

Dietary Manipulation Strategies to Reduce Swine Odours: Part 2

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The Impact of Dietary Additives on Swine Odours:

Feed additives have received considerable attention about their ability to reduce or manipulate some odours related to barn air, fresh faecal samples, or the short-term storage of pig manure (urine and faeces). The following is a review of various additives including how they attempt to reduce odours from pig production.

Manipulating Hindgut Microflora:

Many compounds have been identified as potential contributors to swine odour. Compounds such as sulfides, phenols, and indoles, are produced during microbial fermentation within the caecum and large intestine of the pig. Manipulation of the gut microbial populations and nutrient supply has the potential to affect the production of odour-causing compounds. To date, the common approaches include 1) the feeding of enzyme-resistant carbohydrates to pigs to stimulate the production of less odorous bacteria, the **prebiotic** approach, 2) the use of direct-fed microbials, or **probiotics**, to manipulate

intestinal microflora, and 3) the use of antibiotic or **antimicrobial agents**.

i) The Prebiotic Approach: Pigs have enough enzymatic capacity within their small intestine to digest simple sugars and some common carbohydrates. However complex molecules such as the sugar oligosaccharides and carbohydrates such as inulin, cellulose and pectin are somewhat resistant to enzyme action. These compounds pass readily into the large intestine and caecum, where they are subject to bacterial fermentation and have the potential to alter fermentation patterns. To date, the precise mechanism by which these changes occur remains unclear.

ii) Antibiotics/Antimicrobials: Antimicrobials are used in swine rations for disease control and to improve production performance. The pork industry is under increasing pressure to remove these products from non-therapeutic use. It appears that the potential exists for changes to the odour profiles from swine manure. Zinc bacitracin was demonstrated to cause a significant reduction in skatole concentrations in blood and backfat of boars. Since skatole is a major contributor to swine odours there appears to be the potential to manipulate manure odours. One study reported that high dietary copper caused a significant improvement in the odour characteristics from fresh faecal samples. Copper has been

used for decades in swine rations due to its reported antimicrobial effects. The authors of this study suggested that the antimicrobial effects of high dietary copper were responsible for the improvements in the odours observed. Additional research in this area is warranted in light of rapid changes in regulations and requirements pertaining to the use of dietary antimicrobial agents.

iii) Probiotics: There is much interest in the use of direct-fed microorganisms, or probiotics. The probiotic concept involves the delivery of selected, beneficial organisms to the hindgut of the pig. However, in order to have a suitable probiotic: 1) the organism must survive digestion in the stomach and small intestine; 2) there must be evidence of an increase or establishment of a significant microbial population; and 3) the probiotic must effectively manipulate hindgut fermentation for the desired effect. This final point has received little attention relative to odour production. To date, most trials with probiotics have focused on the potential health-promoting effects of these organisms with the goal of reducing reliance on antibiotics in feed. However, a few studies have documented shifts in microbial populations that produce fewer emissions of malodorous compounds.

Reducing Ammonia Emissions:

Most studies examining the impact of diet on manure odour have focussed on ammonia emissions. Several approaches have been used including:

- 1) the use of low protein-amino acid supplemented diets,
- 2) the increase of dietary non-starch polysaccharides (NSP) to enhance microbial protein synthesis,
- 3) the use of binders or ion exchange compounds to sequester ammonia, and
- 4) dietary acidifiers to reduce ammonia volatilization.

i) Non-Starch Polysaccharides (NSP): Changes to the NSP content of the ration can influence the partitioning of nitrogen excretion between urinary and faecal losses. Increased nitrogen excretion in the urine leads to higher ammonia concentrations, since this form of nitrogen can be converted to ammonia by enzymes present in the manure. NSP in the diet can by-pass stomach and small intestine digestion and enter the hindgut. Here it promotes the shift in nitrogen excretion from urine to faecal nitrogen by providing carbon sources for the synthesis of microbial protein. Nitrogen that would otherwise become part of the plasma urea circulation is used to build microbial protein. Thus, there is less circulating urea in the body and this ultimately leads to a reduction in urea excretion by the kidneys into urine (Figure 1).

Numerous sources of NSP have been used to reduce urinary nitrogen losses, including tapioca, soybean hulls, and sugar beet pulp. How effective this is in reducing swine odours is still unclear. Ammonia is just one

component of air pollution and is poorly correlated to odour strength. However, it is still useful to reduce ammonia emissions from swine facilities. To date, little information is available on the use of NSP to reduce odour.

Increasing the amount of NSP can lead to an increase in volatile fatty acid production rates, which may lead to higher levels of odour. Furthermore, increasing the NSP content of the diet may reduce nutrient digestibilities and increase the total manure production. Both of these factors can have significant economic impacts on producers.

Using NSP's to reduce the production of odour causing compounds in swine manure shows promise. Most studies have only addressed one odour-causing compound at a time. While useful, this provides only partial information. Future studies should focus on the use of objective measures of odour in assessing the impact of NSP in swine diets. In addition, attempts should be made to standardise the inclusion rates of specific NSP components in swine diets rather than using the inclusion rates of raw products.

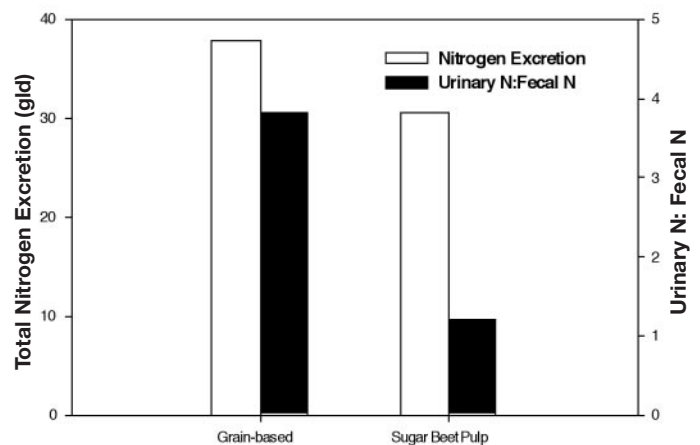
ii) Feed Enzymes: Feed enzymes are routinely used in swine and poultry diets to increase nutrient

utilisation. These enzymes have the potential to reduce endogenous gut nitrogen losses in pigs and this could have an impact on odour production. However, the impact of feed enzymes on odour producing compounds in pigs has not been evaluated.

ii) Yucca Extract: Extracts of the desert plant *Yucca schidigera* have been promoted for their ability to reduce ammonia levels from swine manure. Adding yucca extracts to swine diets reduces ammonia emissions. As mentioned above, ammonia is only single component of air pollution. Therefore, for yucca extract there is no strong justification for adding it to swine diets solely for the purposes of reducing odour.

iii) Zeolites: Zeolites are crystalline, hydrated aluminosilicate compounds that have received interest in agriculture for their ion exchange and adsorption capacity. Zeolites have been shown to be effective in the adsorption and binding of ammonium (NH_4^+) ions. A review of unpublished data supports a marginal effect (although not tested statistically) of 2% zeolite clinoptilolite in the diet on reducing total non-protein nitrogen excretion by 30-50%.

Figure 1. The effect of adding 30% sugar beet pulp, as a source of NSP, to swine diets on total nitrogen excretion and the ratio of nitrogen in urine relative to faeces



However the effects of these zeolites on odour production have not been rigorously evaluated. Some concerns with zeolites in diets include:

- an energy dilution effect of having high concentrations of inorganic matter in diets, and
- high levels of zeolites in manure may pose problems for manure handling equipment.

iv) Dietary Acidifiers: The rate of ammonia volatilisation from manure is dependent on a number of factors. A low, or acidic pH, maintains ammonia in a non-volatile form of ammonium ions (NH_4^+). By maintaining a low pH, the pollution potential related to ammonia may be reduced. Using dietary acidifiers or manipulation of the buffering capacity of the diet help in this regard. Several acidifiers have been investigated, including calcium sulfate, calcium benzoate, and calcium chloride. The addition of 2.4% calcium benzoate to swine diets was effective in reducing urinary pH by 1.6 units. Lab testing has shown that a similar level of reduction in urine pH can significantly reduce ammonia emissions. Diets containing 1.95% calcium chloride had no significant effect on ammonia levels in a nursery unit, however the ammonia levels were

low to begin with. A study that added 1% adipic acid (a flavour enhancer) to grow-finish rations reduced in vitro ammonia release from urine samples (Figure 2) and reported a 25% reduction in ammonia levels in exhaust air from environmental chambers in which the pigs were housed. It appears that dietary acidification, sufficient to produce a urinary pH of approximately 5.5, has the potential to reduce ammonia volatilisation and reduce associated odours.

NSP have the potential to increase volatile fatty acid production in the hindgut. This results in a reduced manure pH and a reduction in ammonia volatilisation rates. However, this research only addressed specific compounds and did not use olfactometry measurements to measure the perceived odour.

Gaps in knowledge and future research:

Most of the research using dietary manipulations to change swine odours has been done in the Netherlands and the Midwestern U.S. This research can be translated to Canada either directly or with further refinement. The differences in cereal crops used (corn vs. barley or wheat) and the differences in

chemical composition (NSP content and types) warrants further consideration.

Most studies measure only one indicator of odour potential. While providing valuable information, they do not give a measurement of odour, per se. Dynamic olfactometry provides a more useful measurement of odour and should be used to assess the impact of diet on odour production.

Summary

When manipulating diets or using dietary additives to change swine odours, consider the following:

- Is it practical and cost effective to modify the diet or use an additive?
- Is the feed ingredient or additive readily available?
- Can the quality or composition of the ingredient or additive be assessed and what is the batch-to-batch variability?
- Are there any negatives associated with the dietary manipulation including:
 - impacts on the pig; overall performance
 - nutrient digestibilities
 - pig health status
 - impacts on meat or carcass quality; tissue residues
 - off flavours or odours (both to the feed and the carcass)
 - lean to fat ratio
 - impacts on staff handling the product; how easy it is to use the product
 - other safety concerns
 - impacts on feeding or manure handling equipment; is it corrosive?

Most important:

Is the strategy effective in significantly reducing or manipulating odours?

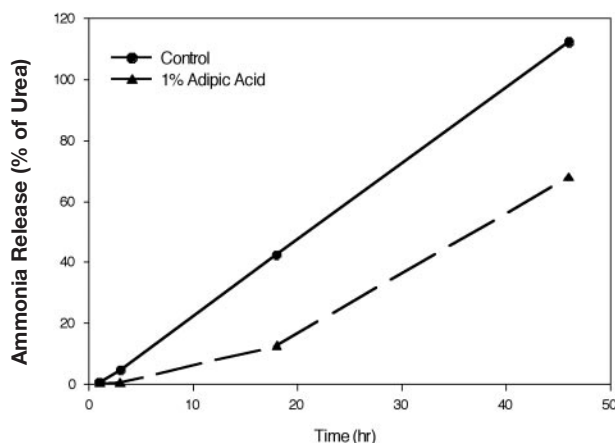


Figure 2. The effect of adding 1% adipic acid to swine diets on in vitro ammonia release from urine. Differences between treatment means at individual time points are significant ($P < 0.05$)

PROFIT POINT MANAGEMENT - Constructing a Business Plan

By: John Maltman, MAF

Farming is a complex business and long term success requires a clear framework or business plan to guide the decision making process. Within every business venture there are critical control points which impact profitability. These profit points can be influenced by management pressure and can result in positive consequences for production and profit. However, too often negative cash flows have occurred before effective remedial activities are undertaken. A properly constructed business plan considers all enterprises on the farm and ensures that targets are set with proper resources applied to each section of an enterprise.

A business plan identifies profit points in its outline. Strategies are identified and monitoring systems are established to maximize returns from capital and labor. This allows progress to be measured and all management activities can be evaluated. Quick changes can be implemented when new technology or market forces come into play.

THINGS TO INCLUDE IN A BUSINESS PLAN:

Structural Elements

Title Page
Executive Summary
Table of Contents
Time Line
Organizational Structure

Operational Elements

Production Plan
Marketing Plan
Financial Plan
Human Resources Plan
Community Plan
Sensitivity Analysis
Summary - concluding remarks which tie everything together.

Review all parts regularly.

CONTROL POINTS

Feed
Farrowing Crate Management
Mortality Rates
Farrowing Rates
Born Live
Growth Rates
Biosecurity

NO CONTROL

Politics
Ingredient Cost
Market Price
Catastrophic Disease Event
Currency Change
Biosecurity

Failure to meet targets is almost always traceable to:

- 1) lower than expected effective price
- 2) higher than expected feed costs
- 3) lower than expected production.

Hunsburger 1999 Advances in Pork Production V.10 P.116

Hog production is a biological process having a large number of records that can be kept. It is important to focus on key profit points and relate the results to target values. The goal is to keep

Upcoming Events

Mark your calendar for the following events:

Western Nutrition Conference,

September 10 & 11, 2003,
Fairmont Hotel, Winnipeg.
For information contact
Dr. Ian Seddon at
(204) 945-0353



the business moving towards profitable objectives.

The primary record keeping tool to accomplish this is the financial reporting system. The goal is to use the production record system to anticipate developing problems so that the financial impact is reduced or even prevented.

The objective of the farm plan is to maintain uniform production, cash flow and cost control. Manitoba Agriculture and Food staff can assist you in constructing a farm business plan. Call your local Ag office for details.

PROFIT POINT MANAGEMENT IN PIG

Item	Type of Operation			
	<u>GF</u>	<u>FW</u>	<u>FF</u>	<u>N</u>
Feed Cost	40 %	34 %	58 %	22 %
Pig Cost	42 %			64 %
Other Costs	9.5 %	27 %	25 %	7.5 %
Investment Costs	1.3 %	6 %	5 %	1 %
Labor Costs	2.3 %	23 %	10 %	2.5 %