

THE NEW SWINE NRC

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1.- INTRODUCTION

The tenth revised edition of the Nutrient Requirements of Swine was published by the National Academy Press in 1998. A decade later, it became clear that a revision of the so-called "NRC for Swine" was needed and discussions with the National Academies about revising the document were initiated. A project proposal was written in February, 2009, and the National Academies committed to the revision provided that funding to cover the costs of the revision could be identified. Subsequently, prospective funding agencies were contacted and in May, 2009, the funding needed for the revision was secured. Funding agencies included the National Pork Board, the American Feed Industry Association via their Institute for Feed, Education, and Research, the Illinois Corn Marketing Board, the Nebraska Corn Board, the Minnesota Corn Growers Association, the U. S. Food and Drug Administration, and internal NRC funds.

Following the successful funding of the revision, the National Academies approved the project and during the summer and fall of 2009, a committee of 10 swine nutritionists was assembled. The committee was approved in November, 2009, and the National Academies provided the Statement of Task to the committee as a guideline for the revision. The Statement of task included a charge to update nutrient and energy requirements for all categories of pigs, to update the feed composition database and the computer model, to provide information about new feed ingredients from the corn- and soybean industries, to review effects of feed additives routinely used in diets fed to pigs, to describe effects of feed processing, to discuss strategies for improved nutrient retention rates and reduced nutrient excretion rates, and to describe areas where future research is needed.

The first meeting of the committee took place in January, 2010, and committee members agreed on an outline for the work and each committee member was assigned specific aspects of the revision. The work was conducted during the following 18 month and the last chapters were completed in July, 2011. All chapters were then assigned to external reviewers who provided feedback, comments, and questions to each chapter. The committee revised the document and responded to reviewer comments in November, 2011, and the final document was approved in December, 2011, and sent to the National Academy Press for printing. The 11th revised edition of "Nutrient Requirements of Swine" was released in July, 2012, and represents the combined results of the committee's efforts. Whereas the 10th revised edition contained 11 chapters, 188 pages, and 79 feed ingredients, the 11th revised edition was expanded to 17 chapters, 400 pages, and 122 feed ingredients.

2.- ENERGY, AMINO ACIDS, LIPIDS, AND CARBOHYDRATES

In Chapter 1, information about general energy metabolism and calculation of values for digestible energy (DE) or metabolizable energy (ME) is included. Equations to calculate net energy (NE) values are also provided and it is concluded that the following equation, which is based on the DE and total nutrient concentrations of feed ingredients, is most practical for calculating NE of feed ingredients:

$$NE = (0.70 \times DE) + (1.61 \times \text{ether extract}) + (0.48 \times \text{starch}) - (0.91 \times \text{crude protein}) - (0.87 \times ADF)$$

NE and DE are expressed in kcal/kg and ether extract, starch, crude protein, and ADF are expressed as g/kg.

The equation, which was adapted from Noblet et al. (1994), was also used to calculate NE of feed ingredients that are included in the feed composition tables.

Factors influencing energy utilization in pigs are discussed and it is concluded that energy metabolism is influenced by the physiological state of the animal, ambient temperature, and physical activity. Factors affecting the maintenance requirement for energy are discussed in detail and it is proposed that ME for maintenance can be predicted in growing-finishing pigs using the following equation:

$$ME_m (\text{growing-finishing pigs}) = 197 \text{ kcal/kg BW}^{0.60}$$

This equation was adapted from Birkett and de Lange (2001) and reflects a suggestion that maintenance energy in growing finishing pigs are better predicted from $BW^{0.60}$ than from $BW^{0.75}$, which was used in NRC, 1998. It was, however, concluded that $BW^{0.75}$ should be used to predict maintenance energy requirements for gestating and lactating sows and the following equations are, therefore, proposed for sows:

$$ME_m (\text{gestating sows}) = 100 \text{ kcal/kg BW}^{0.75}$$

$$ME_m (\text{lactating sows}) = 110 \text{ kcal/kg BW}^{0.75}$$

A new feature of the 11th revision of the Swine NRC is that effects of immunization against gonadotropin releasing hormone and use of Ractopamine in diets fed to finishing pigs is integrated in the document and the implications on energy metabolism of using these technologies are discussed in Chapter 1.

Chapter 2 describes the amino acids that are present in feed ingredients and animal proteins and a division into essential, non-essential, and conditionally essential amino acids is proposed. The theoretical basis for determining amino acid requirements for pigs are explained and numerous studies in which amino acid requirements for different categories of pigs were determined are referenced in this chapter. Theoretical needs for amino acids for maintenance and for protein deposition are described and the needs for amino acids in the different amino acid pools in the body are discussed. As an example, for gestating sows, specific amino acid needs for six different pools are considered and the combined requirements for these pools are considered the requirement for amino acids for gestating sows. Efficiencies of utilization of dietary amino acids for maintenance and protein synthesis in growing-finishing pigs are also presented, and it is concluded that the efficiency of utilization (above maintenance) of standardized ileal digestible lysine for protein deposition decreases from 0.682% in pigs at 20 kg BW to 0.568 in pigs at 120 kg BW. Aspects of calculating amino acid requirements for all categories of pigs are also explained. For growing-finishing pigs, requirements are separated into requirements for gilts, barrows, and intact males. Effects on amino acid requirements of using Ractopamine and immunization against gonadotropin releasing hormone are also discussed.

Chapter 3 describes theoretical aspects of lipid metabolism, synthesis and deposition of lipids, and requirements for specific fatty acids. Advantages of dietary lipids are explained, and analytical procedures used to analyze feed ingredients for lipid concentrations and fatty acids are outlined as well. Quality measures for dietary fatty acids are also presented and analytical procedures to estimate oxidative stability in fat are discussed although it is acknowledged that no single procedure can be used to estimate lipid oxidation. Essential and bioactive fatty acids are also discussed and it is concluded

that dietary n-3 fatty acids may have positive effects on the immune responses of pigs. Although oxidized lipids may have negative effects on the intestinal barrier function, it is acknowledged that evidence for such effects in pigs have been non-conclusive at this point. Digestibility of lipids in feed ingredients is explained and calculation of DE from the chemical composition of fats is proposed. Effects on pig performance of adding fat to diets for growing-finishing pigs and sows are presented, and consequences for pork fat quality of adding fat to the diets of finishing pigs are discussed. The theoretical correlation between dietary iodine value product and pork fat quality is explained as well.

Chapter 4 describes the different carbohydrates that may be included in feed ingredients and classification of carbohydrates into monosaccharides, disaccharides, oligosaccharides, and polysaccharides is explained in detail. Analysis of the different categories of carbohydrates is also discussed. The digestibility and potential fermentability of each category of carbohydrates is explained and the possible energetic contribution of carbohydrates to diets fed to pigs is discussed. Non-energetic aspects of certain carbohydrates (oligosaccharides and fiber components) are mentioned as well.

3.- WATER, MINERALS AND VITAMINS

Chapter 5 describes the importance of water in swine nutrition. Pigs contain between 48 and 82% water, depending on size, and water is needed for most biochemical reactions in the body. Water turnover in pigs is, therefore, described and it is concluded that the requirement for water is between 80 and 120 mL per kg BW in growing finishing pigs and non-lactating sows. However, many factors influence the intake of water by pigs. Among these are level of feed intake, dietary ingredients, ambient temperature and humidity, and health status of the animal. Actual water usage is, therefore, typically much greater than the theoretical requirement and it is recommended that water is freely available to pigs. Specific considerations should be given to lactating sows because of their high water requirement for milk synthesis. Lactating sows may drink up to 40 L of water per day and sow feed intake may be improved if sows are allowed to mix feed and water prior to consumption. The quality of water is also discussed and guidelines for water quality are presented.

The minerals that are used in diets fed to swine are described in Chapter 7. The function and the expected bioavailability of both macro and micro minerals are mentioned and calculation of the electrolyte balance in diets from concentrations of macro minerals is explained. Signs of deficiencies of minerals are also discussed and where excesses of

minerals may be detrimental to pig growth performance, tolerable levels of the minerals are explained.

One of the changes from NRC (1998) to NRC (2012) is that values for relative bioavailability of phosphorus are no longer used. Instead, values for the standardized total tract digestibility (STTD) of phosphorus are used as the basis for estimating requirements of phosphorus by pigs and the STTD of phosphorus in all feed ingredients are also provided in the feed composition tables. The theoretical basis for using values for the STTD of phosphorus is provided in Chapter 7 and calculations of values for STTD of phosphorus are described. Based on published data, it is also concluded that phosphorus requirements of growing-finishing pigs may be calculated from nitrogen retention because a straight line relationship between body contents of nitrogen and phosphorus has been observed. It is also concluded that the requirement for phosphorus to maximize body weight gain and feed efficiency is only 85% of the phosphorus needed to maximize bone mineralization. However, in calculating the requirements for phosphorus, it was assumed that the efficiency of utilizing STTD phosphorus for phosphorus retention is only 77% although many experiments have shown that the efficiency of utilizing STTD phosphorus is close to 100%. Thus, there is a considerable safety margin in the data for the calculated phosphorus requirements. Future research is needed to determine if these safety margins are needed. Nevertheless, the requirements for STTD phosphorus that were calculated using this approach are less than the requirements provided in NRC (1998).

Chapter 7 is the vitamin chapter. Both fat soluble and water soluble vitamins and their biological functions are briefly described and differences in expected bioavailability among different forms of vitamins are mentioned. Specifically for vitamin E, differences between synthetic and natural vitamin E is discussed as are differences among the many forms of synthetic vitamin E. The impact of vitamin D on utilization of minerals is also discussed and new knowledge about the need for vitamin D by pigs is described. Specifically for sows, the requirement for vitamin D was greatly increased because results of recent research indicate that sow and litter performance is improved if greater levels of vitamin D are included in the diets. Toxicity symptoms of excess provisions of vitamin A or vitamin D are also described, whereas it is concluded that toxicity of excess levels of the water soluble vitamins has not been reported.

One of the challenges in estimating vitamin requirements is that vitamin activity often is reduced as feed ingredients are stored and many different factors may influence the activity of vitamins. It is, therefore, common practice to ignore the vitamins that may be provided by the feed ingredients in the diet and the entire need for vitamins is usually supplied from a vitamin premix. However, the activity of vitamins in vitamin premixes

may also decline over time and attention to activity of vitamins in diets fed to swine, is therefore, required.

4.- COMPUTER MODEL

As was the case for the 10th revised edition of the Swine NRC, a computer model to calculate the requirements of nutrients and energy for growing finishing pigs, gestating sows, and lactating sows was also developed for the 11th revised edition. However, nutrient requirements for pigs less than 20 kg are not generated by the model. The basis for the model is described in chapter 8 and model inputs are provided. As mentioned above, energy and nutrient requirements are calculated for not only gilts and barrows, but also for intact males, and the effects of using Ractopamine or immunization against gonadotropin hormone is included in the model. The model uses values for metabolizable energy, standardized ileal digestible (SID) amino acids, and STTD of phosphorus as the basis for all calculations, but values for DE and NE can also be calculated from the model. Likewise, requirements for amino acids and phosphorus can be converted to values for apparent ileal digestibility and apparent total tract digestibility, respectively. The requirement for total calcium is assumed to be $2.15 \times$ STTD phosphorus and is also calculated by the model.

To estimate requirements of nutrients, expected levels of energy intake and animal performance need to be specified by the user. The model will then estimate protein deposition, lipid deposition, and body weight changes. In gestating sows, these changes will be estimated for several pools including the sow, the fetuses, and the reproductive tissue. In lactating sows, litter weight gain and sow weight change are also estimated. Requirements for SID amino acids, STTD phosphorus, and total calcium are then calculated. The model can also be used to calculate retention values for nitrogen, phosphorus, and carbon and by expressing these values relative to intake values, the efficiency of utilization of nitrogen, phosphorus, and carbon is calculated. Retention values for carbon are calculated by assuming that retained protein and lipid contain 53 and 76% carbon, respectively. A detailed user guide and a tutorial for users have been developed to assist users in understanding and using the model.

5.- COPRODUCTS, FEED ADDITIVES, AND FEED CONTAMINANTS

As outlined above, the Statement of Task included a charge to the committee to include information about new feed ingredients from the corn- and soybean industries. The background for this charge is that since publication of the 10th revision of Nutrient

Requirements of Swine, the biofuel industry has been expanded and feed ingredients originating from this industry are now commonly available in the United States and in many other countries in the world. Likewise, the soybean industry has undergone considerable change and many new ingredients from this industry are now available. The committee responded to this charge by writing Chapter 9, which specifically describes each of the feed ingredients that are generated from the corn and soybean industries. Origin, definition, nutrient concentration, and energy, amino acid, and phosphorus digestibility are described for 11 co-products from corn and 9 soybean products. Differences between related feed ingredients are described (i.e., distillers dried grains vs. distillers dried grains with solubles; corn germ vs. corn germ meal; soy protein concentrate vs. soy protein isolate; enzyme treated soybean meal vs. fermented soybean meal, etc.). This chapter, therefore, provides a comprehensive and detailed description of all the co-products from the corn and soybean industries. This information is intended to increase the understanding of using these ingredients in diets fed to swine.

Chapter 10 contains an overview over non-nutritive feed additives that may be included in diets fed to pigs. The additives that are discussed include antibiotic growth promoters, anthelmintics, acidifiers, direct-fed microbials, non-digestible oligosaccharides, plant extracts, exogenous enzymes (i.e., carbohydrases and phytase), feed flavors, mycotoxin binders, antioxidants, pellet binders, flow agents, and Ractopamine. For each additive, a short definition, description of products in the category, inclusion rates, and expected effects are described. For antibiotic growth promoters, anthelmintics, and Ractopamine, usage is regulated by the U. S. Food and Drug Administration, and allowable inclusion rates and required withdrawal periods are mentioned if relevant.

Chapter 11 describes harmful contaminants that may be present in feed ingredients or diets. The fact that this chapter was included in the NRC (2012) does not indicate that we have a problem with feed contaminants in the United States. However, frequent reports about the presence of contaminants in the feed supply in Europe and Asia indicate that contaminants may potentially be included in feed ingredients and the chapter, thus, provides an overview over contaminants that feed manufacturers and swine producers need to be aware of.

The feed contaminants that are described in this chapter include chemical, biological, and physical contaminants. Potential chemical contaminants include pesticides, mycotoxins, heavy metals, melamine, and dioxins. Biological contaminants include bovine spongiform encephalopathy, chronic wasting disease, *Bacillus* spp., *Clostridium* spp., *Escherichia coli*, *Mycobacterium* spp., *Pseudomonas* spp., *Salmonella enterica*, and *Staphylococcus* spp., and physical contaminants include plastic, glass, metal, and vermin

carcasses that accidentally may end up in the feed supply. Potential damaging effects of each of these contaminants are described and preventive measures are proposed where appropriate.

6.- FEED PROCESSING, ENERGY AND NUTRIENT DIGESTIBILITY, AND NUTRIENT EXCRETION

Effects of feed processing on energy and nutrient utilization are discussed in Chapter 12. Feed processing such as extrusion, expander processing, pelleting, gelatinization, grinding, micronization, and hydrothermal treatment may improve the digestibility and fermentability of nonstarch polysaccharides and other nutrients and thereby increase energy utilization of feed ingredients. Heat treatment may also inactivate antinutritional factors in the feed, which also has the potential for improving energy and nutrient digestibility. This may result in improved feed conversion rates of pigs although that is not always the case. However, extrusion and expander processing of feed results in improved pellet quality, which in itself may contribute to improved feed efficiency. Pelleting usually results in improved feed conversion rates, but interactive effects of simultaneously using several different processing technologies are poorly understood, although feed companies often combine more than one feed processing technology. More research in this area is, therefore, needed.

Chapter 13 describes theoretical aspects of determining energy and nutrient digestibility in feed ingredients. For amino acids, it is concluded that diets are most correctly formulated using values for SID of amino acids because values for SID amino acids in different feed ingredients are additive in mixed diets, which is not always the case for values for apparent ileal digestibility. The feed composition tables in NRC (2012), therefore, contain values for the SID of amino acids, and requirements are also expressed as SID amino acids. Values for SID of amino acids are determined by correcting values for apparent ileal digestibility of amino acids for basal endogenous losses. Because basal endogenous losses of amino acids are relatively variable among experiments, it is recommended that these values are determined in each experiment in which apparent ileal amino acid digestibility is measured. Values for calculating SID amino acids are then calculated using the following equation (Stein et al., 2007):

$$\text{SID (\%)} = \text{apparent ileal digestibility (\%)} + [(\text{basal endogenous losses/dietary AA}) \times 100]$$

Basal endogenous losses and dietary amino acids are expressed as g per kg dry matter intake.

For lipids, values for total tract digestibility are influenced by microbial synthesis of lipids, and it is, therefore, more accurate to use values for ileal digestibility. As is the case for amino acids, values for apparent ileal digestibility are not additive in mixed diets. However, values for basal endogenous losses of lipids have not been determined, whereas values for total ileal endogenous losses of lipids are available. These values can, therefore, be used to determine the true ileal digestibility of lipids, and it is recommended that where values for lipid digestibility are used, values for the true ileal digestibility should be determined.

For carbohydrates, the apparent ileal digestibility is used to determine digestibility of monosaccharides, disaccharides, and starch, because monosaccharides are absorbed only in the small intestine. However, for oligosaccharides and non-starch polysaccharides, fermentation takes place in the large intestine, and therefore, values for apparent total tract digestibility of these nutrients are calculated. In contrast to amino acids, lipids, and phosphorus, no endogenous losses of carbohydrates have been demonstrated and it is, therefore, not necessary to correct values for carbohydrate digestibility for endogenous losses. As a consequence, values for apparent digestibility can be used to characterize the digestibility of carbohydrates.

For phosphorus, values for STTD are used and these values are calculated by correcting values for apparent total tract digestibility for basal total tract endogenous loss of phosphorus. However, from more than 10 experiments, it was demonstrated that endogenous losses of phosphorus from pigs is relatively constant and it is, therefore, not necessary to measure the endogenous loss of P in all experiments in which phosphorus digestibility is determined. Instead, a constant value of 190 mg per kg dry matter intake can be used to correct values for apparent total tract digestibility of phosphorus to calculate values for STTD of phosphorus.

Principles for calculating DE and ME are described and it is concluded that there is no evidence of differences among commercial breeds of pigs in their ability to utilize energy from feed ingredients and diets. Pigs will, however, increase energy digestibility if the particle size of ingredients or diets is reduced and it is recommended that a particle size between 400 and 600 microns is used in experiments in which energy digestibility is determined.

The influence of nutrition on nutrient excretion is discussed in Chapter 14. To reduce nutrient excretion it is recommended that diets be frequently adjusted to match the requirements of the animals. Split sex feeding will also allow for more accurate nutrient provision and, therefore, reduced nutrient excretion. Use of feed ingredients that contain

highly digestible nutrients can also contribute to reduced nutrient excretions, but may not always be economical. However, exogenous enzymes may sometimes be used to improve the digestibility of nutrients with low digestibility such as phosphorus in plant based feed ingredients. Proper balancing of dietary digestible amino acids and use of a correct calcium to phosphorus ratio are also necessary to reduce nutrient excretion. Nutrient excretion can be reduced only if the requirements for nutrients in each group of pigs are known, if the chemical composition of the feed ingredients is known, and if the digestibility of each nutrient in all feed ingredients is correctly assessed. Examples of strategies that may be used to reduce nutrient excretion include use of synthetic amino acids, formulation of diets based on an ideal protein, and use of microbial phytase and possibly other exogenous enzymes.

7.- RESEARCH NEEDS

As members of the committee reviewed the literature and established nutrient requirements for all categories of pigs, it became clear that there is a lack of information in many areas. These areas are described in Chapter 15 and the objective of including this chapter is to direct future research and research funding to the areas that are highlighted. Among the areas where the committee realized that data are inadequate are accurate estimates of efficiency of energy and nutrient utilization by pigs, effects of including high fiber ingredients in diets, and effects of nutrient intake in one phase of production on requirements in subsequent phases. Data for effects of energy intake on protein and lipid deposition are also needed. It is also realized that data are needed for calculating the NE of many feed ingredients, which requires that nutrient composition and nutrient digestibility in ingredients are determined. Requirements for amino acids in gestating and lactating sows are also poorly researched and research on effects of activating the immune system on amino acid requirements is needed. It is also recommended that requirements for calcium and phosphorus be reevaluated because modern and leaner genetic lines may have different requirements than genetic lines used in the past. Values for the digestibility of calcium in feed ingredients are also needed. As the committee reviewed the literature to obtain data for the composition of feed ingredients and the energy and nutrient digestibility in feed ingredients, it also became clear that there is a lack of data for many ingredients and that more work in this area is needed. The increased focus on the environmental impact of swine production also makes it necessary that more information about the impact of dietary nitrogen, sulfur, and fiber on emission of ammonia and greenhouse gasses is generated.

8.- REQUIREMENT TABLES

Chapter 16 contains 9 tables that lists the requirements for amino acids, minerals, vitamins, and linoleic acid in diets fed to all categories of pigs. All requirements are provided as units per kg of diet and also as units per day. Amino acid requirements are calculated for SID amino acids, apparent ileal digestible amino acids, and for total amino acids. The calcium requirement is provided for total calcium and phosphorus requirements are provided for STTD phosphorus, apparent total tract digestible phosphorus, and for total phosphorus. Requirements of all nutrients for weanling, growing, and finishing pigs are calculated for 7 separate weight groups, i.e., 5 – 7 kg, 7 – 11 kg, 11 – 25 kg, 25 – 50 kg, 50 – 75 kg, 75 – 100 kg, and 100 – 135 kg. Requirements of all nutrients are provided for mixed sex groups, but for pigs greater than 50 kg, requirements for calcium, phosphorus, and amino acids are also calculated separately for gilts, barrows, and entire males. For pigs greater than 50 kg, requirements for calcium, phosphorus, and amino acids are also provided separately for pigs that deposit an average of 115, 135, or 155 g of protein per day to illustrate the influence of protein deposition on nutrient requirements. For finishing pigs (i.e., pigs greater than 105 kg), requirements for calcium, phosphorus, and amino acids are also provided for male pigs that are immunized against gonadotropin hormone. Likewise, requirements for calcium, phosphorus, and amino acids for entire male pigs or barrows and gilts fed diets containing 5 or 10 ppm Ractopamine from 115 to 135 kg are also provided because inclusion of Ractopamine in the diets increases the requirements for nutrients.

For gestating sows, separate requirements for calcium, phosphorus, and amino acids are provided for sows that have a body weight of 140, 165, 185, or 205 kg at the time of breeding. Within each weight group, requirements are calculated for the initial 90 days of gestation and also for the final 25 days of gestation. The requirement estimates assumes that litter size for first parity sows is 12.5 pigs and 13.5 pigs for older sows. Separate requirement estimates are also calculated for sows farrowing 15.5 pigs per litter.

For lactating sows, requirements for calcium, phosphorus, and amino acids are calculated for sows that have a post-farrowing body weight of 175 or 210 kg. It is assumed that the average litter size is 11 for sows weighing 175 kg and 11.5 for sows weighing 210 kg. Within each weight group, requirements are calculated for sows that do not lose weight during lactation, for sows with a moderate weight loss in lactation, and for sows with more than 15 kg of weight loss.

The last table in this chapter contains requirement estimates for sexually active boars.

9.- FEED COMPOSITION TABLES

The feed composition tables that are included in NRC (2012) were generated by scanning 21 peer-reviewed journals for articles that contained information about energy and nutrient composition of feed ingredients. Data were organized into sections for proximate components, carbohydrates, lipids, crude protein and amino acids, vitamins, minerals and energy. With a few exceptions, only data published after 1998 were used. Data for the digestibility of energy and nutrients in feed ingredients were also collected, but because fewer data are available for energy and nutrient digestibility than for feed composition, data that were published in the peer-reviewed literature during the last 20 years were used. All data were entered into an Excel spreadsheet and all data were summarized within each ingredient. The mean, the least value, the greatest value, the standard deviation, and the variance were calculated for energy, dry matter, and all nutrients in all ingredients. If values for certain nutrients were not available from the literature, values from other published sources were included if such values were available. Data for a total of 122 feed ingredients were collected, but for some ingredients, data for all nutrients were not available. Likewise, the digestibility of all nutrients has not been published for all ingredients, and as a result, for some ingredients, digestibility values are not available.

The feed composition tables are organized with one ingredient per page and all data for that ingredient are presented on the same page. All values are presented with a mean and a standard deviation, and the number of observations for each mean is also provided. This approach hopefully will make it easy for the user to identify the data that are needed. In addition to tables for the composition of the 122 feed ingredients, a table outlining the mineral composition of macro mineral sources is also provided and a separate table containing information about mineral concentration, chemical formula, and relative bioavailability of micro minerals is included in this chapter. The fatty acid composition and the energy value of fats and oils that may be included in diets fed to pigs are also outlined in a table.

10.- CONCLUSIONS

The 11th revised edition of Nutrient Requirements of Swine, also known as "the New Swine NRC", represents a very comprehensive review of the literature of most aspects related to nutrient requirements of swine. The contents of the chapters hopefully will provide the theoretical basis for understanding many aspects of swine nutrition and also understanding the logic that the committee followed in deciding on principles for

establishing nutrient requirements. The requirement tables will likely be used in the formulation of diets around the world - although many nutritionists undoubtedly will adjust the requirements based on their experiences, local situation, and for other reasons. The model may be used to generate requirements estimates for pigs that are different from what is assumed in the printed requirement tables, and the model also provides users with an opportunity to study relationships between input factors, productivity, and nutrient requirements. The feed ingredient tables represent the most comprehensive knowledge about energy and nutrient concentrations and energy and nutrient digestibility in feed ingredients used in diets fed to pigs that can be generated from the peer-reviewed literature. Thus, using the information included in the NRC (2012) provides users an opportunity to formulate diets based on relevant and updated knowledge about nutrient requirements for pigs. Although the document is not perfect, it will hopefully be used and viewed as a helpful tool by everyone involved in formulating diets for pigs.

11.- REFERENCES

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