Calcium Requirements for Egg Laying in Cockatiels

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Calcium has been recognized as an essential element in the diet for almost 200 years. The first experiment to show this was reported in 1791 by Fordyce, who observed in his canaries that "the hen at the time of laying requires a quantity of calcareous earth, otherwise she is frequently killed by the eggs not passing forward properly." We now recognize this as egg binding.

The main function of calcium in the animal is as a structural component of bone. Other functions include its need in blood coagulation, muscle contraction, myocardial function, and normal neural-muscular irritation. It is an important component of the intracellular cement which holds cells together. In birds, of course, calcium has the additional function of being the main mineral component of egg shells, which are almost entirely calcium carbonate, 40% of which is calcium. The calcium requirement for egg production is at least 100 times the requirement of the same hen when it is not laying. Because this remarkable change from a low to a high requirement may take place in less than a month, we are left with a difficult task of evaluating and expressing the calcium requirement of birds. When looking at the calcium requirements for birds, it is first necessary to decide which calcium requirement is to be examined. For example, the calcium requirement for maintenance is low. During growth, the calcium requirement is higher and in breeder chickens the requirement is higher still. In the cockatiel, however, it appears that the calcium requirement for egg laying lies between the calcium requirement for maintenance and the calcium requirement for growth.

The first concern in meeting the calcium requirement of a laying bird is to provide each day the amount needed to produce the shell. In cockatiels, which lay every two days, only half the amount present in a shell is required per day. Because cockatiel shells constitute only 5% of the egg weight and each egg is only 5% of the hen's weight, the daily calcium need is only 50 miligrams per day. Because the bird needs calcium besides that for the shell and because calcium absorption is not 100% efficient, the actual requirement is greater than 50 mg per day.

The second matter of interest in looking at the calcium requirement for egg laying in cockatiels is whether we wish to have a bird lay only a few eggs, perhaps six, or whether we expect the birds to sustain periods of laying in which they may produce 25 or 30 eggs. For such large numbers, we must be concerned with decreased calcium stores in bone, the result of which is bone fragility.

Egg shells are a unique structure in nature. They function both to protect the embryo from external injury and to provide an environment in which it can grow and develop. Egg shells are strong, rigid structures but are penetrated by pores which allow for the exchange of gases between the embryo and its environment. During development of the embryo, oxygen is consumed and carbon dioxide is produced. An exchange of carbon dioxide and oxygen between the embryo and the environment must be allowed to take place. This occurs by the simple process of diffusion through pores in the egg shell. Water also diffuses through the shell and is lost from the embryo to the environment. The egg shell must be produced in a way that will prevent excessive loss of water from the embryo during incubation while at the same time facilitating the exchange of carbon dioxide and oxygen between the embryo and its environment. To do this, the hen produces an egg which allows a well regulated rate of diffusion across the shell. The rate of gas exchange and the rate of water loss through the shell are dependent on shell thickness, the numbers and sizes of pores in the egg shell, and the relative humidity in the nest. Thus to examine the calcium requirement of a bird for laying eggs to be hatched, we must consider the shell thickness.

One measure of the adequacy of the egg shell is the rate at which water is conducted through it. This can be measured by placing the egg in a desiccator at 0% humidity and allowing water to pass out of the egg. The rate of loss of water from the egg is

simply the difference in the weight of the egg when it is put in the desiccator and when it is taken out divided by the time it was there. This is called egg shell conductance. Egg shell conductance is potentially a more useful measure of calcium adequacy than shell thickness because the bird can compensate somewhat for a loss of shell thickness by decreasing the numbers and sizes of pores in the egg shell. Thus, a thinner egg shell can have the same conductance as a thicker one. In studies we have conducted, both shell thickness and conductance were measured. Diets with various levels of calcium were fed to groups of cockatiels which were brought into lay using light and other environmental manipulations. Eggs laid by the birds fed various diets were collected and shell thickness and conductance measured. As calcium in the diet decreases, we reach a point where shell thickness decreases and conductance increases. The other interesting observation is that as a bird lays eggs and begins to deplete its body stores of calcium, shells thin and conductance increases. The level of calcium we are seeking would allow the bird to lay numerous eggs, perhaps as many as 15, without any significant decrease in shell thickness or increase in egg shell conductance. Birds fed 0.3% calcium or more in the diet were able to lay up to 15 eggs and still meet the shell thickness and shell conductance criteria. Birds which were fed less than this showed a gradual decline in shell thickness and a gradual increase in egg shell conductance as more eggs were laid. Even birds maintained at a minimum level of calcium, however, were able to lay two to four normal eggs before significant shell thinning or significant conductance increases were observed. It appears that birds laying a relatively small clutch of eggs, perhaps as few as two eggs, may be able to call upon their body stores to produce shells which have normal thickness and conductance. If, however, more than four eggs are produced, significant calcium must be available from the diet to enable the bird to produce shells of normal thickness and conductance and to ensure that hatchability will not be impaired by egg shell thinning.

One observation from this study is that birds maintained on low calcium diets may still lay eggs. One bird maintained on 0.05% calcium laid 15 eggs before she stopped. She was apparently in good health; however, her bones were fragile, and she suffered a wing fracture. The level of calcium used in this diet is not much lower than the level in most seed diets. If a pet bird is maintained on a diet such as seeds alone and is not allowed additional calcium, egg laying can result in calcium depletion and fragile bones. We recommend that psittacine birds which are being set up to breed be offered at least 0.3% calcium for normal egg shell thickness and to resist bone thinning.

Literature on poultry and game birds indicates that birds should not be fed more than about 1.2% calcium in the diet, except in the case of laying breeds of chickens and turkeys which produce large numbers of eggs. In fact, there is considerable risk in feeding immature birds more than 1.2% calcium. There is no evidence to indicate that psittacine birds need more than 1% calcium in the diet for growth. We recommend that laying birds be fed 0.3% to 1% calcium in the diet. More than 1.2% calcium should be avoided unless there is specific indication that it is necessary. ●

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