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Feed and Animal Management for Swine: Growing and Finishing Pigs

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Acknowledgments

This technical note was authored by Dr. Alan Sutton, Department of Animal Sciences, Purdue University, and Charles Lander, National Agronomist, NRCS (retired), and released in 2003. It was updated by Glenn Carpenter, National Leader, Animal Husbandry, NRCS (retired) and currently NRCS Agriculture Conservation Services (ACES); and Renee Leech, Animal Husbandry Specialist, NRCS, East National Technology Support Center (ENTSC), Greensboro, NC; under the direction of Jeffrey Porter, Team Lead, National Animal Manure and Nutrient Management Team, NRCS, ENTSC, Greensboro, NC.

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Introduction

Swine operations can include a complete farrow to finishing unit or various combinations of separate units for feeder pig production, including nursery units, grower-finishing pigs, or the breeding herd. Distinctly different diets are required for each of these life stages, resulting in significant differences in the volumes and nutrient composition of the manure produced. This technical note briefly highlights several factors affecting nutrient excretion, including potential dietary adjustments that can be used to minimize excess nutrient excretion from growing-finishing pigs.

Selected nutrient requirements for pigs of different sizes are listed in table 1. This table was developed from material in the National Research Council's (NRC) publication "Nutrient Requirements of Swine, 11th Revised Edition," (2012). Reference to these guidelines is important for a thorough evaluation of all swine diets, including the breeding herd, on a commercial operation.

Table 1: Selected Nutrient Requirements for Grower-Finisher Pigs[1]

	Pig, Body Weight Range (lbs.)						
Nutrient (percent or unit/kg of diet; 90% dry matter)	**11–15**	**15–24**	**24–55**	**55–110**	**110–165**	**165–220**	**220–298**
Net energy content of the diet (kcal/kg)	2,448	2,448	2,412	2,475	2,475	2,475	2,475
Lysine, % STTD[2]	1.50	1.35	1.23	0.98	0.85	0.73	0.61
Lysine, % ATTD[3]	1.45	1.31	1.19	0.94	0.81	0.69	0.57
Calcium, %	0.85	0.80	0.70	0.66	0.59	0.52	0.46
Phosphorus, % total	0.70	0.65	0.60	0.56	0.52	0.47	0.43
Phosphorus, % STTD[2]	0.45	0.40	0.33	0.31	0.27	0.24	0.21
Phosphorus, % ATTD[3]	0.41	0.36	0.29	0.26	0.23	0.21	0.18
Potassium, %	0.30	0.28	0.26	0.23	0.19	0.17	0.17
Sodium, %	0.40	0.35	0.28	0.10	0.10	0.10	0.10
Copper, mg/kg	6.0	6.0	5.0	4.0	3.5	3.0	3.0
Zinc, mg/kg	100	100	80	60	50	50	50

[1/] Adapted from National Research Council. 2012. "Nutrient Requirements of Swine, Eleventh Revised Edition," (2012).
[2/] STTD—Standardized Total Tract Digestible
[3/] ATTD—Apparent Total Tract Digestible

Diet Formulation

Feeding diets that are higher in amino acids or phosphorus (P) than required by swine results in manure with more concentrated nitrogen (N) and P, and higher ammonia and hydrogen sulfide gas as the manure breaks down. Producers should feed diets that meet the requirements of their animals without having excessive overages.

Phase Feeding

Dividing the growth period of the pigs into several periods with a small spread in body weight allows producers to provide diets that more closely meet the pig's nutrient requirements. Feeding 3 or 4 diets during the grow-finish period compared to feeding only two diets during this period reduces N and P excretion by at least 5 to 10 percent.

Split-sex Feeding

Gilts require more protein and amino acids than barrows. Penning barrows separate from gilts allows the feeding of lower protein and amino acid levels to barrows without compromising the growth and performance efficiency of gilts, thereby reducing nutrient waste. This can reduce N excretion by at least 5 to 10 percent.

Formulate Diets on an Available Nutrient Basis

A high proportion (55–80%) of the P in cereal grains and oilseed meals occurs as phytate. Phosphorous in this form is not well-utilized by pigs because they lack enough intestinal phytase—the enzyme needed to remove phosphate from the phytate molecule. Therefore, supplemental P is added to the diet to meet the pig's P requirements for growth and bone formation. The nondigestible phytate-P and any excessive P in the diet are excreted.

Supplementing the diet with phytase is one of the most effective means of increasing the breakdown of phytate-P in the digestive tract and reducing P excretion in feces. Using phytase allows managers to feed a lower level of supplemental inorganic P in the diet. A portion (35%) of the unavailable phytate-P in the feed grains is released and made available by the phytase enzyme to help meet the pig's P needs. The inclusion of phytase increases the availability of P in a corn-soy diet by threefold, from approximately 15 to 45 percent, and results in reduced P excretion of 20 to 30 percent.

Because some feedstuffs are high in phytate, and because there is some endogenous phytase in certain small grains (wheat, rye, triticale, barley), there is wide variation in the bioavailability of P in feed ingredients. For example, the P in corn is only 12 to 15 percent available while the P in wheat is 50 percent available. Further, the P in dehulled soybean meal is 23 percent available while the P in cottonseed meal is just 1 percent available. Comparatively, none of these plant sources of P approach the high availability of P in meat and bone meal (90%), fishmeal (93%), or dicalcium phosphate (95%). To reduce excretion levels, diets should be formulated on an available-P-basis according to NRC recommendations, making any adjustments needed for farm-specific animal performance.

Some feed manufacturers formulate swine feeds on an "ideal protein" basis. An ideal protein is one in which the amino acids closely match the animals' requirements for lean tissue protein synthesis and maintenance. One way of doing this is to reduce the amino acids level in the diet and supplement with synthetic amino acids. Although nutritionists cannot prepare perfect amino acid balances from natural feed ingredients, the use of computer programs and having an array of many different ingredients and synthetic amino acids allows them to produce feeds that have reduced amino acid excesses. Reducing excess amino acids from grains in the diet by 3 to 4 percent and supplementing with synthetic amino acids, such as lysine, methionine, threonine, and tryptophan, have shown a 20 to 40 percent reduction in N excretion.

Feed Management

Controlling feed wastage improves herd feed conversion and reduces nutrient losses. Feed wasted in the manure pit can add considerably to the nutrients that need to be applied to the land. Wasted feed also

costs the operation a considerable amount of money—an 800 hog grow-out house with a 3 percent wastage rate will waste as much as 20 tons of feed each year. Check and adjust feeders often to reduce wastage.

Wet-dry feeding systems can significantly reduce feed and water wastage. Research has shown that manure volume per pig was reduced 30 to 50 percent by using wet-dry feeding systems. However, the nutrient concentrations in the manure from a wet-dry feeding system are generally significantly higher; therefore, routine manure analyses are needed to adjust application rates of such manure to agricultural land.

The mineral content of the water supply should be considered with regard to the total intake of dietary minerals. Depending on the quality of the available water supply, water intake can make a substantial contribution to daily mineral intake, particularly with regard to sulfur, and in some areas of the country, salt. Routine water sampling can help the nutritionist formulate properly for the amount of minerals that need to be added to the diet to meet the animal's actual requirements.

Maintaining pigs under comfortable environmental temperature and humidity conditions improves feed utilization and can also reduce nutrient excretion. Cold temperatures increase caloric requirements for body maintenance; and, therefore, increase feed intake and nutrient excretion. Likewise, extremely hot temperatures reduce feed intake, decrease growth rate, and increase time to market, thereby ultimately increasing nutrient excretion at the grow-out operation.

Raising genetically lean pigs (rather than typically fat pigs), controlling diseases and parasites, and using good management practices are further examples of how managers can improve feed conversion efficiency and reduce nutrient excretion.

Fine grinding (600 to 700 microns is most desirable) and pelleting feed are also effective ways to improve feed utilization and decrease dry matter manure volume. Dry matter manure volume can be decreased by 15 percent and nutrient excretion, especially N, by about 5 percent. By reducing the particle size, the surface area of the grain particles is increased, allowing for greater interaction with digestive enzymes. Addition of enzymes, such as phytase, amylase, protease, glucanase, etc., can release nutrients that will enhance nutrient retention and reduce excretion. This is especially true in corn-soybean meal diets.

Feed additives are compounds used in swine diets with the purpose of enhancing performance and health. Many nonantibiotic feed additives are being used to improve growth performance, regulate gut microbes, support immunity, decrease environmental challenges, and enhance reproductive performance. Feed additives include acidifiers, prebiotics, probiotics, direct-fed microbials, enzymes, organic oils, and beta-agonists, among many others.

Feeding food waste to swine is probably not an option with large commercial operations because of the variability of available feed ingredients in the diet. Feeding food waste may be applicable to smaller operations. Feeding food waste is regulated by States and may require a license or registration from the State to be allowed to implement this practice. Food waste to be fed to pigs must be heat-treated as mandated by the 1980 Swine Health Protection Act. This is done to reduce the risk of foreign animal diseases in swine and to eliminate any other harmful pathogens. These diseases could be spread to other livestock or humans if swine consume improperly treated food waste. Food waste must be cooked thoroughly at boiling temperature (212°F or 100°C at sea level) for 30 minutes; and, it must be agitated during cooking, except in steam cooking equipment, to ensure the prescribed cooking temperature is

maintained throughout the cooking container for the prescribed length of time. Producers should check with their State to see if this practice is allowed, and to see what localized procedures are required.

Summary

The NRC's "Nutrient Requirements for Swine" (2012) is a key reference to evaluate all swine diets, including the breeding herd, on a commercial operation. Also, consult qualified nutritionists to accurately evaluate current or planned diet compositions during the development of conservation plans, particularly comprehensive nutrient management plans (CNMPs).

Using multiple strategies in the formulation of swine diets along with techniques to improve feed-use-efficiency can significantly reduce the nutrient content of excreted manure. The potential for these strategies to impact manure nutrient content is shown in table 2.

Table 2: Potential for Feed Management to Impact the Nutrient Content of Swine Manure[1]

Strategy	Nitrogen Reduction %	Phosphorus Reduction %
Formulate diet closer to requirement	10–15	10–15
Reduced protein/AA supplementation	20–40	n/a[2]
Use of highly digestible feeds	5	5
Phytase/low phosphorus diet	2–5	20–30
Selected enzymes	2–5	5
Growth promotants	5	5
Phase feeding	5–10	5–10
Split-sex feeding	5–8	n/a[2]

[1/] Adapted from the Federation of Animal Science Societies (FASS) publication, "Dietary Adjustments to Minimize Nutrient Excretion from Livestock and Poultry," (January 2001).
[2/] Not applicable

The actual impact of a feed management strategy or strategies on a swine operation can only be determined by analysis of the manure after the strategy has been implemented. During the development of CNMPs, the potential impact of a strategy or strategies can be estimated using values in table 2. When using data from this table, planners are encouraged to be conservative in their selection of factors. Also, it is important to remember that the impact of using multiple strategies in a single diet is not likely to be additive for each single strategy being used. Rather, it is more likely to be something greater than the value for the strategy with the smallest impact, but less than the sum of values for all of the individual strategies in use. During the development of CNMPs, it is better to underestimate the potential impact of feed management than to overestimate it. Later, the plan can be modified and fine-tuned based upon data accumulated from the actual production operation.

References

National Research Council. 2012. Nutrient Requirements of Swine, Eleventh Revised Edition. Washington, DC: The National Academies Press. https://doi.org/10.17226/13298.

Federation of Animal Science Societies (FASS). 2001. Dietary Adjustments to Minimize Nutrient Excretion from Livestock and Poultry.

Appendix 1

Glossary of Terms

Amino Acids.—Building blocks for synthesis of protein and vital to maintenance, growth, reproduction, and lactation.

Available Nutrient Basis.—Formulating a diet based on the bioavailability of the nutrients from the feed ingredients in the diet for the intended production purposes.

Barrow.—Male pig that has been castrated before reaching sexual maturity.

Bioavailability of Nutrients.— The amount of nutrient in the diet that is released in the digestion process and that can be absorbed in a form that can be used in the body for the normal functions for which the nutrient is needed.

Diet Formulation.—The process of combining an assortment of feed ingredients into a diet that will meet the nutrient and energy requirements for the intended purpose of the animal production system.

Digestibility.—The relative amount of nutrients released from the digestion process.

Endogenous.—Nutrients within the animal that may be produced or synthesized. Excretion of endogenous nutrients may occur from the recycling of nutrients and normal cellular metabolic processes.

Endogenous Phytase.—The enzyme naturally derived within the animal or from microbial sources within the animal that degrades phytate and releases phosphorus.

Gilt.—Female pig less than one year old.

Ideal Protein Basis.—Formulating a diet based on the concept that the protein content of the diet has a balance of amino acids that exactly meet an animal's amino acid requirements.

Phase Feeding.—Changing the nutrient concentrations in a series of diets formulated to meet an animal's nutrient requirements more precisely at a particular stage of growth or production.

Phytase.—An enzyme that degrades phytate, making the phosphorus available to the animal.

Phytate Phosphorus.—A complex, organic form of phosphorus that is bound to the phytate molecule.

Split-sex Feeding.—A feeding and housing program that divides animals by gender and formulates diets to meet the specific nutrient requirements of each sex more precisely.

Wet-dry Feeding Systems.—Feeding systems designed to introduce water with dry feeds either at prescribed time periods or on demand by the animal. Introducing water at the time of feeding also reduces the potential for water spillage and dust from feed sources.