

INTRODUCTION

This manual has been developed as a study guide for the Florida State Fair Skillathon that is part of the Champion Youth Program. The topic for this year's Skillathon is **nutrition and feeding management**.

The Florida State Fair recognizes that agricultural education instructors, 4-H agents, YLPA representatives, parents, and leaders provide traditional and logical instructional link between youth, their livestock projects, and current trends in the animal agriculture industry. **PLEASE NOTE:** This manual is provided as a **study guide** for the skillathon competition and should be used as an additional aid to ongoing educational programs.

Sections are labeled **Junior, Intermediate & Senior, Intermediate & Senior, or Senior** to help exhibitors and educators identify which materials are required for each age level.

** Additional information is noted in the study manual for preparing for the Champion of Champions competition.

Juniors (age 8-10 as of September 1, 2023)

Digestive tract parts identification
Feed classification & identification

Intermediates (age 11-13 as of September 1, 2023)

all of the above plus....
Digestive tract functions
Feed tag analysis

Seniors (age 14 and over as of September 1, 2023)

all of the above plus....
Evaluating Feed Efficiency
Evaluating and selecting feedstuffs

GOOD LUCK

Swine Nutrition

What an animal eats, how it is digested, absorbed, utilized and what is excreted is the essence of *nutrition*. Good nutrition is basic to good health and production. Proper feeding management requires knowledge of the nutrients in the feedstuffs available to the producer and the nutrient needs of their animals. It also includes an understanding of animal behavior and a management strategy that allows the animals to consume all that is required without causing digestive upset. Though general rules of thumb are helpful, each situation may require adjustments in order to optimize growth and production.

Nutrients are substances in the diet that support normal body functions. Some nutrients can be manufactured in the animal's body and are classified as *dietary non-essential*. *Dietary essential* nutrients must be provided in the ration. Nutrients can be classified into six groups: *water, carbohydrates, fats (lipids), proteins, vitamins and minerals*.

Water is the most essential nutrient and is involved in all body functions. It is the most abundant and therefore the cheapest nutrient. Animals receive water from drinking as well as from feeds that contain water. An animal that is not receiving enough water will not eat well. Factors which affect an animal's water consumption are the animal's size, feed intake environmental temperature, humidity, and water quality.

Proteins function as the basic structural unit of the animal body and in metabolism. Protein is the main component of the organs and soft structures of the animal body with the exception of water. The dietary requirement for protein is highest in young, growing animals. All proteins are composed of simple units called amino acids. The particular amino acids in a protein determine the quality of that protein. Protein is one of the most expensive portions of the diet.

Carbohydrates are organic compounds formed in plants by the process of photosynthesis. They make up about 75% of the dry weight of plants and grain. Carbohydrates serve as a source of energy in the body. A surplus of carbohydrates is transformed into fat and stored.

Fats function much like carbohydrates in that they serve as a source of energy. Fats produce 2 ¼ times more energy per unit of weight than carbohydrates when digested; therefore, a smaller amount is required to serve the same function. Some fats are essential for proper metabolism in the animal.

Vitamins are essential for the development of normal tissue and necessary for metabolic activity. They are effective in the animal body in small amounts. When not consumed in an adequate amount a specific deficiency disease can result, or toxicity may result if eaten in extremely high amounts. Vitamins are classified as being either fat soluble (A, D, E, K) or water soluble (B complex & C). Fat soluble vitamins must be consumed in the diet.

Minerals are inorganic, solid, crystalline chemical elements. They are classified as being either macro (Ca, P, Na, Cl, K, Mg & S) meaning required in high concentrations or micro (Cr, Co, Cu, F, Fe, I, Mn, Mo, Ni, Se, Si, & Zn) meaning required in trace amounts. Calcium makes up nearly 50% of the total body mineral, phosphorus composes 25%, and other minerals make up the remaining 25%. Minerals function in protein synthesis, oxygen transport, and in skeletal formation and maintenance.

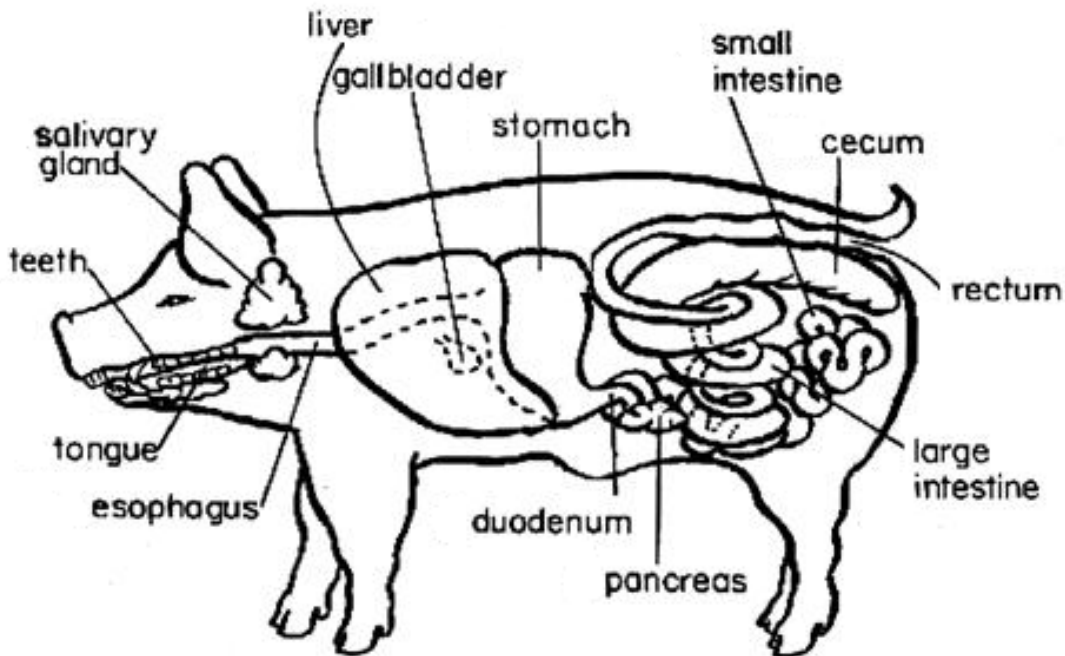
Specific nutrient requirements vary between species but also between individuals. Factors such as weight, environmental temperature, and level of production must be considered when determining optimum nutrient levels in a ration. Though it is tempting to provide more than enough as insurance, some nutrients cause problems (toxicity) if fed in excess. Also, the feeding of livestock accounts for 45-75% of production costs so overfeeding shrinks profits. Too much of a good thing is not good.

Digestive Anatomy

Juniors, Intermediates and Seniors

You are what you eat sounds silly but is somewhat true. Farm animals are grouped by what they eat, which is based on the type of digestive system they possess. *Herbivores* are vegetarians (cattle, sheep, goats, rabbits). *Carnivores* are flesh eaters (dogs, cats). *Omnivores* eat both plants and flesh (pigs, chickens, humans). Based on the digestive system, animals are grouped as *monogastric* or *simple stomach* (pig), *polygastric* or *ruminant* (cattle, sheep, goats), *avian* (chickens), or *pseudo-ruminants* with a functional cecum (rabbits). Understanding the digestive system is fundamental to selecting proper feeds and feeding system for your animal.

After studying this manual, you should be able to identify the parts of the digestive tract of a hog and tell the function of each part.



Feed Classification and Identification

The “stuff” fed to animals in order to meet their nutritional needs are called feeds. The National Research Council (NRC) produces many publications on nutrient requirements of animals and nutrient content of most feedstuffs. Most youth purchase “complete rations”, however, it is helpful to know what may go into those rations. Go to <https://quizlet.com/subject/Feed-ID/> and study feed ingredients so that you can visually identify those typically used in livestock feeds.

Though we generally group feeds into roughages (high fiber, >18% crude fiber less digestible) and concentrates (low fiber, <18% crude fiber, more readily digestible). There are 8 international feed classes that are based on content and use.

1. Dry forages and roughages – cut and cured products with >18% CF like hay, straw, corn cobs, shells and hulls, paper, wood by-products and stover.
2. Pasture, range plants and forages fed fresh – all forages not cut or cut and fed fresh.
3. Silages and haylages – plant material preserved through the ensiling process, forages like corn, alfalfa and grass.
4. Energy feeds – products with <20% CP, <18% CF and > 70% TDN, like cereal grains (corn, oats, wheat), mill byproducts, beet and citrus pulp, molasses, animal, marine and vegetable fats, nuts, roots and tubers. Energy content of a feedstuff is expressed as percent total digestible nutrients (TDN) because it is strongly correlated with digestible energy.
5. Protein supplements – products with >20% CP or more; protein from non-ruminant animal origin, oilseed meals like soybean or cotton, legume seeds, milling by-products of grains, brewery and distillery by-products, yeast, non-protein nitrogen.
6. Mineral supplements
7. Vitamin supplements
8. Non-nutritive additives – supplements such as antimicrobials, antifungals, antibiotics, antioxidants, probiotics, buffers, coloring material, flavors, hormones and medicines.

Digestive Function

Intermediates and Seniors

The physical and chemical changes of feed within the gastrointestinal tract that allow nutrients to be released and absorbed into the body are called digestion. There are significant differences in the digestive processes between species. The type of digestive system an animal has determines what the animal can successfully use as feed. Complicated feed (forage) requires a complicated digestive tract (ruminant). However, monogastric animals, such as swine require grains which are digested more easily. The steps in digestion include: prehension (gathering), mastication (chewing), salivation, deglutition (swallowing), microbial, enzymatic and chemical breakdown, absorption of nutrients, defecation, and micturition (urination). For a review of swine digestive anatomy visit:

<https://www.thepigsite.com/articles/digestive-system-of-the-pig-anatomy-and-function> or <https://extension.purdue.edu/news/county/crawford/2020/11/docs/The-Digestive-Tract-of-the-Pig.pdf>.

- Mouth- Lips, tongue and teeth used in prehension, mastication and salivation processes.
- Esophagus- Hollow muscular tube that transports ingesta from the mouth to the stomach.
- Stomach- Hollow, pear-shaped, muscular organ with acidic secretions. (2 gallons)
- Small Intestine- Pancreatic and intestinal juices break down proteins and carbohydrates while bile from the liver breaks down fats. The first section (duodenum) is involved in digestion, and the next two sections (jejunum & ileum) are actively involved in nutrient absorption. (2 ½ gallons, 60 feet long)
- Large Intestine- Three sections: cecum, colon and rectum. The cecum has little function in swine. Colon is the site for water resorption and storage reservoir of undigested gastrointestinal tract contents. (2 ½ gallons, 17 feet long)

Feed Tag Analysis

Intermediates and Seniors

It is required by law that all commercial feed products carry a proper label. You should be able to read and understand the information on a feed tag. Some of the information included will be: net weight in pounds, company brand name (trade name), product name (class or use), product type (textured, pelleted, extruded, etc.) purpose statement, warning or cautions, active drug ingredient (when applicable), guaranteed analysis (protein, fat, fiber, etc.), feed ingredients in order of content, company name and address, detailed use directions, other feeds (suggestions for other feeds in the total program). Go to a feed store and look at the tags on several types of feeds and determine which feeds are best suited to your program and which are the best value in terms of nutrients per dollar. Be prepared to interpret the information on a feed tag.

<http://www2.ca.uky.edu/agcomm/pubs/ASC/ASC216/ASC216.pdf>

GUARANTEED ANALYSIS:

Crude Protein/Amino Acid Requirement: not less than __%.

This number represents nitrogen content of feed and does not give a clear picture of protein quality (e.g. amino acid profile).

Pigs do not have a specific requirement for crude protein, but rather for the components which make up protein, amino acids. If a diet is inadequate in any essential amino acid, protein synthesis cannot proceed beyond the rate at which that amino acid is available. This is called a limiting amino acid. Lysine is the first limiting amino acid. Swine diets should list the minimum amount of lysine as well.

Crude Fat: not less than __%, typically 1 to 3%.

At equal volumes fat contributes 2.25 times the amount of energy compared to carbohydrates. Increased crude fat levels can decrease digestion of forages (e.g., hays and grasses). Fat can be added to the diet in hot weather to maintain energy level when intake decreases.

Crude Fiber: not more than __%.

The higher the crude fiber, generally, the lower the digestible energy of the feed. The price should reflect this lesser energy, but frequently does not.

Some manufacturers also show minimum/maximum quantities of calcium and phosphorus and other macro and micro minerals. Units of vitamins A and D may also be shown.

Ingredients: listing on the tag does not necessarily identify individual feedstuffs. Instead, it can list *categories* of feedstuffs, e.g., *grains products* (such as corn, oats, barley, wheat), *processed grain by-products* (bran, brewers grain, hominy), *plant protein products* (soybean meal, cottonseed meal, etc.), *molasses products* (cane or beet molasses, dehydrated molasses, wood molasses), and *forage products* (alfalfa meal or leaf meal). The phrase, *roughage products*, identifies the presence of cottonseed hulls or other types of hulls or ground hays. This total must be shown as a percentage of the feed. Their presence will cause the crude fiber guarantee to be high (16-26% or more) and, as indicated above, lowers the digestible energy content.

The feed tag will also list sources of minerals, any preservatives used, and any vitamin supplements present or used. In the case of a medicated feed, the tag will also include the medication dosage provided and the prescribed use.

The fictitious tag below is included to encourage you to think about what information is actually available on the feed tag and to consider what it means to you in your feeding program.

Pig Starter Feed

GUARANTEED ANALYSIS

Crude Protein, Minimum	40.0%
Lysine, Minimum	3.6%
Crude Fat, Minimum	2.5%
Crude Fiber, Maximum	3.8%
Calcium (Ca), Minimum	1.65%
Calcium (Ca), Maximum	2.15%
Phosphorus (P), Minimum	1.5%
Salt (NaCl), Minimum	0.9%
Salt (NaCl), Maximum	1.4%

INGREDIENTS

Ground Newspapers, Ground Uncooked Turkey Feathers, Ammonium Nitrate, Super Phosphate, Tincture of Iodine, Used Crankcase Oil, Hardwood Sawdust, Ground Marble Chips, Vitamin A & D Oil, Ground Shoes (without Rubber Soles), Barber Shop Sweepings, Salt.

Manufactured By: LEAST IN THE EAST

Selling Directions: For price-conscious feeders who are not interested in results.

Evaluating and Selecting Feeds

It is easy to look at the price of a bag of feed and assume that lower cost is the same as higher value. Spend time thinking about your feeding management situation and the types of feeds you have available. Be prepared to judge the relative value of feeds for various scenarios. There are several methods to assess the value of a feed.

1. Physical evaluation of feedstuff: Does it look good and smell good? Is it free of dust and mold? Is it fresh? Can you see indicators of quality such as high leaf to stem ratio in hays or a high percentage of corn in a finishing ration?
2. Cost per unit of nutrients: This requires some analysis and calculations, but it is not difficult.

Example:

Product	Soybean Meal	Linseed Meal
Crude Protein	44%	35%
Cost	\$22 per 100 Pounds	\$17 per 100 pounds

To solve this problem you must determine the value of each feedstuff for protein:
 - Do this by dividing the cost by the percentage of protein

Soybean Meal: $\$22/44 = 50$ cents per pound of Crude Protein
 Linseed Meal: $\$17/35 = 49$ cents per pound of Crude Protein
 Therefore, linseed meal is slightly cheaper.

Another way is to look at productivity. If you must feed your animal twice as many pounds of a low cost, but low protein feed to achieve 100 pounds of gain, it may be more cost effective to pay a higher price and feed less total pounds of feed.

Example:

Let's look at the feed stuffs from above but add in rate of gain expected for each feed.

Product	Soybean Meal	Linseed Meal
Crude Protein	44%	35%
Cost	\$22 per 100 Pounds	\$17 per 100 pounds
Rate of Gain	1 pound of gain per 4 pounds of feed	1 pound of gain per 7 pounds of feed

Solve for cost per pound of gain.
 - First, determine cost per pound of feed
 Soybean Meal $\$22/100$ pounds = \$0.22/pound
 Linseed Meal $\$17/100$ pounds = \$0.17/pound
 - Next, determine cost per pound of gain
 Soy Bean Meal: $\$0.22/\text{pound} \times 3.25$ pounds feed/pound gain = \$0.72/pound of gain
 Linseed Meal: $\$0.17/\text{pound} \times 5.5$ pounds feed/pound gain = \$0.94/pound of gain
 - On a cost of gain basis, soybean Meal is cheaper.

3. There are a number of chemical analyses that are carried out on feeds by the companies that produce them. This information is useful in evaluating quality.
4. An often used method of determining quality is to do a home feeding trial. You may do this already without thinking about it. If you run into problems one year, you make adjustments the next year. With limited numbers of animals, this is a slow, often costly process.

Evaluating Feed Efficiency

Seniors

Performance in swine is evaluated by calculating average daily gain as well as feed efficiency. Feeding management strategies should strive to optimize growth to reach the desired end point in an appropriate time frame. For example; if your hog goes to market in 105 days and it must gain 170 pounds in order to reach the target market weight, the hog must gain an average of 1.6 pounds per day. If the hog eats 4 pounds of feed per day for 105 days at that rate of gain, feed efficiency for that period of time is 2.5 pounds of feed per pound of gain. The cost of gain is determined by multiplying the cost per pound of feed by the pounds of feed per pound of gain. Therefore, in this scenario,

\$16.00 per 100 pounds of feed with 2.5:1 feed efficiency comes out to \$.40 per pound of gain.

As you plan your feeding management program, you should develop some performance goals. A pig's amino acid requirements change over time with growth and development. Feed quality is just as important as quantity. Average daily gains of 1.5 to 2.5 are reasonable. Practice evaluating feed efficiency in different scenarios so that you can plan an appropriate feeding program for your hog.

Feed Safety & Veterinary Feed Directive

Seniors

For decades, antimicrobials and antibiotics have been used in animal feeds at "sub therapeutic" levels to improve growth and feed efficiency. To fight diseases in humans and livestock, antimicrobials are used at therapeutic levels to fight a variety of microorganisms (bacteria, viruses, fungi, parasites) while antibiotics specifically fight bacteria. Microbial resistance is a phenomenon that can develop in humans and animals. The Food and Drug Administration is working with the livestock and feed manufacturing industries to develop strategies to limit the potential for development of resistant microbes. Drugs that are important for treating human disease cannot be used for production purposes. Drugs use to fight animal disease now require veterinary supervision, no more over the counter antimicrobials. Please read about Antibiotics in Livestock & Poultry Production so that you can sort fact from fiction.

<https://www.meatinstitute.org/index.php?ht=d/sp/i/102248/pid/102248>

Seniors

Processing Feeds

Because feed constitutes a major portion of the cost of intensive animal production, it is very important for a diet to have the right nutrient content and be in a form that will encourage consumption without excessive feed waste. Feeds are often processed by mechanical, chemical or thermal methods in order to alter the physical form or particle size to prevent spoilage, isolate certain parts of the seed or plant, to improve palatability and digestibility, or sometimes to inactivate toxins. Occasionally feed is processed to improve handling. Some methods include: roller mill cracking, grinding, steam-rolled and steam-flaked, pelleting, extruding, popping, drying and cubing. Obviously there are costs associated with processing so improvements in productivity must offset price increases:

<https://www.afia.org/feedfacts/how-feed-is-made/> ; <https://www.slideshare.net/BijayShrestha32/feed-processing-methods> .

Poisonous Plants

Seniors

There are many plants and chemicals poisonous to swine and which may be disastrous to a herd. Some poisons to swine include moldy feed, pesticides, blue-green algae, mercury poisoning, and plants such as pokeberry, pigweed, poison hemlock, and cocklebur. Visit the following web sites to learn about poisonous plants in the Southeast.

<http://www.ansci.cornell.edu/plants/php/plants.php?action=display&ispecies=swine>

<http://weedext.ifas.ufl.edu/slides/Poisonous%20Plants%20revised/>

Common Nutritional Disorders**

Disorder

E. coli enterotoxemia

Ketosis

Milk fever

Parakeratosis

Night blindness

Goiter

Rickets

Anemia

Gossypol toxicity

Hypoglycemia

Photosensitization

Salt poisoning

Chief Cause

gut edema, occurs after weaning, sudden death

Sudden need for extra energy

Sudden need for Ca (lactation)

Zn deficiency

Vitamin A deficiency

Iodine deficiency

Ca, P, or vitamin D deficiency (young animals)

Fe, Cu, vitamin B12, or folic acid deficiency

Toxic level of gossypol from cottonseeds

Low blood sugar level

Some feeds or forages or accumulation of metabolites

Excess salt