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RESPONSE OF MARSHALL BROILER CHICKEN FED DIFFERENT LEVELS OF DIETARY ENERGY DURING THE HOT DRY PERIOD IN SEMI-ARID ENVIRONMENT (STARTER PHASE)

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Abstract: *An experiment was conducted to determine the response of broiler chicken (marshall strain) fed different dietary energy levels on the performance parameters during the hot dry period in semi-arid environment. A total of 200 broiler chickens were randomly divided into four treatment groups replicated 5 times with 10 birds per replicate and 50 birds per treatment. Four experimental diets were prepared containing 2900(T1), 3000(T2), 3100(T3) and 3200 (T4) kcal/kg of ME with iso crude protein of 21%. Each experimental diet was fed to the birds for a period of 4 weeks (starter phase). Daily feed intake (FI), water intake (WI), Average daily gain (ADG), feed conversion ratio (FCR) and mortality were determined. Cost of Feed (N/kg) and Feed Cost per Kilogram Weight Gain (Naira) were calculated. The Results of the experimental broiler chickens fed varying dietary energy levels in hot dry period at starter phase showed that daily feed intake was not significant (P<0.05) in all of the treatments. Differences in mean values among these treatments are only different numerically. However, feed intake increased with increase in energy level from treatment 1 to treatment 4. Significant difference (P<0.05) exist in Average daily gained intake. However, T2, T3 and T4 are similar statistically. Results showed that average daily gain increased with increase in the age of the chickens. Feed conversion ratio (FCR) shows significant difference (P<0.05) across the treatments. However, T1 differ from T2, T3, and T4 statistically. Statistically there were no significant differences (P<0.05) in water intake in all of the treatments. The differences observed were only numeric. However, the trend showed that water intake increase with increased energy level from T1 to T3 but declined in T4. Mortality recorded in the experimental broiler chicken shows significant difference (P<0.05) among the treatments. However, T2 and T3 are similar statistically. Mortality increased with increase in energy level. Significant difference was observed (P<0.05) in feed cost per kilogram weight gain across the treatments. However, T1 and T2 differ statistically from T3*

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and T4 while T3 and T4 are similar. Feed cost per kilogram weight gain increased with the increase from T4 to T1. Significant difference (P<0.05) was observed in Feed Cost per Kilogram Weight Gain (Naira) among the treatments. But, T2, T3 and T4 are similar statistically not numerically. Cost of feed increased with increase in nutrient (energy level). The result also showed that T3 and T4 (3100-3200kcal/ME) should be fed to marshall broiler bird at both starter phase in hot season of semi arid Sokoto for optimum performance.

Keywords: Broiler chickens, energy, hot season, cost of feed, feed intake, water intake, weight gain, mortality.

I. INTRODUCTION

Poultry meat is the second most widely consumed meat in the world. A recent survey by (FAO, 2018) reported that the total poultry meat consumption has increased from 91 million tons in 2009 to 125 million tons in 2018 and is forecast to increase nearly 3% in 2019. In the light of this, the poultry industry is obliged to continuously grow for a steady supply of quality and protenous meat. Chicken meat provides high quality protein and high concentration of polyunsaturated fatty acids (Wapi *et al*., 2013).

High environmental temperature is one of the major concerns for broiler producers in many countries of the world, especially in hot tropics which necessitate to investigate the effect of hot season and dietary nutrient level on the growth performance of broilers. Since the broiler have no sweat glands and are mostly fully covered with feathers. The thermoregulations are challenge under hot weather of the semi arid environment, which are believe to affect feed intake, body weight gain and feed conversion ratio as the result of adaptive responses to the hot season(Lin *et al.*,2005). In Nigeria, poultry production is major contributor to animal protein. The predominant systems of poultry production in Nigeria are subsistent raised in open houses with poor ventilation impairing heat exchange, result in economic losses (Hassan and Reddey, 2012).

Among the challenges to the poultry industry in developing countries are the high prices of feed ingredients such as soybean meal and maize, which are used mainly for the formulation of poultry diets. The cost of feed is between 65% and 70% (Al-Sagheer *et al*., 2019) and 70% and 75% (Abd El-Hack *et al*., 2015) of the total cost of production, as opposed to about 50% to 60% in developed countries (Saeed *et al*., 2017). The best strategy to reduce the cost of poultry feeds is to use alternative cheaper local ingredients (Abd El-Hack *et al*., 2015; Ashour *et al*., 2016). Reducing the cost of feed is therefore an important target in the poultry industry. Increased feed costs and limited amounts of animal protein sources in poultry feed have led to the use of alternative plant proteins that make up some or all animal protein in feed (El Boushy *et al*., 2000; Vasso & Russ, 2007). Therefore, considerable attention has been given to the use of unconventional feedstuffs, such as agro-industrial by-products, in the formulation of poultry diets, with the intention of achieving suitable utilization and economic efficiency of poultry production (Alagawany *et al*., 2015; Abd El-Hack *et al*., 2017a; 2017b).

II. MATERIALS AND METHODS

STUDY AREA

The study was conducted at the Poultry Production Unit of the Teaching and Research Farm of the Usmanu Danfodiyo University Sokoto, veterinary clinic, Sokoto. Sokoto lies on latitude 13^{O} 05’ 00” N and 5^{O} 15’ 00” E, within the Sudan Savannah Zone, in the extreme north western part of Nigeria and at an altitude of 350m above the Sea level (Mamman *et al*.,

2000: Aregheore, 2009). Rainfall is between May and September with a peak in August. The average annual Rainfall is about 750mm. The mean annual Temperature is 34.9^{O}C with the highest Temperature (42C) recorded in April and the minimum Temperature (13.2C^{O}) occurring in January, Annonymous, 2007).

Experimental Procedure

A total of two hundred (200) day old broiler chicks of marshal strain averaging 35g were used for the study. The birds were reared on deep litter with all routine management throughout the experimental period of 4weeks with feed and watered *ad libitum*.

The experimental design used was completely randomised design (CRD), with four (4) treatments consisting of different level of energy (2900kcal/kg, 3000kcal/kg, 3100kcal/kg, 3200kcal/kg) as T1, T2, T3 and T4. Each treatment was replicated five (5) times with ten (10) birds per replicate.

The composition of ingredients and nutrients in the experimental diets are shown in Table 1.

Daily Feed intake (FI) was recorded by subtracting feed left over from the quantity of feed given. Water intake (WI) was recorded by subtracting the left over from the quantity of water given. Weight gain (WG) was recorded on weekly basis by subtracting previous body weight from the current weight for each week; average daily gain (ADG) was obtained by dividing weekly gain by seven (7). Record of feed intake and weight gain were used to calculate the feed conversion ratio (FCR) and mortality was recorded as it occurs to adjust the total number of birds. The birds were weighed early in the morning before receiving any feed and water using a weighing balance at weekly interval during the experimental period. Initial and final weight of the birds was measured at the beginning and end of the experiment respectively.

$$\text{FCR} = \frac{feed\ intake}{weig\ ht\ gain}$$

Cost of Feed (N/kg) was calculated from the cost of individual ingredients used in feed preparation and Feed Cost per Kilogram Weight Gain (Naira) was calculated by multiplying feed cost per kilogram by feed conversion ratio.

Table 1: Composition (%) of Experimental Diets

	Starter(0-4 weeks)			
Ingredients	**Diet 1**	**Diet 2**	**Diet 3**	**Diet 4**
Maize	50.00	48.50	49.50	48.80
Wheat offal	2.00	-	0.00	-
Fish meal	3.50	3.50	5.00	5.40
Soya bean meal	15.00	12.00	9.00	11.00
Groundnut cake	18.00	24.00	21.35	17.70
Blood meal	4.00	3.00	4.50	5.00
G/Oil	2.00	4.00	5.50	7.50
Limestone	2.00	2.00	2.00	1.50
Bone meal	2.50	2.00	2.00	1.80
Salt	0.25	0.25	0.20	0.25
Premix	0.25	0.25	0.25	0.25
Methionine	0.30	0.30	0.40	0.40
Lysine	0.20	0.20	0.30	0.40
Total	100.00	100.00	100.00	100.00
Calculated analysis				
Energy(kcal/kg)	2915.30	3013.45	3100.58	3201.59
Crude protein (%)	23.10	23.10	23.02	23.01
Crude fibre (%)	4.20	4.26	3.92	3.75
Ether extract (%)	3.57	3.48	3.42	3.41
Calcium (%)	1.70	1.57	1.68	1.49
Phosphorus	0.78	0.69	0.75	0.75
Methionine	0.62	0.61	0.71	0.72
Lysine	1.41	1.33	1.42	1.59
Cost of feed (N/kg)	162.96	176.09	180.84	182.64

III. DATA ANALYSIS

Data obtained from feed intake, water intake, average daily gain, feed conversion ratio and carcass evaluation were subjected to analysis of variance (ANOVA) using Stat View Analytical computer package version 5. Least significant different (LSD) was used for means comparison at $P<0.05$ while mortality was calculated in percentage.

IV. RESULTS AND DISCUSSION

General Performance of Broiler Chickens at Starter phase (0-4weeks)

Results on the performance of experimental broiler chickens in the starter phase are presented in table 2.

Table 2: Effect of dietary energy on growth performance parameters of broiler at starter phase in hot dry period of semi-arid environment

VARIABLES	T1(2900)	T2(3000)	T3(3100)	T4(3200)	SEM	SIG
Feed intake(g/b/d)	30.79	30.78	31.20	31.38	0.44	NS
Average daily gain(g/b/d)	12.94^{b}	15.10^{ab}	16.76^{a}	16.96^{a}	0.52	*
Feed conversion ratio	2.38^{a}	2.04^{b}	1.95^{b}	1.90^{b}	0.05	*
Water intake (mls/b/d)	70.35	70.39	72.54	71.25	0.66	NS
Mortality (%)	22.00^{c}	34.00^{b}	34.00^{b}	40.00^{a}	3.92	*
Cost of feed (Naira/kg)	162.96^{b}	176.09^{a}	180.84^{a}	182.64^{a}	4.81	*
Feed cost/kg weight gain(Naira)	387.84^{a}	359.22^{b}	352.64^{c}	347.02^{c}	2.74	*

abc=Means across the rows with different super script differ significantly(P<0.05)
SEM=Standard error mean, (N/kg) =Naira per kilogram, (N) =Naira
g /b/d=gram per bird per day

Results of the experimental broiler chickens fed varying dietary energy levels in hot dry period at starter phase showed that daily feed intake was lowest (30.79g) in treatment 1 and highest (31.38g) in treatment 4. Feed intake was not significant (P<0.05) in all of the treatments. Differences in mean values among these treatments are only different numerically. However, feed intake increased with increase in energy level from treatment 1 to treatment 4. High ambient temperature or hot period is generally detrimental to bird which reduced feed intake and subsequently depress average daily gain and F:G. Kamran *et al*.,(2004) noted nonsignificant difference of energy on feed intake which agreed with the finding of the present study. Bartove and Plavnic (1998) reported similar result in terms of feed intake until 42 days age in broilers fed diet with low energy. However, the results of the present findings are not in agreement with those of Lesson *et al*., (1996), Cheng *et al*., (1997) and Nawaz *et al*., (2006). They reported increase feed intake with the reduction in dietary ME. Birds generally eat for calories during the hot period. Feed intake will not be enough to satisfy their energy requirements. One possible ways to fulfill the bird energy requirement during the hot period is to increase the dietary ME.

Average daily gained intake was lowest (12.94g) in T1 and highest (16.96g) in T4. Significant difference (P<0.05) exist in T1. However, T2, T3 and T4 are similar statistically. Results showed that average daily gain increased with increase in the age of the chickens. Average daily gain increased with increase in energy levels. There was a significant increase in average daily gain in all birds, meaning that the gain more weight as they grew, which tally with the findings of Nsoso *et al*.,(2008), who contended that increase in average daily gained represent growth and development of farm animals. Compared to poultry fed dietary energy levels. Those fed very high energy diet tent to have higher average daily gained throughout the starter phase (0-4 weeks of age).The finding of this research concurred with that of Nyaulingo (2013) who observed body weight gain of chicks may be as a result of proper utilization of protein, energy, Vitamins and mineral component of the diet. Latham *et al*., (2016) reported a similar result that a reduction in97 kcal/kg decreased average daily gain

at0 to 42 days of age. Hu *et al*., (2018) also reported that a reduction of dietary energy decreased average daily gain in 0 to 14 days. However, growth response to dietary energy level had been inconsistent in broiler.

Feed conversion ratio (FCR) shows significant difference (P<0.05) across the treatments with the T4 (3200kcal/kg) having (1.90) as the lowest value and T1 (2900kcal/kg) with (2.38) as the highest value. However, T1 differ from T2, T3, and T4 statistically. FCR follow the normal trend, the higher the energy the better the FCR. Feed conversion ratio increased significantly with age in all of the dietary energy levels tested. Latham *et al*., (2016) reported a similar result that a reduction in97 kcal/kg increased FCR at 0 to 42 days of age, which tally with the result of the present study. The result of the present study for feed conversion ratio is in accordance with the findings of F.C Nworgu *et al*., (2007) who also reported significant difference feed conversion ratio at starter phase during late dry season in broilers fed fluted pumpkin (*Telfaria occidentale*) leaves extracted supplement.

Water intake was lowest (70.35mls) in treatment 1 (2900kcal/kg) and was highest (72.54mls) in treatment 3 (3100kcal/kg). Statistically there were no significant differences (P<0.05) in all of the treatments. The differences observed were only numeric. However, the trend showed that water intake increase with increased energy level from T1 to T3 but declined in T4, which disagree with the recommendations of J.A Oluyemi and S.A. Roberts (2000) which stated that there is significant correlation between feed intake and water intake of broiler birds.

Mortality recorded in the experimental broiler chickens, shows highest value in T4 (40%) with the lowest value in T1 (22%). Significant difference (P<0.05) was observed in among the treatments. However, T2 and T3 are similar statistically. Mortality increased with increase in energy level. Although, there is stagnation in T2 and T3, which is in accordance with the finding of this research tally with that of Sa'adu *et al*., (2018) who reported significant difference in mortality of broiler strain fed low, medium and high energy diet in 3 season (hot, cold and raining) at starter phase.

Results showed that feed cost per kilogram weight gain was lowest (347.02Naira) in treatment 4 (3200kcal/kg) and was highest (387.84Naira) in treatment 1 (2900kcal/kg). Significant difference was observed (P<0.05) in feed cost per kilogram weight gain across the treatments. However, T1 and T2 differ statistically from T3 and T4 while T3 and T4 are similar. Feed cost per kilogram weight gain increased with the increase from T4 to T1. Feed cost per kilogram weight gain (Naira) increased with increase in feed conversion ratio. This is due to the differences in feed conversion ratio, as the feed conversion ratio increased so as the feed cost per kilogram weight gain increased. The finding of this research is in accordance with the finding of Gocsik *et al*., (2013) who carried out research on different broiler production system on health care cost in Netherland and found out that increased in feed conversion ratio affects feed cost per kilogram weight gain. The result of the present study also agree with the result of F.C Nworgu *et al*., (2007) who also reported significant difference in feed cost per kilogram weight gain at starter phase during late dry season in broilers fed fluted pumpkin (*Telfaria occidentale*) leaves extracted supplement.

Cost of feed was lowest (162.96Naira/kg) in T1 and was highest (182.64Naira/kg) in T4. Significant difference (P<0.05) was observed in T1 among the treatments. But, T2, T3 and T4 are similar statistically not numerically. Cost of feed increased with increase in nutrient

(energy level). This is due to the fact that the higher the dietary energy the higher the ingredient and so the cost of feed. The result of the present study is in line with the findings of B. Indarish and R.A. E Pym (2009) that of A. Adeoti, and S. Olawuni (2013), that showed increase in the cost of feed of the birds as the protein and content of the diet increased.

V. CONCLUSION

Based on the result of this research, the result obtained for general performance shows that T3 and T4 (3100-3200 kcal/ME) should be fed to marshall broiler strain at starter phase for optimum or better performance during the hot dry period of semi arid Sokoto.

VI. RECOMMENDATIONS

It is recommended that further studies should be carry out in difference of 200kcal of energy for more differences.

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