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PERFORMANCE OF SOME BROILER STRAINS FED VARYING ENERGY LEVLES IN WET SEASON OF SEMI-ARID SOKOTO, NIGERIA

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ABSTRACT

Three commercial broiler strains (*Arbor-acre, Marshall* and *Hubbard*) were placed under three dietary energy and crude protein levels of 2900 Kcal/kg (ME) - 22% CP, 3100 Kcal/kg (ME) - 23% CP, and 3300 Kcal/kg (ME) - 24% CP as low, medium and high energy levels at starter phase, respectively. At the finisher phase, the birds were fed 2800 Kcal/kg (ME) - 19% CP, 3000 Kcal/kg(ME) - 20% CP and 3200 Kcal/kg (ME) - 21% CP, in order to determine their productive performance in wet season of semi-arid. A total of 675 birds were used in a completely randomized design (CRD) comprising 225 birds each of each strain serving as treatments. Each group was replicated five times so that each replicate had 15 birds. Each strain group was fed three dietary energy levels at both starter and finisher phases for 56 days. Feed and water intakes, mortality, weight gain, feed conversion ratio, Cost/kg gain was determined at the end of the trial. Data recorded for each phase were subjected to Analysis of variance (ANOVA) and least significant difference (LSD) was used to compare the means. Results indicated that *Hubbard* strain had significantly ($P<0.05$) lowest cost/kg gain, mortality, feed conversion ratio, feed intake and higher weight gain than other strains. Low energy diet had significant higher ($P<0.05$) weight gain and lower cost/kg gain than both medium and high energy diets. The study concluded that; *Hubbard* strain fed low energy diet should be raised in wet season of semi-arid Sokoto due to its lower cost/kg gain, mortality, better feed conversion ratio and higher average daily gain compared to other strains.

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INTRODUCTION

Broiler birds among other species of poultry have the potential of providing quality protein to the populace owing to its short generation interval, thereby creating source of employment and quicker return of investment. But, there has been allot of constraints hindering growth and development of poultry industry in wet season of semi-arid Sokoto, Nigeria, these include sudden temperature fluctuations in wet season which make it difficult for birds to maintain their thermoneutral zone. Similarly, the wet season of semi-arid Sokoto is characterized by high humidity which encourages the growth and proliferation of microorganisms of economic importance to broiler management. Other factors determining the success of broiler production in semi-arid Sokoto include; vertical immunity of a particular broiler strain to the common infections prevalent in wet season, and their ability to convert feed effectively in the event of stress.

The wet season of Sokoto semi-arid Nigeria extends between May and October and it is characterized by temperature fluctuations (SEPP, 1996 (unpublished); Abdulrahim et al. 2013).This temperature fluctuation does not support efficient performance of some broiler strains(Oluyemi and Roberts 2000; Razuki et al*.,* 2011). Broiler strains commonly supplied to the farmers in semi-arid Sokoto include *Arbor-acre*, *Hubbard* and *Marshall* which were developed in Asia and Europe, hatched and distributed by some companies in south western Nigeria, however, these differences in the environments and strains results in having inconsistent performance resulting from using a particular strain of broilers across different seasons of semi-arid Sokoto.

Nutrient requirements of broiler birds depend on a number of factors which include strain of the bird, age and environment in which the bird is reared. Therefore, knowing the strain that performs better in a wet season of semi-arid Sokoto when given certain energy level will remarkably improve broiler production and reduce the losses incurred by the farmers, which results from rearing less adaptive and disease resistant strain in wet season.

MATERIALS AND METHODS

The study area

The experiment was conducted at the Poultry Production and Research Unit of the Department of Animal Science, Usmanu Danfodiyo University, Sokoto. Sokoto state is located between latitudes 12^{o} and 13^{0} 05'N and between longitudes 4^{0}8 and 6^{0}4 E in the northern part of Nigeria and at an altitude of 350m above sea level (Mamman et al*.,* 2000). The State falls within the Sudan savannah vegetation zone, with alternating wet and dry seasons. Mean annual rainfall is about 700mm. The rainy season starts from June to early October, with a peak in August and potential evapotranspiration has been reported to be162mm. Maximum temperature of 41^{0}C has been reported in April and minimum of 13.2^{0}C in January (SEPP, 1996, unpublished)).

Experimental design

A total of 675 broiler birds were used in each of the trials, two hundred and twenty five (225) birds each of *Hubbard, Arbor acre*, and *Marshall* strains. Each of The strains was divided into three different energy groups of five replicates with each replicate containing fifteen birds. The three different energy groups for starter phase were 2900Kcal/kg (ME) 22% CP, 3100Kcal/kg (ME) 23% CP, and 3300 Kcal/kg (ME) 24% CP, respectively. For the finisher group energy and protein levels were 2800 Kcal/kg(ME) 19% CP, 3000 Kcal/kg(ME) 20% CP and 3200Kcal/kg(ME) 21% CP, respectively as shown in Tables 1 and Table 2, respectively.

Sources of experimental birds

The birds used for this experiment were sourced from three commercial hatcheries all of which were from Oyo State in Nigeria. The strains used were *Hubbard, Marshall* and *Arbor-acre* broiler strains. The birds were purchased from these hatcheries at the same time so that each strain was obtained in the same day.

Table 1. Gross and calculated chemical composition of diets to be fed at the starter phase

Ingredients (%)	Diet-1	Diet-2	Diet-3
Maize	50.00	54.50	50.00
Groundnut cake	14.50	32.00	30.00
Soya bean meal	20.00	4.50	7.50
Wheat Offal	4.00	2.00	-
Maize Bran	5.00	-	-
Blood Meal	1.50	2.00	3.50
Lime Stone	2.00	2.00	2.00
Bone Meal	1.80	1.80	1.80
Premix	0.25	0.25	0.25
Methionine	0.30	0.30	0.30
Lysine	0.30	0.30	0.30
Salt	0.30	0.30	0.30
Oil	-	-	4.00
Total	**100**	**100**	**100**
Calculated Analysis			
M.E.Kcal/kg	2,911	3,070	3,282
C.P.(%)	22.00	23.00	24.00
P(av)(%)	0.45	0.39	0.40
Ca(%)	1.27	1.27	1.28
EE	3.73	4.63	4.12
C.F	3.98	3.17	3.02
Methionine	0.60	0.60	0.60
Lysine	1.36	1.22	1.35

*****Vitamin A 30000000 i.u, Vitamin D3 6000000 i.u, Vitamin E 30000 i.u, Vitamin K 2000 mg, Vitamin B2 30000mg, Vitamin C 30 g, Niacin 40000 mg, Panthothenic acid 12000 mg, Vitamin B6 1500 mg, Vitamin B12 10000 mg, Folic acid 1000 mg, Bioton 400 mg, Choline chloride 300000 mg, Cobalt 200 mg, Copper 1200 mg, Iodine 20000 mg, Iron 40000 mg, Manganese 100000 mg, Selenium 150 mg, Zinc 30 mg, Antioxidant 1250 mg

**M.E= Metabolisable energy, C.P=Crude protein, P(av)=Available phosphorous, Ca=calcium, C.F= crude fiber, and EE = Ether extract

Birds and their management

Experimental birds were kept for three days after transport to take care of stress due to transportation. During the three days, they were administered anti stress drugs, later weighed and allotted to their replicate groups. Each strain group (treatment) was replicated five times. Routine vaccinations were administered; antibiotics and coccidiostats were also administered according to the recommendations of Oluyemi and Roberts (2000). The birds were housed on a deep litter with open sided walls. The house and pens were cleaned, washed Fumigated and disinfected prior to the arrival of the birds. Wood shavings were used as litter material.

Table 2. Gross and calculated chemical composition of diets to be fed at the finisher phase

Ingredients (%)	Diet-1	Diet-2	Diet-3
Maize	45.50	57.10	52.00
Groundnut cake	16.00	22.00	28.00
Soya bean meal	11.50	7.00	7.00
Wheat Offal	10.00	8.00	5.00
Maize Bran	12.00	-	-
Blood Meal	-	1.00	-
Lime Stone	2.00	2.00	2.00
Bone Meal	2.00	1.90	1.90
Premix	0.25	0.25	0.25
Methionine	0.21	0.20	0.25
Lysine	0.21	0.20	0.25
Salt	0.30	0.30	0.30
Oil	-	-	3.00
Total	**100**	**100**	**100**
Calculated Analysis			
M.E.Kcal/kg	2,827	2,977	3,178
C.P.(%)	19.00	20.00	21.00
P(av)(%)	0.44	0.41	0.41
Ca(%)	1.31	1.29	1.29
EE	3.53	4.15	4.18
C.F	4.75	3.39	3.32
Methionine	0.48	0.47	0.53
Lysine	1.02	1.03	1.06

***Vitamin A 30000000 i.u, Vitamin D3 6000000 i.u, Vitamin E 30000 i.u, Vitamin K 2000 mg, Vitamin B2 30000mg, Vitamin C 30 g, Niacin 40000 mg, Panthothenic acid 12000 mg, Vitamin B6 1500 mg, Vitamin B12 10000 mg, Folic acid 1000 mg, Bioton 400 mg, Choline chloride 300000 mg, Cobalt 200 mg, Copper 1200 mg, Iodine 20000 mg, Iron 40000 mg, Manganese 100000 mg, Selenium 150 mg, Zinc 30 mg, Antioxidant 1250 mg

**M.E= Metabolisable energy, C.P=Crude protein, P(av)=Available phosphorous, Ca=calcium, C.F= crude fiber, and EE = Ether extract

Period and duration of the experiments

The experiment was carried out in the months of July and August because they are characterized by high rainfall, temperature fluctuations and high humidity for the period of 56days (8weeks) for both starter and finisher phases from 5th July to 30th August, 2015. At the end of starter phase the replicates were pooled together and then re allotted to different replicate groups for finisher phase depending on the number of birds that survived to the finisher phase after which the experiment was terminated.

Data collection

Feed intake was recorded on daily basis by subtracting remnants from quantity offered the previous day. Body weight gain was recorded weekly by weighing the birds and determining increase or loss of weight. Record of feed intake and weight gain were used to compute the feed conversion ratio for each replicate. This was done for both starter and finisher stages of the study.

Data analysis

Data obtained from feed intake, water intake, weight gain, feed conversion ratio, efficiency, and carcass evaluation was subjected to Analysis of Variance (ANOVA) using Stat View Analytical computer package version 5 (SAS, 1998). Means were compared by Least Significant Difference (LSD).

RESULTS

Table 3 shows the main effect of strain, energy and their interactions on performance parameters of different broiler strains at starter phase in wet season of semi-arid Sokoto. Significant differences (P<0.05) were observed in the main effect of strain in terms of average daily gain, feed intake, feed conversion ratio, mortality and cost/kg gain. *Marshall* and *Hubbard* strains were observed to have significantly (P<0.05) higher value of average daily gain of 13.47 and 12.78g, respectively, than the *Arbor-acre* strain which had 10.92g/b, similarly there was no significant difference (P>0.05) between *Marshall* and *Hubbard* strains in terms of feed intake where the two strains were observed to have an average daily intake of 40.59 and 37.60g/b/d, respectively, but there was significant difference (P<0.05) between *Marshall* and *Arbor-acre* strains, where *Arbor-acre* strain was observed to have a daily feed intake of 36.07g/b. Furthermore, significant difference (P<0.05) was also observed in feed conversion ratio of the different strains, where *Hubbard* strain was observed to have significantly (P<0.05) better feed conversion ratio of 2.99 as compared to the *Arbor-acre* strain which had a feed conversion ratio of 3.35 which was similar to the value obtained for *Marshall* strain. Significant differences further existed with respect to cost/kg gain of the different strains, *Arbor-acre* was observed to have significantly (P<0.05) higher cost/kg gain of N330.71 as compared to *Hubbard* and *Marshall* strains which had a cost/kg gain of N294.59 and N302.87, respectively (P<0.05).

Table 3. Main effects of strain, energy and their interactions on performance parameters of different broiler strains at starter phase in wet season of semi-arid Sokoto

Factor	ADG (g/b)	Feed intake (g/b/day)	FCR	Water intake (mls/b/day)	Mortality (%)	Cost/kg gain
Arbor-acre	10.92^{b}	36.07^{b}	3.35^{a}	49.64	8.44^{a}	330.71^{a}
Hubbard	12.78^{a}	37.60^{ab}	2.99^{b}	43.12	4.00^{b}	294.60^{b}
Marshall	13.47^{a}	40.59^{a}	3.06^{ab}	48.67	8.89^{a}	302.87^{b}
SEM	0.53	1.25	0.12	2.43	1.526	13.48
Energy						
Low energy	13.58^{a}	39.63	2.94	42.293^{b}	5.78	287.69^{b}
Medium energy	12.20^{ab}	38.35	3.25	52.059^{a}	7.56	296.73^{b}
High energy	11.39^{b}	36.24	3.21	47.082^{ab}	8.00	343.75^{a}
SEM	0.55	1.31	0.13	2.284	1.60	12.44
Strain X Energy	*	NS	NS	*	*	*

Means with different superscript across the column are statistically significant at (P<0.05)
ADG= Average daily gain; FCR= Feed conversion ratio

With regards to main effect of energy irrespective of the strain at starter phase of wet season, significant difference (P<0.05) was observed in terms of average daily gain, water intake and cost/kg gain but there was no significant difference (P>0.05) in terms of feed intake, feed conversion ratio and mortalities at different energy levels. Those birds that consumed low energy diet were observed to have significantly (P<0.05) higher average daily gain of 13.58g/b as compared to those that consumed high energy diet which had an average daily gain of 11.39g/b but there was no significant difference (P>0.05) between low and medium energy diets in terms of average daily gain. Similarly, there was no significant difference (P>0.05) between medium and high energy diets in terms of average daily gain.

Significant difference (P<0.05) existed for water intake across different dietary energy levels at starter phase of wet season. The birds that consumed medium energy diet had significantly (P<0.05) higher value for water intake of 52.06mls/b/d as compared to that consumed low energy diet which had an average daily water intake of 42.30m/s/b but there was no significant difference (P>0.05) between birds fed medium and high energy diets and between those fed high and low energy diets. The birds that consumed high energy diet irrespective of strain had significantly (P<0.05) higher cost/kg gain of N343.75 as compared to those that consumed medium and low energy diets, which had a cost/kg gain of N296.73 and N287.69, respectively. There were Significant interactions (P<0.05) between strains and energy in terms of average daily gain, water intake, mortality and cost/kg gain but there was no significant interaction (P>0.05) of strains and energy levels on feed intake and feed conversion ratio at this phase of the experiment.

Table 4. Main effects of strains, dietary energy and their interactions performance parameters of different broiler strains at finisher phase in wet season of semi-arid Sokoto

Factor	ADG (g/b)	Feed intake (g/b/day)	FCR	Water intake (mls/b/day)	Mortality (%)	Cost/kg gain(₦)
Arbor-acre	21.28	80.39	4.00	163.24^{b}	24.04	407.82
Hubbard	21.21	87.57	4.23	170.26^{b}	20.85	427.40
Marshall	21.89	84.92	3.92	188.40^{a}	18.48	397.477
SEM	1.06	3.00	0.23	5.30	3.45	28.23
Energy						
Low energy	22.81^{a}	86.22	3.86^{b}	177.75	20.48	362.59^{b}
Medium energy	23.07^{a}	82.26	3.64^{b}	168.68	20.84	356.69^{b}
High energy	18.49^{b}	84.41	4.67^{a}	175.54	22.05	513.41^{a}
SEM	0.91	3.00	0.21	5.79	3.30	21.68
Strain X Energy	NS	NS	**	NS	*	*

Means with different superscript across the column are statistically significant at (P<0.05)
ADG= Average daily gain; FCR= Feed conversion ratio

Table 4 shows main effects of strain, dietary energy and their interactions on performance parameters of different broiler strains at finisher phase in wet season of semi-arid Sokoto. There was no significant difference (P>0.05) in terms of average daily gain, feed conversion ratio, mortality and cost/kg gain across all the three strains; (*Arbor-acre*, *Hubbard* and *Marshall*) groups. However, there was significant difference (P<0.05) between *Marshall* and the two other strains (*Arbor-acre* and *Hubbard*) in terms of average daily water intake. *Marshall* strain was observed to have significantly (P<0.05) higher value of water intake (188.40mls/b/day) than both *Arbor-acre* and *Hubbard* strains which had an average daily water intake of 163.24 and 170.26mls/b/day, respectively.

Significant difference (P<0.05) was observed with regards to main effect of dietary energy levels in terms average daily gain, feed conversion ratio and cost/kg gain at finisher phase, while there was no significant difference (P>0.05) in terms of feed intake water intake and mortality across all the three dietary energy levels. Irrespective of strains, the birds that consumed low and medium energy diets were observed to have significantly (P<0.05) higher values for average daily gain of 22.83 and 23.07g respectively, as compared to those that consumed higher dietary energy level which had an average daily gain of 18.49g/b. Significant difference (P<0.05) was also observed in terms of feed conversion ratio for the birds across the three different dietary energy levels. Those that consumed low and medium energy diets were observed to have significantly (p<0.05) better feed conversion ratio of 3.86 and 3.64, respectively as compared to those that consumed higher energy which had a feed conversion ratio of 4.67. Furthermore, significant difference (P<0.05) was also observed with regards to cost/kg gain under main effect of energy at finisher phase of wet season. The birds that consumed high energy diet irrespective of strain, were observed to have significantly (P<0.05) higher cost/kg gain of N513.41 as compared to those that consumed low and medium energy diets which had a

cost/kg gain of 362.59 and ₦356.68 ,respectively. Non-significant interaction (P<0.05) between strain and energy was observed in terms of average daily gain, feed intake and water intake. But significant interaction (P<0.05) was observed in terms of feed conversion ratio, mortality and cost/kg gain at finisher phase of wet season of semi-arid Sokoto.

DISCUSSION

Performance parameters of different broiler strains at starter phase in wet season of semi-arid Sokoto

Significant differences that were observed in the main effect of strain in terms of average daily gain, feed intake, feed conversion ratio, mortality and cost/kg gain, were higher than those obtained for the same strains in other researches. For example, *Hubbard* strain was reported to have a feed conversion ratio of 1.98 at 4th week Hossain et al. (2011), while *Arbor-acre* that was reported by Rokonuzzaman et al. (2015) to be having a feed conversion ratio of 1.37 at 4th week of age is having 3.35 at the same age in the current studies. Similarly, the *Marshall* strain that had a feed conversion ratio of 3.06 in the current study was reported by Olawumi et al. (2012) to be having a feed conversion ratio of 1.65, these marked differences in the feed conversion ratio of these strains could be as a result the coccidiosis experienced during the current study which is known to limit or inhibit the absorption of nutrient in the small intestine which is known to harbor a large number of E*mira spp* during the infection, in addition to this, the wet season of every environment is characterized by high humidity, which causes continuous damp litter that favors the growth and proliferation of coccidial parasite that proves to be difficult to handle. As for the significant difference that was noticed across the three strains in terms of mortality *Marshall* and *Arbor-acre* strains were observed to have significantly (P<0.05) higher mortality, compared to *Hubbard* strain, this agrees with the findings of Serker et al. (2001), it equally agrees with the findings of Javid- iqval et al. (2012) that showed *Hubbard* strain to have significantly lower mortality compared to *Arbor-acre* strain. But Hossain et al. (2011); Rokonuzzaman et al. (2015) reported non-significant difference (P<0.05) in the mortality rates of different broiler strains in their separate experiment which contradicts the findings of the current study. Significant differences observed with respect to cost/kg gain of different strains in the current study is in line with the findings of Adeoti and Olawumi (2013) which stated that *Marshall* strain had significantly lower cost of producing 1kg of meat than either *Hubbard* or *Arbor-acre* strains.

The Significant difference that was observed in terms of average daily gain, water intakes and cost/kg gain and non- significant difference in terms of feed intake, feed conversion ratio and mortalities of different energy levels are in line with the findings of Dairo et al. (2012); Huwaida et al. (2012) where they reported significant different between the weight and cost/kg gain of broiler birds fed different protein and energy levels. It can easily be understood from these results that; the energy content of the diet does not necessarily affect the water intake of the diet at starter phase of wet season, since the humidity of the environment was high during the rainy season; the demand for drinking water was expected to be low, because the low energy diet that was supposed to record the highest water intake was observed to have the lowest water intake, similarly the medium energy diet that was supposed to record the medium water intake, recorded highest water intake, this further explained why there was no significant difference in terms of feed intakes across different energy levels. The highest cost/kg gain observed for those that consumed high energy diet in the current study agrees with the findings of Pederoso et al. (2003) that reported significant difference in terms of cost/kg gain of birds fed different amino acid profiles.

Similarly, the Significant interactions (P<0.05) that was observed between strains and energy in terms of average daily gain, water intake, mortality and cost/kg gain and non-significant interaction in terms of feed intake and feed conversion ratio is in line with the report of Ahsanulhaq et al. (2003) that showed *Hubbard* strain to be more profitable than *Arbor-acre* and strains in Parkistan.

Performance parameters of different broiler strains at finisher phase in wet season of semi-arid

The non-significant difference observed in terms of average daily gain, feed conversion ratio , mortality and cost/kg gain across all the three strains; (*Arbor-acre*, *Hubbard* and *Marshall* strains) and the significant difference that was noticed between *Marshall* and two other strains (*Arbor-acre* and *Hubbard*) in terms of average daily water intake were in line with reports of Chew et al. (1978); Zahid and Hussain (2002) that stated that there was non-significant difference in feed intake, weight gain and feed conversion ratio of several

boiler strains they compared in their separate experiments. However, their results disagree with the report of Zollistch et al. (1989) that there was significant difference (P<0.05) in the performance of some broiler strains, it also disagrees with Indarish and Phym (2009) that reported significant difference (P<0.05) in terms of feed intake and feed conversion ratio of three different strains of broilers namely; *Cobb*, *Ingham* and *Steggels*, however this difference could be due to the fact that different strains were used compared to the ones used in this study.

Moreover, the significant difference that was observed with regards to main effect of energy in terms average daily gain, feed conversion ratio and cost/kg gain at finisher phase of wet season and the non-significant difference in feed intake, water intake and mortality across all the three energy levels, is similar to the findings of Zahid and Hussain (2002), which showed significant difference (P<0.05) in the feed conversion ratio of boiler birds fed different energy and protein concentration, however, the values they reported were lower than those observed in the present study. This is because the concentration of the nutrients used in the two separate study differs and also the environmental temperature, but Ebling et al. (2013) reported non-significant difference in the feed conversion ratio of boiler birds fed different amino acid levels which disagrees with findings of this study. As the case with the previous phases of the experiment, the birds that consumed high energy diet had the highest cost of production compared to those fed low and medium energy diets, From this result it can be said that; since the birds that consumed low and medium energy diets performed better in terms of weight gain, than those that consumed high energy diet which also had a better feed conversion ratio than those that consumed high energy diet, yet they had the same feed intake and mortality. It is therefore economical to feed low and medium energy diets to broiler birds irrespective of their strain in wet season of semi-arid Sokoto. This is in line with the findings of Dairo et al. (2012) that recommended feeding low energy and low protein diets to broiler birds because of the high cost, and scarcity of energy and protein feedstuffs. However, Ebling et al. (2013) reported non-significant difference (P>0.05) in the economic performance of broiler birds fed different amino acid concentrations which contradicts the findings of the current study. Achi et al. (2007) reported non-significant difference in the feed intake of broiler birds feed different protein sources which is in line with the findings of the present study. Similarly, Gu et al. (2008) reported non-significant difference in the feed intake of boilers birds fed different levels of protein which tallies with the findings of this study, but disagrees with the findings of Hassan et al. (2011) that reported significant difference in the feed intake of broiler birds fed different dietary regimes.

Furthermore, the non-significant interaction that was seen between strain and energy in terms of average daily gain, feed intake and water intake and the significant interaction observed in terms of feed conversion, mortality and cost/kg gain at finisher phase of wet season, tallies with that of Syed et al. (1998) that reported significant interaction between strains of broiler and seasons in terms of feed conversion ratio and mortality. It equally agrees with the findings of Namakparvar et al. (2014) that reported significant interaction between strain and sex on the feed conversion ratio and weight gain three broiler strains. Similarly, Attia et al. (2015) reported significant interaction between two strains of broilers placed on four different feeding regiments under hot season of Saudi Arabia. But Netshipale et al. (2012) reported non-significant interaction between strains of broiler birds and feeding program in terms of feed conversion ratio which contradicts the findings of this study these differences could be as a result of difference in environment.

CONCLUSION

From the study, it was concluded that *Hubbard* strain had performed better than other strains in the wet season of the semi-arid environment and fed low energy diet engendered more performance among all the strains. It was hence recommended that *Hubbard* strain fed low energy diet should be raised in wet season of semi-arid Sokoto due to its lower cost/kg gain, mortality, better feed conversion ratio and higher average daily gain compared to other strains.

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