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CALCIFICATION PARAMETERS IN AGED LAYING HENS

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A previous report (A.S. Series 77-26) suggested a role for calcium binding protein (CaBP) and carbonic anhydrase (CA) on egg shell quality in aging birds. The results of an additional study related to this possibility are reported here.

Eighty 102-week-old laying hens were selected randomly from a previous trial in which diets of two protein levels (12 and 16%) and two types of feed intake (restricted and ad libitum) had been studied. These aged hens were fed a 16% protein diet for 24 days and egg production was recorded daily. One egg per hen every other day was used for measurement of shell thickness and breaking strength. Based on these data, 30 birds were selected and assigned to three groups of equal numbers, (1) those with high quality shells, (2) those with low quality shells and (3) those hens out of production for the 24 days. These birds, thus grouped, were killed at approximately the same time, and blood serum calcium level, duodenal and uterine CaBP activity and uterine carbonic anhydrase activity were measured in order to study the relationships between these parameters of calcium metabolism and shell quality.

As seen in table 1, the serum calcium levels for low and high quality shell producers were not significantly different. There was, however, a significant difference between producing hens and the nonlayer group. This indicates that shell quality is not directly related to serum calcium concentration.

Table 2 presents the results of CaBP activity determined in the duodenum and uterus of hens from the three groups. Significant differences between all three groups of hens were seen regarding duodenal CaBP activity, with the high shell quality group having the highest activity. The information pertaining to shell gland CaBP activity shows little difference between the nonlaying and low shell quality groups, but the high shell quality group exhibited about twice as much activity as the former. These differences between groups indicate that CaBP activity may affect egg shell formation and shell quality. Others have reported the occurrence of CaBP in the small intestine to be highly correlated with calcium absorption from the diet.

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The results for the final parameter studied, shell gland carbonic anhydrase (CA) activity, are given in table 3. The CA activity in the high quality shell group was roughly twice as great as that of the low quality group, which was, in turn, twice as great as that of the nonlayer group. This indicates that CA activity also plays a role in determining shell quality in old hens.

Table 1. Serum Calcium Level of Hens Selected on the Basis of Shell Quality

	Nonlayer	Low quality shell	High quality shell
Eggs produced/hen during 24-day period	--	10	14
Breaking strength (kg)	--	1.64±0.07	3.60±0.16
Shell thickness (mm x 10 ⁻²)	--	27.2 ±0.7	37.1 ±0.7
Calcium in blood serum (mg/100 ml)	17.7±5.7a	27.8 ±8.8b	26.9 ±5.5b

a,b Means within rows with different subscripts are significantly different (P<.05).

Table 2. Duodenal and Shell Gland CaBP Activity of Hens Selected on the Basis of Shell Quality

	Nonlayer	Low quality shell	High quality shell
Duodenal CaBP activity			
Units/g tissue	3.87±0.10a	6.83± 2.49b	13.75± 5.79c
Units/mg protein (x 10 ⁻²)	19.2 ±4.8a	33.2 ±14.6b	67.4 ±26.6c
Shell gland CaBP activity			
Units/g tissue	3.10±1.00a	3.11± 1.00a	6.54± 2.23b
Units/mg protein (x 10 ⁻²)	14.2 ±3.3a	20.3 ± 9.8a	46.8 ±20.3b

a,b,c Means within rows with different subscripts are significantly different (P<.10).

Table 3. Shell Gland Carbonic Anhydrase Activity of Hens Selected on the Basis of Shell Quality

	High quality shell	Low quality shell	Nonlayer
Shell gland carbonic anhydrase activity			
Units/g tissue	464.4 ±52.2a	269.6 ±82.2b	142.3 ±68.7c
Units/mg protein	11.15± 1.11a	6.85± 2.22b	3.34± 1.47c

a,b,c Means within rows with different subscripts are significantly different (P<.01).