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Effects of Dietary Manipulation on Ammonia Emissions

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Species: Swine
Use Area: Animal Housing
Technology Category: Diet Modification
Air Mitigated Pollutants: Ammonia

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System Summary:

Dietary manipulation, such as lowering crude protein with amino acid supplementation or fiber addition, is an effective method to decrease ammonia emissions from swine finishing facilities. Lowering crude protein content of the diet with amino acid supplementation markedly reduces nitrogen excretion. In studies conducted for the entire finishing period (Bundy et al., 2008; Lachmann et al., 2007), lowering crude protein content by 3 percentage units with amino acid supplementation decreases total nitrogen excretion by approximately 30% and ammonium nitrogen concentration of the slurry by 37%. The decrease in nitrogen excretion reduces the concentration of ammonium in the slurry which in turn decreases ammonia emission. Results suggest a reduction in ammonia emission of up to 50% with the use of a low protein diet. Additionally, the reduction in ammonium concentration of the slurry also reduces slurry pH which affects ammonia volatilization. Addition of fiber sources to the diet reduces urinary urea excretion which can be degraded enzymatically to ammonia. Fiber addition affects nitrogen excretory patterns and reduces ammonium nitrogen concentration of the slurry which can lead to further reductions in ammonia emissions. The reduction in crude protein content or addition of fiber sources to swine diets can reduce or change nitrogen excretion patterns resulting in marked decreases in ammonia emissions for pigs housed in facilities with shallow pit, pull-plug waste storage systems.

Applicability and Mitigating Mechanism:

- NH₃ emissions from swine housing is dependent on the amount of nitrogen excreted
- Swine typically excrete 30 to 50% of the nitrogen consumed
- Reducing dietary crude protein with amino acid supplementation can markedly decrease nitrogen excretion
- Addition of fiber sources to diets also has potential to influence nitrogen excretion patterns
- These dietary manipulations can markedly decrease ammonia emissions from swine finisher facilities

Limitations:

- Correct estimation of the amino acid requirements of the pig is critical
- Accurate supplementation of amino acids is critical to reduce risk on growth performance and carcass traits
- Nutrient content of fiber sources is needed for diet formulation
- Upper limits to crude protein reduction and fiber addition in diets
- Cost of amino acid supplementation and use of nutritionist in formulation

Cost:

The costs associated with dietary manipulation are solely dependent upon ingredient cost assuming growth performance and carcass traits are not adversely affected. Formulation of low protein diets involves the partial removal of soybean meal from the diet accompanied by replacement with corn and crystalline amino acids (lysine HCl, DL-methionine, L-threonine). Therefore, evaluation of implementation cost weighs the decrease in soybean meal costs versus the increase in corn and amino acid costs within the diet. Using March 2008 ingredient costs, diet costs for a conventional corn-soybean meal based diet and a low protein (-3%), amino acid supplemented diet are similar. Thus, assuming no difference in growth rate or feed intake, cost of gain and total feed cost for the finishing period are similar. Dietary costs need to be re-evaluated with changing ingredient costs.