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Phytase, more than an environmental tool

Science has found a way for monogastric animals such as swine and poultry to maximize the use of the nutrients in their feed while minimizing the quantity of nutrients being rejected into the environment. This discovery bodes well for the environment and for producers' pocketbooks. Monogastric animals are unable to digest various nutrients in their feed. The result is the elimination of precious nutrients that would be beneficial to their growth.

About 60-75 per cent of the phosphorus found in cereals and oil seeds used for animal feed is in an organically bound form known as phytate or phytic acid. Monogastric animals are only able to utilize phosphorus in a free form and are unable to digest the phosphorus bound to the phytate ring.

In addition to binding phosphorus to the phytate ring, other nutrients such as proteins, as well as other macro- and micro-nutrients such as calcium (Ca), iron (Fe), magnesium (Mg), and zinc (Zn) can also be bound to the organic structure. The majority of this phytin phosphorus will pass directly through the digestive track of the animal to be found in the manure.

Nitrogen-based systems for calculating manure application rates can contribute to phosphorus being over applied to the land. Many soil types have the ability to bind free phosphorus. However, once the soil's retention capacity has been reached, the surplus phosphorus could be leached or eroded into streams, rivers, and lakes. Phosphorus has a beneficial impact on vegetative growth on land as well as marine vegetation, causing an increased growth of weeds. This enhanced vegetation consumes large amounts of oxygen, resulting in the loss of aquatic life.

What is phytase?

Phytase is a naturally occurring enzyme or specialized protein, which is often present in vegetable sources. It has the specific role of a catalyst for breaking down the links between phosphorus and the phytate ring, therefore, liberating the phytin phosphorus. Unfortunately, the phytase present in plants has a relatively low and irregular activity. In addition, vegetable phytase is rendered inactive by the highly acidic environment of the stomach.

Environmental concerns

How can we maximize the use of the nutrients provided to monogastrics while minimizing the quantity of nutrients being rejected into the environment?

Researchers at the University of Guelph have successfully spliced the genes for phytase production to swine embryos. The next step is to verify that the new genetic makeup is passed on from one generation to the next. Pigs would then be capable of maximizing the uptake of phosphorus and other nutrients on their own. Even if successful, commercialization of these genetically modified organisms (GMO) would be dependent upon public acceptance, especially in countries to which Canada exports agricultural products.

Other organisms such as cattle and certain bacteria have the ability to produce phytase. One such bacteria is *Aspergillus niger*. This bacteria is capable of producing phytase and a form of the enzyme that is highly active and that can withstand a wide range of pH's such as those found throughout the digestive track. The enzyme can be mass-produced at commercial levels with the help of the appropriate bacteria.

Production and economic benefits

When added to livestock feeds, phytase increases the availability of phosphorus, proteins, Ca, Mg, Fe, and Zn from cereal grains. The phosphorus released is then available for bone development and for energy transfer. Research has demonstrated that the improved nutrient availability when using phytase could allow livestock nutritionists to decrease the concentration of certain nutrients in the ration. The increased availability is such that phytase can be included as an ingredient having a nutritive value in the matrix when calculating least cost rations.

the cost of using phytase. In extensive studies, the savings from reformulating the ration will offset phosphorus generally increased after the addition of phytase by 15-35 per cent. The additional release of phytate bound phosphorus would be in the order of 30-50 per cent. Furthermore, there is increasing data that would indicate that production parameters such as average daily gain, feed intake and feed conversion are improved by up to 21.3 per cent, 8.7 per cent, and 10 per cent respectively when phytase is incorporated into the ration.

The result is that fewer nutrients are released into the environment while still meeting the nutritional requirements of the animal with no detrimental effects on production. The use of phytase can decrease the amount of phosphorus in swine manure by 30 to 35 per cent and the amount of nitrogen by five percent.

The rate of incorporation of phytase to the ration is dependant on the degree to which one wishes to reduce the nutrients being expelled through the feces as well as on economic considerations.

The utilization of phytase provides an opportunity for the pork industry to improve its public acceptance by adopting effective environmental practices.

Successful Farming with Phytase

Phytase helps reduce phosphorus in hog manure

New federal manure management standards expected later this year will change the way swine producers apply manure to their fields, according to University of Nebraska Extension swine specialist Dr. Mike Brumm.

Preliminary drafts of Environmental Protection Agency regulations indicate that phosphorus content will determine the amount of manure that can be applied to farm fields, rather than nitrogen content. "If you regulate based on phosphorus, it typically takes twice the acreage than if you regulate based on nitrogen," Brumm says.

He recommends swine producers begin adding phytase to hog rations to reduce phosphorus in manure. The enzyme helps hogs utilize phytate phosphorus in feedstuffs, which helps lower the phosphorus levels in diets without adverse affects.

Brumm recently conducted a study of commercial growing-finishing pigs in Holt County, Nebraska, and found that phytase reduced feces phosphorus content by 34%. Although urinary phosphorus was not measured, previous studies have shown an overall reduction in feces and urine phosphorus content of 30% or greater, he says.

In another study, Brumm tested two commercial phytase products, Ronozyme P and Natuphos, to determine whether the phytases are equal in their ability to replace phosphorus in swine diets. The study showed that both can replace up to 0.1% of phosphorus in feed. "We could detect no difference between the products in terms of the amount of phosphorus they could replace," he says. "There was no difference in pig performance, bone strength or carcass characteristics between the products or a commercial (full-phosphorus) ration without added phytase."

The products differ in how they must be handled in the feed manufacturing process, however. Ronozyme P (CT) granular is recommended for pelleting at typical commercial pelleting temperatures, and Natuphos granules can only be used when pelleting temperatures do not exceed 80 degrees C or 176 degrees F.

Brumm notes that phytase use among Nebraska pork producers has increased dramatically in the past year, both because it has become cost effective and because of growing awareness of the need to reduce phosphorus in manure.

"Feed companies tell me that if you use the level necessary to reduce phosphorus in feed 0.1%, feed costs are about identical or as much as 30 to 50 cents per ton less with phytase," he says. 05/17/2002 06:06 a.m.CDT

SoluZyme Base Notes

- SoluZyme is a mixture of bacteria and enzymes used to enhance the digestion in mono gastric animals.
- A fortified population of digestive bacteria is the first line of defense against enteric disease. These bacteria use surface area to their advantage not leaving any room for pathogenic bacteria to colonize along the inside of the digestive tract. This process alone makes for a more acidic environment increasing the digestibility of proteins and other feed components.
- Because of the proprietary composition of product, SoluZyme contains many benefits to manure management and application. While most products originate as a "pour in" product which involves taking a source of bacteria and surging the pit or lagoon, SoluZyme starts in the gut reducing the overall feed intake for the same amount of required production.
- **Feed Conversion:** It's a known fact that one hog will consume roughly 750lbs of feed throughout its lifetime. Feed that contains metallic components, alkaline components, and odour causing components. So why not reduce the consumption of such feeds to begin with. SoluZyme has proven itself to consistently reduce the feed conversion by 6.5%. So on average, an 800 sow farrow to finish operation using 500 tonne/month could reduce consumption down by 33 tonne per month. And yes, that's like saying 33 tonne less manure per month because the animals don't need to process that much extra feed monthly to acquire the same resolve. This is why this product is crucial to efficient farms because while the cost of manure management rises, SoluZyme covers its costs and then some.
- **Odour Control:** SoluZyme is so beneficial in controlling the emission of NH₃ (Ammonia) and H₂S (Hydrogen Sulfide). From the beginning in the digestive tract, SoluZyme is constantly digesting feed matter all the way through the intestines continuing to do so in the pit or lagoon. These digestive bacteria in their right environment have an amazing potential to break down proteins, fats, and carbohydrates. Even fibers to a certain degree as well. With this enzymatic process the solids in the effluent or existing in barn storage are broken down to their smallest parts leaving only minimal matter much smaller in terms of micron size compared to normal non treated manure. It's because of this process that hazardous gases are minimized. H₂S requires that there be no oxygen for creation and that the environment be acidic. This is the common environment under crusts in lagoon and pits. Get rid of the crusts and you get rid of gases – to a degree. Ammonia also has certain standards. Requiring oxygen and a more base (alkaline) environment. But the common adjuvant here is organic matter – manure in substance. Solids are the elemental energies for gaseous output and if there's to be a reduction in gases there has to be a reduction in solids.

- **Manure Application:** Because SoluZyme and its sister products reduce the hard matter content of manure its making manure application and field nutrient estimation easier. In a normal everyday setup, farms are constantly dealing with crusts and thick, sludgy manure effluent when it comes time to apply on the fields. Now here's the problem. All the nutrients are at the bottom in the solids. Now extrapolate that problem to field irrigation and you'll have 100lbs/acre more nutrients at the end the lagoon on the last 100 acres compared to the first 100 acres where it is all liquid water for the most part. SoluZyme and in company with its Lagoon treatment cohort keep that stored manure liquid. This will ensure an even distribution on minerals throughout the slurry store because the nutrients will be freed from the organic thick micron matter and held in suspension throughout.
- **Worker Safety:** I don't think we need to dwell on this too much. Everyone understands how gases affect the respiratory system of humans and its conclusive effects on eye, throat, and nasal irritation. Through on farm testing due to the lack of solids in the barn, Ammonia and hydrogen sulfide counts have always dropped. Its as simple as gravity. Reduce the solids and you reduce the gases. On sites where ammonia was 60ppm, we've reduced it 15ppm. Is it clean air, no, but its an environment that's a little more manageable. Applying SoluZyme for manure management also reduces the probability of in pit situations and fatal gas build ups due to power failures in the ventilation.