Managing Dietary Calcium In Poultry Layer Diets

By Dan Leiterman

The role of calcium in all phases of poultry production is well documented. However, despite its tremendous importance, there are many details that need to be managed with the delivery of calcium to laying poultry to ensure proper utilization.

There are several key factors involving calcium that can significantly affect eggshell quality and bird performance. Statistics referenced in this article are general values for brown birds, but the concepts can apply to white breed layers as well.

When feeding calcium to layers, focus on:

1. **Phase of production**
   a. **Calcium percentage in the ration**
   b. **Total daily feed intake**
2. **Particle size of the calcium**
3. **Factors that can prevent delivery or utilization of the calcium**

Phase of Production:

Layers have a wide range of nutritional requirements depending on the stage or phase of production they are in. Each phase generally has a different daily feed intake, requiring changes in the diet to meet requirements. It is typical in larger operations to feed a ration specifically designed for each targeted phase of production to accommodate requirements relative to daily feed intake. An example of phase feeding is indicated in **Figure 1**. As the layers enter each phase of production, there is typically a progressive increase in grams of daily feed intake. As the intake increases, the percent of crude protein in the diet formulation can decrease. There is also a similar general trend in feeding calcium. As intake goes up, the percentage of calcium can trend downward. However, there are exceptions to this pattern that need to be addressed to accommodate other factors, such as peak production, age of the birds, breed specifications and the bird's ability to utilize the calcium.

When feeding layers, it is important to consider the phase of production as well as the daily feed intake. Knowing the phase of production brings other factors to bear in deciding how to formulate the ration, i.e. production level and the

Figure 1: Ration Nutrient Composition

	Pre-Lay	Layers						
Crude Protein (%)	16	20	19	18	17	16	15	14
Calcium (%)	2.3	4.1	4.1- 4.4	3.9- 4.4	4.2	4.5	3.9	3.8
Available Phosphorus (%)	.45	0.51	0.51	0.49	0.39	0.36	0.37	0.36
Phase 1 (19 - 45 weeks): Daily Feed Intake		>80	<105	105	110	115	120	>120
Phase 2 (46 - 65 weeks): Daily Feed Intake				<105	105	110	120	115
Phase 3 (After week 65) Daily Feed Intake					<105	105-110	110-115	100-115

bird's ability to utilize the diet. The daily feed intake can vary based on the phase of production and that can influence how the diet should be formulated. **Figure 1** demonstrates that a 17% crude protein diet and its associated calcium levels can be recommended over a wide range of daily feed intake; from under 105 grams to 115 grams, depending on the phase of production. Using daily feed intake as the sole determining factor to diet selection can be misleading. Using Figure 1, look at birds eating 105 grams daily. Should the diet be a 17% crude protein or an 18% crude protein? Using the bird's phase of production is a significant factor in determining the proper diet to ensure both the protein and calcium requirements are properly met.

Calcium Particle Size:

The ability for layers to digest calcium in a manner that will support good eggshell quality and bird health can be affected by several key factors; such as the size and porosity of the calcium particle. Particle size and porosity affect the solubility of the calcium, or in other words, how fast it is broken down for digestion. Generally the larger the calcium particle, the less soluble it is and the slower it will breakdown. Consequently, calcium particle size can have a significant impact on eggshell quality.

"After peak egg production, the layer produces a fairly consistent quantity of shell material for each egg, regardless of its size. As the egg gets larger, the shell necessarily gets thinner and becomes more prone to breakage. Even under ideal conditions, 4-5% of eggs leaving the farm will be graded as cracks. Together with cracked and broken eggs on-farm, industry averages dictate 7-8% of eggshells break for various reasons."[1]

Keep in mind, an eggshell contains approximately 2 grams of calcium, most of which comes from the feed. The majority of the eggshell itself is formed during darkness. Since layers eat very little during darkness, it is critically important for good eggshell development that there be adequate amounts of calcium still in the gizzard during the hours of darkness when the eggshells are being formed. Reduced solubility

(Continued on Page 10)

MANAGING DIETARY CALCIUM IN POULTRY LAYER DIETS

(CONTINUED FROM PAGE 9)

Figure 2: Calcium Solubility Based On Particle Size[1]

Description	Particle Size (mm)	Relative Solubility
Fine	< 0.2	100
Medium	0.2 - 0.5	85
Coarse	0.6 - 1.2	70
Extra Coarse	1.3 - 2.0	55
Large (hen size)	2.0 - 5.0	30
Oyster shell	2.0 - 8.0	30

Figure 3: Calcium Particle Size Ration, Fine Vs Coarse

	Bird Age (weeks)	Fine Limestone ((0 - 0.5mm)	Coarse Limestone (1.5 - 3.5mm)
Layer Phase 1	19 - 45	30%	70%
Layer Phase 2	46 - 65	25%	75%
Layer Phase 3	> 65	15%	85%

of calcium results in longer retention of calcium in the digestive tract, specifically the gizzard. Including a source of calcium into the diet that has larger particle size is important for good eggshell quality. The calcium particle size and its ratio to finer calcium particle size in the diet are extremely important as well. **Figure 3** details the appropriate ratio of fine to course calcium required in brown bird rations based on phase of production to ensure maximum eggshell quality.

The relative solubility of calcium carbonate, a typical source of calcium in layer rations, is listed in **Figure 2**.

"Twelve hours after feeding there can be twice as much calcium in the gizzard from large vs. fine particle limestone."[1] Brown birds tend to have a slightly higher need for large particle calcium than white birds due to a later lay time the following morning. A general rule of thumb is to have at least a 50:50 ratio of coarse to fine particle size calcium in the diet. Depending on production results, higher levels of large particle calcium may be needed. A good fine to coarse ratio for many brown bird species is listed in **Figure 3**.

Calcium particle size can be defined by sieve size as well as millimeters (mm). Appropriate sieve sizes for fine calcium range from #40 to #80 with a #60 sieve being a common size. Appropriate coarse calcium sieve sizes will range from # 6 to #12 with a sieve size of #6 or #8 being the most common. Very large calcium particle size, such as oyster shells should be limited to no more than 10% of total daily calcium intake. See **Figure 4**.

Figure 4: Calcium Particle Sieve Size

Sieve Size	millimeters (mm)
#6	3.36
#8	2.38
#12	1.68
#40	0.42
#60	0.25
#80	0.177

It is important to remember that the ratio of fine to coarse calcium particle size does not change the amount of calcium needed in the diet. Layers will still need the appropriate amount of calcium for consistent eggshell quality. When trying to improve eggshell quality, first investigate if the feed's percentage of calcium is correct for the daily intake and stage of production.

Then review that the birds are receiving the correct ratio of fine to course calcium, again according to the stage of production. Simply adding more calcium in an attempt to improve eggshell quality is short sighted and will often lead to diarrhea and wet bedding.

Factors That Can Reduce Calcium Bioavailability:

There are many other factors that can reduce calcium bioavailability in a layer diet. Below is a list of just a few of the key factors that can impact eggshell quality and/or bird health.

1) Phosphorus: Feed grade phosphorus commonly has high levels of heavy metal contaminants. These contaminants found in poor quality phosphorus sources reduce the bioavailability of calcium and other critical nutrients in the diet. Crystal Creek® Poultry-Pro™ is formulated with extremely high quality phosphorus that has been cleaned to reduce/or eliminate contaminants so it will properly support the layer's ability to utilize calcium.

2) Vitamin D: Vitamin D at proper levels is needed in order for dietary calcium to be well utilized. There are some antagonistic compounds that can tie up Vitamin D and reduce the layers ability to digest calcium. The use of sulfate and/or oxide trace minerals in the diet, as well as grains containing mycotoxins such as T-2, can tie up Vitamin D and significantly reduce the bioavailability of calcium in the diet. The Crystal Creek® Poultry-Pro™ program uses only polysaccharide and proteinated trace minerals (no oxide or sulfate trace minerals) to ensure the layers can get the most from their diet.

3) Stress: Stress of any kind can reduce layer's ability to utilize their diet, including calcium. Heat stress, moving stress, regrouping and crowding can all reduce feed efficiency. More and more producers are using Crystal Creek's® Crystal Pellets™ during stress periods to keep layers healthy and on track with production. Crystal Pellets™ are a potent and important tool for any poultry operation.

4) Poor Mixing Practices: High quality ingredients and excellent formulation are of no use if the diet is poorly mixed. Test feed batches routinely to verify they match target formulation goals and verify proper mixing. Adding ingredients to the mix in the wrong sequence and poor mixing practices are common problems that can easily be corrected. Call Crystal Creek® and discuss your mixing program to see if it is on target, or if there are ways to improve feed efficiency and reduce your feed bill.

The Crystal Creek® Poultry-Pro™ program is an advanced nutritional program for all types of poultry and turkey production. Poultry-Pro™ is specifically designed to improve the bioavailability of your poultry diet to optimize flock health and production while improving your profitability. Contact Crystal Creek® or your local Poultry-Pro™ dealer for more information on how this exciting nutrition formulation technology can improve your flock health, production and profitability!

Resources:
1. Commercial Poultry Nutrition, S. Leeson, J.D. Summers, 3rd Edition