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Original Article

Effect of Dietary Calcium Sources on Laying Hens Performance and Egg Quality

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Abstract

This study was designed to investigate the effect of feeding two different (oystershell and limestone) sources of calcium to layer hens (Bovan) on performance and egg shell quality. The experiment extended for 4 weeks during which 24 Bovan layers at 24 weeks were used. Birds were divided into two groups (12 bird/ treatment) with four replicates in each battery cage. Traits measured were egg production, feed intake, feed conversion ratio,, body weight change, egg weight, egg height, egg diameter, albumen weight, albumen height, yolk weight, shell weight, and shell thickness. Results showed that the source of calcium (oystershell versus limestone) significantly affected ($P<0.05$) egg production(59.82 Vs 76.19), feed intake(139.53 Vs142.02), feed conversion ratio(4.67 Vs 2.99) and body weight change (-4.67 Vs 8.91). On the other hand, the source of calcium had no significant effect ($P<0.05$) on egg weight, egg height, egg diameter, albumen weight, yolk weight, shell weight, shell thickness and shell ash. The results suggest that the inclusion of lime stone in layers ration as calcium source is more beneficial than oystershell.

Keywords: Albumen, ash, limestone, oystershell, yolk.

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Introduction

As meat and eggs from poultry industry in the developing countries are well accepted by consumers (Oluyemi and Roberts 2000), poultry production has been developed very fast these two last decades especially in South of Sahara part of Africa (Téguia *et al.,* 2002). Poultry is also one of the most important sources of income and protein in these countries (Zaman *et al.,* 2004). Eggs are considered as standard or perfect protein (Annie and Francine 1997). The major limitation to the growth of poultry industry is the high cost of feed that may reach about 70 % of total production cost (Omole *et al.,* 2005). Egg breakage and soft shelled eggs are two conditions that cause great economic loss to producers (McPheeet *et al.,* 1982). Calcium is an important feedstuff for shell strength (Nys 1999, William *et al.,* 2006). It is the main mineral component of the egg shells and it is also responsible of the internal egg quality (Roudybush and Grau 1987).Egg shell quality is a vital factor in poultry production as large number of eggs with defective shell lead to great economic losses (Lavelin *et al.,* 2000). Roland *et al.* (1996) reported that calcium deficiency lead to decreased egg production, egg weight, egg specific gravity, feed consumption and bone density and strength. While excess calcium significantly reduced egg production, egg weight, and feed consumption (Harms and Waldroup 1971). Mineral sources such as bone meal, oyster shell, limestone, calcium, phosphate and gypsum are necessary for bone formation and adequate utilization of the feed (NRC 1994 and Omole *et al.,* 2005). Park (1995) reported that limestone is the most common source of calcium for poultry feed containing about 37 % of this mineral, Many studies had been conducted to investigate the use of many sources of calcium such as gypsum, limestone and oyster shell in layers and broilers diets (Omole *et al.,* 2005; Safaa *et al.,* 2008 and Saunders-Blades *et al.,* 2009).The objective of this study was investigate the effect calcium sources differences on performance and egg quality of Bovan hens at 24 wks of age.

Materials and Methods

Study Location

The experiment was carried out in the poultry unit, Faculty of animal Production, university of Khartoum. The ambient temperature range was 22-43°C and the average relative humidity was 45.5%.

Experimental Birds

A total of 24 Bovan laying hens (24 weeks of age) were randomly assigned to two dietary treatments (12 birds /treatment) with four replicates (3 birds/ pen).

Experimental House

One battery cage was used in the experiment. It was composed of 20 full galvanized wire cage distributed on four tiers as 5 cages /tier. Battery was equipped with by water nipples and feed troughs. It was places in an open –sided poultry pen situated in east west direction. Light was provided for 16 hours/day.

Experimental Diet

Experimental diets were formulated from locally purchased ingredients (sorghum, wheat bran, groundnut cake), imported super concentrates and either limestone or oystershell according to NRC (1984). Calcium analysis of oystershell and limestone was shown in table 1. The composition of the experimental diet was shown in table 2.

The calculated and determined analyses of the experimental diets are shown in table 3.

Experimental Procedure

Experimental birds were weighed at the beginning and at the end of the experiment. They were given the commercial diet for one week adaptation period. Feed and water were available adlibitum. Egg production in each group was recorded daily and expressed as rate of lay. Feed consumption for each experimental unit was measured weekly. Eggs were collected on three consecutive days and weighed. 12 eggs from each treatment were randomly selected to obtain egg weight, egg height, egg diameter, albumen weight, albumen height, yolk weight, shell weight, and shell thickness. A digital balance and virnea were used for egg traits measurements.

Chemical Analysis

Samples of the experimental diet were analyzed for crude protein, crude fiber, ash, moisture and ether extract according to the methods of AOAC (1980). Egg shell ash was also determined according to the same method.

Completely Randomized Design was used in this study. Obtained data were tabulated and subjected to analysis of variance using statistical program (Soft Inc., 1995) and the comparison between the two diets was done using t-test.

Experimental Design and Statistical Analysis

Table 1: Calcium contents of limestone and oyster shell.

Calcium source	Calcium %
limestone	39.9
oystershell	39.5

Determined according to titration method. Allison et al. (1954)

Table 2: Composition of experimental diet.

Ingredients	Diet composition (%)	
	A	B
sorghum	63.00	63.00
Wheat bran	12.75	12.75
Groundnut Cake	13.00	13.00
Concentrate	5.00	5.00
Calcium carbonate	-	6.00
Oyster shell	6.00	-
Sodium chloride	0.25	0.25
Total	100	100

Table 3: The calculated and determined analysis of the experimental diet.

Analysis	A	B
Calculated		
Crude protein (%)	17.89	17.89
Ether Extract (%)	3.12	3.12
Crude fiber (%)	4.68	4.68
Ca (g/Kg)	30.03	30.23
ME (M J/Kg)*	11.90	11.90
Total Phosphorus (g/Kg)	5.8	5.8
Lysine (%)	0.66	0.66
Methionine (%)	0.42	0.42
Determined		
Crude protein (%)	20.00	19.00
Ether Extract (%)	4.39	4.45
Crude fiber (%)	5.65	4.00
Nitrogen Free Extract (%)	54.84	56.02
Ash (%)	10.72	11.43
Ca (g/Kg)	2.50	2.80
ME (M J/Kg)*	11.56	11.60

ME was calculated according to proximate analysis reference by Lodhi et al (1976)

Results and Discussion

Results in table 4 depicts that rate of lay was significantly (P<0.05) high in lime stone treatment (76.19 Vs 59.82 % in Oystershell) this in agreement with Sultan *et al.* (2007). The obtained rate of lay was lower than one reported by Pelicia *et al*, (2009). Feed intake was significantly (P<0.05) lower

(139.53) in oyster shell compared to limestone treatment (142.2g/hen).However, Froning and Bergquist (1990) and Scheideler (1998) who reported that feed consumption was not affected by sources of dietary calcium. Estimated daily feed consumption is higher than that reported by Phirinyane *et al.,* (2011) and Pelicia *et al.*(2009).The study showed that the amount of feed required to produces equivalent one kilogram of egg i.e. FCR, was significantly less in lime stone (2.99Vs. 4.67 in oystershell). Feed conversion ratio in this experiment is higher in both treatments (4.67-299) than the results reported by Pelicia *et al.* (2009) who depicted 2.08 -2.19. By the end of the experiment, average body weight decreased by 4.67g in oystershell diet fed hens, while that of limestone diet fed hens increased by 8.91g. Birds fed limestone showed positive body weight change and this effect was supported by the results reported by Van De Velde *et al.* (1986).

Table 4: Effect of dietary calcium source on laying performance of Bovan hens (24 weeks old).

Trait	Calcium source		
	Oyster shell	Lime stone	± SEM
Rate of Lay (%)	59.82[a]	76.19[b]	6.40
Feed Intake (hen g/d)	139.53 [a]	142.02 [b]	0.28
FCR (feed Kg/Kg Egg)	4.67 [a]	2.99 [b]	0.16
Body weight change (g)	-4.67 [a]	8.91 [b]	0.67

FCR: Feed Conversion Ratio.
SEM: standard error of treatment means.
[a-b]values within a column with different superscription are significantly different (P<0.05).

Table 5. Effect of dietary calcium sources on egg quality traits of Bovan hens (24 weeks of age) after 4 weeks of feeding.

Trait	Oyster shell	Limestone	Se	Level of Sig.
Average egg weight (g)	51.52	54.08	1.02	NS
Average egg height (mm)	54.60	65.11	0.77	NS
Average egg diameter (mm)	41.43	41.95	0.70	NS
Average albumen weight (g)	28.77	31.05	1.87	NS
Average albumen height (mm)	6.37	6.36	0.04	NS
Average yolk weight (g)	16.46	16.46	0.23	NS
Average shell weight (g)	5.21	5.45	0.74	NS
Average shell thickness (mm)	0.28	0.27	0.06	NS
Average ash (%)	90.65	92.14	2.21	NS

SEM: standard error of treatment means.
NS: not significant at (P<0.05).

The results for egg weight, egg height, egg diameter, albumen weight, albumen height, yolk weight, shell weight, shell thickness and shell ash are shown in table 5. None of the treatments had significant effect (P<0.05) on these traits. This is in agreement with Van De Velde *et al.* (1986) but not in accordance to Millam *et al.* (1986) and Sultan *et al.* (2007) who found that birds offered oyster shell laid heavier eggs. The present study showed that egg weight was 51.52-54.08 g and this is comparable to the estimates reported by Abd El-Maksoud (2010) who recorded 54,46g but lower than that found by Pelicia *et al.* (2009) who reported (66-67g). Albumen height in the present study is lower than that estimated by Mankpondji *et al.* (2012). Albumen and yolk weights are in the range of 28.77-31.05 and 16.46-16.46 g respectively. The first was is lower while the second trait was higher than estimates reported by Ajakaiye (2011) . Shell weight was found to be 5,21-5.45 g and this is lower than the estimates reported by Mankpondji *et al.* (2012) who recorded 6.58-6.05g. Obtained shell

thickness in this study is 0.28-0.27 mm which is lower than estimates reported by and Pelicia *et al*, (2009) and Abd El-Maksoud (2010). Variations in this response could be to type of the diet, breed, age of the bird or the prevailing environmental conditions. However, there was numerical increase in egg weight, albumen weight, and shell ash for birds fed on limestone.

Conclusion

Findings of this study demonstrated that dietary limestone increased egg production feed intake and improved feed conversion ratio, therefore could be included in laying hen diet as a satisfactory calcium source. None of limestone or oystershell had negative effects on egg shell quality traits.

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