CALCIUM SOURCES FOR LAYING HENS

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Introduction

Ninety-seven percent of the egg shell consists of calcium carbonate. The shell weighs approximately 6.0 g, so almost 6.0 g of calcium carbonate must be synthesized and deposited on the shell each time the hen produces an egg. For many hens, this is almost daily for long sequences. Calcium carbonate is 40% calcium, thus about 2.5 g of elemental calcium must be found and transported to the shell gland in the 18-20 hours it takes to form the egg shell. The calcium content of blood at any given time is no more than 30 mg. Thus the shell contains over 80 times more calcium than the content of the blood.

Calcium is obtained by the hen for shell formation from two sources.
• Firstly, it comes from the feed, via the intestine and the blood stream.
• Secondly, it comes from reserves stored in the medullary bone. These reserves are replenished during the time egg shells are not being formed.

Feed Calcium

The most common source of calcium for layer feeds is limestone. Consisting primarily of calcium carbonate, this mineral supplement is well digested by the chicken. It is important to realize that the limestone is broken down into calcium ions and carbonate ions: it cannot be transported into the blood stream intact. And when it is synthesized to form the egg shell, the calcium and carbonate ions must be recombined to become the calcium carbonate of the egg shell.

Although the hen is capable of digesting the limestone, the process is by no means perfect. In fact, the best that can be expected is 50 - 60 % retention of the calcium in the feed. Therefore, to ensure the retention of 2.5 g of calcium daily, 4.0 - 4.5 g must be fed in the diet.

Calcium Supplement Particle Size

In the mid 1960's, the late Professor Milton Scott and colleagues at Cornell University discovered that providing calcium in the form of oyster shells resulted in higher digestibility and retention than the same amount of calcium carbonate fed as ground limestone. The reason for this, they hypothesized, was that the larger particles of oyster shell remained in the gizzard (the first compartment of the digestive tract) and were slowly dissolved over a prolonged period. In contrast, the smaller particles of ground limestone moved quickly through the digestive tract and were only partially dissolved.

The use of oyster shell resulted in improved calcium retention, and better shell quality as measured by egg specific gravity, and several other criteria such as shell thickness, percent shell, etc. This research was quickly applied in the field, and most breeders' management guides began to recommend various combinations of limestone and oyster shells to achieve optimum shell quality. Since oyster shell is usually much more expensive than limestone, its use is often limited.

Dr. Scott's work was repeated and refined by many other researchers, notably Dr. David Roland at Auburn University. Roland has refined the feeding of layers using econometric methods, and has completed a large amount of research on calcium nutrition. He confirmed that there is no intrinsic benefit to oyster shell as a calcium source, other than the size of the particles. It was shown that any particle of calcium exceeding about 1mm in size will be retained in the gizzard and the calcium will be released slowly into the blood stream.

Roland also showed that limestone from different quarries may have different properties, particularly with respect to solubility. They also vary in chemical content; some contain large amounts of magnesium, and these should be avoided.

Recent Research at Nova Scotia Agricultural College

Anderson et al (PIC project #66) have reported on research using limestone from Atlantic Industrial Minerals Inc. Glen Morrison quarry in Nova Scotia (AIM). They compared four diets. The control (1) consisted of 70% ground limestone plus

30% oyster shell; the second diet (2) was 100% ground limestone (not AIM), the third diet (3) was 70% ground limestone plus 30% AIM and the fourth (4), 100% AIM.

The particle sizes of the oyster shell and AIM were measured using standard sieves. Over 90% of the particles in the oyster shell were over mm in size. In contrast, only 15% of the particles in the AIM were > 1mm, and the largest proportion were retained by a 0.5 mm sieve. Solubilities were measured, but showed no consistent differences between sources.

The diets had no effect on egg production. Some significant effects were noted on egg weight towards the end of the laying period; diet 3 had consistently higher egg weight from about 35 weeks of age. Shell quality was not affected early in the production cycle, but after an unexplained decline in egg specific gravity between 50 and 55 weeks, diet 3 produced significantly higher values for the remainder of the laying period.

The authors conclude that the AIM product would provide a suitable substitute for oyster shell in layer rations, at a price comparable to ground limestone.

Further information:
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