napri.gov.ng

EFFECTS OF SEASONS (COLD, HOT AND WET) AND FEED ENERGY LEVELS ON THE PERFORMANCE OF BROILER CHICKENS IN ZARIA, KADUNA STATE.

[1]Afolayan, M., [2]Dafwang, I. I., [3]Omage J. J., [4]Adesehinwa, A. O. K. and [5]Adeyinka, I. A.
[1]Samaru College of Agriculture, Ahmadu Bello University, Zaria.
[2]National Agricultural Extension and Research Liaison Services, Ahmadu Bello University, Zaria,
[3]Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria.
[4]Livestock Improvement Programme, Institute of Agricultural Research and Training, Moor Plantation, Ibadan
[5]National Animal Production Research Institute, Ahmadu Bello University, Zaria.
Corresponding author: moji_afolayan@yahoo.com

ABSTRACT

Three experiments were conducted to evaluate the effects of seasons (cold hot and wet) and energy levels of diets on the performance of broiler chickens. In the first experiment, 198 birds were used. In the second experiment, 144 birds were used, while, 216 birds were used in the third experiment. The birds were fed the same type of diets during the three seasons. The diets fed were iso-nitrogenous but not iso-caloric, having 3000, 2800 and 2600 ME kcals /kg energy levels, while the crude protein levels was 20%. There was a significant (P< 0.05) difference across the three seasons in terms of ambient temperature, relative humidity and rainfall. And also, significant (P< 0.05) differences existed in the general growth performance and carcass characteristics of the birds. However, the rectal temperatures varied significantly (P <0.05) in relation to the ambient temperature during the three seasons (41.35, 20.40^{0}C) during the cold, (41.87, 30.50^{0}C) for the hot and (41.47, 25.20^{0}C) for rainy season, rectal and ambient temperatures respectively. There was a significant (p< 0.05) differences across the three seasons in terms of final weight, weight gain, feed intake, feed to gain ratio and water intake and feed cost per kg gain (₦). It was therefore concluded that the climatic factors (temperatures, humidity and rainfall) have influence on the general performance of broiler chickens.

Key words: Season, Performance, Broiler chickens, Temperatures, Relative humidity

INTRODUCTION

Generally, birds are more susceptible to changes in environmental conditions than other domestic animals; ideally the body temperature of birds remains slightly higher than the environmental temperature, with a continuous loss of heat from the body to the environment by evaporation, radiation and conduction (Sabah *et al*., 2008; Abidin and Khatoon, 2013). The productive performance of the birds is at peak in thermo neutral conditions when the environmental temperature is within the range of 18 to 24^{0}C. Within this range, weight gain, feed conversion ratio and egg production are normal and birds maintain their normal body temperature 40- 41^{0}C (Narsapur 2012). Tolerance to heat stress is greatly influenced by relative humidity in the air. High temperature and relative humidity form a deadly combination for poultry. As temperatures rise above 26^{0}C, feed consumption would start declining at the rate of 1.5% for every rise of 1^{0}C (Meltzer1983). At 32^{0}C and above, birds begin to pants continuously, increase water intake by 1-3 times above regular intake at normal temperature, sit on litter with flirt wings. Relative humidity can affect evaporative cooling during heat stress. Above 70% relative humidity it is almost impossible for the bird to lose a significant amount of heat through

panting because the moisture difference between the exhaled air and the pen air is similar (Summers, 2000). There is about 10% depression in body weight gain between 5-9 weeks of age at temperature above 32^0C (Meltzer1983). High temperature with high humidity is more detrimental to broilers growth than high temperature with low humidity, broilers as well as other domestic birds cannot tolerate high temperature coupled with high relative humidity as this will result in high mortality due to heat exhaustion (Gary and Richard 2003; Afolayan *et al.,* 2015). Sinkalu *et al.* (2008) had also reported that high ambient temperature and relative humidity are the most important meteorological stress factors causing heat stress in the tropics and it is characterized by elevated rectal temperature. High temperature with high humidity also results in increase in the rectal temperature of the birds (Leventand Kenneth 2005). Environmental temperature had been reported to have a great influence on the rectal temperature in poultry (Afolayan *et al.,* 2010). The recommendation for energy levels for commercial poultry feeds in Nigeria does not discriminate between seasons. Although the standard energy level for broiler starter and finisher in the tropical environment is 3000ME kcal/kg. This study was therefore conducted to evaluate the effects of the three seasons (cold, hot and wet) and varying energy levels (3000, 2800, and 2600 ME kcal/kg) on the performance of broiler chickens.

MATERIALS AND METHOD

Experimental site

The experiments were conducted at the Poultry Unit, Teaching and Research Farm of Animal Science Department, Ahmadu Bello University, Zaria. Zaria is within the Northern Guinea Savannah zone of Nigeria, Latitude 11^o 12'N and Longitude 7^o 33'E, at an altitude of 610m above sea level.

Measurement of temperatures:

The temperatures were recorded for each season during the period of the study.

Room temperature: Two thermometers (mercury in glass thermometer) were hung at two different locations in the pen, the reading was taken twice daily in the morning and at noon (12.00pm) then the average daily room temperature was recorded for the three seasons.

Environmental temperature and relative humidity: Daily (minimum and maximum) temperatures and relative humidity reported during the period of the experiments were obtained from the Institute for Agricultural Research (IAR) meteorological station, Samaru- Zaria which is in proximity with the experimental pen.

***Rectal Temperature*:** The body temperature of the birds was taken during the last week of each experiment, with the aid of a digital thermometer (COCET) designed to measure temperature within the range of 32^oC -42^oC with a resolution of 0.1^oC. Five birds were randomly picked from each replicate, the birds used were colour coded for identification, the thermometer was inserted into the rectum of the birds and the reading was recorded after the thermometer indicated end of measurement with a beep.

Experimental birds and their managements

Three experiments were conducted during the period of this study. The first experiment was carried out during the cold season between December – early February with an average daily temperature of 20.40^0C. While the second experiment was conducted during the hot season between the month of April –early June with an average daily temperature of 30.50 ^{0}C with

average relative humidity of 41.15% and the third experiment was carried out during the rainy (wet) season between the month of July- August with an average daily temperature of 25.20^{0}C and relative humidity of 84.59%.

In the first experiment, 198 birds were used.There were three treatments and each replicated three times, having eleven birds per replicate. In the second experiment, 144 birds were used. There were three treatments each replicated twice.216 birds were usedfor the third experiment, consisting of twelve birds per replicate in a completely randomized design. Thebirds were fed the same type of diets during the three seasons (Tables 1 and 2). The diets fed were iso-nitrogenous but not iso-caloric, having 3000, 2800 and 2600 ME kcals/kg energy levels, while the crude protein level was 20% .The birds were housed in deep litter pens. Feed and water was provided *adlibitum*and all the necessary medication and vaccinations were administered.

Data collections and analysis

The birds were weighed at the beginning of each experiment and the initial weights recorded. The birds were then subsequently weighed on weekly basis. The initial weights were subtracted from the subsequent weights to obtain weekly weight gains. The same set of formulated diets was fed to the birds during the three experiments as shown on tables 1 and 2. A known quantity of feed was supplied on weekly basis, at the end of each week, the left over feeds were weighed and subtracted from the total feed supplied for the week to obtain feed intake per week. The weekly feed intake and weight gains were used to compute the feed conversion ratio.

$$FCR = \frac{\text{Feed intake}}{\text{Weight gain}}$$

Daily water consumption was obtained by subtracting the left over from the previous day from the total volume supplied to each replicate. Evaporative losses was measured by placing two drinkers with known volume of water at two different locations in the pen, the average of the left over was then subtracted from the water consumed by the birds to get the actual daily water consumed.

***Carcass Analysis*:** At the end of each experiment, one bird per replicate (three birds per treatment) was selected with each bird reflecting the average weight of the pen for carcass analysis. The live weights of the birds were taken before slaughtering; the birds were slaughtered, defeathered and eviscerated. Carcasses were weighed and cut into various parts. The weights of cut parts were expressed as percentages of live weight.

Statistical analysis

All data collected during the starter and finisher phase were pooled together and subjected to analysis of variance (ANOVA) test using the SAS (2002) general linear model procedure, treatment means were compared for significance using Tukey's studentized range test.

RESULTS AND DISCUSSIONS

Weather report

The average weather conditions during the period of experiments are as showed in figures 1, 2 and 3.There was a significant ($P< 0.05$) difference across the three seasons in terms of temperatures, relative humidity and rainfall. The Overall average environmental temperatures of 20.40^{o}C, 30.50^{o}C and 25.20^{o}C was recorded during the cold, hot and wet seasons respectively,

while the overall average relative humidity was 18.72,41.15, 84.59, and for the cold , hot, and wet seasons respectively and the average rainfall (mm) was 0.00, 0.15 and 7.04 for the cold, hot, and wet seasons. The observed increased in relative humidity during the hot season was due to the drops of rainfall experienced during the finisher phase of the study.

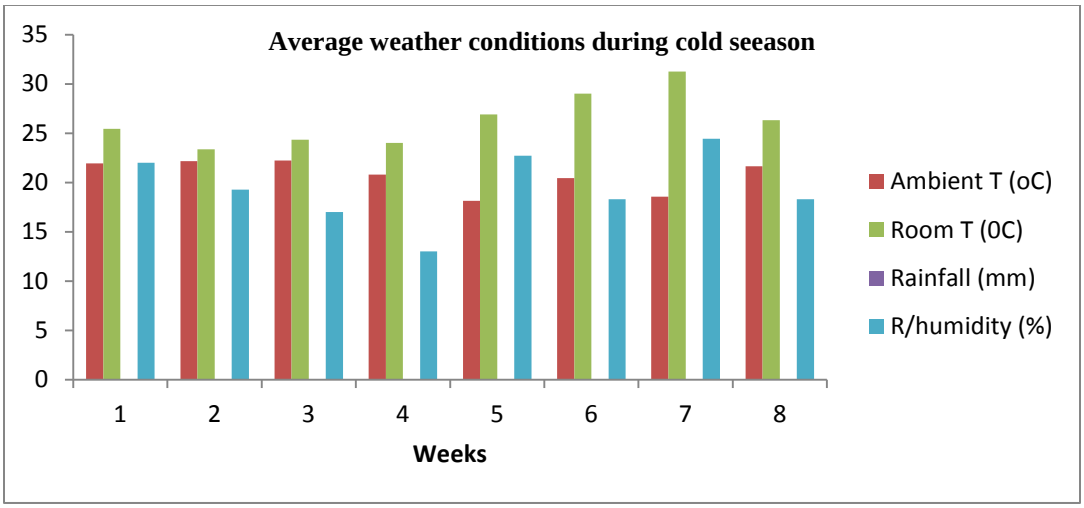


Figure 1: Shows the average weather conditions during the period of experiment 1 (last week in December- February)

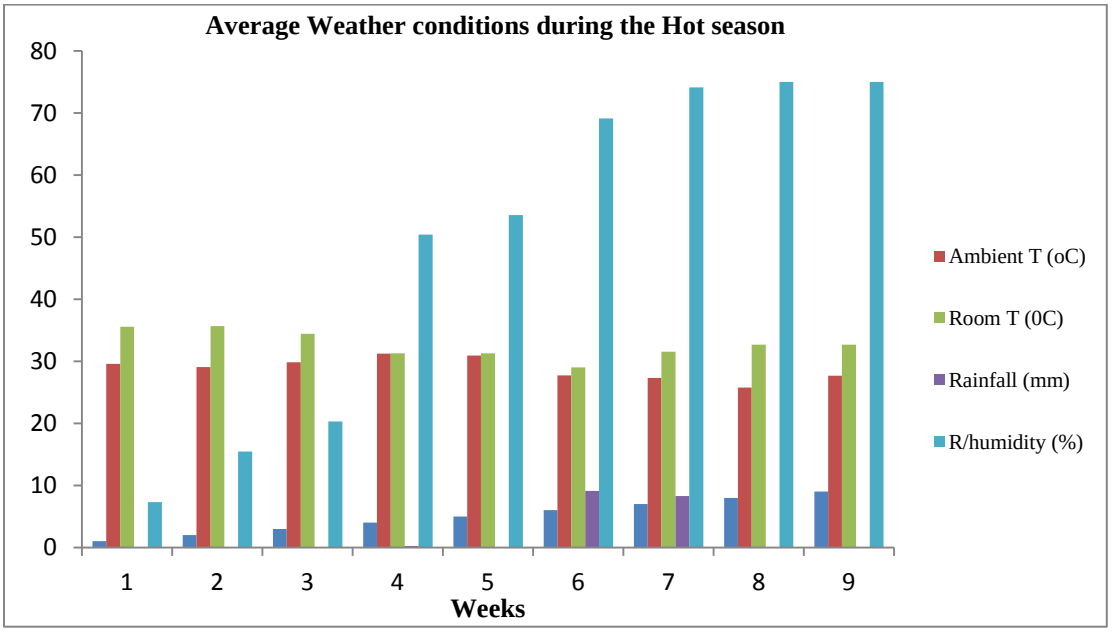


Figure 2: Shows the average weather conditions during the period of experiment 2 (April- early June)

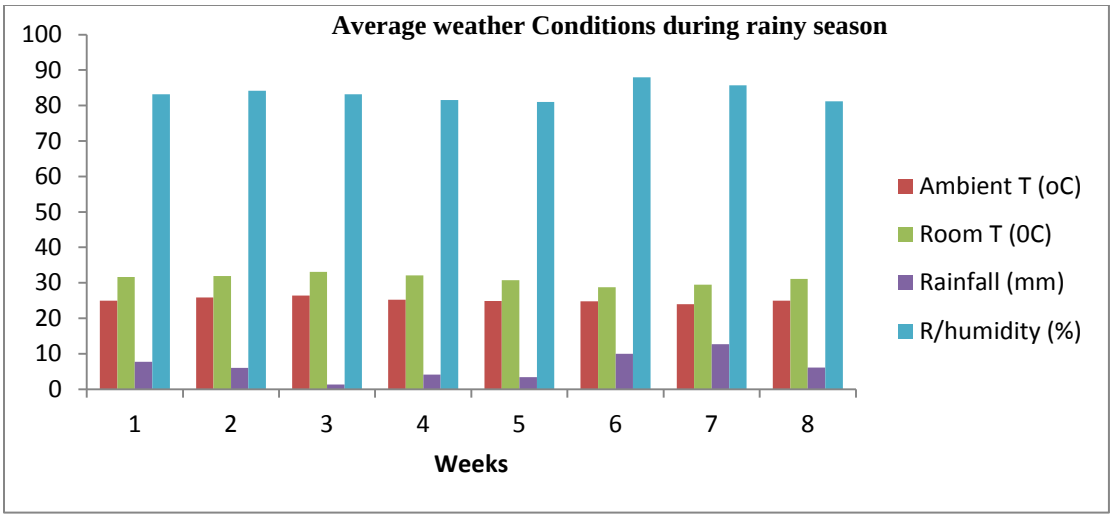


Figure 3: shows the average weather conditions during the period of experiment 3 (July- August)

Effects of seasons and feed energy levels on broiler chickens performance

The average weather conditions during the period of the study revealed that season have influence on the performance of the birds as shown on Table 3. There was a significant ($p< 0.05$) differences across the three seasons in terms of final weight, weight gain, feed intake, feed to gain ratio and water intake and feed cost per kg gain (₦). The birds reared during the hot season had a better final weight (3378.97g) and weight gain (1541.11g), followed by those raised during the cold season (2208.89g) and (1269.07g) for the final weight and weight gain respectively. While the birds raised during the rainy season had the least growth rate, with final weight of 1927.98g and weight gain of 955.25g. However; the poor performance observed during the rainy season may be as a result of weather condition. The environmental conditions under which the birds were raised were harsh, because of high temperatures coupled with high humidity. The rainfall did not have significant positive effect on ambient temperature. This result tallies with the findings of (Summers, 2000;Gary and Richard 2003,Sabah *et al*., 2008; Afolayan *et al.*, 2015), these authors reported that high temperature coupled with high relative humidity has detrimental effects on growth performance of broilers than high temperature with low humidity. The observed performance during the rainy season is also in agreement with the findings of (Gu *et al*., 2008), they reported that high humidity has the tendency of aggravating the badinfluence of high temperature on the broiler chickens.

There was a significant ($p< 0.05$) increase in water intake across the three seasons. The highest cumulative water intake was recorded during the hot season (10,032ml per bird), followed by 8,785ml per bird during the cold season and the least water intake of 6,594ml per bird was recorded during the rainy season. The reason for this may be due to variation in weather conditions during the periods of the study. The result obtained for water to feed ratio agreed with the findings by Aduku (2004), who reported that chickens consume two to three times amount of water per unit of dry feed consumed. And also in consonance with the observation made by Diarra and Tauaciri (2014), they reported that, chickens consumed more water than feed especially at high temperatures. However, feed energy levels had no significant effect on all the parameters except water intake. Water intake was observed to increase as the energy level of the diets decreased (7981.60ml < 8620.40ml < 8809.20ml) for 3000, 2800 and 2600 ME kcal/kg respectively. This observed result may be due to the high crude fiber content of diet containing

2600ME kcals/kg. Feed cost per kg gain observed in this study is an indication that it is cheaper to raise broiler chickens during favourable weather than in the harsh (rainy) weather. when both humidity and temperature is high From the result, the cheapest cost per kg of weight gain was recorded during the cold season (₦81), while the highest cost was recorded during the rainy season (₦167). This is an indication that the climatic stressors (high temperatures and high humidity) which characterized the rainy period of the study had suppressive effects on feed conversion ratio which consequently increased the cost per kg gain. Hence, it is more profitable to raise broilers during the cold season when both the temperatures and humidity are low.

The result of the effect of season and feed energy levels on the carcass characteristics of broilers chickens is presented in Table 4. There were significant ($P < 0.05$) differences in the live weight, dress weight, dressing percentage and the various cut parts across the three seasons except for the abdominal fat, gizzard and gut length in which there were no ($P > 0.05$) significant differences.. The percentage abdominal fats recorded were moderate for the three seasons. However, the effect of feed energy levels were not ($P > 0.05$) on all the parameters measured except on the live weight. The birds fed on diet containing 3000ME kcal/kg were significantly ($P < 0.05$) better in term of live weight than those on 2600 ME kcal/kg. This may be due to the high nutrient density of the diet.

Table 5, shows the effects of seasons on the rectal temperatures of broiler finishers. There were significant ($P < 0.05$) increase in the rectal temperature of the birds across the three seasons. The highest temperature was recorded during the hot season 41.87 ^{0}C, followed by 41.47^{0}C during the wet season and 41.35^{0}C for the cold season. The result obtained in this study revealed that both the ambient and room temperature has influence on the rectal temperature. This observation agreed with the findings of Levent and Kenneth (2005); Sinkalu (2008). They reported that high environmental temperature have a great influence on the rectal temperature in poultry. The result of the rectal temperatures obtained during the three seasons are relatively higher than the environmental temperatures. This result is in line with the findings of Abidin and Khatoon (2013) who gave a report that the ambient temperature is usually above the birds thermo neutral zone.

Table 1: Gross Composition of Broiler starter diet

Ingredient	3000 kcal ME/kg	2800 kcal ME/kg	2600 kcal ME/kg
Maize	30	6	0
Soya/Fullfat	36.1	34	33
Blood meal	3	3	4
Fishmeal	5	5	5
Maize offal	17.1	43.2	39
Rice Offal	0	0	10.2
PKC	5	5	5
Bone meal	3.1	3.1	3.1
Salt	0.3	0.3	0.3

Methionine	0.1	0.1	0.1
Premix	0.3	0.3	0.3
Total	**100**	**100**	**100**
Calculated Analysis			
ME kcals/kg	3010.95	2807.70	2618.10
Crude Protein %)	23.26	23.32	23.25
Crude Fibre (%)	5.83	7.51	10.71

Table 2: Gross Composition of Broiler Finisher diet

Ingredient	**3000 kcal ME/kg**	**2800 kcal ME/kg**	**2600 kcal ME/kg**
Maize	34.00	10.00	0.00
Soya/Fullfat	32.00	30.00	31.00
Blood meal	2.00	2.00	2.00
Fishmeal	0.00	0.00	0.00
Maize offal	23.10	49.10	49.00
Rice Offal	0.00	0.00	9.10
PKC	5.00	5.00	5.00
Bone meal	3.10	3.10	3.10
Common Salt	0.30	0.30	0.30
Methionine	0.20	0.20	0.20
Premix	0.30	0.30	0.30
Total	100	100	100
Calculated Analysis			
ME kcals/kg	3003.75	2802.48	2605.80
Crude Protein %)	20.26	20.34	20.30
Crude Fibre (%)	5.83	7.94	11.09

Table 3 Effect of Season and Feed Energy Levels on Broiler Performance

	Seasons				Feed Energy Levels			
Parameters	**Cold**	**Hot**	**Wet**	**SEM**	**3000**	**2800**	**26000**	**SEM**
Initial weight (g)	939.82^{c}	1837.41^{a}	972.73^{b}	7.11	1249.98	1252.95	1247.02	147.67
Final weight (g)	2208.89^{b}	3378.97^{a}	1927.98^{c}	20.21	2531.92	2513.92	2470.00	223.73
Weight gain(kg)	1269.07^{b}	1541.11^{a}	955.25^{c}	21.60	1281.38	1261.78	1222.27	89.16
Total Feed intake (kg per bird)	3631.11^{b}	4592.41^{a}	4000.00^{b}	133.71	3932.60	3993.90	4297.0	186.44
Feed to gain ratio	2.89^{b}	2.98^{b}	4.23^{a}	0.16	3.20	3.24	3.65	0.26
Total Water intake (mls per bird)	8785^{b}	100032^{a}	6594^{c}	180.69	7981.60^{b}	8620.40^{ab}	8809.20^{a}	135.29
Water to feed ratio	2.44^{a}	2.19^{a}	1.66^{b}	0.07	2.06	2.17	2.06	0.13
Feed cost /kg gain(₦)	81^{a}	97^{a}	167^{b}	19.24	122.89	109.15	111.64	14.89

Table 4 Effects of seasons and Feed Energy Levels on carcass analysis

	Seasons				Feed Energy Levels			
Parameters	**Cold**	**Hot**	**Wet**	**SEM**	**3000**	**2800**	**2600**	**SEM**
Liveweight (g)	2233[b]	3425[a]	1927[c]	0.03	2598.89a	2506.11ab	2481.11b	0.23
Dress weight (g)	1861[b]	3096[a]	1661[c]	0.06	2318.06	2163.89	2136.11	0.23
Dressing %	83.34[b]	90.39[a]	86.20[b]	0.04	89.19	86.34	86.09	0.05
Breast (%)	16.58[a]	17.57[ab]	19.69[b]	1.06	18.45	18.89	17.82	0.91
Back (%)	11.68[a]	12.83[ab]	13.85[a]	0.35	12.77	12.67	12.38	0.28
Thigh (%)	18.66[a]	20.09[b]	20.93[b]	0.45	19.83	19.76	19.41	0.62
Abdominal Fat (%)	2.05	1.76	1.77	0.20	0.018	0.018	0.016	0.14
Gizzard (%)	1.93	2.46	1.96	0.30	0.021	0.021	0.020	0.19
Gut length (cm)	248.78	263.17	262.33	8.75	251.89	253.08	269.31	8.17

Table 5 Effects of Seasons on Rectal Temperature of Broiler Finisher

Seasons	**Ambient Temperature (^{0}C)**	**Room Temperature (^{0}C)**	**Rectal Temperature (^{0}C)**
Wet	25.20	31.11	41.47
Hot	30.50	32.68	41.87
Cold	20.40	26.32	41.35

CONCLUSION

Based on the result obtained from this research, it can be concluded that climatic factors played a significant role on the general performance of broiler chickens.

1) High temperature plus high humidity has negative effect on growth of the birds than the single effect of high temperature
2) It is cheaper to raise broilers during cold, dry and low humid period
3) Effect of varying energy levels is significant on water intake of the birds, the birds fed 2600ME kcal/kg diet had the highest water intake
4) Rectal temperatures recorded are higher than the environmental temperatures across the three seasons

LIMITATIONS

There was no control over the strain of birds supplied for the hot season experiment, although the same strain of birds were requested for, and the same Supplier of day old chicks was maintained

for the three studies. And also, high mortality was recorded during the hot season experiment which led to a reduction in the number (144 instead of 234) of birds used.

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