Waste Management
FACTSHEET

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REDUCING NITROGEN AND PHOSPHORUS IN MANURE THROUGH RATION CHANGES

As manure overproduction by intensive livestock becomes more common, there is increasing interest in manipulating rations to reduce the nitrogen and phosphorus levels in hog manure, rather than treating manure to remove nutrients from it. This factsheet will discuss strategies for reducing the levels of nitrogen and phosphorus in manure through ration manipulation.

NITROGEN

Protein contains about 16% nitrogen, so any reduction in the amount of protein fed hogs will have a direct impact on the amount of nitrogen in the manure. Pigs use only about 30% of the nitrogen in the feed under optimum conditions; the remainder is excreted in the urine as ammonia and in the feces as undigested protein. When excess dietary protein is fed, the percentage used by the pig is even smaller.

The nitrogen level in manure can be minimized by feeding the pig's protein requirement at all stages of growth. Most hog feeds contain more protein than is required by the animal, especially finisher and dry sow rations.

Matching ration protein level to the pig's requirement

The protein requirement of market hogs declines as they grow, from 17 – 18% at 30 kg to only 13 – 14% at 70 kg. If a single 18% protein ration is fed from weaning to market, the pigs will excrete 19% more nitrogen than if they are fed, for example, three different rations with 18% protein from 30 to 50 kg, 16% from 50 to 70 kg and 14% from 70 kg to market. Nitrogen output can be reduced by 10% by feeding two rations with 17% and 15% protein during growing and finishing phases respectively versus one 17% protein ration throughout.

Supplementing with synthetic amino acids

A further reduction in manure nitrogen can be achieved by supplementing rations with synthetic amino acids. The protein level of hog rations is always higher than required in order to provide enough of the essential amino acids, most importantly lysine. By adding synthetic lysine, the protein content can be reduced in grower rations from 17% to 15.5% and nitrogen excretion during that phase can be reduced by 15%. If the protein content of the finisher ration is reduced from 14.5% to 13.5% and synthetic lysine is added, nitrogen excretion can be reduced by 19% during the finishing phase.

It is possible to supplement with other limiting amino acids such as methionine, threonine and tryptophan, and further reduce ration protein levels, with a subsequent reduction in nitrogen excretion. Researchers in the Netherlands have predicted that overall nitrogen excretion by market hogs can be reduced by 30% if high quality protein sources are fed (cereals vs. by-products) and several amino acids are supplemented.

Protein levels for the breeding herd

Similar reductions can be achieved by the breeding herd. Gestating (dry) sows require a much lower protein ration than nursing sows. If sows are fed two rations, 12% protein while gestating and 17% during lactation versus a single 17% protein ration during both gestation and lactation, nitrogen excretion by the breeding herd can be reduced by 34%.

What is a realistic goal for reduction of manure nitrogen?

A conservative prediction is that with better management of protein in rations, a **15 to 20% reduction in nitrogen excretion is possible**. To

achieve this, your rations should contain the correct protein level for each stage of growth. You should be feeding several different rations to ensure that protein level is closely matched to the growth stage of the pig. If you are doing this already, your next step is to go to multi-phase feeding or to supplementation with individual amino acids.

PHOSPHORUS

A recent development in phosphorus nutrition has the potential to reduce the amount of supplemental phosphorus added to rations and reduce phosphorus excretion by hogs. This is because the feed ingredients that make up hog rations, barley, wheat, canola meal and soybean meal contain enough phosphorus to meet the hog's requirements, however, about 50% of the phosphorus in these feed ingredients is unavailable because pigs cannot digest it. The unavailable phosphorus is contained in a compound called phytate which ruminants are able to break down but pigs cannot. To provide the dietary requirement, extra phosphorus in mineral form is added to rations. Mineral phosphorus is 100% available to pigs. All of the undigested phosphorus from the feed is excreted in the manure, about 70% of the phosphorus in an average ration.

Recently, phytase, the enzyme required to break down phytate has become available commercially. The phytase enzyme increased the digestion of the feed phosphorus and reduces the need for added mineral phosphorus. Recent research in the U.S. has determined the excretion of phosphorus can be reduced by up to 50% with added phytase.

Phytase is now in common use in the Netherlands where manurial phosphorus is a more serious concern than nitrogen because it has caused pollution of ditches, streams and other watercourses.

Without using the enzyme phytase, some reduction in phosphorus excretion is possible by specifying the dietary requirement in terms of digestible versus total phosphorus. Feed ingredients vary as to how much of the phosphorus is available – 39% in barley, 16% in corn, 47% in wheat, 30% in canola meal. By formulating rations based on the availability of the phosphorus in the ingredients, the exact requirements can be provided.

POTASSIUM

Little attention has been paid to the amount of potassium being applied to agricultural land from livestock manures. However, in South Coastal BC, the high potassium level in forages is causing health problems in ruminant animals that consume the forages. The high potassium forages are the result of the application of manure and fertilizer to cropland.

In general, pig feeds contain three to five times more potassium than is required for normal growth. It comes from the feed ingredients and is not added as a supplement. Pigs use only about 14% of the potassium in the feed; the rest is excreted.

(compiled from Pig International Feb. 1993, Feed Mix May 1992 and Feedstuffs October 7, 1991)

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