ilc resources

MINERAL WRITES

THIRD 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.

Calcium and Nonphytate Phosphorus Effects on Phytase Efficacy

When formulating diets today, much interest is given to incorporating phytase in rations to unlock phosphorous and alleviate potential environmental concerns with phosphates. Thus, it's a sound theoretical practice to build diets with marginal supplemental phosphorus along with adding phytase to release phytate-bound phosphorus to meet requirements without over exposing the environment to excess P. However, the dynamics involved in this nutritional process may be more complex than this simple supposition. Other factors play key roles as well. Proper bone development during rapid growth also involves calcium. Perhaps a dynamic relationship exists between these two nutrients worthy of further understanding. A recently reported study helps provide some insight.

In a broiler chick study conducted at the University of Georgia, enzymatic phytase supplementation was investigated over a range of dietary Ca and nonphytate phosphorus levels. Current phytase recommendations seldom account for *amounts* of nonphytate phosphorus (NPP) and calcium (Ca) already in the diet. The objective of this study was to determine the efficacy of phytase enzyme over a wide range of Ca and NPP levels in corn-soybean meal diets. For specific details, this study was reported in the September 2005 issue of *the Journal of Poultry Science* (84:1406-1417).

Measured responses to treatments included determinations of body weight gain (BWG) and feed conversion ratios (FCR), along with severity of bone abnormalities identifying Ca rickets, P rickets, and tibial dyschondroplasia (TD).

(NOTE: Tibial dyschondroplasia is a condition characterized by an overgrowth of cartilage in the leg bone of broiler chicks and turkeys. Bent legs and poor growth development result, posing major loss and problems for respective growers. Typically, TD is affected by genetics as well as calcium/phosphorus ratio and acid-base balance of the diet.)

Three experiments were conducted with diets varying in concentrations of Ca and NPP along with phytase enzyme added or in the

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Calcium and Nonphytate Phosphorus Effects *(continued)*

absence of phytase enzyme. Experiment 1 varied Ca and NPP levels from low to high in all combinations with no supplemental phytase. Experiment 2 also consisted of varying levels of Ca and NPP but with phytase added. Experiment 3 was made up of two diets, one diet with low yet balanced (evenly formulated) levels of Ca and NPP and another unbalanced (wider Ca:P ratio) diet with a low level of NPP and a normal level of Ca. Both diet treatments in experiment 3 were conducted with and without phytase enzyme added.

Results from Experiment 1 showed severe P deficiency was induced when Ca concentrations were raised in diets containing low concentrations of P. Depressed BWG, lower feed intake and decreased percentage tibia ash along with an increase in P rickets incidence and severity were observed. Increasing dietary P reduced P rickets at all Ca concentrations. However, higher dietary P concentrations increased the incidence and severity of both Ca rickets and TD, regardless of Ca concentrations.

Results from Experiment 2 showed significant interaction between Ca and P affecting BWG. Increasing Ca levels at low concentrations of P depressed growth but had no effect at higher P levels. Incidence of Ca rickets decreased with increasing Ca concentrations,yet remained unaffected by P levels. When dietary P increased at low levels of Ca, severe TD was induced, but as Ca levels increased, increasing P concentrations had little effect on TD. The addition of phytase in Experiment 2 spared both Ca and P. The magnitude of response depended on dietary concentrations of Ca and P. The greatest improvement was observed at high Ca levels and low P concentrations. At moderate levels of both Ca and P, little effect was seen. Phytase had little effect on performance and bone mineralization when Ca and P were evenly formulated (balanced). Phytase had the greatest impact on percentage tibia ash, P rickets incidence and severity with the lowest concentrations of dietary Ca and P. Phytase effects diminished when diets were fed with progressively higher levels of Ca and P. Improvements in BWG, feed intake, and FCR were not observed with addition of phytase.

Experiment 3 resulted in poor BWG and FCR and very low tibia ash percentage when the *unbalanced* diet A (high Ca–low NPP) was fed without phytase added. High incidence and severity of P rickets were also observed. The same diet supplemented with phytase optimized performance parameters and reduced P rickets. Feeding the more evenly formulated *balanced* diet B (low Ca-low P) improved responses over diet A when neither diet contained phytase. When phytase was added to the *balanced* diet B, similar responses were observed but not of the same magnitude as were measured for *unbalanced* diet A with phytase. Interestingly, feeding the *balanced* diet B induced a high incidence of TD, which was further aggravated by the addition of phytase.

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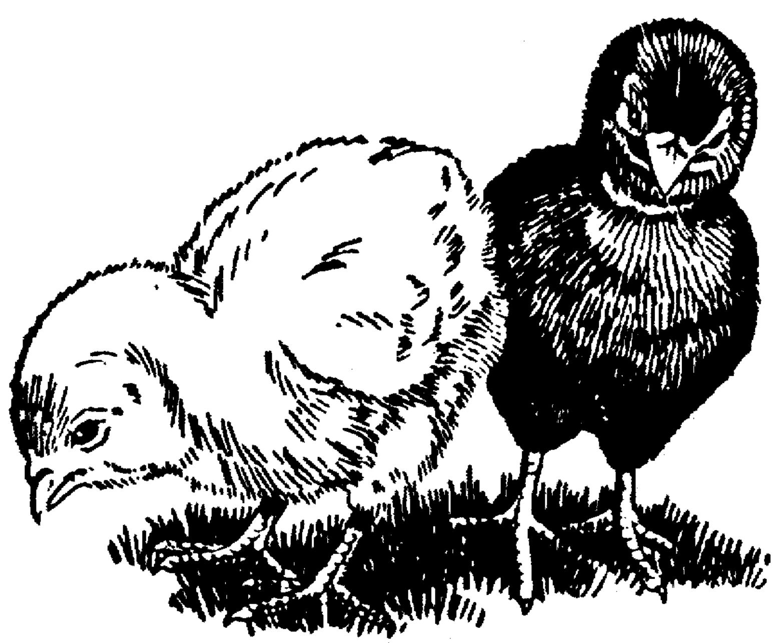

Water – the Forgotten Nutrient

When diets are balanced for meeting nutrient requirements, one immediately thinks of protein and energy. Essential amino acids are properly balanced by targeting an ideal protein standard for the different species. Energy and fiber needs are balanced by appropriately incorporating starches, fats and fiber sources. Mineral needs – including calcium – are accounted for along with other important dietary considerations, such as vitamins and additives. But truly, the last to be considered is **water**. It may even be taken so much for granted that it is overlooked entirely in dietary formulations. Or, it may just be assumed. There is much danger in this posture.

An animal can live for days without feed, but only a short time without water. Percentages present in animals vary, especially according to age of maturity, but water makes up 50% to 80% of body weight. Water is needed for most body functions. It maintains the health and integrity of every cell in the body. Blood carrying essential nutrients to all tissues and cells of the body need water to maintain the liquid bloodstream flowing through blood vessels. Water is needed to eliminate by-products of metabolism, excess electrolytes (e.g. sodium and potassium) and urea, which is a potentially toxic waste product of dietary protein digestive processing. Water helps regulate body temperature, lubricates and cushions joints, and moistens mucous membranes, such as those of the lungs and mouth. There are certainly other functions as well, but these represent key critical functions.

Water also needs to be an integral consideration of *feed formulation*. Obviously, a source of water must be provided for livestock and poultry. But one must consider adequate quantity as well as *quality* to allow for optimum performance. Hardness of water, for example, may diminish the effectiveness of medications delivered in livestock/poultry drinking water.

Water consumption is closely tied to feed *dry-matter intake* (DMI). Milk production, especially in dairy, is dependent upon access to large volumes of water. If water intake declines due to restricted access or inferior quality, both feed consumption and milk production can be negatively impacted.

Water quality is reduced when it contains either biological or inorganic contaminants. Predictably, one of the main sources of organic contaminants found in drinking water is manure. Manure may contain pathogenic bacteria and disease can readily spread from animals drinking from the same contaminated water trough.

Inorganic contaminants — such as sulfates occurring naturally in drinking water — also decrease water quality and can lead to nutritional disorders. Bad smelling water is perceived as unpalatable and animals may learn to associate water flavor with illness and simply refuse to continue drinking water. This can lead to negative impacts on performance as well as health. Consumption of high sulfate-contaminated water in cattle has demonstrated aggressive behavior. Ultimately, such things as milk production and a decline in animal welfare may be affected. High sulfate concentrations have caused laxative effects in poultry and may also interfere with copper absorption.

Many other negative water factors can have deleterious effects on performance and health. Hardness of water, mentioned previously, may be a sign of high concentrations of dissolved solids that could affect a variety of things — from scale on water systems to diminished effectiveness of medications, disinfectants and soaps. Nitrates in water can reduce growth, cause poor coordination, and reduce vitamin A effectiveness. Oxygen-carrying capacity of the blood may be compromised too. High levels of iron may promote bacterial growth, leading to diarrhea. High magnesium levels in drinking water may also cause a laxative effect. High fluoride levels may lead to soft bones. Bacteria at any level indicate water surface contamination by organic material and result in poor performance. All of these conditions suggest need for water treatment options. Detailed, accurate analysis of water samples could allow adjustment in feed formulations that may help correct negativity from high nutrient concentrations. “Consulting a professional” is advisable for resolving some of these issues; professional help in assessing water quality and professional help in dietary formulation adjustments, both are called for.

Water – by all means, let’s not forget the water.

Calcium and Nonphytate Phosphorus Effects *(continued)*

Addition of phytase enzyme to conventional corn-soy diets is believed to liberate P from the phytate molecule. This study showed response to added phytase was dependent on concentrations of P and Ca in the diet. Calcium has been reported to bind to the phytate molecule making phytate P less soluble and, therefore, less accessible to enzymatic breakdown in the gut. Experiment 1 supported this with additional dietary P resulting in dramatic improvement in BWG, tibia ash, and reduction in P rickets. Experiment 2 further demonstrated improvement when phytase was added to diets low in P and high in Ca. Only limited effects from phytase added to the diets with *balanced* Ca and P were observed. Experiment 3 indicated different dietary Ca and P levels alter the value of added phytase. As anticipated, a diet high in Ca and low in P resulted in a severe P deficiency, but was effectively eliminated by feeding phytase. When phytase was added to both diets in Experiment 3, poorer results were consistently observed in the diet with lower Ca and P concentrations and ratios. The researchers suggested that this was probably due to insufficient Ca in the diet, even though phytase may have liberated phytate P in the low NPP diet. Other studies examining the relationship between dietary Ca & P and phytase efficacy have mostly focused on the ratio of Ca:P (either total P or NPP), rather than absolute concentrations of these elements in the diet. Interpretive statements have suggested that wide Ca:P ratios decrease efficacy of phytase, and narrow Ca:P ratios increase enzymatic efficacy. This statement may be misleading. This study demonstrated that the more P deficient a bird was resulted in greater response to supplemental phytase. Diets that induced this condition tended to be high in Ca concentrations and low in P. This research showed that absolute dietary levels of Ca and P are most important in determining animal response to phytase enzyme additions. Their conclusion was that the true value of phytase supplementation involves a complex function of dietary Ca and both total and phytate P concentrations, along with cost of Ca and P supplementation.

Necessary feed formulations building efficacious diets for animals need to factor more into considerations than simply optimizing release of phosphorus levels in dietary feedstuffs. It is not just about phosphorus and alleviation of environmental concerns; it is also about other dietary interactions, principally Ca and NPP as well.

Can interpretations of these findings be applied to other species? Great caution must be employed in doing so. However, the rapidly growing broiler chick does tend to parallel growth in other young animals. Certainly, the exact manifestations may or may not occur in other species. It would seem legitimate to speculate that similar challenges exist with other rapidly growing animals. Facing similar difficulties in maintaining positive skeletal development in other species behooves one to consider these concepts when planning feeding programs for optimum growth.

For additional information contact

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