



Calcium Tetany in Broiler Breeder Hens: UPDATE

By Bradley J. Turner, Technical Services Veterinarian and Marc DeBeer, Nutritionist

SUMMARY

Introduction

Calcium tetany in broiler breeders is characterized by muscle weakness or paralysis and is caused by inadequate levels of calcium (Ca) in the blood. The risk factors associated in the development of calcium tetany are poor pullet uniformity, flocks coming into production quickly, high calcium feed (> 1.2% Ca) being fed before the onset of production and small particle sized calcium.

Calcium Regulation

Calcium tetany develops when the normal response to a decline in blood Ca level becomes disrupted, for example by:

- **Changes in blood pH** - metabolic disturbances that increase blood pH cause blood Ca to become unavailable. The bird has mechanisms to buffer and correct pH changes but under some conditions these may be inadequate.
- **Electrolyte imbalances** - electrolyte balance is crucial for maintaining Ca homeostasis.
- **Intestinal health and transit time** - the bird relies on the diet to supply the calcium that it needs. Anything that increases feed passage rate will limit calcium absorption.
- **Calcium form** - large particle sized calcium remains in the upper intestine for a longer period of time and is therefore available for absorption for longer, helping to provide a supply of Ca during the time of demand.
- **Heat stress** - panting as a result of heat stress leads to a reduction in blood CO₂ and an increase in blood pH.

Diagnosis and Treatment

The muscle weakness and paralysis associated with calcium tetany are usually most obvious in the early morning or after feeding. Typical post-mortem findings include an active, congested ovary, a partially or fully formed egg in the oviduct, and possibly damage to the back of the bird from male abuse. Birds tend to be otherwise healthy and have no leg problems. Treatment of calcium tetany is through calcium supplementation in the form of oyster shell or large particle limestone at 2-5 g/bird/day for three consecutive days followed by three days of rest. This treatment should continue until mortality is under control. Concurrent feeding of Vitamin D will increase Ca absorption.

KEY POINTS FOR THE PREVENTION OF CALCIUM TETANY

- Maximize pullet uniformity.
- Avoid feeding high Ca breeder feed until 5% production - waiting until 5% production will ensure that most birds have reached sexual maturity.
- Utilize large particle sized Ca when possible - large particle Ca stays in the intestinal tract longer, increasing the time that it is available for absorption.
- Provide access to oyster shell in the afternoon - it is an excellent large particle Ca source, with good Ca availability.
- Avoid heat stress.
- Manage blood pH changes - e.g. ensure adequate ventilation and water supplementation, maintain electrolyte balance, bicarbonate supplementation.

History

Calcium tetany in broiler breeder hens is a condition characterized by muscle weakness or paralysis caused by inadequate levels of available calcium in the blood. It is similar to cage layer fatigue in commercial layers, milk fever in dairy cattle, and eclampsia in small animals. Although calcium tetany was first recognized as a significant cause of mortality over ten years ago, there is still very little information about this condition in scientific literature.

Based on observations and mortality surveys over the last few years, it is apparent that the field presentation of calcium tetany is evolving. Classic calcium tetany, which is still occasionally seen, usually presents as high mortality in young (<32 weeks) flocks, especially those coming into production in spring or summer. It is now more common to see lower levels of mortality throughout the life of the flock from calcium tetany, with the highest levels still occurring during the warmer months, instead of high early mortality. Though the exact reason for this change is unknown, implementation of feeding/management programs aimed to address the previously identified risk factors in the development of calcium tetany may play a role. These risk factors include:

- Poor pellet uniformity.
- Flocks coming into production quickly
- High calcium feed (>1.2% Ca) being fed **before** the onset of production.
- Small particle size calcium.

This document discusses the causative factors of calcium tetany giving recommendations for diagnosis, treatment and prevention of the condition.

Calcium Regulation

In broiler breeders calcium is usually associated with eggshell formation, but calcium has many important functions in the body. For example, calcium is essential for the conduction of nerve impulses and the contraction of muscles. Because of its critical importance, there are several mechanisms that help the breeder hen maintain calcium homeostasis despite huge changes in demand during egg shell formation.

All birds experience a decrease in blood calcium during the course of egg shell deposition. The normal response to this decrease is secretion of the parathyroid hormone (PTH), which signals the bone to increase calcium mobilization and the kidney to both decrease calcium excretion

and produce 1,25 dihydroxyvitamin D, the active form of vitamin D. This active form increases calcium absorption from the intestine. In addition to PTH, which responds to low calcium as it occurs, the bird prepares for the calcium demand of egg shell formation with increased levels of estrogen. Increased estrogen production before the onset of lay creates medullary bone, which allows the bird to utilize skeletal calcium without compromising bone strength. Increased estrogen level during ovulation stimulates 1,25 dihydroxyvitamin D production and regulates the bone mobilization of calcium

There are several factors that can negatively impact calcium availability and the normal response to low blood calcium, including:

• Changes in blood pH

Metabolic disturbances that increase blood pH, called respiratory or metabolic alkalosis depending on the underlying cause, cause calcium to change in the blood from the ionized (active) to the protein bound (inactive) form. In cattle, high blood pH appears to affect the responsiveness of the kidney to PTH, which affects the ability to mobilize calcium during milk production. It is not known if this same effect occurs in chickens. Although the bird has mechanisms in place to buffer and correct these pH changes, under some conditions these may be inadequate.

• Electrolyte (Mg, Cl, P, K, Ca, Na) imbalances

Electrolyte balance is crucial for maintaining the metabolic health of the chicken, including calcium homeostasis. The intestinal tract (absorption and excretion) and the kidneys (retention and excretion), through complex mechanisms, are the two organs responsible for maintaining electrolyte balance. Electrolyte balance will be affected by disease of either organ, feed formulation, and water quality. For example, calcium absorption and excretion is closely linked to phosphorus. High or low levels of phosphorus in the feed or the blood will have a significant impact on calcium regulation. Low chloride levels can affect the acid-base balance and increase blood pH with the consequences previously described.

• Intestinal health and transit time

The bird relies on the diet to supply the calcium that it needs for egg shell formation, replenishment of bone stores and metabolic processes. To reach the bloodstream calcium must be absorbed through the intestine. Anything that increases feed passage rate (low viscosity feed, increased water intake, poor intestinal health) will limit calcium absorption.

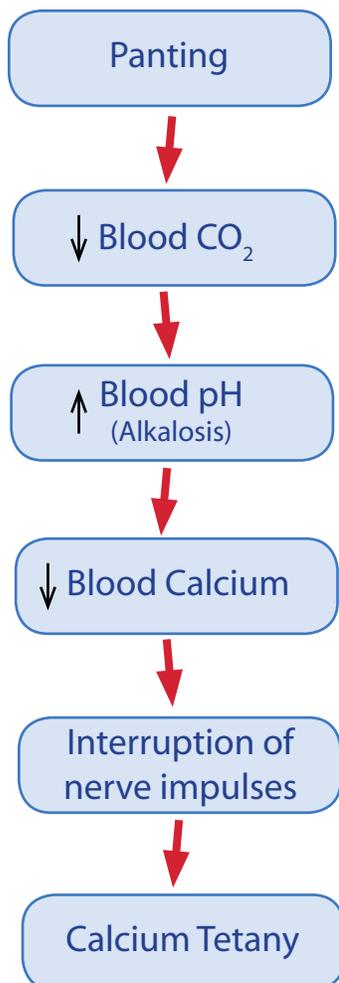
- **Calcium form**

Calcium particle size can affect the length of time calcium is in the intestine and available for absorption. Large particle calcium remains in the upper intestine for a longer period of time. As egg shell formation normally takes place long after feeding time, using larger particles helps to provide the hen with a supply of calcium during the time of egg shell formation.

Role of Heat Stress

Much of our knowledge on the role of heat stress in calcium tetany is based on studies in other species, including humans, and field experience. The normal response in chickens to heat stress is panting which causes increased loss of CO₂ to the environment. The loss of CO₂ increases blood pH. This process is called respiratory alkalosis. The rise in pH, if not buffered, affects calcium availability by changing calcium from the free, ionized form to the biologically inactive protein bound form and potentially reduces the activity of PTH and other hormones needed to maintain calcium homeostasis (see **Figure 1**).

Figure 1: Flow diagram showing the development of calcium tetany related to heat stress



Heat stress is not only caused by high environmental temperatures. Internal body temperature rises significantly after feeding and it is common to find panting birds even when the house temperature feels cool (**Figure 2**). Increased activity and bird density during feeding can cause a significant rise in environmental temperature on the slats versus the scratch area.

Figure 2: A bird showing heat stress after feeding

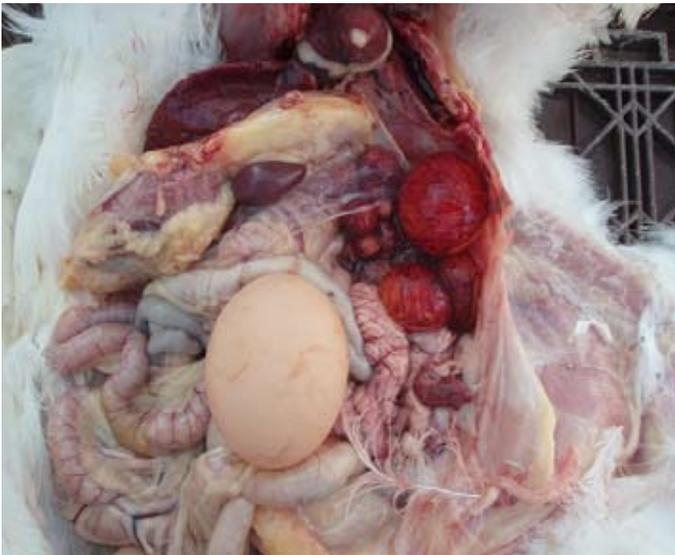


It is important that management programs are in place to address problems of heat stress (see section on prevention).

Diagnosis of Calcium Tetany

The most common signs of calcium tetany are muscle weakness and paralysis which is usually most obvious during the early morning period or after feeding. Birds can be found twitching but this is rare. Mortality is often blamed on “male kills” but the underlying problem here is that the affected hens cannot get away from the males. Typical post-mortem findings include an active, congested ovary, a partially or fully formed egg in the oviduct (see **Figure 3**) and possibly damage to the back of the bird from male abuse. These findings in an otherwise healthy bird with no leg problems or other explanations for the death are considered calcium tetany suspects. Unfortunately, definitive diagnosis is impossible in a dead bird and very difficult in live birds.

Figure 3: A congested ovary with an egg in the tract



Treatment

Recommended treatment for severe cases of calcium tetany has not changed significantly. Calcium can be supplemented in the form of oyster shell or large particle limestone at 2-5g/ bird/ day for three consecutive days followed by three days of rest. Continuous high levels of supplementation can negatively affect calcium regulation and do more harm than good. This program can be used until the mortality is under control which may take several cycles. To get uniform distribution it is best to top dress the feed as it leaves the hopper or broadcast evenly on the litter. Another option is to put the oyster shell in piles throughout the house, but distribution is likely to be less uniform. Vitamin D can be used concurrently to increase absorption of dietary calcium.

Prevention

Maximize Pullet Uniformity

It is very important that the majority of birds reach sexual maturity at the same time. Birds receiving high calcium feed (> 1.2% Ca) in advance of sexual maturity are at a higher risk of developing calcium tetany.

Avoid High Calcium Breeder Feed Until 5% Production

Waiting until 5% production to change to the breeder feed will ensure that most birds have reached sexual maturity, although many may not have started to lay eggs. The mechanisms for calcium regulation set in motion by sexual development will then be in place to allow the bird to respond appropriately to the higher levels of calcium in the breeder feed.

Incorporate Large Particle Sized Calcium When Possible

Large particle calcium stays in the intestinal tract longer than small particle calcium, increasing the time that it is available for absorption. As the eggshell is typically deposited well after the majority of the feed has passed from the intestine, the increased time of availability may be beneficial in maintaining blood calcium levels during this period of demand. Unfortunately, the logistics of manufacturing feed may not always allow the use of large particle calcium.

Oyster Shell

Oyster shell supplementation can be used as both a treatment and preventative measure. It is an excellent large particle calcium source with good calcium availability. It can be supplemented in the morning with the feed or in the afternoon to increase the intestinal calcium availability during peak demand.

Minimize Heat Stress

Heat stress can be caused by a number of factors including:

- High outside temperatures.
- Inadequate ventilation, especially on slats and within nest boxes.
- Inadequate water supply.
- Over weight or over fleshed birds.
- Metabolic activity after feed intake.
- Increased bird activity.
- High bird densities.

Manage Blood pH Changes

There are number of ways to combat changes in blood pH including:

- Bicarbonate supplementation in the feed, this helps to maintain the bird's natural buffering system.
- Adequate water consumption, especially during periods of demand, such as feeding time, will also help the bird manage pH changes.
- Adequate ventilation during hot weather and periods of stress such as feeding time.
- Maintain electrolyte balance, as some imbalances (Chloride in particular) can have a significant impact on acid-base regulation.

Summary

Diagnosis

- ▶ Calcium tetany in broiler breeder hens is a condition characterized by muscle weakness or paralysis caused by inadequate levels of available calcium in the blood.
- ▶ Birds typically die in the morning to early afternoon and often appear as “male kills”.
- ▶ The typical necropsy findings include an active, congested ovary, with a partially or fully formed egg in the oviduct and damage to the back of the bird from male abuse in breeder hens with no other lesions.
- ▶ Definitive diagnosis is very difficult as it requires testing blood calcium levels in affected birds which can be difficult to find in the acute phase.

Treatment

- ▶ Treatment of severe cases of tetany includes calcium supplementation in the form of oyster shell or large particle limestone at 2-5g/ bird/ day for three consecutive days followed by three days of rest.
- ▶ This program can be used until the mortality is under control which may take several cycles. However, over supplementation can also be harmful as it may interfere with normal calcium regulation.
- ▶ Top dressing the feed as it leaves the hopper or broadcasting on the litter is recommended for best distribution.
- ▶ Vitamin D can be used concurrently to increase absorption of dietary calcium.

Prevention

- ▶ Maximize pullet uniformity.
- ▶ Avoid feeding high calcium breeder feed until 5% production.
- ▶ Utilize large particle calcium when possible.
- ▶ Provide access to oyster shell in the afternoon.
- ▶ Avoid heat stress.
- ▶ Manage blood pH changes.



info@aviagen.com

www.aviagen.com