Journal of Animal and Veterinary Advances 6 (5): 735-738, 2007

Replacement Value of Regular Oyster Shell with Mine Oyster Shell on the Performance and Egg Quality of Laying Hens

H. Kermanshahi
Department of Animal Science, Faculty of Agriculture, Ferdowsi University of Mashhad, P.O. Box 91775-1163, Mashhad, Iran

Abstract: A trial was conducted to evaluate the replacement efficacy of Regular Oyster Shell (ROS) with Mine Oyster Shell (MOS) on the performance of 240, 44 weeks Hy-Line W-36 laying hens for 3 periods of 28 days. In a randomized complete block design with 5 treatments and 4 replicates as blocks, 5 levels of 0.0, 25.0, 50.0, 75.0 and 100.0% MOS were replaced with ROS based on their calcium contents. Diets were formulated as Hy-Line manual recommendation for 44-58 weeks laying hens. Feed intake, hen day and hen housed egg production, egg weight, shell weight, shell thickness, number of broken and cracked eggs and specific gravity of the random sample eggs were recorded at their appropriate times. Hen day and hen housed egg production significantly decreased ($p<0.0.5$) as the ratio of MOS in the diets increased. The effect of MOS on shell thickness and specific gravity were significantly increased ($p<0.05$) and the highest values for both traits were for 25% MOS + 75% ROS. The lowest incident of broken eggs was for 25 and 100% replacement of MOS. Under the conditions of this study, it was concluded that MOS might be a suitable calcium source for laying hens when a better egg quality is concern.

Key words: Egg quality, calcium sources, performance, laying hens, replacement, oyster shell

INTRODUCTION

Studies on the importance of calcium in egg production have been of interest to nutritionists for a long time. Many studies focused on the role of calcium on egg production, egg shell thickness, egg breaking strength, feed intake and feed conversion ratio (Chen and Chen, 2004; Watkins *et al*., 1977). Calcium is the most prevalent mineral in the body and is required in the diet in larger quantities than any other minerals (Elaroussi *et al*., 1994). It is one of the key elements required for maintenance and egg production (Elaroussi *et al*., 1994). Calcium plays a major role in a wide variety of biological functions in the body, of which the structuring of the bones is the most important (Siebrits, 1993). In laying hens, most calcium is used for shell formation (Klasing, 1998) and comprises about 1.5% of the bird's weight (Highfill, 1998). Many studies address the problem of egg quality and how calcium affects overall quality. Egg breakage still represents a large economic loss to the poultry industry. It was estimated that 13-20% of the total egg produced are cracked or lost before reaching their final destination (Roland, 1988). Numerous reports have been presented regarding the effectiveness of feeding various calcium sources in either the pulverized or the granulated form on eggshell quality. Scott *et al*. (1999) and Roland (1986) in their studies have shown a positive effect of calcium with a coarse particle size on eggshell quality in half of the reported studies. The shell consists of about 97% calcium carbonate, approximately 6 g that must be synthesized and deposited on the shell during 18-20 h it takes to form the egg shell (Roland, 2000). From the literature it is clear that research on calcium constitutes an important undertaking for researchers interested in both establishing what would be the optimal source of calcium in layer diets and understanding the role that dietary calcium plays in boosting egg production and egg quality in layers. However, a main concern is that mineral calcium source like oyster shell may differ in their origin, purity and particle size. Therefore, this study was focused on the evaluation of a known source of oyster shell, coming from surf shells as regular oyster shell and a mine oyster shells found in north of Iran as rock shells.

MATERIALS AND METHODS

Forty four weeks Hy-Line W-36 laying hens for 3 periods of 28 days, in a randomized complete block design with 5 treatments (5 levels of 0.0, 25.0, 50.0, 75.0 and 100.0% Mine Oyster Shell (MOS) were compared with Regular Oyster Shell (ROS) based on their calcium contents) with 4 replicates as blocks. ROS and MOS contained 34.0 and 37.8% calcium, respectively. Both calcium sources sieved with 0.3 mm mesh size. Hens had access to 15 h light (15L: 9D) and feed and water provided *Ad libitum*. Diets were formulated as Hy-Line manual recommendation for 44-58 weeks laying hens. Feed intake, hen day and hen housed egg production, egg weight, shell weight, shell thickness, number of broken and cracked eggs and specific gravity of the random sample eggs were recorded each week for 3 periods of 28 days (Table 1). To avoid mixing of the diet in each block, the feeders separated with suitable partitions between cages. Data were analyzed based on a general linear model procedure of SAS (1993) and treatment means when significant, were compared using Duncan's multiple rang test (Duncan, 1955).

RESULTS AND DISCUSSION

The overall feed intake (44-56 weeks) significantly increased by calcium sources ($p<0.05$). The highest feed intake was seen when equal amount of calcium sources fed by laying hens (Table 1). This difference was not significant in the periods. Hen day and hen housed egg production significantly decreased ($p<0.0.5$) as the ratio of MOS in the diets increased. Hens produced more eggs when more ROS was used in the diet. This effect was significant in both 52-56 and overall 44-56 weeks of age. As MOS into the diets increased, feed to egg mass ratio and total of feed per dozen of eggs significantly increased ($p<0.05$) (Table 2). The effect of MOS on shell thickness and specific gravity were significantly increased ($p<0.05$) and the highest values for both traits were for 25% replacement (Table 3). The lowest incident of broken eggs was for 25 and 100% replacement of MOS. Egg weight, shell weight to egg weight ratio and cracked eggs were not significantly affected by calcium sources (Table 3). There are some reports clearly show that by increasing or decreasing the amount of calcium in the diet, feed intake decreases or increases, respectively (Farmer *et al.*, 1986; Scott *et al.*, 1999). It is recommended that to ensure maximum shell quality, hens should consume a minimum of 3.75 gram calcium per day (Roland, 1986). In this study the diets contained 4.1% calcium and at least 100 g feed intake per day so it is less possible that hens consume more feed. Scott *et al.* (1979) reported that calcium level of 5% causes a decline in feed consumption, while it does not improve eggshell quality above the obtained with 3.5% calcium. Guinotte and Nys (1990) studied the effect of source (oyster shell vs limestone) and particle size in laying hens and reported egg production or feed efficiency were not modified either by the origin or the particle size of calcium although they showed that coarse calcium supplements increase feed intake. In this study the mixture of 75% ROS and 25% MOS showed better results in egg quality (shell thickness, egg specific gravity) that are in agreement with

Table 1: Composition of experimental diets

Ingredients (%)	1	2	3	4	5	Calculated composition	
Wheat	63.44	63.44	63.44	63.44	63.44	AME (kcal kg^{-1})	2816.00
Soybean meal	14.73	14.73	14.73	14.73	14.73	Crude protein (%)	16.05
Fish meal	4.20	4.20	4.20	4.20	4.20	Crude fiber (%)	2.93
Di calcium phosphate	0.71	0.71	0.71	0.71	0.71	Calcium (%)	4.13
Regular oyster shell	11.00	8.25	5.50	2.75	-	Avail P (%)	0.36
Mine oyster shell	-	2.46	4.92	7.38	9.84	Na (%)	0.19
Vit and min. Premix[1]	0.50	0.50	0.50	0.50	0.50	Arg (%)	0.88
Salt	0.26	0.26	0.26	0.26	0.26	Lys (%)	0.81
Tallow	5.00	5.00	5.00	5.00	5.00	Meth + Cys (%)	0.65
DL-methionine	0.12	0.12	0.12	0.12	0.12		
Fine sand	0.04	0.33	0.62	0.91	1.20		
Total	100.00	100.00	100.00	100.00	100.00		

[1]Supplied per kilogram of diet: Vitamin A, 10000 IU; vitamin D_3, 9790 IU; vitamin E, 121 IU; B_{12}, 20 μg; riboflavin, 4.4 mg; calcium pantothenate, 40 mg; niacin, 22 mg; choline, 840 mg; biotin, 30 μg; thiamine, 4 mg; zinc sulphate, 60 mg; manganese oxide, 60 mg

Table 2a: Effect of calcium sources on the performance of laying hens

	Treatments											
	Average daily feed Intake (g/hen)				Total hen day production (%)				Total hen housed production (%)			
Ca Sources	44-48 weeks	48-52 weeks	52-56 weeks	44-56 weeks	44-48 weeks	48-52 weeks	52-56 weeks	44-56 weeks	44-48 weeks	48-52 weeks	52-56 weeks	44-56 weeks
100% ROS_1	108.69	103.94	98.41	103.68^b	80.05	77.09	76.03^a	77.17^a	80.05	77.09	74.36	77.17^a
75% ROS + 25% MOS	105.95	102.53	100.74	103.08^b	79.99	76.44	71.58^{abc}	75.99^a	79.99	76.44	71.58	75.99^a
50% ROS + 50% MOS	110.27	108.39	104.67	107.78^a	79.45	76.58	73.22^{ab}	76.42^a	79.45	76.58	73.22	76.42^a
25% ROS + 75% MOS	106.25	101.19	101.12	102.85^b	75.97	73.74	69.35^{bc}	73.02^b	75.97	73.74	69.35	73.02^b
100% MOS	109.62	102.98	103.48	105.36^{ab}	76.25	72.52	67.75^c	72.17^b	76.25	72.52	67.75	72.17^b
P value	0.4234	0.2793	0.2319	0.0172	0.5034	0.4852	0.0265	0.0017	0.5034	0.4852	0.1470	0.0039

[a, b, c]Means in each column with different superscripts are significantly different ($p<0.05$). [1] ROS, Regular Oyster Shell; MOS, Marine Oyster Shell

Table 2b: Effect of calcium sources on the performance of laying hens

	Treatments											
	Total number of eggs				Total feed to egg mass ratio ($W W^{-1}$)				Total feed per dozen of egg mass ratio (kg 12)			
Ca sources	44-48 weeks	48-52 weeks	52-56 weeks	44-56 weeks	44-48 weeks	48-52 weeks	52-56 weeks	44-56 weeks	44-48 weeks	48-52 weeks	52-56 weeks	44-56 weeks
100% ROS[1]	22.41	21.58	23.18[a]	22.39[a]	2.24	2.13	2.12[b]	2.17[c]	1.63	1.58	1.65	1.62[b]
75% ROS + 25% MOS	22.40	21.40	18.69[b]	20.83[bc]	2.20	2.20	2.33[a]	2.24[bc]	1.60	1.61	1.83	1.68[ab]
50% ROS + 50% MOS	22.25	21.44	20.50[b]	21.40[ab]	2.28	2.30	2.36[a]	2.31[ab]	1.67	1.71	1.72	1.70[ab]
25% ROS + 75% MOS	21.27	20.65	19.42[b]	20.44[bc]	2.28	2.21	2.38[a]	2.29[b]	1.68	1.65	1.75	1.69[ab]
100% MOS	21.35	20.31	18.97[b]	20.21[c]	2.37	2.33	2.50[a]	2.40[a]	1.73	1.71	1.84	1.76[a]
P value	0.5054	0.5032	0.0011	0.0013	0.4543	0.2177	0.0125	0.0006	0.3824	0.2375	0.2394	0.0528

[a, b, c] Means in each column with different superscripts are significantly different ($p<0.05$). [1]ROS, Regular Oyster Shell; MOS, Marine Oyster Shell

Table 3a: Effect of calcium sources on egg quality of laying hens

	Treatments											
	Egg weight (g)				Shell weight to egg weight ratio (%)				Shell thickness (mm)			
Ca sources	44-48 weeks	48-52 weeks	52-56 weeks	44-56 weeks	44-48 weeks	48-52 weeks	52-56 weeks	44-56 weeks	44-48 weeks	48-52 weeks	52-56 weeks	44-56 weeks
100% ROS[1]	60.57	61.92	60.95	61.15	11.26	12.38	10.23	11.29	0.285	0.373[a]	0.352	0.337[b]
75% ROS + 25% MOS	60.63	61.31	60.45	60.80	11.36	12.82	10.38	11.53	0.362	0.383[a]	0.360	0.368[b]
50% ROS + 50% MOS	61.17	61.79	60.96	61.31	11.90	12.39	11.00	11.76	0.302	0.344[b]	0.348	0.331[b]
25% ROS + 75% MOS	61.32	62.09	61.52	61.64	11.92	12.41	10.66	11.67	0.315	0.377[a]	0.360	0.351[ab]
100% MOS	60.56	60.98	61.10	60.88	11.88	12.13	9.99	11.33	0.308	0.367[ab]	0.358	0.344[ab]
P value	0.7472	0.4196	0.6634	0.1577	0.3741	0.7924	0.1309	0.3020	0.3242	0.0257	0.8460	0.0531

[a, b]Means in each column with different superscripts are significantly different ($p<0.05$). [1]ROS, Regular Oyster Shell; MOS, Marine Oyster Shell

Table 3b: Effect of calcium sources on egg quality of laying hens

	Treatments											
	Egg weight (g)				Shell weight to egg weight ratio (%)				Shell thickness (mm)			
Ca sources	44-48 weeks	48-52 weeks	52-56 weeks	44-56 weeks	44-48 weeks	48-52 weeks	52-56 weeks	44-56 weeks	44-48 weeks	48-52 weeks	52-56 weeks	44-56 weeks
100% ROS[1]	2.77	3.28	0.74	2.26[ab]	0.50	0.29	0.37	0.38	1.0738	1.0793[b]	1.0718	1.0750[b]
75% ROS + 25% MOS	1.58	1.58	0.73	1.30[b]	0.39	0.50	0.33	0.41	1.0792	1.0848[a]	1.0741	1.0794[a]
50% ROS + 50% MOS	2.71	3.73	1.31	2.58[a]	0.30	0.50	0.22	0.38	1.0769	1.0753[c]	1.0749	1.0757[b]
25% ROS + 75% MOS	1.95	2.48	0.73	1.72[ab]	0.60	0.20	0.21	0.38	1.0787	1.0800[ab]	1.0752	1.0780[ab]
100% MOS	1.24	1.96	0.67	1.29[b]	0.29	0.65	0.12	0.35	1.0790	1.0800[ab]	1.0733	1.0774[ab]
P value	0.2207	0.6118	0.6423	0.0438	0.8592	0.5199	0.7082	0.4476	0.3155	0.0202	0.3571	0.0237

[a, b, c] Means in each column with different superscripts are significantly different ($p<0.05$). [1]ROS, Regular Oyster Shell; MOS, Marine Oyster Shell

those of Scott *et al*. (1971) and Watkins *et al*. (1977) who showed that egg breaking strength was improved by feeding two thirds hen-sized oyster shell and one third pulverized limestone. El-Aggoury *et al*. (1989) concluded adding oyster shell to limestone increase the palatability of feed and may increase feed intake. Kermanshahi (1990) showed that combination of two third oyster shell and one third filter mud as powder form (a by-product of sugar refinery plant with 27.5% calcium) increases feed intake and egg quality (shell thickness, shell weight and egg specific gravity). In a study by Finkelstein *et al*. (1993) they evaluated ocean quahog and surf clam shells (both as sea clam shells with a range of 92-96% CO_3Ca) in lactating cows and concluded that sea clam shells can serve as effective calcium supplements for lactating dairy cows.

CONCLUSION

Under the conditions of this study it was concluded that calcium sources may have some impacts on both egg production and egg quality. Combination of 75% ROS with 25% MOS may increase egg quality and can be used in laying hens if egg quality is concern.

ACKNOWLEDGEMENT

The financial support of Ferdowsi University of Mashhad, Iran is gratefully acknowledged by the author.

REFERENCES

Chen, Y.C. and T.C. Chen, 2004. Mineral utilization in layers as influence by dietary oligofructose and insulin. Int. J. Poult. Sci., 3: 442-445.

Elaroussi, M.A., L.R. Forte, S.L. Eber and H.V. Biellier, 1994. Calcium homeostasis in laying hens. 1. Age and calcium effects, Columbia, USA. Poult. Sci., 73: 1581-1589.

Duncan, D.B., 1955. Multiple range and F-tests. Biometrics, 11: 1-42.

El-Aggoury, S.A., A.A. R adwan, M.S. Gado and G.G. El-Gendi, 1989. Pullet's breed, housing and dietary calcium as factors affecting performance in chickens under subtropical conditions. fish and poultry production. Fac. Agric. Alexandra University, Egypt, 2: 923-931.

Farmer, M., D.A. Roland and A.J. Clarc, 1986. Influence of dietary calcium utilization. Poult. Sci., 65: 337-344.

Finkelstein, A.D., J.E. Wohlt and S.M. Emanuele, 1993. Composition and nutritive value of ground sea clam shells as calcium supplements for lactating Holstein cows. J. Dairy Sci., 76: 582-589.

Guinotte, F. and Y. Nys, 1990. Effect of particle size and origin of calcium sources on eggshell quality and bone mineralization in laying hens. Poult. Sci., 70: 583-592.

Highfill, C., 1998. Article 11-Calcium, phosphorous and vitamin D3 in your bird's diet. Pet Bird Magazine, Ezine.

Kermanshahi, H., 1990. Evaluation of calcium sources on the performance and egg quality of laying hens. Thesis, Department of Animal Science, Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad, Iran.

Klasing, K.C., 1998. Comparative Avian Nutrition. CABI Publishing, Wallingford, UK.

Roland, D.A., 1986. Eggshell quality. IV: Oyster shell versus limestone and the importance of particle size or solubility of calcium source. World's Poult. Sci. J., 42: 166-171.

Roland, D.A., 1988. Eggshell problems: Estimates of incidence and economic impact. Poult. Sci., 67: 1801-1803.

Roland, D.A., 2000. Nutrition and feeding for optimum egg shell quality. Proceedings, XXI World's poultry congress 2000, Montreal, Canada. CD Rom.

SAS, Institute, Inc., 1993. SAS User's guide: Version 6.03 Ed. SAS Institute Inc., Cary, North Carolina.

Scott, T.A., R. Kampen and F.G. Silver Sides, 1999. The effect of phosphorous, phytase enzyme and calcium on the performance of layers fed corn-soybean based diets. Poult. Sci., 78: 1742-1746.

Siebrits, F.K., 1993. Mineral and Vitamins in Pig Diets. In: E.H. Kemm (Ed.), Pig Production in South Africa. Agric. Res. Council Bull., pp: 427.

Watkins, R.M., B.C. Dilworth and E.J. Day, 1977. Effect of calcium supplement particle size and source on the performance of laying chickens. Poult. Sci., 56: 1641-1647.