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Progress In Poultry
"THROUGH RESEARCH"

SOURCES OF CALCIUM - EFFECT ON PERFORMANCE

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In recent years, many experiments have been conducted by a number of researchers to study the effect of calcium particle size on egg shell quality and strength. The results of these tests have been variable, but in some cases the incorporation of large calcium particles in the diet has improved egg shell strength.

In several California experiments in which larger particle sizes of calcium were utilized, improvement in egg shell strength was not observed. The reason for these results is unknown, but possibly the hens in our tests were already receiving as much calcium as they could effectively utilize.

Experimental work has suggested also that some calcium sources may be more biologically available to laying hens than others. The authors felt that perhaps differences in availability of calcium may have explained the differing results obtained in experiments where varying particle sizes were utilized. To explore this possibility, an experiment was conducted in 1977 to determine if calcium supplements from different geographic regions would affect performance or egg shell strength.

EXPERIMENTAL

LOCATION: Moreno Ranch, Riverside Co.

HOUSING: California open-type with curtains and hot weather foggers. Three hens per 12 x 18" cage placed back to back.

FEEDING: Ad libitum hand feeding, front feeder.

WATERING: One Hart cup for every 2 cages.

DURATION OF EXPERIMENT: Feb. 2, 1977 to Sept. 13, 1977 (32 weeks). The test started with the 9th week of the 2nd production cycle.

STOCK: 300 - 89-week-old Shaver White Leghorn hens.

EXPERIMENTAL DESIGN: Completely randomized, 5 replicates of 15 hens each, 4 treatments.

MEASUREMENTS: Daily: egg production, feed consumption and mortality. Every 4 weeks: egg weight, candled breakage and shell score. Every 8 weeks: shell thickness, crushing strength and Haugh units.

(continued)

To simplify information, trade names of products have been used. No endorsement of named products is intended, nor is criticism implied of similar products not mentioned.

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Table 1. Treatments: Basal diet (93.3%) plus calcium source (6.7%)

	Treatment 1	2	3	4
Mineral	Pfizer limestone (California)	Pilot Brand* oyster shell (Southeast U.S.)	Limestone (Colorado)	Calcium Carbonate Co. Limestone (Illinois)
Calcium (%)	36.3	36.8	37.7	38.1
Magnesium (%)	2.0	.29	.33	.12
Zinc (ppm)	35	31	6	6
Manganese (ppm)	99	318	126	41
Iron (ppm)	317	570	248	115
Particle size**				
% Coarse	4.6	25.3	24.4	35.9
% Fine	95.4	74.7	75.6	64.1

* Oyster shells were ground to avoid major differences in particle size.
** Separated with a #20 mesh Fisher Scientific screen.

BASAL DIET COMPOSITION

Corn	41.35%	Dehydrated alfalfa meal	2.49
Milo	23.75	Fish soluble	1.49
Meat and bone meal	7.47	Fish meal	1.00
Soybean oil meal	4.98	Fat	.50
Cottonseed meal	4.98	Pre-mix	.31
Wheat mill run	4.98	Calcium material	6.70

(Calcium = 3.50%)

TABLES OF RESULTS

Table 2. Egg production and egg weight (89 to 121 weeks of age)

	Treatment 1	2	3	4	
Trait	Limestone (California)	Oys.shell (Southeast)	Limestone (Colorado)	Limestone (Illinois)	Significant differences*
Hen-day production (%)	68.3	64.6	66.7	68.1	N.S.
Eggs/hen-housed	146	143	144	149	N.S.
Egg wt./hen-housed (kg)	20.6	20.3	20.5	21.0	N.S.
Average egg wt. (g)	64.2	64.4	64.8	63.9	N.S.
Large eggs and above (%)	94.8	95.9	96.3	95.7	N.S.
Mortality (%)	8.5	4.1	7.1	4.3	N.S.
Body wt. gain (%)	7.7a	5.4ab	6.0ab	0.1 b	*

Treatments with different small letters are significantly different ($P < 0.05$).
N.S. = Non-significant differences ($P > 0.05$).
* Significant differences ($P < 0.05$).

Table 3. Feed consumption and conversion

Trait	Treatment 1 Limestone (California)	2 Oys. shell (Southeast)	3 Limestone (Colorado)	4 Limestone (Illinois)	Significant differences
Feed/hen-day (lb)	.244	.236	.240	.237	N.S.
Feed/dozen (lb)	4.29	4.42	4.33	4.17	N.S.
Feed/egg ratio	2.53	2.59	2.53	2.47	N.S.
Protein/hen-day (g)	18.5	17.9	18.2	17.9	N.S.
M.E. Kcal/hen-day	309	299	304	300	N.S.
Calcium/hen-day (g)	3.9	3.8	3.8	3.8	N.S.

N.S. = Non-significant differences ($P > 0.05$).

Table 4. Egg and shell quality

Trait	Treatment 1 Limestone (California)	2 Oys. shell (Southeast)	3 Limestone (Colorado)	4 Limestone (Illinois)	Significant differences
Candled cracks (%)	3.5	5.6	4.5	3.5	N.S.
Shell smoothness*	.50	.55	.58	.54	N.S.
Shell thickness (microns)	361	373	378	366	N.S.
Crushing strength (kg)	3.44	3.44	3.48	3.50	N.S.
Albumen height (mm)	6.8	6.8	6.6	6.5	N.S.
Haugh units	80.5	80.4	79.5	78.8	N.S.

*0 = Smooth shell; 3 = Very rough.
NS = Non-significant differences ($P > 0.05$).

Table 5. Economic results*

Trait	Treatment 1 Limestone (California)	2 Oys. shell (Southeast)	3 Limestone (Colorado)	4 Limestone (Illinois)	Significant differences
Feed cost/dozen	27.9¢	28.7¢	28.2¢	27.1¢	N.S.
Average egg value/dozen	44.7¢	44.8¢	44.8¢	44.8¢	N.S.
Egg income minus feed/ hen-housed	$2.05	$1.94	$2.01	$2.19	N.S.

*Feed was calculated at $6.50/100 lbs.
Eggs were priced at 45¢/dozen for large; 40¢/dozen for medium; and 25¢/dozen for small.
N.S. = Non-significant differences ($P > 0.05$).

Table 6. Shell quality changes by period* (4 weeks)

Trait	Period** 3 March 1	4 March 29	5 April 26	6 May 24	7 June 21	8 July 19	9 August 16	10 September 13
Candled cracks (%)	2.2	3.3	3.2	3.3	5.6	3.3	5.3	8.1
Shell score	.26	.43	.36	.40	.52	.76	.77	.85
Shell thickness (microns)	394	--	381	--	363	--	343	--
Crushing strength (kg)	3.78	--	3.63	--	3.39	--	3.07	--

* All calcium sources combined.
** Periods 1 and 2 include the force molt prior to start of the test.

DISCUSSION

Statistical analyses of over forty measurements failed to show any significant response differences ($P < 0.05$) between calcium sources except for body weight change (Table 2). Even though percentage cracks ranged from 3.5 percent to 5.6 percent, shell thickness from 361 microns to 378 microns (Table 4) and egg income minus feed cost from $1.94 to $2.19 (Table 5), within-treatment variation exceeded that among the various treatments. None of the differences in shell strength measurements approached statistical significance, even at the 10 percent level.

Also of interest is the apparent lack of relationship between any of the shell strength measurements. The least number of candled cracks at point of gathering occurred in the eggs with the thinnest shells (Table 4).

These results suggest that calcium supplements originating from widely different geographic areas do not necessarily vary greatly in their biological availability of calcium as measured by the performance of hens to which the supplements are fed. This is not to say that all calcium sources are alike or of equal value. In the trial reported here, significant differences in responses to the four supplements tested may have resulted if the ration had been formulated to provide for marginal or sub-marginal intakes of calcium. Also, a larger sample size of hens would have increased the possibility of identifying real differences among treatments, even though differences were small and the responses within treatments were somewhat variable.

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