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Performance Characteristics of Broiler Chickens at Starter Phase Fed Varying Protein Levels during Rainy Season in Semi-Arid Sokoto, Nigeria

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This study was conducted to assess the growth and apparent nutrient retention of broiler chickens in semi-arid Sokoto using 80 experimental birds that lasted for 21 days during rainy season. The experiment comprises of 4 treatments and each were fed isocaloric (3000 kcal/kg ME) and varying protein levels diets containing 21, 22, 23 and 24% CP denoted as T1, T2, T3 and T4 in a complete randomized design. Weight gain, feed intake, water intake, feed conversion ratio and mortality were determined. Climatic variables (temperature and relative humidity) were recorded daily. Cost of feed per kg was also determined at the end of the experiment. Data obtained were statistically analyzed using SPSS version 21 computer package program. Results revealed no significant (P>0.05) differences in the performance parameters (feed intake, cost of feed, FCR and mortality) except weight gain and water intake. Assessments of apparent nutrients retention of broiler chickens showed that the parameters were significantly influenced by the dietary treatments. The relationship of performance and climatic variables revealed that increase in temperature did not improve the efficiency of the birds and had led to decrease in average weight gain. The result indicated there were significant (P<0.01) strong negative relationship between feed intake, water intake, average weight gain and FCR with temperature. However, Relative humidity indicated significant (P<0.05) and strong positive relationship with feed intake, water intake and average weight gain. It is concluded that dietary energy (3000kcal/kg ME) and 21%CP at starter can improve the growth and nutritional status of broiler chickens during rainy season.

Keywords: Broiler chickens, starter, crude protein, feed efficiency, semi-arid region.

INTRODUCTION

In tropical environments like Nigeria, seasonal variation is one of the major non-genetic factors that affect poultry production. For instance, the cold rainy season affects both poultry production and the general wellbeing of poultry. The rainy season is usually synonymous with an increase in relative humidity and a reduction in temperature; rainfall affects both the quality and quantity of feeding, while wind speed has an impact on outbreak of diseases. Similarly, according to the findings by Gregory (2010) opined that short-range climate change effects on the meat quality varies between regions.

There are several constraints affecting growth of the poultry industry, among which temperature-associated environmental challenges, especially adverse environmental condition (hot and cold climate) imposes severe stress on birds and leads to reduced performance. Thermal discomfort may result in improper expression of genetic potential in birds (Kataria *et al*., 2008) and production performances of broiler chicken are greatly affected due to adverse ambient temperatures (Zahraa, 2008). In poultry farming, the wet season typically causes the birds to become stressed and this affects their production and their ability to withstand diseases through immunosuppression, leading to

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reduction in the performance of birds.

Chicken meat production from broiler is one of the essential components of livestock in Nigeria. Seasons of a year are highly prejudiced to successful commercial broiler production in Nigeria. Climatic factors and their effects on the economic traits, such as growth and feed utilization on the production performance of broilers have yet to be studied extensively in the semi-arid environment of Sokoto.

Thus, the present study was aim to investigate the performance characteristics of broiler chickens at starter phase fed varying protein levels during rainy season.

MATERIALS AND METHODS

Study Area

Sokoto state is located in the extreme northwest of Nigeria near the confluence of the Sokoto River and the Rima River. Sokoto state is in the dry Sahel, surrounded by sandy savannah and isolated hills (Nigeria Galleria, 2017). It occupies an area of short grass savannah vegetation in the south and thorn scrub in the north with a land area of 26, 648.48km^2 (Kaoje *et al.*, 2017). The state is located between longitude 5.24^{o}N and latitude 13.06^{o}E with 265 meters above the sea level (Sokoto Geographical Data, 2019). Harmattan, a cold dry and dusty wind is experienced in the state between November to January or February with average temperature falling to the lowest of 24.5^{o}C. The Harmattan (cool) season last for 1.6 months from December to January, with an average daily high temperature below 32.78^{o}C. The coldest day of the year is January, with an average low of 16.67^{o}C and highest of 31.1^{o}C (Mamman *et al*., 2000).

Experimental design

Eighty (80) day old *Marshall Strain*broiler chicks were used during the feeding trial in a complete randomized design. The birds were divided into four treatment groups of 20 birds per group with four replicate of 5 chicks per replicates and were randomly allotted to four dietary treatments.

Experimental birds and their management

The chicks were sourced from Zartech at Ibadan. The brooding pens and equipment (flat trays and watering trough) were thoroughly cleaned and disinfected before the arrival of the chicks.

Thereafter, wood shavings were spread on the floor as litter material, light was also provided continuously throughout the experimental period using electric bulb (200-watt). On arrival, the feed was served on the first two days to facilitate acclimatization.

Thereafter, the experimental diets were then administered accordingly, the feeding and watering troughs were washed on daily basis after weighing leftover. Apparent nutrient retention was also carried out at the end of starter phase. All chicks were raised in a well ventilated and sanitized deep litter pen. Routine management practices, medication and vaccination were maintained for all the treatment groups as recommended by (Oluyemi and Roberts, 2000). The feeding trial was conducted from 3rd week of July to September for rainy season.

Experimental diets

Four experimental diets were formulated using variations of protein levels. Protein levels of 21, 22, 23 and 24% CP with 3000kcal/kg ME. The gross and calculated chemical composition of the experimental diets is shown in table 1.

DATA COLLECTION

Performance parameters

Performance variables were monitored and recorded as described by Essiet and Solomon (2013). Parameters such as initial body weight, final body weight, weight gain, feed intake, water intake, and feed conversion ratio were noted. Feed intake was determined by subtracting leftover from feed given .Water intake was determined as observed in feed intake all on daily basis. Weight gain was determined by subtracting the initial body weight gain from the final weight. The body weight gain was monitored weekly. Feed conversion ratio was calculated as the ratio of feed intake to weight gain as follows.

$$FCR = \frac{Feedintake}{Weightgain}$$

Temperature was recorded daily using maximum and minimum thermometer hung in the poultry house. Mortality was recorded as it prevailed.

Apparent nutrient retention

A metabolic cage trial was carried out to determine the apparent nutrient retention of birds. One bird per replicate was individually caged for faecal sample collection.. Feed and water were provided *ad libitum* and lighting provided throughout the trial, each faecal sample collected was immediately weighed and stored in refrigerator for analysis

The feed and faecal samples were taken to animal care laboratories at Kano for proximate analysis. The analysed results obtained were then used to calculate apparent nutrient retention as described by AOAC (2000) using the formula:

Table1: Gross and calculated chemical composition of experimental diets fed to broilers at starter (0-3wks)

Ingredient(kg)	T1 (21%CP)	T2 (22%CP)	T3 (23%CP)	T4 (24%CP)
Maize	54.5	51.5	49.5	46.5
Soya beans meal	10	10	12	12
Groundnut cake	11	14	15	17.5
Wheatoffal	14.5	14.5	13.5	14
Blood meal	5	5	5	5
Limestone	1.0	1.0	1.0	1.0
Bone meal	1.5	1.5	1.5	1.5
Premix	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated chemical Composition				
Meterbolisble energy (kcal/kg)	3100	3100	3100	3100
Crude protein (%)	21	22	23	24
Crude f ibre (%)	4.9	5.3	5.4	5.8
Ether extract (%)	4.5	4.7	4.8	0
Calcium (%)	0.8	0.9	0.9	0.9
Phosphorus (%)	0.4	0.5	0.5	0.5
Methionine (%)	0.5	0.5	0.5	0.5
Lysine (%)	1.0	1.0	1.0	1.0

Premix: Vitamin A 30000000 i.u., Vitamin D3 000000 i.u; VitE 30000 i.u; Vitamin K 2000mg, Vitamin B2 30000mg, Vitamin C30g, Niucin40000mg, panthothemic acid 12000mg, Vitamin B61500mg, Vitamin B12 100000mg , Folic Acid 1000mg, Biotin 400mg, Choline chloride 300000mg, Cobalt 200mg, Copper 1200mg, Iodine 2000mg, Iron 40000mg, Manganese 100000mg, Selenium 150mg, Zinc 30mg, Antioxidant 1250mg.

$$Apparentnutrientretention = \frac{NI - NE}{NI} X\ 100$$

where:

NI = nutrient intake
NE= nutrient excreted

Statistical Analysis

Data generated were subjected to analysis of variance (ANOVA) using General Linear Model (GLM) programme of SPSS computer package version 21 (IBM SPSS, 2013) and statistical significant was set at P<0.05. Significant differences between means were detected using Duncan's multiple range tests as outlined by Steel and Torrie (1980).

RESULTS

Performance characteristic of broiler chickens at starter phase during rainy season

Result on performance characteristic of broilers starter fed during rainy season is presented in table 2. From the results, all the parameters measured were not significantly (P>0.05) affected by the dietary treatments except average water intake with chicks on diet 4 recording highest water consumption.

Apparent Nutrient Retention

Result on the apparent nutrient retention is presented in table 3. From the results, all the parameters were significantly (P<0.05) affected by the dietary treatments. Dry matter retention (DM), crude protein, ash were better (P<0.05) for chicks on diet 1. Crude fibre (CF) and nitrogen extract were retained (P<0.05) in chicks fed with treatment diet 3. Chicks on diet 4were observed record lowest retention of M, CF, ether extract and ash. However, this group of chicks recorded the highest retention of net energy (Table 3).

Correlation between feed intake, water intake, weight gain and feed conversion ratio with temperature during rainy season

Table 4 shows relationships between feed intake, water intake, weight gain and feed conversion ratio with temperature during rainy season. The result indicated there were significant (P<0.01) strong negative relationship between feed intake, water intake, average weight gain and FCR with temperature.

Correlation between feed intake, water intake, weight gain and feed conversion ratio with relative humidity during rainy season

Relationships between feed intake, water intake, weight gain and feed conversion ratio with relative humidity

Table 2: Performance Characteristic of Broiler Fed Levels of Protein Ratio at Starter during Rainy Season (0-3weeks)

Parameters	T1 (21%CP)	T2 (22%CP)	T3 (23%CP)	T4 (24%CP)	SEM
Initial body weight(g/bird)	71.75	72.50	71.25	72.50	2.162
Final body weight(g/bird)	497.28	461.17	448.82	4739	26.941
Average weight gain(g/bird)	421.53	391.67	377.57	398.89	26.710
Total feed intake (g/bird)	290.80	291.36	260.61	294.10	15.342
Average feed intake(g/bird/day)	41.44	41.62	37.23	42.01	2.190
FCR	0.69	0.74	0.69	0.73	0.061
Total water intake (ml/bird)	546.68	574.78	525.32	565.77	33.095
Average water intake(ml/bird)	78.09^{ab}	72.54^{b}	75.05^{b}	80.82^{a}	4.736
Cost of feed (naira/kg)	4269.23	4148.82	4464.35	4077.15	5.891
Mortality (%)	0.070	0.012	0.059	0.024	0.031

abc: Means bearing different superscripts on the same row differs significantly (P>0.05).

Table 3: Apparent Nutrient Retention of Broiler Chickens Fed Varying Protein Levels during Rainy Season

Protein levels	Dry matter	Crude protein	Crude fibre	Ether extract	Ash	Nitrogen free extract	Net energy
21	97.43^{a}	79.65^{a}	57.98^{b}	97.41^{ab}	49.62^{a}	21.28^{c}	78.78^{b}
22	60.04^{b}	69.19^{b}	41.14^{c}	95.58^{b}	10.62^{c}	16.12^{d}	66.72c
23	53.20^{c}	58.96^{d}	57.98^{a}	94.42^{c}	38.36^{b}	45.38^{a}	53.56^{d}
24	49.32^{d}	61.69^{c}	14.45^{d}	90.64^{d}	5.16^{d}	38.88^{b}	S8.82^{a}
SEM	0.010	0.013	0.011	0.026	0.012	0.087	0.206

a-d Means within the same coloumn with different superscripts are significantly different at P<0.05.
SEM= standard error of mean

Table 4: Correlation matrix of Feed intake, Water intake, Average weight gain and FCR with Temperature at starter phase during Rainy season..

Parameters	Feed intake	Water intake	Average weight gain	FCR	Temperature
Feed intake	1				
Water intake	0.863**	1			
Average weight gain	0.651**	0.945**	1		
FCR	0.871**	0.779**	.0.607**	1	
Temperature	-0.850**	-0.875**	-0.766**	-0.755**	1

** Correlation is significant at 0.01 level * Correlation is significant at 0.05 level

Table 5: Correlation matrix of Feed intake, Water intake, Average weight gain, FCR with relative humidity at starter phase during Rainy season

Parameters	Feed intake	Water intake	Average weight gain	FCR	Relative humidity
Feed intake	1				
Water intake	0.863**	1			
Average weight gain	0.651**	0.945**	1		
FCR	0.871**	0.779**	.0.607**	1	
Relative Humidity	0.828**	0.883**	0.792**	0.734**	1

** Correlation is significant at 0.01 level
* Correlation is significant at 0.05 level

during rainy season were established in the present study. Relative humidity indicated significant (P<0.05) and strong positive relationship with feed intake, water intake and average weight gain. Correspondingly, FCR had intermediate positive relationship with relative humidity (Table 5).

DISCUSSION

The values of weight gain, feed intake, FCR, mortality and cost of feed for all the treatment diets at starter phase implies that these parameters were not adversely influenced by the increase in protein levels. This study is

in conformity with the finding of Hassan *et al.* (2011), weight gain elevated with increased CP and ME content of the diet at every stages of the experiment. The author further reviewed that weight gain and feed intake of the experimental birds for all treatments were not affected by the levels of crude protein. This result is not in agreement with earlier report by Waldroup *et al.* (2005) who reported that reduction in CP level in starter diets led to a significant influence on the performance of birds. In another experiment by Ojano-Dirain and Waldroup (2002) suggested that protein /amino acids could be increase to account for reduced feed intake of birds.

Results of apparent nutrient retention indicated that the values of dry matter, crude protein, ether extra and ash were significantly higher across the treatments which could probably be due to the influence of protein levels that may likely plays a vital role in nitrogen retention. Rama *et al.* (2006) had earlier reported that the levels of protein intake influences nitrogen retention.

Relationship between climatic variable (temperature) and performance parameters were established in the present study. Increase in temperature was associated with decrease in feed intake, water intake, average weight gain, FCR and relative humidity. The negative relationship of temperature with other performance indices is in conformity with findings of Elijah and Adedapo (2006) who reported that high rainfall and relative humidity provides a conducive environment for breeding of parasites that causes outbreak of disease which invariably reduces egg and meat production.

The non-significant effect of protein levels on feed intake, total water intake, weight gain and mortality could probably be attributed to the climatic temperature and diet. This study is contrary to the findings by Garcia *et al*. (2000) who reported reducing CP down to 19% did not have a significant effect on broilers performance when compared with those fed high diets. `Waldroup *et al.* (2005) and Khajali *et al.* (2010) found that decreasing CP levels lower than 22% significantly decreased body weight gain.

CONCLUSION

From the results of this study, it can be concluded that improved performance was observed during rainy season on birds fed 21%CP with weight gain of 421.53g and better FCR of 0.69 was recorded. Dietary levels of 22 and 24%CP are also recommended for broilers growth at starter without compromising the physiological and nutritional status rainy season. This recommendation is for climatic regions that fall within the annual temperatures of between 25.6^0 C minimum and 35.5^0 C maximum, having rainfall pattern of between 86-211 minimum and maximum respectively. Further study is recommended with other species of poultry such as the laying chickens, turkey and guinea fowls etc.

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