Factsheet

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Nutrient Requirements of Pigs and Considerations for Making Diets

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INTRODUCTION

Pigs are omnivores, meaning they eat both plant and animal-based foods. Like humans, pigs have a single compartment in their stomach, making them a monogastric species. Pigs are not suited to rely on only forage or pasture-based diets to meet their nutrient requirements because of how their digestive system works.

For a pig to thrive, it must be fed a balanced diet containing:

- energy (fats and carbohydrates)
- amino acids (protein)
- vitamins
- minerals
- water

A pig's diet will impact how long it takes for a hog to achieve optimum market weight, its meat quality, breeding success and health. Nutrient requirements will vary across farming operations according to many different factors, such as:

- the breed or genetics of the animal
- the type of housing system (indoor, outdoor, mixed)
- how they are managed
- the health status of the animals
- the season/time of year or climate they are raised in
- the age of the animal
- the reproductive status of the animal

NUTRIENT REQUIREMENTS FOR PIGS

Energy

Energy is needed for maintenance, growth, and reproductive functions. Energy needs are primarily met by fats and carbohydrates, although a small amount can be generated from dietary amino acids. Fats provide high levels of energy.

Carbohydrates can be divided into 'high energy' and 'low energy' carbohydrates. Starches and sugars are considered high energy, whereas fibre is considered low energy because they are harder for the pig to digest and utilize as nutrients.

Amino Acids

Amino acids are the building blocks of protein. There are 22 different amino acids that combine to make protein. Ten of the 22 amino acids are essential, meaning they must be provided in the diet because they cannot be synthesized by the pig.

Diets should be balanced based on their amino acid content, not on the total crude protein content. When a pig consumes a protein source, it is broken down into individual amino acids in the intestinal tract. The individual amino acids are transported to various tissues around the body, where they can be used for muscle-protein synthesis or synthesis of other protein such as enzymes, transport proteins, immune proteins and milk protein. Lysine is typically the most limiting amino acid in pig diets, and thus should be used as the basis of formulations.

Vitamins and Minerals

Vitamins and minerals are considered micronutrients. Micronutrients are only required in small amounts by the animal but are essential for proper functioning of all physiological processes within the body. Many vitamin and mineral requirements can be met through standard feed ingredients, but not all. For this reason, it is imperative that a vitamin and mineral premix be included in all swine feed. Deficiencies, excesses or imbalances of most vitamins and minerals can cause health and/or production issues. *Iowa State University's Nutritional Deficiencies* webpage is an excellent resource on nutritional deficiencies that may be encountered with pigs.

Premixes will vary in composition based on the age and size of the pig and its productive function (growth vs. reproduction). If you are mixing diets on-farm, you can purchase a premix from a local feed mill or store. If you are purchasing complete feed through a company, your nutritionist will have formulated the correct vitamin and mineral premix into the diets.

Water

Water makes up over 80% of a neonatal pig's body weight and approximately 50% of a market pig's body weight. Water is essential to life and is involved in many physiological processes within the body, including:

- temperature regulation
- structural form via cell turgidity
- movement of nutrients to cells
- removal of waste products from cells
- chemical reactions within the body
- lubrication of joints
- protective cushioning of the nervous system

Pigs obtain water through three main sources:

- direct consumption of water
- water found in feed
- metabolic water produced during chemical reactions in the body

Water is lost from the body by four primary routes:

- respiration from the lungs
- evaporation from the skin
- defecation from the intestinal tract
- urination

Water consumption varies significantly between different sizes of pigs and can be impacted by the environment and dietary intake. For example, consumption can increase by 15%–50% if barn temperatures are above the pig's temperature comfort zone.

CONSIDERATIONS FOR FORMULATING SWINE DIETS

It is recommended that pig producers work with a feed company and a nutritionist to develop a balanced feeding program appropriate to their farming operation. Whether you are a hobby farmer or a commercial producer, a sound nutrition program is key to being successful at raising healthy pigs. Many producers purchase complete feeds from local feed companies, while others will mix their own feed on-farm using specific formulations. Either option (or a combination of both) is a valid system for feeding your pigs. However, be sure to include a proper vitamin and mineral mix into your diets if mixing your own feed on-farm.

It is important to understand that nutrients supplied by different feed ingredients vary greatly. Grains vs. oilseeds vs. byproducts used as feed ingredients all have very different nutritional profiles. In addition, the same source of grain or corn can vary in its nutritional content based on the cultivar, growing season and growing location. If you are growing your own feed, you should have it tested for its nutritional composition before feeding it to your pigs.

For information on how to collect feed samples and have them tested, visit the following OMAFA pages:

- *Nutrient testing in livestock rations*
- *Definitions of feed manufacturing and livestock nutrition terms*

Energy and protein are the main nutrient components in a swine ration. Grains, such as corn, barley, wheat and oats, traditionally supply energy, while protein typically comes from meals produced from oilseeds such as soybean and canola. Feed ingredients also supply essential vitamins and minerals to the pig.

For more details on ingredient options for pigs and their nutrient composition, see the OMAFA factsheets:

- *Nutrient Composition of Feed Ingredients for Swine*
- *Feeding Small Cereal Grains to Pigs*

The USDA National Institute of Food and Agriculture's *Principles of Balancing Swine Diets – Hogs, Pigs, and Pork* is an excellent resource to guide you through the process of gaining a deeper understanding of the principles of balancing swine diets.

Forages

Throughout the last few years, research has shown that pigs are able to use forages as a nutrient source to some degree and that they can be incorporated successfully into swine diets. More mature pigs are better able to digest and absorb nutrients from forages than young animals.

IMPROVING NUTRIENT UTILIZATION

There are several ways to improve nutrient utilization of feed for pigs, including feed milling/mixing (particle size reduction, improving uniformity of feed mixing) and using feed additives such as enzymes.

Feed Milling/Mixing

Particle size refers to the average diameter of individual particles within a ration or, in other words, how finely ground the ingredients are. The impact of reducing particle sizes for pig feed has been well researched over the years and it is well documented that it can have a positive impact on feed efficiency. When a grain is ground prior to mixing in the diet, it increases the surface area of the grain, allowing for greater interaction between the ingredient and the pig's digestive enzymes, which in turn improves nutrient utilization by the pig. However, there are pros and cons to a fine grind, so determining the optimal particle size needs to consider both pig performance and the efficiencies of milling and feeding. Ingredient grinding can improve handling and mixing uniformity, however, too fine a grind can lead to feed bridging in bins and feeders and, in some cases, gastric ulcers in pigs. Finer grinds also increase the cost of feed processing and dust levels in the mill. In most experiments, a dietary particle size of approximately 700 microns optimizes both pig performance and feed/milling efficiencies.

If you are producing feed on-farm, particle size analysis is a relatively inexpensive test and should be routinely incorporated into an on-farm quality control program. Producers should check ground grain or a complete diet at least twice per year and for larger operations, as frequently as every 60–90 days. There are several commercial laboratories that can determine particle size, along with several different on-farm use kits. The key areas to look for on the analysis are:

- the average particle size (700–800 microns)
- shape of the graph/curve (bell-shaped or normal)
- less than 10% of the sample being too coarse (>1,850 microns) or too fine (<300 microns)

Some commercial laboratories may offer this service. For more information on laboratories offering analyses, visit the OMAFA pages:

- *Soil, leaf and petiole tissue, and forages and feed testing labs*
- *Laboratories offering mould and mycotoxin analysis*

When mixing feed on-farm, it is important to ensure that all mill equipment is well-maintained and calibrated properly. Regardless of the type of equipment used, regular maintenance can prevent the mixing of incorrect diets. Surveys of the calibration of on-farm feed mills often show that over 50% of mills are out of calibration for one or more ingredients.

The most common reason for incorrect calibration is that the bulk density (bushel weight) and/or moisture levels of the grain and protein supplements are different from that for which the mill was originally calibrated. Bushel weight and moisture levels of grain can be quite variable from load to load, from bin to bin and field to field. Feed mills must therefore be calibrated regularly. The mill should be re-calibrated if density or moisture change more than 3%.

To obtain a uniform mix of ingredients, mixers should not be under- or over-filled, and the speed of the mix should follow the manufacturer's recommendations. Horizontal batch mixes should be filled to at least one-third while vertical mixers should contain at least 50% of the mixer's capacity. Overfilling may be one of the most common problems. With vertical mixers, never fill above the top of the elevator. With horizontal mixers, you should just be able to see the top edge of the ribbons or screws above the feed.

The order of loading ingredients into the mixer is critical for proper mixing. For vertical mixers, micro-ingredients or premixes should be added midway through the loading process to make sure they are completely flushed into the mixer and to prevent separation. Horizontal mixers should be loaded first with major ingredients, then with supplements, minerals or premixes. Liquids should only be added, in either mixer type, after the dry materials have been mixed because liquids alter the flow pattern and can stop the mixing action altogether.

Build-up in the equipment or carryover into the next batch must be avoided. Fines, sticky feeds or liquids increase build-up and carry-over. Remove build-up as soon as possible, flush after additive or antibiotic use, follow recommended feed sequencing and clean by hand as required.

Enzyme Inclusion

There are many different enzyme products available on the market that can be added to swine rations, with the goal of improving nutrient utilization. Enzymes work by helping to break down specific feed components, making the nutrients more available for digestion and absorption. The most commonly used enzymes for pigs are phytases, proteases and carbohydrases.

Phytase assists with phosphorus availability in the gastrointestinal system by breaking the phytate phosphorus bond found in plant-based feed ingredients. This allows the pig to utilize more of the plant-based phosphorus found in the diet, while reducing the need for supplementing additional phosphorus and excretion of excess phosphorus into the environment. Phytase is included in most commercial swine rations.

The use of carbohydrases and proteases in swine rations can provide variable results. Proteases are enzymes that degrade proteins, whereas carbohydrases degrade carbohydrates. Inclusion of enzymes into rations should match the type of substrate in the diet. For example, if you are trying to assist with the breakdown of protein in soybean meal, a protease should be used. However, if you are trying to break down carbohydrates (especially in high-fibre ingredients such as wheat or barley), xylanase (wheat) or β-glucanase (barley) would be selected. Proteases can be used in conjunction with carbohydrases.

Inclusion of enzymes into swine rations should be economical and provide performance improvements. There are many different products available, so work with your nutritionist to select one that is right for your situation.

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