ilc resources

MINERAL WRITES

FOURTH QUARTER 2005

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 both potassium chloride (KCl) and potassium magnesium sulfate (K/Mg/S) available.

All products are available in both bag and bulk.

Introductory Remarks

This issue of *Mineral Writes* features technical article reviews of three recent research studies. Two involve dairy research and one is a poultry broiler study. We're providing an overview of the essence of each and offering some suggestive interpretations as to their significance. We hope to challenge thinking as to how the conceptual results might be applied.

The first study is a broiler study conducted at Kangwon National University in Chunchon, Korea. The title is ***Effects of Vitamin C and Vitamin D Interaction on the Performance, Immunity, and Bone Characteristics of Commercial Broilers.*** It was published in the *Journal of Applied Poultry Research* Winter 2005. The study has shown that vitamin levels and interactions do affect bone formation and growth performance in growing broilers.

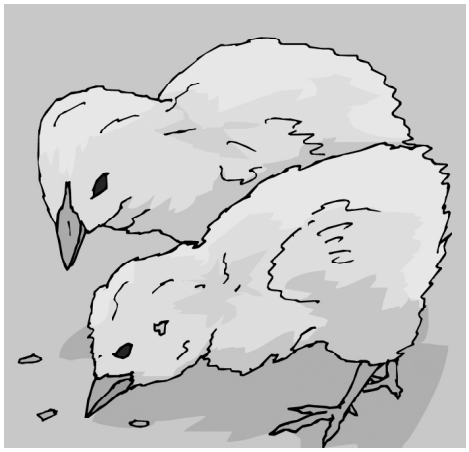
The second study was conducted at Michigan State University in East Lansing, MI. It is titled ***Periparturient Responses of Multiparous Holstein Cows Fed Different Dietary Phosphorus Concentrations Prepartum.*** This dairy research appeared in the October 2005 issue of the *Journal of Dairy Science*. The study examined the impact key dietary mineral levels have on dairy cows just before calving and following through to early lactation.

The third is another dairy study conducted at Pennsylvania State University in University Park, PA, which also was published in the October 2005 issue of the *Journal of Dairy Science*. It is titled ***Ovarian Activity and Reproductive Performance of Dairy Cows Fed Different Amounts of Phosphorus.*** It primarily demonstrates that feeding elevated phosphorus to enhance reproductive performance does not actually work and may hinder interactions among nutrients and subsequent performance.

All of the studies in common demonstrate that caution needs to be exhibited in thinking that if *a little is good, more is better.*

Broiler Study – Kangwon University — Republic of Korea

(J.Appl.Poult.Res. 14:670-678)
{Vitamin Interactions on Performance & Bone in Broilers}



Commercial, fast growing broilers are prone to rickets and tibial dyschondroplasia (refer to 3rd Quarter 2005 *Mineral Writes* article Ca & nPP effect on Phytase Efficacy). Vitamin D has been shown to reduce this problem in field studies. Although NRC recommends only 200 IU/kg vitamin D (VD) for dietary fortification, routinely levels approaching 20 times this are added to commercial broiler diets. Also, chickens and turkeys synthesize vitamin C (VC) in the kidneys, converting glucose sugar to ascorbic acid. VC is necessary for conversion of VD into its metabolite form for calcium regulation and the calcification process essential to bone formation, thus reducing incidence of tibial dyschondroplasia. NRC recommends dietary inclusions of 200 IU of VD per kilogram (kg). From previous studies by the Korean researchers, supplementing 200 mg/kg VC to broiler diets was shown to be beneficial to growth performance versus no supplementation. Therefore, this study compared effects of dietary supplemental VD at either the NRC recommended level of 200 IU/kg or a much elevated level of 1800 IU/kg. These treatments were compared with either 0 or 200 mg/kg supplemental VC. Measurements included performance (body weight, gain feed intake, feed efficiency) as well as bone parameters (bone breaking strength and Ca/P mineral estimation of the tibia). Much interesting detail is available from this study. However, three apparent conclusions were of major note. First, increased growth was observed with VC-supplemented diets versus no VC supplementation, even though the birds can synthesize this vitamin. Secondly, VD at 200 IU/kg promoted better growth in broilers than did the higher 1800 IU/kg. Thirdly, supplementing VC at 200 mg/kg and VD at 200 IU/kg showed the best interactive improvement in bone strength.

What does this study suggest?
Understanding interactions between vitamins and minerals continues to be vital, and refining how those dynamics work is increasingly critical. The practice of simply increasing certain nutrient levels with the expectation of additional improvement in animal performance and/or health should be used cautiously until science more conclusively justifies it. Otherwise, danger lurks within delicate nutritional balances that could well be disrupted and either cause compromised performance or even deleterious effects.

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Dairy Study – Michigan State University

(JDS88:3582-3594)
{Effects of Dietary Phosphorus Levels Pre-Freshening}

Michigan State University researchers determined the effects different dietary levels of phosphorus (P) fed to cows before calving (prepartum) had on metabolism and performance during the time leading up to freshening through early lactation. They looked at three levels of P (low-0.21%, medium-0.31%, high-0.44%) fed to cows four weeks before calving. In larger dairies, herds can more readily be divided and fed accordingly during the transition from late gestation to calving and into early lactation. The cow's nutritional demands are changing rapidly and dramatically during this time. However, what if conditions do not allow for segregation into several groupings to address these dramatic changes? Many smaller dairies cannot easily segregate cows into multiple feeding groups and are often faced with arbitrarily bringing a cow from the dry period back into the lactation feeding area a couple weeks before freshening in an attempt to warm her system up for the demands of lactation. This may have some merit in consideration of energy and protein needs, but what about minerals, especially P? When looking at P, many dry cow diets hover around 0.20-.030% P, equating to 35-50 g P/day. Lactation diets are typically elevated to 0.40-0.50% P (~ 85-100 g P/day). Should there be concern furnishing the prepartum cow this much additional P? Michigan State researchers indicated there is.

They observed that feeding 35 g/d P the last four weeks of gestation had no adverse effects on P or Ca metabolism or milk yields during early lactation. On the other hand, feeding high P during the same period depressed blood Ca levels giving rise to concerns of milk fever, especially in cows predisposed to hypocalcemia. One important finding they made was that even though all three levels of dietary P treatments showed low blood P levels at calving, no clinical cases of *hypophosphatemia* were observed during the first 28 days of lactation. This certainly suggests that a warm-up period of elevated dietary P is not necessary and may cause deleterious results. Their conclusions were that the NRC (2001) recommendation for dietary P during late gestation, although lower than previous recommendations, are sufficient for normal metabolic transition from gestation to lactation.

As mounting understanding of the intricacies in nutritional interactions and metabolic pathways improve, fine tuning diets becomes increasingly important. A common practice of allowing overages of nutrients in dietary formulations to ensure some safety margin is rightfully coming under question. It is understood that overfeeding protein may add unnecessarily to odor and excess ammonia emissions and methane gas emissions, sparking global concerns of pollution and deterioration of the environment. Excess P feeding is under heavy scrutiny for its potential as a pollutant as well. But here is a study that further defines this practice as being detrimental to the cow's metabolic well-being. High P feeding in late gestation will not improve P status at calving nor has it been shown to improve P status going into early lactation, but it may negatively affect circulating blood Ca levels that could precipitate milk fever problems.

Dairy Study – Pennsylvania State University

(JDS88:3609-3618)
{Reproductive Performance of Dairy Cows Fed different P Levels}

At Pennsylvania State University, dairycow reproductive performance was examined under two different dietarylevels of phosphorus (P). The link between P and reproduction in dairy cows goes back to *field* studies reported as early as the late 1920s. Historically, reduced calf crops, lowered conception rates, and altered estruses have been reported with P deficiency. However, no satisfactory explanation establishing phosphorus' specific role in reproduction has been established. Most dairy research on P has centered on milk production and not reproduction. The objective of this study was to examine the relationship between dietary P and ovarian activity. Cows were fed diets of equal nutritional value except for one of two different dietary P concentrations which allowed comparison for either *adequate* (0.35%) or *excessive* (0.47%) levels of P based on the current NRC (2001) recommendations. Key factors shown to be unaffected by P treatments were conception rate of first service, pregnancy loss measured between 30 and 60 days after AI (artificial insemination), overall pregnancy rate at 200 DIM (days in milk), and the number of services per conception. Thus, no effects were observed on postpartum (after birthing) resumption of ovarian activity or reproductive performance. The increased dietary P also did not increase milk yield or DMI (drymatter intake) but did result in increased fecal P concentration. Additionally, if blood levels of calcium (Ca) increase after calving this would be indicative of bone resorption, but this phenomenon was not observed on the 0.35% P diet, thus demonstrating that this amount of P was not low enough to stimulate further bone resorption. Consequently, adequacy of P was validated at a lower level without potentially triggering metabolic disorders or environmental concerns.

This once again demonstrates that over feeding of such critical nutrients as P in an attempt to improve cow performance, especially reproductive performance, is unnecessary.

Conclusions

All three studies examined dynamics of phosphorus in the nutrient profile of both dairy and poultry. The interdependency of this nutrient on other nutrients, both vitamins and minerals, is increasingly apparent. Much attention is being given to the deleterious effects overfeeding of P has on our environment. Naturally, these concerns are well founded. Less recognized matters accompanying environmental pollution issues are perhaps no less disquieting. Excess dietary P leads to imbalances that affect not only sensitive metabolic pathways resulting in functional disorders but reduced performance as well. Further, these studies have pointed to critical interactions of vitamins that affect functionality of P utilization.

Interestingly, as the body of scientific research expands and knowledge of the intricacies of nutritional considerations improves, there becomes less room for "safety-net" overages than ever before in formulating diets to meet requirements. The entrenched mindset of *"a little is good, more is better"* is no longer universally acceptable. It follows that as genetic advances improve our animals' potential and as nutritional understanding allows better focus for meeting emerging potential, continually fine tuning dietaryformulations is increasingly essential.