The new NRC: reviewing the nutrient needs of modern pigs

by J. A. Taylor-Pickard, Alltech Inc and W. H. Close, Close Consultancy.

Pig production is a dynamic and ever changing industry which needs to take account of the many complex interactions that influence the growth and development of the animal. These include genetics, nutrition, health and welfare, the environment as well as market requirements, and public awareness.

Feeding is one of the basic requirements of the animal and represents 60-70% of the cost of production. It is therefore important that the nutrient needs of the animal are met under the various conditions in which pigs are kept and all those factors that influence them.

The latest report of the National Research Committee on 'The Nutrient Requirements of Pigs' is an attempt to provide this information. The report was published in 2012 and is the 11th such edition. The first of these nutrient requirements publications was published in 1944 and the tenth in 1998.

The objectives of these publications are to review and evaluate the scientific literature on the nutrient requirements of pigs at all stages of production and to make recommendations that can form the basis for the practical feeding of pigs to ensure efficient and environmentally sensitive production practices.

During the past decade other reviews have been published, including British Society of Animal Production (2003), Gesellschaft für Ernährungsphysiologie (2006), National Swine Nutrition Guide (2010) and Brazilian Tables of Composition of Feedstuffs and Nutritional Requirements (2011).

A major objective of the current NRC report was to review the nutrient requirements and responses of modern pig genotypes based on new research findings and this has been achieved. However, compared with previous reviews, this publication has added several new topics.

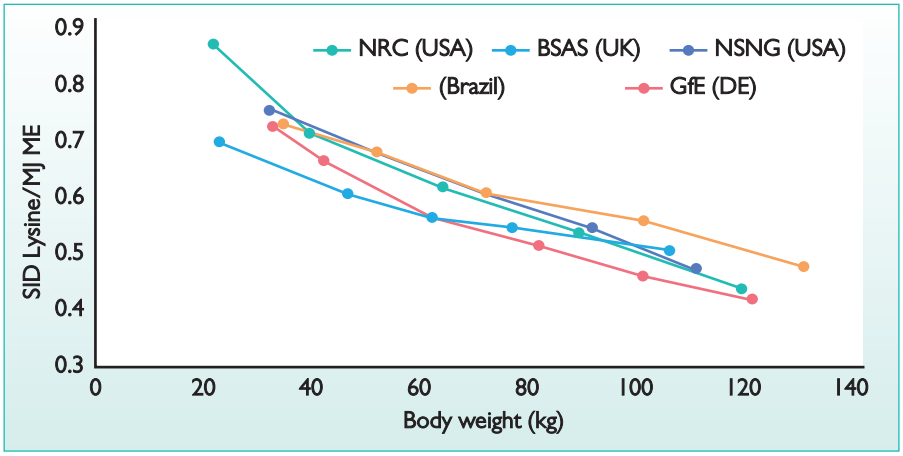

Fig. 1. The change of lysine/energy requirements with body weight (different sources).

An interesting feature has been the further development of computer models for the growing and breeding animal, relative to that in the 1998 Review, and the fundamental concepts represented in the models are described. Indeed the models have been used to estimate the energy and amino acid requirements of all classes of pigs, as well as their Ca and P needs. This model is available and may be downloaded from the NRC website. In addition, an extensive review of the published scientific literature has also been carried out on the nutrient composition of a range of feed ingredients commonly used in pig feeding and the complete analysis of these ingredients has been provided.

Thus, compared with previous reviews, the 11th edition provides information on a range of topics that will help to guide nutritionists and other professionals working in pig nutrition and production to ensure that the nutrient needs of modern pig genotypes are relevant and appropriate.

From a nutritional perspective a major interest in the new NRC publication is the information provided on the energy, amino acids, minerals and vitamin needs of the modern pig and these are briefly discussed.

Energy

For the growing-finishing pig the energy requirements are based on the NE system from which the effective metabolisable energy (ME) and digestible energy (DE) contents of the diets have been calculated.

The effective ME is then used to calculate the energy and feed needs of the animals to promote different rates of gain at various body weight ranges (5-135kg) and protein deposition rates (115, 135 and 155g/day)

Table 1. Trace mineral requirements of breeding sows (NRC).

	1979		1988		1998		2012	
	Gestation	Lactation	Gestation	Lactation	Gestation	Lactation	Gestation	Lactation
Copper (mg/kg)	5	5	5	5	5	5	10	20
Iron (mg/kg)	80	80	80	80	80	80	80	80
Manganese (mg/kg)	10	10	10	10	20	20	25	25
Selenium (mg/kg)	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Zinc (mg/kg)	50	50	50	50	50	50	100	100

for pigs of differing sexes (entire and castrated males and females).

Information is also provided for entire males immunised against GnRH or fed ractopamine and castrates and gilts also fed ractopamine.

For pregnant sows, the requirements are calculated from the body weight at mating, as well as the anticipated body weight and litter weight gain for animals below and above day 90 of gestation.

The requirements are some 18% higher in late compared with early gestation and for a parity three animal with a body weight at mating of 185kg are 6.93 Mcal (29.0) ME increasing to 8.18 Mcal (34.2 MJ) ME /day, respectively.

For lactating sows, the requirements are based on the post-farrowing body weight, the anticipated lactation weight loss, as well as the size and daily growth rate of the litter. The requirements of a sow in its first parity are estimated to be 18.7 Mcal (78 MJ) ME per day and for a later parity sow as 20.7 Mcal (87 MJ) ME per day.

The requirements for sexually active boars are estimated to be 7.84 Mcal (33 MJ) ME per day.

Amino acids

Amino acids requirements are expressed as either standardised or apparent ileal digestible. These better define the needs of the animal and take account of the disappearance of amino acids from the hind gut due to microbial fermentation and which are of no value to the animals per se, as well as endogenous losses.

The amino acid requirements are calculated for the same parameters as those for energy. Because there are differences in the profile of amino acids relative to lysine required for both maintenance and protein gain, the optimum amino acid balance is not constant and therefore varies with the physiological status and level of productivity of the animal.

Because of the intricate relationship between the energy and amino acid needs of the pig, it has been customary to express the requirements as g amino acid per unit energy. It is therefore interesting to compare the current estimates of requirements expressed in this way with those from other recent publications.

Fig. 1 provides this information for pigs above 20kg body weight from the different reviews. There is insufficient information to model correctly the requirements for animals below 20kg body weight.

The comparison of the different recommendations shows a similar decrease in the lysine:energy ratio with increasing body weight.

However there are some differences in the various recommendations especially at lighter body weights and especially below 50kg. These differences probably reflect variations in the rate of growth and protein deposition at the different body weights, as well as on assumptions made in the modelling of the requirements.

Minerals

Requirements for both macro and trace mineral requirements are provided, with the estimates for both Ca and P determined by modelling procedures. The requirements for Ca are given as the total needed, whereas those for P are given as total as well as apparent (ATTD) and standardised total tract digestibility (SAAD). The use of STTD phosphorous allows greater precision in meeting the needs of pigs of different levels of performance and physiological states, whilst minimising the levels of P in excreta.

There has been concern about the trace mineral requirements of modern pigs, and sows in particular, since many of the recommendations are based on work carried out in the 1970s and 1980s when the performance of the animals was considerably lower than those of today.

It is therefore interesting to observe whether these requirements have been changed in recent publications and Table 1 provides this information for the breeding sow.

Table 1 shows that the recommended requirements for Se and Fe have not changed since 1979, whereas those for the other trace minerals have, and this is despite the fact that most of the recent studies on trace minerals have been carried out with Se and, to a lesser extent, with Zn. It is also interesting to note that only limited information is provided on the bioavailability of minerals and indeed on the form of the mineral provided in the diet. A number of recent studies have shown that when organic minerals are provided in the diet performance is enhanced, particularly in the breeding animal.

Vitamins

As with minerals, there is also concern about the requirements for vitamins and Table 2 summarises the requirements in the four publications since 1977.

There have been changes in the recommendations for some vitamins over the last 33 years, but not others. In normal pig diets the levels of both vitamins and minerals are above those presented in Tables 1 and 2.

These requirements are normally those necessary to overcome a deficiency and not necessarily those to optimise the performance of modern pig genotypes or indeed enhance immunity. There is also the question about whether it is the combination of both minerals and vitamins to ensure optimum performance that should be investigated and not necessarily individual minerals and vitamins.

Indeed, in breeding sows and especially

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	1979		1988		1998		2012	
	Gestation	Lactation	Gestation	Lactation	Gestation	Lactation	Gestation	Lactation
Vitamin A (IU)	4,000	2,000	4,000	2,000	4,000	2,000	4,000	2,000
Vitamin D3 (IU)	200	200	200	200	200	200	800	800
Vitamin E (IU)	10	10	22	22	44	44	44	44
Vitamin K (mg)	2	2	0.5	0.5	0.50	0.50	0.50	0.50
Biotin (mg)	0.1	0.1	0.2	0.2	0.20	0.20	0.20	0.20
Choline (g)	1.25	1.25	1.25	1.00	1.25	1.00	1.25	1.00
Folacin (mg)	0.6	0.6	0.3	0.3	1.30	1.30	1.30	1.30
Niacin (mg)	10	10	10	10	10	10	10	10
Pantothenic acid (mg)	12	12	12	12	12	12	12	12
Riboflavin (mg)	3.0	3.0	3.75	3.75	3.75	3.75	3.75	3.75
Thiamin (mg)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
B6 (mg)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
B12 (mcg)	15	15	15	15	15	15	15	15

Table 2. Vitamin requirements of breeding sows (per kg diet).

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those in later parities, additional supplementation of both minerals and vitamins may improve productivity and enhance longevity.

Conclusions

The latest NRC report provides a comprehensive review of the nutrient requirements of modern pig genotypes, as well as information needed to design practical diets to meet these nutritional needs.

These requirements are the best estimates of the needs of the animals at the time the report was prepared and do not include a safety margin. They are guidelines to be used as a reference to establish allowances.

While the information on energy and amino acid of grow-finish pigs is based on considerable investigation it is less so for the breeding sow, especially if sows are to achieve 50-60 weaned piglets per lifetime. There is also interest in how nutrition per se may influence health and immunity and this would have been worthy of consideration.

The recommendations for minerals and vitamins, with some exceptions, are based on research carried out in the 1970s and 1980s and need to be adjusted to take account of the modern pig.

Again, this is particularly relevant to the breeding sow whose needs increase with each parity. Because minerals (and vitamins) interact and have synergistic and antagonist qualities it is expedient to consider them in combination and to take account of their bioavailability. It is now recognised that organic minerals may be more available than inorganic minerals and better meet the needs of the modern hyperprolific sow.

Despite this, this report will provide valuable information on the nutritional needs of pigs, and the many factors influencing them, and thus ensure that their productivity as well as their health, welfare and well-being are being met in the many systems of production available throughout the world. ■