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ASSESSMENT OF THE IMPACT OF GROWER EXPERIMENTAL DIETS ON EARLY LAYING PERFORMANCE OF BLACK HARCO

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ABSTRACT

This study was conducted to determine the effect of feeding grower experimental diets containing 2,400, 2,500 and 2,600 kcal/kg (T1, T2 and T3) of ME on the early laying performance of 180 Black-Harco laying birds from 9 - 19 weeks of age. The effect of feeding a commercial diet of unknown composition containing 2500 kcal/kg of ME purchased from vital feed selling outlet was also evaluated. At the end of the growing phase, birds were assigned to a common layer diet for eight weeks and maintained within the same treatments of 45 birds and replicates of 15 birds used in the grower experiment.The results indicated that feeding high energy diets during the growing period tend to promote onset of lay. However, once laying starts, birds reared on the lower energy diets (2,400-2,500 kcal/kg) reached peak production level earlier within 205 to 208 days. However, at 50% egg production level, birds reared on the commercial diet weighed (1.70 kg) heavier ($P<0.05$) than those reared on the other treatments. These results indicate that in this ecological zone birds could be raised on diets containing 2,400-2,600kcal/kg without compromising laying performance. However, in order to fully appreciate the effect of dietary energy levels in this ecological zone, more trials could be conducted using wider energy variations.

Keywords: Birds; High energy; Low energy; Egg

INTRODUCTION

The diet fed to birds during growing phase must provide adequate caloric needs in order to exploit their full genetic potentials. During the growing period, maintaining a uniform flock body weight should be of primary concern, where as in the laying period, optimizing egg production is the economic objective. Providing pullets with improper nutrients during growing stage can adversely affect the laying cycle. This is because there is a relationship between the pullet‘s development during rearing and subsequent egg laying performance. From point of lay, females undergo a pattern of physical and physiological changes manifested partly in the efficiency of egg production, egg size and body weight (Oluyemi and Roberts, 2000). These parameters are affected by the management system adopted during the growing phase. This experiment therefore, aims at evaluating the effect of the grower experimental diets on sexual maturity and early laying performance.

MATERIALS AND METHODS

Study Area

The study was conducted between August and November, at the poultry production unit of Sokoto State Veterinary Center, Aliyu Jodi Road Sokoto, Sokoto State. Sokoto State is located in northwestern Nigeria, between latitudes 12^{o} 0' and 13^{o} 58' N and longitude 4^{o} 8' and 6^{o} 54' E (SSGR, 2005), with a land area of 56,000 square kilometers (Mamman and Udo, 1993; SSMIYSC, 2001). The state falls within the Sudan savannah vegetation zone to the south, and the Sahel savannah to the north. It is an open tse – tse fly free grassland that favors animal husbandry and cultivation of grains (Malami *et al.,* 2001). The climate is characterized by alternating wet and dry seasons. The hot, dry spell extends from March to May and sometimes to June in the extreme northern part. A short, cool, dry period (the harmattan) lasts between late October and late February. The duration of the annual precipitation (which lasts between May/June and September/October) increases from north to south, ranging from 60 – 160 days. The intensity of the annual precipitation also varies from 635mm in the north to 750mm in the south (Malami *et al.,* 2001). Potential evapotranspiration is estimated at 162mm (Reuben, 1981). The mean annual temperature is 34.9^{o}C, with the highest (41.0^{o}C) occurring in April and the lowest (13.2^{o}C) occurring in January (Reuben, 1981; SSMIYSC, 2001).

Experimental birds and management

The 180 Black- Harco birds that were fed the grower experimental diets in completely randomized design during the growth study were transferred to battery cages. The birds were maintained within the same treatments of 45 birds and replicates of 15 birds used in the grower experiment. The birds were fed a common layer diet for eight weeks. The gross and chemical composition of the diets is shown on tables 1 and 2.

Table 1: Gross composition of the experimental diets

Ingredients	Treatments (energy levels (kcal/kg)				Common layers^ diet 2500 kcal/kg
	T1 (2400)	T2 (2500)	T3 (2600)	T4 (2500)*	
Maize	33.80	36.10	38.40	-	27.2
Maize bran	0.90	8.40	16.10	-	35.5
GNC	4.10	6.50	9.00	-	22.5
Blood meal	3.0	3.0	3.0	-	3.00
Limestone	0.75	0.60	0.40.	-	8.60
Bone meal	2.10	2.30	2.50	-	2.40
Premix	0.25	0.25	0.25	-	0.30
Salt	0.25	0.25	0.25	-	0.30
Methionine	0.17	0.17	0.17	-	0.16
Lysine	0.00	0.05	0.10	-	0.08
Total	100	100	100		100

*Commercial diet, composition unknown; T1, T2, T3 and T4- diets fed to growing from 9-19 weeks age; ^- diet fed to early laying pullets from 20 to 30 weeks of age

The experiment was conducted between the 20th and 30th weeks of age of the birds. Feed and water were offered *ad libitum.* Feed and water intake were monitored daily. Eggs were collected between 5 – 6 pm daily. Weights of eggs were recorded on weekly basis. Live weight of the birds was monitored at onset of lay and when they reached 5 %, 50 % and peak egg production level. Temperature of the pen was also monitored using a maximum and minimum thermometer. Feed conversion ratio was expressed as feed intake (g) per dozen eggs. Data were analysed using a completely randomized design of the General Linear Model of using the Statistical Package for Social Science (SPSS, 1990). Data on growth performance and weight of eggs were analysed using One-way ANOVA. Data on percentage egg production were transformed using arcsin transformation table before being subjected to One-way ANOVA. Duncan's multiple range tests was used to elucidate differing means.

Table 2: Chemical composition of the of the experimental diets

Nutrients	Treatments (energy levels (kcal/kg)				Common^ layers diet
	T1	T2	T3	T4 *	
Energy (kcal/kg)	2400	2500	2600	2500*	2,500^
Protein (%)	16.0	16.0	16.0	14.5	18.0
Lysine (%)	0.8	0.8	0.8	*	0.8
Methionine (%)	0.4	0.4	0.4	*	0.4
Calcium (%)	0.9	0.9	0.9	0.8	3.7
Phosphorus (available) (%)	0.5	0.5	0.5	0.4	0.4
Fiber (%)	5.7	5.7	5.7	7.2	6.0
Ether extract (%)	3.6	3.4	3.2	7.0	2.5

*Commercial diet, composition unknown

T1, T2, T3 and T4- diets fed to growing from 9-19 weeks age.

- diet fed to early laying pullets from 20 to 30 weeks of age

RESULTS

Influence of Grower Diets on Sexual Maturity and Early Laying Performance

For the formulated diets, dietary energy density fed at the grower phase had a significant effect (P<0.05) on the age at first lay, as birds fed the higher energy diets came to lay earlier (148,155 and 157 days for T3, T2 and T1, respectively) (table 3). Birds fed the commercial pelleted diet were the last to start laying (161 days). However, birds fed the low energy diet (2,400 kcal/kg) were the first to reach 50 % egg production at 176 days; this was followed by those reared on the 2,500 and 2,600 kca/kg diets at 179 days. Birds fed on the commercial diet reached 50 % egg production at 180 days. These differences were, however, not significant. The age at peak production level was, however, significantly (P<0.05) affected by energy levels of diets fed at grower stage. Thus, birds reared on the 2,400 kcal/kg diet reached peak production earlier at 205 days compared to those reared on the 2,600 kcal/kg diet at 216 days (Table 3).

Table 3: Influence of grower experimental diets on attainment of sexual maturity and peak egg production

	Treatments (energy levels, kcal/kg, fed during growing period)				
	T1 (2400)	T2 (2500)	T3 (2600)	T4 (2500)	*SEM
Age at first lay (days)	157^{b}	155^{c}	148^{d}	161^{a}	2.71
Age at 50% production (days)	176	179	179	180	1.5
Age at peak production (days)	205^{b}	211^{ab}	216^{a}	208^{ab}	4.06
Peak egg production level (%)	90.1 (71.66)^{b}	90.1 (71.66)^{b}	95.0 (77.08)^{a}	89.2 (70.81)^{c}	2.28
Liveweight at week 20 (kg/b)	1.32	1.27	1.30	1.30	0.02
Liveweight at point of lay (kg/b)	1.37	1.38	1.40	1.39	0.01
Liveweight (kg/b) at :					
5% production	1.49	1.52	1.57	1.47	0.03
50% production	1.56^{b}	1.64^{b}	1.62^{b}	1.70^{a}	0.05
Peak production level	1.85	1.86	1.85	1.87	0.01
Weight of first egg (g)	37.3	34.0	33.3	32.6	1.06

a,b,c, : Means along the same row with different superscript are significantly different (P<0.05); T1, T2, T3 and T4- diets fed to growing from 9-19 weeks age; *Standard error of mean; Figures in parenthesis are transformation to arcsin

Live weight of birds at point of lay did not differ significantly between the treatments (Table 3). The same trend was observed at 5 % production level, even though birds reared on the higher energy diets were slightly heavier. At 50 % egg production level, differences in live weight between the treatments became significant, with birds fed on the commercial diet weighing heavier (P<0.05) than those fed on the formulated diets. The significant difference in live weight however, disappeared at peak production level.

Weight of first egg did not differ significantly between the treatments. For the formulated diets, it tended to decrease with increasing dietary energy level. Thus, it decreased from 37.3 g for birds reared on the 2,400 kca/kg diet to 33.3 g for those reared on the 2,600kca/kg diet (Table 3). Birds grown on the commercial diet recorded the least weight of first egg (32.6g).

Hen–day egg production varied from 36 % for birds raised on the commercial diet to 43 % for those raised on the 2,400 kca/kg diet, with no significant differences between the treatments. A closer look at the hen–day production record (Table 4) indicates that egg production started at week 20 for treatment 3 (2.2 %), week 21 for treatment 2 (2.2 %), and week 24 for treatments 1 (7.3 %) and 4 (1.3 %). Egg production rose steadily up to the 29th week when it peaked at 95% for treatment 3, 90 % for treatments 1 and 2 and 89 % for treatment 4. It then declined at the 30th week. Significant differences in egg production were noticed only between the 23rd and the 26th week, during which time the productivity for birds raised on the low energy diet (T1) was significantly higher than that of other treatments. Overall egg production for the whole period (i.e. up to the 30th week) was also higher for birds raised on the 2,400 kcal/kg diet (43%) followed by those raised on the

2,500 and 2,600 kcal/kg diets (40 %). Birds reared on the commercial diet had the least production (36 %). The differences were however not statistically significant.

Table 4: Hen-day egg production of laying pullets from 20-30 weeks of age reared on diets containing varying energy levels at growing phase

Age (weeks)	Treatments (energy levels kcal/kgfed during the growing phase)				
	T1 (2400)	T2 (2500)	T3 (2600)	T4 (2500)	*SEM
20	-	-	2.2	-	
21	-	2.2	1.9	-	
22	7.3	6.4	3.8	1.3	1.35
23	23.5[a]	9.1[b]	4.8[b]	1.3[b]	8.44
24	20.6[a]	9.9[b]	10.4[b]	5.7 [b]	5.48
25	33.4[a]	27.2[b]	28.0[b]	21.3 [b]	2.21
26	60.5[a]	56.4[ab]	49.4[b]	41.9 [b]	7.07
27	74.2	75.9	71.3	63.2	4.87
28	79.4	81.6	86.3	88.0	3.46
29	90.1	90.1	95.0	89.2	2.32
30	80.5	81.4	87.8	82.7	1.6
Mean	42.7	40.0	40.1	35.9	4.08

abc: Means along the same row with different superscript are significantly different (P<0.05). T1, T2, T3 and T4- diets fed to growing from 9-19 weeks age.
*Standard error of mean

Table 5: Performance indices of pullets reared on diets containing varying energy levels at growing phase

Parameters	Treatments (energy levels, kcal/kg, fed during growing period)				
	T1 (2,400)	T2 (2,500)	T3 (2,600)	T4 (2,500)	*SEM
Feed intake (g/b/d)	96.6[b]	99.7[a]	98.4[a]	98.0[a]	0.63
Water intake (mls/b/d)	333.6 [a]	303.6 [b]	305.9 [b]	315.3 [b]	11.82
Feed conversion ratio	8.05	8.3	8.2	8.2	0.07
Hen–day production (%)	42.7	40.0	40.1	35.9	2.43
Egg weight (g)	42.0	43.2	44.1	41.3	1.08
Mortality (%)	4.4	6.7	6.7	2.2	0.00

abc: Means along the same row with different superscript are significantly different (P<0.05). T1, T2, T3 and T4- diets fed to growing from 9-19 weeks age.
*Standard error of mean

Table 5 indicates that there were significant differences (P<0.05) in feed intake between the treatments. Birds fed the 2,500kcal/kg diet during the growing phase consumed significantly ($P<0.05$) more feed (100 g/b/d) compared to those fed the 2,400 kcal/kg diet (97 g/b/d). For the other treatments, feed intake averaged 98 g/b/d, and did not differ significantly between them. Birds fed the low energy diet during the growing phase consumed significantly higher ($P<0.05$) amount of water (334 mls/b/d) compared to those reared on the other treatments (304-315 mls/b/d) (table 5). There were no significant differences between the treatments in feed conversion ratio (Table 5).

Egg weight averaged 43 g across the treatments, with no significant differences between them. Egg weight increased from 9 g at week 20 to an average of 63 g at week 25, and thereafter tended to stabilize (Table 6). Mean egg weight during the period of study did not differ significantly between the treatments, even though for the formulated diets, it tended to increase with increasing dietary energy level. Birds raised on the commercial diet laid egg with the lowest weight ($P>0.05$). Significant differences in egg weight were recorded only at weeks 23 and 30 (Table 6). At week 23 weight of egg produced by birds raised on the commercial diet were significantly lower than those of the other treatments. However, at week 30 the reverse was the case. Mortality (Table 5) was lower ($P>0.05$) for birds reared on the commercial diet (2.2). For the formulated diets, mortality was lower with birds fed the low energy diet (2,400 kca/kg) compared to those fed the higher energy diets (2,500 and 2,600 kcal/kg).

Table 6: Egg weight of laying pullets from 20 -30 weeks fed on diets containing varying energy levels at growing phase

Age (weeks)	Treatments (energy levels kcal/kg fed during the growing phase)				
	T1 (2400)	T2 (2500)	T3 (2600)	T4 (2600)	*SEM
20	-	-	9.3	-	
21	-	12.1	11.7	-	
22	24.6	23.7	24.2	23.0	0.3
23	39.7^{a}	33.8^{a}	39.8^{a}	23.3^{b}	6.72
24	46.4	46.9	50.0	47.5	1.31
25	61.1	64.3	62.2	63.5	1.22
26	59.8	62.2	59.2	61.6	1.24
27	54.8	56.4	54.9	57.8	1.23
28	57.7	58.6	57.4	59.1	0.68
29	59.1	59.2	61.4	58.3	1.15
30	57.6^{ab}	58.0	55.5^{b}	60.6^{a}	1.04
Mean	42.0	43.2	44.1	41.3	1.65

*Standard error of mean; abc: Means along the same row with different superscript are significantly different ($P<0.05$).
T1, T2, T3 and T4- diets fed to growing from 9-19 weeks age.

Laying Temperature

The experiment was conducted between August and November. Table 7 shows that the average maximum and minimum temperatures were 33.4 and 19.1^{o}C, respectively. The mean daily temperature was 26.9^{0}C.

Table 7: Mean weekly temperature of laying house during early laying

Weeks	Maximum	Minimum	Mean
20	31.8	20.1	26.0
21	32.5	19.5	26.0
22	32.2	20.7	26.5
23	32.2	20.2	26.2
24	34.1	20.9	27.5
25	33.5	21.9	27.7
26	31.9	20.7	26.3
27	35.2	21.7	28.5
28	35.5	21.3	28.4
29	34.6	18.8	26.7
30	34.3	19.1	26.7
Mean	33.4	19.1	26.9

DISCUSSION

Results of this experiment showed that feeding higher energy diets during the growing phase promoted early onset of lay, as birds that were fed higher energy diets came to lay earlier than those fed on the lower energy diets (P<0.05). However, birds reared on the lower energy diet (2,400 kcal/kg) attained 50% and peak production levels earlier than those that were fed on the higher energy density diets, even though peak production level was higher for birds reared on the 2,600 kcal/kg diets.

Live weight at point of lay was not significantly different (P>0.05) among treatments. As expected, weight of first egg followed a similar pattern. However, at 50 % production, the birds reared on the commercial diet were heavier (P<0.05) than those reared on formulated diets. This could be due to the significantly lower egg production of birds on this treatment. The significant difference in live weight however disappeared at peak production level. Abdullahi (2004) reported a decrease in live weight from 1.69 kg at point of lay to 1.67 kg at peak production level, when Shika Brown layers were fed a commercial diet containing 2,300 kcal/kg. In this experiment, all birds gained weight between point of lay and peak production level. The variation in the energy levels of the diets and the strains of birds used in the two experiments could have accounted for these differences.

It was observed that onset of lay was about 19 days late than the 136 days reported by Abdullahi (2004) for Shika Brown layers. It is however, within the range of 134 – 162 days reported by Jacob *et al*. (2003), Sander and Lacy (1999) and Farooq *et al.* (2002). Majoro (1999) reported onset of lay at 111 – 132 days with different strains of commercial layers in southern Nigeria. Oni *et al*. (1999) reported onset of lay at 134 days and 142 days with Shika Brown layers in the southern and northern zones of Nigeria, respectively. The values reported for this study (148 - 161 days) were within the same range of 140 – 149 days and 157 days reported for Shika Brown layers and Black Olympic birds by Abubakar *et al*. (1995) and Ayorinde and Oke (1985) respectively. The values recorded were however lower than the 170 – 179 days reported by Sekoni *et al*. (1991).

Age at peak production was attained between 205 – 216 days across the treatments, with significant differences between the birds reared on the 2,400 kcal/kg diet (205 days) and those raised on the 2,600 kcal/kg diet (216 days). These values were higher than the 182 days reported by Abdullahi (2004) with Shika Brown layers. Peak egg production was attained at week 29 with the highest value of 95 % recorded for the pullets reared on the 2,600 kcal/kg diet. Jacob *at al*. (2003) reported that flock production rises sharply and reaches a peak of about 90 % 6 - 8 weeks later. In this experiment, peak egg production was higher than the value recorded by Abdullahi (2004) (75.2 %) with Shika Brown layers. Oni *et al.* (1999) reported peak production values of 70.2 % and 80.2 % in the southern and northern zones of Nigeria, respectively, which were below the values recorded for this experiment. Keshavarz (1998) reported 76.8 % with a diet containing 2,816 kcal/kg and 77.4 % with a diet containing 3,036 kcal/kg, while Grobas *et al*. (1999) reported 94.4 % with a diet containing 2,680 kcal/kg energy.

Birds fed on 2,600 kcal/kg diet during the growing phase recorded the highest feed intake, and attained the highest egg production (95 %) at week 29. This could possibly be attributed to the relatively higher live weight of this group of birds. This was also observed by (Richard and Jacqueline, 2000). This same group of birds was the first to come to lay. Keshavarz (1995) has observed that early onset of lay tends to increase the number of eggs produced at peak. Ogundipe (1986) and Oluyemi and Roberts (2000) attributed favorable egg production to low temperatures. In our experiment, peak production was attained during the cool period of the year (November) when the average temperature was 26.9^{o}C, which falls within the thermo neutral zone of the fowl. This temperature is said to support the highest egg yield and quality (Oluyemi and Roberts 2000).

Egg weight did not differ significantly between the treatments, even though birds reared on the lower energy diet (2,400 kcal/kg) had significantly lower feed intake. The lower feed intake of this group of birds was not expected, because the same layer diet was fed across the treatments. This observation can only be attributed to the relatively lower body weight of this group of birds compared to the other treatments. The feed intake of birds recorded in this study is within the range reported for birds of similar age (Adamu and Ubosi, 1998; Abdullahi 2004).

The birds with the least feed intake in this experiment (T1) recorded the highest water intake. This was also not expected, as the same diet was fed across the treatments, in addition to the fact that birds in this treatment had the lowest body weight at point of lay. Thus, factors other than feed composition and live weight must have influenced water intake. One of such factors could be rate of egg production (Jacob *et al*., 2003), as birds in this treatment recorded higher, though non significant hen–day egg production.

Feed conversion ratio was not significant between the treatments, despite the fact that birds reared on 2,400 kcal/kg diet consumed less feed ($P<0.05$) and produced more eggs ($P>0.05$) compared to other treatments. Thus, the non-significant differences in egg production must have out-weighed the significant differences observed in feed intake.

Mortality was lower on birds reared on the commercial diet. This could be due to the fact that the commercial diet contained antibiotics and antioxidants added to the feed to prevent spoilage, which could have prevented the birds from some infections. For the formulated diets, mortality was lower on birds raised on the lower energy diet (2,400 kcal/kg) (4.4 %) compared to those raised on the higher energy diets (6.7 %). Average flock viability in this experiment was 95 %, which is higher than the value of 82% reported by NAPRI (2000). Okposio (2002) reported mortality of 0.41 % with Black-Harco layers at early laying phase. The mortality observed in this experiment apparently resulted from laying cage fatigue, because it was observed that birds suffered from weakness of the legs, as a result of which they could hardly stand to eat and drink. Oluyemi and Roberts (2000) reported that this situation is mostly noticed in highly prolific flocks of which Black-Harco layers are not exception.

CONCLUSION

The results indicated that feeding high energy diets during the growing period tend to promote onset of lay. However, once laying starts, birds reared on the lower energy diets (2,400-2,500 kcal/kg) reached peak production level earlier. Liveweight of birds reared on the different dietary energy levels were similar at point of lay. However, at 50% egg production level, birds reared on the commercial diet weighed heavier ($P<0.05$) than those reared on the other treatments, apparently due to the lower egg production level of the former. These results indicate that in this ecological zone birds could be raised on diets containing 2,400-2,600kcal/kg without compromising performance. However, in order to fully appreciate the effect of dietary energy levels in this ecological zone, more trials could be conducted using wider energy variations.

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