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CHAPTER 5

Nutritional Requirements of Growing Swine

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INTRODUCTION

The nutritional requirements of swine are influenced by several factors, such as genetics, sex, gender, development stage, feed intake, dietary energy level, nutrient bioavailability, thermal environment, and health conditions, among others.

This recommendation mentions the requirements of the main nutrients: crude and digestible protein, total and digestible amino acids, calcium, available and digestible phosphorus, sodium, potassium, chlorine, and linoleic acid, as well as metabolizable energy requirements. The recommendations for trace minerals and vitamins are assumed to be adequately met, provided the levels supplied are equivalent to those described in 'Chapter 7 of this publication.

The nutritional requirements of growing swine present in this chapter were established according to the systems and procedures adopted in the 4th Edition of the Brazilian Tables for Poultry and Swine – Composition of Feedstuffs and Nutritional Requirements (Rostagno et al., 2017). For estimating the nutritional requirements, the bases of integrated factorial and empirical models, with changes in procedures, estimates, and parameters indices highlighted throughout this chapter.

In updating the nutritional requirements, the impacts of genetic improvement on animal performance over the past five years were considered. The impact resulted in changes in the growth curve of the animals and an increase in the final live weight at the same age, as evidenced by higher daily weight gain, and improved feed conversion ratio.

Models that allow the adjustment of daily requirements based on animal performance were developed to dynamically determine the requirements of growing swine. Data from numerous experiments and lineage guidelines were utilized to establish the parameters of the Gompertz equation models. Subsequently, growth curves were established to estimate the average live weight and daily weight gain of swine in different phases and to set new performance targets, with energy and nutrient equations redefined.

Considering the differences among the numerous systems and models of swine production, additional performance curves can be established, and the models can also be applied to determine the daily requirements of Metabolizable Energy (ME) and digestible lysine for these animals.

The nutritional recommendations were established for herds of high genetic potential and considered estimates for barrows, gilts, entire males up to 100 kg and immuno-castrated from 100 kg onwards, and mixed-sex pigs of high and standard performance.

In this 5th edition, the recommended nutrient levels as nutritional requirements for growing swine were established through dose-response experiments conducted at UFV, and experiments carried out in Brazil and abroad. In addition, a systematic literature review of indexed journals incorporated data from scientific articles from the Web of Science database from the years 2016 to 2023, and dissertations and theses on swine at different ages and production stages. The systematic search was conducted based on keywords, according to the target nutrient. Responses associated with observations on the behavior of commercial herds in various regions of Brazil were also included.

In the development of the equations for predicting metabolizable energy requirements, results from research conducted at UFV and other national institutions, as well as articles published in the indexed Web of Science database, were considered. Additionally, the fundamental concepts outlined by Sakomura & Rostagno (2016) were applied.

In the equations for daily metabolizable energy requirements, the sum of daily Maintenance Metabolizable Energy (MEm) and Production Metabolizable Energy (MEp) requirements was considered, following the model proposed by Rostagno et al. (2017). The MEm requirement was estimated based on values cited in the NRC (1998), where MEm is determined by the equation MEm (kcal/day) = 106 * $W^{0.75}$, with W representing the average live weight of the animal in kg. Other equations are mentioned in the literature to determine MEm requirements; however, Lee et al. (2016) stated that the

equation for determining MEm presented in the NRC (1998) is suitable for predicting feed intake for pigs and for partitioning energy intake for maintenance and production.

In determining the equations for daily MEp of growing swine, information from experiments conducted at UFV, as well as dissertations and theses published in Brazil, and from articles published in indexed journals between 2018 and 2023, were utilized. Performance, feed intake, and ME consumption of swine were considered based on gender, age, and rearing phases. The ME and nutrient intake from various experiments were recalculated using the same nutritional composition base and energy values of the ingredients. From these data, MEm requirements were estimated, and subsequently, equations for the daily requirements of MEp of barrows, gilts, entire males, and immuno-castrated males were obtained, taking into account parameters such as live weight and weight gain of swine at different ages and rearing phases.

The equation to estimate daily metabolizable energy requirements for standard performance growing barrows and gilts was adjusted for an increase of 3% due to bigger challenges in production, handling, environment, and health that occur in these production systems.

Compared to immuno-castrated males, entire males present lower metabolizable energy requirements and feed intake, where distinct equations are adjusted to estimate daily metabolizable energy requirements for production.

The equation of metabolizable energy requirements for the production of immuno-castrated males (100 to 145 kg) was estimated using data from research conducted at UFV (Barcellos, 2023 – unpublished data).

The knowledge of ME requirement (kcal/day) and dietary ME level, allows the estimation of feed intake through the relation of ME requirement /dietary energy content.

Growing swine can adjust their feed intake according to dietary energy level when consuming feed within certain metabolizable energy limits (3200 and 3450 kcal/kg of ME), which allows a dynamic variable of dietary

metabolizable energy level, dependent on economic factors, such as feedstuffs, pork prices, production system, and feed management.

In conditions where oil or animal fat present low competitive prices, it should be indicated to adopt higher dietary energy levels. In production systems with controlled feeding, in which the aim is reaching a better feed conversion ratio, the adoption of high-energy-level diets is also recommended. Diets formulated with low-energy levels can be viable when alternative low-energy ingredients are available at reduced prices. However, increasing fiber levels should be taken with caution, as it is associated with reduced nutrient utilization and swine performance.

In this way, least-cost diets should be formulated to meet the proposed nutritional levels for a given animal productivity; but also must consider environmental sustainability and food safety of the products.

The impact of dietary metabolizable energy on feed conversion ratio responses should be considered. Calculating the efficiency per metabolizable energy intake is recommended, specifically when using alternative ingredients to corn, soybean meal, and commonly used fat sources, also net energy values should be taken into consideration.

Environmental temperature is a critical factor influencing the metabolizable energy requirements of growing swine. The correction of metabolizable energy requirements based on temperature proposed in the 4th edition has been maintained in this update, considering that temperatures above or below thermal comfort induce changes in metabolizable energy requirements and feed intake. Thus, the corrections that should be applied within certain limits of daily average temperature, above or below the comfort temperature (± 6°C), have been maintained.

Corrections to metabolizable energy requirements and feed intake for environmental changes beyond the suggested values are not recommended, as animals may undergo physiological changes that affect performance and may either underestimate or overestimate the calculated values.

Feed processing affects swine performance; in pelleted diets, an improvement of 4 to 6% in feed conversion ratio is observed. These values

should be considered as a reference for adjusting feed intake by animals, since in many literature studies, the use of mash diets is referenced.

In this 5th edition, in addition to ME, the corresponding Net Energy (NE) levels of the diets are mentioned, calculated using the ME and NE values of feedstuffs cited in Chapter 1.

The reference diets utilized in most experiments in Brazil were formulated based on corn and soybean meal, and for this reason, when other ingredients are used, adjustments related to nutrient digestibility or availability will be necessary. This is why the requirements of standardized digestible amino acids are mentioned.

The same procedure of the previous edition was used to estimate the daily requirements of digestible lysine. The requirement for maintenance of the equations has been redefined utilizing the experimental results of Faria (2019) to determine the nitrogen and lysine requirement for maintenance and production of growing swine. It was decided to use for maintenance the average value of 0.039 g of SID Lys per kg of weight$^{0.75}$.

In the case of SID Lys requirements for production, data (weekly and for the total period) from dose-response experiments with different lysine levels conducted at UFV and published in dissertations, theses, and articles indexed in the Web of Science database between 2016 and 2023 were used. The results were cataloged, and daily intake of digestible lysine was determined. Then, the maintenance digestible lysine requirement was calculated, and the amount of digestible lysine per kg of gain in the various grower phases was obtained.

For these determinations, the results of 165 experimental datasets were utilized, with 123 datasets for barrows, 118 for gilts, 107 for entire males, and 3 for immuno-castrated males (100 to 140 kg). The same 88 datasets from the pre-starter and starter phases (5-15 and 15-30 kg of weight) were included in the calculations for barrows, gilts, and entire males. Tables 5.03, 5.11, and 5.19 present the methodologies used and the equations obtained to calculate the amount of SID Lys per kg of live weight of growing swine.

Physiological changes resulting from the castration process alter

protein deposition rates and feed intake of immuno-castrated males after 100 kg. Given this fact, for this category, a specific equation was established to estimate SID Lys requirements per kg of weight gain, using results from research conducted by Aymerich et al. (2020), Lima (2023), and Barcellos (2023), as presented in Table 5.21.

Performance data of barrows, gilts, entire males, immuno-castrated males, and mixed-sex herds of high and standard performance are shown as an example of the variation in lysine nutritional requirements, where the equations were used to estimate daily SID Lys requirements according to the Gompertz equations in Tables 5.01, 5.09, and 5.17.

The use of equations to estimate the amount of daily SID Lys allows the flexibility of requirements. Thus, there is no longer just one requirement, but several, depending on the performance and feed intake of the animals (Rostagno et al., 2017).

In determining the nutritional requirements of other amino acids, the concept of ideal protein was applied, maintaining the amino acid to lysine ratio expressed in the Standardized Ileal Digestibility (SID) and total amino acids. To update the proportion of different amino acids with lysine in the pre-starter, starter, grower, and finisher phases, data from experiments conducted at UFV, other institutions, and the reviewed Web of Science database were used.

Different ratios may be necessary to maximize swine performance under specific production conditions, related to environment, health, and feed ingredients. Imbalances between specific amino acids in some feed ingredients used in swine nutrition can provoke antagonisms that result in reduced performance, even if minimum proportions of amino acids in the ideal protein are maintained.

High levels of leucine and low levels of isoleucine and valine, branched-chain amino acids, should be taken into consideration in ingredients such as blood meal, dried blood cells, and corn by-products like corn gluten meal 60% CP, distillers dried grains with soluble (DDGS), and high protein distillers dried grains (DDG HP). When high levels of these ingredients are used in swine diets, there may be a disproportionate increase in the SID Leu

to SID Lys ratio. It is recommended to increase the SID Ile to SID Lys and the SID Val to SID Lys ratios to maintain optimal performance (Kerkaert et al., 2021; Williams et al., 2021; Clizer et al., 2022).

The levels of amino acids should closely approximate the recommended levels, avoiding excesses. Similarly, excess protein should also be avoided.

Calculations of total lysine requirements for swine considered the SID of lysine in the diet, which is 88% on average.

The SID methionine + cysteine requirements were established to ensure at least 55% of methionine in total sulfur amino acids (Qiao et al., 2008). Phenylalanine + tyrosine requirements considered a minimum ratio of 54% phenylalanine.

Currently, in addition to traditional industrial amino acids added to swine diets, there are other crystalline amino acids available such as valine, isoleucine, arginine, and glutamic acid, allowing for further reduction of dietary protein. According to experiments conducted at UFV, as the protein content is reduced, Non-Essential Nitrogen (Nne) may become limiting in the diets. Therefore, defining an optimal Ne: Total N or Ne: Nne ratio in low-protein diets is important for achieving optimal performance and improved protein utilization efficiency. In this chapter, following the recommendation of the 4th edition, the determination of Ne and Total N and the Ne: Total N ratio for growing swine were maintained.

In determining the quantity of Ne and Total N and the Ne: Total N ratio to subsequently calculate the recommended crude protein and digestible protein in growing swine diets, the procedures described in the 4th edition of the Brazilian Tables were used. In these procedures, the levels of digestible Ne (dig. Ne) and total Ne (Net) are determined taking into account the requirements of digestible and total amino acids and the nitrogen content of essential amino acids. The essential amino acids used to calculate the ratios are lysine, methionine, threonine, tryptophan, arginine, valine, isoleucine, leucine, histidine, and phenylalanine. Subsequently, the total digestible nitrogen (total dig. N) and total nitrogen (total N) were calculated, considering

the dig. Ne: Total N ratio and the Net: Total N ratio. The recommended ratio for growing swine was 37%, and in the pre-starter phase I and II, due to the many functions of this amino acid, in addition to protein synthesis, the contribution of arginine to nitrogen was considered to be 35%.

Once the total digestible N and the total N for each period are obtained, the total and digestible protein requirements in the diets are estimated by multiplying the total digestible N and the total N by 6.25, considering that the average N content of protein is 16%.

The minimum crude and digestible protein levels may be estimated in a simplified manner, using the proportion of digestible lysine in crude and digestible proteins of 6.2 and 7.0%, respectively. As an example, for a swine of 105 days of age, where the estimated SID Lys requirement is 0.893%, the crude protein requirement is calculated as (% SID Lys x 100)/ 6.2 = (0.893 x 100)/ 6.2 = 14.40%, and the digestible protein requirement as (% SID Lys x 100)/ 7.0 = (0.893 x 100)/ 7.0 = 12.75%. The 7.0% SID Lys content in dietary digestible protein is close to the body composition of swine mentioned in the NRC (2012) as 7.10 g of lysine/100 g of protein.

Similarly, to the recommendation for utilizing amino acid requirements based on digestibility, using digestible protein requirements is important to prevent deficiencies in diets with alternative feed ingredients, with lower digestibility, than the traditional corn/soybean-based diet

When using levels of digestible essential amino acids to estimate the requirement for digestible and total protein, it emphasizes the importance of the concept that animals have dietary requirements for amino acids (not protein). According to Wu & Li (2022), the optimal quantity and ratio of all proteinogenic amino acids should be considered.

In general, at the recommended protein levels in corn and soybean meal-based diets, the requirements for arginine, valine, isoleucine, leucine, histidine, and phenylalanine + tyrosine are usually met. Amino acid levels should closely approximate the recommended levels, avoiding excesses. Similarly, excess protein should also be avoided.

In order to reduce the environmental impact of excess nutrients in

swine diets, excellent results have been achieved in experimental trials and commercial herds with diets containing lower protein levels while maintaining recommended levels of essential amino acids (Pena et al., 2013; Cappelaere et al., 2022). A recent literature review by Rocha et al. (2022) recommends the following minimum crude protein levels, which do not affect swine performance: 18.4% (Pre/Starter), 16.2% (Grower), and 11.5% (Finisher). It should be noted, that these protein levels are close to the values mentioned for growing swine in this chapter.

A procedure similar to that used for evaluating lysine requirements was followed to obtain the equations estimating the requirements for digestible and available phosphorus (P) for growing swine. However, it should be noted that the number of studies that have assessed phosphorus requirements for high performance swine is limited.

The estimated maintenance phosphorus requirement was obtained using data on endogenous excretion obtained in the UFV thesis by Bunzen (2009), where the Phosphorus for Maintenance (Pm) requirement is 0.046 x Weight$^{0.75}$. Subsequently, the results of dose-response experiments for digestible and available phosphorus requirements conducted at UFV, other national institutions, and indexed journals were used to calculate the amount of phosphorus (standardized digestible and available) per kg of weight gain in different growing phases of swine.

In this edition, we emphasize the importance of nutritionists using standardized digestible phosphorus base requirements, as they only represent the digestibility coefficients of phosphorus in the ingredients used. While available phosphorus requirements may vary in terms of bioavailability for each phosphorus source, depending on the inorganic source used as the standard (considered 100% available). The values for digestible and available phosphorus in the ingredients determined with growing swine are mentioned in Chapter 1.

It is important to consider that calcium and phosphorus levels higher than recommended may lead to increased deposition of phosphorus and calcium in bones. Similarly, under controlled feed intake conditions, attention

should be given to meeting nutrient intake in grams per swine per day to avoid compromising performance and bone structure and mobilization.

Based on experimental results, total calcium requirements were recommended, taking into account total Ca: digestible P and total Ca: available P ratios of 2.04 and 2.10, respectively.

The calcium requirement was calculated based on the averages of digestible and available phosphorus levels and then multiplied by their respective ratios.

High levels of calcium should be avoided in diets as they not only affect animal performance but also increase environmental contamination.

Calcium levels below the nutritional requirement are commonly recommended for the pre-starter and starter phases of piglets due to their effects on reducing the incidence of diarrhea. In general, values between 0.70% and 0.80% of total calcium are recommended.

The requirements based on digestible calcium were not addressed, as although there is literature data on calcium digestibility in ingredients for swine, recent research (Lagos et al., 2021) did not identify the benefits of formulating diets based on digestible calcium compared to total calcium in diets for swine without the excess of this mineral.

It is important to ensure an adequate dietary electrolyte balance of sodium, chlorine, and potassium for swine. However, due to the lack of scientific literature and experimental results, the equations cited in the 4th edition of the Brazilian Tables were used to estimate requirements, in %, of Mcal of ME according to the live weight of the pig.

The requirement for the essential fatty acid linoleic acid was established based on the recommendation of NRC (2012), calculating the requirement in grams per kilogram of animal body weight, and subsequently, establishing an equation to estimate the linoleic acid requirement.

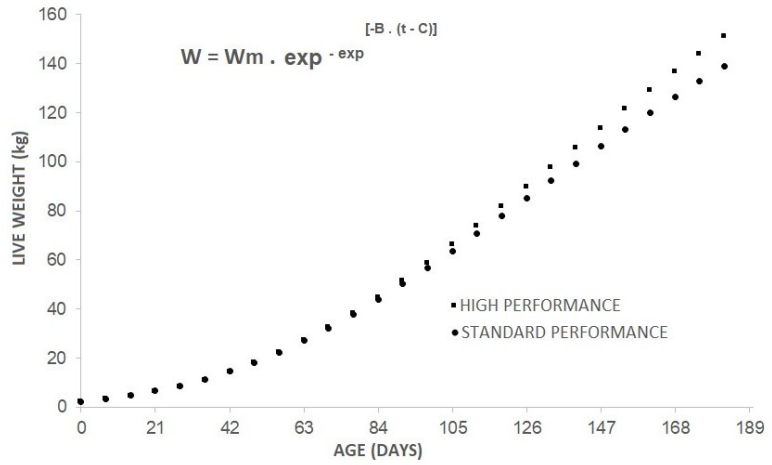
Examples of requirements are presented for swine with high and standard performance, barrows, gilts, entire males, immuno-castrated males, and mixed-sex herds in the starter, grower, and finisher phases to facilitate the use of the Brazilian Tables. Diets were established containing energy levels

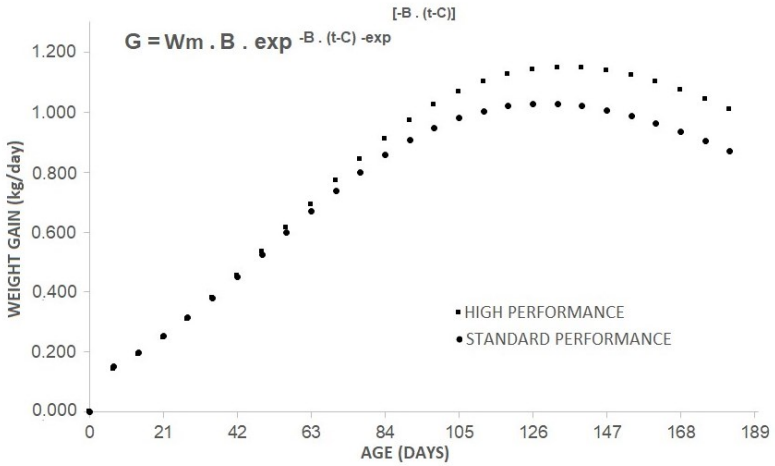
commonly used in Brazil and recommended in the main lineage guidelines. For other energy levels, corresponding adjustments of feed intake and other nutrients should be made.

In Brazil and several Latin American countries, the additive ractopamine is used in the finisher phase as a performance enhancer. When ractopamine is added to the diet, there is an increase in the percentage of lysine and protein in the muscles of the animals. Thus, adjustments in the concentrations of digestible lysine and essential amino acids based on the ideal protein are necessary to achieve benefits on weight gain and feed conversion ratio.

Based on research results conducted at UFV and using the model developed by Schinckel et al. (2003), performance changes and nutritional requirements were estimated, of mixed-sex pigs, fed diets containing 10 or 20 ppm of ractopamine, during 21 or 28 days, respectively.

Table 5.01 - Live Weight and Daily Weight Gain Curves According to the Gompertz Equation and the Derivative for Standard and High Performance Growing Barrows





Equation parameters for standard performance growing barrows: Wm= 230.6674; b=4.592166; C=0.01211085; R^2=0.96. High performance growing barrows: Wm= 262.0234; b=4.806177; C=0.01190569; R^2=0.95. W= weight (kg); G= weight gain (kg); t=age (days); Wm= mature weight (kg); b=maturity rate (g/day per g); t*= age at maximum growth rate (days).

Table 5.02 - Equation Used to Estimate Metabolizable Energy (ME) Requirements of High Genetic Potential Barrows (kcal/day)

ME Requirement of High Performance Growing Barrows

$ME\ Req. = (106\ W^{0.75}) + (2069.2 + 69.777\ W - 0.2184\ W^2)\ G$

ME Requirement of Standard Performance Growing Barrows[1]

$ME\ Req. = ((106\ W^{0.75}) + (2069.2 + 69.777\ W - 0.2184\ W^2)\ G)\ 1.03$

[1]Considering Standard Performance Growing Barrows 3% less efficient

$Correction\ for\ temperature = 2.4\ W^{0.75}\ (TN - T)$

W = Average body weight (kg); G = Weight gain (kg/day);
T= Average temperature (°C); TN=Thermoneutral temperature (°C)

Suggested temperatures for the correction of ME requirements

Weight (kg)	TN (°C)	Temperature Range (°C)
15 – 30	25	18 – 32
30 – 50	24	17 – 31
50 – 70	23	16 – 30
70 – 100	22	15 – 29
100 – 130	21	14 – 28

Higher temperature values may negatively influence swine performance and overestimate corrections for feed intake and nutritional levels.

Example: High Performance Growing Barrows (105 days of age)
W = 66.127 kg; $W^{0.75}$ = 23.189; G = 1.065 kg/day; Diet. ME = 3350 kcal/kg

ME Req. = (106 x 23.189) + (2069.2 + 69.777 x 66.127 - 0.2184 x 66.127^2) x 1.065
ME Req. = 2458.04 + 5728.3 x 1.065 = 8561.1 kcal/day
Estimated Feed Intake = 2.556 kg/day

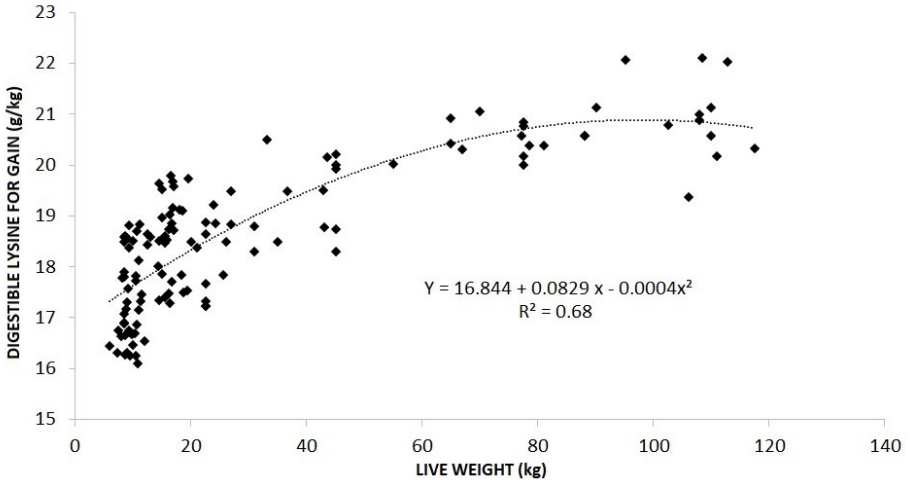
Correction for the average temperature of 28°C (TN=23°C)
Correction for T° = 2.4 x 23.189 (23 – 28) = -278.27 kcal/day
ME Req. for 28 °C = 8561.1 – 278.27 = 8282.8 kcal/day
Estimated Feed Intake= 2.472 kg/day

Table 5.03 - Methodology Applied to Obtain the Equation to Calculate Standardized Digestible Lysine (SID Lys) Requirements/kg Weight Gain of High Genetic Potential Barrows

Weight, kg	5 -15 [3]	15 - 30 [3]	30 - 60	60 – 95	95-135
Experimental Data[1]	42	46	11	13	11
Avg. Weight in Period, kg	9.49	18.93	39.06	79.11	110.22
Feed Intake, g/day	407.14	876.2	1904.7	2907.8	3281.6
SID Lys Intake, g/day	5.502	10.918	18.401	23.575	23.65
SID Lys Maint., g/day[2]	0.210	0.352	0.652	1.013	1.298
SID Lys Weight Gain, g/day	5.292	10.566	17.75	22.561	22.354
Mean Gain, kg/day	0.305	0.578	0.911	1.087	1.086
g. SID Lys / kg Gain	17.34	18.93	19.512	20.58	20.95
Equation, g SID Lys/ kg G	17.59	18.27	19.47	20.9	21.12
Eq: Y (g SID Lys / kg G) = 16.844 + 0.0829 (Avg. Weight, kg) – 0.00042 (Avg. Weight, kg)^2 R^2 = 0.68					

Avg.: Average; Maint.: Maintenance; G: Weight Gain

[1] Experimental data (week and total period) were obtained in dose-response trials with different lysine levels.
[2] Daily Standardized Digestible Lysine Requirement for Maintenance = 0.039 x (Avg. Weight)$^{0.75}$, was estimated according to Damaceno (2021) (Ph.D. Thesis).
[3] In this phase, experimental data of barrows, gilts, and entire males were used.



Equation to Estimate the Value, in grams, of Standardized Digestible Lysine (SID Lys) / kg Weight Gain of Barrows as a function of Weight (5 to 155 kg).

Table 5.04 - Equation Used to Estimate Standardized Digestible Lysine (SID Lys) Requirements of High Genetic Potential Barrows

SID Lys Req. (g/day) = (SID Lys for Maintenance) + (SID Lys for Gain)

SID Lys Req. (g/day) = $(0.039\ W^{0.75})+(16.844 + 0.0829\ W - 0.0004\ W^2)\ G$

W = Average Body Weight (kg);
G = Weight Gain (kg/day)

Example: High Performance Growing Barrows (105 days of age)

W = 66.127 kg; $W^{0.75}$ = 23.189; G = 1.065 kg/day

SID Lys Req. = $(0.039 \times 23.189) + (16.844 + 0.0829 \times 66.127 - 0.0004 \times 66.127^2) \times 1.065$
SID Lys Req. = 0.904 + 20.577 x 1.065 = 22.827 g/day
Estimated Feed Intake = 2.556 kg/day (Table 5.02)
Dietary SID Lys = 0.893%

Correction for average temperature of 28°C (TN=23°C)
Estimated Feed Intake = 2.472 kg/day (Table 5.02)
Dietary SID Lys = 0.923%

Table 5.05 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of High Performance Growing Barrows with High Genetic Potential Using the Equations in Tables 5.01, 5.02, and 5.04

Age, Days	Weight, Kg	Gain, kg/day	SID Lys Req., g/day	ME Req. kcal/day[1]	Feed Intake, kg/day	Cumulative Intake, kg	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
21	6.21	0.246	4.42	1031	0.299	2.1	0.429	1.480
28	8.37	0.309	5.61	1338	0.388	4.8	0.419	1.446
35	11.02	0.379	6.95	1707	0.502	8.3	0.407	1.384
42	14.20	0.454	8.43	2145	0.631	12.7	0.393	1.336
49	17.93	0.533	10.03	2655	0.792	18.3	0.378	1.266
56	22.22	0.613	11.73	3236	0.966	25.0	0.362	1.214
63	27.07	0.692	13.48	3887	1.160	33.2	0.347	1.161
70	32.45	0.770	15.24	4600	1.373	42.8	0.331	1.110
77	38.35	0.843	16.98	5362	1.601	54.0	0.317	1.061
84	44.72	0.910	18.65	6158	1.838	66.9	0.303	1.014
91	51.51	0.970	20.20	6971	2.081	81.4	0.290	0.971
98	58.67	1.022	21.61	7778	2.322	97.7	0.278	0.931
105	66.13	1.065	22.83	8561	2.556	115.6	0.267	0.893
112	73.82	1.099	23.83	9299	2.776	135.0	0.256	0.859
119	81.69	1.124	24.61	9976	2.978	155.8	0.247	0.826
126	89.67	1.140	25.14	10578	3.158	177.9	0.238	0.796
133	97.70	1.147	25.44	11094	3.312	201.1	0.229	0.768
140	105.72	1.146	25.50	11520	3.439	225.2	0.221	0.742
147	113.68	1.137	25.34	11852	3.538	250.0	0.214	0.716
154	121.53	1.121	24.99	12092	3.610	275.2	0.207	0.692
161	129.23	1.100	24.46	12246	3.655	300.8	0.200	0.669
168	136.74	1.074	23.78	12319	3.677	326.6	0.193	0.647
175	144.04	1.043	22.98	12320	3.678	352.3	0.187	0.625
182	151.10	1.008	22.09	12259	3.659	377.9	0.180	0.604

[1] Diets containing 3450, 3400, and 3350 kcal ME/kg for the phases 21-35, 35-49, and 49-182 days of age.

Table 5.06 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of Standard Performance Growing Barrows with High Genetic Potential Using the Equations in Tables 5.01, 5.02, and 5.04

Age, Days	Weight, Kg	Gain, kg/day	SID Lys Req., g/day	ME Req. kcal/day[1]	Feed Intake, kg/day	Cumulative Intake, kg	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
21	6.55	0.253	4.55	1103	0.324	2.3	0.413	1.404
28	8.75	0.314	5.71	1418	0.417	5.2	0.403	1.370
35	11.42	0.381	7.00	1792	0.531	8.9	0.391	1.319
42	14.58	0.451	8.40	2228	0.660	13.5	0.377	1.273
49	18.25	0.524	9.90	2729	0.809	19.2	0.363	1.224
56	22.43	0.597	11.45	3292	1.013	26.3	0.348	1.130
63	27.11	0.668	13.03	3913	1.204	34.7	0.333	1.082
70	32.26	0.736	14.59	4581	1.410	44.6	0.318	1.035
77	37.85	0.799	16.10	5285	1.626	56.0	0.305	0.990
84	43.84	0.856	17.53	6010	1.849	68.9	0.292	0.948
91	50.18	0.905	18.83	6738	2.073	83.4	0.279	0.908
98	56.80	0.946	19.98	7452	2.293	99.5	0.268	0.871
105	63.65	0.979	20.95	8134	2.503	117.0	0.258	0.837
112	70.68	1.003	21.72	8768	2.698	135.9	0.248	0.805
119	77.81	1.019	22.29	9342	2.875	156.0	0.239	0.775
126	84.99	1.027	22.65	9846	3.030	177.2	0.230	0.748
133	92.18	1.026	22.80	10274	3.161	199.3	0.222	0.721
140	99.31	1.019	22.77	10621	3.268	222.2	0.214	0.697
147	106.36	1.006	22.55	10889	3.350	245.7	0.207	0.673
154	113.26	0.987	22.18	11079	3.409	269.5	0.200	0.651
161	120.00	0.963	21.67	11197	3.445	293.6	0.194	0.629
168	126.55	0.935	21.04	11249	3.461	317.9	0.187	0.608
175	132.88	0.904	20.33	11243	3.459	342.1	0.181	0.588
182	138.97	0.870	19.54	11186	3.442	366.2	0.175	0.568

[1] Diet containing 3400, 3375, and 3250 kcal ME/kg for the phases 21-35, 35-49, and 49-182 days of age.

Table 5.07 - Equations Used to Estimate Available Phosphorus (Pav), Standardized Digestible Phosphorus (Dig. P), and Calcium to Phosphorus Ratio Requirements of Growing Barrows with High Genetic Potential[1]

Standardized Digestible Phosphorus Requirement

High and Standard Performance Growing Barrows

Dig. P Req. (g/day) = $(0.046\ W^{0.75}) + 5.42\ G$

W = Average Body Weight (kg); G = Daily Gain (kg/day)

Recommended Total Ca: Dig. P Ratio: 2.04

Example: High Performance Growing Barrows (105 days of age)

W = 66.127 kg; G = 1.065 kg/day; Feed Intake = 2556 g/day

Dig. P Req. (g/day) = $(0.046 \times 66.127^{0.75}) + 5.42 \times 1.065 = 6.841$g

Dietary Dig. P = (6.841 x 100) / 2556 = 0.268%

Dietary Ca = 0.268 x 2.04 = 0.546%

Available Phosphorus Requirement

High and Standard Performance Growing Barrows

Pav Req. (g/day) = $(0.046\ W^{0.75}) + 5.68\ G$

W = Average Body Weight (kg); G = Daily Gain (kg/day)

Recommended Total Ca: Pav Ratio: 2.10

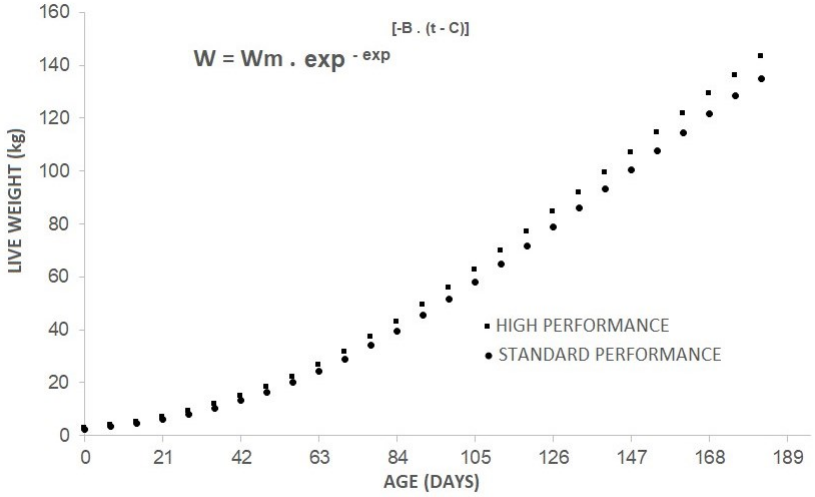
[1] Daily phosphorus requirements for maintenance and gain were estimated according to Bünzen (2009) (Ph.D. Thesis, UFV), Jongbloed et al (1993), and performance data obtained from dissertations, thesis, and scientific papers.

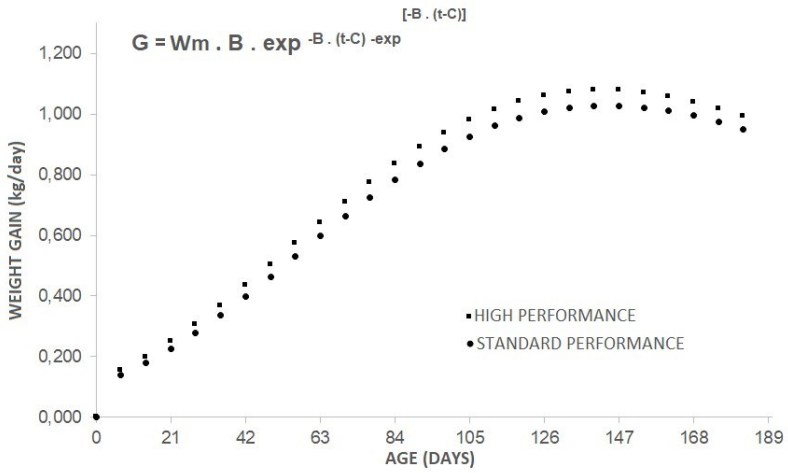
Table 5.08 - Performance and Available Phosphorus (Pav), Standardized Digestible Phosphorus (Dig. P), and Calcium Requirements of Standard and High Performance Growing Barrows with High Genetic Potential Using the Equations in Table 5.07

Age, days	Weight, kg	Gain, kg/day	Intake, kg/day	Dig. P, g/day	Dig. P, %	Pav, g/day	Pav, %	Ca[1], %
High Performance Growing Barrows								
28	8.37	0.309	0.388	1.903	0.491	1.983	0.512	1.038
42	14.20	0.454	0.631	2.798	0.443	2.916	0.462	0.938
56	22.22	0.613	0.966	3.791	0.392	3.951	0.409	0.830
70	32.45	0.770	1.373	4.797	0.349	4.997	0.364	0.738
84	44.72	0.910	1.838	5.728	0.312	5.964	0.324	0.658
98	58.67	1.022	2.322	6.515	0.281	6.781	0.292	0.593
112	73.82	1.099	2.776	7.118	0.256	7.403	0.267	0.542
126	89.67	1.140	3.158	7.519	0.238	7.815	0.247	0.503
140	105.72	1.146	3.439	7.726	0.225	8.024	0.233	0.474
154	121.53	1.121	3.610	7.762	0.215	8.053	0.223	0.454
168	136.74	1.074	3.677	7.658	0.208	7.937	0.216	0.439
182	151.10	1.008	3.659	7.448	0.204	7.710	0.211	0.429
Standard Performance Growing Barrows								
28	8.75	0.314	0.417	1.937	0.465	2.019	0.484	0.982
42	14.58	0.451	0.660	2.790	0.423	2.908	0.440	0.893
56	22.43	0.597	1.013	3.710	0.366	3.865	0.382	0.774
70	32.26	0.736	1.410	4.613	0.327	4.804	0.341	0.692
84	43.84	0.856	1.849	5.421	0.293	5.644	0.305	0.619
98	56.80	0.946	2.293	6.080	0.265	6.326	0.276	0.560
112	70.68	1.003	2.698	6.559	0.243	6.820	0.253	0.513
126	84.99	1.027	3.030	6.851	0.226	7.118	0.235	0.477
140	99.31	1.019	3.268	6.972	0.213	7.237	0.221	0.450
154	113.26	0.987	3.409	6.946	0.204	7.202	0.211	0.430
168	126.55	0.935	3.461	6.804	0.197	7.047	0.204	0.414
182	138.97	0.870	3.442	6.579	0.191	6.806	0.198	0.403

[1] Average %Ca was calculated by multiplying %Dig. P by the factor of 2.04 and %Pav by the factor of 2.10.

Table 5.09 - Live Weight and Daily Weight Gain Curves According to the Gompertz Equation and the Derivative for Standard and High Performance Growing Gilts





Equation parameters for standard performance growing gilts: Wm= 253.2377; b=4.692423; C=0.01104085; R^2=0.98. High performance growing gilts: Wm= 266.0062; b=4.608439; C=0.01102709; R^2=0.99. W= weight (kg); G= weight gain (kg); t=age (days); Wm= mature weight (kg); b= maturity rate (g/day per g); t*= age at maximum growth rate (days).

Table 5.10 - Equation Used to Estimate Metabolizable Energy (ME) Requirements of Growing Gilts with High Genetic Potential (kcal/day)

ME Requirement of High Performance Growing Gilts

$ME\ Req. = (106\ W^{0.75}) + (2129.3 + 58.311\ W - 0.1701\ W^2)\ G$

ME Requirement of Standard Performance Growing Gilts[1]

$ME\ Req. = ((106\ W^{0.75}) + (2129.3 + 58.311\ W - 0.1701\ W^2)\ G)\ 1.03$

[1]Considering Standard Performance Growing Gilts 3% less efficient

$Correction\ for\ temperature = 2.4\ W^{0.75}\ (TN - T)$

W = Average body weight (kg); G = Weight gain (kg/day);
T= Average temperature (°C); TN= Thermoneutral temperature (°C)

Suggested temperatures for the correction of ME requirements

Weight (kg)	TN (°C)	Temperature Range (°C)
15 – 30	25	18 – 32
30 – 50	24	17 – 31
50 – 70	23	16 – 30
70 – 100	22	15 – 29
100 – 130	21	14 – 28

Higher temperature values may negatively influence swine performance and overestimate corrections for feed intake and nutritional levels.

Example: High Performance Growing Gilts (105 days of age)
W = 62.535 kg; $W^{0.75}$ = 22.238; G = 0.980 kg/day; Diet. ME = 3350 kcal/kg

$ME\ Req. = (106 \times 22.238) + (2129.3 + 58.31 \times 62.535 - 0.1701 \times 62.535^2) \times 0.980$
ME Req. = 2357.20 + 5110.6 x 0.980= 7365 kcal/day
Estimated Feed Intake = 2.198 kg/day

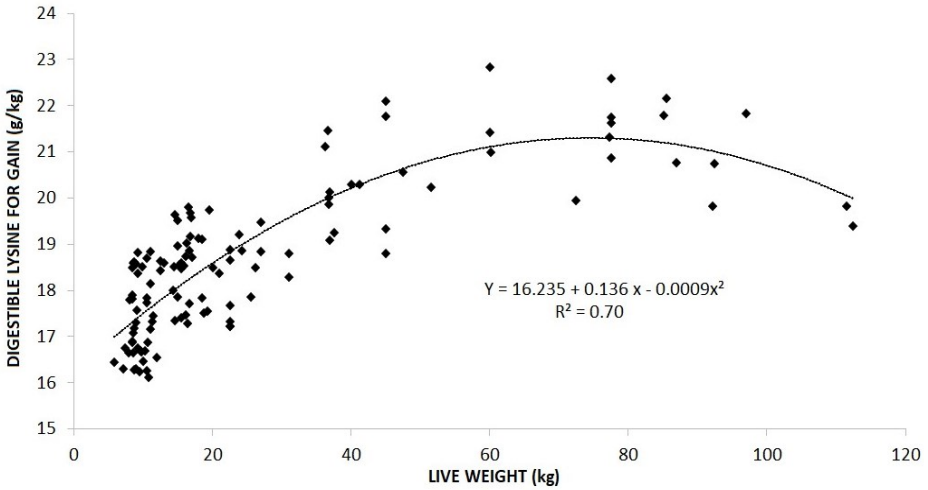
Correction for the average temperature of 28°C (TN=23°C)
Correction for T° = 2.4 x 22.24 (23 – 28) = -266.86 kcal/day
ME Req. for 28°C = 7365 – 266.86 = 7098.1 kcal/day
Estimated Feed Intake = 2.119 kg/day

Table 5.11 - Methodology Applied to Obtain the Equation to Calculate Standardized Digestible Lysine (SID Lys) Requirements/kg Weight Gain of Growing Gilts with High Genetic Potential

Weight, kg	5 – 15 [3]	15 – 30 [3]	30 - 60	60 – 95	95 – 130
Experimental Data[1]	42	46	14	13	3
Avg. Weight in Period, kg	9.49	18.93	41.19	77.3	106.98
Feed Intake, g/day	407.14	876.2	1775	2600.2	2690.3
SID Lys Intake, g/day	5.502	10.918	18.134	21.781	22.025
SID Lys Maint., g/day[2]	0.210	0.352	0.614	1.015	1.297
SID Lys Gain, g/day	5.292	10.566	17.520	20.766	20.728
Mean Gain, kg/d	0.305	0.578	0.869	0.974	1.02
g. SID Lys / kg Gain	17.34	18.93	20.29	21.33	20.35
Equation, g SID Lys/ kg G	17.44	18.49	20.31	21.37	20.48
Eq: Y (g SID Lys / kg G) = 16.235 + 0.136 (Avg. Weight, kg) – 0.0009 (Avg. Weight, kg)^2 R^2 = 0.70					

Avg.: Average; Maint.: Maintenance; G: Weight Gain

[1] Experimental data (week and total period) were obtained in dose-response trials with different lysine levels.
[2] Daily Standardized Digestible Lysine Requirement for Maintenance = 0.039 x (Avg. Weight)$^{0.75}$, was estimated according to Damaceno (2021) (Ph.D. Thesis).
[3] In this phase, experimental data of barrows, gilts, and entire males were used.



Equation to Estimate the Value, in grams, of Standardized Digestible Lysine (SID Lys) / kg Weight Gain of Gilts as a Function of Weight (5 to 130 kg).

Table 5.12 - Equation Used to Estimate Standardized Digestible Lysine (SID Lys) Requirements of Growing Gilts with High Genetic Potential

SID Lys Req. (g/day) = (SID Lys for Maintenance) + (SID Lys for Gain)

SID Lys Req. (g/day) = $(0.039\ W^{0.75}) + (16.235 + 0.136\ W - 0.0009\ W^{2})\ G$

W = Average Body Weight (kg);
G = Weight Gain (kg/day)

Example: High Performance Growing Gilts (105 days of age)

W = 62.535 kg; $W^{0.75}$ = 22.238; G = 0.980 kg/day

SID Lys Req. = $(0.039 \times 22.238) + (16.235 + 0.136 \times 62.535 - 0.0009 \times 62.535^{2}) \times 0.980$
SID Lys Req. = 0.867 + 21.220 x 0.980 = 21.661 g/day
Estimated Feed Intake = 2.198 kg/day (Table 5.10)
Dietary SID Lys = 0.985%

Correction for the average temperature of 28°C (TN=23°C)
W = 62.535; G = 0.980 kg/day
SID Lys Req. = 21.661 g/day
Estimated Feed Intake = 2.119 kg/day (Table 5.10)
Dietary SID Lys = 1.023%

Table 5.13 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of High Performance Growing Gilts with High Genetic Potential Using the Equations in Tables 5.09, 5.10, and 5.12

Age, Days	Weight, Kg	Gain, kg/day	SID Lys Req., g/day	ME Req., kcal/day[1]	Feed Intake, kg/day	Cumulative Intake, kg	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
21	6.87	0.250	4.44	1080	0.313	2.2	0.411	1.419
28	9.02	0.306	5.53	1361	0.394	5.0	0.406	1.402
35	11.60	0.368	6.76	1691	0.497	8.4	0.400	1.359
42	14.63	0.434	8.12	2072	0.609	12.7	0.392	1.332
49	18.15	0.503	9.59	2506	0.748	17.9	0.383	1.282
56	22.16	0.572	11.16	2993	0.893	24.2	0.373	1.249
63	26.65	0.642	12.79	3530	1.054	31.6	0.362	1.214
70	31.62	0.710	14.45	4112	1.228	40.2	0.351	1.177
77	37.04	0.774	16.10	4732	1.412	50.0	0.340	1.140
84	42.88	0.835	17.69	5379	1.606	61.3	0.329	1.102
91	49.11	0.889	19.17	6043	1.804	73.9	0.317	1.063
98	55.68	0.938	20.51	6709	2.003	87.9	0.306	1.024
105	62.53	0.980	21.66	7365	2.198	103.3	0.294	0.985
112	69.64	1.014	22.59	7997	2.387	120.0	0.282	0.946
119	76.93	1.041	23.27	8594	2.565	138.0	0.271	0.907
126	84.35	1.061	23.69	9144	2.730	157.1	0.259	0.868
133	91.86	1.073	23.84	9639	2.877	177.2	0.247	0.828
140	99.41	1.079	23.73	10073	3.007	198.3	0.236	0.789
147	106.96	1.077	23.37	10442	3.117	220.1	0.224	0.750
154	114.44	1.070	22.78	10744	3.207	242.6	0.212	0.710
161	121.84	1.057	21.99	10980	3.277	265.5	0.200	0.671
168	129.12	1.039	21.03	11152	3.329	288.8	0.189	0.632
175	136.24	1.017	19.93	11264	3.362	312.3	0.177	0.593
182	143.19	0.992	18.73	11322	3.380	336.0	0.165	0.554

[1] Diets containing 3450, 3400, and 3350 kcal ME/kg for the phases 21-35, 35-49, and 49-182 days of age.

Table 5.14 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of Standard Performance Growing Gilts with High Genetic Potential Using the Equations in Tables 5.09, 5.10, and 5.12

Age, Days	Weight, Kg	Gain, kg/day	SID Lys Req., g/day	ME Req., kcal/day[1]	Feed Intake, kg/day	Cumulative Intake, kg	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
21	6.13	0.226	4.01	1003	0.295	2.1	0.399	1.358
28	8.08	0.279	5.01	1268	0.373	4.7	0.395	1.343
35	10.44	0.337	6.15	1579	0.468	8.0	0.389	1.314
42	13.24	0.399	7.41	1938	0.574	12.0	0.382	1.290
49	16.49	0.464	8.78	2349	0.696	16.8	0.374	1.262
56	20.20	0.531	10.25	2810	0.865	22.9	0.365	1.185
63	24.38	0.597	11.78	3320	1.021	30.0	0.355	1.154
70	29.02	0.662	13.35	3874	1.192	38.4	0.345	1.120
77	34.09	0.725	14.92	4466	1.374	48.0	0.334	1.086
84	39.57	0.783	16.44	5087	1.565	59.0	0.323	1.050
91	45.43	0.837	17.89	5727	1.762	71.3	0.312	1.015
98	51.62	0.885	19.20	6373	1.961	85.0	0.301	0.979
105	58.11	0.926	20.36	7013	2.158	100.1	0.290	0.944
112	64.83	0.960	21.32	7633	2.349	116.6	0.279	0.908
119	71.74	0.988	22.06	8223	2.530	134.3	0.268	0.872
126	78.80	1.008	22.56	8772	2.699	153.2	0.257	0.836
133	85.95	1.021	22.83	9271	2.853	173.1	0.246	0.800
140	93.14	1.028	22.84	9713	2.989	194.1	0.235	0.764
147	100.33	1.028	22.63	10095	3.106	215.8	0.224	0.729
154	107.48	1.022	22.20	10413	3.204	238.2	0.213	0.693
161	114.56	1.011	21.58	10669	3.283	261.2	0.202	0.657
168	121.52	0.995	20.79	10863	3.342	284.6	0.191	0.622
175	128.34	0.974	19.87	10999	3.384	308.3	0.181	0.587
182	135.00	0.951	18.84	11081	3.410	332.2	0.170	0.553

[1] Diets containing 3400, 3375, and 3250 kcal ME/kg for the phases 21-35, 35-49, and 49-182 days of age.

Table 5.15 - Equations Used to Estimate Available Phosphorus (Pav), Standardized Digestible Phosphorus (Dig. P), and Calcium to Phosphorus Ratio Requirements of Growing Gilts with High Genetic Potential [1]

Standardized Digestible Phosphorus Requirement

High and Standard Performance Growing Gilts

Dig. P Req. (g/day) = $(0.046\ W^{0.75}) + 5.42\ G$

W = Average Body Weight (kg); G = Daily Gain (kg/day)

Recommended Total Ca: Dig. P Ratio: 2.04

Example: High Performance Growing Gilts

W = 62.535 kg; G = 0.980 kg/day; Feed Intake = 2198 g/day

Dig. P Req. (g/day) = $(0.046 \times 62.535^{0.75}) + 5.42 \times 0.980 = 6.334$ g

Dietary Dig. P = (6.334 x 100) / 2198 = 0.288 %

Dietary Ca = 0.288 x 2.04 = 0.588 %

Available Phosphorus Requirement

High and Standard Performance Growing Gilts

Pav Req. (g/day) = $(0.046\ W^{0.75}) + 5.68\ G$

W = Average Body Weight (kg); G = Daily Gain (kg/day)

Recommended Total Ca: Pav Ratio: 2.10

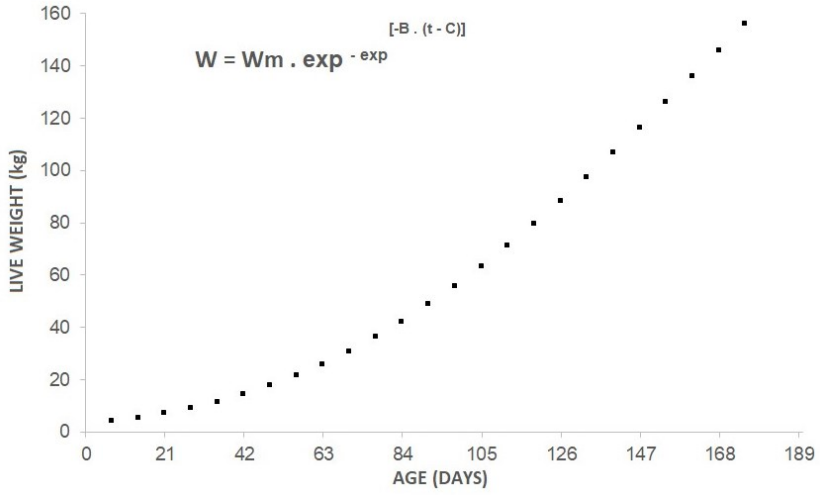
[1] Daily phosphorus requirements for maintenance and gain were estimated according to Bünzen (2009) (Ph.D. Thesis, UFV), Jongbloed et al (1993), and performance data obtained from dissertations, thesis, and scientific papers.

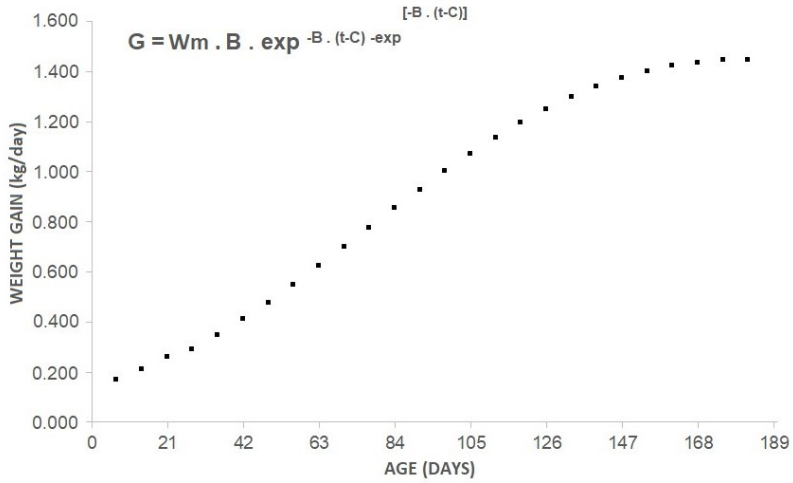
Table 5.16 - Performance and Available Phosphorus (Pav), Standardized Digestible Phosphorus (Dig. P), and Calcium Requirements of Standard and High Performance Growing Gilts with High Genetic Potential Using the Equations in Table 5.15

Age, days	Weight, kg	Gain, kg/day	Intake, kg/day	Dig. P, g/day	Dig. P, %	Pav, g/day	Pav, %	Ca[1], %
High Performance Growing Gilts								
28	9.02	0.306	0.394	1.900	0.482	1.980	0.502	1.018
42	14.63	0.434	0.609	2.697	0.443	2.810	0.461	0.935
56	22.16	0.572	0.893	3.572	0.400	3.721	0.416	0.845
70	31.62	0.710	1.228	4.460	0.363	4.644	0.378	0.768
84	42.88	0.835	1.606	5.294	0.330	5.511	0.343	0.697
98	55.68	0.938	2.003	6.022	0.301	6.266	0.313	0.635
112	69.64	1.014	2.387	6.607	0.277	6.871	0.288	0.584
126	84.35	1.061	2.730	7.031	0.258	7.307	0.268	0.544
140	99.41	1.079	3.007	7.294	0.243	7.574	0.252	0.512
154	114.44	1.070	3.207	7.409	0.231	7.687	0.240	0.487
168	129.12	1.039	3.329	7.396	0.222	7.666	0.230	0.468
182	143.19	0.992	3.380	7.280	0.215	7.538	0.223	0.454
Standard Performance Growing Gilts								
28	8.08	0.279	0.373	1.734	0.465	1.806	0.484	0.983
42	13.24	0.399	0.574	2.483	0.432	2.587	0.450	0.914
56	20.20	0.531	0.865	3.314	0.383	3.452	0.399	0.810
70	29.02	0.662	1.192	4.165	0.349	4.337	0.364	0.738
84	39.57	0.783	1.565	4.971	0.318	5.175	0.331	0.671
98	51.62	0.885	1.961	5.681	0.290	5.911	0.301	0.612
112	64.83	0.960	2.349	6.256	0.266	6.506	0.277	0.563
126	78.80	1.008	2.699	6.680	0.247	6.942	0.257	0.522
140	93.14	1.028	2.989	6.948	0.232	7.215	0.241	0.491
154	107.48	1.022	3.204	7.073	0.221	7.339	0.229	0.466
168	121.52	0.995	3.342	7.074	0.212	7.333	0.219	0.446
182	135.00	0.951	3.410	6.974	0.205	7.221	0.212	0.431

[1] Average %Ca was calculated by multiplying %Dig. P by the factor of 2.04 and %Pav by the factor of 2.10.

Table 5.17 - Live Weight and Daily Weight Gain Curves According to the Gompertz Equation and the Derivative for Growing Entire Males up to 105 kg and Immuno-Castrated Males (105-155 kg)





Equation parameters for growing entire males and immuno-castrated males: Wm= 433.5277; b= 4.992764; c= 0.0090659; R^2=0.99. W= weight (kg); G= weight gain (kg); t=age (days); Wm= mature weight (kg); b=maturity rate (g/day per g); t*= age at maximum growth rate (days).

Table 5.18 - Equation Used to Estimate Metabolizable Energy (ME) Requirements of Growing Entire Males up to 105 kg and Immuno-Castrated Males (105-155 kg) with High Genetic Potential (kcal/day)

ME Requirement of Growing Entire Males up to 105 kg weight

$ME\ Req. = (106\ W^{0.75}) + (1782.4 + 71.426\ W - 0.4552\ W^2)\ G$

ME Requirement of Immuno-Castrated Males (105 to 155 kg)[1]

$ME\ Req. = (106\ W^{0.75}) + 5876.5\ G$

[1] ME requirement of immuno-castrated males for gain was estimated according to experimental data carried out at UFV by Barcellos (2023) (unpublished data).

$Correction\ for\ temperature = 2.4 \times W^{0.75}\ (TN - T)$

W = Average body weight (kg); G = Weight gain (kg/day);
T= Average temperature (°C); TN= Thermoneutral temperature (°C)

Suggested temperatures for the correction of ME requirements

Weight (kg)	TN (°C)	Temperature Range (°C)
15 – 30	25	18 – 32
30 – 50	24	17 – 31
50 – 70	23	16 – 30
70 – 100	22	15 – 29
100 - 130	21	14 – 28

Higher temperature values may negatively influence swine performance and overestimate corrections for feed intake and nutritional levels.

Example: Growing Entire Males (105 days of age)
W = 63.102 kg; $W^{0.75}$ = 22.389; G=1.069 kg/day; Diet. ME = 3300 kcal/Kg

$ME\ Req. = (106 \times 22.389) + (1782.4 + 71.426 \times 63.102 - 0.4552 \times 63.102^2) \times 1.069$
ME Req. = 2373.22 + 4477.0 x 1.069 = 7160.5 kcal/day
Estimated Feed Intake = 2.170 kg/day

Correction for the average temperature of 28°C (TN=23°C)
Correction for T° = 2.4 x 22.389 (23 – 28) = -268.7 kcal/day
ME Req. for 28°C = 7160.5 – 268.7 = 6891.8 kcal/day
Estimated Feed Intake = 2.088 kg/day

Table 5.19 - Methodology Applied to Obtain the Equations to Calculate Standardized Digestible Lysine (SID Lys) Requirements/kg Weight Gain of Growing Entire Males and Immuno-Castrated Males with High-Genetic Potential

	Growing Entire Males				Immuno-Castrated Males
Weight, kg	5 -15 [3]	15 – 30 [3]	30 - 60	60 – 95	95-155 [4]
Experimental Data[1]	42	46	5	14	3
Avg. Weight in Period, kg	9.49	18.93	39.06	79.11	110.22
Feed Intake, g/day	407.14	876.2	1655.2	2581.8	3415.0
SID Lys Intake, g/day	5.502	10.918	19.065	25.163	25.736
SID Lys Maint., g/day[2]	0.210	0.352	0.600	1.033	1.326
SID Lys Gain, g/day	5.292	10.566	18.465	24.131	24.41
Mean Gain, kg/day	0.305	0.578	0.881	1.163	1.317
g. SID Lys / kg Gain	17.34	18.93	20.93	20.83	18.71
Equation, g SID Lys/ kg G	17.42	18.54	20.22	20.68	18.71

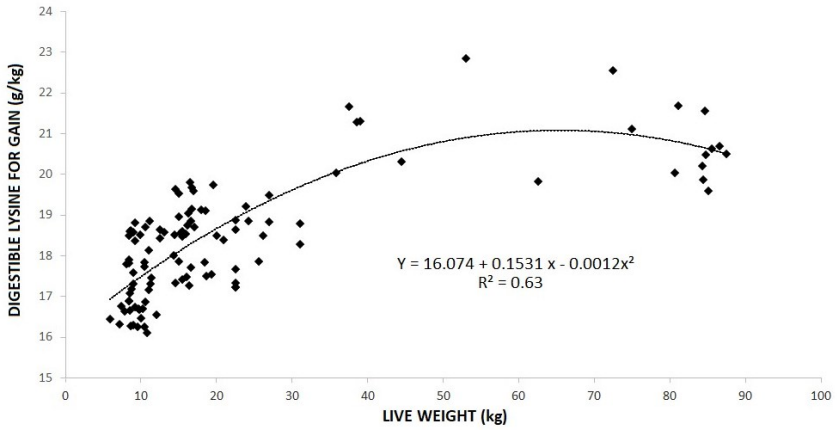
Avg.: Average; Maint.: Maintenance; G: Weight Gain

[1] Experimental data (week and total period) were obtained in dose-response trials with different lysine levels.

[2] Daily Standardized Digestible Lysine Requirement for Maintenance = 0.039 x (Avg. Weight)$^{0.75}$, was estimated according to Faria (2019) (Ph.D. Thesis).

[3] In this phase, experimental data of barrows, entire males, and females were used.

[4] Standardized Digestible Lysine Requirement for Gain (from 95 to 155 kg weight) was estimated with the experimental data of males that received a second dose of the immunocastration vaccine (avg. weight of 100 kg) (Aymerich et al. 2020; and unpublished data of Barcellos, 2023, and Lima, 2023).



Equation to Estimate the Value, in grams, of Standardized Digestible Lysine (SID Lys) / kg Weight Gain of Entire Males as a Function of Weight (5 a 105 kg).

Table 5.20 - Equation Used to Estimate Standardized Digestible Lysine (SID Lys) Requirements of Growing Entire Males with High Genetic Potential

SID Lys Req. (g/day) = (SID Lys for Maintenance) + (SID Lys for Gain)

SID Lys Req. (g/day)= $(0.039\ W^{0.75}) + (16.074 + 0.1531\ W - 0.0012\ W^2)\ G$

W = Average Body Weight (kg);
G = Weight Gain (kg/day)

Example: Growing Entire Males (105 days of age)

W = 63.102 kg; $W^{0.75}$ = 22.389; G = 1.069 kg/day

SID Lys Req.= $(0.039 \times 22.389) + (16.074 + 0.1531 \times 63.102 - 0.0012 \times 63.102^2) \times 1.069$
SID Lys Req. = 0.873 + 20.957 x 1.069 = 23.282 g/day
Estimated Feed Intake = 2.170 kg/day (Table 5.18)
Dietary SID Lys = 1.073%

Correction for the average temperature of 28°C (TN=23°C)
W = 63.102 kg; G = 1.069 kg/day
SID Lys Req. = 23.282 g/day
Estimated Feed Intake = 2.088 kg/day (Table 5.18)
Dietary SID Lys = 1.115%

Table 5.21 - Equation Used to Estimate Standardized Digestible Lysine (SID Lys) Requirements of Immuno-Castrated Males with High Genetic Potential (100-140 kg)

SID Lys Req. (g/day) = (SID Lys for Maintenance) + (SID Lys for Gain)

SID Lys Req. (g/day) = $(0.039\ W^{0.75}) + (18.71)\ G$

W = Average Body Weight (kg);
G = Weight Gain (kg/day)

Example: Immuno-Castrated Males (161 days of age)

W = 135.911 kg; $W^{0.75}$ = 39.805 kg; G = 1.421 kg/day

SID Lys Req. = (0.039 x 39.805) + (18.71) x 1.421
SID Lys Req. = 1.552 + 26.585 = 28.137 g/day
Estimated Feed Intake = 3.867 kg/day (Equation -Table 5.18)
Dietary SID Lys = 0.728%

Table 5.22 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of Entire Males and Immuno-Castrated Males with High Genetic Potential Using the Equations in Tables 5.17, 5.18, 5.20, and 5.21

Age, Days	Weight, kg	Gain, kg/day	SID Lys Req., g/day	ME Req., kcal/day[1]	Feed Intake, kg/day	Cumulative Intake, kg	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
21	6.99	0.237	4.21	990.5	0.287	2.0	0.425	1.467
28	9.01	0.289	5.21	1240.7	0.360	4.5	0.420	1.449
35	11.44	0.346	6.36	1538.4	0.452	7.7	0.413	1.405
42	14.30	0.409	7.66	1888.6	0.555	11.6	0.406	1.379
49	17.64	0.477	9.11	2295.3	0.696	16.5	0.397	1.310
56	21.48	0.548	10.70	2760.6	0.837	22.3	0.388	1.279
63	25.83	0.623	12.42	3284.1	0.995	29.3	0.378	1.248
70	30.73	0.699	14.24	3862.3	1.170	37.5	0.369	1.216
77	36.16	0.776	16.12	4487.6	1.360	47.0	0.359	1.186
84	42.12	0.852	18.03	5148.1	1.560	57.9	0.350	1.156
91	48.62	0.928	19.90	5827.7	1.766	70.3	0.341	1.127
98	55.62	1.000	21.67	6506.3	1.972	84.1	0.333	1.099
105	63.10	1.069	23.28	7160.5	2.170	99.3	0.325	1.073
112	71.04	1.134	24.65	7764.6	2.353	115.7	0.317	1.048
119	79.40	1.194	25.71	8291.9	2.513	133.3	0.310	1.023
126	88.13	1.248	26.39	8716.6	2.641	151.8	0.303	0.999
133	97.20	1.296	26.63	9014.4	2.732	170.9	0.295	0.975
140	106.56	1.337	26.38	9164.8	2.777	190.4	0.288	0.950
147	116.17	1.372	25.61	9151.6	2.816	210.1	0.280	0.910
154	125.97	1.400	27.66	12210.5	3.757	236.4	0.226	0.736
161	135.91	1.421	28.14	12568.5	3.867	263.5	0.224	0.728
168	145.96	1.435	28.49	12885.8	3.965	291.2	0.221	0.719
175	156.06	1.444	28.73	13162.7	4.050	319.6	0.218	0.709
182	166.18	1.446	28.85	13400.4	4.123	348.4	0.215	0.700

[1] Diet containing 3450, 3400, 3300, and 3250 kcal ME/kg for the phases 21-35, 35-49, 49-147, and 147-182 days of age.

Table 5.23 - Equations Used to Estimate Available Phosphorus (Pav), Standardized Digestible Phosphorus (Dig. P), and Calcium to Phosphorus Ratio Requirements of Growing Entire Males and Immuno-castrated Males with High Genetic Potential[1]

Standardized Digestible Phosphorus Requirement

Growing Entire Males and Immuno-Castrated Males

Dig. P Req. (g/day) = 0.046 $W^{0.75}$ + 5.42 G

W = Average Body Weight (kg); G = Daily Gain (kg/day)

Recommended Total Ca: Dig. P Ratio: 2.04

Example: Growing Entire Males and Immuno-Castrated Males

W = 63.102 kg; G = 1.069 kg/day; Feed Intake = 2170 g/day

Dig. P Req. (g/day) = 0.046 x $(63.102)^{0.75}$ + 5.42 x 1.069 = 6.824 g/day

Dietary Dig. P = (6.824 x 100) / 2170 = 0.314 %

Dietary Ca = 0.314 x 2.04 = 0.642 %

Available Phosphorus Requirement

Growing Entire Males and Immuno-Castrated Males

Pav Req. (g/day) = 0.046 $W^{0.75}$ + 5.68 G

W = Average Body Weight (kg); G = Daily Gain (kg/day)

Recommended Total Ca: Pav Ratio: 2.10

[1] Daily phosphorus requirements for maintenance and gain were estimated according to Bünzen (2009) (Ph.D. Thesis, UFV), Jongbloed et al (1993), and performance data obtained from dissertations, thesis, and scientific papers.

Table 5.24 - Performance and Available Phosphorus (Pav), Standardized Digestible Phosphorus (Dig. P), and Calcium Requirements of Growing Entire Males and Immuno-Castrated Males with High Genetic Potential Using the Equations in Table 5.23

Age, days	Weight, kg	Gain, kg/day	Intake, kg/day	Dig. P, g/day	Dig. P, %	Pav, g/day	Pav, %	Ca[1], %
Growing Entire Males and Immuno-Castrated Males								
28	9.01	0.289	0.360	1.803	0.501	1.878	0.522	1.060
42	14.30	0.409	0.555	2.556	0.460	2.662	0.479	0.973
56	21.48	0.548	0.837	3.431	0.410	3.573	0.427	0.867
70	30.73	0.699	1.170	4.388	0.375	4.570	0.390	0.792
84	42.12	0.852	1.560	5.381	0.345	5.602	0.359	0.729
98	55.62	1.000	1.972	6.358	0.322	6.618	0.336	0.681
112	71.04	1.134	2.353	7.273	0.309	7.567	0.322	0.653
126	88.13	1.248	2.641	8.087	0.306	8.411	0.318	0.647
140	106.56	1.337	2.777	8.773	0.316	9.121	0.328	0.667
154	125.97	1.400	3.757	9.316	0.248	9.680	0.258	0.523
168	145.96	1.435	3.965	9.712	0.245	10.085	0.254	0.517
182	166.18	1.446	4.123	9.964	0.242	10.340	0.251	0.510

[1] Average %Ca was calculated by multiplying %Dig. P by the factor of 2.04 and %Pav by the factor of 2.10.

Table 5.25 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of High Performance Mixed-Sex Pigs with High Genetic Potential Using the Equations in Tables 5.05 and 5.13

Age, Days	Weight, kg	Gain, kg/day	SID Lys Req., g/day	ME Req., kcal/day[1]	Feed Intake, kg/day	Cumulative Intake, kg	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
21	6.54	0.248	4.43	1056	0.306	2.2	0.420	1.450
28	8.70	0.308	5.57	1350	0.391	4.9	0.413	1.424
35	11.31	0.374	6.86	1699	0.500	8.4	0.404	1.372
42	14.42	0.444	8.28	2109	0.620	12.7	0.393	1.334
49	18.04	0.518	9.81	2581	0.770	18.1	0.381	1.274
56	22.19	0.593	11.45	3115	0.930	24.6	0.368	1.232
63	26.86	0.667	13.14	3709	1.107	32.4	0.355	1.188
70	32.04	0.740	14.85	4356	1.301	41.5	0.341	1.144
77	37.70	0.809	16.54	5047	1.507	52.0	0.329	1.101
84	43.80	0.873	18.17	5769	1.722	64.1	0.316	1.058
91	50.31	0.930	19.69	6507	1.943	77.7	0.304	1.017
98	57.18	0.980	21.06	7244	2.163	92.8	0.292	0.978
105	64.33	1.023	22.25	7963	2.377	109.5	0.281	0.939
112	71.73	1.057	23.21	8648	2.582	127.5	0.269	0.903
119	79.31	1.083	23.94	9285	2.772	146.9	0.259	0.867
126	87.01	1.101	24.42	9861	2.944	167.5	0.249	0.832
133	94.78	1.110	24.64	10367	3.095	189.2	0.238	0.798
140	102.57	1.113	24.62	10797	3.223	211.8	0.229	0.766
147	110.32	1.107	24.36	11147	3.328	235.1	0.219	0.733
154	117.99	1.096	23.89	11418	3.409	258.9	0.210	0.701
161	125.54	1.079	23.23	11613	3.466	283.2	0.200	0.670
168	132.93	1.057	22.41	11736	3.503	307.7	0.191	0.640
175	140.14	1.030	21.46	11792	3.520	332.3	0.182	0.609
182	147.15	1.000	20.41	11791	3.520	357.0	0.173	0.579

[1] Diets containing 3450, 3400, and 3350 kcal ME/kg for the phases 21-35, 35-49, and 49-182 days of age.

Table 5.26 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of Standard Performance Mixed-Sex Pigs with High Genetic Potential Using the Equations in Tables 5.06 and 5.14

Age, Days	Weight, kg	Gain, kg/day	SID Lys Req., g/day	ME Req., kcal/day[1]	Feed Intake, kg/day	Cumulative Intake, kg	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
21	6.34	0.240	4.28	1053	0.310	2.2	0.406	1.381
28	8.42	0.297	5.36	1343	0.395	5.0	0.399	1.357
35	10.93	0.359	6.58	1686	0.500	8.5	0.390	1.317
42	13.91	0.425	7.91	2083	0.617	12.8	0.380	1.282
49	17.37	0.494	9.34	2539	0.753	18.0	0.369	1.243
56	21.32	0.564	10.85	3051	0.939	24.6	0.357	1.158
63	25.75	0.633	12.41	3617	1.113	32.4	0.344	1.118
70	30.64	0.699	13.97	4228	1.301	41.5	0.332	1.078
77	35.97	0.762	15.51	4876	1.500	52.0	0.320	1.038
84	41.71	0.820	16.99	5549	1.707	64.0	0.308	0.999
91	47.81	0.871	18.36	6233	1.918	77.4	0.296	0.962
98	54.21	0.916	19.59	6913	2.127	92.3	0.285	0.925
105	60.88	0.953	20.66	7574	2.331	108.6	0.274	0.891
112	67.76	0.982	21.52	8201	2.524	126.3	0.264	0.857
119	74.78	1.004	22.18	8783	2.703	145.2	0.254	0.824
126	81.90	1.018	22.61	9309	2.865	165.2	0.244	0.792
133	89.07	1.024	22.82	9773	3.007	186.2	0.234	0.761
140	96.23	1.024	22.81	10167	3.129	208.2	0.225	0.731
147	103.35	1.017	22.59	10492	3.228	230.8	0.216	0.701
154	110.37	1.005	22.19	10746	3.307	253.9	0.207	0.672
161	117.28	0.987	21.63	10933	3.364	277.4	0.198	0.643
168	124.04	0.965	20.92	11056	3.402	301.3	0.189	0.615
175	130.61	0.939	20.10	11121	3.422	325.2	0.181	0.588
182	136.99	0.911	19.19	11134	3.426	349.2	0.173	0.561

[1] Diet containing 3400, 3375, and 3250 kcal ME/kg for the phases 21-35, 35-49, and 49-182 days of age.

Table 5.27 - Performance and Available Phosphorus (Pav), Standardized Digestible Phosphorus (Dig. P), and Calcium Requirements of Standard and High Performance Mixed-Sex Pigs with High Genetic Potential Using the Equations in Tables 5.08 and 5.16

Age, days	Weight, kg	Gain, kg/day	Intake, kg/day	Dig. P, g/day	Dig. P, %	Pav, g/day	Pav, %	Ca[1], %
High Performance Mixed-Sex Pigs								
28	8.70	0.308	0.391	1.902	0.487	1.982	0.507	1.028
42	14.42	0.444	0.620	2.748	0.443	2.863	0.462	0.937
56	22.19	0.593	0.930	3.682	0.396	3.836	0.413	0.838
70	32.04	0.740	1.301	4.629	0.356	4.821	0.371	0.753
84	43.80	0.873	1.722	5.511	0.321	5.738	0.334	0.678
98	57.18	0.980	2.163	6.269	0.291	6.524	0.303	0.614
112	71.73	1.057	2.582	6.863	0.267	7.137	0.278	0.563
126	87.01	1.101	2.944	7.275	0.248	7.561	0.258	0.524
140	102.57	1.113	3.223	7.510	0.234	7.799	0.243	0.493
154	117.99	1.096	3.409	7.586	0.223	7.870	0.232	0.471
168	132.93	1.057	3.503	7.527	0.215	7.802	0.223	0.454
182	147.15	1.000	3.520	7.364	0.210	7.624	0.217	0.442
Standard Performance Mixed-Sex Pigs								
28	8.42	0.297	0.395	1.836	0.465	1.913	0.484	0.983
42	13.91	0.425	0.617	2.637	0.428	2.748	0.445	0.904
56	21.32	0.564	0.939	3.512	0.375	3.659	0.391	0.792
70	30.64	0.699	1.301	4.389	0.338	4.571	0.353	0.715
84	41.71	0.820	1.707	5.196	0.306	5.410	0.318	0.645
98	54.21	0.916	2.127	5.881	0.278	6.119	0.289	0.586
112	67.76	0.982	2.524	6.408	0.255	6.663	0.265	0.538
126	81.90	1.018	2.865	6.766	0.237	7.030	0.246	0.500
140	96.23	1.024	3.129	6.960	0.223	7.226	0.231	0.471
154	110.37	1.005	3.307	7.010	0.213	7.271	0.220	0.448
168	124.04	0.965	3.402	6.939	0.205	7.190	0.212	0.430
182	136.99	0.911	3.426	6.777	0.198	7.014	0.205	0.417

[1] Average %Ca was calculated by multiplying %Dig. P by the factor of 2.04 and %Pav by the factor of 2.10.

Table 5.28 - Equations Used to Estimate the Recommended Dietary Levels (Y) of Potassium, Sodium, and Chlorine for Growing Pigs with High Genetic Potential, in % per Mcal of ME, as a Function of Average Body Weight (X)[1]

Nutrients	Equation[1]
Barrows, Gilts, and Entire Males (5 to 135 kg)	
Potassium	$Y = (154.9 – 0.427\ X + 0.0006\ X^2) / 1000$
Sodium	$Y = (68.4 – 0.346\ X + 0.0014\ X^2) / 1000$
Chlorine	$Y = (65.4 – 0.346\ X + 0.0014\ X^2) / 1000$

[1] In order to determine nutrient percentage in the diet of a nutritional program, use the equations above. Y = nutrients % by 1.0 Mcal of ME/kg and X = average weight (kg). The obtained value must be multiplied by the dietary ME in Mcal; E.g.: The sodium requirement of high performance growing barrows at 105 days of age (average weight of 66.13 kg) is: $Y = 68.4 – 0.346\ (66.13) + 0.0014\ (66.13^2) / 1000 = 0.052\%$ Mcal x 3.350 Mcal ME/kg diet = 0.173 % of sodium.

Table 5.29 - Equation Used to Estimate the Recommended Dietary Levels (Y) of Linoleic Acid of Growing Pigs with High Genetic Potential, in g per day, as a Function of Average Body Weight (X)[1]

Nutrients	Equation[1]
Barrows, Gilts, and Entire Males (5 to 135 kg)	
Linoleic Acid	$Y= 1.3476 + 0.0152\ X$

[1] In order to determine linoleic acid in the diet of a nutritional program, use the equation above. Y= Linoleic acid (g/day) and X = average weight (kg). Dietary linoleic acid in percentage must be determined in function of the estimated feed intake at age, e.g.: Linoleic acid requirement of high performance growing barrows at 105 days of age (average weight = 66.13 kg; estimated feed intake = 2.556 kg) is $Y= 1.3476 + 0.0152\ (66.13) = 2.353$ g/day and 0.092% of linoleic acid in the diet.

Table 5.30 - Amino Acid to Lysine Ratios Used to Estimate the Amino Acid Requirements of Growing Swine

Phase		Pre Starter I and II		Starter		Grower		Finisher	
Age		Up to 49 days		49 - 63		63 - 119		119 - 175	
Amino Acids		SID	Total	SID	Total	SID	Total	SID	Total
Lysine	%	100	100	100	100	100	100	100	100
Methionine	%	33	32	33	32	33	32	33	32
Met + Cys	%	60	59	60	59	60	59	60	59
Threonine	%	68	71	68	71	68	71	68	71
Tryptophan	%	21	21	20	20	20	20	20	20
Arginine	%	100	99	45	44	42	40	40	38
Valine	%	70	71	70	71	69	70	69	70
Isoleucine	%	55	55	55	55	55	55	55	55
Leucine	%	102	99	102	99	100	97	100	97
Histidine	%	33	32	33	32	33	32	33	32
Phenylalanine	%	54	53	54	53	54	53	54	53
Phe + Tyr	%	100	98	100	98	100	98	100	98

Table 5.31 - Example for Calculation of Digestible Essential Nitrogen (Dig. Ne), Total Essential Nitrogen (Net), and Digestible and Total Crude Protein Requirements of Growing Swine[1]

Amino Acids	N (%)	SID AA Req. (%)	Dig. Ne (%)	Total AA Req. (%)	Net (%)
Lysine	19.16	0.893	0.171	1.015	0.194
Methionine	9.39	0.295	0.028	0.325	0.031
Threonine	11.76	0.607	0.071	0.721	0.085
Tryptophan	13.72	0.179	0.025	0.203	0.028
Arginine[2]	32.16	0.375	0.121	0.406	0.131
Valine	11.96	0.616	0.074	0.711	0.085
Isoleucine	10.68	0.491	0.052	0.558	0.060
Leucine	10.68	0.893	0.095	0.985	0.105
Histidine	27.08	0.295	0.080	0.325	0.088
Phenylalanine	8.48	0.482	0.041	0.538	0.046
Ne Req.		0.758		0.852	
Total N Req.[3]		2.048		2.301	
Protein Req.[4]		12.80		14.38	

[1] High Performance Growing Barrows (50 to 80 kg).
[2] Due to the diverse arginine functions during the pre-starter I and II phases, the N contribution was considered of 35%.
[3] Ne:Nt ratio used 37%.
[4] N to a protein conversion factor of 6.25.

The total lysine requirement was calculated considering 88.0% the ileal digestibility of lysine in the diet, and the total amino acid to total lysine ratios were used to estimate total amino acid requirements (Table 5.30).

- Simplified calculation of Crude and Digestible Protein levels using the SID Lys percentage on Crude Protein of 6.2% (6.09 – 6.30) and on Digestible Protein of 7.0% (6.87 – 7.13), respectively.

- Example: High Performance Growing Barrows (105 days)

Average Weight = 66.127 kg, $W^{0.75}$ = 23.189; G = 1.065 kg / day; Estimated Feed Intake = 2.556 g/day; Dietary SID Lys = 0.893%

Dietary Crude Protein = (% SID Lys x 100)/6.2 = (0.893x100)/ 6.2 = 14.40%
Dietary Digestible Protein=(% SID Lysx100)/7.0=(0.893x100)/7.0= 12.75%

Table 5.32 - Nutritional Requirements of High Genetic Potential Piglets in the Pre-Starter Phase – Barrows, Gilts, and Entire Males

Age	Days	14 - 21	21 - 35	35 - 49
Weight Range	kg	4.4 to 6.2	6.2 to 8.4	8.4 to 17.9
Average Weight	kg	-	8.37	14.20
Gain	kg/day	-	0.309	0.454
SID Lys Requirement	g/day	-	5.61	8.43
Digestible P Requirement	g/day	-	1.90	2.80
Available P Requirement	g/day	-	1.98	2.92
Metabolizable Energy Req.	kcal/day	-	1338	2145
Diet Metabolizable Energy	kcal/kg	3450	3450	3400
Diet Net Energy	kcal/kg	2588	2588	2550
Intake	kg/day	-	0.388	0.631
		Nutrients		
Calcium*	%	1.086	1.038	0.938
Available Phosphorus	%	0.514	0.491	0.443
Digestible Phosphorus	%	0.535	0.512	0.462
Potassium	%	0.527	0.522	0.506
Sodium	%	0.230	0.226	0.217
Chlorine	%	0.219	0.216	0.207
Linoleic Acid	%	0.554	0.380	0.248
		Digestible Protein and Amino Acid		
Digestible Protein	%	20.94	20.29	18.75
Lysine	%	1.493	1.446	1.336
Methionine	%	0.493	0.477	0.441
Methionine + Cysteine	%	0.896	0.868	0.802
Threonine	%	1.015	0.984	0.909
Tryptophan	%	0.313	0.304	0.281
Arginine	%	1.493	1.446	1.336
Valine	%	1.045	1.012	0.936
Isoleucine	%	0.821	0.796	0.735
Leucine	%	1.522	1.475	1.363
Histidine	%	0.493	0.477	0.441
Phenylalanine	%	0.806	0.781	0.722
Phenylalanine + Tyrosine	%	1.493	1.446	1.336
Digestible Essential Nitrogen	%	1.240	1.201	1.110
		Total Protein and Amino Acid		
Crude Protein	%	23.68	22.94	21.20
Lysine	%	1.696	1.644	1.519
Methionine	%	0.543	0.526	0.486
Methionine + Cysteine	%	1.001	0.970	0.896
Threonine	%	1.204	1.167	1.078
Tryptophan	%	0.356	0.345	0.319
Arginine	%	1.679	1.627	1.504
Valine	%	1.204	1.167	1.078
Isoleucine	%	0.933	0.904	0.835
Leucine	%	1.679	1.627	1.504
Histidine	%	0.543	0.526	0.486
Phenylalanine	%	0.899	0.871	0.805
Phenylalanine + Tyrosine	%	1.662	1.611	1.488
Total Essential Nitrogen	%	1.402	1.358	1.255

*Values between 0.800 and 0.700% of Total Calcium are recommended to reduce the incidence of diarrhea.

Table 5.33 - Nutritional Requirements of High Performance Barrows with High Genetic Potential

Phase		Starter	Grower		Finisher	
Age	Days	49 - 63	63 - 91	91- 119	119 - 147	147 - 175
Weight Range	kg	18 to 27	27 to 51	51 to 82	82 to 113	113 to 145
Average Weight	kg	22.22	38.35	66.13	97.70	129.23
Gain	kg/day	0.613	0.843	1.065	1.147	1.100
SID Lys Requirement	g/day	11.73	16.98	22.83	25.44	24.46
Digestible P Requirement	g/day	3.79	5.28	6.84	7.65	7.73
Available P Requirement	g/day	3.95	5.50	7.12	7.94	8.01
Metabolizable Energy Req.	kcal/day	3236	5362	8561	11094	12246
Diet Metabolizable Energy	kcal/kg	3350	3350	3350	3350	3350
Diet Net Energy	kcal/kg	2462	2543	2578	2601	2622
Intake	kg/day	0.966	1.601	2.556	3.312	3.655
				Nutrients		
Calcium	%	0.830	0.697	0.566	0.487	0.446
Digestible Phosphorus	%	0.392	0.330	0.268	0.231	0.211
Available Phosphorus	%	0.409	0.343	0.279	0.240	0.219
Potassium	%	0.488	0.467	0.433	0.398	0.368
Sodium	%	0.206	0.192	0.173	0.161	0.158
Chlorine	%	0.196	0.182	0.163	0.151	0.148
Linoleic Acid	%	0.174	0.121	0.092	0.086	0.091
				Digestible Protein and Amino Acid		
Digestible Protein	%	17.66	15.20	12.80	10.92	9.52
Lysine	%	1.214	1.061	0.893	0.768	0.669
Methionine	%	0.401	0.350	0.295	0.253	0.221
Methionine + Cysteine	%	0.728	0.636	0.536	0.461	0.401
Threonine	%	0.825	0.721	0.607	0.522	0.455
Tryptophan	%	0.243	0.212	0.179	0.154	0.134
Arginine	%	0.546	0.446	0.375	0.307	0.268
Valine	%	0.850	0.732	0.616	0.530	0.462
Isoleucine	%	0.668	0.583	0.491	0.422	0.368
Leucine	%	1.238	1.061	0.893	0.768	0.669
Histidine	%	0.401	0.350	0.295	0.253	0.221
Phenylalanine	%	0.655	0.573	0.482	0.415	0.361
Phenylalanine + Tyrosine	%	1.214	1.061	0.893	0.768	0.669
Digestible Essential Nitrogen	%	1.045	0.900	0.758	0.647	0.563
				Total Protein and Amino Acid		
Crude Protein	%	19.92	17.08	14.38	12.27	10.69
Lysine	%	1.379	1.205	1.015	0.873	0.760
Methionine	%	0.441	0.386	0.325	0.279	0.243
Methionine + Cysteine	%	0.814	0.711	0.599	0.515	0.449
Threonine	%	0.979	0.856	0.721	0.620	0.540
Tryptophan	%	0.276	0.241	0.203	0.175	0.152
Arginine	%	0.607	0.482	0.406	0.332	0.289
Valine	%	0.979	0.844	0.711	0.611	0.532
Isoleucine	%	0.759	0.663	0.558	0.480	0.418
Leucine	%	1.366	1.169	0.985	0.847	0.738
Histidine	%	0.441	0.386	0.325	0.279	0.243
Phenylalanine	%	0.731	0.639	0.538	0.463	0.403
Phenylalanine + Tyrosine	%	1.352	1.181	0.995	0.855	0.745
Total Essential Nitrogen	%	1.179	1.011	0.852	0.727	0.633

Table 5.34 - Nutritional Requirements of High Performance Barrows with High Genetic Potential Reared at +5 °C Above Thermo-neutral Temperature

Phase		Grower		Finisher	
Age	Days	63 - 91	91- 119	119 - 147	147 - 175
Weight Range	kg	27 to 51	51 to 82	82 to 113	113 to 145
Average Weight	kg	38.35	66.13	97.70	129.23
Gain	kg/day	0.843	1.065	1.147	1.100
SID Lys Requirement	g/day	16.98	22.83	25.44	24.46
Digestible P Requirement	g/day	5.28	6.84	7.65	7.73
Available P Requirement	g/day	5.50	7.12	7.94	8.01
Metabolizable Energy Req.	kcal/day	5177	8283	10721	11786
Diet Metabolizable Energy	kcal/kg	3350	3350	3350	3350
Diet Net Energy	kcal/kg	2535	2571	2596	2616
Intake	kg/day	1.545	2.472	3.200	3.518
			Nutrients		
Calcium	%	0.722	0.585	0.504	0.463
Digestible Phosphorus	%	0.341	0.277	0.239	0.220
Available Phosphorus	%	0.356	0.288	0.248	0.228
Potassium	%	0.467	0.433	0.398	0.368
Sodium	%	0.192	0.173	0.161	0.158
Chlorine	%	0.182	0.163	0.151	0.148
Linoleic Acid	%	0.125	0.095	0.089	0.094
			Digestible Protein and Amino Acid		
Digestible Protein	%	15.74	13.23	11.30	9.89
Lysine	%	1.099	0.923	0.795	0.695
Methionine	%	0.363	0.305	0.262	0.229
Methionine + Cysteine	%	0.659	0.554	0.477	0.417
Threonine	%	0.747	0.628	0.541	0.473
Tryptophan	%	0.220	0.185	0.159	0.139
Arginine	%	0.461	0.388	0.318	0.278
Valine	%	0.758	0.637	0.548	0.480
Isoleucine	%	0.604	0.508	0.437	0.382
Leucine	%	1.099	0.923	0.795	0.695
Histidine	%	0.363	0.305	0.262	0.229
Phenylalanine	%	0.593	0.499	0.429	0.375
Phenylalanine + Tyrosine	%	1.099	0.923	0.795	0.695
Digestible Essential Nitrogen	%	0.932	0.783	0.669	0.585
			Total Protein and Amino Acid		
Crude Protein	%	17.69	14.87	12.70	11.11
Lysine	%	1.249	1.049	0.903	0.790
Methionine	%	0.400	0.336	0.289	0.253
Methionine + Cysteine	%	0.737	0.619	0.533	0.466
Threonine	%	0.886	0.745	0.641	0.561
Tryptophan	%	0.250	0.210	0.181	0.158
Arginine	%	0.499	0.420	0.343	0.300
Valine	%	0.874	0.734	0.632	0.553
Isoleucine	%	0.687	0.577	0.497	0.435
Leucine	%	1.211	1.018	0.876	0.766
Histidine	%	0.400	0.336	0.289	0.253
Phenylalanine	%	0.662	0.556	0.479	0.419
Phenylalanine + Tyrosine	%	1.224	1.028	0.885	0.774
Total Essential Nitrogen	%	1.047	0.880	0.752	0.658

Table 5.35 - Nutritional Requirements of Standard Performance Barrows with High Genetic Potential

Phase		Starter	Grower		Finisher	
Age	Days	49 - 63	63 - 91	91- 119	119 - 147	147 - 175
Weight Range	kg	18 to 27	27 to 50	50 to 78	78 to 106	106 to 133
Average Weight	kg	22.43	37.85	63.65	92.18	120.00
Gain	kg/day	0.597	0.799	0.979	1.026	0.963
SID Lys Requirement	g/day	11.45	16.10	20.95	22.80	21.67
Digestible P Requirement	g/day	3.71	5.03	6.34	6.93	6.89
Available P Requirement	g/day	3.87	5.24	6.60	7.20	7.14
Metabolizable Energy Req.	kcal/day	3292	5285	8134	10274	11197
Diet Metabolizable Energy	kcal/kg	3250	3250	3250	3250	3250
Diet Net Energy	kcal/kg	2432	2464	2496	2487	2504
Intake	kg/day	1.013	1.626	2.503	3.161	3.445
				Nutrients		
Calcium	%	0.774	0.654	0.535	0.463	0.421
Available Phosphorus	%	0.366	0.309	0.253	0.219	0.200
Digestible Phosphorus	%	0.382	0.322	0.264	0.228	0.207
Potassium	%	0.473	0.454	0.423	0.392	0.365
Sodium	%	0.199	0.186	0.169	0.157	0.153
Chlorine	%	0.190	0.177	0.159	0.148	0.143
Linoleic Acid	%	0.167	0.118	0.093	0.087	0.092
				Digestible Protein and Amino Acid		
Digestible Protein	%	16.44	14.19	11.99	10.26	8.94
Lysine	%	1.130	0.990	0.837	0.721	0.629
Methionine	%	0.373	0.327	0.276	0.238	0.208
Methionine + Cysteine	%	0.678	0.594	0.502	0.433	0.377
Threonine	%	0.768	0.673	0.569	0.491	0.428
Tryptophan	%	0.226	0.198	0.167	0.144	0.126
Arginine	%	0.509	0.416	0.352	0.289	0.252
Valine	%	0.791	0.683	0.578	0.498	0.434
Isoleucine	%	0.622	0.545	0.460	0.397	0.346
Leucine	%	1.153	0.990	0.837	0.721	0.629
Histidine	%	0.373	0.327	0.276	0.238	0.208
Phenylalanine	%	0.610	0.535	0.452	0.390	0.340
Phenylalanine + Tyrosine	%	1.130	0.990	0.837	0.721	0.629
Digestible Essential Nitrogen	%	0.973	0.840	0.710	0.607	0.529
				Total Protein and Amino Acid		
Crude Protein	%	18.55	15.95	13.48	11.53	10.05
Lysine	%	1.284	1.125	0.951	0.820	0.715
Methionine	%	0.411	0.360	0.304	0.262	0.229
Methionine + Cysteine	%	0.758	0.664	0.561	0.484	0.422
Threonine	%	0.912	0.799	0.675	0.582	0.507
Tryptophan	%	0.257	0.225	0.190	0.164	0.143
Arginine	%	0.565	0.450	0.380	0.312	0.272
Valine	%	0.912	0.788	0.666	0.574	0.500
Isoleucine	%	0.706	0.619	0.523	0.451	0.393
Leucine	%	1.271	1.091	0.923	0.795	0.693
Histidine	%	0.411	0.360	0.304	0.262	0.229
Phenylalanine	%	0.681	0.596	0.504	0.434	0.379
Phenylalanine + Tyrosine	%	1.258	1.103	0.932	0.803	0.700
Total Essential Nitrogen	%	1.098	0.944	0.798	0.682	0.595

Table 5.36 - Nutritional Requirements of High Performance Gilts with High Genetic Potential

Phase		Starter	Grower		Finisher	
Age	Days	49 - 63	63 - 91	91 - 119	119 - 147	147 - 175
Weight Range	kg	18 to 27	27 to 50	50 to 77	77 to 107	107 to 137
Average Weight	Kg	22.16	37.04	62.53	91.86	121.84
Gain	kg/day	0.572	0.774	0.980	1.073	1.057
SID Lys Requirement	g/day	11.16	16.10	21.66	23.84	21.99
Digestible P Requirement	g/day	3.57	4.89	6.33	7.18	7.42
Available P Requirement	g/day	3.72	5.09	6.59	7.46	7.69
Metabolizable Energy Req.	kcal/day	2993	4732	7365	9639	10980
Diet Metabolizable Energy	kcal/kg	3350	3350	3350	3350	3350
Diet Net Energy	kcal/kg	2501	2526	2550	2556	2604
Intake	kg/day	0.893	1.412	2.198	2.877	3.277
				Nutrients		
Calcium	%	0.845	0.731	0.609	0.527	0.477
Available Phosphorus	%	0.400	0.346	0.288	0.250	0.226
Digestible Phosphorus	%	0.416	0.360	0.300	0.259	0.235
Potassium	%	0.488	0.469	0.437	0.404	0.374
Sodium	%	0.206	0.193	0.175	0.162	0.158
Chlorine	%	0.196	0.183	0.165	0.152	0.147
Linoleic Acid	%	0.189	0.135	0.105	0.095	0.098
				Digestible Protein and Amino Acid		
Digestible Protein	%	18.18	16.33	14.12	11.78	9.54
Lysine	%	1.249	1.140	0.985	0.828	0.671
Methionine	%	0.412	0.376	0.325	0.273	0.221
Methionine + Cysteine	%	0.750	0.684	0.591	0.497	0.402
Threonine	%	0.850	0.775	0.670	0.563	0.456
Tryptophan	%	0.250	0.228	0.197	0.166	0.134
Arginine	%	0.562	0.479	0.414	0.331	0.268
Valine	%	0.875	0.787	0.680	0.572	0.463
Isoleucine	%	0.687	0.627	0.542	0.456	0.369
Leucine	%	1.274	1.140	0.985	0.828	0.671
Histidine	%	0.412	0.376	0.325	0.273	0.221
Phenylalanine	%	0.675	0.616	0.532	0.447	0.362
Phenylalanine + Tyrosine	%	1.249	1.140	0.985	0.828	0.671
Digestible Essential Nitrogen	%	1.076	0.967	0.836	0.697	0.565
				Total Protein and Amino Acid		
Crude Protein	%	20.51	18.35	15.87	13.24	10.72
Lysine	%	1.420	1.295	1.120	0.941	0.762
Methionine	%	0.454	0.414	0.358	0.301	0.244
Methionine + Cysteine	%	0.838	0.764	0.661	0.555	0.450
Threonine	%	1.008	0.920	0.795	0.668	0.541
Tryptophan	%	0.284	0.259	0.224	0.188	0.152
Arginine	%	0.625	0.518	0.448	0.358	0.290
Valine	%	1.008	0.907	0.784	0.659	0.534
Isoleucine	%	0.781	0.712	0.616	0.518	0.419
Leucine	%	1.406	1.256	1.086	0.913	0.739
Histidine	%	0.454	0.414	0.358	0.301	0.244
Phenylalanine	%	0.752	0.687	0.593	0.499	0.404
Phenylalanine + Tyrosine	%	1.391	1.269	1.097	0.923	0.747
Total Essential Nitrogen	%	1.214	1.087	0.939	0.784	0.635

Table 5.37 - Nutritional Requirements of High Performance Gilts with High Genetic Potential Reared at +5 °C Above Thermo-neutral Temperature

Phase		Grower		Finisher	
Age	Days	63 - 91	91 - 119	119 - 147	147 - 175
Weight Range	kg	27 to 50	50 to 77	77 to 107	107 to 137
Average Weight	kg	37.04	62.53	91.86	121.84
Gain	kg/day	0.774	0.980	1.073	1.057
SID Lys Requirement	g/day	16.10	21.66	23.84	21.99
Digestible P Requirement	g/day	4.89	6.33	7.18	7.42
Available P Requirement	g/day	5.09	6.59	7.46	7.69
Metabolizable Energy Req.	kcal/day	4552	7098	9283	10539
Diet Metabolizable Energy	kcal/kg	3350	3350	3350	3350
Diet Net Energy	kcal/kg	2517	2551	2583	2616
Intake	kg/day	1.359	2.119	2.771	3.146
			Nutrients		
Calcium	%	0.760	0.631	0.547	0.497
Digestible Phosphorus	%	0.360	0.299	0.259	0.236
Available Phosphorus	%	0.375	0.311	0.269	0.244
Potassium	%	0.469	0.437	0.404	0.374
Sodium	%	0.193	0.175	0.162	0.158
Chlorine	%	0.183	0.165	0.152	0.147
Linoleic Acid	%	0.141	0.108	0.099	0.102
			Digestible Protein and Amino Acid		
Digestible Protein	%	16.98	14.65	12.23	9.94
Lysine	%	1.185	1.022	0.860	0.699
Methionine	%	0.391	0.337	0.284	0.231
Methionine + Cysteine	%	0.711	0.613	0.516	0.419
Threonine	%	0.806	0.695	0.585	0.475
Tryptophan	%	0.237	0.204	0.172	0.140
Arginine	%	0.498	0.429	0.344	0.280
Valine	%	0.818	0.705	0.594	0.482
Isoleucine	%	0.652	0.562	0.473	0.384
Leucine	%	1.185	1.022	0.860	0.699
Histidine	%	0.391	0.337	0.284	0.231
Phenylalanine	%	0.640	0.552	0.465	0.377
Phenylalanine + Tyrosine	%	1.185	1.022	0.860	0.699
Digestible Essential Nitrogen	%	1.005	0.867	0.724	0.588
			Total Protein and Amino Acid		
Crude Protein		19.08	16.46	13.75	11.17
Lysine	%	1.347	1.162	0.978	0.794
Methionine	%	0.794	0.685	0.577	0.469
Methionine + Cysteine	%	0.431	0.372	0.313	0.254
Threonine	%	0.956	0.825	0.694	0.564
Tryptophan	%	0.269	0.232	0.196	0.159
Arginine	%	0.539	0.465	0.371	0.302
Valine	%	0.943	0.813	0.684	0.556
Isoleucine	%	0.741	0.639	0.538	0.437
Leucine	%	1.306	1.127	0.948	0.770
Histidine	%	0.431	0.372	0.313	0.254
Phenylalanine	%	0.714	0.616	0.518	0.421
Phenylalanine + Tyrosine	%	1.320	1.138	0.958	0.778
Total Essential Nitrogen	%	1.130	0.975	0.814	0.661

Table 5.38 - Nutritional Requirements of Standard Performance Gilts with High Genetic Potential

Phase		Starter	Grower		Finisher	
Age	Days	49 - 63	63 - 91	91 - 119	119 - 147	147 - 175
Weight Range	kg	15 to 25	25 to 45	45 to 70	70 to 100	100 to 129
Average Weight	kg	20.20	34.09	58.11	85.95	114.56
Gain	kg/day	0.531	0.725	0.926	1.021	1.011
SID Lys Requirement	g/day	10.25	14.92	20.36	22.83	21.58
Digestible P Requirement	g/day	3.31	4.58	5.99	6.83	7.09
Available P Requirement	g/day	3.45	4.77	6.23	7.10	7.35
Metabolizable Energy Req.	kcal/day	2810	4466	7013	9271	10669
Diet Metabolizable Energy	kcal/kg	3250	3250	3250	3250	3250
Diet Net Energy	kcal/kg	2421	2444	2475	2471	2499
Intake	kg/day	0.865	1.374	2.158	2.853	3.283
				Nutrients		
Calcium	%	0.810	0.704	0.586	0.506	0.455
Available Phosphorus	%	0.383	0.333	0.277	0.240	0.216
Digestible Phosphorus	%	0.399	0.347	0.289	0.249	0.224
Potassium	%	0.476	0.458	0.429	0.399	0.370
Sodium	%	0.201	0.189	0.172	0.159	0.153
Chlorine	%	0.192	0.180	0.163	0.150	0.143
Linoleic Acid	%	0.191	0.136	0.103	0.093	0.094
				Digestible Protein and Amino Acid		
Digestible Protein	%	17.25	15.56	13.52	11.38	9.35
Lysine	%	1.185	1.086	0.944	0.800	0.657
Methionine	%	0.391	0.358	0.311	0.264	0.217
Methionine + Cysteine	%	0.711	0.651	0.566	0.480	0.394
Threonine	%	0.806	0.738	0.642	0.544	0.447
Tryptophan	%	0.237	0.217	0.189	0.160	0.131
Arginine	%	0.533	0.456	0.396	0.320	0.263
Valine	%	0.830	0.749	0.651	0.552	0.454
Isoleucine	%	0.652	0.597	0.519	0.440	0.362
Leucine	%	1.209	1.086	0.944	0.800	0.657
Histidine	%	0.391	0.358	0.311	0.264	0.217
Phenylalanine	%	0.640	0.586	0.509	0.432	0.355
Phenylalanine + Tyrosine	%	1.185	1.086	0.944	0.800	0.657
Digestible Essential Nitrogen	%	1.021	0.921	0.800	0.674	0.553
				Total Protein and Amino Acid		
Crude Protein	%	19.46	17.48	15.19	12.79	10.50
Lysine	%	1.347	1.234	1.072	0.909	0.747
Methionine	%	0.431	0.395	0.343	0.291	0.239
Methionine + Cysteine	%	0.795	0.728	0.633	0.536	0.441
Threonine	%	0.956	0.876	0.761	0.646	0.530
Tryptophan	%	0.269	0.247	0.214	0.182	0.149
Arginine	%	0.593	0.493	0.429	0.346	0.284
Valine	%	0.956	0.864	0.751	0.637	0.523
Isoleucine	%	0.741	0.679	0.590	0.500	0.411
Leucine	%	1.334	1.197	1.040	0.882	0.725
Histidine	%	0.431	0.395	0.343	0.291	0.239
Phenylalanine	%	0.714	0.654	0.568	0.482	0.396
Phenylalanine + Tyrosine	%	1.320	1.209	1.051	0.891	0.732
Total Essential Nitrogen	%	1.152	1.035	0.899	0.757	0.622

Table 5.39 - Nutritional Requirements of Standard Performance Entire Males and Immuno-Castrated Males with High Genetic Potential

Phase		Starter	Grower		Finisher	
Age	Days	49 - 63	63 - 91	91- 119	119 - 147	147 - 175
Weight Range	kg	17 to 26	26 to 49	49 to 80	80 to 116	116 to 156
Average Weight	kg	21.48	36.16	63.10	97.20	135.91
Gain	kg/day	0.548	0.776	1.069	1.296	1.421
SID Lys Requirement	g/day	10.70	16.12	23.28	26.63	28.14
Digestible P Requirement	g/day	3.43	4.88	6.83	8.45	9.53
Available P Requirement	g/day	3.57	5.08	7.10	8.78	9.90
Metabolizable Energy Req.	kcal/day	2761	4488	7161	9014	12569
Diet Metabolizable Energy	kcal/kg	3300	3300	3300	3300	3250
Diet Net Energy	kcal/kg	2455	2473	2494	2511	2485
Intake	kg/day	0.837	1.360	2.170	2.732	3.867
				Nutrients		
Calcium	%	0.867	0.759	0.665	0.653	0.520
Digestible Phosphorus	%	0.410	0.359	0.315	0.309	0.246
Available Phosphorus	%	0.427	0.374	0.327	0.322	0.256
Potassium	%	0.482	0.463	0.430	0.393	0.351
Sodium	%	0.203	0.190	0.172	0.158	0.154
Chlorine	%	0.193	0.181	0.162	0.148	0.144
Linoleic Acid	%	0.200	0.140	0.106	0.103	0.088
				Digestible Protein and Amino Acid		
Digestible Protein	%	18.61	16.99	15.38	13.86	10.35
Lysine	%	1.279	1.186	1.073	0.975	0.728
Methionine	%	0.422	0.391	0.354	0.322	0.240
Methionine + Cysteine	%	0.768	0.711	0.644	0.585	0.437
Threonine	%	0.870	0.806	0.730	0.663	0.495
Tryptophan	%	0.256	0.237	0.215	0.195	0.146
Arginine	%	0.576	0.498	0.451	0.390	0.291
Valine	%	0.895	0.818	0.740	0.673	0.502
Isoleucine	%	0.704	0.652	0.590	0.536	0.400
Leucine	%	1.305	1.186	1.073	0.975	0.728
Histidine	%	0.422	0.391	0.354	0.322	0.240
Phenylalanine	%	0.691	0.640	0.579	0.526	0.393
Phenylalanine + Tyrosine	%	1.279	1.186	1.073	0.975	0.728
Digestible Essential Nitrogen	%	1.102	1.006	0.910	0.821	0.613
				Total Protein and Amino Acid		
Crude Protein	%	21.00	19.09	17.28	15.58	11.63
Lysine	%	1.454	1.347	1.219	1.108	0.827
Methionine	%	0.465	0.431	0.390	0.354	0.265
Methionine + Cysteine	%	0.858	0.795	0.719	0.654	0.488
Threonine	%	1.032	0.957	0.866	0.786	0.587
Tryptophan	%	0.291	0.269	0.244	0.222	0.165
Arginine	%	0.640	0.539	0.488	0.421	0.314
Valine	%	1.032	0.943	0.854	0.775	0.579
Isoleucine	%	0.800	0.741	0.671	0.609	0.455
Leucine	%	1.439	1.307	1.183	1.074	0.802
Histidine	%	0.465	0.431	0.390	0.354	0.265
Phenylalanine	%	0.770	0.714	0.646	0.587	0.438
Phenylalanine + Tyrosine	%	1.425	1.320	1.195	1.086	0.810
Total Essential Nitrogen	%	1.243	1.130	1.023	0.922	0.688

Table 5.40 - Nutritional Requirements of High Performance Entire Males and Immuno-Castrated Males with High Genetic Potential Reared at +5 °C Above Thermo-neutral Temperature

Phase		Grower		Finisher	
Age	Days	63 - 91	91- 119	119 - 147	147 - 175
Weight Range	kg	25 to 45	45 to 70	70 to 105	105 to 145
Average Weight	kg	36.16	63.10	97.20	135.91
Gain	kg/day	0.776	1.069	1.296	1.421
SID Lys Requirement	g/day	16.12	23.28	26.63	28.14
Digestible P Requirement	g/day	4.88	6.83	8.45	9.53
Available P Requirement	g/day	5.08	7.10	8.78	9.90
Metabolizable Energy Req.	kcal/day	4311	6892	8643	12091
Diet Metabolizable Energy	kcal/kg	3300	3300	3300	3250
Diet Net Energy	kcal/kg	2462	2485	2502	2479
Intake	kg/day	1.306	2.088	2.619	3.720
			Nutrients		
Calcium	%	0.790	0.691	0.681	0.541
Digestible Phosphorus	%	0.374	0.327	0.323	0.256
Available Phosphorus	%	0.389	0.340	0.335	0.266
Potassium	%	0.463	0.430	0.393	0.351
Sodium	%	0.190	0.172	0.158	0.154
Chlorine	%	0.181	0.162	0.148	0.144
Linoleic Acid	%	0.145	0.110	0.108	0.092
			Digestible Protein and Amino Acid		
Digestible Protein	%	17.69	15.97	14.46	10.76
Lysine	%	1.234	1.115	1.017	0.756
Methionine	%	0.407	0.368	0.336	0.250
Methionine + Cysteine	%	0.741	0.669	0.610	0.454
Threonine	%	0.839	0.758	0.691	0.514
Tryptophan	%	0.247	0.223	0.203	0.151
Arginine	%	0.518	0.468	0.407	0.303
Valine	%	0.852	0.769	0.702	0.522
Isoleucine	%	0.679	0.613	0.559	0.416
Leucine	%	1.234	1.115	1.017	0.756
Histidine	%	0.407	0.368	0.336	0.250
Phenylalanine	%	0.667	0.602	0.549	0.408
Phenylalanine + Tyrosine	%	1.234	1.115	1.017	0.756
Digestible Essential Nitrogen	%	1.047	0.946	0.856	0.637
			Total Protein and Amino Acid		
Crude Protein	%	19.88	17.95	16.25	12.09
Lysine	%	1.403	1.267	1.155	0.859
Methionine	%	0.449	0.405	0.370	0.275
Methionine + Cysteine	%	0.828	0.747	0.682	0.507
Threonine	%	0.996	0.899	0.820	0.610
Tryptophan	%	0.281	0.253	0.231	0.172
Arginine	%	0.561	0.507	0.439	0.327
Valine	%	0.982	0.887	0.809	0.602
Isoleucine	%	0.771	0.697	0.635	0.473
Leucine	%	1.361	1.229	1.121	0.834
Histidine	%	0.449	0.405	0.370	0.275
Phenylalanine	%	0.743	0.671	0.612	0.456
Phenylalanine + Tyrosine	%	1.375	1.242	1.132	0.842
Total Essential Nitrogen	%	1.177	1.063	0.962	0.715

Table 5.41 - Nutritional Requirements of High Performance Mixed-Sex Pigs with High Genetic Potential

Phase		Starter	Grower		Finisher	
Age	Days	49 - 63	63 - 91	91 - 119	119 - 147	147 - 175
Weight Range	kg	18 to 27	27 to 50	50 to 80	80 to 110	110 to 141
Average Weight	kg	22.19	37.70	64.33	94.78	125.54
Gain	kg/day	0.593	0.809	1.023	1.110	1.079
SID Lys Requirement	g/day	11.45	16.54	22.25	24.64	23.23
Digestible P Requirement	g/day	3.68	5.09	6.59	7.42	7.58
Available P Requirement	g/day	3.84	5.30	6.86	7.70	7.85
Metabolizable Energy Req.	kcal/day	3115	5047	7963	10367	11613
Diet Metabolizable Energy	kcal/kg	3350	3350	3350	3350	3350
Diet Net Energy	kcal/kg	2482	2535	2564	2579	2613
Intake	kg/day	0.930	1.507	2.377	3.095	3.466
				Nutrients		
Calcium	%	0.838	0.714	0.588	0.507	0.462
Available Phosphorus	%	0.396	0.338	0.278	0.241	0.219
Digestible Phosphorus	%	0.413	0.352	0.290	0.250	0.227
Potassium	%	0.488	0.468	0.435	0.401	0.371
Sodium	%	0.206	0.192	0.172	0.158	0.154
Chlorine	%	0.196	0.183	0.158	0.150	0.147
Linoleic Acid	%	0.182	0.128	0.099	0.091	0.095
				Digestible Protein and Amino Acid		
Digestible Protein	%	17.92	15.77	13.46	11.35	9.53
Lysine	%	1.232	1.101	0.939	0.798	0.670
Methionine	%	0.407	0.363	0.310	0.263	0.221
Methionine + Cysteine	%	0.739	0.660	0.564	0.479	0.402
Threonine	%	0.838	0.748	0.639	0.543	0.456
Tryptophan	%	0.247	0.220	0.188	0.160	0.134
Arginine	%	0.554	0.463	0.395	0.319	0.268
Valine	%	0.863	0.760	0.648	0.551	0.463
Isoleucine	%	0.678	0.605	0.517	0.439	0.369
Leucine	%	1.256	1.101	0.939	0.798	0.670
Histidine	%	0.407	0.363	0.310	0.263	0.221
Phenylalanine	%	0.665	0.595	0.507	0.431	0.362
Phenylalanine + Tyrosine	%	1.232	1.101	0.939	0.798	0.670
Digestible Essential Nitrogen	%	1.061	0.934	0.797	0.672	0.564
				Total Protein and Amino Acid		
Crude Protein	%	20.22	17.72	15.13	12.76	10.71
Lysine	%	1.400	1.250	1.068	0.907	0.761
Methionine	%	0.448	0.400	0.342	0.290	0.244
Methionine + Cysteine	%	0.826	0.738	0.630	0.535	0.450
Threonine	%	0.994	0.888	0.758	0.644	0.541
Tryptophan	%	0.280	0.250	0.214	0.182	0.152
Arginine	%	0.616	0.500	0.427	0.345	0.290
Valine	%	0.994	0.876	0.748	0.635	0.533
Isoleucine	%	0.770	0.688	0.587	0.499	0.419
Leucine	%	1.386	1.213	1.036	0.880	0.739
Histidine	%	0.448	0.400	0.342	0.290	0.244
Phenylalanine	%	0.742	0.663	0.566	0.481	0.404
Phenylalanine + Tyrosine	%	1.372	1.225	1.046	0.889	0.746
Total Essential Nitrogen	%	1.197	1.049	0.896	0.756	0.634

Table 5.42 - Nutritional Requirements of High Performance Mixed-Sex Pigs with High Genetic Potential Reared at +5 ºC Above Thermo-neutral Temperature

Phase		Grower		Finisher	
Age	Days	63 - 91	91 - 119	119 - 147	147 - 175
Weight Range	kg	27 to 50	50 to 80	80 to 110	110 to 141
Average Weight	kg	37.70	64.33	94.78	125.54
Gain	kg/day	0.809	1.023	1.110	1.079
SID Lys Requirement	g/day	16.54	22.24	24.64	23.23
Digestible P Requirement	g/day	5.08	6.59	7.41	7.57
Available P Requirement	g/day	5.29	6.85	7.70	7.85
Metabolizable Energy Req.	kcal/day	4865	7691	10002	11163
Diet Metabolizable Energy	kcal/kg	3350	3350	3350	3350
Diet Net Energy	kcal/kg	2526	2561	2590	2616
Intake	kg/day	1.452	2.296	2.986	3.332
			Nutrients		
Calcium	%	0.741	0.608	0.526	0.480
Digestible Phosphorus	%	0.351	0.288	0.249	0.228
Available Phosphorus	%	0.366	0.300	0.259	0.236
Potassium	%	0.468	0.435	0.401	0.371
Sodium	%	0.193	0.174	0.162	0.158
Chlorine	%	0.183	0.164	0.152	0.148
Linoleic Acid	%	0.133	0.102	0.094	0.098
			Digestible Protein and Amino Acid		
Digestible Protein	%	16.36	13.94	11.77	9.92
Lysine	%	1.142	0.973	0.828	0.697
Methionine	%	0.377	0.321	0.273	0.230
Methionine + Cysteine	%	0.685	0.584	0.497	0.418
Threonine	%	0.777	0.662	0.563	0.474
Tryptophan	%	0.229	0.195	0.166	0.140
Arginine	%	0.480	0.409	0.331	0.279
Valine	%	0.788	0.671	0.571	0.481
Isoleucine	%	0.628	0.535	0.455	0.383
Leucine	%	1.142	0.973	0.828	0.697
Histidine	%	0.377	0.321	0.273	0.230
Phenylalanine	%	0.617	0.526	0.447	0.376
Phenylalanine + Tyrosine	%	1.142	0.973	0.828	0.697
Digestible Essential Nitrogen	%	0.969	0.825	0.697	0.587
			Total Protein and Amino Acid		
Crude Protein		18.67	15.91	13.43	11.30
Lysine	%	1.298	1.106	0.941	0.792
Methionine	%	0.419	0.357	0.303	0.256
Methionine + Cysteine	%	0.766	0.652	0.555	0.468
Threonine	%	0.921	0.785	0.668	0.563
Tryptophan	%	0.260	0.221	0.189	0.159
Arginine	%	0.519	0.443	0.357	0.301
Valine	%	0.909	0.774	0.658	0.555
Isoleucine	%	0.714	0.608	0.518	0.436
Leucine	%	1.259	1.073	0.912	0.768
Histidine	%	0.416	0.354	0.301	0.254
Phenylalanine	%	0.681	0.580	0.494	0.416
Phenylalanine + Tyrosine	%	1.272	1.083	0.922	0.776
Total Essential Nitrogen	%	1.105	0.942	0.795	0.669

Table 5.43 - Nutritional Requirements of Standard Performance Mixed-Sex Pigs with High Genetic Potential

Phase		Starter	Grower		Finisher	
Age	Days	49 - 63	63 - 91	91 - 119	119 - 147	147 - 175
Weight Range	kg	16 to 26	26 to 47	47 to 74	74 to 103	103 to 131
Average Weight	kg	21.32	35.97	60.88	89.07	117.28
Gain	kg/day	0.564	0.762	0.953	1.024	0.987
SID Lys Requirement	g/day	10.85	15.51	20.66	22.82	21.63
Digestible P Requirement	g/day	3.51	4.81	6.17	6.88	6.99
Available P Requirement	g/day	3.66	5.01	6.42	7.15	7.25
Metabolizable Energy Req.	kcal/day	3051	4876	7574	9773	10933
Diet Metabolizable Energy	kcal/kg	3250	3250	3250	3250	3250
Diet Net Energy	kcal/kg	2427	2454	2486	2479	2501
Intake	kg/day	0.939	1.500	2.331	3.007	3.364
				Nutrients		
Calcium	%	0.792	0.679	0.561	0.485	0.438
Available Phosphorus	%	0.375	0.321	0.265	0.230	0.208
Digestible Phosphorus	%	0.391	0.335	0.277	0.239	0.216
Potassium	%	0.475	0.456	0.426	0.396	0.368
Sodium	%	0.200	0.188	0.171	0.158	0.153
Chlorine	%	0.191	0.179	0.161	0.149	0.143
Linoleic Acid	%	0.179	0.127	0.098	0.090	0.093
				Digestible Protein and Amino Acid		
Digestible Protein	%	16.85	14.88	12.76	10.82	9.15
Lysine	%	1.158	1.038	0.891	0.761	0.643
Methionine	%	0.382	0.343	0.294	0.251	0.213
Methionine + Cysteine	%	0.695	0.623	0.534	0.457	0.386
Threonine	%	0.787	0.706	0.606	0.518	0.438
Tryptophan	%	0.232	0.208	0.178	0.152	0.129
Arginine	%	0.521	0.436	0.374	0.305	0.258
Valine	%	0.811	0.716	0.615	0.525	0.444
Isoleucine	%	0.637	0.571	0.490	0.419	0.354
Leucine	%	1.181	1.038	0.891	0.761	0.643
Histidine	%	0.382	0.343	0.294	0.251	0.213
Phenylalanine	%	0.625	0.561	0.481	0.411	0.348
Phenylalanine + Tyrosine	%	1.158	1.038	0.891	0.761	0.643
Digestible Essential Nitrogen	%	0.997	0.881	0.755	0.641	0.541
				Total Protein and Amino Acid		
Crude Protein	%	19.01	16.72	14.34	12.16	10.28
Lysine	%	1.316	1.180	1.012	0.865	0.731
Methionine	%	0.421	0.378	0.324	0.277	0.234
Methionine + Cysteine	%	0.777	0.696	0.597	0.510	0.432
Threonine	%	0.934	0.838	0.718	0.614	0.519
Tryptophan	%	0.263	0.236	0.202	0.173	0.146
Arginine	%	0.579	0.472	0.405	0.329	0.278
Valine	%	0.934	0.826	0.709	0.606	0.512
Isoleucine	%	0.724	0.649	0.557	0.476	0.402
Leucine	%	1.303	1.144	0.982	0.839	0.709
Histidine	%	0.421	0.378	0.324	0.277	0.234
Phenylalanine	%	0.698	0.625	0.536	0.458	0.388
Phenylalanine + Tyrosine	%	1.289	1.156	0.992	0.847	0.716
Total Essential Nitrogen	%	1.125	0.990	0.849	0.720	0.609

Table 5.44 - Changes in Performance and Standardized Digestible Lysine (SID Lys) Requirements of High and Standard Performance Growing Mixed-Sex Pigs Fed Diets Containing Different Ractopamine Levels[1]

Days of Usage	High			Standard	
	Ractopamine Levels (ppm)				
	0	10	20	10	20
	Change in Weight Gain (g/day)				
21	0	+0.154	+0.176	+0.141	+0.162
28	0	+0.129	+0.151	+0.118	+0.138
	Change in Feed Intake (g/day)				
21	0	-44	-86	-41	-82
28	0	-56	-116	-51	-106
	Change in SID Lys Requirement (g/day)				
21	0	+3.87	+4.42	+3.59	+4.10
28	0	+3.16	+3.69	+2.95	+3.44
	Change in SID Lys Requirement (%)				
21	0	0.839	0.866	0.862	0.889
28	0	0.770	0.798	0.797	0.825

[1] Values were estimated according to two Thesis of the Department of Animal Science (UFV) and the model proposed by Schinckel et al. (J. Anim. Sci. 81:1106, 2003).

Table 5.45 - Example of Performance and Nutritional Requirements of High Performance Finishing Mixed-Sex Pigs with 125 kg Average Weight (110-140 kg) Fed Diets Containing Different Ractopamine Levels for 21 or 28 days

Days of Usage		21		28	
Ractopamine (ppm)		10	20	10	20
Gain	kg/day	1.256	1.278	1.208	1.230
SID Lys Requirement	g/day	27.87	28.42	26.24	26.77
Digestible Phosphorus	g/day	8.43	8.55	8.31	8.43
Available Phosphorus	g/day	8.76	8.88	8.62	8.75
Metabolizable Energy Req.	kcal/day	11135	10994	11424	11241
Diet Metabolizable Energy	kcal/kg	3350	3350	3350	3350
Diet Net Energy	kcal/kg	2612	2612	2612	2612
Feed Intake	kg/day	3.324	3.282	3.410	3.355
			Nutrients		
Calcium	%	0.535	0.550	0.514	0.530
Digestible Phosphorus	%	0.254	0.261	0.244	0.251
Available Phosphorus	%	0.263	0.271	0.253	0.261
Potassium	%	0.382	0.382	0.371	0.371
Sodium	%	0.158	0.158	0.158	0.158
Chlorine	%	0.148	0.148	0.147	0.147
Linoleic Acid	%	0.093	0.094	0.095	0.097
			Digestible Protein and Amino Acid		
Digestible Protein	%	11.93	12.32	10.94	11.35
Lysine	%	0.839	0.866	0.770	0.798
Methionine	%	0.277	0.286	0.254	0.263
Methionine + Cysteine	%	0.503	0.520	0.462	0.479
Threonine	%	0.570	0.589	0.523	0.543
Tryptophan	%	0.168	0.173	0.154	0.160
Arginine	%	0.335	0.346	0.308	0.319
Valine	%	0.579	0.598	0.531	0.551
Isoleucine	%	0.461	0.476	0.423	0.439
Leucine	%	0.839	0.866	0.770	0.798
Histidine	%	0.277	0.286	0.254	0.263
Phenylalanine	%	0.453	0.468	0.416	0.431
Phenylalanine + Tyrosine	%	0.839	0.866	0.770	0.798
Digestible Essential Nitrogen	%	0.706	0.729	0.648	0.672
			Total Protein and Amino Acid		
Crude Protein		13.40	13.84	12.30	12.75
Lysine	%	0.953	0.984	0.875	0.907
Methionine	%	0.305	0.315	0.280	0.290
Methionine + Cysteine	%	0.562	0.581	0.516	0.535
Threonine	%	0.677	0.699	0.621	0.644
Tryptophan	%	0.191	0.197	0.175	0.181
Arginine	%	0.362	0.374	0.332	0.345
Valine	%	0.667	0.689	0.612	0.635
Isoleucine	%	0.524	0.541	0.481	0.499
Leucine	%	0.924	0.955	0.848	0.879
Histidine	%	0.305	0.315	0.280	0.290
Phenylalanine	%	0.505	0.522	0.464	0.481
Phenylalanine + Tyrosine	%	0.934	0.965	0.857	0.889
Total Essential Nitrogen	%	0.793	0.819	0.728	0.755