CHAPTER 3b

Reduction Of Manure Nutrient Concentrations

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Animal manure is the accumulation of metabolic waste, undigested feed, water and trash such as animal hair, feathers and bedding materials. Each farm animal species consumes specific feed ingredients balanced to provide a diet able to sustain growth and reproduction based on that species digestive system. In most confined feeding facilities, the concentration of nutrients in the manure directly reflects the composition of the feed, managements attempt to effect carcass quality, bio-security and efficiency practices emphasized by the producer.

The diet may be manipulated to reduce cost, bulk, feed efficiency or production efficiency. The ingredients may also be manipulated to some extent to reduce odors such as ammonia or the density of particular nutrients. A modern livestock feeder may alter, to some extent, the composition of the manure produced in a confined animal feeding facility.

Management / Nutrient Manipulation

There are several standard management / nutrition manipulation practices that will directly influence the nitrogen content of swine manure. These are:

A. Split Sex Feeding - This practice works best on facilities with high animal numbers, since the maximum advantage occurs when a feed delivery system delivers feed to animals of one sex and one weight group. Pigs are divided by sex and weight entering the nursery. Establishing a group of pigs at this age eliminates the need to mix pigs at heavier weights when fighting may result in injury or stress. Pens in one barn, or a side of a barn are filled with pigs of a single sex and a similar weight.

Barrows and gilts are normally fed the same rations until a body weight of approximately 165 pounds. At this weight, the two types of pigs metabolize feed at different efficiencies. Gilts may use higher protein rations to build lean muscle mass. Barrows do not require as much protein because they are not as lean as gilts. Reducing the protein fed to barrows reduces the nitrogen content of the urine.

Split sex feeding also assists marketing, since barrows reach a given weight faster than gilts, often 8 days quicker to 240 pounds, Also, they will begin to deposit fat at lighter body weight compared to their litter mate gilts and should be sold at lighter weights. Division of pigs for marketing may be done less often as the single sex pens will be more uniform in weight an body condition. Loads of pigs may be created that result in less discounts for variation in weights.

B. Phase Feeding - Pork production may be subdivided into a number of physiological phases requiring different nutrient combinations. The practice of designing a feed for each life stage is termed phase feeding. As is often the case, this management practice works best on large units or production units where only specific life functions occur such as the large integrator units division into farrowing, nursery or feeding units. While a herd with 50 sows may only use three or four different feeds due to cost restrictions, a herd with two thousand sows farrow to finish may use 16 or more specifically designed rations.

A simple example may be found in feeding sows. Pregnant sows require less energy in a days total feed intake than is required by a nursing sow. The pregnant sow eats smaller quantities of a nutrient dense feed, which provides less energy but adequate minerals and protein. She does not require as much energy to develop a litter of pigs as she will to nurse those pigs as they grow. Intake differences such as this result in a reduction in the amount of manure produced.

This process of change continues through each stage of production. Two hundred pound pigs require less protein per pound of feed than forty pound pigs. If management properly balances the production / nutrition changes, less metabolic surpluses will occur and fewer nutrients will pass unnecessarily into the waste stream or effluent. These changes will reduce production cost and help reduce the production of ammonia.

C. Reduction of Feed Wastage - Feed efficiency is a high priority item in reducing the cost of production. Most producers perform periodic adjustments to self feeders but have few measurement tools to evaluate their efficiency. Dedication to correct feeder adjustment will result in considerable reductions to manure nutrients. Every ounce of feed that falls through the slats is a an ounce of nutrients that did not pass through the pig. Maintaining feeders in good condition and making prompt adjustment may reduce the total nitrogen and phosphorous concentration of the manure by as much as 10%.

D. Genetic Efficiency- Market hog feed efficiencies of four pounds of feed per pound of gain were not uncommon in the 1950's and 60's. In the 90's, feed efficiencies of 2.7 and 2.8 are frequently achieved. Changes in housing, feed delivery equipment, nutrition and herd health have all played an important part in this feed efficiency improvement. The greatest improvement has been realized in the genetic makeup of animals to remain lean and grow efficiently. Artificial insemination has accelerated the incorporation of improved genetics into production. The combination of these techniques and abilities has reduced the total feed required for pork production by 30% or more. Manure nutrients produced are also reduced.

Nutrient Substitution or Enhancement

A. Amino Acid Supplementation - Animals break down the nutritional products provided by the feed into those basic nutrients that may be synthesized into body building materials or catabolized into the energy necessary for life's processes. Protein is a complex combination of long strings of amino acids. Percent protein is calculated after nutrient analysis as nitrogen times

6.25. Some amino acids are provided directly by plant proteins, others may be produced by the animals metabolism. High protein body tissue (like muscle) may only be developed at the rate the feed consumed provides the essential amino acids.

If the feed source remains fairly constant, such as a corn - soybean oil meal diet, it may be predicted which amino acid that must come from the feed will be available in limited quantities. Other amino acids will be in excess, and will not result in further muscle growth. Much of the excess will pass from the body in urine.

It is common in swine feeding to calculate rations that provide the limiting amino acid in sufficient quantity to maximize growth. In most instances, this amino acid is Lysine. Synthetic lysine may be cost effectively supplemented in swine feeds. Lysine may be added, while total protein is reduced to the point where another amino acid will now be deficient and further growth will not occur. In feeding market hogs, this substitution will usually allow a reduction of crude protein content by approximately two percentage points. Reducing a 16% ration by 2 percentage points is a 12.5% reduction in protein, and nutrient concentrations of the manure will also be reduced.

B. Phytase - Inclusion of the enzyme phytase in swine diets has recently been approved in the United States by the FDA. This product may become one of the most valuable tools pork producers have in their manure management program. Phosphorous is one of the more difficult minerals producers must account for in their waste management plan. Phosphorous has a tendency to stay where it is deposited in the soil profile. It is required for plant growth, but usually not at the rate it is provided by manure when manure is applied at the rate required to balance nitrogen requirements.

Pigs require phosphorous in their feed for both growth and body functions. Phosphorous occurs in both corn and soybean oil meal, but much of it is in a phytate form. Pigs do not have the enzyme necessary to reduce the phytate form of phosphorous, so this source goes to waste. Producers typically amend feeds with inorganic phosphorous such as deflorinated rock phosphate, bone meal**,** dical. or other sources to provide enough phosphorous to support maximum growth.

Inclusion of the enzyme phytase into the diet of the pig enables the digestive system to reduce the phytate phosphorous in the feed. More than forty percent of the phosphorous normally found in swine manure may be removed by this addition. The incorporation of phytase into feeds is limited by it's cost. Currently the enzyme cost a few cents more to include than the minerals cost that would be saved. As the environmental necessity of reducing phosphorous increases the cost of waste management programs, the use of the enzyme will become more prevalent.

Additional suggested reading:
NRC of Swine, Tenth edition, 1998
Swine Feeding Suggestions, Clemson Extension Circular 509

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