ISSN 1682-8356
ansinet.org/ijps

INTERNATIONAL JOURNAL OF POULTRY SCIENCE

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International Journal of Poultry Science 2 (2): 128-132, 2003

Early Lay Characteristics and Haematology of Pearl Guinea Fowls as Influenced by Dietary Protein and Energy Levels

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Abstract: An experiment involving 3 metabolizable energy and 3 crude protein levels was used to investigate the influence of dietary protein and energy levels on the early lay characteristics and haematological parameters in 270 sub–humid tropical Pearl guinea fowl hens. The results indicated significantly ($P<0.05$) earlier age at sexual maturity and higher hen-housed average for birds on the 2750 kcal/kg ME - 18% protein diet than the other diets. Evaluation of the diets based on the responses of guinea fowls suggests that the diet that contains 2750 kcal/kg ME and 18% crude protein excelled in egg number, cost/dozen eggs and survival of birds. However, of the five blood components evaluated, total protein, vitellogenin and serum calcium were optimized by the 2750kcal/kg ME - 16% protein up to 36 weeks of age. Packed cell volume (PCV), total protein, cholesterol, vitellogenin and serum calcium showed no significant variations ($P>0.05$) among diets as a result of differences in energy or protein content. However, of the blood components evaluated, total protein, vitellogenin and serum calcium in serum were optimized by the 2750kcal/kg ME - 18% protein diet.

Key words: Guinea fowls, protein/energy levels, early lay characteristics

Introduction

Most wild birds breed during a restricted period of the year irrespective of the latitude at which they are found (Sharp, 1988). The restriction is usually imposed by the seasonal availability of the appropriate food resources required for feeding and fledging the young (Murton and Westwood, 1977). The sub-humid tropical Pearl female guinea fowls are monogamous and seasonal breeders (Nwagu and Alawa, 1995). The seasonality in reproduction has been recognized as one of the major problems that may hinder large-scale commercial guinea fowl production. Factors responsible for this seasonality are however not yet clearly known.

The identification of specific genetic or environmental factors affecting the variation of egg production traits should be of value in designing more accurate techniques for evaluation in breeding operations in the Pearl guinea fowl. Attempts to improve egg production in the domestic fowl include manipulation of feeding regime (Soller *et al*., 1984) and diet (Zelenka *et al*., 1985). The nutrient requirements of the guinea fowl have however been assumed to be the same as that of the chicken as regards the major nutrients (Oluyemi, 1982). Vogt and Stute (1974) however, earlier showed some differences in the utilization of some nutrients. Insects form a component feature in the guinea fowl diet, especially in the wet season which coincides with the breeding season. This suggests that protein and energy rich components predominate in the diets and are necessary for maintenance of the daily activities of the birds (Tewe, 1983). Data on the protein and energy requirement of guinea fowl pullets intended for use as layers are limiting. There is need to fill this gap and to provide baseline data on which breed and improvement criteria may be based. The objective of the study therefore was to determine the influence of dietary protein and energy levels on egg production traits of the sub-humid tropical Pearl guinea fowl in the first year.

Materials and Methods

A total of 270 female Pearl guinea fowls from hatches of eggs collected from the Department of Animal Production, University of Ilorin, Nigeria were used for the study. The keets were brooded for the first four weeks of life under continuous illumination. Thereafter, they were raised on deep litter under natural daylight until 20 weeks of age. The birds were fed starter rations containing 23.89% crude protein and 2994.74 kcal/kg ME during the first 8 weeks. A grower diet containing 20.01% crude protein and 2750 kcal/kg ME was fed between 8 and 20 weeks of age. At 20 weeks of age, the birds were sexed by vent examination, weighed individually and 270 pullets randomly selected for the study. The birds were divided in 9 groups of 30 birds each. Each group was assigned to a treatment following the schedule in Table 1. Each treatment group was

Table 1: Composition of experimental diets fed to guinea fowls at ages 20 – 52 weeks

Energy/Kcal/kg	2650			2750			2850		
Diet No.	1	2	3	4	5	6	7	8	9
Protein Level	16	18	20	16	18	20	16	18	20
Ingredient (%)									
Maize	57.41	57.41	51.88	59.03	59.03	55.83	63.13	59.75	58.42
Wheat offal	11.89	6.89	8.05	5.00	3.00	3.00	1.50	3.48	1.00
Fish Meal	3.50	3.50	3. 50	2.00	3 .80	5.00	2.00	3.50	5.20
GNC	13.83	18.83	23.20	20.00	20.80	22.80	20.00	19.90	22.01
SBM	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Oyster Shell	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Bone Shell	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Salt	0.30	0.30	0.03	0.30	0.30	0.30	0.30	0.30	0.30
Vit, premix*	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
Nutrient Contents									
M.E.	2652	2682	2651	2755	2781	2757	2853	2866	2850
C.F.	3.5	3.15	3.34	3.11	2.94	2.94	2.85	2.97	2.69
E. E.	3.99	4.89	4.19	4.08	4.16	4.25	4.08	4.13	4.23
C.P.	16.45	18.34	20.02	16.05	18.41	20.03	16.38	18.33	20.11

*Provide per kg of diet, vitamin A (800 iu). Vitamin D_3 (1,200iu), vitamin E (3iu), vitamin k_3- KASTAB (2mg); vitamin B_2-Riboflavin (8m), vitamin B_3- Nicotinic acid (10 mg), vitamin B_5- Pantothenic acid (150 mg) manganese (mn), (80 mg), zinc (Zn) (50 mg); copper (Cu) (2mg); iodine (I) (1.2 mg); cobalt (Co) (0.2 mg) selenium (Se) (0.1mg)

further divided into three replicates of 10 birds each and moved into laying cages, two birds per cage. Body weights and feed intake were measured fortnightly throughout the experimental period.

Data collection and analysis: Age and body weight at first egg were taken for each group and age when 50% rate of lay was first attained was used as an estimate of age at sexual maturity. Weekly hen housed and average hen day rates of lay were determined for the egg production records of each group. Egg weights were taken on all eggs laid in the each week of each month. The average egg mass was calculated by multiplying the weekly egg weights by the hen housed average. The cost of raising the pullets to point of lay was obtained by adding the cost of day-old keets, medication, feed intake and compensation for mortality. The economy of egg production was taken as cost of feed required to produce a dozen eggs.

Data collected were subjected to analysis of variance (Steel and Torrie, 1980). Significantly different means were separated using the Duncan's new multiple range test.

Results and Discussion

Body weight was significantly higher ($P<0.05$) in the 2750 kcal/kg ME for 16 percent protein up to 36 weeks of age (Table 2). However, various dietary protein and energy levels at 36 to 52 weeks of age (age at sexual maturity) did not produce consistent or significant changes in body weight gain. Guinea fowls in this study made initial gains in body weight at housing but the rise in egg production was altered by a reduction and also in some cases by fluctuation in body weight gains.

These reductions or fluctuations in body weight gains following the onset of egg production may have resulted from increased use of physiological reserves to meet the demand for egg production. The birds attained sexual maturity at a low body weight. Ayorinde (1983) observed that light body weight is characteristic of the local guinea fowls. The light body weight and growth pattern observed in this study suggest that the guinea fowls used are closer to an egg laying light breed, in view of the general low mature body weight despite the initial rapid growth rate, than heavy breeds. From this study, it could be suggested that a diet containing 16 percent protein and 2750 kcal/kg ME is ideal for optimum body weight gain for growing guinea fowls probably because the diet contains a good balance between energy and protein.

Oluyemi (1982) has suggested that adult guinea fowl mash should contain 15 -16 percent crude protein.

Mortality was not significantly ($P>0.05$) different at both the rearing and laying stages of the birds. However, while guinea fowls fed on 16% CP cum 2650kcal/kg ME diet recorded mortalities during the rearing stage, none of the other groups had mortalities. Low mortality suggests favourable conditions and that the various diets can sustain the growing guinea fowls.

Mean blood profile of indigenous Pearl guinea fowl layers given various levels of protein and energy at ages 20 - 52 weeks of age is shown in Table 3.

Table 2: Responses of Pearl guinea fowl layers to various levels of dietary energy and protein during rearing and laying periods

Energy (kcal/kg)	2650			2750			2850		
Protein (%)	16	18	20	16	18	20	16	18	20
Diet No.	1	2	3	4	5	6	7	8	9
Pullet guinea fowls (20 – 28 wks)									
Age at first egg (days)	237 [a]	231[a]	225[a]	227[a]	219[b]	228[a]	223[a]	220[a]	225[a]
Weight at first egg (g)	1129.74	1126.40	1128.70	1135.40	1137.45	1134.50	1134.78	1128.61	1139.45
Total feed to 1st egg (g)	11303.08 [a]	11345.85[a]	11196.57[a]	10588.01[a]	9906.23[b]	10602.85[a]	10004.04[a]	9656.44[b]	9547.14[b]
Weight of 1st egg (g)	34.10	34.75	34.42	34.20	33.95	34.80	34.20	33.89	34.55
Cost at 28wks (N)*	260.50	250.87	247.75	235.06	221.04	235.89	223.83	218.84	219.81
Layer guinea fowls (29 - 52 wks)									
Egg/Hen	36.60 [b]	37.50[b]	39.40[b]	41.25[b]	48.58[a]	39.8[b]	33.58[c]	39.5[b]	37.42[b]
Percent hen day egg production (%)	17.02 [b]	17.93[b]	17.58[b]	18.41[b]	21.68[a]	17.76[b]	14.99[c]	17.63[b]	16.70[b]
Hen-housed production (%)	15.89 [b]	16.74[b]	17.58[b]	18.41[b]	21.68[a]	17.76[b]	14.99[c]	17.63[b]	16.70[b]
Age at sexual maturity (d)	324 [a]	315[a]	321[a]	308[a]	299[b]	307[a]	315[a]	306[a]	309[a]
Average daily feed intake (g)	122.66 [a]	107.56[a]	108.76[a]	100.42[b]	70.05[c]	100.54[b]	95.50[b]	94.35[b]	94.79[b]
Mean egg weight (g)	34.85	34.81	34.50	34.53	33.45	34.92	34.60	34.20	34.60
Egg mass	581.57 [c]	627.75[b]	692.65[b]	759.41[b]	1053.21[a]	706.84[b]	503.36[c]	698.67[b]	624.91[b]
Feed/dozen egg (g)	9261.77 [a]	7709.68[b]	7419.74[b]	6543.70[c]	3875.84[d]	6790.24[c]	7644.18[b]	6420.67[c]	6809.42[c]
Cost/dozen egg (N)	192.64 [a]	160.36[b]	154.30[b]	136.10[c]	80.61[d]	141.23[c]	158.99[b]	133.54[c]	141.63[c]
Bodyweight at 52wks	1165.30	1188.40	1175.40	1187.50	1196.40	1184.65	1164.30	1205.64	1185.6

[a,b,c] Means along rows with no common superscripts are significantly different ($P<0.05$), *Nigerian Naira (N) exchanges at 124: 1 US $

Packed cell volume and serum total protein contents showed no significant differences among diets ($P>0.05$) as a result of differences in energy or protein contents. Of the five blood components evaluated in this work, total protein, vitellogenin and serum calcium were optimized by the 2750kcal/kg M.E and 18% protein. Two other parameters, packed cell volume, and cholesterol level were maximized at 2650 kcal/kg ME and 18% protein.

Sulton (1984) showed that nutrients influence egg cholesterol content. In selection studies for high and low egg cholesterol level, selection was effective only in the upward direction (Washburns, 1990) .

Griffin *et al.* (1982) noted a cholesterol level of 3.8mg/100ml for laying birds which is close to that observed in the study. This suggests that a basal level is required for egg formation. The slight higher values of these parameters in diet 2650 kcal/kg ME were not associated with high egg production. The persistence of abnormally high level of cholesterol can cause deposit of cholesterol plaques to occur in the aorta, which can ultimately contribute to health hazard. Egg laying birds had lower cholesterol and packed cell volume levels as a result of higher egg production due to an increase in demand for egg production.

Vitellogenin and calcium were optimized by the 2750kcal/kg ME at 18% protein. This confirms the findings of Wallace (1970) that vitellogenin contains calcium and iron and it may be the main carrier of these elements to the yolk. In laying domestic fowl hens, blood vitellogenin concentration ranges from 10 - 25 mg/ml (Burkey and Vendehra, 1989) while the range for guinea fowl in this study was 13 - 17 mg/100ml which shows that the basal level is higher in the

Table 3: Blood profile of indigenous Pearl guinea fowl layers given various levels of energy and protein at ages 20 – 52 weeks

Energy (kca1/kg)	2650			2750			2850		
Protein (%)	16	18	20	16	18	20	16	18	20
Diet No	1	2	3	4	5	6	7	8	9
Packed cell volume (%)	31.33	34.52	30.48	28.91	27.61	30.15	30.14	32.61	33.62
Total protein (g/l00ml)	2.50	2.40	1.85	3.70	4.90	1.34	2.51	2.73	2.81
Cholesterol (mg/100ml)	3.65	3.70	3.58	3.45	2.98	3.14	2.65	3.40	3.25
Vitellogenin (mg/100m1)	16.40	18.5	20.95	19.58	21.58	18.89	17.81	16.81	13.45
Serum calcium (mg/100ml)	1.94	2.87	2.00	2.39	3.33	2.94	2.08	2.13	2.50

guinea fowl than in the chicken indicating that the calcium demand for guinea fowls may be slightly higher than for the chicken (Olomu 1979; Orji *et al*., 1986).

The egg laying performance of the guinea fowls in response to dietary treatments is shown in Table 2. A significant difference (P<0.05) was found to exist in age at first lay and average age at sexual maturity. Birds on the diet with 2750kcal/kg ME on 18% birds on this list attained sexual maturity at significantly (P<0.05) lower age. On the average the guinea fowls on diets with 2650, 2750 and 2850 kcal/kg ME at 18% crude protein came into lay at 231, 219 and 220 days of age, at mean liveweights of 1126.40 g, 1137.45 g and 1128.61 g respectively. Ayorinde and Ayeni (1983) working with different breeds of guinea fowls observed that the body weight at the beginning of egg production were 1052.25 g for Pearl and 1088.50 g for Black guinea fowl which were close to the values obtained in this study. The obvious implication of the results obtained is that it appears that there is a mature or point-of-lay body composition that guinea fowl pullets must attain before the onset of egg production. Soller *et al*. (1984); Ayorinde and Oke (1995) had earlier indicated this. Their works demonstrated that there also appear to be a critical lean body mass required as well.

A desirable trait in poultry is early attainment of puberty and consequently greater egg production. Body weight at first egg was not significantly different (P>0.05) in all the treatments. Weight at first egg was slightly lower (P>0.05) in the birds on diet with 2750 kcal/kg ME and 18% protein probably on account of early onset of lay. It is generalized that if a pullet matures too early in life, eggs will be smaller, and a long time will be required to attain maximum egg size; maximum egg size will also be smaller than that of late maturing pullet (Oke, 2000). Egg production was significantly (P<0.05) higher in diet with 2750 kcal/kg ME - 18% protein than the other diets. This is an indication that this level of protein and energy is optimal for egg production in the guinea fowl. Evaluation of the nine diets based on responses of the guinea fowls suggests that the diet that contained 2750 kcal/kg ME and 18% crude protein excelled in cost/dozen egg and egg mass. It appears that the response of the indigenous Pearl guinea fowls to diet in excess of 18 percent protein were generally equal or inferior to that in the 18% and 2750 kcal/kg diet irrespective of their energy levels. The results suggest that the energy level of 2650 kcal/kg appear inadequate to elicit optimum performance at the 18% protein level.

The diet containing 2750kcal/kg ME was associated with the best response in several of the parameters measured. This observation as it affects feed intake is consistent with the view that high dietary energy levels inhibit feed intake (Obioha *et al*., 1983). This performance is an indication that the NRC (1977) recommendation of 15% protein and 2.85 Mcal/kg ME for chicken appears inadequate for egg laying guinea fowls in Nigeria. Chawla *et al*. (1967) observed that egg production in summer months of the guinea fowl increased with increased protein levels up to 18.50%, while further increase up to 21.60% did not yield any significant improvement. Hence, the assumption that the nutrient requirements of the guinea fowl is the same as that of chicken as regard the major nutrients may not be valid from the findings of this study. It is our suggestion that a separate determination and development of nutrient levels for indigenous Pearl guinea fowl layers is essential for improved and sustained guinea fowl production in Nigeria. It is recommended that a diet containing 18 percent crude protein and 2750 kcal/kg ME would be ideal for the achievement of optimum egg production and revenue-cost ratio in the sub-humid tropical Pearl guinea fowl layers raised in Nigeria.

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