

Feeding for the pig and the environment

*Harold Tilstra, DVM; Suzanne T. Petersen, PhD
Land O'Lakes Purina Mills, Shoreview, Minnesota*

Introduction

Today, excess application of manure to the soil is one of the greatest concerns regarding livestock production. Throughout the US, there are regulations in place to monitor this process, such as manure management plans, phosphorus indexes, federal air emissions laws amongst others including confinement, construction, separation distances and composting laws. In the US, an estimated 45 million pigs are being fed phytase to help reduce the level of phosphorus in manure. Although, manure phosphorus and nitrogen are focused upon in US, the EU now also maintains a close eye on trace minerals in the soil such as zinc which may replace nitrogen as a limiting factor for spreading manure.

Environmental issues are a growing concern. Many of them can be categorized under the following headings; air quality, manure storage and handling, manure nutrient concentration and soil nutrient levels. The market today contains a large number of products for air & manure management but no supplier markets a feed which covers all the bases of precision formulation, appropriate feed additives and tools needed as a purpose-driven option for optimum ecological care. This is the aim of a new Land O'Lakes Feed program - to address the entire environment question not just parts it through an effective and proactive feeding program for grower-finisher pigs. EcoCare™ feed is a dedicated and affordable feed program addressing manure management, odor emissions and nutrient utilization, while optimizing pig performance in grower/ finisher production.

The new EcoCare™ feed program has the following features:

1. Constant phytase delivery for maximum phosphorus reduction
2. Optimum crystalline amino acid inclusion to reduce nitrogen output
3. Refined trace mineral concentrations to reduce soil accumulation of heavy metals
4. Organic selenium for improved bioavailability, increased bioactivity and better retention
5. Use of ammonia and manure solids-reducing technologies

6. Nutrient formulation for optimal swine performance
7. Field support tools to show a measure of effectiveness

How does the EcoCare™ feed program address current environmental concerns?

Air quality

Manure odors are directly related to the animal's diet. The odor compounds found in swine manure are natural by-products produced by anaerobic decomposition of urine and feces. Most of the odor compounds found in swine manure originate from undigested carbohydrates and proteins (nitrogen) that have passed through the gastro-intestinal and urinary tract.¹ Ammonia (NH₃) results from the decomposition of urea nitrogen in the urine and undigested proteins in the manure. The National Institute for Occupational Safety and Health (NIOSH) standard for ammonia exposure is 25 ppm over an 8 hour day. Ammonia is not only an irritant to humans but also animals and can have detrimental effects on health and performance causing respiratory infections, and poorer rate of gain and feed efficiency. Particularly in swine, it was estimated that an ammonia concentration of 25 ppm results in eye and lung irritation and an approximate 6% reduction in average daily gain. Fifty ppm ammonia results in an approximate 12% reduction in average daily gain, and 100 ppm results in an approximate 30% reduction in average daily gain and 9% reduction in feed efficiency.²

EcoCare™ feed is an environmentally-conscious nutritional program that has been developed to, amongst other benefits, reduce manure odor. This is achieved primarily by better formulating diets to meet the pig's nutritional requirement through elevated crystalline amino acid maximum restriction rates to reduce nitrogen output, as well as through the addition of specific *Bacillus* bacteria and saponin-derived compounds. Through the incorporation of these latest technologies at constant and optimal levels, EcoCare™ has a positive impact on intestinal microbial populations and beneficially alters the manure decomposition process. EcoCare™ can result over time in reduced production of odorous compounds by 40% in commercial situations.

Ammonia emissions were measured in a pit simulation trial performed at LongView Animal Nutrition Center. Four pigs per treatment were housed individually in metabolism cages and fed a 3-phase program. Urine and feces were collected 5 d/week for 7 weeks. Within this research facility, ammonia emission from pigs consuming key EcoCare™ components was reduced by 18% over a 45 day period when compared to the control pigs.

Manure storage and handling

Improving manure solids digestion has a multitude of benefits. EcoCare™ components not only reduce manure solids but also reduce the stickiness, or viscosity, of the manure. This results in,

1. Manure that is easier to agitate and handle through equipment, saving time and energy
2. More complete pit pump-out
3. Increased physical uniformity of the manure means better nutrient distribution while spreading.
4. Reduced solids build-up at the bottom of the pit so that maximum pit capacity is maintained.
5. Reduced facility wash time
6. Better sanitation from reduced microbial load which means less stress on animals.

In the same pit simulation trial described above, we found a 14% reduction in manure solids and a 22% reduction in viscosity over a 45 day period. It would be expected that over a period of several months, a commercial deep pit facility could reduce manure solids by 30-40% which would result in a visible and economic difference for the producer.

A field trial was performed in Minnesota using a barn with 1000 head per room. The two rooms had separate pits. The East room was fed a control diet and the West room was fed the EcoCare™ feed. The barn only had one group of pigs through, prior to the trial. After 50 days, there was a visual difference between the manure in each pit. Solids were reduced by 11% in the manure pit of the EcoCare™ feed treatment and there were already changes to the manure nutrient concentrations as described below.

Manure nutrient concentration

The main goal when managing nutrients contained in manure is to balance them with the nutrient needs of growing plants for efficient crop production. The nutrient profile of manure has come under a great deal of scrutiny in recent years. Changing it by adjusting the

nutritional intake of hogs has shown great potential. By doing a better job targeting the nutritional needs of growing pigs, fewer 'wasted' nutrients end up in manure.

Improved nitrogen retention

The total quantity of nutrients in manure is not as critical as the availability of the nutrients for crop uptake. Manure nitrogen is present in both organic and inorganic forms. Organic nitrogen compounds are relatively stable and slowly breakdown through microbial activity into plant-available forms. Inorganic nitrogen in manure is considered 100% available to the plants in the year of application but is subject to losses due to volatilization, leaching and denitrification.

Swine manure has a ratio of available ammonium-N (NH₄-N) and unavailable organic-N in solid manure of 60:40 and in liquid manure of 70:30.³

The previously discussed field trial in Minnesota demonstrated a clear improvement in nitrogen retention. This was the result of incorporating crystalline amino acids and feed additives which reduce the volatilization of nitrogen-containing ammonia from manure pits. In this trial, pigs fed EcoCare™ feeds produced manure that contained less total nitrogen. However, the manure had a better ratio of NH₄-N to organic N (66:34) compared to the control group (63:37) within 50 days of the trial starting.

Reduced phosphorus

A survey of phosphorus bioavailability for a number of feedstuffs commonly fed to swine reveals that 60-80% of the phosphorus is bound as phytic acid (phytate) and is unavailable to the pig. Adding phytase makes some of the unavailable phosphorus in feedstuffs available to the pig. This allows formulation to reduce the amount of dietary inorganic phosphorus (mono or dicalcium phosphate). In extensive tests by various scientists, the availability of total dietary phosphorus generally increased by 15-35% with the addition of dietary phytase (227 FTU/lb). Diets containing 227 FTU phytase/lb feed, are formulated with approx 0.10% less dietary available phosphorus than comparable diets without phytase. Less phosphorus in the diet means less phosphorus in the manure. Considerable discussion exists in literature regarding the extent to which the addition of dietary phytase can reduce manure phosphorus concentration, estimates range from 30-50%.

Swine manure has a nitrogen to phosphorus ratio of about 3:1. This is often lower than that needed by the

types of crops (corn needs a 6:1 ratio) grown on soil where manure has been applied. Using phytase reduces phosphorus excretion because less inorganic phosphate is added to the diet. Lowering the phosphorus content of swine manure will improve the nitrogen to phosphorus ratio of the manure allowing more nitrogen to be applied through manure.

Key EcoCare™ components, such as phytase, are provided at constant and optimal levels over all phases of grower finisher production.

When phytase is a component of a grow/finish premix, dietary phytase concentrations decline with declining premix inclusion rates as pigs become heavier. Feeding the EcoCare™ program ensures an optimum and constant level of phytase across production phases with sufficient available phosphorus for optimal grower/finisher pig production. This situation results in the greatest phosphorus reduction possible in feed and thus in the manure.

Refined trace minerals

Trace mineral concentration in manure (DM basis) is ~10X that in feed. The EU now maintains an additional close eye on trace minerals in the soil such as zinc which may replace nitrogen as a limiting factor for spreading manure. Some states (CO) in the USA are also now doing the same. This is because increasing trace mineral accumulation in soil is believed to have negative effects on soil micro-organisms. J. L. Burkett *et al*, 2006, compared differing concentrations of organic and inorganic Cu, Fe, and Zn supplementation on fecal excretion and growth, performance, and carcass characteristics.⁴ They reduced the inorganic minerals of the control diet, containing 169 ppm Fe, 163 ppm Zn and 85 ppm Cu, by 75%. Results showed fecal trace mineral excretion was significantly reduced and there were no deleterious effect on pig performance. Based on this and other data, the EcoCare™ program has refined trace minerals content as a proactive program, delivering manure technology today, for tomorrow's possible regulation.

Organic selenium

The discovery of selenium as an integral component in glutathione peroxidase was the key to understanding its importance in nutrition and health. Glutathione peroxidase, or GSH-Px, is essential for protecting cellular membranes from being destroyed. Compounds called free radicals are highly reactive molecules, and if left unchecked will destroy cellular membranes.⁵

Vitamin E and GSH-Px are two molecules that help prevent this damage. Selenium has also been recently found in another enzyme, 5'-deiodinase. 5'-deiodinase is an enzyme that catalyzes the reaction of the inactive form of thyroxine to the active form. There are theories that selenium may be involved in many other functions in the body, such as a selenoprotein in sperm, RNA, in prostaglandin synthesis, in essential fatty acid metabolism and required for normal immune response. Absorbed selenium travels in the plasma on a protein to its destination tissue. Tissue concentrations vary; the kidneys retain a large amount of selenium, along with cardiac and skeletal muscle, and the liver. Selenium is deposited more readily when it is in an organic form. Selenium retention is higher and excretion is lower when organic selenium-enriched yeast source is added to grower-finisher swine diets.⁶ For these reasons, EcoCare™ feed contains organic selenium.

Swine performance

To ensure that the EcoCare™ feed program maximizes performance while minimizing waste, a trial was conducted at Longview Animal Nutrition Centre, comparing the current Land O'Lakes Lean Gain® feeding program with the EcoCare™ feeding program. Eight pigs per pen with 8 pens per treatment were fed a 5-phase feeding program. The pigs (EBX × GPK 35) started at 60 lbs body weight and performance (Body Weight (BW), Average Daily Gain (ADG), Feed Intake (FI) and Feed Conversion Ratio (FCR)) were measured at each phase.

Overall ADG for the control was 2.16 lbs/d versus 2.16 lbs/d for EcoCare™ feed.

Overall Feed/Gain for the control was 2.55 lb/lb versus 2.54 lb/lb for EcoCare™ feed.

There were no significant differences between the two treatments.

The commercial standard for the grower-finisher industry in ADG is 1.69 lbs/day, with expectations of 1.80 lbs/day. The commercial standard for the grower-finisher industry in Feed Conversion is 2.95 lb/lb, with expectations of 2.75 lb/lb. It was realized that the conditions are exceptional at Longview and that a significant improvement would be difficult to achieve in this situation. There are additional trials ongoing to compare performance in commercial settings.

Summary

In today's climate, the diligence in preserving the environment is ever growing. Producers have many options available to them to address the issues at hand. Land O'Lakes Feed has introduced a premium program at an affordable price to the margin-conscious grower-finisher market. EcoCare™ feed optimizes nutrient and feed additive delivery in every phase of grower-finisher production, and incorporates appropriate assessment tools needed, as a purpose-driven option for optimum ecological care. With the EcoCare™ value calculator and manure assessment program, a Land O'Lakes feed consultant can demonstrate the possible savings from optimal pig performance and the benefits of improved manure composition for any producer feeding EcoCare™ feed. To learn more, please contact either author: Harold Tilstra (hdtilstra@landolakes.com) or Suzanne Petersen (STPetersen@landolakes.com).

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