

# MINERAL Writes

Second QUARTER 2012

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**CALCIUM**

Feed-grade calcium products are available in a wide variety of particle sizes, from liquid suspendable products to large particle products for laying hen diets.

**DICALCIUM PHOSPHATE**

Both 18.5% and 21% phosphorus products are available.

**SODIUM BENTONITE**

Bentonite products are available in a wide variety of particle sizes suitable for any purpose.

**POTASSIUM**

ILC Resources has potassium magnesium sulfate (K/Mg/S) available.

All products are available in both bag and bulk.



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**Endings followed by Beginnings....(an editorial)**

General Douglas MacArthur said in his farewell address that "...old soldiers never die, they just fade away." I'm not sure I would even suggest my equal footing with this historic soldier, but I find myself in a bit of a parallel situation. I will be retiring from ILC Resources on June 1 of this year. I have had the rare opportunity to represent my company as *director of nutrition & technical services* for the past decade since October 2002. As my four decades' career is coming to a close, I could not possibly envision a more fulfilling *last decade* than the one I've had right here at *Iowa Limestone Company*. There have been perhaps two specific legacies I am particularly proud of as I depart into the tranquil world of retirement.

One has been the authorship of this venue – *Mineral Writes* – during my tenure here. This edition numbers 38 continuous quarterly publications. I have greatly enjoyed that challenge and consider myself fortunate to have had the splendid audience of readership we now

reach. Along the way, we've received feedback that has let us know our mailings have not been in vain. A few times we've gotten some rebuttal. Wonderful! People are reading it! At this point I have to say I've also received generous comments with heartfelt gratitude and joy. If I could reach out to each of you singly, I would simply say *thank you*. One goal I set out to accomplish is to advance our composite knowledge of *calcium* and its mounting mysteries of complex dynamic interactions in nutrition. Some might be led to believe calcium (Ca<sup>++</sup>) is a simple nutrient that is well researched needing no more scrutiny. We've heralded "...au contraire" repeatedly. We have been delighted to discover many new complexities helping to define further Ca's powerful role in maintaining good health and structural soundness while supporting optimum performance. Supporting skeletal integrity, metabolic efficiency, milk production (for propagation of species & human consumption), along with safely encasing the

*incredible edible egg*, **calcium** does play a starring role, not just “behind the scenes” support alone. We believe we are building a significant body of references attesting to just that. If you’d like to visit or maybe perhaps *revisit* our library, please feel free to browse our website [www.ilcresources.com](http://www.ilcresources.com) and peruse our bookshelves.

Secondly, ILC Resources has operated for nearly nine decades serving American agriculture by predominantly supplying a rich source of calcium to meet nutritional needs of the livestock/poultry feeding industry. We’ve been blessed by nature to harvest a product created from the farthest reaches of antiquity by simple marine *crinoids* settling to ancient sea beds and solidifying into the  $Ca^{++}$  rich limestone we now process into graded  $CaCO_3$  products. We start with the best; we take seriously our commitment to maintain quality, integrity and safety of this simple ingredient for our customers to process into feed ultimately supplying the human food chain. We have an historic reputation for “doing the right things.” As dynamic events and concerns have increased in the past decade, we’ve continued to focus on providing quality and safety with each sale of our products. Today’s society demands proof of these activities. As one such pathway of accreditation has surfaced, flourished, and built upon these tenets, ILC Resources has followed in a spirit of fully preparing to answer requests and inquiry of our accountability. AFIA (*American*

*Feed Industry Association*) introduced the **Safe Feed/Safe Food** program of *third party certification* several years back. During the ensuing interval of time, ILC has actively evolved in compliance to this doctrine. We’ve furnished many proofs upon request from a wide range of customer based inquiry and even have opened our doors for people to come see for themselves. Recognizing the power of association in this plan to demonstrate product safety, ILC Resources has now joined the ranks of the *Safe Feed/Safe Food* family of businesses. Our company owned facilities are now **certified** as providing *safe feed ingredients* to the livestock/poultry feeding industry as they provide *safe food* for hungry humans. I am personally proud to have been an active participant in leading our company toward this accomplishment.

On the other hand, these accomplishments are far from the end. They must be realized for just what they actually are, only a *beginning* of our continuing commitment to excellence.

As we embrace our present reality as only *beginning*, we want to introduce the next individual soon to sit behind this desk. ILC Resources has brought on board Todd Owens to be our new *director of nutrition & technical services* as of June of this year. Todd comes to ILC with over twenty years of experience in the feed industry, with credentials in sales, management, nutritional consulting and technical support. He received his bachelors’

degree from Iowa State University majoring in animal science. Interrupting his career later on, Todd pursued an advanced degree from South Dakota State University, receiving his M.S. in ruminant nutrition, specifically dairy science in 2009. His career has taken him throughout the Midwest and even into the New England states working with and helping dairymen and other livestock/poultry producers. He’s “an old Iowa boy” by heritage and upbringing, but throughout his time in industry he’s traveled, lived, and worked in a vast geographical breadbasket here in the U.S. Todd has been orienting himself here at ILC since April 2 and is enthusiastically embracing his challenges ahead. We are pleased to have him in our midst.

ILC Resources’ mission statement declares: **“ILC is committed to providing the highest quality products and to striving for continuous improvement. We are dedicated to consistently exceed our customers’ expectations of service and quality at every opportunity.”** Our people make this happen.

*Rick Burtel*



Meet Todd Owens...

## June is Dairy Month — Calcium “good health” by Todd Owens, M.S., P.A.S.

Since June is Dairy Month, it seems appropriate to investigate the interactions of calcium within dairy products. We all know consumption of milk and other dairy products affects bone health. Specifically calcium and other nutrients that are found in those products are key elements of good nutrition for bone health and development in the young and old. Researchers in Italy recently published an excellent overview of this topic. The wide variety of dairy products available and the many benefits of consuming them as part of a healthy diet at all ages are well documented. The full article, “Invited review: Dairy intake and bone health: A viewpoint from the state of the art,” by A. Caroli, A. Pli, D. Ricotta, G. Banfi and C. Cocchi can be found in the *Journal of Dairy Science*, Volume 94, pages 5249-5262. The authors explained calcium availability in dairy products, the nutritional benefits of calcium and focused on the relationship between dairy product consumption and bone health, specifically osteoporosis.

### **Drink milk as kids**

It is important for children to establish the habit of drinking milk. This youthful habit will more likely extend into adulthood. Consuming enough milk while children are growing is the most critical nutritional factor for peak bone mass development. Recommended daily allowances for calcium range between 700 to 1,300 mg/d. In the U.S., the average calcium intake is between 1,008 to 1,296 mg/d for men and be-

tween 918 to 1,186 mg/d for women. On average, calcium intake decreases after age 50. Therefore, the aging body cannot rely on calcium supplements to return to youthful bone health status. Clearly then, calcium supplements used more by older age groups do not sufficiently meet recommended levels for calcium consumption.

### **Other needs for calcium**

What are other reasons to continue making sure we get enough calcium in our diets? Calcium is important for neurotransmitter functions, neuron firing, muscle contraction and even blood coagulation. Calcium enters the body through the intestine by two mechanisms. The first mechanism is active transportation by Vitamin D across the duodenum. Second is the continuous diffusion of calcium throughout the small intestine.

Vitamin D is necessary for calcium absorption. It is hard to determine the adequate nutrition levels because Vitamin D comes from both diet and exposure to sunlight. Vitamin D is not found in many foods naturally. It is found in oily fish like salmon, mackerel and herring and in fish oils. In the U.S., we have been fortifying juice, breads, yogurts and cheese with Vitamin D. Europe has recently started the trend for Vitamin D supplementation as well.

### **In Human diets**

Most calcium comes from milk and dairy products. Other sources include low-oxalate

(calcium that is in a high bioavailable form) vegetables, legumes, nuts and fortified foods. In general, calcium in milk and other dairy products is more readily absorbed than the calcium in spinach or in cereal grains. There is not much difference among dairy products (milk, yogurt, cheese) in terms of calcium bioavailability. In normal diets, about 40% of the calcium in milk and cheese is absorbed in the body. It is interesting to note that dairy products such as cream, sour cream and cream cheese are actually very low in dietary calcium. Dairy products also provide for the simultaneous absorption of phosphorous.

It is predicted that 10-15% of dietary calcium is retained in the skeleton during adolescence. Dairy products provide more protein, calcium, magnesium, potassium, zinc and phosphorus per calories than any other typical food found in the adult diet.

### **Benefits**

Benefits of consuming adequate levels of calcium, vitamin D and protein are decreased bone loss, better calcium retention, reduced age-related bone loss (osteoporosis) and a decrease in risk of fracture.

In our youth, the intake of calcium and vitamin D is essential to bone mass density and growth. As we age, these nutrients continue to influence bone mass density by limiting the loss of bone mass. Osteoporosis is a medical condition that the authors defined “as a dis-

ease characterized by low bone mass and microscopic deterioration of bone tissue and structure.” This condition leads to bones becoming more fragile and increases a person’s risk of fractures. Incidence of osteoporotic fracture is rising as a result of increasing industrialization and decreasing physical activity of people. Many studies have proven that adults whose diets include significant dairy intake minimize bone loss in midlife, because of the association between milk consumption and bone mineral density. Studies reveal a positive association between bone mineral density and body mass index, muscle strength and calcium intake. These findings may lead to developing strategies for preventing osteoporosis. While these associations are important in adults, they are strongest during a person’s physical development.

**Factors affecting bone**

Many factors during bone development increase bone mass and strength. These include genetics, sunlight exposure (which causes vitamin D synthesis) and physical activity. Proper nutrition (specifically calcium intake) is also a major player in the development of bones. Dairy foods contain the greatest amount of available calcium in a person’s diet. Other nutrients found in dairy products that may be otherwise limiting are potassium and magnesium. Vitamin D fortification of dairy products is a staple in today’s diets. It is important to note, that even though calcium intake affects bone health, there are known dietary substances (i.e., alcohol, caffeine and tobacco prod-

ucts) that negatively interact with calcium absorption or excretion. These different elements and their interactions have to be considered as a whole when looking at the relationship between calcium intake and the risk of fracture.

Milk furnishes many other limiting nutrients and it is the most readily available form of dietary calcium. It is also a perfect medium for fortification with additional calcium, vitamin D and other minerals.

Enriched skim milk, containing 1,200 mg of calcium is a useful, safe and acceptable measure for healthy elderly postmenopausal women. Other positive nutritional attributes of skim milk are lower levels of cholesterol, saturated fatty acids and sodium. Three glasses of skim milk a day, fortified with calcium, phosphorus, lactose and vitamin D may reduce bone loss in women 10 or more years past menopause. Other studies have found that consuming fortified dairy products may induce favorable changes in the pelvis, total spine, and total body bone mineral density in postmenopausal women. As part of a holistic approach, consuming fortified dairy products along with nutrition and education as an intervention approach for 12 months induces positive changes in bone metabolism.

**Calcium in dairy products**

It is obvious that calcium and other nutrients in dairy products are important in human development. It seems logical to extrapolate much of this information as having application to the bone and growth devel-

opment of livestock also requiring dietary calcium. Nutrient supplementation of *Mom’s* milk as well as subsequent dietary stages of production may be beneficial. What is good for “us” is also good for the animal origins of meat, milk, and eggs we consume. Improving their health, may help us improve our own health.

**Cal/Vit D for skeletal health**

In summary, there continues to be strong evidence supporting the key role calcium and vitamin D play in skeletal health. This is a complex relationship. Bone metabolism is influenced by more than just these two factors by also including genetic, hormonal, physiological and other nutritional effects. Bone health is influenced by the variety of fortified dairy products available, what supplemental nutrients are included and how readily the body absorbs those dietary supplements.

Regardless of the variety of factors that influence bone health, milk and dairy products are the best sources of calcium and other limiting nutrients (like potassium and magnesium). Calcium intake positively affects bone mass and is crucial during childhood for bone development. In adults, dietary calcium alone may not prevent bone loss because of other contributing factors, but milk and dairy products do provide a highly available, relatively inexpensive source of calcium to support a strong skeletal system.



## Calcium/Phosphorus/Phytase/Vitamin D Interactions in Swine Breeding Herd — Rich Bristol, M.S.

Calcium and phosphorus build strong bones to support skeletal growth leading to improved performance, whether targeting finishing for ultimate meat, milk, or eggs for food or proper skeletal development leading to soundness and longevity of breeding stock – pertinent to all species of livestock and poultry. There were significant concepts reported affecting breeding swine production longevity recently we'd like to share regarding bone formation and structural integrity.

This year's joint Midwest Animal Science/Dairy Science Meetings in Des Moines mid March featured two poster presentations of interest regarding interactive dynamics of *calcium* (Ca) and *phosphorus* (P) in skeletal development and bone integrity as further influenced by dietary phytase as well as additional active Vitamin D supplementation with 25-Hydroxicholecalciferol (25OHD<sub>3</sub>). Both studies were conducted by a team of researchers from Mexico. Their reports can be found in the published abstracts from this meeting.

### Poster Study #1

The first poster presented findings of their study titled **Use of 25OHD<sub>3</sub> favors opportune and sound bone maturation.** Lack of structural soundness in skeletal development commonly causes poor growth along with gilt culling in swine breeding herds. Typically, over supplementing with Ca and P has been reactionary to compensate insufficient bone struc-

ture. Excess dietary Ca & P may not only fail to improve bone mineralization but additional physiological disturbances may occur. If better utilization of Ca/P along with greater retention of both could be accomplished without detrimental excesses, improvements in skeletal integrity may result.

Vitamin D's role is actively transporting Ca during absorption for subsequent utilization of bone formation. Enhancing Vitamin D sufficiency without necessarily increasing Ca/P concentrations may improve structural soundness of growing gilts destined for reproductive service. "This experiment was designed to investigate the effects of *moderate* levels of dietary Ca and P in the presence of greater Vitamin D<sub>3</sub> dietary density from 25OHD<sub>3</sub> to protect structural soundness of growing gilts."

### Trial & Findings

Fifty-six day old crossbred gilts were subjected to five feeding phases, the first 4 in intervals of 28-days up to 168-days of age, after which the fifth phase commenced until 224 days of age. The phase diets were formulated to contain Ca, 0.61, 0.50, 0.49, 0.45, and 0.62%; digestible P, 0.25, 0.15, 0.13, 0.11 and 0.18% respectively for each phase; with Phytase added to all diets. Treatments were established by addition or **not** of 25OHD<sub>3</sub> (similar to 2000 IU vitamin D<sub>3</sub>/kg of feed), on top of a minimum level of 1530 IU from Vitamin D<sub>3</sub>/kg of feed. Growth performance was measured and visual appraisal

for structural soundness was conducted. No differences in growth were detected until 168 days of age, but gilts fed additional 25OHD<sub>3</sub> gained more weight with improved feed efficiency after 168 days of age, and these responses were followed by improved structural soundness score (5 for control vs. 5.75 for 25OHD<sub>3</sub> fed gilts). The researchers concluded "... that greater dosing of vitamin D from 25OHD<sub>3</sub> improved bone development and contributed to better structural soundness in developing gilts."

### Interpretations

This is exciting news in that overdosing of Ca/P in the diet is ineffective versus moderate Ca/P supplementation in the presence of phytase to unlock additional sources along with improving pathways of absorption and utilization of Ca & P with enhanced levels of vitamin D by dietary inclusion of 25OHD<sub>3</sub>.

### Poster Study #2

This research team's second poster was titled **Rationalization of the dietary Ca levels by the use of phytase and 25 OHD<sub>3</sub> in diets for lactating first-litter sows.** Phytase is well documented to increase nutrient digestibility among Ca, P, and energy allowing reduction of these in diet formulations while still meeting requirements. Commercial swine diets frequently override this by formulating excessive Ca and P supposedly to achieve greater bone mineralization in favor of structural soundness. The danger of excess Ca and elevated

Ca:P ratio is a decrease in ileal energy digestion and the availability of P and other minerals (principally zinc, magnesium and manganese) while phytase activity is actually rendered diminished. “This experiment was designed to investigate the effects of moderate levels of dietary Ca and P in the presence of greater Vitamin D dietary density in the form of 25OHD<sub>3</sub> to protect structural soundness of growing gilts.” The study sought to test the hypothesis that dietary reduction of Ca, associated with the use of phytase will not affect growth performance, but will improve Ca and P efficiency of utilization in lactating first-litter sows. By adding 25OHD<sub>3</sub>, the researchers tested the possibility of improving Ca and P mobilization.

**Trial**

First litter gilts (averaging 11 pigs per litter) were assigned to one of three dietary treatments. The first was the control diet of 0.95% Ca, 0.76% total P and 0.47% digestible P (dP). The second treatment was a reduced energy and Ca diet (low Ca) with added phytase (0.55% Ca, 0.53% total P and 0.25% dP). The third treatment was the same as the second but with the addition of 25OHD<sub>3</sub> equivalent to 2000 IU of D<sub>3</sub>/kg of feed. All diets were formulated with a basal supplementation of 1800 IU Vitamin D<sub>3</sub>/kg feed with the third diet containing a total of 3800 IU/kg feed. The three diets were of equal protein and lysine content, with energy values higher in the control versus the other two treatments diets (3.20 Mcal vs. 3.15 Mcal of ME/kg). Sow productive performance was

measured at day of insemination, at 109<sup>th</sup> day of gestation, at post-farrowing and at weaning.

**Findings**

Productive performance and nutrient balance were similar, but energy digestibility was better for the two phytase diets, “implying that the energy liberation (from phytate) by phytase plus the reduction of Ca was calculated correctly.” The chart below reports the Ca & P balance among treatments from the Poster #2 study.

The study noted that consumption and excretion of both Ca and P were lower with the reduced Ca & P diets, but Ca & P retentions were similar among all three diets. Hence, their conclusion was “...the use of phytase is an effective mean to reduce Ca and P wastage and it is suggested that 25OHD<sub>3</sub> is a good tool to protect Ca and P metabolism.”

**Interpretations**

These findings bring good news to our overall understanding of Ca/P dynamics, along with clearer direction for dietary considerations. “More is not always better.” We validated that truth again here.

By reducing dietary levels of both Ca and P in closer balance with each other, more efficacious results improved performance. Concurrent dietary incorporation of supplemental phytase and perhaps additional vitamin D – notably in more active form of 25OHD<sub>3</sub> – not only allow more efficient utilization of Ca/P but improve other nutrient utilization too, principally energy.

More exciting pieces of the puzzle are being added to the developing Calcium picture. ILC Resources remains committed to advancing focus on these vital dynamics.

Poster #2 Study	Treatment Diets		
	1	2	3
<b>Ca</b>	Control	Low Ca	25OHD
Intake	48.04	34.99	36.03
Fecal Excretion	35.30	22.96	21.87
Urinary Excretion	0.51	0.28	0.25
Retained by litter	18.28	18.13	18.23
<b>Balance (retention)</b>	<b>-6.05</b>	<b>-6.38</b>	<b>-4.32</b>
	1	2	3
<b>P</b>	Control	Low Ca	25OHD
Intake	38.31	26.96	27.77
Fecal Excretion	24.51	15.28	15.34
Urinary Excretion	1.19	0.24	0.23
Retained by litter	13.01	12.47	12.51
<b>Balance (retention)</b>	<b>-0.40</b>	<b>-1.03</b>	<b>-0.31</b>