PHOSPHORUS FOR LAYING HENS

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The objectives of the following experiment were to determine: (a) whether a low phosphate intake improved egg shell quality, (b) whether hen size oyster shell as compared to pulverized limestone improved shell quality, (c) whether oyster shell "spared" phosphorus, and (d) whether 0.44% total phosphorus was sufficient for egg production.

Based on theoretical considerations of blood acid-base balance, low plasma phosphate might result in improved egg shell calcifications (1). Plasma phosphate can be altered by dietary means (2). In 1973 a report of the Tennessee Random Sample Laying Tests indicated an improvement in egg shell calcification by some leghorn strains fed diets containing low levels of dietary phosphorus (3).

Several investigators have reported that the feeding of hen size oyster shell as compared to the less expensive pulverized limestone results in improved egg shell calcification (4,5). Scott, et al., (4) hypothesized that the beneficial effect of oyster shell were due to the metering of calcium from the gizzard in the late night hours. If true, a corollary would be that bone mineral turnover was reduced. In that case the dietary phosphorus requirement would be expected to be less.

Lastly, there are reports that the NRC (6) recommended level of phosphorus (0.6% of a 1300 kcal/lb diet) is too high; that 0.45% total dietary phosphorus may be sufficient (7).

Our study involved 2800 Babcock hens which were beginning the second year of production. They had been force molted at 17 months of age. They returned to production and peaked at 75%. They were housed 3 per cage in a laying house of commercial design. The house was insulated and equipped with fans for environmental control. The hens were fed by automatic feeders (Diamond Automation) and the eggs gathered by egg belts. The experiment began in March, 1975 and terminated in June, 1975. The basal low phosphorus diet contained 65.5% corn, 23.8% soybean meal, 0.56% defluorinated phosphate, plus vitamins, minerals and methionine. The diets contained 1300 Kc of ME/lb., 17% protein, and 3.8% calcium. The three dietary treatments were: (1) pulverized limestone, 0.44% total phosphorus, (2) pulverized limestone and 0.66% total phosphorus, and (3) hen size oyster shell (100 lbs/ton), 0.44% total phosphorus.

The following results were obtained for the four months of lay (March through June).

Table 1.

Diet	Hen Day Egg Prod., %	Lbs. Feed/ Doz. Eggs	Egg Wt. Oz./Doz.
1 LS, 0.44% P	69	3.88	27.6
2 LS, 0.66% P	69	3.85	27.8
3 OS, 0.44% P	68	3.79	27.6

Table 2.

Diet	% Shell	Shell Thickness mg/cm^2	Breaking Strength, Kg
1 LS, 0.44% P	8.69 b*	73.9 b	2.51 b
2 LS, 0.66% P	8.61 b	73.2 b	2.56 b
3 OS, 0.44% P	9.01 a	76.6 a	2.60 a

*Values not followed by the same letter are significantly different, $P<0.001$.

Table 3.

Diet	Serum P, mg %			Bone Sp. Gravity	
	April	May	June	May	June
1 LS, 0.44% P	5.7	4.9	4.9	0.79	0.83
2 LS, 0.66% P	6.3	5.4	5.7	0.81	0.87
3 OS, 0.44% P	5.1	4.2	5.2	0.82	0.85

Table 4.

Diet	Mortality, %				
	March	April	May	June	Total
1 LS, 0.44% P	0.71	0.88	5.47	4.04	11.1
2 LS, 0.66% P	0.44	0.62	0.53	0.64	2.2
3 OS, 0.44% P	0.44	0.79	5.33	10.24	16.8

There were no differences in egg production, feed conversion, or egg weight (Table 1). When pulverized limestone was fed there was no difference between low and high phosphorus with regard to egg shell calcification (Table 2). There was an improvement in egg shell calcification when hen size oyster shell was fed (compare diets 1 and 3, Table 2).

Serum phosphorus values were lower when the diet was low in phosphorus. There were no differences between diets 1 and 3. The low phosphorus values do not seem abnormally low or indicative of a phosphorus deficiency (2) (Table 3). Bone specific gravity (an indicator of phosphorus status of the hen (2) increased between May and June (Table 3). Although there are numerical differences between diets, the only statistically significant differences were between the two times May and June. The results discussed so far suggest that the 0.44% phosphorus was adequate. Weekly checks by chemical analysis on the dietary phosphorus content indicated values very close to 0.44 and 0.66.

That the 0.44 level of phosphorus was definitely not adequate is revealed in mortality during the third and fourth month of the experiment.

In conclusion, while 0.44% phosphorus will support egg production for several months, it is not adequate and mortality occurs after the skeletal reserves are depleted (2). The low phosphorus diet did not improve egg shell calcification. Oyster shell certainly did give better egg shell calcification but did not "spare" phosphorus.

References

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