Calcium and Phosphorus Requirements of Laying fowls in the Warm Wet Climates

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INTRODUCTION

From the beginning when man started to domesticate farm animals, it has been his consistent desire and pursuit to improve his lot by improving the potentials of animals. More so, with the advent of scientific methods and approaches this pursuit have been carried to great heights enhancing improvement into the minutest component of farm animal diets, of which calcium and phosphorus are part.

The importance of calcium and phosphorus cannot be over-emphasized in the animal body as they are the building blocks (structural components) of the skeleton which not only play the supportive role in the body but also plays important roles in many biochemical processes in the body.

The nutritional importance of calcium and phosphorus has led to extensive research on their metabolism in monogastrics, ruminants and in human being as far back as the turn of the century till present day. Albright, *et al* (1929), Patton *et al*, (1953), Oluyemi and Fowokan, (1973). Akinsoyinu and Adeloye (1983) and Hartel (1990).

Studies therefore, into poultry and the egg in particular is a necessity which must not only be accomplished with precision and accuracy but also conducted in the shortest possible time to reduce the losses associated with the poultry industry due to egg breakage caused by poor egg shell quality. And to further improve the fate of human being by the cheapness and availability of nature's best source of essential nutrients.

MATERIALS AND METHODS

Birds and their management

A total number of sixteen birds Harco breed layers aged 23 weeks averaging 1.67± 0.33kg live weight used for the experiment.

The birds were managed in battery cages (2 birds/cage) with stair-step design in a ware house with roofed-top to prevent direct sunlight and rain from falling on the cages. Good ventilation and a drought - free environment was made possible by this design Birds were weighed individually at the beginning and at the end of the experiment and then given water and feed *ad libitum* for 8 weeks.

Experimental diets and treatments

Four different diets were formulated in the experiment all having the same basal composition except for level of inclusion of ground oyster shell and bone meal (Table 1) .

The birds were randomly assigned in duplicates of four treatment groups with two birds per replicate.

Performance Traits

The performance traits studied were hen-day percent (egg production), shell thickness, egg size (weight), feed consumption, feed efficiency and feed conversion ratio and mortality.

Experimental design and analysis

The Completely Randomized Design (C.R.D) was used and statistical analysis of the data collected was carried out using the analysis of variance method as outlined by Steel and Torrie (1981). Significantly different means at 5% level of probability were separated using the Duncan multiple range test.

RESULTS AND DISCUSSION

Summaries of the performance of the laying fowls' fed four different experimental diets is shown in table 2.

The result conclusively indicated that traits measured not only depended on the dietary concentrations of calcium and phosphorus but were markedly affected by particular combinations.

Egg Production

The experimental birds were 23 weeks old at the beginning of this investigation and as such were at their 1st phase of production which is characterized by increasing rate of production (Oluyemi and Roberts, 1979). The peak production obtained was expected but the results recorded were astonishing this perhaps is not unconnected to not only the genetic potentials of the birds but also the adequacy of the nutritional standard of the diets. The eggs were collected daily throughout the eight weeks of the experiment and there were days in which birds on diet II and III (Table 1) produced three eggs per two birds in a replicate/day. (days 2 and 3 in week four, days, 2, 4 and 5 in week six, days 1, 2 and 7 in week seven). These were specifically singled out for mentioning because of the amazing nature of the results obtained, as no literature has been found to support a three eggs per 2 birds/day production respectively for diets II and III in the eight weeks investigation period.

The high production observed may also have been due to the low bird density. (2 birds/cage) adopted during the feeding trial. It has been documented (Harted, 1990) that not only is there social stress but also phosphorus deficiency is made pronounced with high bird density which invariably depresses production.

Ademosun and Kalango (1973) reported the highest egg production of 63% with 3.5% calcium and 0.6% phosphorus which is not to far-fetched from the highest egg production recorded in this study with a combination of 3.54% calcium and 0.43% phosphorus (diet 1 on Table 1).

The result of the hen-day percent showed a significant difference ($P \leq 0.05$) between only treatment 1 (diet 1) and the rest of the three other treatment, though slight numerical differences existed between diets II, III and IV.

Egg weight

Egg weight as would be expected indicated significant difference ($P \leq 0.05$) between diet I (control diet) and the rest of the diets as shown in table 2. Egg weight progressively increased from week one of the experiment to a peak at the third week of the experiment then slightly decreasing gradually until the lowest weight was recorded at the seventh week after which the egg weight began to rise again in the eight week. It is worth mentioning here that contrary to what Oluyemi and Roberts (1979) reported that the thermoneutral zone of the adult fowl within which the performance of the fowl is not adversely affected by the ambient temperature is from 12.8 to 26°C. Peak egg weight was recorded in this experiment when the ambient temperature was 31.2°C (IITA, 1995).

Shell Thickness

Shell characteristics such as breaking strength and thickness responded differently to dietary calcium and phosphorus, then egg production. In this investigation diet II with calcium and phosphorus combination of 3.161 and 0.58% respectively had the highest mean (74.99±2.169) value for egg production, highest mean (0.35± 0.148mm) value for shell thickness. But conversely, also the highest cracked egg percentage (0.52%) was obtained from diet II out of a total of 0.87% for the whole diet.

Hartel (1990) reported that diets containing between 0.4 - 0.82% phosphorus, their shell quality only deteriorated by about 2%, a result similar to that obtained by Yannakopoulus and Morris (1979).

It seems possible that thick shells which result from diets high in calcium and low in phosphorus are inelastic, brittle and therefore prone to breakage, whereas diets high in calcium and phosphorus than in diet II of this experiment resulted in thinness shells but more resistant to breakage as the rest treatment means of diets I, III, and IV of the shell thickness (mm) were significantly ($P \leq 0.05$) lower than the treatment mean of diet II and with less cracked egg percentage.

. ***Feed consumption, feed efficiency ratio and feed conversion ratio.***

Feed consumption for the four treatments did not differ significantly ($P \geq 0.05$).

Feed efficiency ratio and feed conversion ratio followed the same pattern with the other performance criteria. Diet I was significantly lower ($P \leq 0.05$) than the rest three diets, this was followed by diet IV which was significantly ($P \leq 0.05$) different from diet II for feed efficiency ratio only. But for feed conversion ratio diets II, III and IV were not significantly different ($P \geq 0.05$). Hartel (1990) reported that diets with high calcium contents and sufficient phosphorus favours feed conversion rates whereas those high in phosphorus tend to produce the opposite effect. This was contrary to the results obtained in this experiment, diet I having 3.16% calcium and 0.58% phosphorus, higher in phosphorus than diets II and IV and lower in phosphorus than diets III was significantly lower ($P \geq 0.05$) in feed conversion rates than the other three diets.

Body Weight

Body weight gain showed no significant difference ($P \geq 0.05$) though loss in weight was recorded which is not unconnected with the resorption of medullary calcium from the bone marrow of the birds for egg production. Nutrients in the feed were also used in egg production rather than for body weight gain (Ogunseye, 1989).

Mortality

Mortality was recorded for only diet III due to largeness of egg which was difficult for the bird in question to pass-out, it resulted in turn vent, which eventually killed the bird. This represented approximately 3% of the total number of birds housed for the study. This is in line with the recommendation of Oluyemi and Roberts (1979) who stated that percent mortality during the laying period should not exceed 10%.

Table 1: Experimental Diets

Ingredient (%)	I	II	III	IV
Maize	43.50	43.50	43.50	43.50
Soyabean meal	20.00	20.00	20.00	20.00
Wheat offal	10.00	10.00	10.00	10.00
Corn bran	13.00	13.00	13.00	13.00
Fish meal	3.0	3.0	3.0	3.0
Salt	0.25	0.25	0.25	0.25
Layer premix	0.25	0.25	0.25	0.25
Oyster Shell (kg)	7.00	8.00	6.00	9.00
Bone meal (kg)	3.00	2.00	4.00	1.00
total	100.00	100.00	100.00	100.00
Calculated Analysis (%)				
Calcium	3.79	3.77	3.81	3.75
Phosphorus	0.77	0.52	0.92	0.47
Proximate Analysis (%)				
Calcium	3.61	3.54	3.69	4.64
Phosphorus	0.58	0.43	0.83	0.20
P:Ca	1:6.11	1:4.94	1:4.15	1:8.02

Experimental diet calculated energy 2639.5kcal/kg
Calculated crude Protein (%) 18.26

Table 2: Means of Performance of the Laying Fowls fed on different experimental diets

Parameter	I	II	III	IV
Egg production (% Hen-day)	54.17±1.84^{a}	74.99±2.164^{b}	73.25±2.14^{b}	68.30±2.06^{b}
Egg weight (gm)	36.25±1.51^{a}	55.91±1.87^{b}	53.63±1.83^{bc}	46.65±1.71^{b}
Shell thickness (mm)	0.34±0.46^{a}	0.35±0.148^{b}	0.32±0.141^{c}	0.34±0.146^{a}
Food consumption (gm)	118.22±1.027	118.57±1.029	118.35±1.028	119.42±1.03
Feed efficiency ratio	0.307±0.196^{a}	0.472±0.243^{b}	0.453±0.238^{bc}	0.391±0.221^{c}
Feed conversion ratio	3.261±0.638^{a}	2.121±0.515^{b}	2.207±0.525^{b}	2.559±0.566^{a}
Body weight (kg)	1.625±0.637	1.544±0.621	1.650±0.642	1.526±0.618
Mortality (%)	0/4	0/4	1/4	0/4

*Mean value ± SEM

a,b,c Means in the same row with different superscript are significantly ($P < 0.05$) different.

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