Brazilian Tables for Poultry and Swine

Composition of Feedstuffs and Nutritional Requirements

3rd edition

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We also especially thank the companies Ajinomoto, Evonik and Adisseo for performing a large number of amino acid analyses of feedstuffs and digesta of the poultry and swine experiments. We also thank the company AB Vista for the phosphorus and phytate analysis in Brazilian feedstuffs.

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PRESENTATION

Brazil is one of the world's largest poultry and swine producer, and consequently, of compound feeds as well.

The general level of technology used in the Brazilian poultry and swine industries is generally high, especially in the feed industry. However, feed formulation technology previously used information on feedstuff composition and nutritional requirements determined mainly in the United States and in Europe. The tables used for feed calculation, both in companies and in research institutions, were published abroad, or published in Brazil, but using data generated abroad.

It is indubitable that the use of foreign tables promoted the adoption of cutting-edge technology, allowing the development observed in the Brazilian industry today. However, in many aspects, those tables cannot be fully applied to Brazilian circumstances.

The Department of Animal Science of the Federal University of Viçosa has performed experiments and research studied aiming at developing a table of feedstuff composition and nutritional requirements of poultry and swine using data generated in Brazil. This resulted in the publication of the first BRAZILIAN TABLES OF FEEDSTUFF COMPOSITION AND NUTRITIONAL REQUIREMENTS in 1983, and subsequently the 1st edition of the Brazilian Tables in 2000, and the 2nd edition in 2005. The studies carried out since 2005 allowed the update of that information, with the consequent publication of the 3rd edition.

Most of the data presented here were already published in scientific journals, M. Sc. and Ph. D. Theses, as well as in the proceedings of scientific meetings and congresses.

Most papers can be retrieved in Revista Brasileira de Zootecnia, in the proceedings of the meetings of the Brazilian Society of Animal Science, and in the proceedings of APINCO Foundation of Poultry Science and Technology, as well as in other media.

To prepare the Brazilian Tables of Feedstuff Composition, thousands of ingredients produced in Brazil were analyzed. Specifically, for the determination of energy values, tens of trials with animals and numerous chemical analyses were carried out.

The determination of nutritional requirements involved the performance of many biological assays with broilers, layers, and swine in different production stages and under different environmental and temperature conditions.

The data obtained were tested under stringent experimental conditions, involving the observation of commercial-size groups of animals. Least cost feeds were calculated using feedstuff nutritional values and nutritional requirements determined in our university, and compared to feeds which calculation was based on international tables.

The new information published here will allow the Brazilian animal scientists to formulate more cost-effective feeds for poultry and swine.

The aim of the authors was to contribute for the improvement of animal production in Brazil. Nevertheless, although these tables make important contributions to the achievement of the objective, further development is needed. More experiments and the collaboration of researchers, technicians, and producers will allow further improvement of the information presented in this book.

The authors

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CHAPTER 1

Composition of Feedstuffs and of Vitamin and Mineral Supplements

INTRODUCTION

Chemical analyses of the ingredients deserved special care. Most of these analyses were carried out at the Animal Nutrition Laboratory of the Department of Animal Sciences of the Federal University of Viçosa (UFV).

* The following methodologies were adopted for the determination of the chemical composition: dry matter content (DM), sample dried in oven at 105 ^{o}C for 4 to 6 hours; crude protein (CP), classic method of Kjedahl; ether extract (EE), hot method, using "Goldfisch" extract, and petrol ether as solvent; starch, using enzymatic method; crude fiber (CF), using the method of Weende; neutral detergent fiber (NDF) and acid detergent fiber (ADF), method of Van Soest; gross energy (GE), "Parr" bomb calorimeter; ash, sample was incinerated at 600 ^{o}C for 4 hours; minerals were determined by atomic absorption spectrophotometer, except for sodium and potassium (flame spectrophotometer), and phosphorus by colorimeter. In a limited number of feedstuffs, minerals were also analyzed by the plasma induction spectrophotometer of the Department of Soils of UFV. A table with fatty-acid profile determined by chromatography, of the most important oils and fats used in animal feeds was included (Table 1.06).

* Potassium, sodium and chloride content in the feedstuffs were included in Table 1.01 to allow the calculation of the electrolytic balance of poultry and swine feeds.

* Metabolizable energy (ME) in feedstuffs for poultry was determined using, in general, the method of total excreta collection. However, the ME values of several feedstuffs were also determined using chromium oxide or insoluble acid ash (IAA) were used as fecal marker. The $ME_{poultry}$ values presented in Table 1.0 are values corrected for nitrogen retention and were determined in broilers of different ages. Studies carried

out at UFV to evaluate the influence of bird age on feedstuff energy values allowed us to conclude that mature birds generally obtained higher ME values in vegetable feedstuffs as compared to broilers. Using these experimental data it was possible to estimate an ME increase in 0.3 kcal/g of non-digested nitrogen-free extract + crude fiber (NDEF). NDEF was calculated by subtracting digested nitrogen-free extract from nitrogen-free extract and then adding crude fiber (NDEF = non-digested nitrogen-free extract + crude fiber). This allowed to obtain two ME values for poultry. Table 1.01 shows ME for poultry in general ($ME_{poultry}$) and another for hens or mature poultry ($ME_{hens} = ME_{poultry} + 0.3$ NDEF).

* Energy values (digestible energy – DE_{swine} – and metabolizable energy – ME_{swine}) and protein digestibility in feedstuffs for swine were determined using metabolic cages, by the method of total feces collection and ferric oxide as fecal marker. Growing pigs between 20 and 75kg body weight were used. Table 1.01 shows the net energy of feedstuffs for swine. These values were obtained applying the equation developed in France by Dr. J. Noblet and it is described in Table 1.03. The increase in feedstuff energy values for mature pigs as compared to growing pigs was quantified by Dr. Noblet in the feedstuff composition tables published in France in 1kcal/g of non-digested residue. This value was used to correct $DE_{swine,}$ and the value of 0.75kcal/g to correct $ME_{swine.}$ Table 1.01 shows two DE (DE_{swine} and DE_{sows}) and two ME (ME_{swine} and ME_{sows}). Only vegetable feedstuff values were corrected using non-digested organic matter data (organic matter – digested organic matter) presented in Table 1.01.

* Several digestibility trials were conducted with grower and finisher pigs in order to determined digestibility coefficients of fat, CF, NDF, and ADF in feedstuffs. Organic matter coefficient of digestibility for swine was calculated as the ratio between

digestible energy and gross energy in the feedstuffs. Literature data were used to estimate coefficients of digestibility of fat and nitrogen-free extract of feedstuffs for poultry (Table 1.01).

* In order to allow the correction of feedstuff energy values according to the variation in composition, equations were developed to estimate metabolizable energy in feedstuffs for poultry (Table 1.02) and to estimate digestible energy and metabolizable energy for swine (Tables 1.03 and 1.04). Composition data and coefficients of digestibility of the main nutrients were used. In order to have data in the equations similar to the energy values determined at UFV, the coefficients of digestibility of fat (poultry and swine), nitrogen-free extract – NFE – (poultry) and organic matter (swine) were slightly changed. Feedstuffs which composition is different from those presented in Table 1.01 will have different energy values. These new values allow nutritionists of the feed industry to correct and to adjust feedstuff composition matrixes.

* Table 1.07 shows total and true digestible amino acid content of feedstuffs for poultry and swine. The methods to determine amino acid content in feedstuffs and their true digestibility for poultry and swine are expensive and time-consuming. However, thanks to the companies Adisseo, Ajinomoto and Evonik, it was possible to obtain a large number of analyses that otherwise could not be carried out in the UFV.

* True digestible amino acid content of feedstuffs for poultry was determined using two methodologies: the precision-feeding method of Sibbald with cecectomized cockerels, and the ileal digesta collection method with broilers (21-28 days of age). Endogenous amino acid excretion was estimated in fasted cecectomized cockerels (Sibbald) or feeding broilers with a protein-free diet (Ileal). In swine, growing pigs with ileal-rectal anastomosis or fitted with ileal re-entrant cannula were used. Endogenous amino acids were estimated using a protein-free

diet. The coefficient of protein digestibility for poultry was estimated by the ratio between true digestible amino acids and total amino acids in the feedstuffs.

* Amino acid content in corn, sorghum, meat and bone meal, and soybeans (grain and meal) were estimated by equations that allow calculating the sum of amino acids in the feedstuffs. Based on this sum and considering a constant ratio of each amino acid to the sum of amino acids in the protein, the content of each amino acid can be estimated. Equations are useful to make adjustments in amino acid values according to changes in the feedstuff protein content (Tables 1.10, 1.11 and 1.12).

* In Brazil, most wheat mills produce only one by-product during wheat processing, which is a mixture of bran and middlings. Therefore, this is the product identified in Tables 1.01 and 1.07 as wheat bran.

* In vegetable feedstuffs, in addition to total phosphorus, phytate phosphorus was also determined. The company AB Vista kindly supplied the results of 205 phosphorus and phytate analyses for Brazilian feedstuffs. In the laboratory of UFV, phytate content was determined only in 10 corn samples and in 10 soybean meal samples. Non-phytic phosphorus in vegetable feedstuffs was considered equal to available phosphorus, that is, presenting 100% availability. Phosphorus content and bioavailability in Brazilian phosphates are described in Table 1.15. Phosphorus bioavailability in phosphates was determined by comparison with a standard source, dicalcium phosphate, to which an availability coefficient of 100% was attributed. This is why some phosphates present available phosphorus content higher than 100%.

* Available phosphorus in animal feedstuffs was calculated based on total phosphorus, considering 100% availability, except for meat and bone meals, which studies have shown to be only

90% available. Phosphorus true digestibility was determined in grower and finisher broilers and pigs in experiments carried out at UFV and from literature. Phosphorus apparent digestibility in the feedstuffs mentioned in literature was transformed in true digestibility by correcting for excreted endogenous phosphorus, the values used were 0.138mg P/kg DM intake for poultry and 0.258mg P/kg DM intake for pigs (Bünzen, S. PhD thesis, UFV, 2009). Available and digestible phosphorus contents and coefficients are presented in Table 1.13.

* Foreign literature has reported that some phosphates may present high levels of heavy metals. Table 1.14 shows composition data of Brazilian phosphates, particularly of important minerals, such as lead, cadmium, and vanadium.

* In this chapter, vitamin and trace mineral supplementation levels for poultry and swine rations are also presented. Diets with these supplementation levels (Tables 1.18 and 1.21) should not cause any deficiency problems. Tables 1.20 and 1.22 show supplementation levels per kg of poultry and swine feeds with the energy levels commonly used in Brazil. The amount recommended for each trace mineral and vitamin according to phase were calculated to maintain constant intake per kg of weight gain, e.g. for broilers: Vit A, 12,000 IU; nicotinic acid, 47 mg, and zinc, 100 mg/kg weight gain.

* In order to make the use of alternative feedstuffs easier, Tables 1.23 and 1.24 present their recommended inclusion levels in poultry and swine diets, respectively. These are practical levels, that is, the percentage commonly included in the diet, and maximum inclusion levels that will not negatively affect animal performance.

* Tables 1.25 and 1.26 show the standard deviations of nutrient levels of the most important feedstuffs used in poultry and swine feeds in Brazil. These deviations and coefficients of

variation can be used as correction factors in order to prevent possible nutritional deficiencies due to variations in feedstuff composition. However, it is recommended to perform chemical analyses of the feedstuffs that will be used in feed formulation.

* A simplified table showing the nutrient content of the most common feedstuffs used in poultry and swine feed formulation is at the end of this publication (Table 4.01) providing a quick reference guide of feedstuffs composition.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Babassu Meal	Babassu Starch Meal	Bakery Cookie-Cracker Res	Bakery Residue	Blood Cells Dried
Dry Matter	%	92.41	86.27	91.95	87.00	90.21
Crude Protein (CP)	%	20.19	1.91	8.45	12.50	86.29
Coef. Dig. CP Poultry	%	-	-	81.30	90.00	90.00
Digestible CP Poultry	%	-	-	6.87	11.25	77.66
Coef. Dig. CP Swine	%	-	-	85.00	90.00	88.00
Digestible CP Swine	%	-	-	7.18	11.00	75.93
Fat	%	2.15	0.29	9.20	1.57	0.51
Coef. Dig.Fat Poultry[1]	%	-	-	96.00	-	85.00
Digestible Fat Poultry	%	-	-	8.83	-	0.43
Coef. Dig. Fat Swine[1]	%	-	-	90.00	-	85.00
Digestible Fat Swine	%	-	-	8.28	-	0.43
Linoleic Acid	%	-	-	1.60	-	-
Linolenic Acid	%	-	-	-	-	-
Starch	%	-	-	46.50	-	-
Crude Fiber (CF)	%	47.52	9.69	1.70	1.02	-
Coef. Dig. CF Swine	%	-	-	-	-	-
NDF	%	63.21	37.09	4.35	6.13	-
Coef. Dig. NDF Swine	%	-	-	-	-	-
ADF	%	36.93	15.09	1.60	0.79	-
Coef. Dig. ADF Swine	%	-	-	-	-	-
Nitrogen-Free Ext (NFE)	%	-	71.88	71.38	68.15	-
Coef. Dig. NFE Poultry[1]	%	-	-	98.00	-	-
Digestible NFE Poultry	%	-	-	69.95	-	-
Non Dig. NFE + CF Poultry	%	-	-	3.13	-	-
Organic Matter (OM)	%	-	-	90.73	84.40	86.35
Coef. Dig. OM Swine[1]	%	-	-	79.50	-	84.00
Digestible OM Swine	%	-	-	72.13	-	72.53
Non Dig. OM Swine	%	-	-	18.60	-	-
Ash	%	4.06	2.50	1.50	2.56	3.86
Potassium	%	-	-	0.17	-	0.30
Sodium	%	-	-	0.19	-	0.60
Chlorine	%	-	-	0.30	-	0.80
Gross Energy	kcal/kg	4207	3687	4402	3926	4981
Met. Energy Poultry	kcal/kg	1116	1731	4010	3352	3385
Met. Energy Hens	kcal/kg	-	-	4019	-	-
True Met. Energy Poultry	kcal/kg	-	-	4217	-	-
Digestible Energy Swine	kcal/kg	-	-	3551	3812	4300
Digestible Energy Sows	kcal/kg	-	-	3737	-	-
Met. Energy Swine	kcal/kg	-	-	3480	3660	3787
Met. Energy Sows	kcal/kg	-	-	3620	-	-
Net Energy Swine[1]	kcal/kg	-	-	2760	-	2193

[1] Calculated or estimated values.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Blood Meal	Blood Plasma	Canola Meal	Carob Meal	Casein
Dry Matter	%	92,90	91,01	89.29	90.67	91.35
Crude Protein (CP)	%	83,50	71,89	37.97	8.79	84.21
Coef. Dig. CP Poultry	%	76,00	90,00	78.00	-	97.94
Digestible CP Poultry	%	63,46	64,70	29.62	-	82.48
Coef. Dig. CP Swine	%	75,00	95,00	75.10	43.57	98.00
Digestible CP Swine	%	62,60	68,30	28.52	3.83	82.53
Fat	%	0,46	1,09	1.21	0.52	0.80
Coef. Dig.Fat Poultry[1]	%	70,00	95,00	70.00	-	-
Digestible Fat Poultry	%	0,32	1,04	0.85	-	-
Coef. Dig. Fat Swine[1]	%	70,00	95,00	70.00	-	-
Digestible Fat Swine	%	0,32	1,04	0.85	-	-
Linoleic Acid	%	-	-	0.23	-	-
Linolenic Acid	%	-	-	0.12	-	-
Starch	%	-	-	7.00	-	-
Crude Fiber (CF)	%	-	-	11.20	-	-
Coef. Dig. CF Swine	%	-	-	-	-	-
NDF	%	-	-	24.48	17.68	-
Coef. Dig. NDF Swine	%	-	-	-	-	-
ADF	%	-	-	2.05	-	-
Coef. Dig. ADF Swine	%	-	-	-	-	-
Nitrogen-Free Ext (NFE)	%	5,50	6,15	33.08	77.91	3.74
Coef. Dig. NFE Poultry[1]	%	40,00	90,00	25.00	-	-
Digestible NFE Poultry	%	2,20	5,54	8.27	-	-
Non Dig. NFE + CF Poultry	%	-	-	36.01	-	-
Organic Matter (OM)	%	89,46	79,11	83.46	87.22	88.75
Coef. Dig. OM Swine[1]	%	66,00	89,00	73.00	59.43	79.83
Digestible OM Swine	%	59,04	70,40	60.92	51.84	70.85
Non Dig. OM Swine	%	-	-	22.54	-	-
Ash	%	3,44	11,90	5.83	3.45	2.60
Potassium	%	0,26	0,56	0.55	0.91	0.01
Sodium	%	0,48	3,12	0.09	-	0.01
Chlorine	%	0,36	-	0.11	-	0.04
Gross Energy	kcal/kg	5134	4580	4203	4501	5210
Met. Energy Poultry	kcal/kg	2857	3114	1692	1520	3900
Met. Energy Hens	kcal/kg	-	-	1800	-	-
True Met. Energy Poultry	kcal/kg	3067	3304	1900	1807	-
Digestible Energy Swine	kcal/kg	3381	4050	3019	2675	4159
Digestible Energy Sows	kcal/kg	-	-	3244	-	-
Met. Energy Swine	kcal/kg	2986	3714	2787	2432	3529
Met. Energy Sows	kcal/kg	-	-	2956	-	-
Net Energy Swine[1]	kcal/kg	1626	2244	1713	1723	2022

[1] Calculated or estimated values.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Cassava With Hulls Dried	Castor Oil Plant Meal	Citrus Pulp	Coconut Meal	Corn (7.88%)
Dry Matter	%	87.67	89.40	88.44	90.90	87.48
Crude Protein (CP)	%	2.47	39.20	6.37	21.85	7.88
Coef. Dig. CP Poultry	%	46.00	-	27.70	71.20	87.00
Digestible CP Poultry	%	1.14	-	1.76	15.56	6.86
Coef. Dig. CP Swine	%	35.00	-	55.00	67.30	85.00
Digestible CP Swine	%	0.87	-	3.50	14.71	6.70
Fat	%	0.59	1.55	2.02	3.15	3.65
Coef. Dig.Fat Poultry[1]	%	20.00	-	-	-	92.00
Digestible Fat Poultry	%	0.12	-	-	-	3.36
Coef. Dig. Fat Swine[1]	%	42.50	-	55.00	65.00	90.00
Digestible Fat Swine	%	0.25	-	1.11	2.05	3.29
Linoleic Acid	%	0.08	-	0.45	0.06	1.91
Linolenic Acid	%	-	-	0.08	-	0.03
Starch	%	67.85	-	-	-	62.66
Crude Fiber (CF)	%	5.42	18.50	12.70	13.90	1.73
Coef. Dig. CF Swine	%	64.60	-	-	-	41.40
NDF	%	11.75	-	-	51.35	11.93
Coef. Dig. NDF Swine	%	59.00	-	-	-	66.40
ADF	%	4.27	-	-	27.10	3.38
Coef. Dig. ADF Swine	%	-	-	-	-	68.20
Nitrogen-Free Ext (NFE)	%	75.59	23.35	61.10	45.64	72.95
Coef. Dig. NFE Poultry[1]	%	93.00	-	-	-	91.80
Digestible NFE Poultry	%	70.30	-	-	-	66.97
Non Dig. NFE + CF Poultry	%	10.71	-	-	-	7.71
Organic Matter (OM)	%	84.07	82.60	82.19	84.54	86.21
Coef. Dig. OM Swine[1]	%	86.80	-	83.50	77.10	90.00
Digestible OM Swine	%	72.97	-	68.62	65.18	77.59
Non Dig. OM Swine	%	11.10	-	13.57	19.36	8.62
Ash	%	3.60	6.80	6.26	6.36	1.27
Potassium	%	0.52	0.60	0.75	1.61	0.29
Sodium	%	0.03	0.01	0.07	0.05	0.02
Chlorine	%	0.05	-	0.05	0.80	0.06
Gross Energy	kcal/kg	3621	-	3701	3979	3940
Met. Energy Poultry	kcal/kg	2973	1484	1100	1921	3381
Met. Energy Hens	kcal/kg	3005	-	-	-	3404
True Met. Energy Poultry	kcal/kg	3192	-	-	2323	3500
Digestible Energy Swine	kcal/kg	3048	2230	2956	3030	3460
Digestible Energy Sows	kcal/kg	3159	-	3092	3224	3546
Met. Energy Swine	kcal/kg	3020	2084	2863	2885	3340
Met. Energy Sows	kcal/kg	3103	-	2965	3030	3405
Net Energy Swine[1]	kcal/kg	2394	-	1951	1866	2648

[1] Calculated or estimated values.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Corn Germ	Corn Gluten Meal (21%)	Corn Gluten Meal (60%)	Corn High Lysine	Corn High Oil
Dry Matter	%	89.71	88.50	91.11	88.43	87.70
Crude Protein (CP)	%	10.38	21.10	61.07	8.26	8.21
Coef. Dig. CP Poultry	%	86.00	78.00	94.00	87.84	87.00
Digestible CP Poultry	%	8.92	16.46	57.41	7.25	7.14
Coef. Dig. CP Swine	%	74.00	76.00	93.00	87.00	85.00
Digestible CP Swine	%	7.68	16.04	56.80	7.18	6.98
Fat	%	9.60	3.34	2.30	3.66	6.30
Coef. Dig.Fat Poultry[1]	%	81.00	56.00	95.00	92.00	93.00
Digestible Fat Poultry	%	7.78	1.87	2.19	3.37	5.86
Coef. Dig. Fat Swine[1]	%	80.00	76.00	70.00	90.00	90.00
Digestible Fat Swine	%	6.68	2.54	1.61	3.29	5.67
Linoleic Acid	%	5.04	1.75	1.21	1.92	3.30
Linolenic Acid	%	0.07	0.02	0.02	0.03	0.04
Starch	%	48.56	21.53	15.80	65.37	59.00
Crude Fiber (CF)	%	4.48	7.78	1.12	1.52	2.60
Coef. Dig. CF Swine	%	-	51.00	-	-	-
NDF	%	27.80	36.19	6.39	12.09	10.80
Coef. Dig. NDF Swine	%	-	55.70	73.50	-	-
ADF	%	7.90	11.08	8.63	3.05	3.35
Coef. Dig. ADF Swine	%	-	59.00	44.70	-	-
Nitrogen-Free Ext (NFE)	%	61.55	50.55	25.02	73.88	69.41
Coef. Dig. NFE Poultry[1]	%	80.00	44.50	98.00	90.80	94.00
Digestible NFE Poultry	%	49.24	22.49	24.52	67.08	65.25
Non Dig. NFE + CF Poultry	%	16.79	35.84	1.62	8.32	6.76
Organic Matter (OM)	%	86.01	82.77	89.51	87.32	86.52
Coef. Dig. OM Swine[1]	%	80.00	67.00	91.30	89.00	90.00
Digestible OM Swine	%	68.81	55.46	81.72	77.71	77.87
Non Dig. OM Swine	%	17.20	27.31	7.79	9.61	8.65
Ash	%	3.70	5.73	1.60	1.12	1.18
Potassium	%	0.62	1.12	0.13	0.21	0.35
Sodium	%	0.02	0.11	0.01	0.01	0.01
Chlorine	%	0.08	0.21	0.05	0.05	0.05
Gross Energy	kcal/kg	4250	3952	5010	3907	4216
Met. Energy Poultry	kcal/kg	3144	1813	3696	3405	3560
Met. Energy Hens	kcal/kg	3194	1921	3701	3430	3580
True Met. Energy Poultry	kcal/kg	-	1895	3868	3579	-
Digestible Energy Swine	kcal/kg	3355	2700	4341	3508	3630
Digestible Energy Sows	kcal/kg	3527	2973	4419	3604	3717
Met. Energy Swine	kcal/kg	3260	2560	3929	3409	3582
Met. Energy Sows	kcal/kg	3389	2765	3987	3481	3647
Net Energy Swine[1]	kcal/kg	2572	1775	2536	2708	2835

[1] Calculated or estimated values.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Corn Pre-cooked	Cottonseed Meal (30%)	Cottonseed Meal (39%)	Fat Coconut	Fat Lard
Dry Matter	%	88.33	89.65	89.83	99.30	99.55
Crude Protein (CP)	%	7.61	29.98	39.21	-	-
Coef. Dig. CP Poultry	%	89.04	76.00	78.73	-	-
Digestible CP Poultry	%	6.78	22.78	30.87	-	-
Coef. Dig. CP Swine	%	87.00	75.00	76.00	-	-
Digestible CP Swine	%	6.62	22.49	29.80	-	-
Fat	%	1.71	1.28	1.37	99.30	99.30
Coef. Dig.Fat Poultry[1]	%	92.00	85.00	85.00	-	-
Digestible Fat Poultry	%	1.57	1.09	1.16	-	-
Coef. Dig. Fat Swine[1]	%	90.00	75.00	80.00	-	-
Digestible Fat Swine	%	1.54	0.96	1.10	-	-
Linoleic Acid	%	0.89	0.69	0.74	1.79	9.63
Linolenic Acid	%	0.01	-	-	-	0.94
Starch	%	64.00	3.00	4.00	-	-
Crude Fiber (CF)	%	1.23	24.93	13.97	-	-
Coef. Dig. CF Swine	%	-	32.00	19.00	-	-
NDF	%	10.64	42.33	29.40	-	-
Coef. Dig. NDF Swine	%	-	43.82	18.00	-	-
ADF	%	2.37	31.11	17.00	-	-
Coef. Dig. ADF Swine	%	-	47.66	17.30	-	-
Nitrogen-Free Ext (NFE)	%	76.79	28.16	29.07	-	-
Coef. Dig. NFE Poultry[1]	%	94.00	49.00	42.00	-	-
Digestible NFE Poultry	%	72.18	13.23	12.21	-	-
Non Dig. NFE + CF Poultry	%	5.84	39.86	30.83	-	-
Organic Matter (OM)	%	87.34	84.35	83.62	99.30	99.55
Coef. Dig. OM Swine[1]	%	92.30	52.00	58.20	92.80	87.30
Digestible OM Swine	%	80.61	43.86	48.67	92.15	86.92
Non Dig. OM Swine	%	6.73	40.49	34.95	-	-
Ash	%	0.99	5.30	6.21	-	-
Potassium	%	0.25	0.59	1.34	-	-
Sodium	%	0.02	0.04	0.11	-	-
Chlorine	%	-	-	0.04	-	-
Gross Energy	kcal/kg	3987	4130	4170	9229	9369
Met. Energy Poultry	kcal/kg	3429	1666	1947	7924	8080
Met. Energy Hens	kcal/kg	3447	1786	2039	-	-
True Met. Energy Poultry	kcal/kg	3514	1768	2173	-	-
Digestible Energy Swine	kcal/kg	3519	2222	2507	8565	8180
Digestible Energy Sows	kcal/kg	3586	2627	2857	-	-
Met. Energy Swine	kcal/kg	3444	1996	2323	8262	7939
Met. Energy Sows	kcal/kg	3494	2300	2585	-	-
Net Energy Swine[1]	kcal/kg	2699	1042	1330	7096	7096

[1] Calculated or estimated values.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Fat Poultry	Fat Tallow	Feather Meal (75%)	Feather Meal (84%)	Feather Poultry By-Prod. Meal
Dry Matter	%	99.60	99.39	89.74	91.06	91.40
Crude Protein (CP)	%	-	-	74.91	83.63	65.71
Coef. Dig. CP Poultry	%	-	-	72.40	71.80	77.00
Digestible CP Poultry	%	-	-	54.23	60.04	50.60
Coef. Dig. CP Swine	%	-	-	70.00	67.00	70.00
Digestible CP Swine	%	-	-	52.43	56.03	46.00
Fat	%	99.00	99.39	6.13	4.70	14.63
Coef. Dig.Fat Poultry[1]	%	94.40	80.00	50.00	40.00	80.00
Digestible Fat Poultry	%	93.40	79.51	3.06	1.88	11.70
Coef. Dig. Fat Swine[1]	%	91.50	87.10	40.00	40.00	71.00
Digestible Fat Swine	%	90.59	86.57	2.45	1.88	10.39
Linoleic Acid	%	20.47	3.08	-	-	2.00
Linolenic Acid	%	1.29	0.60	-	-	0.23
Starch	%	-	-	-	-	-
Crude Fiber (CF)	%	-	-	-	-	-
Coef. Dig. CF Swine	%	-	-	-	-	-
NDF	%	-	-	-	-	-
Coef. Dig. NDF Swine	%	-	-	-	-	-
ADF	%	-	-	-	-	-
Coef. Dig. ADF Swine	%	-	-	-	-	-
Nitrogen-Free Ext (NFE)	%	-	-	5.70	0.31	4.45
Coef. Dig. NFE Poultry[1]	%	-	-	-	-	-
Digestible NFE Poultry	%	-	-	-	-	-
Non Dig. NFE + CF Poultry	%	-	-	-	-	-
Organic Matter (OM)	%	99.60	99.39	86.74	88.64	84.79
Coef. Dig. OM Swine[1]	%	92.22	81.10	60.89	64.69	68.21
Digestible OM Swine	%	91.85	80.61	52.82	57.34	57.84
Non Dig. OM Swine	%	-	-	-	-	-
Ash	%	-	-	3.00	2.42	6.61
Potassium	%	-	-	0.12	0.25	0.35
Sodium	%	-	-	0.12	0.27	0.33
Chlorine	%	-	-	0.19	0.25	0.34
Gross Energy	kcal/kg	9282	9408	5206	5225	5231
Met. Energy Poultry	kcal/kg	8681	7401	2621	2761	3264
Met. Energy Hens	kcal/kg	-	-	-	-	-
True Met. Energy Poultry	kcal/kg	9159	8116	2766	2849	3482
Digestible Energy Swine	kcal/kg	8560	8193	3170	3380	3568
Digestible Energy Sows	kcal/kg	-	-	-	-	-
Met. Energy Swine	kcal/kg	8228	7886	2805	2922	3263
Met. Energy Sows	kcal/kg	-	-	-	-	-
Net Energy Swine[1]	kcal/kg	7303	7061	1626	1634	2133

[1] Calculated or estimated values.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Fish Meal (54%)	Fish Meal (61%)	Glucose	Glycerine (87%)	Lactose
Dry Matter	%	92.06	91.71	90.37	90.00	97.80
Crude Protein (CP)	%	54.58	61.42	-	0.23	0.23
Coef. Dig. CP Poultry	%	87.00	87.00	-	-	-
Digestible CP Poultry	%	47.49	53.44	-	-	-
Coef. Dig. CP Swine	%	78.00	80.00	-	-	-
Digestible CP Swine	%	42.57	49.14	-	-	-
Fat	%	7.46	5.85	-	-	-
Coef. Dig.Fat Poultry[1]	%	90.00	87.00	-	-	-
Digestible Fat Poultry	%	6.71	5.09	-	-	-
Coef. Dig. Fat Swine[1]	%	90.00	75.00	-	-	-
Digestible Fat Swine	%	6.71	4.39	-	-	-
Linoleic Acid	%	0.10	0.8	-	-	-
Linolenic Acid	%	0.06	0.04	-	-	-
Starch	%	-	-	-	-	-
Crude Fiber (CF)	%	-	-	-	-	-
Coef. Dig. CF Swine	%	-	-	-	-	-
NDF	%	-	-	-	-	-
Coef. Dig. NDF Swine	%	-	-	-	-	-
ADF	%	-	-	-	-	-
Coef. Dig. ADF Swine	%	-	-	-	-	-
Nitrogen-Free Ext (NFE)	%	7.28	4.80	90.37	-	-
Coef. Dig. NFE Poultry[1]	%	-	-	-	-	-
Digestible NFE Poultry	%	-	-	-	-	-
Non Dig. NFE + CF Poultry	%	-	-	-	-	-
Organic Matter (OM)	%	69.32	72.36	90.37	-	97.63
Coef. Dig. OM Swine[1]	%	75.03	75.49	-	-	90.00
Digestible OM Swine	%	52.01	54.62	-	-	87.87
Non Dig. OM Swine	%	-	-	-	-	-
Ash	%	22.74	19.35	-	-	0.17
Potassium	%	0.60	0.58	-	-	-
Sodium	%	0.68	0.50	-	-	-
Chlorine	%	0.90	0.70	-	-	-
Gross Energy	kcal/kg	4065	4199	4017	3696	3908
Met. Energy Poultry	kcal/kg	2670	2778	3393	3510	-
Met. Energy Hens	kcal/kg	-	-	-	-	-
True Met. Energy Poultry	kcal/kg	3065	-	-	-	-
Digestible Energy Swine	kcal/kg	3050	3170	3340	3652	3604
Digestible Energy Sows	kcal/kg	-	-		-	-
Met. Energy Swine	kcal/kg	2740	2845	3334	3579	3511
Met. Energy Sows	kcal/kg	-	-	-	-	-
Net Energy Swine[1]	kcal/kg	1732	1742	2434	2611	2561

[1] Calculated or estimated values.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Lecithin	Meat & Bone Meal (36%)	Meat & Bone Meal (38%)	Meat & Bone Meal (41%)	Meat & Bone Meal (44%)
Dry Matter	%	99.36	92.91	93.60	92.74	93.27
Crude Protein (CP)	%	-	36.31	38.48	40.83	43.50
Coef. Dig. CP Poultry	%	-	73.00	77.00	77.00	79.50
Digestible CP Poultry	%	-	26.51	29.62	31.44	34.58
Coef. Dig. CP Swine	%	-	70.00	74.00	78.00	78.00
Digestible CP Swine	%	-	25.42	28.47	31.85	33.93
Fat	%	92.76	12.63	12.32	12.50	12.44
Coef. Dig.Fat Poultry[1]	%	-	48.00	52.30	50.00	58.80
Digestible Fat Poultry	%	-	6.06	6.44	6.25	7.31
Coef. Dig. Fat Swine[1]	%	-	36.70	35.20	41.80	44.00
Digestible Fat Swine	%	-	4.64	4.34	5.22	5.47
Linoleic Acid	%	-	0.39	0.38	0.39	0.39
Linolenic Acid	%	-	0.08	0.07	0.08	0.07
Starch	%	-	-	-	-	-
Crude Fiber (CF)	%	-	-	-	-	-
Coef. Dig. CF Swine	%	-	-	-	-	-
NDF	%	-	-	-	-	-
Coef. Dig. NDF Swine	%	-	-	-	-	-
ADF	%	-	-	-	-	-
Coef. Dig. ADF Swine	%	-	-	-	-	-
Nitrogen-Free Ext (NFE)	%	0.49	2.17	2.60	0.98	1.20
Coef. Dig. NFE Poultry[1]	%	-	-	-	-	-
Digestible NFE Poultry	%	-	-	-	-	-
Non Dig. NFE + CF Poultry	%	-	-	-	-	-
Organic Matter (OM)	%	93.25	51.11	53.40	54.31	57.14
Coef. Dig. OM Swine[1]	%	80.79	58.00	64.00	67.00	70.00
Digestible OM Swine	%	75.34	29.64	34.18	36.39	40.00
Non Dig. OM Swine	%	-	-	-	-	-
Ash	%	6.11	41.80	40.20	38.43	36.13
Potassium	%	-	0.70	0.70	0.70	-
Sodium	%	-	0.49	0.32	0.51	0.70
Chlorine	%	-	0.50	-	0.60	-
Gross Energy	kcal/kg	8188	3122	3209	3286	3490
Met. Energy Poultry	kcal/kg	6036	1700	1873	1937	2177
Met. Energy Hens	kcal/kg	-	-	-	-	-
True Met. Energy Poultry	kcal/kg	6240	1778	-	1995	-
Digestible Energy Swine	kcal/kg	6615	1852	2044	2296	2430
Digestible Energy Sows	kcal/kg	-	-	-	-	-
Met. Energy Swine	kcal/kg	6375	1695	1820	2068	2200
Met. Energy Sows	kcal/kg	-	-	-	-	-
Net Energy Swine[1]	kcal/kg	5869	1160	1232	1400	1477

[1] Calculated or estimated values.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Meat & Bone Meal (46%)	Meat & Bone Meal (48%)	Meat & Bone Meal (50%)	Meat & Bone Meal (55%)	Meat & Bone Meal (63%)
Dry Matter	%	93,27	93,77	93.95	93.54	94.50
Crude Protein (CP)	%	45,87	48,01	50.36	54.74	63.17
Coef. Dig. CP Poultry	%	79,50	81,00	81.50	82.00	81.00
Digestible CP Poultry	%	36,47	38,89	41.04	44.89	51.17
Coef. Dig. CP Swine	%	79,00	79,50	80.00	80.00	81.00
Digestible CP Swine	%	36,24	38,17	40.45	43.79	51.17
Fat	%	12,04	12,23	12.65	11.54	10.10
Coef. Dig.Fat Poultry[1]	%	76,00	73,40	70.00	72.20	64.70
Digestible Fat Poultry	%	9,15	8,98	8.86	8.33	6.53
Coef. Dig. Fat Swine[1]	%	47,50	48,00	40.00	39.70	35.00
Digestible Fat Swine	%	5,72	5,87	5.06	4.58	3.53
Linoleic Acid	%	0,37	0,38	0.39	0.36	0.31
Linolenic Acid	%	0,07	0,07	0.08	0.07	0.06
Starch	%	-	-	-	-	-
Crude Fiber (CF)	%	-	-	-	-	-
Coef. Dig. CF Swine	%	-	-	-	-	-
NDF	%	-	-	-	-	-
Coef. Dig. NDF Swine	%	-	-	-	-	-
ADF	%	-	-	-	-	-
Coef. Dig. ADF Swine	%	-	-	-	-	-
Nitrogen-Free Ext (NFE)	%	0,25	0,51	0.13	0.38	0.92
Coef. Dig. NFE Poultry[1]	%	-	-	-	-	-
Digestible NFE Poultry	%	-	-	-	-	-
Non Dig. NFE + CF Poultry	%	-	-	-	-	-
Organic Matter (OM)	%	58,16	60,75	62.88	66.66	72.75
Coef. Dig. OM Swine[1]	%	69,40	69,50	69.50	70.90	71.70
Digestible OM Swine	%	40,36	42,22	43.70	47.26	52.16
Non Dig. OM Swine	%	-	-	-	-	-
Ash	%	35,11	33,02	31.07	26.88	21.76
Potassium	%	0,66	0,54	0.54	0.50	0.47
Sodium	%	0,72	0,59	0.59	0.70	0.60
Chlorine	%	0,63	0,60	0.60	0.57	0.55
Gross Energy	kcal/kg	3665	3984	3984	4017	4341
Met. Energy Poultry	kcal/kg	2417	2511	2591	2710	2810
Met. Energy Hens	kcal/kg	-	-	-	-	-
True Met. Energy Poultry	kcal/kg	-	-	2701	-	2872
Digestible Energy Swine	kcal/kg	2564	2705	2752	2905	3210
Digestible Energy Sows	kcal/kg	-	-	-	-	-
Met. Energy Swine	kcal/kg	2332	2446	2485	2598	2870
Met. Energy Sows	kcal/kg	-	-	-	-	-
Net Energy Swine[1]	kcal/kg			1642	1681	1804

[1] Calculated or estimated values.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Millet	Milk Skimmed Dried	Milk Whey Dried	Milk Whey Permeate Dried	Milk Whole Dried
Dry Matter	%	89.30	94.30	95.40	94.50	96.20
Crude Protein (CP)	%	12.71	33.10	12.07	3.00	23.70
Coef. Dig. CP Poultry	%	91.00	-	93.00	-	-
Digestible CP Poultry	%	11.57	-	11.21	-	-
Coef. Dig. CP Swine	%	91.00	94.00	92.00	-	92.00
Digestible CP Swine	%	11.57	31.11	11.09	-	21.80
Fat	%	3.95	0.73	0.90	0.20	26.00
Coef. Dig.Fat Poultry[1]	%	75.00	-	-	-	-
Digestible Fat Poultry	%	2.96	-	-	-	-
Coef. Dig. Fat Swine[1]	%	75.00	95.00	95.00	-	92.00
Digestible Fat Swine	%	2.96	0.69	0.86	-	23.92
Linoleic Acid	%	1.63	0.02	0.02	-	-
Linolenic Acid	%	-	-	-	-	-
Starch	%	63.20	-	-	-	-
Crude Fiber (CF)	%	3.48	-	-	-	-
Coef. Dig. CF Swine	%	-	-	-	-	-
NDF	%	20.30	-	-	-	-
Coef. Dig. NDF Swine	%	-	-	-	-	-
ADF	%	8.58	-	-	-	-
Coef. Dig. ADF Swine	%		-	-	-	-
Nitrogen-Free Ext (NFE)	%	67.64	52.77	73.98	85.60	40.00
Coef. Dig. NFE Poultry[1]	%	85.50	-	-	-	-
Digestible NFE Poultry	%	57.83	-	-	-	-
Non Dig. NFE + CF Poultry	%	13.29	-	-	-	-
Organic Matter (OM)	%	87.78	86.60	86.95	88.80	89.70
Coef. Dig. OM Swine[1]	%	74.00	92.00	90.00	96.00	94.50
Digestible OM Swine	%	64.96	79.67	78.26	85.24	84.76
Non Dig. OM Swine	%	22.82	-	-	-	-
Ash	%	1.52	7.70	8.45	5.70	6.50
Potassium	%	0.34	1.47	2.08	2.10	1.17
Sodium	%	0.01	0.41	0.79	1.00	0.32
Chlorine	%	0.03	0.90	1.34	2.00	0.71
Gross Energy	kcal/kg	3930	4163	3703	3446	5431
Met. Energy Poultry	kcal/kg	3165	2781	-	-	-
Met. Energy Hens	kcal/kg	3205	-	-	-	-
True Met. Energy Poultry	kcal/kg	3354	-	-	-	-
Digestible Energy Swine	kcal/kg	3036	3805	3486	3311	5137
Digestible Energy Sows	kcal/kg	3264	-	-	-	-
Met. Energy Swine	kcal/kg	2940	3590	3371	3225	4948
Met. Energy Sows	kcal/kg	3111	-	-	-	-
Net Energy Swine[1]	kcal/kg	2313	2408	2392	-	3794

[1] Calculated or estimated values.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Oil Canola	Oil Corn	Oil Palm	Oil Soybean	Palm Ouricuri Meal
Dry Matter	%	99.50	99.25	99.50	99.60	90.00
Crude Protein (CP)	%	-	-	-	-	23.00
Coef. Dig. CP Poultry	%	-	-	-	-	-
Digestible CP Poultry	%	-	-	-	-	-
Coef. Dig. CP Swine	%	-	-	-	-	-
Digestible CP Swine	%	-	-	-	-	-
Fat	%	99.50	99.00	99.40	99.60	0.82
Coef. Dig.Fat Poultry[1]	%	95.00	95.10	-	95.00	-
Digestible Fat Poultry	%	94.53	94.15	-	94.62	-
Coef. Dig. Fat Swine[1]	%	91.80	91.80	-	91.50	-
Digestible Fat Swine	%	91.34	90.88	-	91.13	-
Linoleic Acid	%	18.73	51.93	10.25	52.57	-
Linolenic Acid	%	9.50	0.69	-	6.94	-
Starch	%	-	-	-	-	-
Crude Fiber (CF)	%	-	-	-	-	17.60
Coef. Dig. CF Swine	%	-	-	-	-	-
NDF	%	-	-	-	-	-
Coef. Dig. NDF Swine	%	-	-	-	-	-
ADF	%	-	-	-	-	-
Coef. Dig. ADF Swine	%	-	-	-	-	-
Nitrogen-Free Ext (NFE)	%	-	-	-	-	42.26
Coef. Dig. NFE Poultry[1]	%	-	-	-	-	-
Digestible NFE Poultry	%	-	-	-	-	-
Non Dig. NFE + CF Poultry	%	-	-	-	-	-
Organic Matter (OM)	%	99.50	99.25	99.50	99.60	83.68
Coef. Dig. OM Swine[1]	%	91.80	90.00	85.21	92.15	-
Digestible OM Swine	%	91.34	89.33	84.79	91.78	-
Non Dig. OM Swine	%	-	-	-	-	-
Ash	%	-	-	-	-	6.32
Potassium	%	-	-	-	-	0.62
Sodium	%	-	-	-	-	0.03
Chlorine	%	-	-	-	-	-
Gross Energy	kcal/kg	9399	9350	9400	9333	-
Met. Energy Poultry	kcal/kg	8784	8773	8817	8790	1431
Met. Energy Hens	kcal/kg	-	-	-	-	-
True Met. Energy Poultry	kcal/kg	9130	9250	-	9200	-
Digestible Energy Swine	kcal/kg	8630	8580	8010	8600	1982
Digestible Energy Sows	kcal/kg	-	-	-	-	-
Met. Energy Swine	kcal/kg	8455	8280	7690	8300	1766
Met. Energy Sows	kcal/kg	-	-	-	-	-
Net Energy Swine[1]	kcal/kg	7476	7341	6916	7364	975

[1] Calculated or estimated values.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Passion Fruit Pulp Dried	Pasta-Spaghetti Residue	Peanut Meal	Poultry By-Product Meal	Poultry By-Prod Meal High Fat
Dry Matter	%	90.69	88.40	89.42	93.00	93.90
Crude Protein (CP)	%	12.42	12.30	47.77	57.68	55.30
Coef. Dig. CP Poultry	%	81.44	90.00	85.00	82.00	82.00
Digestible CP Poultry	%	10.12	11.07	40.60	47.30	45.35
Coef. Dig. CP Swine	%	-	88.60	90.50	81.00	81.00
Digestible CP Swine	%	-	10.90	43.23	46.72	44.79
Fat	%	6.04	1.17	1.01	14.17	20.60
Coef. Dig.Fat Poultry[1]	%	-	-	83.00	91.30	90.20
Digestible Fat Poultry	%	-	-	0.85	12.94	18.59
Coef. Dig. Fat Swine[1]	%	-	-	55.00	93.50	94.00
Digestible Fat Swine	%	-	-	0.56	13.25	17.81
Linoleic Acid	%	-	0.46	0.28	2.93	4.26
Linolenic Acid	%	-	-	-	0.18	0.27
Starch	%	-	-	-	-	-
Crude Fiber (CF)	%	34.85	1.90	7.55	-	-
Coef. Dig. CF Swine	%	-	-	-	-	-
NDF	%	68.04	1.10	15.60	-	-
Coef. Dig. NDF Swine	%	-	-	-	-	-
ADF	%	64.92	0.60	10.88	-	-
Coef. Dig. ADF Swine	%	-	-	-	-	-
Nitrogen-Free Ext (NFE)	%	36.24	72.03	27.06	5.96	6.40
Coef. Dig. NFE Poultry[1]	%	-	-	38.00	-	-
Digestible NFE Poultry	%	-	-	10.28	-	-
Non Dig. NFE + CF Poultry	%	-	-	24.33	-	-
Organic Matter (OM)	%	89.55	87.40	83.39	77.81	82.30
Coef. Dig. OM Swine[1]	%	-	95.44	81.00	82.00	79.00
Digestible OM Swine	%	-	83.41	67.55	63.80	65.00
Non Dig. OM Swine	%	-	3.99	15.84	-	-
Ash	%	1.14	1.00	6.03	15.19	11.60
Potassium	%	-	0.18	1.28	0.52	0.53
Sodium	%	-	0.01	0.03	0.39	0.51
Chlorine	%	-	-	0.06	0.51	0.51
Gross Energy	kcal/kg	5435	3861	4316	4750	5343
Met. Energy Poultry	kcal/kg	3284	3494	2253	3241	3682
Met. Energy Hens	kcal/kg	-	-	2326	-	-
True Met. Energy Poultry	kcal/kg	-	-	2396	3546	3850
Digestible Energy Swine	kcal/kg	-	3685	3475	3905	4215
Digestible Energy Sows	kcal/kg	-	3725	3633	-	-
Met. Energy Swine	kcal/kg	-	3538	3178	3566	3905
Met. Energy Sows	kcal/kg	-	3568	3297	-	-
Net Energy Swine[1]	kcal/kg	-	-	1940	2402	2750

[1] Calculated or estimated values.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Rice Broken	Rice Bran	Rice Bran Defatted	Sorghum High Tannin	Sorghum Low Tannin
Dry Matter	%	88.20	89.34	89.72	85.88	87.90
Crude Protein (CP)	%	8.50	13.13	15.29	8.94	8.97
Coef. Dig. CP Poultry	%	79.00	77.70	77.70	68.00	88.00
Digestible CP Poultry	%	6.72	10.20	11.88	6.08	7.89
Coef. Dig. CP Swine	%	88.00	74.60	74.60	73.30	85.00
Digestible CP Swine	%	7.48	9.79	11.41	6.55	7.62
Fat	%	1.14	14.49	1.65	2.35	2.96
Coef. Dig.Fat Poultry[1]	%	80.00	78.50	62.00	83.00	85.00
Digestible Fat Poultry	%	0.91	11.37	1.02	1.95	2.52
Coef. Dig. Fat Swine[1]	%	85.00	80.00	70.00	75.00	80.00
Digestible Fat Swine	%	0.97	11.59	1.16	1.76	2.37
Linoleic Acid	%	0.35	2.37	0.49	1.13	1.05
Linolenic Acid	%	0.20	0.02	-	-	-
Starch	%	74.45	22.70	26.00	56.80	63.24
Crude Fiber (CF)	%	0.50	8.07	10.86	2.78	2.30
Coef. Dig. CF Swine	%	-	39.72	39.72	-	75.49
NDF	%	4.70	21.53	24.30	9.80	10.03
Coef. Dig. NDF Swine	%	14.50	50.65	50.65	-	73.21
ADF	%	7.00	12.58	15.80	4.60	5.90
Coef. Dig. ADF Swine	%	93.00	52.86	52.86	-	85.40
Nitrogen-Free Ext (NFE)	%	77.13	44.67	51.84	69.95	72.26
Coef. Dig. NFE Poultry[1]	%	91.00	55.40	55.40	86.50	87.40
Digestible NFE Poultry	%	70.19	24.75	28.72	60.51	63.16
Non Dig. NFE + CF Poultry	%	7.44	27.99	33.98	-	11.40
Organic Matter (OM)	%	87.27	80.36	79.64	84.02	87.30
Coef. Dig. OM Swine[1]	%	94.00	72.60	69.80	83.00	86.50
Digestible OM Swine	%	82.00	58.34	55.59	69.74	75.53
Non Dig. OM Swine	%	5.27	22.02	24.05	-	11.77
Ash	%	0.93	8.98	10.08	1.86	1.41
Potassium	%	0.19	1.40	1.59	0.31	0.34
Sodium	%	0.02	0.04	0.04	0.01	0.02
Chlorine	%	0.04	0.06	0.07	0.01	0.05
Gross Energy	kcal/kg	3821	4335	3740	3860	3912
Met. Energy Poultry	kcal/kg	3279	2521	1795	2956	3189
Met. Energy Hens	kcal/kg	3301	2605	1897	3012	3223
True Met. Energy Poultry	kcal/kg	3507	3143	-	3037	3407
Digestible Energy Swine	kcal/kg	3595	3179	2531	3081	3383
Digestible Energy Sows	kcal/kg	3647	3399	2772	3224	3501
Met. Energy Swine	kcal/kg	3491	3111	2450	2984	3315
Met. Energy Sows	kcal/kg	3531	3276	2630	3091	3403
Net Energy Swine[1]	kcal/kg	2777	2379	1699	2318	2610

[1] Calculated or estimated values.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Soybean Hulls	Soybean Protein Concentrate	Soybean Meal (45%)	Soybean Meal (48%)
Dry Matter	%	89.13	90.22	88.75	89.18
Crude Protein (CP)	%	13.88	63.07	45.22	48.10
Coef. Dig. CP Poultry	%	57.00	92.00	91.00	91.40
Digestible CP Poultry	%	7.91	58.02	41.15	43.96
Coef. Dig. CP Swine	%	66.00	92.00	90.00	91.00
Digestible CP Swine	%	9.16	58.02	40.70	43.77
Fat	%	3.00	0.45	1.69	1.45
Coef. Dig.Fat Poultry[1]	%	60.00	50.00	50.00	50.00
Digestible Fat Poultry	%	1.80	0.23	0.85	0.73
Coef. Dig. Fat Swine[1]	%	60.00	50.00	60.00	60.00
Digestible Fat Swine	%	1.80	0.23	1.01	0.87
Linoleic Acid	%	1.58	0.24	0.89	0.77
Linolenic Acid	%	0.21	-	0.12	0.10
Starch	%	-	-	12.38	3.00
Crude Fiber (CF)	%	32.70	2.77	5.30	4.19
Coef. Dig. CF Swine	%	-	-	-	68.60
NDF	%	57.40	11.61	13.79	14.93
Coef. Dig. NDF Swine	%	-	-	-	82.60
ADF	%	44.90	6.06	8.07	12.28
Coef. Dig. ADF Swine	%	-	-	-	77.70
Nitrogen-Free Ext (NFE)	%	34.95	18.79	30.71	29.74
Coef. Dig. NFE Poultry[1]	%	24.40	28.00	31.60	27.00
Digestible NFE Poultry	%	8.52	5.26	9.70	8.03
Non Dig. NFE + CF Poultry	%	59.13	16.30	26.31	25.90
Organic Matter (OM)	%	84.53	85.08	82.92	83.48
Coef. Dig. OM Swine[1]	%	58.00	88.10	80.68	82.50
Digestible OM Swine	%	49.03	74.96	66.90	68.87
Non Dig. OM Swine	%	35.50	10.12	16.02	14.61
Ash	%	4.60	5.14	5.83	5.70
Potassium	%	-	2.18	1.83	2.11
Sodium	%	-	0.05	0.02	0.02
Chlorine	%	-	-	0.05	0.05
Gross Energy	kcal/kg	3900	4461	4090	4161
Met. Energy Poultry	kcal/kg	858	2621	2254	2295
Met. Energy Hens	kcal/kg	1035	2670	2333	2373
True Met. Energy Poultry	kcal/kg	-	2870	2506	2590
Digestible Energy Swine	kcal/kg	2261	4017	3425	3540
Digestible Energy Sows	kcal/kg	2616	4118	3585	3686
Met. Energy Swine	kcal/kg	2207	3586	3154	3253
Met. Energy Sows	kcal/kg	2473	3662	3274	3363
Net Energy Swine[1]	kcal/kg	1185	2174	2016	2042

[1] Calculated or estimated values.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Soybean Full-Fat Extruded	Soybean Full-Fat Toasted	Soybean Full-Fat Micronized	Soybean Part- Defat Extruded	Soybean Part- Defat Toasted
Dry Matter	%	89.94	89.94	92.62	90.50	90.50
Crude Protein (CP)	%	36.42	36.42	39.14	40.07	40.07
Coef. Dig. CP Poultry	%	90.00	87.00	90.00	90.00	87.00
Digestible CP Poultry	%	32.78	31.69	35.23	36.06	34.86
Coef. Dig. CP Swine	%	88.00	80.00	88.00	88.00	80.00
Digestible CP Swine	%	32.05	29.30	34.44	35.26	32.06
Fat	%	18.32	18.32	21.50	8.32	8.32
Coef. Dig.Fat Poultry[1]	%	90.00	85.00	86.00	88.00	85.00
Digestible Fat Poultry	%	16.49	15.57	18.49	7.32	7.07
Coef. Dig. Fat Swine[1]	%	82.00	78.00	81.00	80.00	78.00
Digestible Fat Swine	%	15.02	14.29	17.42	6.66	6.49
Linoleic Acid	%	9.67	9.67	11.35	4.39	4.39
Linolenic Acid	%	1.28	1.28	1.50	0.58	0.58
Starch	%	6.70	6.70	6.70	7.37	7.37
Crude Fiber (CF)	%	6.03	6.03	1.36	6.63	6.63
Coef. Dig. CF Swine	%	76.60	76.60	77.65	76.60	76.60
NDF	%	16.60	16.60	27.60	18.26	18.26
Coef. Dig. NDF Swine	%	76.70	76.70	98.32	76.70	76.70
ADF	%	12.40	12.40	5.82	13.64	13.64
Coef. Dig. ADF Swine	%	85.10	85.10	82.55	85.10	85.10
Nitrogen-Free Ext (NFE)	%	24.57	24.57	26.15	30.42	30.42
Coef. Dig. NFE Poultry[1]	%	45.70	45.00	40.00	45.70	45.00
Digestible NFE Poultry	%	11.22	11.01	10.46	13.90	13.69
Non Dig. NFE + CF Poultry	%	19.38	19.59	17.05	23.15	23.36
Organic Matter (OM)	%	85.34	85.34	88.15	85.44	85.44
Coef. Dig. OM Swine[1]	%	83.00	76.70	86.00	81.70	76.70
Digestible OM Swine	%	70.83	65.45	75.81	69.80	65.53
Non Dig. OM Swine	%	14.51	19.89	12.34	15.64	19.91
Ash	%	4.60	4.60	4.47	5.06	5.06
Potassium	%	1.64	1.64	1.65	1.80	1.80
Sodium	%	0.01	0.01	0.01	0.01	0.01
Chlorine	%	0.02	0.02	0.03	0.02	0.02
Gross Energy	kcal/kg	5032	5032	5279	4456	4456
Met. Energy Poultry	kcal/kg	3409	3263	3660	2811	2726
Met. Energy Hens	kcal/kg	3467	3322	3711	2880	2796
True Met. Energy Poultry	kcal/kg	3538	3454	4171	-	-
Digestible Energy Swine	kcal/kg	4161	3930	4583	3760	3525
Digestible Energy Sows	kcal/kg	4306	4129	4706	3916	3724
Met. Energy Swine	kcal/kg	3913	3706	4330	3530	3315
Met. Energy Sows	kcal/kg	4022	3855	4423	3647	3464
Net Energy Swine[1]	kcal/kg	2819	2667	3192	2380	2223

[1] Calculated or estimated values.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Starch	Sugar	Sugarcane Juice	Sugarcane Molasses
Dry Matter	%	88.50	99.00	18.55	73.98
Crude Protein (CP)	%	-	-	0.30	3.66
Coef. Dig. CP Poultry	%	-	-	-	-
Digestible CP Poultry	%	-	-	-	-
Coef. Dig. CP Swine	%	-	-	-	-
Digestible CP Swine	%	-	-	-	-
Fat	%	-	-	-	0.10
Coef. Dig.Fat Poultry[1]	%	-	-	-	-
Digestible Fat Poultry	%	-	-	-	-
Coef. Dig. Fat Swine[1]	%	-	-	-	-
Digestible Fat Swine	%	-	-	-	-
Linoleic Acid	%	-	-	-	-
Linolenic Acid	%	-	-	-	-
Starch	%	87.70	-	-	-
Crude Fiber (CF)	%	-	-	0.05	2.46
Coef. Dig. CF Swine	%	-	-	-	-
NDF	%	-	-	-	-
Coef. Dig. NDF Swine	%	-	-	-	-
ADF	%	-	-	-	-
Coef. Dig. ADF Swine	%	-	-	-	-
Nitrogen-Free Ext (NFE)	%	87.70	98.86	17.90	59.02
Coef. Dig. NFE Poultry[1]	%	97.10	97.00	-	-
Digestible NFE Poultry	%	85.16	95.89	-	-
Non Dig. NFE + CF Poultry	%	2.54	2.97	-	-
Organic Matter (OM)	%	87.70	98.86	18.25	65.23
Coef. Dig. OM Swine[1]	%	98.00	98.00	93.39	-
Digestible OM Swine	%	85.95	96.88	17.04	-
Non Dig. OM Swine	%	1.75	1.98	-	-
Ash	%	-	0.14	0.30	8.75
Potassium	%	-	-	-	3.25
Sodium	%	-	-	-	0.58
Chlorine	%	-	-	-	1.38
Gross Energy	kcal/kg	3737	4008	757	2850
Met. Energy Poultry	kcal/kg	3528	3831	-	1880
Met. Energy Hens	kcal/kg	3536	3840	-	-
True Met. Energy Poultry	kcal/kg	-	3887	-	2230
Digestible Energy Swine	kcal/kg	3594	3873	707	2403
Digestible Energy Sows	kcal/kg	3612	3893	-	-
Met. Energy Swine	kcal/kg	3546	3737	675	2345
Met. Energy Sows	kcal/kg	3559	3752	-	-
Net Energy Swine[1]	kcal/kg	2913	2729	490	1665

[1] Calculated or estimated values.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Sugarcane Molasses Dried	Sunflower Meal	Sweet Potato Dried	Swine By-Product Meal	Triticale
Dry Matter	%	93.26	89.74	88.72	94.00	88.23
Crude Protein (CP)	%	2.44	30.22	3.87	47.00	12.23
Coef. Dig. CP Poultry	%	-	85.00	-	84.00	86.60
Digestible CP Poultry	%	-	25.69	-	39.48	10.59
Coef. Dig. CP Swine	%	-	80.00	30.00	78.00	85.00
Digestible CP Swine	%	-	24.18	1.16	30.79	10.39
Fat	%	-	1.78	0.91	14.60	1.51
Coef. Dig.Fat Poultry[1]	%	-	60.00	-	40.00	67.00
Digestible Fat Poultry	%	-	1.07	-	5.84	1.01
Coef. Dig. Fat Swine[1]	%	-	20.00	70.00	53.70	70.00
Digestible Fat Swine	%	-	0.36	0.63	7.84	1.06
Linoleic Acid	%	-	-	-	1.42	0.54
Linolenic Acid	%	-	-	-	0.14	-
Starch	%	-	5.00	62.90	-	55.25
Crude Fiber (CF)	%	6.20	25.73	2.69	-	2.61
Coef. Dig. CF Swine	%	-	-	-	-	-
NDF	%	-	41.01	8.80	-	12.45
Coef. Dig. NDF Swine	%	-		-	-	-
ADF	%	-	24.89	3.60	-	3.95
Coef. Dig. ADF Swine	%	-	-	-	-	-
Nitrogen-Free Ext (NFE)	%	68.32	26.03	78.26	4.50	70.24
Coef. Dig. NFE Poultry[1]	%	-	54.50	-	-	85.30
Digestible NFE Poultry	%	-	14.19	-	-	59.91
Non Dig. NFE + CF Poultry	%	-	37.57	-	-	12.94
Organic Matter (OM)	%	76.96	83.73	85.72	66.10	86.59
Coef. Dig. OM Swine[1]	%	-	50.20	91.50	58.00	85.00
Digestible OM Swine	%	-	42.03	78.43	38.34	73.60
Non Dig. OM Swine	%	-	41.70	-	-	12.99
Ash	%	16.30	5.98	3.00	27.90	1.64
Potassium	%	2.19	1.57	0.65	-	0.44
Sodium	%	0.15	0.02	0.15	-	0.02
Chlorine	%	-	-	0.09	-	0.03
Gross Energy	kcal/kg	3170	4289	3875	4200	3853
Met. Energy Poultry	kcal/kg	2153	1795	2706	2240	3031
Met. Energy Hens	kcal/kg	-	1908	-	-	3070
True Met. Energy Poultry	kcal/kg	2480	2200	2519	-	3165
Digestible Energy Swine	kcal/kg	2616	2141	3305	2485	3278
Digestible Energy Sows	kcal/kg	-	2558	-	-	3408
Met. Energy Swine	kcal/kg	2495	1955	3284	2266	3181
Met. Energy Sows	kcal/kg	-	2268	-	-	3278
Net Energy Swine[1]	kcal/kg	1745	1017	2590	1531	2439

[1] Calculated or estimated values.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Wheat	Wheat Bran-Midds	Wheat Flour	Wheat Germ
Dry Matter	%	88.10	88.38	87.00	88.27
Crude Protein (CP)	%	11.70	15.62	12.26	28.29
Coef. Dig. CP Poultry	%	87.50	77.00	93.40	89.00
Digestible CP Poultry	%	10.24	12.03	11.45	25.18
Coef. Dig. CP Swine	%	86.00	79.00	93.00	86.00
Digestible CP Swine	%	10.06	12.34	11.40	24.33
Fat	%	1.68	3.50	1.70	9.19
Coef. Dig.Fat Poultry[1]	%	68.00	65.00	87.00	64.00
Digestible Fat Poultry	%	1.14	2.28	1.48	5.88
Coef. Dig. Fat Swine[1]	%	70.00	60.00	-	60.00
Digestible Fat Swine	%	1.17	2.10	-	5.51
Linoleic Acid	%	0.68	1.54	0.54	3.43
Linolenic Acid	%	-	-	-	-
Starch	%	54.93	31.35	76.50	15.45
Crude Fiber (CF)	%	2.37	9.50	-	2.50
Coef. Dig. CF Swine	%	-	36.08	-	-
NDF	%	12.26	40.10	2.65	9.58
Coef. Dig. NDF Swine	%	-	50.44	-	-
ADF	%	3.19	13.64	-	3.65
Coef. Dig. ADF Swine	%	-	52.40	-	-
Nitrogen-Free Ext (NFE)	%	70.76	55.06	72.51	44.16
Coef. Dig. NFE Poultry[1]	%	85.30	47.30	95.60	49.50
Digestible NFE Poultry	%	60.36	26.04	69.31	21.86
Non Dig. NFE + CF Poultry	%	12.77	38.52	3.20	24.80
Organic Matter (OM)	%	86.51	83.68	86.47	84.13
Coef. Dig. OM Swine[1]	%	87.00	64.40	95.00	87.30
Digestible OM Swine	%	75.26	53.89	82.15	73.45
Non Dig. OM Swine	%	11.25	29.79	4.32	10.68
Ash	%	1.59	4.70	0.47	4.14
Potassium	%	0.40	1.03	0.11	0.73
Sodium	%	0.01	0.02	0.01	0.01
Chlorine	%	0.07	0.06	-	0.07
Gross Energy	kcal/kg	3819	3914	3775	4343
Met. Energy Poultry	kcal/kg	3046	1795	3503	2536
Met. Energy Hens	kcal/kg	3084	1911	3513	2610
True Met. Energy Poultry	kcal/kg	3124	2119	3551	2718
Digestible Energy Swine	kcal/kg	3351	2504	3588	3700
Digestible Energy Sows	kcal/kg	3464	2802	3631	3807
Met. Energy Swine	kcal/kg	3260	2390	3388	3578
Met. Energy Sows	kcal/kg	3344	2613	3420	3658
Net Energy Swine[1]	kcal/kg	2505	1748	2696	2576

[1] Calculated or estimated values.

Table 1.01 - Chemical Composition and Energy Values of Feedstuffs for Poultry and Swine (as fed)

Nutrient		Wheat Screenings	Wheat Shorts	Yeast Alcohol Distillery	Yeast Brewery
Dry Matter	%	88.17	88.19	91.20	90.00
Crude Protein (CP)	%	13.61	17.52	37.20	41.80
Coef. Dig. CP Poultry	%	86.00	84	58.00	64.00
Digestible CP Poultry	%	11.70	14.72	21.58	26.75
Coef. Dig. CP Swine	%	82.00	78	77.00	77.00
Digestible CP Swine	%	11.16	13.67	28.64	32.19
Fat	%	2.11	2.63	0.48	1.38
Coef. Dig.Fat Poultry[1]	%	60.00	87.00	70.00	75.00
Digestible Fat Poultry	%	1.26	2.28	0.34	1.04
Coef. Dig. Fat Swine[1]	%	70.00	80.00	80.00	82.00
Digestible Fat Swine	%	1.47	2.10	0.38	1.13
Linoleic Acid	%	0.79	1.46	-	-
Linolenic Acid	%	-	-	-	-
Starch	%	-	27.74	-	1.00
Crude Fiber (CF)	%	6.55	7.59	0.50	1.33
Coef. Dig. CF Swine	%	-	-	-	-
NDF	%	18.71	31.48	-	6.20
Coef. Dig. NDF Swine	%	-	-	-	-
ADF	%	8.85	9.57	-	1.80
Coef. Dig. ADF Swine	%	-	-	-	-
Nitrogen-Free Ext (NFE)	%	63.15	56.35	49.66	41.85
Coef. Dig. NFE Poultry[1]	%	82.60	63.2	75.10	77.40
Digestible NFE Poultry	%	52.16	35.61	37.29	32.39
Non Dig. NFE + CF Poultry	%	18.54	28.33	12.87	10.79
Organic Matter (OM)	%	85.41	84.08	87.84	86.36
Coef. Dig. OM Swine[1]	%	81.80	72.5	80.00	81.60
Digestible OM Swine	%	69.87	60.96	70.27	70.47
Non Dig. OM Swine	%	15.54	23.12	17.57	15.89
Ash	%	2.76	4.11	3.36	3.64
Potassium	%	0.43	1.00	1.13	1.32
Sodium	%	0.02	0.03	0.20	0.19
Chlorine	%	-	0.04	-	-
Gross Energy	kcal/kg	3875	3798	4157	4339
Met. Energy Poultry	kcal/kg	2783	2321	2506	2590
Met. Energy Hens	kcal/kg	2839	2406	2545	2622
True Met. Energy Poultry	kcal/kg	-	-	2615	-
Digestible Energy Swine	kcal/kg	3141	2848	3370	3474
Digestible Energy Sows	kcal/kg	3296	3079	3546	3633
Met. Energy Swine	kcal/kg	3027	2740	3164	3240
Met. Energy Sows	kcal/kg	3144	2913	3296	3359
Net Energy Swine[1]	kcal/kg	2083	1946	2062	2094

[1] Calculated or estimated values.

Table 1.02 - Equations to Estimate the Metabolizable Energy of Feedstuffs for Young and Mature Poultry

VEGETABLE FEEDSTUFFS

Poultry: Broilers and Young Poultry

$ME_{Poultry} = 4.31\ CPd + 9.29\ Fd + 4.14\ NFEd$

Hens and Mature Poultry

$ME_{Hens} = 4.31\ CPd + 9.29\ Fd + 4.14\ NFEd + 0.3\ NDEF$

ANIMAL FEEDSTUFFS AND FATS

Poultry: Young and Mature

$ME_{Poultry} = 4.31\ CPd + 9.29\ Fd$

$ME_{Poultry}$	= Metabolizable Energy Poultry, kcal/kg.
ME_{Hens}	= Metabolizable Energy Hens, kcal/kg.
CPd	= Digestible Protein Poultry, g/kg
Fd	= Digestible Fat Poultry, g/kg
NFEd	= Digestible Nitrogen-Free Extract Poultry, g/kg
NDEF	= Non-Digested NFE + Crude Fiber, g/kg

Data from UFV Theses.
Janssen, W. M. European Table of Energy Values for Poultry Feedstuffs. Wageningen, The Netherlands. 1989, 104p. Titus, H. W. Alimentación Científica de las Gallinas. Ed. Acribia, Spain. 1960, 290p.

Table 1.03 - Equations to Estimate the Energy Values of Feedstuffs for Swine in General

DIGESTIBLE ENERGY - Swine

Vegetable Feedstuffs and Dairy Products

$DE_{Swine} = 5.65\ CPd + 9.45\ Fd + 4.14\ (OMd - CPd - Fd)$

Animal by Product and Fat Feedstuffs

$DE = 5.65\ CPd + 9.45\ Fd$

METABOLIZABLE ENERGY - Swine

Vegetable feedstuffs and Dairy products

$ME_{Swine} = 4.952\ CPd + 9.45\ Fd + 4.14\ (OMd - CPd - Fd)$

Animal by Product Feedstuffs

$ME = 4.952\ CPd + 9.45\ Fd$

Fat and Carbohydrate Feedstuffs

$ME_{Swine} = 0.965\ DE$

NET ENERGY - Swine

$NE_{Swine} = 0.73\ ME_{Swine} + 13.1\ F + 3.7\ S - 6.7\ CP - 9.7\ CF$

DE_{swine}	= Dig. Energy Swine, kcal/kg	NE_{swine}	= Net Energy Swine, kcal/kg
ME_{swine}	= Metab. Energy Swine, kcal/kg	F	= Fat, %
CPd	= Dig. Protein Swine, g/kg	S	= Starch, %
Fd	= Fat Dig. Swine, g/kg	CP	= Crude Protein, %
OMd	= Dig. Organic Matt. Swine, g/kg	CF	= Crude Fiber, %

Data from UFV Theses.

Coutinho, R. Noções de Fisiologia da Nutrição. Ed. O Cruzeiro. Rio de Janeiro. 1966, 471p.
Sauvant, D., Perez, J. M. and Tran, G. (Editors). Tablas de Composición y de Valores Nutritivos de las Materias Primas Destinadas a los Animales de Interés Ganadero. Ed. Mundi-Prensa. España. 2004, 310p.

Table 1.04 - Equations to Estimate the Energy Values of Feedstuffs for Sows and Mature Pigs

DIGESTIBLE ENERGY- Sows

Vegetable Feedstuffs

$$DE_{Sows} = 5.65\ CPd + 9.45\ Fd + 4.14\ (OMd - CPd - Fd) + 1\ NDOM$$

METABOLIZABLE ENERGY - Sows

Vegetable Feedstuffs

$$ME_{Sows} = 4.952\ CPd + 9.45\ Fd + 4.14\ (OMd - CPd - Fd) + 0.75\ NDOM$$

NET ENERGY - Sows

Vegetable Feedstuffs

$$NE_{Sows} = 0.73\ EM_{Sows} + 13.1\ G + 3.7\ A - 6.7\ CP - 9.7\ CF$$

DE_{Sows} = Dig. Energy Sows, kcal/kg
ME_{Sows} = Metab. Energy Sows, kcal/kg
CPd = Dig. Protein Swine, g/kg
Fd = Dig.Fat Swine, g/kg
OMd = Dig. Organic Matter Swine, g/kg
NDOM = Non-Digested Organic Matter Swine, g/kg
NE_{Sows} = Net Energy Sows, kcal/kg
F = Fat, %
S = Starch, %
CP = Crude Protein, %
CF = Crude Fiber, %

Data from UFV Theses.

Coutinho, R. Noções de Fisiologia da Nutrição. Ed. O Cruzeiro. Rio de Janeiro. 1966, 471p.
Sauvant, D., Perez, J. M. and Tran, G. (Editors). Tablas de Composición y de Valores Nutritivos de las Materias Primas Destinadas a los Animales de Interés Ganadero. Ed. Mundi-Prensa. España. 2004, 310p.

Table 1.05 - Equation to Estimate Metabolizable Energy Lost (MEL) for Poultry as a Function of Corn Grading/Type[1]

ME_L = -0.064 + 1.62 BRK + 6.98 FRIM + 10.06 MOLD + 12.28 INS + 5.87 ADC

ME_L = Metabolizable Energy Loss for Poultry, Kcal/kg.
BRK = Broken Grains, %
FRIM = Fragmented Grains and Impurities, %
MOLD = Grains Contaminated by Molds, %
INS = Grains Attacked by Insects, %
ADC = Grains Affected by Different Causes, %

Example:

Grading/Type	"0"	I[2]	II[2]	III[2]
BRK, %	0	0.16	1.32	5.88
FRIM, %	0	0	1.18	1.96
MOLD, %	0	2.60	3.64	6.32
INS, %	0	0.24	0.12	0.16
ADC, %%	0	0	0	0
MEL Eq., Kcal/kg	0	- 29	- 51	- 89
ME poultry, Kcal/kg	3432[3]	3403	3381[3]	3343

[1] Adapted from de Barbarino (2001). PhD Thesis, UFV
[2] Grading by the Ministry of Agriculture.
[3] Considering Type II Corn with 3381 Kcal/kg (Table 1.01), Corn with 0 % de BRK, FRIM, MOLD, INS and ADC has ME_L = 0, then the ME poultry is 3381 + 51 = 3432 Kcal/kg.

Table 1.06 - Fatty Acid Profile of Fats and Oils (% as fed)

	Fatty Acids (%)										
	≤10	Lauric C12:0	Myristic C14:0	Palmitic C16:0	Palmitoleic C16:1	Stearic C18:0	Oleic C18:1	Linoleic C18:2	Linolenic C18:3 n6	Arachidonic C20:4 n6	≥20
Fats											
Coconut	14.10	44.60	16.80	8.20	-	2.80	5.80	1.80	-	-	-
Fish	-	0.20	6.11	14.34	10.00	3.04	15.08	1.36	0.74	0.73	56.52
Lard	0.10	0.15	1.35	24.06	2.80	13.95	41.84	9.70	0.95	1.70	1.30
Poultry	-	0.10	1.00	20.74	5.40	6.74	42.68	20.68	1.30	0.10	1.63
Tallow	0.20	0.15	3.00	23.90	4.43	19.05	38.20	3.10	0.60	0.20	1.80
Oils											
Canola	-	0.20	0.10	3.94	0.17	1.76	60.00	18.82	9.55	-	4.07
Corn	-	-	-	10.85	0.11	1.69	36.38	52.45	0.70	-	2.05
Cottonseed	-	-	0.80	20.72	0.80	2.45	17.56	54.08	0.20	-	0.91
Soybeans	-	-	0.10	9.76	0.20	3.77	23.32	52.78	6.97	-	2.13
Sunflower	-	0.20	0.17	5.41	0.30	3.60	32.19	51.98	0.25	-	3.15
Palm	-	-	0.20	10.92	0.45	4.35	36.85	9.50	0.25	-	0.50

Table 1.07 - Total and Digestible Amino Acid Content of Feedstuffs for Poultry and Swine (as Fed)

Nutrient		Babassu Meal		Babassu Starch Meal		Bakery Cookie Cracker Res		Bakery Residue		Blood Cells Dried	
Total Amino Acid											
		Value[1]		Value[1]		Value[1]		Value[1]		Value[1]	
Crude Protein	%	20.19		1.91		8.45		12.50		86.29	
Lysine	%	0.66		0.10		0.21		0.25		8.62	
Methionine	%	0.44		0.03		0.13		0.17		1.22	
Met + Cys	%	0.60		0.08		0.30		0.43		1.80	
Threonine	%	0.61		0.11		0.26		0.34		4.25	
Tryptophan	%	-		-		0.10		0.11		1.43	
Arginine	%	2.34		0.11		0.34		0.47		3.40	
Gly + Ser	%	1.75		0.26		0.74		0.93		8.70	
Valine	%	0.93		0.11		0.36		0.48		8.20	
Isoleucine	%	0.63		0.08		0.29		0.39		0.49	
Leucine	%	1.23		0.16		0.58		0.78		12.40	
Histidine	%	0.36		0.05		0.19		0.24		6.03	
Phenylalanine	%	0.88		0.10		0.38		0.53		7.10	
Phe + Tyr	%	1.32		0.17		0.57		0.87		9.80	
True Digestible Amino Acid – Poultry											
		Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]
Lysine	%	0.38	57.6	-	-	0.15	72.1	0.21	85.0	7.66	95.3
Methionine	%	0.37	84.1	-	-	0.11	83.3	0.15	89.5	1.07	94.5
Met + Cys	%	0.31	51.7	-	-	0.25	83.6	0.37	86.0	1.44	90.0
Threonine	%	0.35	57.4	-	-	0.16	61.4	0.27	80.0	3.69	94.1
Tryptophan	%	-	-	-	-	0.08	78.9	0.09	84.0	1.22	94.7
Arginine	%	1.88	80.3	-	-	0.29	85.7	0.42	90.2	3.17	95.4
Gly + Ser	%	0.95	54.3	-	-	0.58	77.8	0.82	88.0	8.31	95.5
Valine	%	0.74	79.6	-	-	0.28	77.6	0.44	92.7	7.16	94.5
Isoleucine	%	0.47	74.6	-	-	0.25	83.8	0.37	93.5	0.33	80.8
Leucine	%	0.94	76.4	-	-	0.50	87.2	0.75	95.5	12.15	98.3
Histidine	%	0.23	63.9	-	-	0.15	78.0	0.22	92.3	5.55	96.9
Phenylalanine	%	0.68	77.3	-	-	0.34	89.6	0.50	95.2	6.97	98.6
Phe +Tyr	%	0.94	71.2	-	-	0.49	86.1	0.82	94.8	9.55	98.6
True Digestible Amino Acid – Swine											
Lysine	%	-	-	-	-	0.17	84.0	0.20	80.0	8.06	93.5
Methionine	%	-	-	-	-	0.11	86.7	0.15	90.0	1.14	93.1
Met + Cys	%	-	-	-	-	0.26	86.1	0.40	92.0	1.51	84.2
Threonine	%	-	-	-	-	0.22	83.5	0.27	78.0	3.67	86.3
Tryptophan	%	-	-	-	-	0.08	78.9	0.09	83.0	1.28	89.5
Arginine	%	-	-	-	-	0.28	83.5	0.42	90.0	3.17	93.2
Valine	%	-	-	-	-	0.32	87.8	0.41	87.0	7.34	89.6
Isoleucine	%	-	-	-	-	0.26	88.2	0.35	90.0	0.27	55.8
Leucine	%	-	-	-	-	0.48	83.5	0.71	91.0	11.91	96.1
Histidine	%	-	-	-	-	0.16	83.5	0.21	90.0	6.03	100.0
Phenylalanine	%	-	-	-	-	0.32	83.5	0.50	94.0	6.80	95.8
Phe +Tyr	%	-	-	-	-	0.48	83.5	0.81	93.0	9.22	94.0

[1] Amino Acid Content [2] Digestibility Coefficient.

Table 1.07 - Total and Digestible Amino Acid Content of Feedstuffs for Poultry and Swine (as Fed)

Nutrient		Blood Meal		Blood Plasma		Canola Meal		Carob Meal		Casein	
Total Amino Acid											
		Value¹		Value¹		Value¹		Value¹		Value¹	
Crude Protein	%	83.50		71.89		37.97		8.79		84.21	
Lysine	%	7.55		6.54		2.01		0.28		6.94	
Methionine	%	1.04		0.88		0.78		0.07		2.60	
Met + Cys	%	1.81		3.03		1.64		-		2.97	
Threonine	%	4.17		4.41		1.57		0.27		3.79	
Tryptophan	%	1.46		1.28		0.49		0.05		1.08	
Arginine	%	3.44		3.89		2.32		0.43		3.07	
Gly + Ser	%	8.20		7.07		3.43		-		6.31	
Valine	%	7.35		4.90		1.84		0.54		5.66	
Isoleucine	%	0.69		2.26		1.56		0.26		4.61	
Leucine	%	10.97		6.99		2.65		0.59		7.47	
Histidine	%	5.09		2.16		1.01		0.12		2.43	
Phenylalanine	%	6.16		3.95		1.45		0.20		4.13	
Phe + Tyr	%	8.50		7.04		2.36		0.47		9.51	
True Digestible Amino Acid – Poultry											
		Value¹	Coef.²	Value¹	Coef.²	Value¹	Coef.²	Value¹	Coef.²	Value¹	Coef.²
Lysine	%	5.83	77.2	6.00	91.8	1.72	85.4	-	-	6.64	95.7
Methionine	%	0.84	80.4	0.79	89.7	0.70	90.0	-	-	2.50	96.3
Met + Cys	%	1.31	72.2	2.72	90.0	1.48	90.1	-	-	2.84	95.6
Threonine	%	3.22	77.1	3.98	90.1	1.30	83.0	-	-	3.55	93.7
Tryptophan	%	1.17	79.9	1.15	89.3	0.42	86.0	-	-	1.05	96.9
Arginine	%	2.71	78.8	3.63	93.4	2.10	90.4	-	-	3.05	99.3
Gly + Ser	%	6.23	76.0	5.83	82.4	2.91	85.0	-	-	6.15	97.4
Valine	%	5.67	77.1	4.40	89.7	1.59	86.2	-	-	5.55	98.1
Isoleucine	%	0.45	65.4	1.99	88.3	1.24	79.8	-	-	4.52	98.1
Leucine	%	8.72	79.5	6.37	91.1	2.20	82.9	-	-	7.44	99.6
Histidine	%	4.01	78.8	1.96	90.8	0.90	89.3	-	-	2.41	99.2
Phenylalanine	%	5.01	81.4	3.65	92.5	1.27	87.8	-	-	4.12	99.8
Phe +Tyr	%	6.89	81.0	6.75	95.8	2.02	85.7	-	-	9.49	99.8
True Digestible Amino Acid – Swine											
Lysine	%	5.84	77.3	6.25	95.7	1.54	76.5	-	-	6.83	98.4
Methionine	%	0.80	76.4	0.82	92.3	0.67	86.5	-	-	2.57	98.9
Met + Cys	%	1.38	76.2	2.79	92.2	1.38	84.0	-	-	2.88	97.1
Threonine	%	3.17	76.1	4.06	92.0	1.18	75.5	-	-	3.63	95.8
Tryptophan	%	1.07	73.3	1.16	90.2	0.38	77.5	-	-	1.06	98.3
Arginine	%	2.65	77.0	3.79	97.3	2.00	86.0	-	-	-	-
Valine	%	5.16	70.2	4.55	92.8	1.42	77.0	-	-	5.43	95.9
Isoleucine	%	0.55	79.9	2.06	91.5	1.22	78.0	-	-	4.42	96.1
Leucine	%	7.70	70.2	6.59	94.3	2.16	81.5	-	-	-	-
Histidine	%	3.74	73.6	2.08	96.2	0.85	84.5	-	-	-	-
Phenylalanine	%	4.40	71.5	3.71	93.9	1.20	82.5	-	-	-	-
Phe +Tyr	%	6.55	77.0	6.54	92.8	1.91	81.0	-	-	-	-

¹ Amino Acid Content ² Digestibility Coefficient.

Table 1.07 - Total and Digestible Amino Acid Content of Feedstuffs for Poultry and Swine (as Fed)

Nutrient		Cassava with Hulls Dried		Castor Oil Plant Meal		Citrus Pulp		Coconut Meal		Corn Germ	
Total Amino Acid											
		Value¹		Value¹		Value¹		Value¹		Value¹	
Crude Protein	%	2.47		39.20		6.37		21.85		10.38	
Lysine	%	0.09		0.78		0.17		0.58		0.45	
Methionine	%	0.03		0.61		0.07		0.33		0.19	
Met + Cys	%	0.07		1.07		0.16		0.62		0.41	
Threonine	%	0.07		1.13		0.18		0.67		0.39	
Tryptophan	%	0.02		0.58		0.05		0.18		0.11	
Arginine	%	0.15		3.21		0.24		2.56		0.65	
Gly + Ser	%	0.16		3.18		0.47		1.84		0.97	
Valine	%	0.11		1.78		0.25		1.12		0.50	
Isoleucine	%	0.09		1.75		0.19		0.77		0.33	
Leucine	%	0.12		2.68		0.32		1.37		0.90	
Histidine	%	0.08		56.00		0.17		0.44		0.31	
Phenylalanine	%	0.08		1.35		0.25		0.85		0.43	
Phe + Tyr	%	0.16		2.26		0.41		1.37		0.71	
True Digestible Amino Acid – Poultry											
		Value¹	Coef.²	Value¹	Coef.²	Value¹	Coef.²	Value¹	Coef.²	Value¹	Coef.²
Lysine	%	-	-	-	-	-	-	-	-	0.38	85.1
Methionine	%	-	-	-	-	-	-	-	-	0.17	88.3
Met + Cys	%	-	-	-	-	-	-	-	-	0.35	84.3
Threonine	%	-	-	-	-	-	-	-	-	0.30	76.5
Tryptophan	%	-	-	-	-	-	-	-	-	0.09	87.3
Arginine	%	-	-	-	-	-	-	-	-	0.62	95.3
Gly + Ser	%	-	-	-	-	-	-	-	-	0.84	86.2
Valine	%	-	-	-	-	-	-	-	-	0.43	85.2
Isoleucine	%	-	-	-	-	-	-	-	-	0.29	85.8
Leucine	%	-	-	-	-	-	-	-	-	0.82	91.0
Histidine	%	-	-	-	-	-	-	-	-	0.28	91.0
Phenylalanine	%	-	-	-	-	-	-	-	-	0.39	89.5
Phe +Tyr	%	-	-	-	-	-	-	-	-	0.65	91.6
True Digestible Amino Acid – Swine											
Lysine	%	-	-	-	-	-	-	-	-	-	-
Methionine	%	-	-	-	-	-	-	-	-	-	-
Met + Cys	%	-	-	-	-	-	-	-	-	-	-
Threonine	%	-	-	-	-	-	-	-	-	-	-
Tryptophan	%	-	-	-	-	-	-	-	-	-	-
Arginine	%	-	-	-	-	-	-	-	-	-	-
Valine	%	-	-	-	-	-	-	-	-	-	-
Isoleucine	%	-	-	-	-	-	-	-	-	-	-
Leucine	%	-	-	-	-	-	-	-	-	-	-
Histidine	%	-	-	-	-	-	-	-	-	-	-
Phenylalanine	%	-	-	-	-	-	-	-	-	-	-
Phe +Tyr	%	-	-	-	-	-	-	-	-	-	-

¹ Amino Acid Content ² Digestibility Coefficient.

Table 1.07 - Total and Digestible Amino Acid Content of Feedstuffs for Poultry and Swine (as Fed)

Nutrient		Corn (7.29%)		Corn (7.88 %)		Corn (8.48 %)		Corn Gluten Meal (21%)		Corn Gluten Meal (60%)	
Total Amino Acid											
		Value[1]		Value[1]		Value[1]		Value[1]		Value[1]	
Crude Protein	%	7.29		7.88		8.48		21.10		61.07	
Lysine	%	0.21		0.23		0.24		0.55		1.00	
Methionine	%	0.15		0.16		0.17		0.35		1.38	
Met + Cys	%	0.30		0.33		0.35		0.85		2.45	
Threonine	%	0.29		0.32		0.35		0.77		2.09	
Tryptophan	%	0.05		0.06		0.06		0.13		0.31	
Arginine	%	0.35		0.37		0.39		0.87		1.96	
Gly + Ser	%	0.65		0.69		0.74		1.85		4.89	
Valine	%	0.34		0.37		0.40		1.05		2.86	
Isoleucine	%	0.24		0.27		0.29		0.64		2.54	
Leucine	%	0.87		0.94		1.01		1.87		10.61	
Histidine	%	0.21		0.23		0.25		0.70		1.28	
Phenylalanine	%	0.33		0.37		0.40		0.76		3.93	
Phe + Tyr	%	0.57		0.63		0.69		1.20		7.16	
True Digestible Amino Acid – Poultry											
		Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]
Lysine	%	0.18	85.3	0.19	85.3	0.20	85.3	0.40	72.9	0.91	91.2
Methionine	%	0.14	92.9	0.15	92.9	0.16	92.9	0.30	85.2	1.33	96.4
Met + Cys	%	0.27	89.9	0.29	90.0	0.32	90.0	0.64	75.5	2.27	92.7
Threonine	%	0.24	83.7	0.27	83.7	0.29	83.7	0.58	75.8	1.92	92.3
Tryptophan	%	0.05	89.5	0.05	89.5	0.06	89.5	0.10	77.5	0.29	90.9
Arginine	%	0.32	91.7	0.34	91.7	0.36	91.7	0.78	89.4	1.88	96.2
Gly + Ser	%	0.57	87.3	0.60	87.3	0.64	87.3	1.33	72.0	4.20	85.9
Valine	%	0.30	87.7	0.33	87.7	0.35	87.7	0.88	83.4	2.68	94.0
Isoleucine	%	0.22	90.8	0.24	90.8	0.27	90.8	0.53	82.7	2.39	94.1
Leucine	%	0.83	94.9	0.90	94.9	0.96	94.9	1.68	90.0	10.35	97.5
Histidine	%	0.20	92.3	0.21	92.3	0.23	92.3	0.58	82.8	1.19	93.5
Phenylalanine	%	0.30	91.7	0.34	91.7	0.37	91.7	0.66	86.9	3.74	95.3
Phe +Tyr	%	0.52	91.7	0.58	91.7	0.63	91.7	1.03	85.7	6.95	97.1
True Digestible Amino Acid – Swine											
Lysine	%	0.17	79.8	0.18	79.8	0.19	79.8	0.36	65.7	0.86	85.9
Methionine	%	0.13	89.2	0.14	89.2	0.15	89.2	0.29	83.4	1.28	92.5
Met + Cys	%	0.27	87.7	0.29	87.7	0.31	87.7	0.63	73.5	2.24	91.4
Threonine	%	0.23	81.4	0.26	81.4	0.28	81.4	0.54	70.6	1.89	90.6
Tryptophan	%	0.04	80.8	0.05	80.8	0.05	80.8	0.08	65.4	0.25	80.3
Arginine	%	0.32	91.4	0.34	91.4	0.36	91.4	0.75	86.0	1.85	94.4
Valine	%	0.30	86.7	0.32	86.7	0.35	86.7	0.78	74.4	2.55	89.1
Isoleucine	%	0.21	87.3	0.23	87.3	0.26	87.3	0.50	78.1	2.25	88.6
Leucine	%	0.81	92.5	0.87	92.5	0.94	92.5	1.57	83.9	9.77	92.1
Histidine	%	0.19	89.0	0.21	89.0	0.22	89.0	0.51	72.9	1.17	91.8
Phenylalanine	%	0.30	90.9	0.33	90.9	0.37	90.9	0.64	84.9	3.61	91.8
Phe +Tyr	%	0.51	90.1	0.57	90.1	0.62	90.1	1.01	83.5	6.55	91.4

[1] Amino Acid Content [2] Digestibility Coefficient.

Table 1.07 - Total and Digestible Amino Acid Content of Feedstuffs for Poultry and Swine (as Fed)

Nutrient		Corn High Lysine		Corn High Oil		Corn Pre-Cooked		Cottonseed Meal (30%)		Cottonseed Meal (39%)	
Total Amino Acid											
		Value[1]		Value[1]		Value[1]		Value[1]		Value[1]	
Crude Protein	%	8.26		8.21		7.61		29.98		39.21	
Lysine	%	0.35		0.26		0.23		1.21		1.62	
Methionine	%	0.15		0.18		0.16		0.44		0.59	
Met + Cys	%	0.33		0.39		0.33		0.93		1.27	
Threonine	%	0.34		0.31		0.32		0.94		1.34	
Tryptophan	%	0.11		0.07		0.06		0.51		0.51	
Arginine	%	0.51		0.40		0.37		3.41		4.43	
Gly + Ser	%	0.82		0.79		0.69		2.46		3.57	
Valine	%	0.45		0.41		0.37		1.30		1.84	
Isoleucine	%	0.26		0.32		0.27		0.92		1.35	
Leucine	%	0.73		1.03		0.94		1.74		2.36	
Histidine	%	0.31		0.27		0.23		0.84		1.14	
Phenylalanine	%	0.34		0.42		0.37		1.64		2.20	
Phe + Tyr	%	0.57		0.71		0.63		2.35		3.27	
True Digestible Amino Acid – Poultry											
		Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]
Lysine	%	0.30	86.4	0.21	81.8	0.19	85.3	0.89	73.3	1.19	73.5
Methionine	%	0.13	89.9	0.16	91.4	0.15	92.9	0.33	75.5	0.47	78.9
Met + Cys	%	0.28	86.0	0.34	86.7	0.29	90.0	0.63	67.7	0.94	74.3
Threonine	%	0.26	77.8	0.27	87.4	0.27	83.7	0.65	77.0	0.98	73.3
Tryptophan	%	0.1	90.9	0.06	81.5	0.05	89.5	0.39	69.5	0.36	70.6
Arginine	%	0.47	92.2	0.37	93.3	0.34	91.7	2.50	73.3	3.96	89.4
Gly + Ser	%	0.72	87.3	0.69	87.2	0.60	87.3	1.85	75.1	2.54	71.1
Valine	%	0.38	85.4	0.34	82.6	0.33	87.7	0.98	75.3	1.35	73.2
Isoleucine	%	0.22	84.6	0.27	84.7	0.24	90.8	0.83	90.4	0.95	70.1
Leucine	%	0.66	90.9	0.95	92.1	0.90	94.9	1.27	73.3	1.85	78.3
Histidine	%	0.29	95.1	0.25	91.4	0.21	92.3	0.61	72.5	0.89	78.5
Phenylalanine	%	0.30	91.0	0.37	88.1	0.34	91.7	1.28	77.9	1.89	86.0
Phe +Tyr	%	0.51	90.2	0.65	91.7	0.57	91.7	1.83	77.9	2.66	81.2
True Digestible Amino Acid – Swine											
Lysine	%	0.27	78.4	0.21	79.8	0.20	87.4	0.71	58.7	1.04	64.3
Methionine	%	0.14	93.8	0.14	76.9	0.14	90.9	0.30	69.7	0.44	75.3
Met + Cys	%	0.30	91.4	0.35	88.9	0.30	90.4	0.58	62.2	0.94	74.1
Threonine	%	0.27	80.0	0.26	84.2	0.27	85.1	0.54	70.2	0.94	70.5
Tryptophan	%	0.09	81.8	0.06	82.8	0.05	86.6	0.36	57.5	0.35	68.3
Arginine	%	0.47	92.9	0.37	91.4	0.34	93.1	3.01	88.4	3.96	89.5
Valine	%	0.38	86.4	0.36	86.7	0.33	88.7	0.86	65.7	1.37	74.4
Isoleucine	%	0.22	84.6	0.28	87.8	0.24	89.9	0.58	63.1	0.98	72.3
Leucine	%	0.67	92.2	0.90	87.1	0.85	90.2	1.16	66.6	1.76	74.6
Histidine	%	0.28	90.0	0.24	89.0	0.21	90.1	0.69	82.1	0.88	77.4
Phenylalanine	%	0.31	91.7	0.38	90.9	0.34	91.4	1.28	78.2	1.80	82.0
Phe +Tyr	%	0.50	88.9	0.64	90.1	0.55	87.7	1.88	80.2	2.65	81.0

[1] Amino Acid Content [2] Digestibility Coefficient.

Table 1.07 - Total and Digestible Amino Acid Content of Feedstuffs for Poultry and Swine (as Fed)

Nutrient		Feather Meal (75%)		Feather Meal (84%)		Feather & Poultry By Product Meal		Fish Meal (54%)		Fish Meal (61%)	
						Total Amino Acid					
		Value[1]		Value[1]		Value[1]		Value[1]		Value[1]	
Crude Protein	%	74.91		83.63		65.71		54.58		61.42	
Lysine	%	2.32		2.41		2.84		3.40		4.33	
Methionine	%	0.66		0.68		0.89		1.35		1.61	
Met + Cys	%	3.80		4.17		2.80		2.28		2.25	
Threonine	%	3.66		3.84		2.81		2.30		2.55	
Tryptophan	%	0.55		0.60		0.56		0.47		0.59	
Arginine	%	5.07		5.58		4.47		3.38		3.81	
Gly + Ser	%	14.03		15.39		10.10		7.63		8.31	
Valine	%	5.56		5.97		3.86		2.82		3.04	
Isoleucine	%	3.56		3.85		2.82		2.24		2.49	
Leucine	%	6.47		6.96		4.98		3.89		4.40	
Histidine	%	1.07		1.14		1.18		1.08		1.32	
Phenylalanine	%	3.77		4.04		2.93		2.24		2.38	
Phe + Tyr	%	5.91		6.54		5.24		3.74		4.34	
						True Digestible Amino Acid – Poultry					
		Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]
Lysine	%	1.65	71.2	1.68	69.8	1.91	67.2	2.96	86.9	3.81	87.8
Methionine	%	0.51	76.8	0.52	76.4	0.78	87.5	1.20	89.1	1.43	89.3
Met + Cys	%	2.22	58.5	2.73	65.5	1.77	63.3	1.93	84.7	1.89	84.0
Threonine	%	2.50	68.2	2.80	73.0	2.22	79.1	1.95	84.8	2.13	83.7
Tryptophan	%	0.41	73.6	0.44	73.5	0.46	82.0	0.41	87.4	0.51	86.6
Arginine	%	3.86	76.1	4.50	80.6	3.71	83.1	3.02	89.3	3.37	88.4
Gly + Ser	%	12.24	87.2	12.21	79.3	7.88	78.0	6.56	86.0	7.23	87.0
Valine	%	4.18	75.0	4.70	78.7	3.04	78.8	2.42	85.7	2.52	83.0
Isoleucine	%	2.85	79.9	3.08	80.0	2.32	82.2	2.04	91.4	2.23	89.6
Leucine	%	5.01	77.5	5.32	76.5	3.89	78.2	3.39	87.0	3.81	86.6
Histidine	%	0.75	70.4	0.86	75.8	0.82	69.5	0.89	82.6	1.13	85.3
Phenylalanine	%	3.05	80.9	3.24	80.1	2.41	82.1	1.95	87.1	2.10	88.5
Phe +Tyr	%	4.41	74.7	5.36	81.9	4.23	80.7	3.10	83.1	3.82	88.0
						True Digestible Amino Acid – Swine					
Lysine	%	1.76	75.8	1.81	75.2	-	-	2.63	77.1	3.61	83.3
Methionine	%	0.49	74.7	0.54	79.3	-	-	1.00	74.2	1.31	81.3
Met + Cys	%	2.66	70.0	3.29	78.9	-	-	1.43	62.8	1.68	74.7
Threonine	%	2.88	78.7	3.21	83.6	-	-	1.56	67.6	1.99	77.9
Tryptophan	%	0.40	72.0	0.41	67.8	-	-	0.35	73.7	0.47	80.1
Arginine	%	4.44	87.7	4.83	86.5	-	-	2.81	83.0	3.16	83.0
Valine	%	4.37	78.6	5.01	84.0	-	-	1.98	70.2	2.42	79.6
Isoleucine	%	2.91	81.8	3.34	86.8	-	-	1.71	76.5	2.07	83.3
Leucine	%	5.14	79.4	5.88	84.4	-	-	2.84	73.1	3.52	80.1
Histidine	%	0.79	74.3	0.87	76.7	-	-	0.79	73.5	1.06	80.7
Phenylalanine	%	3.10	82.4	3.49	86.3	-	-	1.65	73.6	1.92	80.6
Phe +Tyr	%	4.36	73.8	5.54	84.6	-	-	2.95	79.0	3.50	80.6

[1] Amino Acid Content [2] Digestibility Coefficient.

Table 1.07 - Total and Digestible Amino Acid Content of Feedstuffs for Poultry and Swine (as Fed)

Nutrient		Meat & bone meal (36%)		Meat & bone meal (38%)		Meat & bone meal (41%)		Meat & Bone Meal (44%)		Meat & Bone Meal (46%)	
Total Amino Acid											
		Value[1]		Value[1]		Value[1]		Value[1]		Value[1]	
Crude Protein	%	36.31		38.48		40.83		43.50		45.87	
Lysine	%	1.69		1.82		1.98		2.14		2.27	
Methionine	%	0.46		0.48		0.56		0.56		0.58	
Met + Cys	%	0.68		0.74		0.87		0.92		0.98	
Threonine	%	0.99		1.09		1.21		1.34		1.45	
Tryptophan	%	0.14		0.16		0.18		0.20		0.22	
Arginine	%	2.86		3.05		3.22		3.20		3.32	
Gly + Ser	%	8.14		8.27		8.46		8.63		8.82	
Valine	%	1.32		1.48		1.48		1.62		1.75	
Isoleucine	%	0.80		0.89		0.99		1.06		1.13	
Leucine	%	1.73		1.90		2.10		2.29		2.45	
Histidine	%	0.51		0.54		0.62		0.67		0.72	
Phenylalanine	%	1.09		1.46		1.45		1.29		1.40	
Phe + Tyr	%	1.60		1.71		1.86		2.05		2.15	
True Digestible Amino Acid – Poultry											
		Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]
Lysine	%	1.25	73.8	1.49	82.0	1.64	83.2	1.78	83.4	1.90	83.7
Methionine	%	0.29	61.5	0.38	79.1	0.42	75.9	0.44	78.4	0.47	80.9
Met + Cys	%	0.43	63.9	0.56	76.0	0.65	74.7	0.71	76.8	0.77	79.0
Threonine	%	0.67	67.4	0.87	79.2	0.93	76.7	1.05	78.6	1.17	80.5
Tryptophan	%	0.09	64.4	0.13	82.5	0.14	80.9	0.16	79.7	0.17	78.6
Arginine	%	2.25	78.6	2.61	85.7	2.66	82.7	2.63	82.1	2.71	81.6
Gly + Ser	%	5.61	69.0	6.78	82.0	6.77	80.0	7.07	82.0	7.15	81.0
Valine	%	0.90	68.5	1.21	81.6	1.32	89.3	1.38	85.1	1.40	80.3
Isoleucine	%	0.56	70.1	0.74	83.7	0.81	82.0	0.88	82.8	0.94	83.6
Leucine	%	1.25	71.9	1.62	85.2	1.75	83.7	1.90	82.8	2.01	82.0
Histidine	%	0.34	66.1	0.44	81.6	0.43	70.0	0.56	83.1	0.58	80.8
Phenylalanine	%	0.78	71.1	1.21	82.9	1.21	83.6	1.06	81.8	1.12	80.0
Phe +Tyr	%	1.15	72.0	1.40	82.0	1.52	82.0	1.65	80.9	1.71	79.8
True Digestible Amino Acid – Swine											
Lysine	%	1.22	72.4	1.36	74.9	1.47	74.6	1.61	75.4	1.73	76.3
Methionine	%	0.38	80.0	0.36	75.0	0.44	78.7	0.44	79.0	0.46	79.4
Met + Cys	%	0.51	77.0	0.54	73.0	0.65	75.0	0.70	76.0	0.75	77.0
Threonine	%	0.74	73.0	0.80	73.6	0.93	76.5	1.03	77.0	1.13	77.5
Tryptophan	%	0.11	76.0	0.11	73.0	0.14	78.0	0.16	78.6	0.17	79.1
Arginine	%	2.41	83.0	2.41	79.0	2.67	83.0	2.73	85.2	2.90	87.5
Valine	%	0.99	74.9	1.11	75.1	1.11	75.5	1.25	76.9	1.37	78.2
Isoleucine	%	0.61	76.3	0.66	74.4	0.75	75.2	0.81	76.4	0.88	77.5
Leucine	%	1.38	79.5	1.44	76.0	1.63	78.0	1.78	77.6	1.89	77.3
Histidine	%	0.39	76.7	0.41	76.3	0.47	77.0	0.52	77.9	0.56	78.8
Phenylalanine	%	0.86	78.3	1.11	76.3	1.16	80.1	1.03	80.0	1.11	79.8
Phe +Tyr	%	1.25	78.0	1.28	75.0	1.49	80.0	1.62	79.3	1.69	78.5

[1] Amino Acid Content [2] Digestibility Coefficient.

Table 1.07 - Total and Digestible Amino Acid Content of Feedstuffs for Poultry and Swine (as Fed)

Nutrient		Meat & Bone Meal (48%)		Meat & Bone Meal (50%)		Meat & Bone Meal (55%)		Meat & Bone Meal (63%)		Milk Skimmed Dried	
		Total Amino Acid									
		Value[1]		Value[1]		Value[1]		Value[1]		Value[1]	
Crude Protein	%	48.01		50.36		54.74		63.17		33.10	
Lysine	%	2.54		2.65		2.91		3.30		2.77	
Methionine	%	0.65		0.67		0.77		0.92		0.88	
Met + Cys	%	1.08		1.17		1.32		1.50		1.19	
Threonine	%	1.56		1.65		1.80		2.02		1.55	
Tryptophan	%	0.25		0.27		0.32		0.22		0.45	
Arginine	%	3.69		3.80		3.80		4.05		1.26	
Gly + Ser	%	8.92		9.10		9.52		9.80		2.59	
Valine	%	2.13		2.24		2.46		2.67		2.28	
Isoleucine	%	1.40		1.46		1.60		1.84		1.97	
Leucine	%	2.67		2.84		3.16		3.74		3.38	
Histidine	%	0.81		0.86		0.99		1.14		1.02	
Phenylalanine	%	1.22		1.42		1.70		2.08		1.70	
Phe + Tyr	%	2.32		2.47		2.83		3.40		3.11	
		True Digestible Amino Acid – Poultry									
		Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]
Lysine	%	2.10	82.7	2.17	82.0	2.35	81.0	-	-	-	-
Methionine	%	0.52	80.7	0.54	80.6	0.65	83.7	-	-	-	-
Met + Cys	%	0.85	78.5	0.92	79.0	1.07	80.8	-	-	-	-
Threonine	%	1.23	78.8	1.29	78.1	1.43	79.4	-	-	-	-
Tryptophan	%	0.20	80.9	0.22	83.3	0.24	80.2	-	-	-	-
Arginine	%	3.08	83.6	3.26	85.7	3.19	84.0	-	-	-	-
Gly + Ser	%	7.05	79.0	7.28	80.0	7.61	80.0	-	-	-	-
Valine	%	1.73	81.0	1.83	81.8	1.99	81.0	-	-	-	-
Isoleucine	%	1.17	83.3	1.21	83.1	1.32	82.6	-	-	-	-
Leucine	%	2.23	83.7	2.43	85.4	2.66	84.0	-	-	-	-
Histidine	%	0.66	81.4	0.68	79.3	0.81	82.0	-	-	-	-
Phenylalanine	%	1.01	82.7	1.21	85.4	1.43	84.0	-	-	-	-
Phe +Tyr	%	1.91	82.4	2.10	85.0	2.38	84.0	-	-	-	-
		True Digestible Amino Acid – Swine									
Lysine	%	1.98	78.2	2.12	80.1	2.35	81.0	-	-	2.65	95.6
Methionine	%	0.52	80.7	0.55	82.1	0.64	82.3	-	-	0.84	96.0
Met + Cys	%	0.84	77.4	0.91	77.7	1.04	79.0	-	-	1.10	92.8
Threonine	%	1.22	78.3	1.31	79.1	1.40	77.8	-	-	1.41	91.2
Tryptophan	%	0.20	79.6	0.22	80.0	0.26	78.9	-	-	0.43	94.5
Arginine	%	3.20	86.9	3.28	86.3	3.27	86.0	-	-	1.19	94.2
Valine	%	1.69	79.2	1.80	80.1	1.96	79.6	-	-	2.08	91.2
Isoleucine	%	1.11	78.9	1.17	80.4	1.30	81.4	-	-	1.77	90.1
Leucine	%	2.13	80.1	2.35	82.9	2.69	85.0	-	-	3.27	96.7
Histidine	%	0.66	80.8	0.71	82.9	0.78	79.0	-	-	0.97	94.7
Phenylalanine	%	0.99	81.0	1.17	82.2	1.44	85.0	-	-	1.66	97.4
Phe +Tyr	%	1.85	79.5	1.99	80.5	2.38	84.0	-	-	3.02	97.0

[1] Amino Acid Content [2] Digestibility Coefficient.

Table 1.07 - Total and Digestible Amino Acid Content of Feedstuffs for Poultry and Swine (as Fed)

Nutrient		Milk Whey Dried		Milk Whey Permeate Dried		Milk Whole Dried		Millet		Palm Ouricuri Meal	
		Total Amino Acid									
		Value[1]		Value[1]		Value[1]		Value[1]		Value[1]	
Crude Protein	%	12.07		3.00		23.70		12.71		23.00	
Lysine	%	0.98		0.14		1.95		0.36		0.70	
Methionine	%	0.22		0.02		0.61		0.26		0.36	
Met + Cys	%	0.47		0.06		0.84		0.47		0.68	
Threonine	%	0.75		0.11		1.14		0.48		0.59	
Tryptophan	%	0.18		0.02		0.31		0.15		0.21	
Arginine	%	0.38		0.05		0.91		0.51		2.71	
Gly + Ser	%	1.15		-		1.90		1.07		1.68	
Valine	%	0.68		0.10		1.56		0.64		1.06	
Isoleucine	%	0.67		0.13		1.33		0.63		0.76	
Leucine	%	1.12		0.17		2.44		1.22		1.30	
Histidine	%	0.27		0.04		0.71		0.30		0.38	
Phenylalanine	%	0.42		0.05		1.22		0.59		0.92	
Phe + Tyr	%	0.64		0.07		2.20		0.86		1.39	
		True Digestible Amino Acid – Poultry									
		Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]
Lysine	%	-	-	-	-	-	-	0.33	90.6	-	-
Methionine	%	-	-	-	-	-	-	0.24	92.6	-	-
Met + Cys	%	-	-	-	-	-	-	0.43	90.0	-	-
Threonine	%	-	-	-	-	-	-	0.41	85.7	-	-
Tryptophan	%	-	-	-	-	-	-	0.14	92.9	-	-
Arginine	%	-	-	-	-	-	-	0.50	96.8	-	-
Gly + Ser	%	-	-	-	-	-	-	0.91	85.2	-	-
Valine	%	-	-	-	-	-	-	0.59	90.8	-	-
Isoleucine	%	-	-	-	-	-	-	0.58	92.1	-	-
Leucine	%	-	-	-	-	-	-	1.15	94.9	-	-
Histidine	%	-	-	-	-	-	-	0.29	96.1	-	-
Phenylalanine	%	-	-	-	-	-	-	0.56	94.7	-	-
Phe +Tyr	%	-	-	-	-	-	-	0.81	93.6	-	-
		True Digestible Amino Acid – Swine									
Lysine	%	0.89	90.8	-	-	1.80	92.3	0.29	81.8	-	-
Methionine	%	0.20	90.9	-	-	0.59	96.0	0.24	92.6	-	-
Met + Cys	%	0.42	90.3	-	-	0.79	94.4	0.43	91.3	-	-
Threonine	%	0.64	85.8	-	-	1.06	92.6	0.38	80.3	-	-
Tryptophan	%	0.15	84.4	-	-	0.30	95.8	0.13	85.7	-	-
Arginine	%	0.35	90.9	-	-	0.83	91.1	0.49	94.8	-	-
Valine	%	0.59	87.1	-	-	1.43	91.6	0.57	88.0	-	-
Isoleucine	%	0.60	89.1	-	-	1.19	89.6	0.55	87.3	-	-
Leucine	%	1.03	92.1	-	-	2.36	96.9	1.09	89.8	-	-
Histidine	%	0.24	91.5	-	-	0.68	95.9	0.28	94.6	-	-
Phenylalanine	%	0.38	90.4	-	-	1.19	97.7	0.53	90.0	-	-
Phe +Tyr	%	0.58	89.8	-	-	2.15	97.5	0.77	89.6	-	-

[1] Amino Acid Content [2] Digestibility Coefficient.

Table 1.07 - Total and Digestible Amino Acid Content of Feedstuffs for Poultry and Swine (as Fed)

Nutrient		Passion Fruit Pulp Dried		Pasta Spaghetty Residue		Peanut Meal		Poultry By Product Meal		Poultry By Product Meal High Fat	
Total Amino Acid											
		Value[1]		Value[1]		Value[1]		Value[1]		Value[1]	
Crude Protein	%	12.42		12.30		47.77		57.68		55.30	
Lysine	%	0.26		0.25		1.57		3.33		3.09	
Methionine	%	0.30		0.19		0.52		1.10		1.06	
Met + Cys	%	0.50		0.47		1.11		1.95		1.84	
Threonine	%	0.33		0.34		1.26		2.36		2.16	
Tryptophan	%	-		0.13		0.58		0.54		0.52	
Arginine	%	1.50		0.47		5.31		4.09		3.90	
Gly + Ser	%	1.10		0.99		4.95		8.41		7.75	
Valine	%	0.43		0.50		1.95		2.93		2.67	
Isoleucine	%	0.31		0.42		1.64		2.31		2.07	
Leucine	%	0.65		0.82		3.07		4.10		3.89	
Histidine	%	0.25		0.27		1.12		1.10		1.07	
Phenylalanine	%	0.85		0.56		2.37		2.39		2.24	
Phe + Tyr	%	1.05		0.85		4.18		3.99		3.71	
True Digestible Amino Acid – Poultry											
		Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]
Lysine	%	0.18	71.9	0.22	86.1	1.22	78.0	2.67	80.0	2.47	80.0
Methionine	%	0.27	89.5	0.18	91.5	0.45	87.0	0.92	83.9	0.89	83.9
Met + Cys	%	0.28	56.5	0.43	92.7	0.92	83.0	1.53	78.5	1.44	78.5
Threonine	%	0.20	59.2	0.26	78.8	1.06	84.0	1.85	78.4	1.69	78.4
Tryptophan	%	-	-	0.12	92.3	0.50	86.0	0.42	78.3	0.41	78.3
Arginine	%	1.41	93.9	0.45	95.4	4.73	89.0	3.59	87.9	3.43	87.9
Gly + Ser	%	-	-	0.88	89.6	4.03	82.0	6.45	76.7	5.95	76.7
Valine	%	0.33	75.8	0.45	88.9	1.72	88.0	2.41	82.2	2.19	82.2
Isoleucine	%	0.24	78.2	0.39	92.2	1.43	87.0	1.92	83.5	1.73	83.5
Leucine	%	0.53	82.4	0.75	90.8	2.76	90.0	3.40	82.9	3.23	82.9
Histidine	%	0.20	80.0	0.24	88.8	1.00	89.0	0.78	71.0	0.76	71.0
Phenylalanine	%	0.78	91.6	0.54	95.4	2.16	91.0	2.03	84.9	1.90	84.9
Phe +Tyr	%	0.92	88.0	0.80	93.8	3.80	91.0	3.39	84.8	3.15	84.8
True Digestible Amino Acid – Swine											
Lysine	%	-	-	-	-	1.24	79.0	2.48	74.5	2.30	74.5
Methionine	%	-	-	-	-	0.44	84.0	0.87	78.7	0.83	78.7
Met + Cys	%	-	-	-	-	0.92	82.7	1.42	72.8	1.34	72.8
Threonine	%	-	-	-	-	1.05	83.7	1.83	77.3	1.67	77.3
Tryptophan	%	-	-	-	-	0.49	84.7	0.41	76.6	0.40	76.6
Arginine	%	-	-	-	-	5.04	95.0	3.50	85.5	3.34	85.5
Valine	%	-	-	-	-	1.71	87.7	2.08	71.2	1.90	71.2
Isoleucine	%	-	-	-	-	1.46	89.0	1.76	76.2	1.58	76.2
Leucine	%	-	-	-	-	2.78	90.7	3.13	76.2	2.97	76.2
Histidine	%	-	-	-	-	0.98	87.1	0.88	79.5	0.85	79.5
Phenylalanine	%	-	-	-	-	2.20	92.7	1.84	77.2	1.73	77.2
Phe +Tyr	%	-	-	-	-	3.87	92.7	3.06	76.5	2.84	76.5

[1] Amino Acid Content [2] Digestibility Coefficient.

Table 1.07 - Total and Digestible Amino Acid Content of Feedstuffs for Poultry and Swine (as Fed)

Nutrient		Rice Bran		Rice Bran Defatted		Rice Broken		Sorghum High Tannin		Sorghum Low Tannin	
		Total Amino Acid									
		Value[1]		Value[1]		Value[1]		Value[1]		Value[1]	
Crude Protein	%	13.13		15.29		8.50		8.94		8.97	
Lysine	%	0.63		0.69		0.29		0.20		0.20	
Methionine	%	0.26		0.31		0.21		0.15		0.15	
Met + Cys	%	0.52		0.59		0.39		0.32		0.30	
Threonine	%	0.49		0.57		0.28		0.31		0.29	
Tryptophan	%	0.16		0.19		0.11		0.09		0.10	
Arginine	%	0.98		1.12		0.60		0.35		0.35	
Gly + Ser	%	1.33		1.52		0.75		0.71		0.68	
Valine	%	0.70		0.81		0.45		0.47		0.45	
Isoleucine	%	0.46		0.53		0.35		0.37		0.36	
Leucine	%	0.94		1.09		0.69		1.20		1.19	
Histidine	%	0.34		0.40		0.19		0.21		0.20	
Phenylalanine	%	0.60		0.69		0.39		0.51		0.47	
Phe + Tyr	%	0.99		1.08		0.77		0.96		0.79	
		True Digestible Amino Acid – Poultry									
		Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]
Lysine	%	0.49	77.4	0.54	77.4	0.24	81.7	0.14	72.7	0.17	84.8
Methionine	%	0.20	78.2	0.25	78.2	0.17	79.1	0.11	75.0	0.13	88.8
Met + Cys	%	0.38	73.0	0.43	73.0	0.26	68.3	0.22	69.7	0.26	86.2
Threonine	%	0.35	72.5	0.42	72.5	0.21	75.7	0.21	69.7	0.25	88.9
Tryptophan	%	0.12	76.3	0.14	76.3	0.09	78.6	0.06	66.7	0.09	85.4
Arginine	%	0.85	86.4	0.97	86.4	0.53	88.1	0.26	73.7	0.31	89.0
Gly + Ser	%	1.10	83.3	1.27	83.3	0.52	70.0	-	-	0.57	84.0
Valine	%	0.53	76.4	0.62	76.4	0.35	78.8	0.35	73.6	0.41	89.7
Isoleucine	%	0.34	75.0	0.40	75.0	0.28	79.5	0.27	74.4	0.33	91.0
Leucine	%	0.71	75.4	0.82	75.4	0.57	81.7	0.68	56.7	1.12	93.8
Histidine	%	0.28	83.7	0.33	83.7	0.14	74.5	0.12	59.1	0.18	87.7
Phenylalanine	%	0.44	73.6	0.51	73.6	0.30	76.8	0.39	77.1	0.45	95.0
Phe +Tyr	%	0.78	78.7	0.85	78.7	0.60	78.5	0.72	74.7	0.76	95.3
		True Digestible Amino Acid – Swine									
Lysine	%	0.46	72.6	0.50	72.6	0.26	88.2	0.14	72.7	0.16	79.4
Methionine	%	0.18	72.3	0.23	72.3	0.19	88.0	0.12	81.3	0.13	86.4
Met + Cys	%	0.36	70.6	0.41	70.6	0.33	85.0	0.23	72.7	0.25	84.2
Threonine	%	0.35	72.4	0.42	72.4	0.24	85.9	0.23	75.8	0.24	82.4
Tryptophan	%	0.11	70.0	0.13	70.0	0.09	87.0	0.07	77.8	0.08	81.9
Arginine	%	0.85	85.9	0.97	85.9	0.57	94.6	0.24	68.4	0.30	86.6
Valine	%	0.51	73.5	0.60	73.5	0.40	89.7	0.37	79.2	0.38	85.2
Isoleucine	%	0.33	72.4	0.39	72.4	0.32	91.0	0.30	81.4	0.32	87.4
Leucine	%	0.69	73.9	0.81	73.9	0.64	92.2	1.02	85.1	1.05	88.1
Histidine	%	0.29	84.8	0.34	84.8	0.17	92.3	0.17	81.8	0.17	83.0
Phenylalanine	%	0.44	72.1	0.50	72.1	0.35	90.3	0.42	83.3	0.42	88.5
Phe +Tyr	%	0.74	75.2	0.81	75.2	0.69	89.0	0.80	83.5	0.70	88.3

[1] Amino Acid Content [2] Digestibility Coefficient.

Table 1.07 - Total and Digestible Amino Acid Content of Feedstuffs for Poultry and Swine (as Fed)

Nutrient		Soybean Full-Fat Extruded		Soybean Full-Fat Toasted		Soybean Full-Fat Micronized		Soybean Part. Defatted Extruded		Soybean Part. Defatted Toasted	
		Total Amino Acid									
		Value[1]		Value[1]		Value[1]		Value[1]		Value[1]	
Crude Protein	%	36.42		36.42		39.14		40.07		40.07	
Lysine	%	2.26		2.26		2.43		2.48		2.48	
Methionine	%	0.51		0.51		0.58		0.56		0.56	
Met + Cys	%	1.04		1.04		1.11		1.15		1.15	
Threonine	%	1.46		1.46		1.50		1.60		1.60	
Tryptophan	%	0.55		0.55		0.51		0.60		0.60	
Arginine	%	2.68		2.68		3.06		2.95		2.95	
Gly + Ser	%	3.34		3.34		3.67		3.68		3.68	
Valine	%	1.75		1.75		1.96		1.93		1.93	
Isoleucine	%	1.68		1.68		1.87		1.84		1.84	
Leucine	%	2.79		2.79		3.11		3.07		3.07	
Histidine	%	0.96		0.96		1.12		1.06		1.06	
Phenylalanine	%	1.87		1.87		2.09		2.05		2.05	
Phe + Tyr	%	3.14		3.14		3.42		3.46		3.46	
		True Digestible Amino Acid – Poultry									
		Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]
Lysine	%	2.04	90.4	1.96	86.8	2.26	93.1	2.24	90.4	2.15	86.8
Methionine	%	0.46	89.6	0.45	86.8	0.53	92.2	0.51	89.6	0.49	86.8
Met + Cys	%	0.90	86.0	0.87	83.6	0.97	87.0	0.99	86.0	0.96	83.6
Threonine	%	1.27	87.4	1.22	83.6	1.31	87.2	1.40	87.4	1.34	83.6
Tryptophan	%	0.50	90.3	0.47	84.9	0.47	92.2	0.54	90.3	0.51	84.9
Arginine	%	2.51	93.6	2.45	91.4	2.86	93.3	2.76	93.6	2.69	91.4
Gly + Ser	%	3.01	90.0	2.94	88.0	3.30	90.0	3.31	90.0	3.24	88.0
Valine	%	1.56	88.8	1.47	84.2	1.74	88.9	1.71	88.8	1.62	84.2
Isoleucine	%	1.51	89.8	1.46	86.8	1.71	91.4	1.66	89.8	1.60	86.8
Leucine	%	2.52	90.2	2.43	86.9	2.87	92.2	2.77	90.2	2.67	86.9
Histidine	%	0.87	91.0	0.86	89.7	1.04	93.7	0.96	91.0	0.95	89.7
Phenylalanine	%	1.67	89.7	1.64	87.7	1.93	92.3	1.84	89.7	1.80	87.7
Phe +Tyr	%	2.81	89.4	2.77	88.0	3.27	95.5	3.09	89.4	3.04	88.0
		True Digestible Amino Acid – Swine									
Lysine	%	2.01	89.3	1.83	81.3	2.26	92.8	2.22	89.3	2.02	81.3
Methionine	%	0.45	88.2	0.41	79.8	0.54	94.0	0.50	88.2	0.45	79.8
Met + Cys	%	0.90	86.0	0.82	78.3	1.00	89.6	0.99	86.0	0.90	78.3
Threonine	%	1.26	86.6	1.14	78.2	1.28	85.1	1.39	86.6	1.25	78.2
Tryptophan	%	0.47	85.0	0.45	82.1	0.43	85.1	0.51	85.0	0.50	82.1
Arginine	%	2.49	93.0	2.28	85.1	2.91	95.3	2.74	93.0	2.51	85.1
Valine	%	1.52	86.7	1.34	76.3	1.74	88.8	1.67	86.7	1.47	76.3
Isoleucine	%	1.47	87.8	1.29	77.0	1.71	91.4	1.62	87.8	1.42	77.0
Leucine	%	2.47	88.6	2.16	77.4	2.82	90.7	2.72	88.6	2.38	77.4
Histidine	%	0.88	91.1	0.79	82.6	1.04	93.3	0.96	91.1	0.87	82.6
Phenylalanine	%	1.67	89.2	1.47	78.9	1.91	91.4	1.83	89.2	1.62	78.9
Phe +Tyr	%	2.82	89.8	2.48	79.0	3.14	91.9	3.10	89.8	2.73	79.0

[1] Amino Acid Content [2] Digestibility Coefficient.

Table 1.07 - Total and Digestible Amino Acid Content of Feedstuffs for Poultry and Swine (as Fed)

Nutrient		Soybean Hulls		Soybean Meal (44%)		Soybean Meal (45%)		Soybean Meal (46%)		Soybean Meal (48%)	
Total Amino Acid											
		Value[1]		Value[1]		Value[1]		Value[1]		Value[1]	
Crude Protein	%	13.88		44.28		45.22		46.13		48.10	
Lysine	%	0.88		2.74		2.79		2.83		2.93	
Methionine	%	0.17		0.60		0.60		0.61		0.65	
Met + Cys	%	0.39		1.27		1.28		1.30		1.36	
Threonine	%	0.51		1.76		1.78		1.81		1.87	
Tryptophan	%	0.14		0.63		0.63		0.64		0.67	
Arginine	%	0.83		3.29		3.34		3.38		3.47	
Gly + Ser	%	1.73		4.38		4.46		4.54		4.74	
Valine	%	0.66		2.18		2.21		2.24		2.31	
Isoleucine	%	0.57		2.10		2.12		2.14		2.26	
Leucine	%	0.95		3.45		3.50		3.55		3.66	
Histidine	%	0.37		1.19		1.20		1.22		1.25	
Phenylalanine	%	0.58		2.32		2.36		2.39		2.46	
Phe + Tyr	%	1.08		3.93		4.01		4.08		4.20	
True Digestible Amino Acid – Poultry											
		Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]
Lysine	%	0.54	62.1	2.53	92.2	2.57	92.2	2.61	92.2	2.71	92.5
Methionine	%	0.11	65.7	0.55	91.7	0.55	91.7	0.56	91.7	0.60	92.5
Met + Cys	%	0.19	49.4	1.11	87.7	1.13	87.7	1.14	87.7	1.22	89.8
Threonine	%	0.24	47.1	1.55	88.3	1.57	88.3	1.60	88.3	1.65	88.7
Tryptophan	%	0.06	43.5	0.57	90.8	0.58	90.8	0.58	90.8	0.61	90.9
Arginine	%	0.65	78.2	3.12	94.9	3.17	94.9	3.21	94.9	3.26	93.8
Gly + Ser	%	0.77	44.8	3.90	89.0	3.97	89.0	4.04	89.0	4.23	89.2
Valine	%	0.38	57.0	1.94	89.2	1.97	89.2	1.99	89.2	2.08	90.1
Isoleucine	%	0.34	59.6	1.90	90.6	1.92	90.6	1.94	90.6	2.05	90.8
Leucine	%	0.59	62.6	3.14	91.1	3.19	91.1	3.23	91.1	3.40	92.9
Histidine	%	0.18	49.4	1.11	92.9	1.12	92.9	1.13	92.9	1.14	91.2
Phenylalanine	%	0.37	63.4	2.14	92.6	2.18	92.6	2.22	92.6	2.31	93.8
Phe +Tyr	%	0.67	62.7	3.66	93.0	3.73	93.0	3.79	93.0	3.86	91.9
True Digestible Amino Acid – Swine											
Lysine	%	0.53	60.0	2.50	91.2	2.54	91.2	2.58	91.2	2.67	91.2
Methionine	%	0.12	71.0	0.55	92.2	0.56	92.2	0.56	92.2	0.60	92.1
Met + Cys	%	0.26	66.0	1.14	90.2	1.16	90.2	1.17	90.2	1.23	90.5
Threonine	%	0.31	61.0	1.53	87.2	1.55	87.2	1.58	87.2	1.63	87.4
Tryptophan	%	0.09	63.0	0.56	89.0	0.57	89.0	0.57	89.0	0.61	89.9
Arginine	%	0.70	84.0	3.14	95.5	3.19	95.5	3.23	95.5	3.30	95.0
Valine	%	0.40	61.0	1.93	88.8	1.96	88.8	1.99	88.8	2.06	89.1
Isoleucine	%	0.39	68.0	1.88	89.5	1.90	89.5	1.92	89.5	2.03	89.8
Leucine	%	0.67	70.0	3.11	90.4	3.16	90.4	3.21	90.4	3.31	90.5
Histidine	%	0.22	58.0	1.09	91.1	1.10	91.1	1.11	91.1	1.14	91.4
Phenylalanine	%	0.42	72.0	2.09	90.2	2.12	90.2	2.16	90.2	2.23	90.6
Phe +Tyr	%	0.74	69.0	3.51	89.2	3.57	89.2	3.64	89.2	3.78	90.0

[1] Amino Acid Content [2] Digestibility Coefficient.

Table 1.07 - Total and Digestible Amino Acid Content of Feedstuffs for Poultry and Swine (as Fed)

Nutrient		Soybean Protein Concentrate		Sunflower Meal		Sweet Potato Dried		Swine By Product Meal		Triticale	
Total Amino Acid											
		Value[1]		Value[1]		Value[1]		Value[1]		Value[1]	
Crude Protein	%	63.07		30.22		3.87		47.00		12.23	
Lysine	%	4.07		0.95		0.11		2.60		0.41	
Methionine	%	0.92		0.62		0.05		0.74		0.20	
Met + Cys	%	1.88		1.10		0.09		1.12		0.49	
Threonine	%	2.59		1.04		0.12		1.88		0.37	
Tryptophan	%	0.87		0.39		0.05		0.23		0.14	
Arginine	%	5.21		2.25		0.11		3.61		0.61	
Gly + Ser	%	6.07		2.80		0.56		8.40		1.13	
Valine	%	3.16		1.39		0.14		2.22		0.46	
Isoleucine	%	3.00		1.16		0.12		1.42		0.43	
Leucine	%	5.07		1.74		0.17		3.47		0.80	
Histidine	%	1.72		0.67		0.15		1.02		0.31	
Phenylalanine	%	3.37		1.26		0.14		1.82		0.56	
Phe + Tyr	%	5.73		1.94		0.21		2.87		0.86	
True Digestible Amino Acid – Poultry											
		Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]
Lysine	%	3.77	92.8	0.78	82.2	-	-	2.24	86.1	0.34	83.9
Methionine	%	0.85	91.9	0.56	91.1	-	-	0.65	87.2	0.18	90.0
Met + Cys	%	1.69	90.0	0.94	85.7	-	-	0.95	84.5	0.40	82.4
Threonine	%	2.29	88.6	0.86	83.0	-	-	1.56	82.8	0.31	83.0
Tryptophan	%	0.80	91.8	0.33	85.0	-	-	0.20	86.0	0.13	89.3
Arginine	%	5.02	96.5	2.06	91.8	-	-	3.21	89.1	0.56	92.6
Gly + Ser	%	5.52	91.0	2.24	80.2	-	-	7.14	85.0	0.98	86.5
Valine	%	2.85	90.1	1.23	88.4	-	-	1.97	88.9	0.39	85.8
Isoleucine	%	2.75	91.4	1.04	89.6	-	-	1.26	88.4	0.38	88.1
Leucine	%	4.68	92.4	1.55	89.1	-	-	3.09	89.1	0.70	87.8
Histidine	%	1.61	93.8	0.58	86.9	-	-	0.85	82.8	0.28	88.9
Phenylalanine	%	3.10	92.2	1.13	90.0	-	-	1.62	88.9	0.50	89.4
Phe +Tyr	%	5.28	92.2	1.73	89.1	-	-	2.53	88.1	0.73	84.9
True Digestible Amino Acid – Swine											
Lysine	%	3.78	93.0	0.74	78.3	0.06	58.3	1.97	75.9	0.33	81.3
Methionine	%	0.84	91.0	0.56	90.7	0.03	60.0	0.61	82.0	0.18	90.0
Met + Cys	%	1.70	90.5	0.94	85.8	0.05	54.5	0.89	80.0	0.43	88.7
Threonine	%	2.33	90.0	0.82	79.1	0.05	45.5	1.55	82.4	0.30	80.0
Tryptophan	%	0.78	90.0	0.32	82.6	0.03	50.0	0.18	78.0	0.11	82.1
Arginine	%	5.05	97.0	2.09	93.1	-	-	2.97	82.5	0.54	88.9
Valine	%	2.87	91.0	1.13	81.3	0.08	53.8	1.82	81.8	0.39	84.7
Isoleucine	%	2.79	93.0	0.96	83.2	0.06	53.8	1.17	82.4	0.38	87.9
Leucine	%	4.71	93.0	1.47	84.1	-	-	2.86	82.5	0.70	87.8
Histidine	%	1.64	95.0	0.56	82.5	-	-	0.53	52.2	0.26	85.2
Phenylalanine	%	3.16	94.0	1.10	87.0	-	-	1.49	81.6	0.50	89.4
Phe +Tyr	%	3.78	93.5	1.69	87.1	-	-	2.34	81.6	0.75	87.7

[1] Amino Acid Content [2] Digestibility Coefficient.

Table 1.07 - Total and Digestible Amino Acid Content of Feedstuffs for Poultry and Swine (as Fed)

Nutrient		Wheat		Wheat Bran-Midds		Wheat Flour		Wheat Germ		Wheat Shorts	
		Total Amino Acid									
		Value¹		Value¹		Value¹		Value¹		Value¹	
Crude Protein	%	11.70		15.62		12.26		28.29		17.52	
Lysine	%	0.35		0.62		0.30		1.75		0.73	
Methionine	%	0.20		0.24		0.20		0.49		0.27	
Met + Cys	%	0.49		0.58		0.49		0.91		0.61	
Threonine	%	0.37		0.51		0.35		1.04		0.58	
Tryptophan	%	0.15		0.24		0.14		0.3		0.2	
Arginine	%	0.61		1.05		0.52		2.07		1.22	
Gly + Ser	%	1.17		1.39		1.04		2.39		0.94	
Valine	%	0.55		0.72		0.50		1.35		0.81	
Isoleucine	%	0.45		0.50		0.48		0.92		0.56	
Leucine	%	0.87		0.95		0.85		1.70		1.08	
Histidine	%	0.31		0.43		0.28		0.67		0.46	
Phenylalanine	%	0.60		0.60		0.60		0.99		0.69	
Phe + Tyr	%	0.91		0.97		0.88		1.67		1.09	
		True Digestible Amino Acid – Poultry									
		Value¹	Coef.²	Value¹	Coef.²	Value¹	Coef.²	Value¹	Coef.²	Value¹	Coef.²
Lysine	%	0.29	82.1	0.47	75.5	0.28	93.2	1.64	93.8	0.60	81.8
Methionine	%	0.18	89.4	0.18	73.9	0.19	95.2	0.46	94.4	0.22	81.6
Met + Cys	%	0.43	87.8	0.43	74.6	0.46	93.6	0.83	91.6	0.50	81.4
Threonine	%	0.30	81.4	0.37	72.1	0.30	87.1	0.91	88.3	0.46	79.3
Tryptophan	%	0.13	85.2	0.19	80.0	0.13	92.9	0.26	86.7	0.17	85
Arginine	%	0.55	90.4	0.93	88.0	0.50	96.4	1.96	94.6	1.12	92.3
Gly + Ser	%	1.01	86.0	0.97	70.0	0.97	93.0	-	-	-	-
Valine	%	0.47	85.8	0.52	72.4	0.46	92.8	1.21	89.6	0.66	82.0
Isoleucine	%	0.40	88.6	0.37	74.9	0.46	95.0	0.84	91.5	0.46	83.5
Leucine	%	0.78	89.4	0.73	76.8	0.80	94.3	1.56	91.5	0.92	85.2
Histidine	%	0.27	87.4	0.34	80.3	0.26	94.2	0.63	93.7	0.40	86.8
Phenylalanine	%	0.54	89.9	0.47	78.6	0.56	93.3	0.90	91.1	0.61	87.8
Phe +Tyr	%	0.81	89.1	0.77	79.2	0.81	92.4	1.53	91.7	0.94	87.1
		True Digestible Amino Acid – Swine									
Lysine	%	0.29	82.7	0.46	74.6	0.28	92.0	1.52	86.9	0.54	73.6
Methionine	%	0.18	89.5	0.20	81.8	0.19	95.0	0.44	89.8	0.22	80.0
Met + Cys	%	0.44	89.4	0.46	79.2	0.46	93.0	0.75	82.6	0.45	74.1
Threonine	%	0.31	83.6	0.37	71.4	0.32	90.0	0.80	77.5	0.41	71.7
Tryptophan	%	0.13	86.5	0.18	75.0	0.13	91.0	0.22	73.3	0.15	75
Arginine	%	0.53	87.6	0.93	88.7	0.50	96.0	1.93	93.1	1.04	85.7
Valine	%	0.47	86.0	0.55	76.1	0.46	92.0	1.11	82.4	0.62	77.2
Isoleucine	%	0.40	89.0	0.38	76.8	0.45	94.0	0.75	82.4	0.43	77.8
Leucine	%	0.78	89.6	0.75	78.6	0.81	95.0	1.43	84.0	0.86	80.0
Histidine	%	0.28	89.4	0.36	84.1	0.27	96.0	0.62	92.2	0.37	81.4
Phenylalanine	%	0.55	91.8	0.49	81.8	0.58	96.0	0.85	86.0	0.56	81.4
Phe +Tyr	%	0.83	90.8	0.77	79.0	0.84	95.0	1.46	87.6	0.86	79.6

¹ Amino Acid Content ² Digestibility Coefficient.

Table 1.07 - Total and Digestible Amino Acid Content of Feedstuffs for Poultry and Swine (as Fed)

Nutrient		Wheat Screenings		Yeast Alcohol Distillery		Yeast Brewery	
		Total Amino Acid					
		Value[1]		Value[1]		Value[1]	
Crude Protein	%	13.61		37.20		41.80	
Lysine	%	0.46		2.99		3.54	
Methionine	%	0.21		0.61		0.69	
Met + Cys	%	0.50		0.89		1.05	
Threonine	%	0.42		2.14		2.31	
Tryptophan	%	0.17		0.48		0.51	
Arginine	%	0.67		1.75		2.14	
Gly + Ser	%	1.22		3.77		4.20	
Valine	%	0.60		2.24		2.36	
Isoleucine	%	0.48		1.92		2.45	
Leucine	%	0.89		2.69		3.16	
Histidine	%	0.32		0.83		0.96	
Phenylalanine	%	0.55		1.64		1.84	
Phe + Tyr	%	0.89		2.53		3.05	
		True Digestible Amino Acid – Poultry					
		Value[1]	Coef.[2]	Value[1]	Coef.[2]	Value[1]	Coef.[2]
Lysine	%	0.38	83.5	2.11	70.6	2.57	72.5
Methionine	%	0.18	86.9	0.35	57.5	0.42	60.7
Met + Cys	%	0.45	89.8	0.43	49.0	0.51	49.0
Threonine	%	0.38	90.4	1.07	49.8	1.23	53.4
Tryptophan	%	0.15	90.5	0.26	53.6	0.30	58.7
Arginine	%	0.66	98.5	1.25	71.5	1.59	74.5
Gly + Ser	%	1.05	86.0	2.41	64.0	2.70	64.4
Valine	%	0.52	87.3	1.26	56.3	1.48	63.0
Isoleucine	%	0.43	90.4	1.04	54.3	1.59	65.0
Leucine	%	0.81	91.2	1.53	57.0	2.14	67.9
Histidine	%	0.26	80.6	0.47	56.8	0.65	67.8
Phenylalanine	%	0.52	94.5	0.84	51.2	1.30	70.3
Phe +Tyr	%	0.84	94.6	1.29	51.1	2.14	70.3
		True Digestible Amino Acid – Swine					
Lysine	%	-	-	2.48	83.0	2.94	83.0
Methionine	%	-	-	0.47	77.1	0.53	77.1
Met + Cys	%	-	-	0.64	72.5	0.76	72.5
Threonine	%	-	-	1.51	70.4	1.62	70.4
Tryptophan	%	-	-	0.38	78.4	0.40	78.4
Arginine	%	-	-	1.47	83.8	1.79	83.8
Valine	%	-	-	1.63	72.7	1.71	72.7
Isoleucine	%	-	-	1.43	74.6	1.83	74.6
Leucine	%	-	-	2.03	75.7	2.39	75.7
Histidine	%	-	-	0.67	80.5	0.77	80.5
Phenylalanine	%	-	-	1.21	74.2	1.37	74.2
Phe +Tyr	%	-	-	1.98	78.3	2.39	78.3

[1] Amino Acid Content [2] Digestibility Coefficient.

Table 1.08 - Composition, Digestibility, and Energy Values of Crystalline Amino Acids for Poultry (on Dry Matter Basis)

Amino acid	Nitrogen	Protein (N x 6.25)	True Digestibility[1]	Gross Energy	True Dig. Energy and Met. Energy	
	(%)	(%)	(%)	(kcal/kg)	TDE-(kcal/kg)-TMEn[2]	
Alanine	16.39	102.45	99.7	4,389	4,376	3,029
Arginine	29.90	186.60	100	4,492	4,492	2,863
Aspartic acid	10.30	64.36	99.7	2,854	2,854	1,998
Cystine	11.90	74.40	97.2	4,325	4,204	3,226
Phenylalanine	8.21	51.32	98.1	6,932	6,800	6,125
Glycine	19.00	118.75	97.0	3,163	3,068	1,506
Glutamic acid	9.09	56.80	99.4	3,686	3,664	2,917
Histidine	23.83	148.90	99.0	4,036	3,996	2,037
Isoleucine	11.01	68.78	100	6,605	6,605	5,700
Leucine	10.98	68.63	99.5	6,714	6,680	5,777
Lysine - HCL	13.73	85.81	99.8	4,901	4,891	3,762
Methionine	9.50	59.38	99.2	5,684	5,639	4,858
Proline	11.28	70.51	99.1	5,065	5,019	4,092
Tyrosine	7.80	48.75	99.6	3,860	3,845	2,994
Threonine	12.50	78.09	98.1	4,173	4,094	3,067
Tryptophan	13.71	85.64	99.3	6,506	6,461	5,334
Valine	12.59	78.68	100	6,026	6,026	4,991

[1] Determined with cecectomized cockerels and broiler chicks (ileal digestibility).
[2] Considering nitrogen conversion into uric acid, except for arginine into urea.

Table 1.09 - Composition, Digestibility, and Energy Values of Crystalline Amino Acids for Swine (on Dry Matter Basis)

Amino acid	Nitrogen	Protein (N x 6.25)	True Digestibility[1]	Gross Energy	True Dig. Energy and Met. Energy	
	(%)	(%)	(%)	(kcal/kg)	TDE-(kcal/kg)-TME[2]	
Alanine	16.39	102.45	92.0	4,389	4,038	3,725
Arginine	29.90	186.60	95.5	4,492	4,290	3,720
Aspartic acid	10.30	64.36	93.5	2,854	2,669	2,473
Cystine	11.90	74.40	92.4	4,325	3,996	3,769
Phenylalanine	8.21	51.32	95.2	6,932	6,599	6,442
Glycine	19.00	118.75	97.0	3,163	3,068	2,706
Glutamic acid	9.09	56.80	99.2	3,686	3,657	3,484
Histidine	23.83	148.90	100.0	4,036	4,036	3,581
Isoleucine	11.01	68.78	97.1	6,605	6,414	6,204
Leucine	10.98	68.63	95.4	6,714	6,405	6,196
Lysine - HCL	13.73	85.81	98.1	4,901	4,808	4,599
Methionine	9.50	59.38	99.5	5,684	5,656	5,475
Proline	11.28	70.51	99.0	5,065	5,014	4,799
Tyrosine	7.80	48.75	98.0	5,990	5,870	5,721
Threonine	12.50	78.09	96.8	4,173	4,040	3,802
Tryptophan	13.71	85.64	99.0	6,506	6,441	6,180
Valine	12.59	78.68	95.5	6,026	5,755	5,069

[1] Determined in pigs cannulated at the terminal ileum.
[2] Considering the conversion of 35% of nitrogen into urea.

Table 1.10 - Equation to Estimate Corn and Sorghum Amino Acid Content as Function of Crude Protein

1.-Determine feedstuff crude protein. 2.- Use the equation to estimate the sum of amino acids (AAs). 3.- Calculate the content (%) of each amino acid considering its percentage in the sum.

CP: Crude Protein;
AA sum=Lys + Met + Met+Cys + Thr + Trp + Arg + Gly+Ser + Val + Iso+Leu+His+ Phe+ Phe+Tyr

Eq. Corn: Y(AA Sum, %)= 0.3468 + 0.5757 (%CP); R^2 = 0.71; n=428

Eq. Sorghum: Y(AA Sum, %)= 1.0723 + 0.4977 (CP); R^2 = 0.75; n=118

Amino Acids	Corn		Low Tannin Sorghum	
	% AA in the Sum	E.g. Corn 7.1% CP	% AA in the Sum	E.g. Sorghum 8.15% CP
Sum of AAs, %	100	4.434	100	5.128
Lysine, %	4.570	0.203	3.593	0.184
Methionine, %	3.200	0.142	2.709	0.139
Met+Cys, %	6.611	0.293	5.426	0.278
Threonine, %	6.388	0.283	5.273	0.270
Tryptophan, %	1.154	0.051	1.846	0.095
Arginine, %	7.430	0.329	6.334	0.325
Glic+Ser, %	13.974	0.620	12.305	0.631
Valine, %	7.534	0.334	8.123	0.417
Isoleucine, %	5.384	0.239	6.492	0.333
Leucine, %	19.033	0.844	21.476	1.101
Histidine, %	4.663	0.207	3.660	0.188
Phenylalanine, %	7.406	0.328	8.455	0.434
Phe+Tyr, %	12.653	0.561	14.308	0.734

Example for Lysine:

Corn Determined CP: 7.10 %
Y(AA sum)= 0.3468 + 0.5757 (7.10)= 4.434%
Calculation: 4.570 x 4.434 / 100 = 0.203 % Lysine

Sorghum Determined CP: 8.15 %
Y(AA sum)= 1.0723 + 0.4977 (8.15)= 5.128%
Calculation: 3.593 x 5.128 / 100 = 0.184 % Lysine

Table 1.11 - Equation to Estimate Soybean Amino Acid Content as Function of Crude Protein

1.-Determine feedstuff crude protein. 2.- Use the equation to estimate the sum of amino acids (AAs). 3.- Calculate the content (%) of each amino acid considering its percentage in the sum.

CP: Crude Protein;
AA sum=Lys + Met + Met+Cys + Thr + Trp + Arg + Gly+Ser + Val + Iso +Leu+His+Phe+ Phe+Tyr

Eq. Soybeans (full fat and meal): Y(sum)= -0.3850 + 0.6750(%CP) R^2=0.93; n=299

Amino Acids	% AA in the Sum	Full-Fat Soybean (FFS)	Soybean Meal (SBM)	
		E.g. FFS 35.1% CP	E.g. SBM 43.7% CP	E.g. SBM 47.22% CP
Sum of AAs,%	100	23.307	29.112	31.488
Lysine, %	9.256	2.157	2.695	2.915
Methionine, %	2.025	0.472	0.590	0.638
Met+Cys, %	4.256	0.992	1.239	1.340
Threonine, %	5.924	1.381	1.725	1.865
Tryptophan, %	2.142	0.499	0.624	0.674
Arginine, %	11.036	2.572	3.213	3.475
Glic+Ser, %	14.565	3.395	4.240	4.586
Valine, %	7.283	1.697	2.120	2.293
Isoleucine, %	7.008	1.633	2.040	2.207
Leucine, %	11.563	2.695	3.366	3.641
Histidine, %	3.976	0.927	1.157	1.252
Phenylalanine, %	7.771	1.811	2.262	2.447
Phe+Tyr, %	13.196	3.076	3.842	4.155

Example for Lysine:

Full-Fat Soybean Determined CP: 35.1%
Y(AA sum)= - 0.3850 + 0.6750 (35.1) = 23.307%
Calculation: 9.256 x 23.307 / 100 = 2.157% Lysine

Soybean Meal Determined CP: 43.7%
Y(AA sum)= - 0.3850 + 0.6750 (43.7) = 29.112%
Calculation: 9.256 x 29.112 / 100 = 2.695% Lysine

Table 1.12 - Equation to Estimate Amino Acid Content as a Function of Crude Protein, Fat and Ash in Meat and Bone Meal

1.-Determine feedstuff crude protein, fat and ash. 2.- Use the equation to estimate the sum of amino acids (AAs). 3.- Calculate the content (%) of each amino acid considering its percentage in the sum.

MBM: Meat and Bone Meal; CP: Crude Protein; F: Fat; Ash: Ash
AA Sum=Lys + Met + Met+Cys + Thr + Trp + Arg + Gly+Ser + Val+Iso+Leu+His+Phe + Phe+Tyr

Eq. 1: Meat and Bone Meal with 35 to 39.5% CP; n=92
Y(AA Sum)= 16.321+0.43212(CP) - 0.00509(F) - 0.2369(Ash); R^2= 0.55

Eq. 2: Meat and Bone Meal 39.6 a 46.95% CP; n=490
Y(AA Sum)= 23.6964+0.27763(CP) - 0.12017(F) - 0.2254(Ash); R^2=0.58

Eq. 3: Meat and Bone Meal 46.96 a 60.10% CP; n=337
Y(AA Sum)= 14.7955+0.4338(CP) - 0.1440(F) - 0.13787(Ash); R^2= 0.72

Amino Acids	MBM Eq. 1		MBM Eq. 2		MBM Eq. 3	
	% AA Sum	37.30%CP 11.85% F 41.79%Ash	% AA Sum	41.80%CP 11.58% F 39.59%Ash	% AA Sum	49.57%CP 12.41% F 33.47%Ash
Sum of AAs,%	100	22.479	100	24.986	100	29.897
Lysine, %	7.693	1.729	8.188	2.046	8.678	2.594
Methionine, %	2.060	0.463	2.159	0.539	2.226	0.666
Met+Cys, %	3.126	0.703	3.534	0.883	3.798	1.135
Threonine, %	4.586	1.031	5.131	1.282	5.387	1.611
Tryptophan, %	0.651	0.146	0.774	0.193	0.884	0.264
Arginine, %	12.965	2.914	12.435	3.107	12.345	3.691
Glic+Ser, %	35.715	8.028	33.148	8.282	29.861	8.928
Valine, %	6.178	1.389	6.213	1.552	7.328	2.191
Isoleucine, %	3.721	0.836	4.077	1.019	4.785	1.431
Leucine, %	7.983	1.794	8.765	2.190	9.258	2.768
Histidine, %	2.312	0.520	2.569	0.642	2.827	0.845
Phenyl, %	5.770	1.297	5.238	1.309	4.531	1.355
Phe+Tyr, %	7.241	1.628	7.769	1.941	8.093	2.420

Example for Lysine: Eq. 1. MBM, CP= 37.3%; F=11.85%; Ash=41.79%
Y(AA sum)= 16.321+0.43212(37.30) - 0.00509(11.85) - 0.2369(41.79)=22.479%
Calculation: 7.693 x 22.479 / 100 = 1.729% Lysine

Table 1.13 - Calcium and Phosphorus (Total, Phytic, Available, and True Digestible) Content of Feedstuffs for Poultry and Swine (As Fed)

Feedstuff	Ca	PT	Pphy	Pav	P True Digestibility (%)			
					Poultry		Swine	
	%	%	%	%	Value	Coef	Value	Coef
Babassu Meal	0.12	1.23	0.82	0.41	-	-	-	-
Blood Cells	0.03	0.20	-	0.20	0.18	92.0	0.18	92.0
Blood Meal	0.23	0.22	-	0.22	0.20	92.0	0.20	92.0
Blood Plasma	0.19	0.45	-	0.45	0.41	92.0	0.41	92.0
Bakery Cookie Cracker Res.	0.06	0.17	0.11	0.06	0.05	28.0	0.05	28.0
Bakery Residue	0.19	0.32	0.21	0.11	0.09	28.0	0.09	28.0
Canola Meal	0.56	0.81	0.54	0.27	0.35	43.1	0.29	35.2
Carob Meal	0.27	0.14	0.09	0.05	-	-	-	-
Casein	0.40	0.70	-	0.70	0.63	90.0	0.63	90.0
Cassava with Hulls Dried	0.20	0.09	0.06	0.03	0.03	38.0	0.03	38.0
Castor Oil Plant Meal	0.62	0.62	0.42	0.20	-	-	-	-
Citrus Pulp	1.57	0.20	0.13	0.07	-	-	0.07	33.0
Coconut Meal	0.18	0.61	0.41	0.20	-	-	0.21	35.2
Corn (7.88%)	0.03	0.25	0.19	0.06	0.10	40.8	0.11	44.0
Corn Germ	0.04	0.51	0.32	0.19	0.15	30.0	0.13	25.0
Corn Gluten Meal (21%)	0.11	0.74	0.64	0.10	0.22	30.0	0.21	28.0
Corn Gluten Meal (60%)	0.03	0.47	0.41	0.06	0.14	30.0	0.14	30.0
Corn High Lysine	0.04	0.20	0.15	0.05	0.08	40.8	0.09	44.0
Corn High Oil	0.02	0.27	0.20	0.07	0.11	40.8	0.12	44.0
Corn Pre-Cooked	0.02	0.19	0.16	0.03	0.08	40.8	0.08	44.0
Cottonseed Meal (30%)	0.23	0.87	0.50	0.37	0.33	37.8	0.30	37.8
Cottonseed Meal (39%)	0.43	1.03	0.59	0.44	0.39	37.8	0.37	37.8
Feather meal (75%)	0.35	0.63	-	0.63	0.35	56.0	0.35	56.0
Feather meal (84%)	0.31	0.66	-	0.66	0.37	56.0	0.37	56.0

Ca: Calcium; PT: Total Phosphorus; Pphy: Phytic Phosphorus;
Pav: Available Phosphorus (PT – Pphy)

Table 1.13 - Calcium and Phosphorus (Total, Phytic, Available, and True Digestible) Content of Feedstuffs for Poultry and Swine (As Fed)

Feedstuff	Ca	PT	Pphy	Pav	P True Digestibility (%)			
					Poultry		Swine	
	%	%	%	%	Value	Coef	Value	Coef
Feather & Poul. Prod. Meal	2.54	1.37	-	1.37	0.73	53.0	0.73	53.0
Fish Meal (54%)	5.88	2.89	-	2.89	2.17	75.0	2.33	80.7
Fish Meal (61%)	4.70	2.41	-	2.41	1.81	75.0	1.94	80.7
Lecithin	-	1.60	-	1.60	-	-	-	-
Meat & Bone Meal (36%)	14.21	7.11	-	6.40	4.41	62.0	4.55	64.0
Meat & Bone Meal (38%)	13.67	6.83	-	6.15	4.23	62.0	4.37	64.0
Meat & Bone Meal (41%)	13.07	6.53	-	5.88	4.05	62.0	4.18	64.0
Meat & Bone Meal (44%)	12.28	6.14	-	5.53	3.81	62.0	3.93	64.0
Meat & Bone Meal (46%)	11.94	5.97	-	5.37	3.70	62.0	3.82	64.0
Meat & Bone Meal (48%)	11.23	5.61	-	5.05	3.48	62.0	3.59	64.0
Meat & Bone Meal (50%)	10.56	5.28	-	4.75	3.27	62.0	3.38	64.0
Meat & Bone Meal (55%)	9.14	4.57	-	4.11	2.83	62.0	2.92	64.0
Meat & Bone Meal (60%)	7.40	3.70	-	3.33	2.29	62.0	2.37	64.0
Milk Skimmed Dried	1.21	0.75	-	0.75	-	-	0.67	90.0
Milk Whey Dried	0.75	0.68	-	0.68	-	-	0.61	90.0
Milk Whey Permeate Dried	0.86	0.66	-	0.66	-	-	0.59	90.0
Milk Whole Dried	0.97	0.60	-	0.60			0.54	90.0
Millet	0.04	0.31	0.21	0.10	0.12	38.0	0.12	38.0
Palm Ouricuri Meal	0.10	0.70	0.47	0.23	0.21	30.0	0.24	34.7
Pasta-Spaghetti Residue	0.08	0.14	0.09	0.05	0.04	28.0	0.04	28.0
Peanut Meal	0.17	0.63	0.42	0.21	-	-	-	-
Poultry By-Product Meal	4.34	2.54	-	2.54	1.34	53.0	1.35	53.0
Poul By-Prod. Meal High Fat	4.06	2.37	-	2.37	1.26	53.0	1.26	53.0
Rice Bran	0.11	1.67	1.43	0.24	0.48	29.0	0.47	28.0
Rice Bran Deffated	0.10	1.89	1.61	0.28	0.55	29.0	0.53	28.0
Rice Broken	0.04	0.17	0.15	0.02	0.06	36.0	0.06	36.0
Sorghum High Tannin	0.03	0.26	0.18	0.08	0.09	36.0	0.09	36.0

Ca: Calcium; PT: Total Phosphorus; Pphy: Phytic Phosphorus;
Pav: Available Phosphorus (PT – Pphy).

Table 1.13 - Calcium and Phosphorus (Total, Phytic, Available, and True Digestible) Content of Feedstuffs for Poultry and Swine (As Fed)

Feedstuff[1]	Ca	PT	Pphy	Pav	P True Digestibility (%)			
					Poultry		Swine	
	%	%	%	%	Value	Coef	Value	Coef
Sorghum Low Tannin	0.03	0.26	0.18	0.08	0.09	36.0	0.09	36.0
Swine By-Product Meal	7.28	4.68	-	4.68	2.90	62.0	3.00	64.0
Soybean Full-Fat Ext.	0.23	0.52	0.33	0.19	0.20	38.0	0.20	38.0
Soybean Full-Fat Micron.	0.22	0.51	0.33	0.18	0.19	38.0	0.19	38.0
Soybean Full-Fat Toas.	0.23	0.52	0.33	0.19	0.20	38.0	0.20	38.0
Soybean Hulls	0.50	0.14	0.03	0.11	0.04	30.0	0.04	30.0
Soybean Meal (45%)	0.24	0.56	0.34	0.22	0.25	45.0	0.26	45.7
Soybean Meal (48%)	0.31	0.63	0.39	0.24	0.28	45.0	0.29	45.7
Soybean Protein Conc.	0.28	0.80	0.59	0.21	0.32	40.0	0.32	40.0
Soybean Part-def. Ext.	0.25	0.56	0.37	0.19	0.21	38.0	0.21	38.0
Soybean Part-defToas.	0.25	0.56	0.37	0.19	0.21	38.0	0.21	38.0
Sugarcane Juice	0.01	0.02	0.01	0.01	-	-	0.01	32.0
Sugarcane Molasses	0.76	0.06	0.04	0.02	-	-	0.02	32.0
Sugarcan Molas. Dried	6.21	0.21	0.14	0.07	-	-	0.07	32.0
Sunflower Meal	0.35	1.03	0.69	0.34	0.40	39.0	0.26	25.0
Sweat Potato Dried	0.10	0.16	0.11	0.05	-	-	-	-
Triticale	0.04	0.29	0.20	0.09	0.14 (0.10)	50 (34)	0.14 (0.10)	50 (34)
Wheat	0.05	0.32	0.21	0.11	0.16 (0.11)	50 (35)	0.16 (0.11)	49 (34)
Wheat Bran-Midds	0.14	0.97	0.64	0.33	0.48 (0.24)	50 (25)	0.50 (0.26)	52 (27)
Wheat Flour	0.11	0.08	0.05	0.03	0.02	28.0	0.02	28.0
Wheat Germ	0.09	0.88	0.58	0.30	0.25	28.0	0.25	28.0
Wheat Screenings	0.12	0.43	0.29	0.14	0.21 (0.15)	50 (35)	0.21 (0.15)	49 (34)
Wheat Shorts	0.14	0.90	0.60	0.30	0.25	28.0	0.25	28.0
Yeast Alcohol Distillery	0.29	0.82	-	0.27	0.38	45.9	0.38	45.9
Yeast Brewery	0.26	0.77	-	0.25	0.35	45.9	0.35	45.9

Ca: Calcium; PT: Total Phosphorus; Pphy: Phytic Phosphorus;
Pav: Available Phosphorus (PT – Pphy)
[1] The values in parenthesis are for pelleted diet.

Table 1.14 - Mineral Sources for Poultry and Swine (as Fed)

Phosphorus Source	Ca %	Phosphorus (P) %							Fluorine %
		Total	Avail		Dig Poultry		Dig Swine		
			Value	Coef	Value	Coef	Value	Coef	
Phosphoric Acid	-	21.5	25.8	120	-	-	19.4	90.0	0.16
Bone Meal Steamed	25.0	11.4	11.4	100	6.84	60.0	6.84	60.0	-
Bone Meal ash	33.8	16.2	14.9	92	9.72	60.0	9.72	60.0	-
Phosphate Dicalcium	24.5	18.5	18.5	100	12.9	70.0	13.9	75.0	0.14
Phosph. Monodical	20.3	18.6	19.6	105	15.8	85.0	15.9	85.3	0.19
Phosph. Monocalcium	18.9	21.4	21.2	101	-	-	16.4	78.2	0.25
Phosp. Monoam.	-	24.0	25.9	108	-	-	-	-	0.22
Phosph. Diammonium	-	23.1	28.9	125	-	-	-	-	0.10
Phosphate Tricalcium	35.2	17.9	17.9	100	-	-	-	-	-
Rock Phosph. Araxá	26.0	12.1	6.2	51	-	-	-	-	1.59
Rock Phosph. Catalão	32.3	15.1	7.9	52	-	-	9.6	63.3	2.17
Rock Phos. Jacupirang	34.8	13.2	4.1	31	-	-	-	-	1.65
Rock Phos. Patos Min.	20.8	10.6	6.1	58	-	-	-	-	1.50
Rock Phosp.Tapira	33.6	15.0	7.8	52	-	-	-	-	1.10
Phos Semidefluor.	30.3	16.7	10.2	61	-	-	-	-	0.88
Phosp. Super Simple	21.5	8.6	-	-	-	-	-	-	1.31
Phosp. Super Triple	17.9	20.4	20.4	100	-	-	15.7	76.9	0.74

Ca and Mg Sources	Calcium %	Magnesium %
Limestone	37.7	0.23
Dolomitic Limestone	18.6	10.0
Oyster Shell	36.4	-
Magnesium Oxide	-	52.8
Sodium Sources	**Sodium %**	**Chlorine%**
Salt	39.7	59.6
Sodium Bicarbonate	27.0	-
Sodium Carbonate	43.0	-
Potassium Sources	**Potassium %**	
Potassium Carbonate	42.3	

Table 1.15 - Mineral Content of Brazilian Phosphates (as fed)

Phosphate	Mg[1]	Mn[1]	Zn[1]	Fe[1]	Cu[1]	Cr[1]	Pb[1]	Ni[1]	Cd[1]	Va[1]
	%	---------- mg / kg----------								
Phosphoric Acid P A	0.37	0.7	0.6	31.3	1.8	3.7	12.6	0.5	2.0	-
Phosphoric Acid	0.56	29.7	7.3	39.3	4.9	8.1	13.6	5.1	2.1	-
Dicalcium Phosphate	0.91	284.2	40.3	4023	11.7	17.4	24.0	19.7	3.6	74.0
Monodicalc Phosph. .	0.81	36.3	4.6	1432	7.8	5.9	18.5	9.6	2.0	-
Monoam. Phosph.	-	371.0	130.0	9000	79.0	50.0	10.0	27.0	4.6	54.0
Rock Ph. Araxá	0.54	52.5	208.8	6464	11.1	13.5	39.1	40.6	3.7	-
Rock Ph. Catalão	0.81	405.0	36.7	8486	14.9	9.1	37.1	37.2	2.9	-
Rock Ph. Jacupiranga	-	321.0	11.0	6000	27.0	3.0	12.0	10.0	1.0	17.0
Rock Ph. Tapira	0.50	234	127.0	7520	9.8	5.4	28.7	16.3	3.5	70.0
Ph. Semidefluorinated	0.81	19.0	3.8	913	139.6	5.9	48.5	22.2	3.3	-
Ph. Super Simple	0.46	36.1	142.4	7010	13.9	17.5	18.9	28.6	3.0	-
Ph. Super Triple	0.71	36.2	154.6	3298	38.0	93.4	19.0	25.2	4.9	41.0

[1] [1] Mg = Magnesium, Mn = Manganese, Zn = Zinc, Fe = Iron, Cu = Copper, Cr = Chromium, Pb = Lead, Ni = Nickel, Cd = Cadmium, Va = Vanadium.

Table 1.16 - Trace Mineral Content in Feedstuffs (As Fed)

Feedstuff	Mg[1]	Mn[1]	Fe[1]	Cu[1]	Zn[1]	Se[1]	S[1]
	%	----------mg/kg ----------					g /kg
Babassu, Meal	0.38	118.1	350	16.8	38.2	-	-
Bakery Cookie Cracker Res	0.04	13.4	125.1	3.2	61.5	-	-
Blood, Meal	0.10	7.3	1664.2	13.8	36.1	0.58	-
Blood Red Cells, Dried	0.01	-	2021.0	13.8	130.3	0.24	-
Blood Plasma	0.02	-	105.9	45.9	89.2	0.42	-
Cassava with Hulls ,Dried	0.09	23.9	92.6	4.5	11.1	0.15	-
Castor Oil Plant, Meal	0.35	23.7	1.0	3.9	11.3	-	-
Coconut, Meal	0.26	68.2	423	25.6	62.3	-	3.10
Corn	0.09	5.3	23.5	2.1	21.5	0.07	5.30
Corn Germ	0.31	19.6	116.4	10.0	45.9	0.10	2.20
Corn Gluten, Meal (21%)	0.30	19.2	133.5	16.9	72.9	0.21	2.80
Corn Gluten, Meal (60%)	0.06	3.1	112.9	19.1	25.3	0.20	5.30
Corn High Lysine	0.05	10.3	53.4	2.6	17.6	0.05	-
Corn High Oil	0.10	4.3	93.0	3.0	21.5	0.19	-
Corn Pre-Cooked	0.04	11.4	43.9	2.7	26.5	0.16	-
Cottonseed, Meal (30%)	0.36	9.7	53.9	6.7	23.9	0.31	3.30
Cottonseed,Meal (39%)	0.48	14.3	157.9	10.5	56.7	0.58	3.30
Feather, Meal (75%)	0.03	3.3	567.9	20.9	72.4	0.29	1.43
Feat & Poul. By Prod, Meal	0.13	6.8	221.1	9.5	95.2	0.61	5.20
Fish, Meal (54%)	0.16	41.4	444.1	12.0	84.3	0.79	6.40
Meat & Bone Meal (35%)	0.22	11.7	816.4	36.3	66.9	0.42	-
Meat & Bone Meal (41%)	0.22	1.5	323.9	48.0	69.3	0.36	-
Meat & Bone Meal (45%)	0.28	12.9	449.7	14.0	80.6	0.30	-
Meat & Bone Meal (51%)	0.42	20.0	247.7	8.5	80.8	0.37	8.90
Milk Whey Permeate, Dried	0.11	3.0	12.3	16.5	114.6	0.21	3.00
Millet	0.13	17.79	96.8	17.6	29.03	0.06	1.40

[1] Mg = Magnesium, Mn = Manganese, Fe = Iron, Cu = Copper, Zn = Zinc, Se = Selenium, S = Sulfur

Table 1.16 - Trace Mineral Content in Feedstuffs (As Fed)

Feedstuff	Mg[1]	Mn[1]	Fe[1]	Cu[1]	Zn[1]	Se[1]	S[1]
	%	----------mg/kg ----------					g /kg
Palm Ouricuri, Meal	0.25	39.3	310.0	15.6	68.7	-	-
Pasta-Spaghetti, Residue	0.05	9.4	195.8	3.4	35.6	-	-
Peanut, Meal	0.31	37.0	195	17.5	48.3	0.25	3.10
Poultry by Product, Meal	0.16	2.1	176.7	19.3	80.4	0.52	5.50
Rice, Bran	0.81	194.5	115.4	28.2	49.8	0.35	1.60
Rice, Bran Defatted	0.75	170.3	170.1	14.7	47.7	-	1.70
Rice, Broken	0.08	16.6	15.6	2.3	10.3	0.31	-
Sorghum Low Tannin	0.11	10.9	59.7	7.6	18.6	0.25	1.00
Soyb. Full-fat Extr./Toast	0.32	24.8	179.1	13.7	41.6	0.21	3.10
Soyb. Full-fat Micron.	0.20	19.2	56.2	13.7	36.2	0.20	-
Soybean Hulls	0.17	19.0	534.0	76.2	35.7	0.22	1.10
Soybean Meal (45%)	0.32	31.9	150.4	16.3	46.2	0.44	3.10
Soybean Meal (48%)	0.23	31.7	168.0	--	44.8	0.34	-
Soybeans Protein Conc.	0.29	38.3	92.3	32.6	24.0	--	-
Sugarcane Molasses	0.35	43.9	200	55.0	33.1	-	
Sugarcane Molasses Dried	0.19	76.4	238.5	19.4	21	-	-
Sunflower Meal	0.60	0.34	248	26	79	0.50	3.20
Swine by Product, Meal	0.15	23.9	655.0	16.7	115.0	-	-
Triticale	0.10	38.3	44.9	6.4	32.7	0.31	1.40
Wheat	0.12	29.7	68.4	5.6	49.8	0.35	1.40
Wheat Screenings	0.17	44.6	156.4	21.8	64.1	-	-
Wheat, Bran-Midds	0.43	102.7	141.9	15.0	134.5	0.31	2.10
Wheat, Germ	0.25	134.5	110.3	4.8	197.4	-	-
Wheat, Shorts	0.31	103.5	162.8	14.1	141.0	-	-
Wheat, Flour	0.03	6.8	29.3	3.01	22.0	-	-
Yeast Alcohol Dist.	0.09	14.0	191.3	30.0	107.9	0.55	4.00

[1] Mg = Magnesium, Mn = Manganese, Fe = Iron, Cu = Copper, Zn = Zinc, Se = Selenium, S = Sulfur

Table 1.17 - Sources of Trace Minerals Used to Supplement Poultry and Swine Diets

Sources of Cobalt	Co (%)
Cobalt Carbonate ($CoCO_3$)	45.0
Cobalt Sulfate ($CoSO_4\ H_2O$)	33.0
Cobalt Sulfate ($CoSO_4\ 7H_2O$)	21.0
Sources of Copper	Cu (%)
Copper Carbonate ($CuCO_3Cu(OH)_2$)	53.0
Copper Oxide (CuO)	75.0
Copper Sulfate ($CuSO_4H_2O$)	34.5
Copper Sulfate ($CuSO_45H_2O$)	25.0
Sources of Iron	Fe (%)
Iron Carbonate ($FeCO_3$)	43.0
Ferrous Sulfate ($FeSO_4H_2O$)	30.0
Ferrous Sulfate ($FeSO_47H_2O$)	20.0
Sources of Iodine	I (%)
Calcium Iodate ($Ca(IO_3)_2$)	62.0
Copper Iodide (CuI_2)	66.0
Potassium Iodate (KIO_3)	59.0
Potassium Iodide (KI)	76.0
Sources of Manganese	Mn (%)
Manganese Carbonate ($MnCO_3$)	47.0
Manganous Oxide (MnO)	52 - 62
Manganese Sulfate ($MnSO_4H_2O$)	31.0
Manganese Sulfate ($MnSO_45H_2O$)	22.7
Sources of Selenium	Se (%)
Sodium Selenide (Na_2SeO_4)	42.0
Sodium Selenite (Na_2SeO_3)	45.0
Sources of Zinc	Zn (%)
Zinc Carbonate ($ZnCO_3$)	52.0
Zinc Oxide (ZnO)	73.0
Zinc Sulfate ($ZnSO_4H_2O$)	35.0
Zinc Sulfate ($ZnSO_47H_2O$)	22.0

Table 1.18 - Vitamin and Trace Mineral Supplementation Levels in Broiler Diets (Amount / kg Diet)[1]

Phase		Prestarter	Starter	Grower I and II		Finisher
Age	days	1 - 7	8 – 21	22 – 33	34 - 42	43 – 49
Vitamin A	UI	9375	8250	7500	5625	4875
Vitamin D_3	UI	2375	2090	1900	1425	1235
Vitamin E	UI	35	31	28	21	18
Vitamin K_3	mg	1.88	1.65	1.50	1.13	0.98
Vitamin B_1	mg	2.50	2.20	2.00	1.50	1.30
Vitamin B_2	mg	6.25	5.50	5.00	3.75	3.25
Nicotinic Acid	mg	37.5	33.0	30	22.5	19.5
Pantothenic Ac.	mg	12.5	11.0	10.0	7.5	6.5
Vitamin B_6	mg	3.5	3.08	2.80	2.10	1.82
Vitamin B_{12}	mg	0.015	0.013	0.012	0.009	0.008
Folic Acid	mg	0.875	0.770	0.700	0.525	0.455
Biotin	mg	0.088	0.077	0.070	0.053	0.046
Choline	mg	375	330	300	225	195
Copper	mg	12.5	11	10	7.5	6.5
Iron	mg	62.5	55.0	50.0	37.5	32.5
Iodine	mg	1.25	1.10	1.00	0.75	0.65
Manganese	mg	88	77	70	53	46
Selenium	mg	0.375	0.330	0.300	0.225	0.195
Zinc	mg	81.3	71.5	65.0	48.8	42.3

[1]. Amount recommended in each phase to maintain constant vitamin and trace mineral intake per kg weight gain: e.g.. Vit A, 12000 IU; nicotinic acid, 47 mg and zinc, 100 mg/kg gain.

Table 1.19 - Vitamin and Trace Mineral Supplementation Levels in the Diets of Replacement Pullets, Layers and Breeders (Amount/kg Feed)

Poultry Type		Replacement Pullets		Layers	Breeders
Phase		Starter	Grower		
Vitamin A	UI	8250	7500	7500	10000
Vitamin D_3	UI	2090	1900	2000	2700
Vitamin E	UI	31	28	10	40
Vitamin K_3	mg	1.65	1.50	1.8	2
Vitamin B_1	mg	2.20	2.00	1.5	2.5
Vitamin B_2	mg	5.50	5.00	4	7
Nicotinic Acid	mg	33.0	30	25	35
Pantothenic Ac.	mg	11.0	10.0	10	15
Vitamin B_6	mg	3.08	2.80	1.7	2.5
Vitamin B_{12}	mg	0.013	0.012	0.013	0.020
Folic Acid	mg	0.770	0.700	0.5	0.9
Biotin	mg	0.077	0.070	0.05	0.11
Choline	mg	330	300	220	350
Copper	mg	11	10	11	12
Iron	mg	55.0	50.0	55	60
Iodine	mg	1.10	1.00	1.1	1.2
Manganese	mg	77	70	77	84
Selenium	mg	0.33	0.30	0.33	0.36
Zinc	mg	71.5	65.0	72	78

Table 1.20 - Mineral Supplement for Poultry Diets[1,2,3]

Element	Amount g/kg	Mineral Source	Amount g/kg
Copper	10.0	Copper Sulfate (25%) ($CuSO_45H_2O$)	40.00
Iron	50.0	Ferrous Sulfate (30%) ($FeSO_4H_2O$)	166.67
Iodine	0.8	Potassium Iodate (59%) (KIO_3)	1.69
Manganese	65.0	Manganese Sulfate (31%) ($MnSO_4H_2O$)	225.81
Selenium	0.3	Sodium Selenite (45%) (Na_2SeO_3)	0.67
Zinc	60.00	Zinc Oxide (73%) (ZnO)	89.04
		Excipient	476.12
Total			1,000.00

[1] Calculations made using data from Tables 1.17 and 1.18.
[2] Recommended inclusion (kg) per MT of feed: Broilers: Prestarter, 1.25; Starter, 1.10; Grower I (22 – 33 days), 1.00; Grower II (34 – 42 days), 0.75; Finisher, 0.65; Replacement pullets: Starter, 1.10; Grower, 1.00; Layers, 1.10; Breeders, 1.20.
[3] Broilers: The amount recommended for each phase to maintain constant trace mineral intake per kg weight gain: e.g. Zinc, 100 mg/kg gain.

Table 1.21 - Vitamin and Trace Mineral Supplementation Levels in Swine Diets (Amount/Kg Feed)[1]

Phase		Pre-starter	Starter	Grower I, II		Finisher I, II		Breeding
Weight	kg	4 - 15	15 - 30	30 - 50	50 - 70	70-100	100-120	
Vitamin A	IU	7700	6875	5500	4840	4125	3410	8000
Vitamin D_3	IU	1680	1500	1200	1056	900	744	1200
Vitamin E	IU	44.8	40.0	32.0	28.2	24.0	19.8	45
Vitamin K_3	mg	3.36	3.00	2.40	2.11	1.80	1.49	2.00
Vitamin B_1	mg	1.12	1.00	0.80	0.70	0.60	0.50	1.00
Vitamin B_2	mg	3.50	3.13	2.50	2.20	1.88	1.55	4.00
Nicotinic Acid	mg	34	30	24	21.0	18.0	15	25
Pantothenic Ac	mg	16.8	15.0	12.0	10.6	9.0	7.4	16.0
Vitamin B_6	mg	2.24	2.00	1.60	1.41	1.20	0.99	1.50
Vitamin B_{12}	mg	0.022	0.020	0.016	0.014	0.012	0.010	0.020
Folic Acid	mg	0.336	0.300	0.240	0.211	0.180	0.149	1.000
Biotin	mg	0.112	0.100	0.080	0.070	0.060	0.050	0.250
Choline	mg	224	200	160	141	120	99	600
Copper	mg	13.4	12.0	9.6	8.4	7.2	6.0	12.0
Iron	mg	90	80	64	56	48	40	80
Iodine	mg	1.12	1.00	0.80	0.70	0.60	0.50	1.00
Manganese	mg	45	40	32	28	24	20	40
Selenium	mg	0.41	0.36	0.29	0.26	0.22	0.18	0.36
Zinc	mg	123	110	88	77	66	55	110

[1.] Growing pigs: Amount recommended in each phase to maintain constant vitamin and trace mineral intake per kg weight gain: e.g., Vit A, 11000 IU; nicotinic acid, 50 mg and zinc, 182 mg/kg gain.

Table 1.22 - Trace Mineral Supplements for Swine[1, 2, 3]

Element	Amount g/kg	Fonte of Mineral	Quantidade g/kg
Copper	9.6	Copper Sulfate (25%) ($CuSO_45H_2O$)	38.40
Iron	64	Ferrous Sulfate(30%) ($FeSO_4H_2O$)	213.33
Iodine	0.80	Potassium Iodate (59%) (KIO_3)	1.36
Manganese	32	Manganese Sulfate (31%) ($MnSO_4H_2O$)	103.23
Selenium	0.29	Sodium Selenite (45%) (Na_2SeO_3)	0.64
Zinc	88	Zinc Oxide (73%) (ZnO)	120.55
		Excipient	522.49
		Total	1,000.00

[1] Calculations made using data from Tables 1.17 and 1.21.
[2] Recommended addition (kg) per tonne of feed: growing pigs: Prestarter, 1.40; Starter, 1.25; Grower I (30 – 50 kg).1.00; Grower II (50 – 70 kg), 0.88; Finisher I (70 a 100 kg), 0.75; Finisher II (100 – 120 kg), 0.62; Breeding, 1.25.
[3] Growing pigs: : Amount recommended in each phase to maintain constant trace mineral intake per kg weight gain: e.g. Zinc, 182 mg /kg gain.

Table 1.23 - Practical (Pr) and Maximum (Max) Inclusion Levels of Feedstuffs in Broiler and Layer Diets (Percentage in the Diet)

Feedstuff	Broilers				Layers	
	Starter		Grower			
	Pr	Max	Pr	Max	Pr	Max
Bakery Cracker-Cookie Resd.	5	10	8	15	8	15
Bakery, Residue	10	20	15	25	15	25
Blood, Meal	1	2	2	3	1	2
Canola, Meal	1	3	2	5	2	4
Carob, Meal	3	5	4	8	5	10
Cassava, with Hulls Dried	5	20	10	20	10	20
Coconut, Meal	3	6	4	8	5	8
Corn	65	65	65	65	65	65
Corn, Germ	5	15	10	20	10	20
Corn, Gluten Meal (22%)	3	8	4	8	4	12
Corn, Gluten Meal (60%)	4	8	4	8	4	10
Corn High Lysine	65	65	65	65	65	65
Corn High Oil	60	65	55	65	60	65
Cottonseed, Meal (30%)	2	4	3	5	3	5
Cottonseed, Meal (39%)	3	7	5	8	5	8
Fat, Poultry, Coconut, Lard	3	6	3	7	3	7
Fat, Tallow	2	4	3	6	3	6
Feather, Meal	1	2	2	4	2	4
Feather Poul. Prod, Meal	2	4	2	4	2	4
Fish, Meal	3	7	2	5	2	5
Glycerin (87%)	5	8	7	10	7	10
Meat & Bone Meal (41%)	4	7	4	8	4	8
Meat & Bone Meal (50%)	5	8	5	10	5	10
Millet	15	40	20	45	20	45
Pasta-Spaguetti, Residue	10	15	12	20	12	20
Peanut, Meal	3	7	5	10	5	10

Table 1.23 - Practical (Pr) and Maximum (Max) Inclusion Levels of Feedstuffs in Broiler and Layer Diets (Percentage in the Diet)

Feedstuff	Broilers				Layers	
	Starter		Grower			
	Pr	Max	Pr	Max	Pr	Max
Poultry by Product, Meal	3	7	3	8	3	8
Rice, Bran	3	8	6	12	6	12
Rice Bran Deffated	2	6	5	8	5	10
Rice, Broken	30	65	30	65	30	65
Sorghum, High Tannin	15	30	20	30	20	30
Sorghum, Low Tannin	30	65	30	65	30	65
Soybean, Full-Fat Extrud.	8	15	10	20	10	20
Soybean, Full-Fat Micron.	8	15	10	20	10	20
Soybean, Full-Fat Toasted	5	10	8	20	10	20
Soybean, Meal (45%)	35	35	35	35	30	30
Soybean, Meal (48%)	35	35	35	35	30	30
Sugar	-	5	-	10	-	15
Sugarcane, Molasses	1	1	1	3	1	3
Sugarcane, Molas. Dried	1	2	1	3	1	3
Sunflower, Meal	5	10	8	15	8	15
Swine by Product, Meal	4	7	4	8	4	8
Triticale	10	20	15	25	15	30
Vegetable Oil	3	6	3	7	3	7
Wheat	12	20	20	30	20	30
Wheat Screenings	10	20	12	25	15	30
Wheat, Flour	20	40	20	40	20	40
Wheat, Germ	5	15	8	15	8	15
Wheat, Bran-Midds	3	10	5	15	6	15
Wheat, Shorts	6	15	8	15	8	20
Yeast, Dist. Alcohol	2	3	3	4	3	4
Yeast, Brewery	2	3	3	4	3	4

Table 1.24 - Practical (Pr) and Maximum (Max) Inclusion Levels of Feedstuffs for Growing Pigs and Sows (Percentage in the Diet)

Feedstuffs	Growing pigs						Sows			
	Starter		Grower		Finisher		Gestation		Lactation	
	Pr	Max	Pr	Max	Pr	Max	Pr	Max	Pr	Max
Blood, Meal	1	2	1	3	2	4	2	4	1	3
Backery Residue	12	20	20	40	20	40	25	40	25	40
Back-Cracker Cookie	8	15	10	20	15	30	10	20	10	20
Canola, Meal	2	4	5	8	10	15	10	20	5	10
Carob, Meal	3	6	5	8	7	10	7	10	5	8
Cassava, Hulls Dried	10	20	15	30	15	30	15	30	15	30
Citrus Pulp	-	2	3	5	4	6	5	8	2	5
Coconut, Meal	2	5	4	7	5	8	5	10	4	7
Corn	60	60	65	65	70	70	65	65	70	70
Corn Germ	10	15	20	30	30	40	30	40	20	30
Corn, Glut. Meal (22%)	3	8	4	10	5	10	5	12	4	8
Corn, Glut. Meal (60%)	3	8	4	10	5	10	5	10	4	8
Corn High Lysine	60	60	65	65	70	70	65	65	70	70
Corn High Oil	50	60	65	65	70	70	50	65	70	70
Cotton. Meal (30%)	2	4	4	7	5	8	5	8	3	6
Cotton. Meal (39%)	3	5	5	8	6	10	6	10	5	8

Table 1.24 - Practical (Pr) and Maximum (Max) Inclusion Levels of Feedstuffs for Growing Pigs and Sows (Percentage in the Diet)

Feedstuffs	Growing pigs						Sows			
	Starter		Grower		Finisher		Gestation		Lactation	
	Pr	Max	Pr	Max	Pr	Max	Pr	Max	Pr	Max
Fat, Poul, Coco, Lard	2	5	2	5	2	5	-	4	2	5
Fat, Tallow	2	4	2	5	2	5	-	4	2	5
Feath Poul Prod Meal	1	2	2	4	2	5	2	5	2	4
Feather, Meal	1	2	2	4	2	5	2	5	2	4
Fish, meal	5	12	5	10	5	5	5	10	5	10
Glycerin (87%)	5	8	7	10	7	10	7	10	7	10
Meat Bone Meal (41%)	3	5	4	6	4	7	4	7	4	7
Meat Bone Meal (50%)	4	6	4	7	4	8	4	8	4	8
Millet	20	40	30	50	40	60	40	60	30	50
Poult by Product Meal	3	5	4	7	4	8	4	8	4	8
Swine by Product Meal	3	5	4	6	4	7	4	7	4	7
Oil Vegetable	2	5	2	5	2	5	-	4	2	5
Pasta-Spaghetti, Resid	10	15	15	25	20	30	20	30	20	30
Peanut, Meal	4	7	6	10	6	10	6	10	6	10
Rice, Broken	30	30	40	40	40	40	40	40	40	40
Rice, Bran Defatted	3	8	5	12	7	20	10	20	5	12
Rice, Bran	4	10	7	15	10	20	10	20	5	15
Sorghum High Tannin	15	30	20	35	20	35	20	35	20	35
Sorghum Low Tannin	30	60	35	65	35	70	35	65	35	70

Table 1.24 - Practical (Pr) and Maximum (Max) Inclusion Levels of Feedstuffs for Growing Pigs and Sows (Percentage in the Diet)

Feedstuff	Growing pigs						Sows			
	Starter		Grower		Finisher		Gestation		Lactation	
	Pr	Max	Pr	Max	Pr	Max	Pr	Max	Pr	Max
Soybean Hulls	-	-	-	3	-	5	5	12	-	5
Soyb. Meal(45%)	30	30	25	25	20	20	15	15	25	25
Soyb. Meal (48%)	30	30	25	25	20	20	15	15	25	25
Soyb. Full-fat Extru.	10	25	10	25	10	25	5	25	10	30
Soyb. Full-fat Micro.	5	20	10	20	10	20	5	25	10	30
Soyb. Full-fat Toast	10	25	10	25	10	25	5	25	10	30
Sugar	2	10	-	10	-	10	-	10	2	10
Sugar. Molasses	2	3	2	5	2	5	2	5	2	5
Sugar. Molas. Dried	1	2	2	3	2	3	2	3	2	3
Sunflower, Meal	5	10	8	15	10	18	13	20	10	20
Sweet Potato, Dried	2	5	5	10	6	12	6	12	5	8
Triticale	10	25	20	35	20	35	20	35	20	35
Wheat	10	25	20	35	20	35	20	35	20	35
Wheat, Bran-Midds	2	5	5	12	8	15	15	35	5	15
Wheat, Flour	20	40	20	40	20	40	20	40	20	40
Wheat, Germ	10	20	15	30	15	30	15	35	15	35
Wheat Screenings	10	20	15	30	15	30	15	30	15	30
Wheat, Shorts	8	15	15	30	15	30	20	40	15	35
Yeast, Brewery	2	8	4	10	4	15	4	15	4	10
Yeast, Dist. Alcohol	2	6	3	8	4	12	3	10	4	10

Table 1.25 - Variation in Nutrient Content of Primary Feedstuffs - Crude Protein, Calcium and Phosphorus – Data from the Brazilian Tables, 2005 (as fed)

Feedstuff	Crude Protein			Calcium			Phosphorus		
	Mean %	Std. Dev%	n	Mean %	Std. Dev%	n	Mean %	Std. Dev%	n
Corn	8.26	0.90	1493	0.03	0.03	252	0.24	0.05	233
Feather, Meal (84%)	83.90	2.95	461	0.29	0.12	22	0.74	0.15	20
Fish, Meal (54%)	54.40	4.59	73	5.90	1.75	43	2.41	0.80	41
Meat & Bone Meal (41%)	41.00	0.63	136	10.08	1.32	53	6.80	1.22	54
Meat & Bone Meal (45%)	44.54	1.13	111	9.55	1.32	47	4.96	1.22	54
Poultry by Product Meal	57.00	5.84	1186	4.00	1.86	17	2.66	0.77	17
Rice, Bran	13.24	1.96	236	0.11	0.065	46	1.81	0.42	45
Sorghum	9.23	1.35	355	0.03	0.045	43	0.26	0.060	55
Soybean, Full-fat Extr. / Toasted Meal	37.00	1.03	422	0.23	0.14	44	0.52	0.05	41
Soybean, Meal (45%)	45.32	1.15	1605	0.24	0.07	125	0.53	0.09	132
Wheat, Bran-Midds	15.52	1.65	350	0.14	0.07	72	0.99	0.25	63
Dicalcium phosphate	-	-	-	24.50	1.43	135	18.50	0.94	148
Limestone	-	-	-	38.40	1.23	61	-	-	-

n=number of observations.

Table 1.26 - Variation in Nutrient Content of Primary Feedstuffs – Lysine, Methionine + Cystine and Threonine – Data from the Brazilian Tables, 2005 (as fed)

Feedstuff	Lysine			Methionine + Cystine			Threonine		
	Mean %	Std. Dev%	n	Mean %	Std. Dev%	n	Mean %	Std. Dev%	n
Corn	0.24	0.045	1234	0.36	0.038	1214	0.32	0.043	1198
Feather, Meal (84%)	2.40	0.30	451	4.05	0.51	451	3.66	0.22	450
Fish, Meal (54%)	3.41	1.02	24	2.35	0.25	20	2.34	0.31	24
Meat & Bone Meal (41%)	1.98	0.18	110	0.80	0.16	105	1.15	0.20	110
Meat & Bone Meal (45%)	2.19	0.21	105	0.99	0.19	99	1.36	0.22	105
Poultry by Product Meal	3.35	0.48	756	2.02	0.53	756	2.43	0.53	756
Rice, Bran	0.63	0.11	191	0.52	0.06	186	0.49	0.10	191
Sorghum	0.20	0.036	271	0.32	0.033	265	0.31	0.048	271
Soybean, Full-Fat Extr. / Toasted Meal	2.23	0.11	357	1.08	0.05	352	1.47	0.08	357
Soybean, Meal (45%)	2.77	0.10	1164	1.27	0.09	1145	1.78	0.10	1127
Wheat, Bran-Midds	0.62	0.09	257	0.58	0.06	256	0.51	0.08	255

n = number of observations.

CHAPTER 2

Nutritional Requirements of Poultry

INTRODUCTION

The following observations should be considered for a better understanding of the tables.

* Several factors may influence poultry requirements, such as breed, strain, sex, feed intake, dietary energy level, nutrient availability, environmental temperature, air humidity, health status, etc.

* Poultry nutritional requirements were determined in a series of dose-response trials carried out at UFV and other research institutions, associated with observations of commercial flocks in several Brazilian regions.

* For the determination of poultry nutritional requirements, basal diets were formulated using mainly corn and soybean meal. Therefore, when other ingredients are used, corrections as to nutrients digestibility or availability need to be made. This is the reason why requirements are expressed on true digestible amino acids.

* Only the main nutrients are mentioned. The others are assumed as adequately supplied, provided they are offered in amounts equivalent to the vitamin and mineral supplements included in this publication.

* When birds are fed “ad libitum”, feed intake and particularly feed conversion largely depend on the energy level. These Tables include examples of nutritional requirements for poultry diets containing the energy levels commonly used in Brazil. When other energy levels are used, corresponding adjustments should be made to maintain constant the ratio of nutrient percentage per 1000 kcal ME in the diet.

* It is virtually impossible to establish an energy level for each type of poultry. Energy levels vary according to feedstuff and

poultry product prices. For instance, if oil has a reasonable price, high energy levels are recommended. On the other hand, the availability of cheap low-energy feedstuffs would lead to the formulation of lower-energy diets. The main concern is not only to formulate least cost diets, rather, a formulation that allows chicken meat and egg production at the least cost.

* Lysine was used as reference to estimate the nutritional requirements of the amino acids. Lysine requirements were determined in several dose-response trials, run in the UFV with birds of different ages. Some experimental results published in Brazil were also used. The requirements of the other amino acids was established using the concept of Ideal Protein, maintaining for each type of bird the amino acid / lysine ratio, expressed on total and true amino acid digestibility basis.

* For broilers, firstly all dose-response experiments with lysine were compiled, and digestible lysine daily intake was determined. Then, lysine maintenance requirements were calculated to obtain the amount of digestible lysine / kg of gain in the different growing phases. Results of several dose-response trials were used for this determination, 79 values for males and 36 for females were obtained. Tables 2.01 to 2.04 show the methodology used to calculate the amount of true digestible lysine / kg of broiler weight gain. The two equations used to estimate true digestible lysine requirements for male and female broilers according to their performance are presented in Tables 2.05 to 2.08.

* The use of equations to estimate the true digestible lysine requirement of birds allows more flexibility, because in reality there is not a single requirement, but many as a function of performance and feed intake. As an example of the variation in lysine requirement, performance data of broilers (females and males) are shown and daily lysine requirements calculated. To make the manipulation of the Brazilian Tables easier, examples of male and female requirements of broilers with low, standard and high performance are shown.

* The established protein levels should be assumed as suggestions, not as recommendations. These are minimum dietary values based on corn and soybean meal when the Crystalline amino acids lysine, methionine, and threonine are offered. Aiming at reducing environmental impact of excessive nutrients in poultry diets, excellent experimental and practical results have been obtained with low protein diets while maintaining the recommended levels of essential amino acids, which are indeed the most important.

* In general, at the suggested protein levels, the requirements of arginine, valine, isoleucine, leucine, histidine and phenylalanine + tyrosine are usually supplied.

* Amino acid dietary levels must be similar to the recommended levels, avoiding excess. Excessive protein levels must also be avoided.

* Methionine + cystine requirements were established based on the fact that methionine should supply at least 55% of sulfur amino acid requirements. Phenylalanine + tyrosine requirements were also determined considering that the first must supply at least 55% of the requirement. Serine and glycine are presented together as these amino acids are interchangeable.

* A procedure similar to that used for lysine was applied to obtain the equation that calculates phosphorus requirements for broilers, but the number of experiments was lower, and the variation was wider. Firstly, phosphorus requirement for maintenance was calculated (0.026 body weight$^{0.75}$), using the endogenous excretion data obtained in 2009 by Bunzen (PhD thesis, UFV). Results of dose-response trials on phosphorus requirements were used to calculate the amount of phosphorus (available and true digestible) / kg weight gain for the different growing phases. Table 2.09 shows the equations obtained to

estimated phosphorus requirements and Ca:P ratios recommended for male and female broilers.

* High calcium and phosphorus levels must be avoided in broiler feeds, as in addition to affecting bird performance, they increase environmental contamination. Ca : available P ratio must be maintained around 2.13:1 and 2.35:1 for Ca: digestible P ratio at the recommended levels. Ca requirements were calculated based on available P and digestible P means multiplied by their respective ratios.

* Nutritional requirements of sodium were estimated in several trials. For potassium, three experiments were performed with broilers. However, we decided to include also recommendations for potassium, sodium, and chloride for all birds in order to obtain adequate dietary electrolyte balance in poultry feeds.

* For layers and broiler breeders, requirements were established as amount of nutrient per day per bird for optimal performance. There is also an equation to determine daily ME requirement per hen. This equation takes into account data on body weight, daily weight gain, egg mass, and environmental temperature. By using data obtained by the equation and the dietary energy level, it is possible to estimate daily feed intake and to calculate the percentage of nutrients in the diet.

* For layers and broiler breeders, requirements are expressed as amount of nutrient per day per bird for optimal performance. An equation to calculate true digestible lysine requirement was estimated on the results of 15 dose-response experiments (Tables 2.21 and 2.35). An example of the variation in lysine requirements is shown, where daily lysine requirements were calculated based on the performance data of layers (white-egg and brown-eggs) and broiler breeder hens. In order to make the use of the Brazilian Tables easier, examples are presented describing the nutritional

requirements of layers and breeder hens with different body weight, daily gain, egg mass and feed intake.

* In nutritional requirements studies, the influence of high environmental temperature on broiler and layer performance was evident. The main effect was a decrease in feed intake, caused by the lower energy requirement for maintenance of birds reared at temperatures higher than 21°C (up to 27°C). There are correction factors to estimate the requirements of broilers, but examples of requirements of broilers reared at high environmental temperatures are not mentioned, because if performance and feed intake are known, the optimal nutritional levels can be easily calculated using the tables shown in the text.

* For layers and broiler breeder hens, it was established that metabolizable energy requirement vary in 3 kcal ME per unit of metabolic weight ($BW^{0.75}$) for each 1°C of environmental temperature below or above 21°C (Tables 2.22 and 2.36). This correction is adequate up to a limit of 27 °C, approximately.

* It is also important to have in mind that broiler and layer diets must contain adequate levels of xanthophylls for carcass and egg pigmentation.

* Quail egg production in Brazil has developed in the last few years, and the number of flocks and egg production per bird has increased. This is a result from studies on quail environment, nutrition, genetics and health and the application of technologies in commercial farms.

* Quails today are heavier, more productive, and lay larger eggs. Due to these changes, commercial quail strains are not yet standardized, which significantly contributes to the variation in performance results.

* Quails present different anatomic, physiological, and behavioral characteristics as compared to commercial laying hens, and therefore, although both are layers, these birds cannot be compared. Quails have different nutritional requirements, which demand research studies to determine their real nutritional requirements to obtain optimal performance.

* The nutritional requirements tables for quails presented here were developed by compiling results of studies on quail performance carried out at UFV and other Brazilian research institutes.

* In the case of laying quails, the requirements were established as amount of nutrient per bird per day for optimal performance. An equation to estimate true digestible lysine requirement (Table 2.46) was developed based on the results of studies carried out at UFV and other Brazilian research institutions. An example of the variation in lysine requirements is shown, where daily lysine requirements were calculated based on the performance data of Japanese quails. In order to make the use of the Brazilian Tables easier, examples of the nutritional requirements of quails with different body weight, daily gain, egg mass and feed intake are shown.

* Simplified and practical tables of poultry nutritional requirements are presented at the end of this publication (Tables 4.02 and 4.03), allowing a rapid and easy check of the nutritional levels commonly recommended for poultry, which are related to the dietary energy levels commonly used in Brazil.

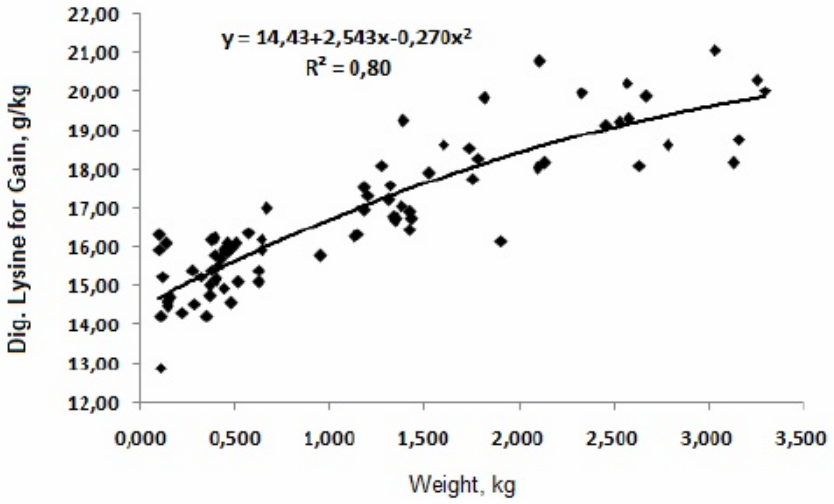
Nutritional Requirements of Broilers Chickens

Table 2.01 - Methodology Used to Obtain the Equation that Calculates the Amount of True Digestible Lysine / Kg Weight Gain of Male Broilers

Weight Range, kg	0.040 – 0.400	0.401 – 1.200	1.201 – 2.200	2.201 – 3.305
Experimental Data[1]	22	22	22	13
Mean Weight in the Period, kg	0.244	0.656	1.578	2.806
Feed Intake, g/day	38.14	87.77	159.89	217.28
Dig. Lys Intake, g/day	0.4449	0.9730	1.6084	2.0934
Maintenance Dig. Lys, g/day[2]	0.0237	0.0503	0.0983	0.1516
Dig. Lys Weight Gain, g/day	0.4212	0.9227	1.5102	1.9418
Mean Gain, kg/day	0.0279	0.0577	0.0850	0.0999
g. Dig. Lys/ kg Gain	15.06	15.90	17.78	19.45
Equation, g Lys/ kg Gain	15.03	15.98	17.77	19.44

Eq: Y (g Dig. lys/kg gain) = 14.43 + 2.543 (Av. weight, kg) – 0.270 (Av. weight, kg)^2 R^2 = 0.80

[1] Total of 79 experimental data obtained in dose response trial with different lysine levels.
[2] Daily requirements of digestible lysine for maintenance = 0.07 x (Av. weight)$^{0.75}$. Estimated according to the values of Fisher, 1998 (Poultry Sci. 77:124), Edwards et. al., 1999 (Poultry Sci. 78:1412) and Siqueira, 2009 (PhD thesis – Estimates of lysine requirements for Broilers using dose-response and factorial methods – UNESP, Jaboticabal, SP).



Graph 2.01 - Equation Estimating the Value, in Grams, of True Digestible Lysine / kg Weight Gain of Male Broilers as a Function of Weight (0.040 to 3.305 kg).

Table 2.02 - Equation Used to Estimate True Digestible Lysine (Dig. Lys) Requirements for Male Broilers

Dig. Lys Req. (g/day) = (Dig. Lys for Maintenance) + (Dig. Lys for Gain)
Dig. Lys Req. (g/day) = $(0.07\ W^{0.75}) + (14.43 + 2.543\ W - 0.270\ W^{2})\ G$

W = Average Body Weight in kg;
G = Gain / day in kg

Example:

Male Broilers of 36 to 42 days of age.
Av. Weight = 2.531 kg, with $W^{0.75} = 2.007$
G = 0.100 kg / day

Lys Req. = $(0.07 \times 2.007) + (14.43 + 2.543 \times 2.531 - 0.270 \times 2.531^{2}) \times 0.100$
Dig. Lys Req. = (0.1405) + (19.136 x 0.100) = 2.054 g/day

Intake Estimate = 204.4 g/day

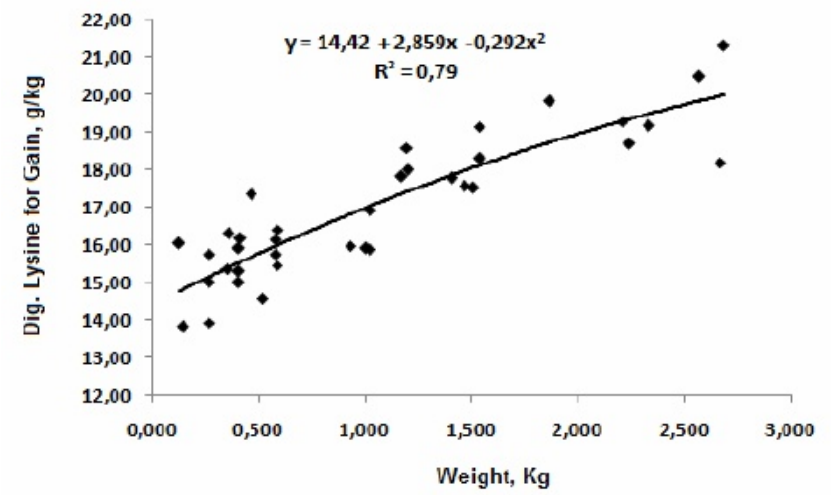
% Dig. Lys in the Diet = 1.005%

Table 2.03 - Methodology Used to Obtain the Equation that Calculates the Amount of True Digestible Lysine / Kg Weight Gain of Female Broilers

Weight Range, kg	0.040 – 0.500	0.501 – 1.200	1.201 – 1.900	1.901 – 2.690
Experimental Data[1]	12	12	6	6
Mean weight in the Period, kg	0.325	0.866	1.552	2.449
Feed Intake, g/day	48.76	105.77	150.44	191.09
Dig. lys intake, g/day	0.5538	1.0791	1.4197	1.6914
Maintenance Dig. lys, g/day[2]	0.0298	0.0623	0.0973	0.1370
Dig. Lys Weight Gain, g/day	0.5241	1.0168	1.3224	1.5544
Mean Gain, kg/day	0.0336	0.0616	0.0721	0.0780
g. Dig. Lys/ kg gain	15.50	16.46	18.36	19.52
Equation, g Lys/ kg gain	15.32	16.68	18.15	19.67

Eq: Y (g Dig. lys/kg gain) = 14.42 + 2.859 (Av. weight, kg) – 0.292 (Av. weight, kg)^2 R^2 = 0.79

[1] Total of 36 experimental data obtained in dose-response trials with different lysine levels.
[2] Daily requirements of digestible lysine for maintenance = 0.07 x (Av. weight)$^{0.75}$. Estimated according to the values of Fisher, 1998 (Poultry Sci. 77:124), Edwards et. al., 1999 (Poultry Sci. 78:1412) and Siqueira, 2009 (PhD thesis – Estimates of lysine requirements for Broilers using dose-response and factorial methods – UNESP, Jaboticabal, SP).



Graph 2.02 - Equation Estimating the Value, in Grams, of True Digestible Lysine / kg Weight Gain of Female Broilers as a Function of Weight (0.040 to 2.690 kg).

Table 2.04 - Equation Used to Estimate True Digestible Lysine (Dig. Lys) Requirements for Female Broilers

Dig. Lys Req. (g/day) = (Dig. Lys for Maintenance) + (Dig. Lys for Gain)
Dig. Lys Req. (g/day) = $(0.07\ W^{0.75}) + (14.42 + 2.859\ W - 0.292\ W^{2})\ G$

W = Average body weight in kg;
G = Gain / day in kg

Example:

Female Broilers with 36 to 42 days of age.
Av. Weight = 2.091 kg, with $W^{0.75} = 1.739$
G = 0.074 kg / day

Lys Req. = $(0.07 \times 1.739) + (14.42 + 2.859 \times 2.091 - 0.292 \times 2.091^{2}) \times 0.074$
Dig. Lys Req. = (0.1217) + (19.121 x 0.074) = 1.537 g/day

Intake Estimate = 173.9 g/day

% Dig. Lys in the Diet = 0.884%

Table 2.05 - Digestible Lysine Requirement of Broiler Males with Standard Performance Using the Equation on Table 2.02

Age Days	Weight kg	Gain g/day	Dig. Lys Req. g/day	Intake g/day	Cumulative Intake, g	ME intake kcal/day[1]	Lys/ME Ratio %/Mcal	Dig. Lys Diet, %
1	0.059	13.9	0.211	15.2	15.2	44.91	0.469	1.384
2	0.073	15.7	0.240	17.8	33.1	52.61	0.456	1.345
3	0.089	18.2	0.278	21.1	54.2	62.29	0.447	1.319
4	0.107	20.9	0.321	24.2	78.4	71.40	0.449	1.324
5	0.128	23.9	0.368	27.8	106.2	82.04	0.448	1.322
6	0.152	27.1	0.419	31.9	138.1	94.19	0.444	1.311
7	0.179	28.3	0.440	35.7	173.8	105.28	0.418	1.233
8	0.207	31.3	0.489	40.0	213.8	120.05	0.408	1.223
9	0.238	34.3	0.540	44.1	258.0	132.38	0.408	1.223
10	0.273	38.9	0.614	50.3	308.2	150.87	0.407	1.221
11	0.312	43.9	0.696	57.3	365.6	171.96	0.405	1.215
12	0.355	45.5	0.729	60.6	426.1	181.69	0.401	1.204
13	0.401	48.9	0.788	66.1	492.2	198.15	0.398	1.193
14	0.450	52.4	0.852	72.3	564.5	216.96	0.392	1.177
15	0.502	56.1	0.919	75.4	639.9	226.16	0.407	1.220
16	0.558	59.2	0.979	81.8	721.7	245.55	0.399	1.196
17	0.618	62.3	1.040	89.0	810.7	266.87	0.390	1.169
18	0.680	65.6	1.105	95.4	906.1	286.26	0.386	1.158
19	0.746	68.9	1.172	102.5	1008.6	307.58	0.381	1.143
20	0.814	71.8	1.233	109.2	1117.8	327.61	0.376	1.129
21	0.886	74.7	1.295	115.2	1233.1	345.71	0.375	1.124
22	0.961	77.6	1.359	120.4	1353.4	373.12	0.364	1.129
23	1.039	80.5	1.424	124.6	1478.1	386.36	0.368	1.142
24	1.119	82.6	1.476	132.0	1610.1	409.20	0.361	1.118
25	1.202	85.3	1.539	140.0	1750.1	434.00	0.355	1.099
26	1.287	87.2	1.589	146.0	1896.1	452.60	0.351	1.088
27	1.374	89.6	1.650	153.0	2049.1	474.30	0.348	1.079
28	1.464	91.3	1.698	158.6	2207.7	491.61	0.345	1.071
29	1.555	92.5	1.739	162.4	2370.0	503.32	0.345	1.071
30	1.648	94.6	1.794	169.3	2539.3	524.80	0.342	1.060
31	1.742	95.6	1.832	174.2	2713.5	540.14	0.339	1.051
32	1.838	96.9	1.873	179.2	2892.7	555.49	0.337	1.045
33	1.935	97.5	1.903	183.2	3075.9	567.77	0.335	1.039
34	2.032	98.8	1.945	189.1	3265.0	586.18	0.332	1.028
35	2.131	98.8	1.963	192.3	3457.2	605.59	0.324	1.021
36	2.230	99.4	1.992	195.0	3652.2	614.25	0.324	1.021
37	2.329	100.5	2.031	200.0	3852.2	630.00	0.322	1.015
38	2.430	101.0	2.057	203.5	4055.7	641.03	0.321	1.011
39	2.531	101.0	2.073	205.6	4261.4	647.77	0.320	1.008
40	2.632	101.0	2.089	208.6	4470.0	657.09	0.318	1.001
41	2.733	100.0	2.085	208.8	4678.8	657.72	0.317	0.998
42	2.833	97.0	2.040	209.0	4887.8	658.35	0.310	0.976
43	2.930	93.9	1.994	209.2	5097.0	669.44	0.298	0.953
44	3.024	91.9	1.966	209.4	5306.4	670.08	0.293	0.939
45	3.116	90.9	1.957	209.7	5516.1	671.04	0.292	0.933
46	3.206	88.9	1.928	210.0	5726.1	672.00	0.287	0.918
47	3.295	87.9	1.917	210.2	5936.3	672.64	0.285	0.912
48	3.383	86.9	1.906	210.5	6146.8	673.60	0.283	0.906
49	3.470	84.8	1.874	210.8	6357.6	674.64	0.278	0.889
50	3.555	83.8	1.862	211.0	6568.6	675.20	0.276	0.882
51	3.639	82.8	1.849	210.7	6779.3	674.24	0.274	0.878
52	3.721	81.8	1.836	210.3	6989.6	672.96	0.273	0.873
53	3.803	80.8	1.822	210.0	7199.6	672.00	0.271	0.868
54	3.884	79.8	1.807	209.8	7409.4	671.36	0.269	0.861
55	3.964	78.8	1.793	209.5	7618.9	670.40	0.267	0.856
56	4.043	77.0	1.762	209.3	7828.2	669.76	0.263	0.842

[1] Diets containing 2950; 3000; 3100; 3150 and 3200 kcal ME/kg for the phases de 1-7; 8-21; 22-34; 35-42; 43-56 days of age.

Table 2.06 - Digestible Lysine Requirement of Broiler Males with High Performance Using the Equation on Table 2.02

Age Days	Weight kg	Gain g/day	Dig. Lys Req. g/day	Intake g/day	Cumulative Intake, g	ME intake kcal/day[1]	Lys/ME Ratio %/Mcal	Dig. Lys Diet, %
1	0.066	14.9	0.226	15.2	15.2	45.1	0.501	1.483
2	0.081	16.1	0.246	18.0	33.3	53.4	0.461	1.364
3	0.097	18.2	0.279	21.1	54.4	62.5	0.447	1.323
4	0.115	21.4	0.329	24.7	79.1	73.2	0.450	1.332
5	0.137	23.6	0.364	27.3	106.4	80.8	0.450	1.333
6	0.160	26.8	0.415	31.4	137.8	93.0	0.446	1.321
7	0.187	31.4	0.488	38.9	176.7	115.2	0.423	1.252
8	0.218	35.7	0.557	44.6	221.3	135.9	0.410	1.250
9	0.254	40.8	0.640	51.4	272.7	156.7	0.408	1.245
10	0.295	45.9	0.724	58.1	330.8	177.1	0.409	1.246
11	0.341	50.0	0.794	63.8	394.6	194.6	0.408	1.245
12	0.391	53.9	0.864	70.0	464.5	213.4	0.405	1.235
13	0.445	57.3	0.926	75.7	540.2	230.9	0.401	1.224
14	0.502	62.2	1.015	83.3	623.5	254.0	0.400	1.219
15	0.564	67.3	1.108	88.4	711.9	269.7	0.411	1.253
16	0.631	68.7	1.144	91.6	803.5	279.2	0.410	1.250
17	0.700	70.5	1.187	96.8	900.3	295.1	0.402	1.227
18	0.771	73.9	1.257	103.3	1003.6	315.2	0.399	1.217
19	0.844	76.5	1.315	111.3	1114.9	339.5	0.387	1.182
20	0.921	79.4	1.380	117.6	1232.5	358.6	0.385	1.174
21	1.000	82.0	1.440	123.3	1355.8	376.1	0.383	1.168
22	1.082	84.5	1.499	127.2	1483.0	400.6	0.374	1.179
23	1.167	86.9	1.559	130.5	1613.4	410.9	0.379	1.195
24	1.254	89.0	1.613	136.9	1750.3	431.3	0.374	1.178
25	1.343	91.0	1.667	143.7	1894.1	452.7	0.368	1.160
26	1.434	93.0	1.721	150.5	2044.6	474.1	0.363	1.144
27	1.527	94.2	1.762	155.6	2200.2	490.1	0.359	1.132
28	1.621	96.1	1.815	162.4	2362.6	511.5	0.355	1.118
29	1.717	97.5	1.861	165.8	2528.4	522.3	0.356	1.122
30	1.815	99.0	1.907	171.3	2699.6	539.5	0.353	1.113
31	1.914	100.1	1.946	176.2	2875.9	555.1	0.351	1.104
32	2.014	101.0	1.983	181.2	3057.0	570.7	0.347	1.095
33	2.115	102.0	2.020	186.1	3243.2	586.3	0.345	1.085
34	2.217	102.9	2.055	191.1	3434.2	601.9	0.341	1.076
35	2.320	104.5	2.104	195.1	3629.3	624.2	0.337	1.079
36	2.424	102.5	2.084	191.6	3820.9	613.1	0.340	1.088
37	2.527	102.0	2.092	194.5	4015.4	622.3	0.336	1.075
38	2.629	102.0	2.108	197.8	4213.2	633.1	0.333	1.065
39	2.731	102.0	2.123	201.7	4414.9	645.4	0.329	1.053
40	2.833	102.0	2.138	204.6	4619.5	654.6	0.327	1.045
41	2.935	101.6	2.145	207.4	4826.9	663.8	0.323	1.034
42	3.036	100.5	2.136	208.0	5034.9	665.6	0.321	1.027
43	3.137	99.9	2.137	208.0	5242.9	676.0	0.316	1.027
44	3.236	98.9	2.131	208.9	5451.8	679.1	0.314	1.020
45	3.335	95.9	2.081	208.9	5660.8	679.1	0.306	0.996
46	3.431	93.8	2.051	209.1	5869.9	679.6	0.302	0.981
47	3.525	89.8	1.978	209.6	6079.5	681.2	0.290	0.944
48	3.615	88.7	1.966	210.4	6289.9	683.8	0.288	0.935
49	3.704	87.7	1.953	210.8	6500.7	685.2	0.285	0.927
50	3.791	84.7	1.899	210.8	6711.6	685.2	0.277	0.901
51	3.876	83.6	1.885	210.8	6922.4	685.2	0.275	0.894
52	3.960	82.6	1.870	209.9	7132.3	682.1	0.274	0.891
53	4.042	81.6	1.855	209.0	7341.3	679.3	0.273	0.888
54	4.124	79.6	1.819	208.9	7550.2	679.1	0.268	0.871
55	4.203	78.5	1.803	208.6	7758.8	678.0	0.266	0.864
56	4.282	76.0	1.756	208.2	7967.0	676.7	0.259	0.843

[1] Diets containing 2960; 3050; 3150; 3200 and 3250 kcal ME/kg for the phases of 1-7; 8-21; 22-34; 35-42; 43-56 days of age.

Table 2.07 - Digestible Lysine Requirement of Broiler Females with Standard Performance Using the Equation on Table 2.04

Age Days	Weight kg	Gain g/day	Dig. Lys Req. g/day	Intake g/day	Cumulative Intake, g	ME intake kcal/day[1]	Lys/ME Ratio %/Mcal	Dig. Lys Diet, %
1	0.054	16.0	0.241	16.7	16.7	49.16	0.490	1.446
2	0.070	17.0	0.258	18.2	34.8	53.63	0.481	1.419
3	0.087	20.0	0.305	22.2	57.1	65.55	0.465	1.371
4	0.107	21.0	0.322	24.2	81.3	71.51	0.451	1.329
5	0.128	24.0	0.370	28.3	109.6	83.43	0.443	1.307
6	0.152	26.0	0.403	31.3	140.9	92.36	0.436	1.287
7	0.178	32.0	0.497	39.4	180.3	116.20	0.427	1.261
8	0.210	35.0	0.547	43.9	224.2	131.81	0.415	1.245
9	0.245	36.0	0.568	46.0	270.2	137.87	0.412	1.236
10	0.281	37.0	0.589	48.5	318.7	145.44	0.405	1.216
11	0.318	38.0	0.611	50.5	369.2	151.50	0.403	1.210
12	0.356	39.0	0.633	53.0	422.2	159.08	0.398	1.194
13	0.395	44.0	0.717	60.6	482.8	181.80	0.394	1.183
14	0.439	46.0	0.756	64.6	547.4	193.92	0.390	1.170
15	0.485	48.0	0.796	68.0	615.4	204.00	0.390	1.171
16	0.533	53.0	0.884	76.0	691.4	228.00	0.388	1.164
17	0.586	54.0	0.911	79.0	770.4	237.00	0.384	1.153
18	0.640	57.0	0.970	84.5	854.9	253.50	0.382	1.147
19	0.697	58.0	0.997	88.0	942.9	264.00	0.378	1.133
20	0.755	59.0	1.025	91.0	1033.9	273.00	0.375	1.126
21	0.814	60.0	1.053	95.0	1128.9	285.00	0.370	1.109
22	0.874	62.0	1.098	102.0	1230.9	316.20	0.347	1.077
23	0.936	64.0	1.144	107.5	1338.4	333.25	0.343	1.065
24	1.000	66.0	1.191	113.0	1451.4	350.30	0.340	1.054
25	1.066	67.0	1.222	118.0	1569.4	365.80	0.334	1.035
26	1.133	68.0	1.252	122.0	1691.4	378.20	0.331	1.026
27	1.201	70.0	1.301	128.0	1819.4	396.80	0.328	1.016
28	1.271	72.0	1.350	136.0	1955.4	421.60	0.320	0.992
29	1.343	74.0	1.400	141.5	2096.9	438.65	0.319	0.989
30	1.417	75.0	1.432	147.0	2243.9	455.70	0.314	0.974
31	1.492	75.0	1.447	149.5	2393.4	463.45	0.312	0.968
32	1.567	75.0	1.462	152.0	2545.4	471.20	0.310	0.962
33	1.642	76.0	1.494	156.0	2701.4	483.60	0.309	0.958
34	1.718	75.0	1.490	158.0	2859.4	489.80	0.304	0.943
35	1.793	75.0	1.504	162.0	3021.4	510.30	0.295	0.928
36	1.868	75.0	1.517	166.8	3188.2	525.26	0.289	0.910
37	1.943	75.0	1.531	169.0	3357.2	532.35	0.288	0.906
38	2.018	74.0	1.525	171.5	3528.7	540.23	0.282	0.889
39	2.092	74.0	1.537	175.3	3703.9	552.04	0.278	0.877
40	2.166	73.0	1.530	176.5	3880.4	555.98	0.275	0.867
41	2.239	72.0	1.522	178.0	4058.4	560.70	0.271	0.855
42	2.311	72.0	1.533	180.5	4238.9	568.58	0.270	0.849
43	2.383	71.0	1.524	181.0	4419.9	579.20	0.263	0.842
44	2.454	70.0	1.515	182.0	4601.9	582.40	0.260	0.832
45	2.524	68.0	1.485	183.0	4784.9	585.60	0.254	0.811
46	2.592	67.0	1.474	184.0	4968.9	588.80	0.250	0.801
47	2.659	66.0	1.463	185.0	5153.9	592.00	0.247	0.791
48	2.725	63.0	1.411	185.0	5338.9	592.00	0.238	0.763
49	2.788	61.0	1.378	185.5	5524.4	593.60	0.232	0.743
50	2.849	61.0	1.385	188.0	5712.4	601.60	0.230	0.737
51	2.910	60.0	1.372	188.0	5900.4	601.60	0.228	0.730
52	2.970	58.0	1.338	188.0	6088.4	601.60	0.222	0.712
53	3.028	55.0	1.283	188.0	6276.4	601.60	0.213	0.682
54	3.083	53.0	1.247	188.0	6464.4	601.60	0.207	0.663
55	3.136	50.0	1.191	188.0	6652.4	601.60	0.198	0.633
56	3.186	48.0	1.154	188.0	6840.4	601.60	0.192	0.614

[1] Diets containing 2950; 3000; 3100; 3150 and 3200 kcal ME/kg for the phases of 1-7; 8-21; 22-34; 35-42; 43-56 days of age.

Table 2.08 - Digestible Lysine Requirement of Broiler Females with High Performance Using the Equation on Table 2.04

Age days	Weight kg	Gain g/day	Dig. Lys Req. g/day	Intake g/day	Cumulative Intake g	ME Intake kcal/day[1]	Lys/ME Ratio%/Mcal	Lys. Dig Diet %
1	0.056	16.0	0.241	16.7	16.7	49.3	0.489	1.448
2	0.072	18.0	0.273	19.2	35.9	56.8	0.481	1.422
3	0.090	20.0	0.305	22.2	58.1	65.8	0.464	1.373
4	0.110	23.0	0.352	26.3	84.3	77.7	0.453	1.341
5	0.133	27.0	0.415	31.3	115.6	92.7	0.448	1.325
6	0.160	29.0	0.449	34.3	150.0	101.6	0.442	1.307
7	0.189	34.0	0.528	40.9	190.9	121.1	0.436	1.292
8	0.223	37.0	0.577	45.5	236.3	138.6	0.416	1.269
9	0.260	37.7	0.593	47.1	283.4	143.6	0.413	1.260
10	0.298	39.3	0.624	49.8	333.2	151.9	0.411	1.253
11	0.337	41.7	0.669	53.5	386.7	163.3	0.410	1.249
12	0.379	44.7	0.723	58.6	445.3	178.7	0.404	1.233
13	0.423	51.9	0.843	68.7	514.0	209.5	0.402	1.227
14	0.475	53.0	0.870	71.7	585.7	218.7	0.398	1.213
15	0.528	56.3	0.933	77.0	662.7	234.9	0.397	1.212
16	0.585	58.7	0.982	82.0	744.7	250.1	0.392	1.197
17	0.643	59.0	0.999	84.0	828.7	256.2	0.390	1.189
18	0.702	61.7	1.054	90.0	918.7	274.5	0.384	1.172
19	0.764	64.0	1.105	95.0	1013.7	289.8	0.382	1.164
20	0.828	66.0	1.152	99.5	1113.2	303.5	0.380	1.158
21	0.894	67.7	1.194	104.0	1217.2	317.2	0.376	1.148
22	0.962	69.7	1.242	110.0	1327.2	346.5	0.358	1.129
23	1.031	71.3	1.285	115.0	1442.2	362.3	0.355	1.117
24	1.103	72.7	1.323	120.0	1562.2	378.0	0.350	1.102
25	1.175	74.0	1.361	125.0	1687.2	393.8	0.346	1.089
26	1.249	75.3	1.400	130.0	1817.2	409.4	0.342	1.077
27	1.325	76.0	1.428	135.0	1952.2	425.3	0.336	1.057
28	1.401	77.0	1.461	137.6	2089.8	433.5	0.337	1.062
29	1.478	77.3	1.483	141.6	2231.4	446.0	0.332	1.047
30	1.555	77.7	1.504	145.5	2376.9	458.5	0.328	1.034
31	1.633	78.0	1.526	149.5	2526.4	470.9	0.324	1.020
32	1.711	78.7	1.553	154.5	2680.9	486.5	0.319	1.005
33	1.789	78.7	1.568	157.4	2838.3	495.9	0.316	0.996
34	1.868	77.7	1.564	160.4	2998.7	505.2	0.310	0.975
35	1.946	77.7	1.578	162.6	3161.3	520.2	0.303	0.971
36	2.023	77.0	1.579	163.9	3325.1	524.4	0.301	0.963
37	2.100	77.0	1.592	166.8	3492.0	533.8	0.298	0.955
38	2.177	76.3	1.592	169.7	3661.7	543.2	0.293	0.938
39	2.254	75.3	1.585	172.7	3834.4	552.5	0.287	0.918
40	2.329	74.0	1.571	173.6	4008.0	555.7	0.283	0.905
41	2.403	73.0	1.563	174.6	4182.6	558.8	0.280	0.895
42	2.476	72.0	1.554	175.6	4358.2	561.9	0.277	0.885
43	2.548	71.0	1.545	175.7	4533.9	571.1	0.270	0.879
44	2.619	70.0	1.535	176.7	4710.6	574.3	0.267	0.868
45	2.689	69.0	1.524	177.7	4888.3	577.4	0.264	0.858
46	2.758	68.0	1.513	179.6	5067.9	583.7	0.259	0.842
47	2.826	67.0	1.501	180.6	5248.5	586.9	0.256	0.831
48	2.893	65.0	1.469	181.6	5430.1	590.0	0.249	0.809
49	2.958	64.0	1.456	182.5	5612.6	593.2	0.245	0.798
50	3.022	63.0	1.443	184.5	5797.1	599.5	0.241	0.782
51	3.085	62.0	1.429	185.4	5982.5	602.7	0.237	0.771
52	3.147	61.0	1.415	187.4	6169.9	609.0	0.232	0.755
53	3.208	59.0	1.380	187.4	6357.2	609.0	0.227	0.736
54	3.267	57.0	1.344	187.4	6544.6	609.0	0.221	0.718
55	3.324	55.0	1.308	188.3	6733.0	612.1	0.214	0.695
56	3.379	53.0	1.272	189.3	6922.3	615.3	0.207	0.672

[1] Diets containing 2950; 3000; 3100; 3150 and 3200 kcal ME/kg for the phases of 1-7; 8-21; 22-34; 35-42; 43-56 days of age.

Table 2.09 - Equations Used to Estimate Available Phosphorus (Pav) and Digestible Phosphorus (Pdig) Requirements and Calcium:Phosphorus Ratio for Male and Female Broilers[1]

Req.(g/day) = (P for Maintenance) + (P for Weight Gain)

AVAILABLE PHOSPHORUS REQUIREMENT

Equation 8 – 21 days: Y (g Pav/day) = 0.026 x $W^{0.75}$ + 5.2 x G
W = Av. Weight (kg); 5.2 = g Pav. / kg Gain; G = Daily Gain (kg)

Equation 22 – 56 days: Y (g Pav/day) = 0.026 x $W^{0.75}$ + 5.5 x G
W = Av. Weight (kg); 5.5 = g Pav. / kg Gain; G = Daily Gain (kg)

Recommended Total Ca:Available P Ratio: 2.13

E.g.: 14-d-old male broilers
Av. Weight: 0.450 kg; G: 0.0524 kg / day; Intake : 72.32 g / day

Y (g Pav/day) : 0.026 x $(0.450)^{0.75}$ + 5.2 x 0.0524 = 0.287 g.
% Pav : (0.287 x 100) / 72.32 = 0.396 %
% Ca in the Diet : 0.396 x 2.13 = 0.843 %

TRUE DIGESTIBLE PHOSPHORUS REQUIREMENT

Equation 8 – 21 days: Y (g Pdig/day) = 0.026 $W^{0.75}$ + 4.53 x G
W = Av. Weight; 4.53 = g Pdig. / kg gain; G = Daily Gain

Equation 22 – 56 days: Y (g Pdig/day) = 0.026 $P^{0.75}$ + 5.0 x F
W = Av. weight; 5.0 = g Pdig. / kg gain; G = Daily Gain

Recommended Total Ca:Digestible P Ratio: 2.35

1. Daily phosphorus requirements for maintenance and gain were estimated from the values of Bünzen 2009 (PhD Thesis, UFV), Klis and Versteegh (1999), and performance data obtained in theses at UFV.

Table 2.10 - Nutritional requirements of available phosphorus, true digestible phosphorus of standard and high performance males and females broilers using the equations on Table 2.09

Age days	Weight kg	Gain g/day	Intake g/day	Pav g/day	Pav %	Pdig g/day	Pdig. %	Calcium[1], %
Standard Performance Males								
1 – 7	0.112	21.15	24.83	--	0.470	--	0.395	0.920
8	0.207	31.3	40.0	0.171	0.427	0.150	0.374	0.894
14	0.450	52.4	72.3	0.287	0.396	0.252	0.348	0.831
21	0.886	74.7	115.2	0.412	0.358	0.362	0.314	0.750
28	1.464	91.3	158.6	0.537	0.338	0.491	0.310	0.724
35	2.131	98.8	192.3	0.589	0.306	0.540	0.281	0.656
42	2.833	97.0	209.0	0.590	0.282	0.542	0.259	0.605
49	3.470	84.8	210.8	0.533	0.253	0.490	0.233	0.543
56	4.043	77.0	209.3	0.498	0.238	0.459	0.219	0.515
High Performance Males								
1 - 7	0.120	21.8	25.25	--	0.470	--	0.395	0.920
8	0.218	35.7	44.6	0.194	0.435	0.170	0.382	0.910
14	0.502	62.2	83.3	0.339	0.407	0.297	0.357	0.853
21	1.000	82.0	123.3	0.452	0.367	0.397	0.322	0.770
28	1.621	96.1	162.4	0.566	0.348	0.518	0.319	0.745
35	2.320	104.5	195.1	0.624	0.320	0.571	0.293	0.685
42	3.036	100.5	208.0	0.612	0.294	0.562	0.270	0.630
49	3.704	87.7	210.8	0.552	0.262	0.508	0.241	0.562
56	4.282	76.0	208.2	0.495	0.238	0.457	0.220	0.530
Standard Performance Females								
1 - 7	0.111	22.3	25.8	--	0.470	--	0.395	0.920
8	0.210	35.0	43.9	0.190	0.433	0.167	0.379	0.900
14	0.439	46.0	64.6	0.253	0.392	0.222	0.344	0.822
21	0.814	60.0	95.0	0.334	0.352	0.294	0.310	0.740
28	1.271	72.0	136.0	0.427	0.314	0.391	0.288	0.673
35	1.793	75.0	162.0	0.453	0.279	0.415	0.256	0.600
42	2.311	72.0	180.5	0.445	0.246	0.409	0.226	0.530
49	2.788	61.0	185.5	0.392	0.211	0.361	0.195	0.500
56	3.186	48.0	188.0	0.326	0.173	0.302	0.161	0.490
High Performance Females								
1 - 7	0.116	23.9	27.3	--	0.470	--	0.395	0.920
8	0.223	37.0	45.5	0.201	0.442	0.176	0.387	0.910
14	0.475	53.0	71.7	0.290	0.405	0.255	0.356	0.850
21	0.894	67.7	104.0	0.376	0.361	0.330	0.318	0.758
28	1.401	77.0	137.6	0.457	0.332	0.418	0.304	0.711
35	1.946	77.7	162.6	0.470	0.289	0.431	0.265	0.619
42	2.476	72.0	175.6	0.447	0.255	0.411	0.234	0.550
49	2.958	64.0	182.5	0.411	0.225	0.379	0.207	0.520
56	3.379	53.0	189.3	0.356	0.188	0.330	0.174	0.500

[1] Mean %Ca calculated multiplying avail P% by the factor 2.13 and dig P% by the factor 2.35.

Table 2.11 - Amino Acid / Lysine Ratios Used to Estimate Amino Acid Requirements of Broilers

Amino Acid		Phases			
		PreStarter – Starter		Grower – Finisher	
		1 – 21 days		22 – 56 days	
		Dig.	Total	Dig.	Total
Lysine	%	100	100	100	100
Methionine	%	39	38	40	39
Methionine + Cystine	%	72	72	73	73
Threonine	%	65	68	65	68
Tryptophan	%	17	17	18	18
Arginine	%	108	105	108	105
Glycine + Serine	%	147	150	134	137
Valine	%	77	79	78	80
Isoleucine	%	67	67	68	68
Leucine	%	107	107	108	108
Histidine	%	37	37	37	37
Phenylalanine	%	63	63	63	63
Phen + Tyr	%	115	115	115	115

Table 2.12 - Nutritional Requirements of Broiler Males with Below Average Performance[1]

		Age, days				
		1-7	8-21	22-33	34-42	43-46
Weight Range	kg	0.04-0.18	0.21-0.79	0.85-1.68	1.77-2.46	2.55-2.80
Average Weight	kg.	0.100	0.463	1.330	2,198	2.675
Gain	g/day	19.6	45.8	77.6	87.0	85.7
Intake	g/day	23.0	65.8	137.0	181.0	202.0
Avail. P Requirement	g/day	0.108	0.253	0.459	0.525	0.525
Dig.P Requirement	g/day	0.091	0.222	0.421	0.481	0.483
Dig. Lys Requirement	g/day	0.300	0.751	1.432	1.754	1.800
Metabolizable Energy	kcal/kg	2925	2980	3050	3100	3150
				Nutrient		
Protein	%	22.00	20.00	19.00	17.80	17.00
Calcium	%	0.920	0.860	0.750	0.650	0.582
Available Phosphorus	%	0.470	0.384	0.335	0.290	0.260
Digestible Phosphorus	%	0.395	0.337	0.307	0.266	0.239
Potassium	%	0.590	0.585	0.580	0.580	0.580
Sodium	%	0.220	0.210	0.200	0.195	0.190
Chlorine	%	0.200	0.190	0.180	0.170	0.165
Linoleic acid	%	1.090	1.060	1.040	1.020	1.000
				Digestible Amino Acids		
Lysine	%	1.304	1.141	1.045	0.969	0.891
Methionine	%	0.509	0.445	0.418	0.388	0.356
Methionine + Cystine	%	0.939	0.822	0.763	0.707	0.650
Threonine	%	0.848	0.742	0.679	0.630	0.579
Tryptophan	%	0.222	0.194	0.188	0.174	0.160
Arginine	%	1.409	1.233	1.129	1.047	0.962
Glycine + Serine	%	1.917	1.678	1.401	1.299	1.194
Valine	%	1.004	0.879	0.815	0.756	0.695
Isoleucine	%	0.874	0.765	0.711	0.659	0.606
Leucine	%	1.396	1.221	1.129	1.047	0.962
Histidine	%	0.483	0.422	0.387	0.359	0.330
Phenylalanine	%	0.822	0.719	0.659	0.611	0.561
Phen + Tyr	%	1.500	1.313	1.202	1.114	1.025
				Total Amino Acids		
Lysine	%	1.437	1.258	1.152	1.068	0.982
Methionine	%	0.546	0.478	0.438	0.406	0.373
Methionine + Cystine	%	1.035	0.906	0.841	0.780	0.717
Threonine	%	0.977	0.855	0.783	0.726	0.668
Tryptophan	%	0.244	0.214	0.207	0.192	0.177
Arginine	%	1.509	1.321	1.210	1.121	1.031
Glycine + Serine	%	2.156	1.887	1.578	1.463	1.345
Valine	%	1.135	0.994	0.922	0.854	0.786
Isoleucine	%	0.963	0.843	0.783	0.726	0.668
Leucine	%	1.538	1.347	1.244	1.153	1.061
Histidine	%	0.532	0.465	0.426	0.395	0.363
Phenylalanine	%	0.905	0.793	0.726	0.673	0.619
Phen + Tyr	%	1.653	1.447	1.325	1.228	1.129

[1] Nutrient percentage was determined using Tables 2.02 (dig. Lys requirement.), 2.11 (amino acid / lysine ratio) and 2.09 (phosphorus requirement). Total lysine requirement was calculated considering an average lysine true digestibility of 90.7%.

Table 2.13 - Nutritional Requirements of Broiler Males with Standard Performance[1]

		Age, days				
		1-7	8-21	22-33	34-42	43-46
Weight Range	kg	0.04-0.18	0.21-0.89	0.96-1.94	2.03-2.83	2.93-3.21
Average Weight	kg	0.104	0.503	1.430	2.431	3.069
Gain	g/day	21.1	53.9	89.3	99.7	91.4
Intake	g/day	24.8	75.7	153.6	201.3	209.6
Avail. P Requirement	g/day	0.115	0.296	0.525	0.599	0.563
Dig.P Requirement	g/day	0.101	0.260	0.480	0.549	0.517
Dig. Lys Requirement	g/day	0.325	0.889	1.656	2.030	1.961
Metabolizable energy	kcal/kg	2950	3000	3100	3150	3200
				Nutrients		
Protein	%	22.20	20.80	19.50	18.00	17.30
Calcium	%	0.920	0.819	0.732	0.638	0.576
Avail. P Requirement	%	0.470	0.391	0.342	0.298	0.260
Dig.P Requirement	%	0.395	0.343	0.313	0.273	0.247
Potassium	%	0.590	0.585	0.580	0.580	0.580
Sodium	%	0.220	0.210	0.200	0.195	0.190
Chlorine	%	0.200	0.190	0.180	0.170	0.165
Linoleic acid	%	1.090	1.060	1.040	1.020	1.000
				Digestible Amino Acids		
Lysine	%	1.310	1.174	1.078	1.010	0.936
Methionine	%	0.511	0.458	0.431	0.404	0.374
Methionine + Cystine	%	0.944	0.846	0.787	0.737	0.683
Threonine	%	0.852	0.763	0.701	0.656	0.608
Tryptophan	%	0.223	0.200	0.194	0.182	0.168
Arginine	%	1.415	1.268	1.164	1.091	1.011
Glycine + Serine	%	1.926	1.726	1.445	1.353	1.254
Valine	%	1.009	0.904	0.841	0.788	0.730
Isoleucine	%	0.878	0.787	0.733	0.687	0.636
Leucine	%	1.402	1.257	1.164	1.091	1.011
Histidine	%	0.485	0.435	0.399	0.374	0.346
Phenylalanine	%	0.826	0.740	0.679	0.636	0.590
Phen + Tyr	%	1.507	1.351	1.240	1.161	1.076
				Total Amino Acids		
Lysine	%	1.444	1.294	1.189	1.114	1.032
Methionine	%	0.549	0.492	0.464	0.434	0.402
Methionine + Cystine	%	1.040	0.932	0.868	0.813	0.753
Threonine	%	0.982	0.880	0.809	0.758	0.702
Tryptophan	%	0.245	0.220	0.214	0.201	0.186
Arginine	%	1.516	1.359	1.248	1.170	1.084
Glycine + Serine	%	2.166	1.941	1.629	1.526	1.414
Valine	%	1.141	1.022	0.951	0.891	0.826
Isoleucine	%	0.967	0.867	0.809	0.758	0.702
Leucine	%	1.545	1.385	1.284	1.203	1.115
Histidine	%	0.534	0.479	0.440	0.412	0.382
Phenylalanine	%	0.910	0.815	0.749	0.702	0.650
Phen + Tyr	%	1.661	1.488	1.367	1.281	1.187

[1] Nutrient percentage was determined using Tables 2.02 (dig. Lys requirement.), 2.11 (amino acid / lysine ratio) and 2.09 (phosphorus requirement). Total lysine requirement was calculated considering an average lysine true digestibility of 90.7%.

Table 2.14 - Nutritional Requirements of Broiler Males with High Performance[1]

		Age, days				
		1-7	8-21	22-33	34-42	43-46
Weight Range	kg	0.04-0.19	0.22-1.00	1.08-2.12	2.22-3.04	3.14-3.43
Average Weight	kg.	0.111	0.563	1.583	2.628	3.285
Gain	g/day	21.8	61.7	94.5	102.2	97.1
Intake	g/day	25.3	84.2	157.3	199.1	208.8
Avail. P Requirement	g/day	0.115	0.338	0.556	0.616	0.597
Dig.P Requirement	g/day	0.104	0.296	0.509	0.565	0.549
Dig. Lys Requirement	g/day	0.335	1.025	1.779	2.110	2.100
Metabolizable energy	kcal/kg	2960	3050	3150	3200	3250
				Nutrients		
Protein	%	22.40	21.20	19.80	18.40	17.60
Calcium	%	0.920	0.841	0.758	0.663	0.614
Available Phosphorus	%	0.470	0.401	0.354	0.309	0.286
Digestible Phosphorus	%	0.395	0.352	0.324	0.284	0.263
Potassium	%	0.590	0.585	0.580	0.580	0.580
Sodium	%	0.220	0.210	0.200	0.195	0.190
Chlorine	%	0.200	0.190	0.180	0.170	0.165
Linoleic acid	%	1.090	1.060	1.040	1.020	1.000
				Digestible Amino Acids		
Lysine	%	1.324	1.217	1.131	1.060	1.006
Methionine	%	0.516	0.475	0.452	0.424	0.402
Methionine + Cystine	%	0.953	0.876	0.826	0.774	0.734
Threonine	%	0.861	0.791	0.735	0.689	0.654
Tryptophan	%	0.225	0.207	0.204	0.191	0.181
Arginine	%	1.430	1.315	1.221	1.145	1.086
Glycine + Serine	%	1.946	1.789	1.515	1.420	1.348
Valine	%	1.020	0.937	0.882	0.827	0.785
Isoleucine	%	0.887	0.816	0.769	0.721	0.684
Leucine	%	1.417	1.303	1.221	1.145	1.086
Histidine	%	0.490	0.450	0.418	0.392	0.372
Phenylalanine	%	0.834	0.767	0.713	0.668	0.634
Phen + Tyr	%	1.523	1.400	1.301	1.219	1.157
				Total Amino Acids		
Lysine	%	1.460	1.342	1.247	1.169	1.109
Methionine	%	0.555	0.510	0.486	0.456	0.433
Methionine + Cystine	%	1.051	0.966	0.910	0.853	0.810
Threonine	%	0.993	0.913	0.848	0.795	0.754
Tryptophan	%	0.248	0.228	0.224	0.210	0.200
Arginine	%	1.533	1.409	1.309	1.227	1.164
Glycine + Serine	%	2.190	2.013	1.708	1.602	1.519
Valine	%	1.153	1.060	0.998	0.935	0.887
Isoleucine	%	0.978	0.899	0.848	0.795	0.754
Leucine	%	1.562	1.436	1.347	1.263	1.198
Histidine	%	0.540	0.497	0.461	0.433	0.410
Phenylalanine	%	0.920	0.845	0.786	0.736	0.699
Pheny + Tyr	%	1.679	1.543	1.434	1.344	1.275

[1] Nutrient percentage was determined using Tables 2.02 (dig. Lys requirement.), 2.11 (amino acid / lysine ratio) and 2.09 (phosphorus requirement). Total lysine requirement was calculated considering an average lysine true digestibility of 90.7%.

Table 2.15 - Nutritional Requirements of Broiler Females with Below Average Performance[1]

		Age, days				
		1-7	8-21	22-33	34-42	43-46
Weight Range	kg	0.04-0.18	0.21-0.74	0.79-1.48	1.54-2.07	2.13-2.32
Average Weight	kg.	0.100	0.442	1.189	1.874	2.228
Gain	g/day	18.9	41.7	63.3	65.3	63.0
Intake	g/day	22.5	61.1	121	156	171
Avail. P Requirement	g/day	0.106	0.231	0.378	0.401	0.394
Dig.P Requirement	g/day	0.089	0.203	0.346	0.368	0.362
Dig. Lys Requirement	g/day	0.290	0.690	1.182	1.337	1.346
Metabolizable energy	kcal/kg	2925	2980	3050	3100	3150
				Nutrients		
Protein	%	21.60	20.00	18.80	17.30	16.80
Calcium	%	0.920	0.793	0.688	0.551	0.494
Available Phosphorus	%	0.470	0.378	0.312	0.257	0.230
Digestible Phosphorus	%	0.395	0.332	0.286	0.236	0.212
Potassium	%	0.590	0.560	0.555	0.550	0.540
Sodium	%	0.220	0.200	0.195	0.185	0.180
Chlorine	%	0.200	0.185	0.172	0.162	0.155
Linoleic acid	%	1.090	1.060	1.040	1.020	1.000
				Digestible Amino Acids		
Lysine	%	1.290	1.129	0.977	0.857	0.787
Methionine	%	0.503	0.440	0.391	0.343	0.315
Methionine + Cystine	%	0.929	0.813	0.713	0.626	0.575
Threonine	%	0.838	0.734	0.635	0.557	0.512
Tryptophan	%	0.219	0.192	0.176	0.154	0.142
Arginine	%	1.393	1.219	1.055	0.926	0.850
Glycine + Serine	%	1.896	1.660	1.309	1.148	1.055
Valine	%	0.993	0.869	0.762	0.668	0.614
Isoleucine	%	0.864	0.756	0.664	0.583	0.535
Leucine	%	1.380	1.208	1.055	0.926	0.850
Histidine	%	0.477	0.418	0.361	0.317	0.291
Phenylalanine	%	0.813	0.711	0.616	0.540	0.496
Phen + Tyr	%	1.484	1.298	1.124	0.986	0.905
				Total Amino Acids		
Lysine	%	1.422	1.245	1.077	0.945	0.868
Methionine	%	0.540	0.473	0.420	0.369	0.339
Methionine + Cystine	%	1.024	0.896	0.786	0.690	0.634
Threonine	%	0.967	0.847	0.732	0.643	0.590
Tryptophan	%	0.242	0.212	0.194	0.170	0.156
Arginine	%	1.493	1.307	1.131	0.992	0.911
Glycine + Serine	%	2.133	1.868	1.475	1.295	1.189
Valine	%	1.123	0.984	0.862	0.756	0.694
Isoleucine	%	0.953	0.834	0.732	0.643	0.590
Leucine	%	1.522	1.332	1.163	1.021	0.937
Histidine	%	0.526	0.461	0.398	0.350	0.321
Phenylalanine	%	0.896	0.784	0.679	0.595	0.547
Phen + Tyr	%	1.635	1.432	1.239	1.087	0.998

[1] Nutrient percentage was determined using Tables 2.04 (dig. Lys requirement.), 2.11 (amino acid / lysine ratio) and 2.09 (phosphorus requirement). Total lysine requirement was calculated considering an average lysine true digestibility of 90.7%.

Table 2.16 - Nutritional Requirements of Broiler Females with Standard Performance[1]

		Age, days				
		1-7	8-21	22-33	34-42	43-46
Weight Range	Kg	0.04-0.18	0.21-0.81	0.87-1.64	1.72-2.31	2.38-2.59
Average Weight	Kg	0.102	0.482	1.245	2.016	2.488
Gain	g/day	21.1	47.4	70.3	73.9	69.0
Intake	g/day	25.8	67.8	131.0	170.8	182.5
Avail. P Requirement	g/day	0.121	0.262	0.417	0.450	0.431
Dig.P Requirement	g/day	0.106	0.230	0.382	0.413	0.397
Dig. Lys Requirement	g/day	0.342	0.790	1.316	1.521	1.499
Metabolizable energy	kcal/kg	2950	3000	3100	3150	3200
				Nutrients		
Protein	%	21.80	20.40	19.00	17.50	17.00
Calcium	%	0.920	0.809	0.683	0.566	0.506
Available Phosphorus	%	0.470	0.386	0.319	0.264	0.236
Digestible Phosphorus	%	0.395	0.339	0.292	0.242	0.217
Potassium	%	0.590	0.560	0.555	0.550	0.540
Sodium	%	0.220	0.200	0.195	0.185	0.180
Chlorine	%	0.200	0.185	0.172	0.162	0.155
Linoleic acid	%	1.090	1.060	1.040	1.020	1.000
				Digestible Amino Acids		
Lysine	%	1.326	1.165	1.005	0.892	0.822
Methionine	%	0.517	0.454	0.402	0.357	0.329
Methionine + Cystine	%	0.954	0.839	0.733	0.651	0.600
Threonine	%	0.862	0.757	0.653	0.580	0.534
Tryptophan	%	0.225	0.198	0.181	0.161	0.148
Arginine	%	1.432	1.258	1.085	0.963	0.888
Glycine + Serine	%	1.949	1.713	1.346	1.195	1.101
Valine	%	1.021	0.897	0.784	0.696	0.641
Isoleucine	%	0.888	0.781	0.683	0.607	0.559
Leucine	%	1.418	1.247	1.085	0.963	0.888
Histidine	%	0.490	0.431	0.372	0.330	0.304
Phenylalanine	%	0.835	0.734	0.633	0.562	0.518
Phen + Tyr	%	1.524	1.340	1.155	1.026	0.945
				Total Amino Acids		
Lysine	%	1.462	1.284	1.108	0.983	0.906
Methionine	%	0.556	0.488	0.432	0.383	0.353
Methionine + Cystine	%	1.053	0.924	0.809	0.718	0.661
Threonine	%	0.994	0.873	0.753	0.668	0.616
Tryptophan	%	0.249	0.218	0.199	0.177	0.163
Arginine	%	1.535	1.348	1.163	1.032	0.951
Glycine + Serine	%	2.193	1.926	1.518	1.347	1.241
Valine	%	1.155	1.014	0.886	0.786	0.725
Isoleucine	%	0.980	0.860	0.753	0.668	0.616
Leucine	%	1.564	1.374	1.197	1.062	0.978
Histidine	%	0.541	0.475	0.410	0.364	0.335
Phenylalanine	%	0.921	0.809	0.698	0.619	0.571
Phen + Tyr	%	1.681	1.477	1.274	1.130	1.042

[1] Nutrient percentage was determined using Tables 2.04 (dig. Lys requirement.), 2.11 (amino acid / lysine ratio) and 2.09 (phosphorus requirement). Total lysine requirement was calculated considering an average lysine true digestibility of 90.7%.

Table 2.17 - Nutritional Requirements of Broiler Females with High Performance[1]

		Age, days				
		1-7	8-21	22-33	35-42	43-56
Weight Range	Kg	0.04-0.19	0.22-0.89	0.96-1.79	1.87-2.48	2.55-2.76
Average Weight	Kg	0.107	0.524	1.368	2.175	2.654
Gain	g/day	22.6	52.8	75.5	75.6	69.5
Intake	g/day	27.3	73.3	135.1	168.9	177.4
Avail. P Requirement	g/day	0.129	0.291	0.448	0.462	0.436
Dig.P Requirement	g/day	0.113	0.255	0.410	0.425	0.402
Dig. Lys Requirement	g/day	0.366	0.880	1.428	1.576	1.529
Metabolizable energy	kcal/kg	2960	3050	3150	3200	3250
				Nutrients		
Protein	%	22.00	20.80	19.20	17.80	17.10
Calcium	%	0.920	0.831	0.711	0.587	0.528
Available Phosphorus	%	0.470	0.396	0.332	0.274	0.246
Digestible Phosphorus	%	0.395	0.348	0.304	0.251	0.226
Potassium	%	0.590	0.560	0.555	0.550	0.540
Sodium	%	0.220	0.200	0.195	0.185	0.180
Chlorine	%	0.200	0.185	0.172	0.162	0.155
Linoleic acid	%	1.090	1.060	1.040	1.020	1.000
				Digestible Amino Acids		
Lysine	%	1.341	1.201	1.057	0.933	0.862
Methionine	%	0.523	0.468	0.423	0.373	0.345
Methionine + Cystine	%	0.965	0.864	0.772	0.681	0.629
Threonine	%	0.871	0.780	0.687	0.607	0.560
Tryptophan	%	0.228	0.204	0.190	0.168	0.155
Arginine	%	1.448	1.297	1.142	1.008	0.931
Glycine + Serine	%	1.971	1.765	1.416	1.250	1.155
Valine	%	1.032	0.924	0.824	0.728	0.672
Isoleucine	%	0.898	0.804	0.719	0.635	0.586
Leucine	%	1.435	1.285	1.142	1.008	0.931
Histidine	%	0.496	0.444	0.391	0.345	0.319
Phenylalanine	%	0.845	0.756	0.666	0.588	0.543
Phen + Tyr	%	1.542	1.381	1.216	1.073	0.991
				Total Amino Acids		
Lysine	%	1.478	1.324	1.165	1.029	0.950
Methionine	%	0.562	0.503	0.454	0.401	0.371
Methionine + Cystine	%	1.064	0.953	0.850	0.751	0.694
Threonine	%	1.005	0.900	0.792	0.700	0.646
Tryptophan	%	0.251	0.225	0.210	0.185	0.171
Arginine	%	1.552	1.390	1.223	1.080	0.998
Glycine + Serine	%	2.217	1.986	1.596	1.410	1.302
Valine	%	1.168	1.046	0.932	0.823	0.760
Isoleucine	%	0.990	0.887	0.792	0.700	0.646
Leucine	%	1.581	1.417	1.258	1.111	1.026
Histidine	%	0.547	0.490	0.431	0.381	0.352
Phenylalanine	%	0.931	0.834	0.734	0.648	0.599
Phen + Tyr	%	1.700	1.523	1.340	1.183	1.093

[1] Nutrient percentage was determined using Tables 2.04 (dig. Lys requirement.), 2.11 (amino acid / lysine ratio) and 2.09 (phosphorus requirement). Total lysine requirement was calculated considering an average lysine true digestibility of 90.7%.

Nutritional Requirements of Replacement Pullets and Layers

Table 2.18 - Amino Acid / Lysine Ratios Used to Estimate Amino Acid Requirements of White-Egg and Brown-Egg Replacement Pullets

Phase	Starter		Grower		Developer	
Age (weeks)	1 – 6		7 - 12		13 – 18	
Amino acid	Dig.	Total	Dig.	Total	Dig.	Total
Lysine	100	100	100	100	100	100
Methionine	40	40	44	44	45	45
Methionine + Cystine	73	73	80	80	82	83
Threonine	67	70	68	71	69	72
Tryptophan	18	18	20	20	22	22
Arginine	107	105	108	106	110	107
Glycine + Serine	125	130	115	120	106	110
Valine	76	78	80	81	82	83
Isoleucine	69	70	75	76	77	78
Leucine	112	111	118	117	125	124
Histidine	37	37	38	38	39	39
Phenylalanine	66	66	69	69	72	72
Phen + Tyr	121	120	125	125	130	130

Table 2.19 - Nutritional Requirements of White-Egg Replacement Pullets as a Function of Dietary Energy Level[1]

Phase		Starter		Grower		Developer	
Age (weeks)		1- 6		7 - 12		13 - 18	
ME	kcal/kg	2.900		2.900		2.900	
Crude Protein	%	18.00		16.0		14.0	
Calcium	%	0.940		0.832		0.800	
Available Phosphorus	%	0.437		0.392		0.310	
Digestible Phosphorus	%	0.367		0.334		0.275	
Potassium	%	0.530		0.520		0.500	
Sodium	%	0.180		0.160		0.150	
Chlorine	%	0.160		0.150		0.140	
Linoleic Acid	%	1.027		1.000		0.980	
Amino Acid		Dig.	Total	Dig.	Total	Dig.	Total
Lysine	%	0.876	0.973	0.621	0.690	0.483	0.537
Methionine	%	0.350	0.389	0.273	0.304	0.217	0.242
Methionine + Cystine	%	0.640	0.710	0.497	0.552	0.396	0.446
Threonine	%	0.587	0.681	0.422	0.490	0.333	0.387
Tryptophan	%	0.158	0.175	0.124	0.138	0.106	0.118
Arginine	%	0.937	1.022	0.671	0.731	0.531	0.575
Glycine + Serine	%	0.675	1.265	0.478	0.828	0.372	0.591
Valine	%	0.666	0.759	0.497	0.559	0.396	0.446
Isoleucine	%	0.604	0.681	0.466	0.524	0.372	0.419
Leucine	%	0.981	1.080	0.733	0.807	0.604	0.666
Histidine	%	0.324	0.360	0.236	0.262	0.188	0.209
Phenylalanine	%	0.578	0.642	0.429	0.476	0.348	0.387
Phen + Tyr	%	1.060	1.168	0.776	0.863	0.628	0.698

[1] Amino acid percentage was determined using the recommended dig. Lys level and the amino acid / lysine ratio on Table 2.18. Total lysine requirement was calculated considering an average lysine true digestibility of 90%.

Table 2.20 - Nutritional Requirements of Brown-Egg Replacement Pullets as a Function of Dietary Energy Level[1]

Phase		Starter		Grower		Developer	
Age (weeks)		1 - 6		7 - 12		13 - 18	
ME	Kcal/Kg	2.900		2.900		2.900	
Crude Protein	%	18.00		16.00		14.00	
Calcium	%	0.940		0.815		0.780	
Available Phosphorus	%	0.430		0.380		0.305	
Digestible Phosphorus	%	0.365		0.325		0.275	
Potassium	%	0.530		0.520		0.500	
Sodium	%	0.180		0.160		0.150	
Chlorine	%	0.160		0.150		0.140	
Linoleic Acid	%	1.044		1.030		1.018	
Amino Acid		Dig.	Total	Dig.	Total	Dig.	Total
Lysine	%	0.847	0.943	0.611	0.679	0.467	0.519
Methionine	%	0.339	0.377	0.269	0.299	0.210	0.234
Methionine + Cystine	%	0.619	0.688	0.489	0.543	0.383	0.431
Threonine	%	0.568	0.660	0.416	0.482	0.322	0.374
Tryptophan	%	0.153	0.170	0.122	0.136	0.103	0.114
Arginine	%	0.907	0.990	0.660	0.720	0.514	0.555
Glycine + Serine	%	0.652	1.226	0.470	0.815	0.360	0.571
Valine	%	0.645	0.736	0.489	0.550	0.383	0.431
Isoleucine	%	0.585	0.660	0.458	0.516	0.360	0.405
Leucine	%	0.950	1.047	0.721	0.794	0.584	0.644
Histidine	%	0.314	0.349	0.232	0.258	0.182	0.202
Phenylalanine	%	0.560	0.622	0.422	0.469	0.336	0.374
Phen + Tyr	%	1.026	1.132	0.764	0.849	0.607	0.675

[1] Amino acid percentage was determined using the recommended dig. Lys level and the amino acid / lysine ratio on Table 2.18. Total lysine requirement was calculated considering an average lysine true digestibility of 90%.

Table 2.21 - Equation Used to Estimate True Digestible Lysine Requirement of White-Egg and Brown-Egg Layers in g/bird/day and in %[1]

Dig. Lys $_{(g/\ bird/\ day)}$ = 0.07 $W^{0.75}$ + 0.020 G + 0.0124 Egg

W = Body Weight in kg;
G = Weight gain/ bird/ day in g
Egg = Egg mass, g egg/ bird/ day = $\frac{\%\ lay}{100}$ x Egg Weight

Example:
W = 1.601 kg, with: $P^{0.75}$ = 1.423
G = 0.3 g/ bird/ day
Egg = 55.5 g/ bird/ day

Dig. Lys Req. = 0.07 x 1.423 + 0.020 x 0.3 + 0.0124 x 55.5 = 0.794 g/day
Estimated Feed Intake = 104.9 g/day
Lysine dig. in the Diet = $\frac{0.794}{104.9}$ x 100 = 0.757%

[1] Daily digestible lysine requirement for maintenance = 0.07 x (Av. weight)$^{0.75}$. Estimated according to the values obtained by Fisher, 1998 (Poultry Sci. 77:124), Edwards et. al., 1999 (Poultry Sci. 78:1412) and Siqueira, 2009 (PhD thesis – UNESP, Jaboticabal, SP). Digestible lysine requirement for weight gain was estimated as 0.020 g/g daily gain, considering results of broiler trials. The value 0.0124 g. dig. lysine/g egg mass was determined using the results of dose-response trials carried out at UFV, being 7 with white-egg layers, 6 with brown-egg layers and 2 with broiler breeders hens.

Table 2.22 - Equation Used to Estimate Metabolizable Energy (ME) Requirement of White-Egg and Brown-Egg Layers in kcal/bird/day[1]

$ME_{(kcal/\ bird/\ day)} = 115.5\ W^{0.75} + 7.62\ G + 2.4\ Egg + 3\ W^{0.75}\ (21 - T)$

W = Body Weight in kg;
G = Weight Gain g /bird/ day
Egg = g egg/ bird/ day = $\frac{\%\ lay}{100}$ x Egg weight
T = Average Temperature in ^{o}C

Example:
W = 1.601 kg, with $W^{0.75}$ = 1.423
G = 0.3 g/ bird/ day
Egg = 55.5 g/ bird/ day
T = 20 ^{o}C

ME Req. = 115.50 x 1.423 + 7.62 x 0.3 + 2.4 x 55.5 + 3 x 1.423 (21 - 20)
ME = 164.36 + 2.286 + 133.2 + 4.269 = 304 kcal/ bird/ day
ME in the Diet = 2900 kcal/ kg
Estimated Feed Intake = 104.9 g/day

[1] The equation that estimates daily ME requirement was based on the values of Sakomura 1989 (PhD Thesis – UFV) and Sakomura and Rostagno (2007) .

Table 2.23 - True Digestible Lysine Requirements (Dig. Lys) of White-Egg Layers as a Function of Productivity

Age (week)	Weight (kg)	Gain (g/day)	Egg Weight (g)	Production (%)	Egg Mass (g/day)	Dig. Lys[1] (g/day)	MEReq[2] (kcal/day)	Intake[3] g/day	Dig. Lys (%)
25	1.520	2.1	54.7	92.4	50.5	0.765	300	103.4	0.740
26	1.535	2.1	55.7	93.0	51.8	0.782	304	104.9	0.746
27	1.550	1.0	56.5	93.4	52.7	0.771	299	103.0	0.748
28	1.557	1.0	57.3	93.8	53.7	0.783	302	104.0	0.753
29	1.564	1.0	57.9	93.2	54.0	0.787	303	104.4	0.754
30	1.571	0.7	58.5	93.1	54.4	0.787	302	104.3	0.755
31	1.576	0.7	58.8	93.0	54.7	0.791	303	104.6	0.756
32	1.581	0.7	59.2	92.9	55.0	0.795	305	105.0	0.757
33	1.586	0.4	59.5	92.8	55.2	0.791	303	104.5	0.757
34	1.589	0.4	59.8	92.2	55.1	0.790	303	104.5	0.756
35	1.592	0.4	60.0	92.1	55.3	0.792	304	104.7	0.757
36	1.594	0.4	60.3	92.0	55.4	0.795	304	104.9	0.758
37	1.597	0.3	60.5	91.4	55.3	0.791	303	104.6	0.756
38	1.599	0.3	60.8	91.3	55.5	0.793	304	104.8	0.757
39	1.601	0.3	60.9	91.2	55.5	0.794	304	104.9	0.757
40	1.603	0.3	61.1	90.6	55.3	0.792	304	104.8	0.756
41	1.606	0.3	61.3	90.4	55.4	0.793	304	104.9	0.756
42	1.608	0.3	61.5	89.8	55.2	0.790	304	104.8	0.754
43	1.610	0.3	61.7	89.6	55.2	0.791	304	104.9	0.754
44	1.612	0.3	61.8	89.0	54.9	0.787	304	104.7	0.752
45	1.614	0.3	61.9	88.8	54.9	0.787	304	104.8	0.752
46	1.616	0.3	61.9	88.7	54.9	0.787	304	106.6	0.738
47	1.618	0.2	62.0	88.0	54.6	0.781	302	106.1	0.736
48	1.620	0.2	62.1	87.3	54.2	0.777	302	105.9	0.734
49	1.621	0.2	62.2	87.1	54.1	0.776	302	105.8	0.733
50	1.622	0.2	62.2	86.9	54.1	0.775	302	105.8	0.732
51	1.624	0.2	62.4	86.2	53.7	0.771	301	105.6	0.730
52	1.625	0.2	62.5	85.5	53.4	0.767	300	105.3	0.728
53	1.627	0.2	62.5	85.3	53.3	0.766	300	105.3	0.727
54	1.628	0.2	62.6	85.1	53.3	0.765	300	105.3	0.727
55	1.629	0.2	62.7	84.4	52.9	0.761	299	105.1	0.724
56	1.631	0.2	62.9	84.2	52.9	0.761	300	105.1	0.724
57	1.632	0.2	62.9	83.5	52.5	0.756	299	104.8	0.722
58	1.634	0.2	63.0	83.3	52.4	0.755	299	104.8	0.721
59	1.635	0.2	63.1	83.0	52.4	0.755	299	104.8	0.720
60	1.636	0.1	63.2	82.3	51.9	0.747	297	104.2	0.717
61	1.637	0.1	63.3	82.0	51.9	0.746	297	104.1	0.717
62	1.638	0.1	63.3	81.3	51.4	0.741	296	103.8	0.714
63	1.638	0.1	63.5	80.5	51.0	0.736	295	103.5	0.712
64	1.639	0.1	63.5	80.2	50.9	0.735	295	103.4	0.711
65	1.640	0.1	63.6	79.4	50.5	0.729	294	103.0	0.708
66	1.641	0.1	63.7	79.1	50.3	0.727	293	104.7	0.694
67	1.641	0.1	63.7	78.3	49.8	0.722	292	104.4	0.691
68	1.642	0.1	63.8	78.0	49.7	0.720	292	104.3	0.691
69	1.643	0.1	64.0	77.6	49.6	0.719	292	104.2	0.690
70	1.643	0.1	64.0	77.3	49.4	0.717	291	104.1	0.689
71	1.644	0.0	64.2	76.4	49.0	0.709	290	103.5	0.686
72	1.644	0.0	64.2	76.1	48.8	0.707	289	103.3	0.685
73	1.644	0.0	64.3	75.7	48.6	0.705	289	103.1	0.683
74	1.644	0.0	64.5	77.4	49.9	0.720	292	104.2	0.691
75	1.644	0.0	64.6	77.0	49.7	0.718	291	104.0	0.690
76	1.644	0.0	64.6	76.1	49.1	0.711	290	103.6	0.686
77	1.644	0.0	64.8	75.7	49.0	0.709	290	103.5	0.686
78	1.644	0.0	64.8	74.8	48.5	0.703	288	103.0	0.682
79	1.644	0.0	64.9	73.9	48.0	0.696	287	102.6	0.679
80	1.644	0.0	65.0	73.0	47.4	0.690	286	102.1	0.675

[1] Determined by the equation on Table 2.21.
[2] Determined by the equation on Table 2.22, for an environmental temperature of 20 °C.
[3] Considering levels of 2900; 2850 and 2800 kcal ME/kg diet for the ages of 18 to 45; 46 to 65 and 66 to 80 weeks, respectively.

Table 2.24 - True Digestible Lysine Requirements (Dig. Lys) of Brown-Egg Layers as a Function of Productivity

Age (week)	Weight (kg)	Gain (g/day)	Egg Weight (g)	Production (%)	Egg Mass (g/day)	Dig Lys[1] (g/day)	ME Req[2] (kcal/day)	Intake[3] (g/day)	Dig. Lys (%)
25	1.795	1.5	57.8	93.0	53.7	0.806	325	111.9	0.720
26	1.806	1.5	58.7	93.5	54.8	0.819	328	112.9	0.725
27	1.816	1.4	59.2	94.0	55.6	0.828	330	113.7	0.728
28	1.826	1.3	59.7	95.0	56.7	0.840	333	114.7	0.733
29	1.836	1.3	60.2	94.2	56.7	0.840	333	114.9	0.731
30	1.845	1.3	60.7	93.6	56.8	0.842	334	115.2	0.731
31	1.855	0.5	61.0	93.5	57.0	0.829	329	113.6	0.730
32	1.858	0.5	61.3	93.2	57.1	0.830	330	113.6	0.730
33	1.862	0.5	61.7	92.8	57.2	0.831	330	113.8	0.730
34	1.865	0.3	61.9	92.2	57.1	0.826	329	113.3	0.729
35	1.868	0.3	62.1	92.1	57.2	0.828	329	113.5	0.729
36	1.870	0.3	62.3	92.0	57.2	0.828	329	113.6	0.729
37	1.872	0.3	62.5	91.3	57.0	0.825	329	113.4	0.728
38	1.875	0.3	62.6	91.2	57.0	0.826	329	113.6	0.728
39	1.877	0.3	62.7	91.1	57.1	0.826	329	113.6	0.728
40	1.879	0.3	62.9	90.9	57.1	0.827	330	113.6	0.727
41	1.881	0.3	63.0	90.3	56.9	0.824	329	113.6	0.726
42	1.883	0.3	63.1	90.1	56.8	0.824	329	113.6	0.725
43	1.886	0.7	63.2	90.0	56.8	0.831	332	114.6	0.725
44	1.890	0.3	63.3	89.8	56.8	0.824	330	113.8	0.724
45	1.893	0.3	63.3	89.7	56.7	0.823	330	113.8	0.724
46	1.895	0.3	63.4	89.0	56.4	0.819	329	115.6	0.709
47	1.898	0.3	63.5	88.8	56.3	0.817	329	115.4	0.708
48	1.900	0.3	63.6	88.6	56.3	0.818	329	115.6	0.708
49	1.902	0.2	63.6	88.4	56.2	0.814	328	115.2	0.707
50	1.903	0.2	63.7	88.1	56.1	0.813	328	115.2	0.706
51	1.905	0.2	63.8	87.4	55.7	0.808	327	114.8	0.704
52	1.906	0.2	63.8	87.1	55.5	0.806	327	114.7	0.702
53	1.908	0.2	63.9	86.9	55.5	0.805	327	114.7	0.702
54	1.909	0.2	63.9	86.1	55.0	0.800	326	114.4	0.699
55	1.910	0.2	64.0	85.9	54.9	0.799	326	114.4	0.699
56	1.912	0.2	64.0	85.6	54.8	0.797	326	114.3	0.698
57	1.913	0.2	64.1	84.9	54.4	0.792	325	114.0	0.695
58	1.915	0.2	64.2	84.6	54.3	0.791	325	113.9	0.694
59	1.916	0.2	64.2	83.9	53.8	0.786	324	113.6	0.692
60	1.917	0.2	64.3	83.6	53.7	0.784	324	113.5	0.691
61	1.919	0.1	64.3	82.8	53.2	0.776	322	112.9	0.688
62	1.920	0.1	64.4	82.5	53.1	0.775	322	112.8	0.687
63	1.920	0.1	64.5	81.7	52.7	0.770	321	112.5	0.684
64	1.921	0.1	64.5	81.4	52.5	0.767	320	112.3	0.683
65	1.922	0.1	64.6	80.7	52.1	0.762	319	112.0	0.681
66	1.922	0.1	64.7	80.3	51.9	0.760	319	113.9	0.667
67	1.923	0.1	64.8	79.4	51.4	0.754	318	113.5	0.664
68	1.924	0.1	64.8	79.0	51.2	0.751	317	113.3	0.663
69	1.924	0.1	64.9	78.1	50.6	0.744	316	112.8	0.660
70	1.925	0.1	64.9	77.2	50.1	0.738	315	112.4	0.656
71	1.926	0.1	65.1	76.3	49.6	0.732	314	112.0	0.653
72	1.927	0.1	65.1	75.4	49.0	0.725	312	111.5	0.650
73	1.927	0.1	65.2	75.0	48.9	0.722	312	111.4	0.649
74	1.928	0.1	65.2	74.1	48.3	0.715	311	110.9	0.645
75	1.929	0.1	65.3	73.2	47.8	0.709	309	110.5	0.642
76	1.929	0.1	65.3	72.8	47.5	0.706	309	110.3	0.640
77	1.930	0.1	65.4	71.9	47.0	0.700	308	109.9	0.637
78	1.931	0.1	65.4	71.0	46.4	0.692	306	109.4	0.633
79	1.931	0.1	65.5	70.2	45.9	0.686	305	109.0	0.630
80	1.932	0.1	65.6	69.7	45.7	0.683	305	108.8	0.628

[1] Determined by the equation on Table 2.21.
[2] Determined by the equation on Table 2.22, for an environmental temperature of 20 °C.
[3] Levels of 2900; 2850 and 2800 kcal ME/kg diet were considered for the ages of 18 to 45; 46 to 65 and 66 to 80 weeks, respectively.

Table 2.25 - Amino Acid / Lysine Ratios Used to Estimate Amino Acids Requirements of White-Egg and Brown-Egg Layers

Amino Acid	Digestible	Total
Lysine	100	100
Methionine	50	49
Methionine + Cystine	91	90
Threonine	76	79
Tryptophan	23	23
Arginine	100	96
Glycine + Serine	77	80
Valine	95	95
Isoleucine	76	76
Leucine	122	119
Histidine	29	28
Phenylalanine	65	63
Phenylalanine + Tyrosine	118	115

Table 2.26 - Nutritional Requirements of White-Egg Layers (g/bird/day)

Nutrient	White-Egg Layers					
Crude Protein	16.5					
Calcium	4.02					
Available Phosphorus	0.300					
Digestible Phosphorus	0.270					
Potassium	0.580					
Sodium	0.225					
Chlorine	0.200					
Linoleic Acid	1.210					
Body Weight, kg	1.500		1.600		1.650	
Gain, g/day	1.0		0.2		0.0	
Egg Mass, g/day	55.5		51.0		48.0	
Amino Acid[1]	Dig.	Total	Dig.	Total	Dig.	Total
Lysine	0.803	0.902	0.736	0.827	0.697	0.783
Methionine	0.402	0.442	0.368	0.405	0.349	0.384
Methionine + Cystine	0.731	0.812	0.670	0.744	0.634	0.705
Threonine	0.610	0.713	0.559	0.653	0.530	0.619
Tryptophan	0.185	0.207	0.169	0.190	0.160	0.180
Arginine	0.803	0.866	0.736	0.794	0.697	0.751
Glycine + Serine	0.618	0.722	0.567	0.662	0.537	0.626
Valine	0.763	0.857	0.699	0.786	0.662	0.744
Isoleucine	0.610	0.686	0.559	0.629	0.530	0.595
Leucine	0.980	1.073	0.898	0.984	0.850	0.932
Histidine	0.233	0.253	0.213	0.232	0.202	0.219
Phenylalanine	0.522	0.568	0.478	0.521	0.453	0.493
Phenylalanine + Tyrosine	0.948	1.037	0.868	0.951	0.822	0.900

[1] Amino acids requirement were determined using Table 2.21 (dig. lysine equation) and Table 2.25 (amino acid / lysine ratio). Total Lysine requirement was calculated considering the average true lysine digestibility of 89%.

Table 2.27 - Nutritional Requirements of Brown-Egg Layers (g/bird/day)

Nutrient	Brown-Egg Layers					
Crude Protein	17.0					
Calcium	4.20					
Available Phosphorus	0.300					
Digestible Phosphorus	0.270					
Potassium	0.590					
Sodium	0.230					
Chlorine	0.210					
Linoleic Acid	1.210					
Body Weight, kg	1.600		1.800		1.900	
Gain, g/day	2.0		1.0		0.0	
Egg Mass, g/day	57.0		52.0		48.0	
Amino Acid[1]	Dig.	Total	Dig.	Total	Dig.	Total
Lysine	0.846	0.951	0.774	0.870	0.708	0.796
Methionine	0.423	0.466	0.387	0.426	0.354	0.390
Methionine + Cystine	0.770	0.856	0.704	0.783	0.644	0.716
Threonine	0.643	0.751	0.588	0.687	0.538	0.629
Tryptophan	0.195	0.219	0.178	0.200	0.163	0.183
Arginine	0.846	0.913	0.774	0.835	0.708	0.764
Glycine + Serine	0.651	0.761	0.569	0.696	0.545	0.637
Valine	0.804	0.903	0.735	0.826	0.673	0.756
Isoleucine	0.643	0.723	0.588	0.661	0.538	0.605
Leucine	1.032	1.132	0.944	1.035	0.864	0.947
Histidine	0.245	0.266	0.224	0.244	0.205	0.223
Phenylalanine	0.550	0.599	0.503	0.548	0.460	0.501
Phenylalanine + Tyrosine	0.998	1.093	0.913	1.000	0.835	0.915

[1] Amino acids requirement were determined using Table 2.21 (dig. lysine equation) and Table 2.25 (amino acid / lysine ratio). Total Lysine requirement was calculated considering the average true lysine digestibility of 89%.

Table 2.28 - Energy Requirements (kcal/bird/day) and Feed Intake (g/bird/day) of White-Egg and Brown-Egg Layers [1.2]

Body Weight (kg)	1.500			1.600			1.800		
Weight Gain (g/ bird/ day)	2.0			1.0			0.0		
Egg Mass (g/ bird/ day)	56.0	52.0	48.0	56.0	52.0	48.0	56.0	52.0	48.0
Average Temperature									
16 °C	326.5[1]	316.9	307.3	327.7	318.1	308.5	337.2	327.6	318.0
	(112.6)[2]	(111.2)	(109.8)	(113.0)	(111.6)	(110.2)	(116.3)	(114.9)	(113.6)
21 °C	306.2	296.6	287.0	306.3	296.7	287.1	313.9	304.3	294.7
	(105.6)	(104.1)	(102.5)	(105.6)	(104.1)	(102.5)	(108.2)	(106.8)	(105.2)
26 °C	285.9	276.3	266.7	285.0	275.4	265.8	290.6	281.0	271.4
	(98.6)	(96.9)	(95.2)	(98.3)	(96.6)	(94.9)	(100.2)	(98.6)	(96.9)

[1] Energy requirements were determined using the equation on Table 2.22.
[2] Feed intake was determined by dividing ME requirement / bird/ day by dietary ME content, considering 2900, 2850 and 2800 kcal ME/kg diet, for egg mass of 56, 52 and 48 g/day, respectively

Table 2.29 - Nutritional Requirements (%) of White-Egg Layers as a Function of Productivity, Metabolizable Energy and Feed Intake

Body Weight, kg		1.500		1.600		1.650	
Gain, g/day		1.0		0.2		0.0	
Egg Mass, g/day		55.5		51.0		48.0	
ME requirement, kcal/day[1]		299		293		288	
Dietary ME, kcal/kg		2900		2850		2800	
Feed Intake, g/day[2]		103		103		103	
Crude Protein[3]	%	16.02		16.02		16.02	
Calcium	%	3.90		3.90		3.90	
Available Phosphorus	%	0.291		0.291		0.291	
Digestible Phosphorus	%	0.262		0.262		0.262	
Potassium	%	0.563		0.563		0.563	
Sodium	%	0.218		0.218		0.218	
Chlorine	%	0.194		0.194		0.194	
Linoleic Acid	%	1.175		1.175		1.175	
Amino Acid		Dig.	Total	Dig.	Total	Dig.	Total
Lysine[3]	%	0.777	0.873	0.717	0.806	0.678	0.762
Methionine	%	0.389	0.428	0.359	0.395	0.339	0.373
Methionine + Cystine	%	0.707	0.786	0.652	0.725	0.617	0.686
Threonine	%	0.591	0.690	0.545	0.637	0.515	0.602
Tryptophan	%	0.179	0.201	0.165	0.185	0.156	0.175
Arginine	%	0.777	0.838	0.717	0.774	0.678	0.732
Glycine + Serine	%	0.598	0.698	0.552	0.645	0.522	0.610
Valine	%	0.738	0.829	0.681	0.766	0.644	0.724
Isoleucine	%	0.591	0.664	0.545	0.613	0.515	0.579
Leucine	%	0.948	1.039	0.875	0.959	0.827	0.907
Histidine	%	0.225	0.244	0.208	0.226	0.197	0.213
Phenylalanine	%	0.505	0.550	0.466	0.508	0.441	0.480
Phenylalanine + Tyrosine	%	0.917	1.004	0.846	0.927	0.800	0.876

[1] Determined by the equation on Table 2.22 for an environmental temperature of 20^0C.
[2] Determined by dividing daily ME requirement by dietary ME content.
[3] Nutrient percentage is determined using nutrient requirement in g/ bird/ day on Table 2.26 and ME intake in g/ bird/ day.

Table 2.30 - Nutritional Requirements (%) of White-Egg Layers as a Function of Productivity, Metab. Energy and Feed Intake, Under Different Temperatures (High, Average and Low)

Body Weight, kg			1.47			1.6	
Gain, g/day			1.5			0.5	
Egg Mass, g/day			55			50	
ME Requirement, kcal/day[1]		270	286	302	264	275	288
Intake, g/day[2]		93	100	108	91	97	103
Crude Protein[3]	%	17.7	16.5	15.3	18.1	17.0	16.0
Calcium	%	4.32	4.02	3.72	4.42	4.14	3.9
Available Phosphorus	%	0.323	0.300	0.278	0.330	0.309	0.291
Digestible Phosphorus	%	0.290	0.270	0.250	0.297	0.278	0.262
Potassium	%	0.624	0.580	0.537	0.637	0.598	0.563
Sodium	%	0.242	0.225	0.208	0.247	0.232	0.218
Chlorine	%	0.215	0.200	0.185	0.220	0.206	0.194
Linoleic Acid	%	1.301	1.210	1.120	1.330	1.247	1.175
				Digestible Amino Acids			
Lysine[3]	%	0.866	0.804	0.748	0.805	0.755	0.711
Methionine	%	0.433	0.402	0.374	0.403	0.378	0.356
Methionine + Cystine	%	0.788	0.732	0.681	0.733	0.687	0.647
Threonine	%	0.658	0.611	0.568	0.612	0.574	0.540
Tryptophan	%	0.199	0.185	0.172	0.185	0.174	0.164
Arginine	%	0.866	0.804	0.748	0.805	0.755	0.711
Glycine + Serine	%	0.667	0.619	0.576	0.620	0.581	0.547
Valine	%	0.823	0.764	0.711	0.765	0.717	0.675
Isoleucine	%	0.658	0.611	0.568	0.612	0.574	0.540
Leucine	%	1.057	0.981	0.913	0.982	0.921	0.867
Histidine	%	0.251	0.233	0.217	0.233	0.219	0.206
Phenylalanine	%	0.563	0.523	0.486	0.523	0.491	0.462
Phenylalanine + Tyrosine	%	1.022	0.949	0.883	0.950	0.891	0.839
				Total Amino Acids			
Lysine	%	0.973	0.903	0.840	0.904	0.848	0.799
Methionine	%	0.477	0.443	0.412	0.443	0.416	0.391
Methionine + Cystine	%	0.876	0.813	0.756	0.814	0.763	0.719
Threonine	%	0.769	0.714	0.664	0.715	0.670	0.631
Tryptophan	%	0.224	0.208	0.193	0.208	0.195	0.184
Arginine	%	0.934	0.867	0.807	0.868	0.814	0.767
Glycine + Serine	%	0.778	0.723	0.672	0.724	0.679	0.639
Valine	%	0.924	0.858	0.798	0.859	0.806	0.759
Isoleucine	%	0.740	0.687	0.639	0.687	0.645	0.607
Leucine	%	1.158	1.075	1.000	1.076	1.009	0.951
Histidine	%	0.272	0.253	0.235	0.253	0.238	0.224
Phenylalanine	%	0.613	0.569	0.529	0.570	0.534	0.503
Phenylalanine + Tyrosine	%	1.119	1.039	0.967	1.040	0.976	0.919

1 Determined by the equation on Table 2.22 for layers under different temperatures. 2 Determined by dividing daily ME requirement by dietary ME content, considering levels of 2900, 2850 and 2800 kcal ME/ kg feed, respectively. 3Nutrient percentages are determined using nutrient requirements in g/ bird/ day on Tables 2.21, 2.25, 2.26 and ME intake in g/ bird/ day.

Table 2.31 - Nutritional Requirements Brown-Egg Layers as a Function of Productivity, Metabolizable Energy and Feed Intake

Body Weight, kg		1.600		1.800		1.900	
Gain, g/day		2		1		0	
Egg Mass, g/day		55		50		45	
ME Requirement, kcal/day[1]		316		312		300	
Dietary ME, kcal/kg		2900		2850		2800	
Feed Intake, g/day[2]		109		109		107	
Crude Protein[3]	%	15.60		15.60		15.89	
Calcium	%	3.85		3.85		3.93	
Available Phosphorus	%	0.275		0.275		0.280	
Digestible Phosphorus	%	0.248		0.248		0.252	
Potassium	%	0.541		0.541		0.551	
Sodium	%	0.211		0.211		0.215	
Chlorine	%	0.193		0.193		0.196	
Linoleic Acid	%	1.110		1.110		1.131	
Amino Acid		Dig.	Total	Dig.	Total	Dig.	Total
Lysine[3]	%	0.754	0.847	0.684	0.769	0.627	0.704
Methionine	%	0.377	0.415	0.342	0.377	0.314	0.345
Methionine + Cystine	%	0.686	0.762	0.622	0.692	0.571	0.634
Threonine	%	0.573	0.669	0.520	0.607	0.477	0.557
Tryptophan	%	0.173	0.195	0.157	0.177	0.144	0.162
Arginine	%	0.754	0.813	0.684	0.738	0.627	0.676
Glycine + Serine	%	0.580	0.678	0.527	0.615	0.483	0.564
Valine	%	0.716	0.805	0.650	0.730	0.596	0.669
Isoleucine	%	0.573	0.644	0.520	0.584	0.477	0.535
Leucine	%	0.920	1.008	0.834	0.915	0.765	0.838
Histidine	%	0.219	0.237	0.198	0.215	0.182	0.197
Phenylalanine	%	0.490	0.534	0.445	0.484	0.408	0.444
Phenylalanine + Tyrosine	%	0.890	0.974	0.807	0.884	0.740	0.810

[1] Determined by the equation on Table 2.22 for an environmental temperature of 20^0C.
[2] Determined by dividing daily ME requirement by dietary ME content.
[3] Nutrient percentage is determined using nutrient requirement in g/ bird/ day on Tables 2.21, 2.25, 2.27 and ME intake in g/ bird/ day.

Table 2.32 - Nutritional Requirements (%) of Brown-Egg Layers as a Function of Productivity, Metab. Energy and Feed Intake, Under Different Temperatures (High, Average and Low)

Body Weight, kg			1.6			1.8	
Gain, g/day			2			1	
Egg Mass, g/day			55			50	
ME Requirement, kcal/day[1]		282	299	316	274	293	312
Intake, g/day[2]		97	105	113	96	103	109
Crude Protein[3]	%	17.5	16.2	15.0	17.7	16.5	15.6
Calcium	%	4.33	4.00	3.72	4.38	4.08	3.85
Available Phosphorus	%	0.309	0.286	0.265	0.313	0.291	0.275
Digestible Phosphorus	%	0.278	0.257	0.239	0.281	0.262	0.248
Potassium	%	0.608	0.562	0.522	0.615	0.573	0.541
Sodium	%	0.237	0.219	0.204	0.240	0.223	0.211
Chlorine	%	0.216	0.200	0.186	0.219	0.204	0.193
Linoleic Acid	%	1.247	1.152	1.071	1.260	1.175	1.110
Digestible Amino Acid							
Lysine[3]	%	0.846	0.784	0.728	0.777	0.728	0.684
Methionine	%	0.423	0.392	0.364	0.389	0.364	0.342
Methionine + Cystine	%	0.770	0.713	0.663	0.708	0.663	0.623
Threonine	%	0.643	0.596	0.554	0.591	0.553	0.520
Tryptophan	%	0.195	0.180	0.168	0.179	0.167	0.157
Arginine	%	0.846	0.784	0.728	0.777	0.728	0.684
Glycine + Serine	%	0.651	0.604	0.561	0.598	0.561	0.527
Valine	%	0.804	0.745	0.692	0.739	0.692	0.650
Isoleucine	%	0.643	0.596	0.554	0.591	0.553	0.520
Leucine	%	1.032	0.956	0.889	0.949	0.888	0.835
Histidine	%	0.245	0.227	0.211	0.225	0.211	0.199
Phenylalanine	%	0.550	0.509	0.473	0.505	0.473	0.445
Phenylalanine + Tyrosine	%	0.998	0.925	0.860	0.917	0.859	0.808
Total Amino Acid							
Lysine	%	0.951	0.881	0.818	0.874	0.818	0.769
Methionine	%	0.466	0.432	0.401	0.428	0.401	0.377
Methionine + Cystine	%	0.856	0.793	0.737	0.786	0.736	0.692
Threonine	%	0.751	0.696	0.647	0.690	0.646	0.608
Tryptophan	%	0.219	0.203	0.188	0.201	0.188	0.177
Arginine	%	0.913	0.845	0.786	0.839	0.785	0.738
Glycine + Serine	%	0.760	0.705	0.655	0.699	0.654	0.615
Valine	%	0.903	0.837	0.778	0.830	0.777	0.731
Isoleucine	%	0.722	0.669	0.622	0.664	0.622	0.585
Leucine	%	1.131	1.048	0.974	1.040	0.973	0.915
Histidine	%	0.266	0.247	0.229	0.245	0.229	0.215
Phenylalanine	%	0.599	0.555	0.516	0.550	0.515	0.485
Phenylalanine + Tyrosine	%	1.093	1.013	0.941	1.005	0.941	0.884

1 Determined by the equation on Table 2.22 for layers under different temperatures.
2 Determined by dividing daily ME requirement by dietary ME content, considering levels of 2900, 2850 and 2800 kcal ME/ kg diet, respectively.
3 Nutrient percentages are determined using nutrient requirements in g/ bird/ day on Tables 2.21, 2.25, 2.26 and ME intake in g/ bird/ day.

Nutritional Requirements of Broiler Breeders

Table 2.33 - Amino Acid / Lysine Ratios Used to Estimate Amino Acid Requirements of Replacement Broiler Breeder Pullets

Phase	Starter		Grower		Developer	
Age (weeks)	1- 6		7 – 12		13 – 18	
Amino acid	Digestible	Total	Digestible	Total	Digestible	Total
Lysine	100	100	100	100	100	100
Methionine	40	40	43	44	45	45
Methionine + Cystine	73	73	79	80	82	83
Threonine	67	70	68	71	69	72
Tryptophan	18	18	20	20	22	22
Arginine	107	105	108	106	110	107
Glycine + Serine	135	140	130	135	125	130
Valine	76	78	80	81	82	83
Isoleucine	69	70	75	76	77	78
Leucine	112	111	118	117	125	124
Histidine	37	37	38	38	39	39
Phenylalanine	66	66	69	69	72	72
Phen + Tyr	121	120	125	125	130	130

Table 2.34 - Nutritional Requirements of Broiler Breeder Pullets as a Function of Dietary Energy Level[1]

Phases		Starter		Grower		Developer	
Age (Weeks)		1 - 6		7 - 12		13 – 18	
ME kcal/kg		2.975		2.800		2.800	
Crude Protein	%	19.0		16.0		14.0	
Calcium	%	0.970		0.894		0.850	
Available Phosphorus	%	0.450		0.410		0.330	
Digestible Phosphorus	%	0.382		0.350		0.290	
Potassium	%	0.530		0.510		0.490	
Sodium	%	0.180		0.166		0.160	
Chlorine	%	0.160		0.150		0.150	
Linoleic Acid	%	1.078		1.053		1.010	
Amino Acid		Dig.	Total	Dig.	Total	Dig.	Total
Lysine	%	0.925	1.027	0.613	0.680	0.571	0.636
Methionine	%	0.371	0.411	0.268	0.300	0.257	0.286
Methionine + Cystine	%	0.675	0.750	0.488	0.543	0.468	0.526
Threonine	%	0.620	0.719	0.417	0.484	0.394	0.456
Tryptophan	%	0.166	0.185	0.123	0.137	0.126	0.140
Arginine	%	0.990	1.078	0.662	0.722	0.628	0.680
Glycine + Serine	%	1.249	1.438	0.797	0.918	0.714	0.826
Valine	%	0.703	0.801	0.490	0.552	0.468	0.526
Isoleucine	%	0.638	0.719	0.460	0.518	0.440	0.496
Leucine	%	1.036	1.140	0.723	0.795	0.714	0.787
Histidine	%	0.342	0.380	0.233	0.258	0.223	0.246
Phenylalanine	%	0.611	0.678	0.423	0.470	0.411	0.456
Phenylalanine + Tyrosine	%	1.119	1.232	0.766	0.851	0.742	0.826

[1] Amino acid percentage was determined using the recommended dig. Lys level and the amino acid / lysine ratio on Table 2.33 Total lysine requirement was calculated considering an average lysine true digestibility of 90%.

Table 2.35 - Equation Used to Estimate True Digestible Lysine Requirement of Broiler Breeders Hens in g/bird/day and in %[1]

Dig. Lys (g/bird/day) = 0.07 $W^{0.75}$ + 0.020 G + 0.0124 Egg
W = Body Weight, kg
G = Weight Gain, g/ bird/ day
Egg = Egg Mass, g egg/bird/day = $\frac{\%\ lay}{100}$ x Egg weight

Example:
W = 3.0 kg, with: $W^{0.75}$ = 2.279
G = 10 g/ bird/ day
Egg = 47g/ bird/ day

Dig. Lys Req. = 0.07 x 2.279 + 0.020 x 10 + 0.0124 x 47 = 0.942g/day
Estimated Feed Intake = 164.0 g/ bird/ day
Dig. Lys in the feed = $\frac{0.942 \times 100}{164.0}$ = 0.575%

[1] Daily digestible lysine requirement for maintenance = 0.07 x (Av. weight)$^{0.75}$. Estimated according to the values obtained by Fisher, 1998 (Poultry Sci. 77:124), Edwards et. al., 1999 (Poultry Sci. 78:1412) and Siqueira, 2009 (PhD thesis – UNESP, Jaboticabal, SP). Digestible lysine requirement for weight gain was estimated as 0.020 g/g daily gain, considering results of broiler trials. The value 0.0124 g. dig. lysine/g egg mass was determined using the results of dose-response trials carried out at UFV, being 7 with white-egg layers, 6 with brown-egg layers and 2 with broiler breeders hens.

Table 2.36 - Equation Used to Estimate Metabolizable Energy (ME) Requirement of Broiler Breeder Hens in kcal/bird/day[1]

$$ME\ (kcal/bird/day) = 115.5\ W^{0.75} + 7.62\ G + 2.4\ Egg + 3\ W^{0.75}\ (21 - T)$$

W = Body Weight, kg
G = Weight Gain, g/ bird/ day
Egg = g egg/bird/day = $\frac{\%\ lay}{100}$ x egg weight
T = Average Temperature, °C

Example:
W = 3.483 kg, with: $W^{0.75}$ = 2.549
G = 5.4 g/ bird/ day
Egg = 47.7g/ bird/ day
T = 20°C

ME Req. = 115.50 x 2.549 + 7.62 x 5.4 + 2.4 x 47.7 + 3.0 x 2.549 (21 - 20)
ME = 294.41 + 41.15 + 114.48 + 5.098 = 458 kcal/ bird/ day
Feed ME = 2750 kcal/ kg
Estimated Feed Intake = 166.4 g/ bird/ day

[1] The equation that estimates daily ME requirement was based on the values of Sakomura 1989 (PhD thesis – UFV) and Sakomura and Rostagno (2007) .

Table 2.37 - True Digestible Lysine (Dig. Lys) Requirements of Broiler Breeders Hens as a Function of Productivity

Age (weeks)	Weight (kg)	Gain (g/day)	Egg Weight (g)	Production (%)	Egg Mass (g/day)	Dig. Lys[1] (g/day)	EM[2] (kcal/day)	Intake[3] (g/day)	Dig. Lys (%)
25	2.939	22.0	48.3	4.9	2.4	0.626	439	159.6	-[4]
26	3.093	19.8	52.1	18.8	9.8	0.681	451	164.0	-[4]
27	3.231	15.5	53.5	44.8	24.0	0.777	462	167.8	-[4]
28	3.340	12.3	54.8	66.3	36.3	0.869	474	172.3	-[4]
29	3.426	8.0	56.2	78.0	43.9	0.881	465	169.1	-[4]
30	3.483	5.4	57.3	83.3	47.7	0.877	457	166.3	0.527
31	3.520	3.8	58.5	85.3	49.9	0.874	453	164.7	0.531
32	3.546	2.3	59.4	85.6	50.8	0.857	446	162.1	0.529
33	3.563	2.1	59.8	84.9	50.8	0.854	445	162.0	0.527
34	3.578	2.0	60.5	84.2	50.9	0.854	446	162.1	0.527
35	3.592	2.0	61.2	83.3	51.0	0.855	447	162.4	0.526
36	3.606	2.0	61.9	82.4	51.0	0.856	448	162.8	0.526
37	3.620	2.0	62.2	81.5	50.7	0.852	448	162.9	0.523
38	3.634	2.0	62.8	80.6	50.7	0.853	449	163.2	0.522
39	3.648	2.0	63.1	79.6	50.2	0.848	449	163.1	0.520
40	3.662	2.0	63.8	78.5	50.1	0.846	449	163.3	0.518
41	3.676	2.0	64.0	77.5	49.6	0.841	449	163.2	0.515
42	3.690	2.0	64.6	76.6	49.5	0.840	449	163.4	0.514
43	3.704	2.0	64.9	75.6	49.0	0.835	449	163.4	0.511
44	3.718	2.0	65.2	74.7	48.7	0.831	449	163.4	0.509
45	3.732	2.0	65.4	73.7	48.2	0.826	449	163.3	0.506
46	3.746	2.0	65.7	72.8	47.8	0.821	449	163.3	0.503
47	3.760	2.0	65.9	71.8	47.3	0.816	449	163.2	0.500
48	3.774	2.0	66.2	70.8	46.9	0.811	449	163.1	0.497
49	3.788	2.0	66.4	69.8	46.4	0.805	448	163.0	0.494
50	3.802	2.0	66.7	68.8	45.9	0.799	448	162.9	0.491
51	3.816	2.0	67.0	67.5	45.2	0.792	447	162.6	0.487
52	3.830	2.0	67.5	66.5	44.9	0.788	447	162.7	0.484
53	3.844	2.0	67.7	65.5	44.3	0.782	447	162.5	0.481
54	3.858	2.0	67.9	64.4	43.7	0.775	446	162.3	0.478
55	3.872	2.0	68.1	63.4	43.2	0.769	446	162.2	0.474
56	3.886	1.0	68.3	62.5	42.7	0.743	438	159.3	0.466
57	3.893	1.0	68.4	61.4	42.0	0.735	437	158.9	0.463
58	3.900	1.0	68.5	60.4	41.4	0.728	436	158.5	0.459
59	3.907	1.0	68.7	59.5	40.9	0.721	435	158.2	0.456
60	3.914	1.0	68.8	58.4	40.2	0.713	434	157.8	0.452
61	3.921	1.0	68.9	57.4	39.6	0.706	433	157.4	0.448
62	3.928	1.0	69.0	56.4	38.9	0.698	432	157.0	0.445
63	3.935	1.0	69.1	55.5	38.3	0.691	431	156.6	0.441
64	3.942	1.0	69.5	54.5	37.9	0.686	430	156.4	0.438
65	3.949	1.0	69.6	53.5	37.2	0.678	429	156.0	0.435
66	3.956	1.0	69.7	52.5	36.6	0.670	428	155.6	0.431
67	3.963	1.0	69.8	51.5	36.0	0.663	427	155.2	0.427
68	3.970	1.0	69.9	50.6	35.4	0.655	426	154.8	0.423
69	3.977	1.0	70.0	49.6	34.7	0.648	425	154.4	0.420
70	3.984	1.0	70.1	48.6	34.1	0.640	424	154.0	0.416

[1] Determined by the equation on Table 2.35.
[2] Determined by the equation on Table 2.36, for environmental temperature of 20 °C.
[3] Levels of 2750 kcal ME/kg diet for all ages.
[4] Use value of week 30.

Table 2.38 - Amino Acid / Lysine Ratio Used to Estimate Amino Acid Requirements of Broiler Breeders

	Females		Males	
Amino acid	Digestible	Total	Digestible	Total
Lysine	100	100	100	100
Methionine	48	47	58	57
Methionine + Cystine	87	86	105	103
Threonine	81	84	97	101
Tryptophan	23	23	29	29
Arginine	115	109	140	133
Glycine + Serine	102	106	125	130
Valine	90	90	127	127
Isoleucine	90	89	109	108
Leucine	135	132	155	150
Histidine	35	34	31	30
Phenylalanine	73	72	82	81
Phenylalanine + Tyrosine	132	130	153	150

Table 2.39 - Nutritional Requirements of Broiler Breeders Hens(g/bird/day)

Nutrient	Broiler Breeders Hens					
Crude Protein	21.0					
Calcium	4.10					
Available Phosphorus	0.400					
Digestible Phosphorus	0.380					
Potassium	0.700					
Sodium	0.250					
Chlorine	0.220					
Linoleic Acid	2.000					
Body Weight, kg	3.000		3.400		3.800	
Gain, g/day	6.0		2.0		1.0	
Egg Mass, g/day	51.0		45.0		40.0	
Amino Acid[1]	Dig.	Total	Dig.	Total	Dig.	Total
Lysine	0.912	1.025	0.773	0.869	0.707	0.794
Methionine	0.438	0.482	0.371	0.408	0.339	0.373
Methionine + Cystine	0.793	0.882	0.673	0.747	0.615	0.683
Threonine	0.739	0.861	0.626	0.730	0.573	0.667
Tryptophan	0.210	0.236	0.178	0.200	0.163	0.183
Arginine	1.049	1.117	0.889	0.947	0.813	0.865
Glycine + Serine	0.930	1.087	0.788	0.921	0.721	0.842
Valine	0.821	0.923	0.696	0.782	0.636	0.715
Isoleucine	0.821	0.912	0.696	0.773	0.636	0.707
Leucine	1.231	1.353	1.044	1.147	0.954	1.048
Histidine	0.319	0.349	0.271	0.295	0.247	0.270
Phenylalanine	0.666	0.738	0.564	0.626	0.516	0.572
Phenylalanine + Tyrosine	1.204	1.333	1.020	1.130	0.933	1.032

[1] Amino acid requirements were determined using: Table 2.35 (dig lysine equation) and Table 2.38 (amino acid / lysine ratio). Total lysine requirement was calculated considering an average true lysine digestibility of 89%.

Table 2.40 - Energy Requirements (kcal ME/bird/day) and Feed Intake (g/bird/day) of Broiler Breeders Hens[1.2]

Body Weight (kg)	3.000			3.400			3.800		
Weight Gain (g/ bird/ day)	6.0			2.0			1.0		
Egg Mass (g/ bird/ day)	51.0	45.0	40.0	51.0	45.0	40.0	51.0	45.0	40.0
Average Temperature									
16 °C	465.6	451.2	439.2	464.4	450.0	438.0	485.2	470.8	458.8
	(169.3)[2]	(164.1)	(159.7)	(168.9)	(163.6)	(159.3)	(176.4)	(171.2)	(166.8)
21 °C	431.4	417.0	405.0	426.8	412.4	400.4	444.4	430.0	418.0
	(156.9)	(151.6)	(147.3)	(155.2)	(150.0)	(145.6)	(161.6)	(156.4)	(152.0)
26 °C	397.2	382.8	370.8	389.3	374.9	362.9	403.5	389.1	377.1
	(144.4)	(139.2)	(134.8)	(141.6)	(136.3)	(132.0)	(146.7)	(141.5)	(137.1)

[1] Energy requirements are determined by the equation on Table 2.36.
[2] Feed intake was determined by dividing ME requirement / bird/ day by dietary ME content, considering the level of 2750 kcal ME / kg feed

Table 2.41 - Nutritional Requirements (%) of Broiler Breeders Hens as a Function of Productivity, Metabolizable Energy and Feed Intake

Body Weight, kg		3.000		3.400		3.800	
Gain, g/day		6.0		2.0		1.0	
Egg Mass, g/day		51.0		45.0		40.0	
ME Requirement, kcal/day[1]		438		420		426	
Dietary ME, kcal/kg		2750		2750		2750	
Feed Intake, g/day[2]		159		153		155	
Crude Protein[3]	%	13.21		13.73		13.55	
Calcium	%	2.58		2.68		2.65	
Available Phosphorus	%	0.252		0.261		0.258	
Digestible Phosphorus	%	0.239		0.248		0.452	
Potassium	%	0.440		0.458		0.645	
Sodium	%	0.157		0.163		0.161	
Chlorine	%	0.138		0.144		0.142	
Linoleic Acid	%	1.258		1.307		1.290	
Amino Acid		Dig.	Total	Dig.	Total	Dig.	Total
Lysine[3]	%	0.574	0.645	0.505	0.567	0.456	0.512
Methionine	%	0.276	0.303	0.242	0.266	0.219	0.241
Methionine + Cystine	%	0.499	0.555	0.439	0.488	0.397	0.440
Threonine	%	0.465	0.542	0.409	0.476	0.369	0.430
Tryptophan	%	0.132	0.148	0.116	0.130	0.105	0.118
Arginine	%	0.660	0.703	0.581	0.618	0.524	0.558
Glycine + Serine	%	0.585	0.684	0.515	0.601	0.465	0.543
Valine	%	0.517	0.581	0.455	0.510	0.410	0.461
Isoleucine	%	0.517	0.574	0.455	0.505	0.410	0.456
Leucine	%	0.775	0.851	0.682	0.748	0.616	0.676
Histidine	%	0.201	0.219	0.177	0.193	0.160	0.174
Phenylalanine	%	0.419	0.464	0.369	0.408	0.333	0.369
Phenylalanine + Tyrosine	%	0.758	0.839	0.667	0.737	0.602	0.666

[1] Determined by the equation on Table 2.36 for an environmental temperature of 20^0C.

[2] Determined by dividing daily ME requirement by dietary energy content, considering a level of 2750 kcal ME / kg diet.

[3] Nutrient percentage is determined using nutrient requirement in g/ bird/ day on Tables 2.35, 2.38, 2.39 and ME intake in g/ bird/ day. Total lysine requirement was calculated considering an average true lysine digestibility of 89%.

Table 2.42 - Nutritional Requirements (%) of Broiler Beeders Hens as a Function of Productivity, Metabolizable Energy and Feed Intake, Under Different Temperatures (High, Average and Low)

Body Weight, kg			3.000			3.400	
Gain, g/day			6.0			2.0	
Egg Mass, g/day			51			45	
ME Requirement, kcal/day[1]		399	439	467	385	426	454
Intake, g/day[2]		145	160	170	140	155	165
Crude Protein[3]	%	14.5	13.1	12.4	15.0	13.6	12.7
Calcium	%	2.83	2.56	2.41	2.93	2.65	2.49
Available Phosphorus	%	0.276	0.250	0.235	0.286	0.258	0.242
Digestible Phosphorus	%	0.262	0.238	0.224	0.271	0.245	0.230
Potassium	%	0.483	0.438	0.412	0.500	0.452	0.424
Sodium	%	0.172	0.156	0.147	0.179	0.161	0.152
Chlorine	%	0.152	0.138	0.129	0.157	0.142	0.133
Linoleic Acid	%	1.379	1.250	1.176	1.429	1.290	1.212
				Digestible Amino Acid			
Lysine[3]	%	0.629	0.570	0.536	0.552	0.499	0.468
Methionine	%	0.302	0.274	0.257	0.265	0.240	0.225
Methionine + Cystine	%	0.547	0.496	0.466	0.480	0.434	0.407
Threonine	%	0.509	0.462	0.434	0.447	0.404	0.379
Tryptophan	%	0.145	0.131	0.123	0.127	0.115	0.108
Arginine	%	0.723	0.656	0.616	0.635	0.574	0.538
Glycine + Serine	%	0.642	0.581	0.547	0.563	0.509	0.477
Valine	%	0.566	0.513	0.482	0.497	0.449	0.421
Isoleucine	%	0.566	0.513	0.482	0.497	0.449	0.421
Leucine	%	0.849	0.770	0.724	0.745	0.674	0.632
Histidine	%	0.220	0.200	0.188	0.193	0.175	0.164
Phenylalanine	%	0.459	0.416	0.391	0.403	0.364	0.342
Phenylalanine + Tyrosine	%	0.830	0.752	0.708	0.729	0.659	0.618
				Total Amino Acid			
Lysine	%	0.707	0.640	0.602	0.620	0.561	0.526
Methionine	%	0.332	0.301	0.283	0.291	0.264	0.247
Methionine + Cystine	%	0.608	0.550	0.518	0.533	0.482	0.452
Threonine	%	0.594	0.538	0.506	0.521	0.471	0.442
Tryptophan	%	0.163	0.147	0.138	0.143	0.129	0.121
Arginine	%	0.771	0.698	0.656	0.676	0.611	0.573
Glycine + Serine	%	0.749	0.678	0.638	0.657	0.595	0.558
Valine	%	0.636	0.576	0.542	0.558	0.505	0.473
Isoleucine	%	0.629	0.570	0.536	0.552	0.499	0.468
Leucine	%	0.933	0.845	0.795	0.818	0.741	0.694
Histidine	%	0.240	0.218	0.205	0.211	0.191	0.179
Phenylalanine	%	0.509	0.461	0.433	0.446	0.404	0.379
Phenylalanine + Tyrosine	%	0.919	0.832	0.783	0.806	0.729	0.684

1 Determined by the equation on Table 2.36 for breeders under different temperatures (high, average, low). 2 Determined by dividing daily ME requirement by dietary ME content, considering a level of 2750 kcal ME/ kg diet. [3] Nutrient percentage is determined using nutrient requirement in g/ bird/ day on Tables 2.35, 2.38, 2.39 and ME intake in g/ bird/ day. Total lysine requirement was calculated considering an average true lysine digestibility of 89%

Table 2.43 - Nutritional Requirements Broiler Breeder Cockerels as a Function of Metabolizable Energy and Feed Intake (kcal/day or %) [1, 2]

ME Requirement kcal/day	-		360		385	
Feed Intake, g/day[1]	-		130		140	
Nutrient	g/day		%		%	
Crude Protein[2]	16.4		12.6		11.7	
Calcium	0.65		0.50		0.46	
Available Phosphorus	0.300		0.231		0.214	
Digestible Phosphorus	0.270		0.208		0.193	
Potassium	0.750		0.577		0.536	
Sodium	0.230		0.177		0.164	
Chlorine	0.187		0.144		0.134	
Linoleic Acid	1.300		1.000		0.929	
Amino Acid	Dig. g/day	Total g/day	Dig. %	Total %	Dig. %	Total %
Lysine[2]	0.464	0.525	0.357	0.404	0.331	0.375
Methionine	0.268	0.298	0.206	0.229	0.191	0.213
Methionine + Cystine	0.488	0.542	0.375	0.417	0.349	0.387
Threonine	0.449	0.528	0.345	0.406	0.321	0.377
Tryptophan	0.135	0.153	0.104	0.118	0.096	0.109
Arginine	0.651	0.700	0.501	0.538	0.465	0.500
Glycine + Serine	0.580	0.682	0.446	0.525	0.414	0.487
Valine	0.588	0.666	0.452	0.512	0.420	0.476
Isoleucine	0.505	0.565	0.388	0.435	0.361	0.404
Leucine	0.719	0.790	0.553	0.608	0.514	0.564
Histidine	0.146	0.160	0.112	0.123	0.104	0.114
Phenylalanine	0.387	0.425	0.298	0.327	0.276	0.304
Phen + Tyr	0.719	0.790	0.553	0.608	0.514	0.564

[1] Determined by dividing daily ME requirement by dietary ME content, considering a level of 2750 kcal ME/ kg diet.

[2] Nutrient percentage is determined using nutrient requirement in g/ bird/ day on the table above, table 2.38 (Amino Acid Lysine ratio) and feed intake in g/ bird/ day. Total lysine requirement was calculated considering an average true lysine digestibility of 89%

Nutritional Requirements of Japanese Quails

Table 2.44 - Amino Acid / Lysine Ratios Used to Estimate Amino Acid Requirements of Japanese Quails for the Grower and Developer Phases

Amino Acids	Grower and Developer	
	Digestible	Total
Lysine	100	100
Methionine	38	38
Methionine + Cystine	68	68
Threonine	71	74
Tryptophan	19	19
Arginine	106	103
Glycine + Serine	89	92
Valine	85	86
Isoleucine	71	72
Leucine	137	136
Histidine	29	29
Phenylalanine	77	77
Phenylalanine + Tyrosine	146	145

Table 2.45 - Nutritional Requirements of Japanese Quails for the Grower and Developer Phases[1]

Metabolizable Energy	(kcal/kg)	2900	
Crude Protein	%	22.0	
Calcium	%	0.900	
Available Phosphorus	%	0.375	
Digestible Phosphorus	%	0.333	
Sodium	%	0.176	
Amino Acids		Digestible	Total
Lysine	%	1.120	1.244
Methionine	%	0.420	0.467
Methionine + Cystine	%	0.760	0.844
Threonine	%	0.790	0.915
Tryptophan	%	0.210	0.236
Arginine	%	1.190	1.283
Glycine + Serine	%	0.997	1.150
Valine	%	0.950	1.068
Isoleucine	%	0.800	0.898
Leucine	%	1.530	1.690
Histidine	%	0.320	0.360
Phenylalanine	%	0.860	0.960
Phenylalanine + Tyrosine	%	1.630	1.800

[1] Total lysine requirement was calculated considering an average true lysine digestibility of 90%.

Table 2.46 - Equation Used to Estimate True Digestible Lysine Requirement of Laying Japanese Quails in g/bird/day and in %[1]

Dig. Lys (g/bird/day) = $0.07\ W^{0.75} + 0.020\ G + 0.0248\ Egg$

W = Body Weight, kg
G = Weight Gain, g/ bird/ day
Egg = Egg Mass, g egg/bird/day = $\frac{\%\ lay}{100}$ x Egg weight

Example:

W= 0.1789 kg, with $P^{0.75}$ = 0.2751

G= 0.04 g/bird/day

Egg= 9.62 g/bird/day

Dig. Lys Req. = 0.07 X 0.2751 + 0.020 X 0.04 + 0.0248 X 9.62
Dig. Lys Req. = 0.0193 + 0.0008 + 0.2385 = 0.2586 g/day
Estimated Feed Intake = 25.10 g/bird/day
Lysine Dig. in the feed = $\frac{0.2586}{25.10}$ x 100 = 1.030%

[1] Daily digestible lysine requirement for maintenance = 0.07 x (Av. weight)$^{0.75}$. Estimated according to the values obtained by Fisher, 1998 (Poultry Sci. 77:124), Edwards et. al., 1999 (Poultry Sci. 78:1412) and Siqueira, 2009 (PhD thesis – UNESP, Jaboticabal, SP). Digestible lysine requirement for weight gain was estimated as 0.020 g/g daily gain, considering results of broiler trials. The value 0.0248 g. dig. lysine/g egg mass was determined using the results of trials with quails carried out at UFV.

Table 2.47 - Equation Used to Estimate Metabolizable Energy (ME) Requirement of Laying Japanese Quails in kcal/bird/day and in % [1]

$ME_{(kcal/bird/day)} = 148.83\ W^{0.75} + 5.03G + 3.03\ Egg + 2\ P(21-T)$

W = Body Weight in kg

G = Weight gain/bird/day in g

Egg = egg mass, g egg/bird/day = $\frac{\%\ lay}{100}$ x Egg weight

T = Average Temperature in °C

Example

W = 0.1789 kg, with $P^{0.75}$=0.2751

G = 0.04 g/bird/day

Egg = 9.62 g/bird/day

T = 21ºC

ME = 148.83 x 0.2751 + 5.03 x 0.04 + 3.03 x 9.62 + 2 x 0.1789 (21-21)

ME = 40.94 + 0.201 + 29.15 = 70.29

Dietary ME = 2800 kcal/kg

Estimated feed intake = 25.10 g/day

[1] Energy requirements for maintenance, weight gain and egg mass were estimated based on the values obtained by Rostagno et al. (2005), Sakomura & Rostagno (2007) and Jordão Filho, 2008. (PhD thesis UFCP - Areias).

Table 2.48 - True Digestible Lysine (Dig. Lys) Requirements of Laying Japanese Quails as a Function of Productivity

Age (weeks)	Weight kg	Weight $^{0.75}$	Gain g/day	Egg Mass g/day	Dig. Lys[1] g/day	ME [2] kcal/day	Intake[3] g/day	Dig. lys %
8 - (6 a 10)	0.156	0.248	1.3	4.7	----[4]	----[4]	----[4]	----[4]
14 - (10 a 18)	0.160	0.253	0.05	10.703	0.284	70.35	24.26	1.172
22- (18 a 26)	0.179	0.275	0.09	10.720	0.287	73.79	26.35	1.088
29 - (26 a 32)	0.186	0.284	0.01	10.63	0.284	74.46	26.59	1.067
35 - (32 a 38)	0.183	0.280	0.03	10.45	0.279	73.41	26.22	1.065
48 - (38 a 50)	0.185	0.283	0.08	9.85	0.266	72.32	25.83	1.029
55 - (50 a 59)	0.186	0.283	0.01	9.61	0.258	71.32	25.65	1.007
62 - (59 a 65)	0.187	0.284	0.02	9.38	0.253	70.84	25.30	1.000

[1] Determined by the equation on Table 2.46
[2] Determined by the equation on Table 2.47, at environmental temperature of 21°C.
[3] A level of 2800 kcal ME/kg diet was used for all ages.
[4] Use value of week 14.

Table 2.49 - Amino Acid / Lysine Ratios Used to Estimate Amino Acid Requirements of Laying Japanese Quails

Amino Acid	Laying	
	Digestible	Total
Lysine	100	100
Methionine	45	44
Methionine + Cystine	82	81
Threonine	60	63
Tryptophan	21	21
Arginine	116	113
Glycine + Serine	114	119
Valine	75	76
Isoleucine	65	65
Leucine	150	148
Histidine	42	41
Phenylalanine	74	73
Phenylalanine + Tyrosine	135	133

Table 2.50 - Nutritional Requirements of Laying Japanese Quails (g/bird/day)

Nutrient	Laying Japanese Quails					
Crude Protein	4.94					
Calcium	0.768					
Available Phosphorus	0.080					
Digestible Phosphorus	0.073					
Sodium	0.038					
Linoleic Acid	0.256					
Body Weight, kg	0.165		0.175		0.189	
Gain, g/day	0.11		0.02		0.00	
Egg Mass, g/day	10.00		10.85		10.32	
Amino Acid [1]	Dig	Total	Dig	Total	Dig	Total
Lysine	0.268	0.301	0.288	0.324	0.276	0.310
Methionine	0.121	0.133	0.130	0.143	0.124	0.136
Methionine+Cystine	0.220	0.244	0.237	0.262	0.226	0.251
Threonine	0.161	0.190	0.173	0.204	0.166	0.195
Tryptophan	0.056	0.063	0.061	0.068	0.058	0.065
Arginine	0.311	0.341	0.335	0.366	0.320	0.350
Glycine + Serine	0.306	0.359	0.328	0.386	0.315	0.369
Valine	0.201	0.229	0.216	0.246	0.207	0.236
Isoleucine	0.174	0.196	0.187	0.211	0.179	0.202
Leucine	0.402	0.446	0.433	0.480	0.414	0.459
Histidine	0.113	0.124	0.121	0.133	0.116	0.127
Phenylalanine	0.199	0.220	0.213	0.104	0.204	0.226
Phenylalanine+Tyrosine	0.362	0.401	0.389	0.431	0.373	0.412

[1] Amino acid requirement was determined using Table 2.46 (dig lysine equation) and Table 2.49 (amino acid / lysine ratio). Total lysine requirement was calculated considering an average true lysine digestibility of 89%.

Table 2.51 - Nutritional Requirements (%) of Laying Japanese Quails as a Function of Productivity and Feed Intake

Body Weight, kg		0.165		0.177		0.189	
Gain, g/day		0.11		0.02		0.00	
Egg Mass, g/day		10.00		10.85		10.32	
ME Requirement, kcal/day[1]		69.38		73.59		73.93	
Dietary ME, kcal/kg		2800		2800		2800	
Feed Intake[2], g/day		24.78		26.28		26.40	
Crude Protein	%	19.94		18.80		18.71	
Calcium	%	3.099		2.922		2.909	
Available Phosphorus	%	0.323		0.304		0.303	
Digestible Phosphorus	%	0.295		0.278		0.277	
Sodium	%	0.155		0.146		0.145	
Linoleic Acid	%	1.033		0.974		0.970	
Amino Acid		Dig	Total	Dig	Total	Dig	Total
Lysine[3]	%	1.083	1.217	1.097	1.233	1.045	1.174
Methionine	%	0.487	0.535	0.494	0.543	0.470	0.517
Methionine+Cystine	%	0.888	0.985	0.900	0.999	0.857	0.951
Threonine	%	0.650	0.766	0.658	0.777	0.627	0.740
Tryptophan	%	0.227	0.255	0.230	0.259	0.220	0.247
Arginine	%	1.256	1.375	1.273	1.393	1.213	1.327
Glycine + Serine	%	1.235	1.448	1.251	1.467	1.191	1.398
Valine	%	0.812	0.925	0.823	0.937	0.784	0.893
Isoleucine	%	0.704	0.791	0.713	0.801	0.679	0.763
Leucine	%	1.624	1.801	1.646	1.825	1.568	1.738
Histidine	%	0.455	0.499	0.461	0.506	0.439	0.482
Phenylalanine	%	0.801	0.888	0.812	0.900	0.774	0.857
Phenylalanine + Tyrosine	%	1.462	1.618	1.481	1.640	1.411	1.562

[1] Determined by the equation on Table 2.47 for an environmental temperature of 21 ^{0}C.
[2] Determined by dividing daily ME requirement by dietary I content, considering 2800 kcal ME / kg diet.
[3] Nutrient percentage is determined using nutrient requirement in g/ bird/ day on Tables 2.48 and ME intake in g/ bird/ day.

CHAPTER 3

Nutritional Requirements of Swine

INTRODUCTION

In order to understand the following tables, some issues must be considered:

* Swine nutritional requirements depend on several factors, such as breed, genetic strain, sex, heterosis, development stage, feed intake, dietary energy level, nutrient availability, environmental temperature, air humidity, health status, etc.

* Swine nutritional requirements were determined in a series of dose-response trials carried out at the Universidade Federal de Viçosa (UFV) and other research institutions, associated to the observation of commercial herds in several Brazilian regions.

* Basal reference diets used in the experiments were formulated on corn and soybean meal. Therefore, when other ingredients are used, corrections as to nutrients digestibility or availability need to be made. This is the reason why requirements are expressed on true digestible amino acids.

* Only the main nutrients are mentioned. The others are assumed as adequately supplied provided they are offered in equivalent amount to the vitamin and mineral supplements included in this publication.

* All nutritional recommendations are for herds with high genetic potential. In order to aid the formulation of diets for high genetic potential pigs with different performances, nutritional recommendations for below average, standard and high performance indexes are included.

* When growing swine are fed “ad libitum”, feed intake and particularly feed conversion largely depend on the energy level. These Tables include examples of nutritional requirements for pig diets containing the energy levels commonly used in Brazil. Other

energy levels require adjustments to maintain constant the nutrient ratios for each 1000 kcal ME in the diet

* It would be virtually impossible to establish one single energy level for each type of swine ration. Dietary energy level varies according to the economic results to be obtained, that is, with the prices of the ingredients and of the pork products. For instance, if vegetable oil or animal fat can be obtained at reasonable prices, higher energy levels can be used in the diets. On the other hand, low energy feedstuffs available at low prices allow diet formulation with lower dietary energy levels.

* The main concern should not be to formulate only least cost rations. It is more important to formulate a feed that allows the least production cost, that is, a diet that promotes the best possible performance at the lowest possible cost.

* Lysine was used as reference to estimate amino acid nutritional requirements. Lysine requirements for barrows, sows, and entire males were determined in several dose-response trials carried out with pigs of different ages at UFV. Results of experiments carried out in other Brazilian institutions were also used. The requirement of the other amino acids was based on the concept of Ideal Protein, maintaining for each type of pig the Amino Acid / Lysine Ratio, expressed on total and true digestibility basis.

* For swine in the starter, grower and finisher phases, firstly all dose-response experiments with lysine were compiled and daily intake of digestible lysine was determined. Then, lysine maintenance requirements were calculated and the amount of digestible lysine / kg of gain for the difference phases were obtained. The results of 57 experimental data sets were used: 24 with barrows, 18 with sows, and 15 with entire males. It must be mentioned that the same 8 data sets of starter pigs (15-30

kg body weight) were included in all calculations. Tables 3.01, 3.03 and 3.05 show the methodology used to calculate the amount of true digestible lysine / kg weight gain of growing pigs. The equations used to estimate true digestible lysine requirements of barrows, gilts and entire males according to performance are presented in Tables 3.02, 3.04 and 3.06.

* The use of equations to estimate true digestible lysine requirement of pigs allows more flexibility, because in reality there is not only one single requirement, but many as a function of performance and feed intake. As an example of the variation of lysine requirements, performance data of barrows, gilts, and entire males are shown. In order to make the use of Brazilian Tables easier, examples of requirements for the starter, grower, and finisher phases of pigs with below average, standard, and high performance are presented.

* In Brazil and several Latin-American countries, the addition of ractopamine in finisher pig diets is very common. Two tables are included here with recommendations considering the effect of ractopamine on pig performance and on changes in digestible lysine requirements. Data obtained in two PhD theses developed at the Dept. of Animal Science of UFV and the model developed by Schinckel et al. (J. Anim. Sci. 81:1106, 2003) were used. Ractopamine dietary levels and its decreasing effect with time on pig performance and protein deposition were considered. Values are 100%, 90%, 78%, and 65% on weeks 1, 2, 3, and 4 of feeding, respectively (Tables 3.24 and 3.25).

* The established protein levels should be assumed only as practical suggestions. These are minimum values for diets based on corn and soybean meal when the Crystalline amino acids lysine, methionine, and threonine are offered. Aiming at reducing environmental impact of excessive nutrients in pig

diets, excellent experimental and practical results have been obtained with low protein diets while maintaining the recommended levels of essential amino acids, which are indeed the most important.

* In general, at the recommended protein levels, arginine, valine, isoleucine, leucine, histidine, and phenylalanine + tyrosine requirements are met.

* Amino acids levels must be close to the recommendations. High protein diets must also be avoided.

* Digestible methionine + cystine requirements were established based on a minimum of 50% sulfur amino acids supplied by methionine. As to phenylalanine + tyrosine requirements, the first must also supply at least 50% of the requirements.

* A procedure similar to that used for lysine was applied to obtain the equation that calculates phosphorus requirements for growing pigs. However, it was based in a lower number of experiments and higher variation was found. First, phosphorus requirement for maintenance (0.046 $W^{0.75}$) was calculated using endogenous excretion data in 2009 by Bünzen (PhD thesis, UFV). Results of dose-response trials on phosphorus requirements were used to calculate the amount of phosphorus (available and true digestible) / kg weight gain for the different growing phases. Table 3.12 shows the equations obtained to estimated phosphorus requirements and Ca:P ratios recommended for barrows, gilts, and entire males.

* High calcium and phosphorus levels must be avoided in swine feeds, as in addition to affecting animal performance, they increase environmental contamination. Ca : available P ratio must be maintained around 2.03:1 and in 2.08:1 for Ca: digestible P ratio at the recommended levels. Ca requirements

were calculated based on available P and digestible P means multiplied by their respective ratios.

* There is little experimental information on sodium, potassium and chlorine requirements of pigs, but we decided to include the recommendations for these nutrients in order to obtain proper electrolyte balance in pig feeds.

* Nutritional requirements of sows were established as amount of nutrient per day per sow for optimal performance. Equations to determine ME and true digestible lysine daily requirements of lactating and gestating sows are also presented. These equations take into account data on body weight, weight gain, and reproductive weight gain during gestation and body weight, body weight loss, and litter weight gain during lactation. By using data obtained by the equation and the dietary energy level, it is possible to estimate daily feed intake and to calculate the percentage of nutrients in the diet.

* As an example of variation in ME and lysine requirements, the performance data of gestating and lactating females are shown, where their ME and lysine requirements and feed intake are calculated. In order to make the use of the Brazilian Tables easier, examples of the nutritional requirements of sows with different production levels are shown in g/day and in %.

* In nutritional requirements studies, a strong influence of high environmental temperature on growing and finishing pigs is observed, with lower feed intake, caused by the lower energy requirements, in pigs maintained in environmental temperatures lower than those considered optimal for each rearing stage. There are correction factors to estimate the requirements of growing pigs, but examples of requirements of pigs reared at high environmental temperatures are not mentioned, because if performance and feed

intake are known, the optimal nutritional levels can be easily calculated using the tables shown in the text.

* Correction factors should also be established for pigs maintained in temperatures below 21°C. However, we consider that the stress effects of high environmental temperatures are more important in Brazil. In the case of replacement gilts and sows, energy requirements are lower when environmental temperature is higher than 16°C, up to an upper limit of 27°C.

* Simplified and practical tables of swine nutritional requirements are presented at the end of this publication (Tables 4.04 and 4.05) allowing a quick check of the nutritional levels commonly used in Brazil.

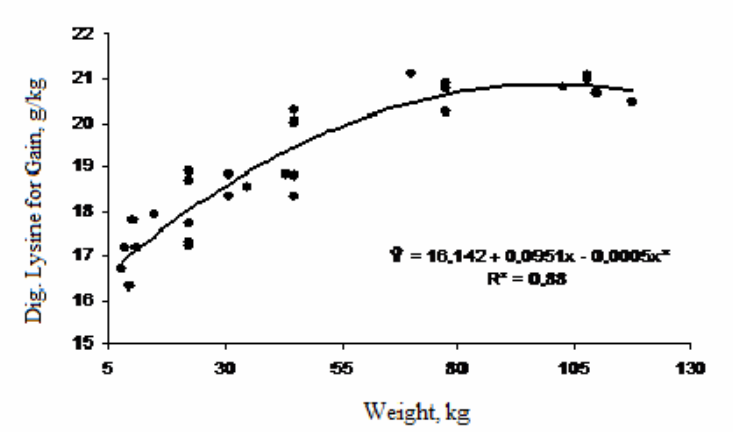
Nutritional Requirements of Growing Swine

Table 3.01 - Methodology Used to Obtain the Equation that Calculates the Amount of True Digestible Lysine / Kg Weight Gain of Barrows with High Genetic Potential

Weight, kg	15 – 30 [3]	30 - 60	60 - 95	95 – 125
Experimental Data[1]	8	7	4	5
Mean Weight in the Period, kg	22.5	40	77.5	110
Feed Intake, g/day	1252	2003	2935	3300
Dig Lys Intake, g/day	13.92	19.60	24.52	22.68
Lysine Maintenance, g/day[2]	0.397	0.607	0.923	1.216
Dig Lysine for Weight Gain, g/day	13.527	18.951	23.597	21.468
Average Gain, kg/day	0.782	0.983	1.105	1.078
g. Dig Lys / kg gain	18.036	19.260	20.761	20.792
Equation, g Lys/kg gain	18.182	19.307	20.474	20.565

Equation: $Y = 16.142 + 0.0951 \times (W) - 0.0005 \times (W)^2$ $R^2 = 0.88$
where Y = g Dig Lys / kg gain; W = Average Weight, kg.

[1] Total of 24 dose-response experiments with different lysine levels.
[2] Daily digestible lysine requirement for maintenance = 0.036 x (Av. weight)$^{0.75}$. Estimate based on the values obtained by Fuller et al. 1989 (British J. Nutr. 62:255).
[3] In this phase, experimental data of barrows and females were used



Graph 3.01 – Equation Estimating the Value, in Grams, of True Digestible Lysine / Kg Weight Gain of Barrows as a Function of Weight (15 to 125 kg).

Table 3.02 - Equation Used to Estimate True Digestible Lysine (Dig. Lys) Requirements of Barrows with High Genetic Potential

Dig Lys (g/day) = $0.036 \times W^{0.75}$ + (g. Dig. Lys/kg gain) x G

W = Average Body Weight in kg
g. Dig. Lys / kg gain = $16.142 + 0.0951 \times (W, kg) - 0.0005 \times (W)^2$
G = Gain / day in kg

Example: Barrows
Av. weight = 50 kg, where $W^{0.75} = 18.803$
g. Dig. Lys/kg gain = $16.142 + 0.0951 (50) - 0.0005 (50)^2 = 19.647$ g.
G = 0.950 kg

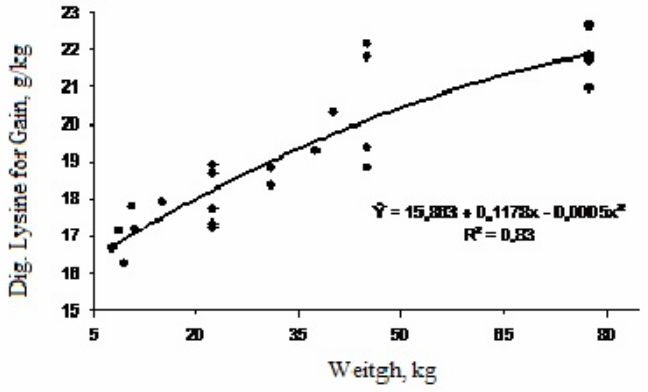
Dig. Lys Req.= $0.036 \times 18.803 + (19.647 \times 0.950) = 19.342$ g/day
Intake estimate = 2145 g/day
% Dig Lys in the diet = 0.902%

Table 3.03 - Methodology Used to Obtain The Equation that Calculates the Amount of True Digestible Lysine / Kg Weight Gain of Gilts with High Genetic Potential

Weight, kg	15 – 30 [3]	30 - 60	60-95
Experimental Data[1]	8	6	4
Mean, Weight The Period, kg	22.5	45	77.5
Feedlintake, g/day	1252	1914	2467
Dig Lys Intake, g/day	13.92	20.01	22.90
Lysine Maintenance, g/day[2]	0.397	0.603	0.940
Dig Lysine Weight Gain, g/day	13.527	19.402	21.958
Average Gain, kg/day	0.782	0.969	1.007
g Dig Lys / kg gain	18.036	20.299	21.782
Equation, g Lys / kg gain	18.461	19.998	21.989

Equation: $Y = 15.863 + 0.1178 \times (W) - 0.0005 \times (W)^2$ $R^2 = 0.83$
where Y = g Dig Lys / kg gain; W = Average weight, kg.

[1] Total of 18 dose-response experiments with different lysine levels.
[2] Daily digestible lysine requirement for maintenance = 0.036 x (Av. weight)$^{0.75}$. Estimate based on the values obtained by Fuller et al. 1989 (British J. Nutr. 62:255).
[3] In this phase, experimental data of barrows and females were used



Graph 3.02 -Equation Estimating the Value in Grams of True Digestible Lysine/Kg Weight Gain of Gilts as a Function of Weight (15 to 95 kg).

Table 3.04 - Equation Used to Estimate True Digestible Lysine (Dig. Lys) Requirements for Gilts with High Genetic Potential

Dig Lys (g/day) = $0.036 \times W^{0.75}$ + (g. Dig. Lys / kg gain) x G

W = Average Body Weight in kg
g. Dig. Lys / kg gain = $15.863 + 0.1178 \times (W) - 0.0005 \times (W)^2$
G = Gain / day in kg

Example: Gilts

Av. weight = 60 kg, where $W^{0.75} = 21.558$
g. Dig. Lys/kg gain = $15.863 + 0.1178 \times (60) - 0.0005 \times (60)^2$ = 21.131 g.
G = 0.957 kg

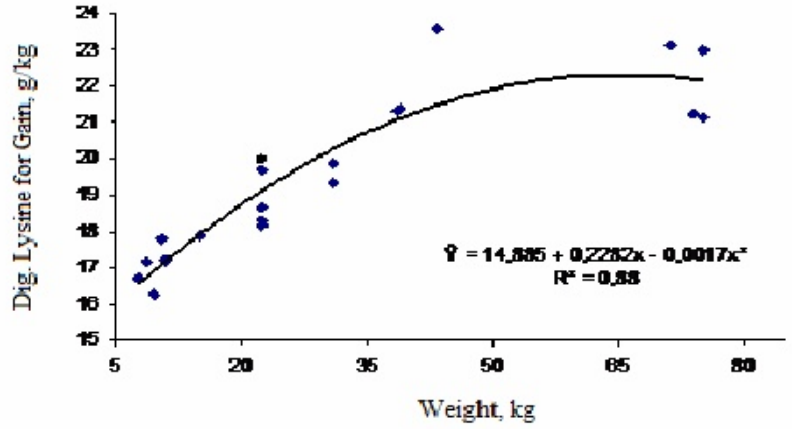
Dig. Lys Req.(g/day) = $0.036 \times 21.558 + (21.131 \times 0.957)$ = 20.998 g.
Intake estimate = 2260 g/day
% Dig Lys in the diet = 0.929%

Table 3.05 - Methodology Used to Obtain the Equation that Calculates the Amount of True Digestible Lysine / Kg Weight Gain of Entire Males with High Genetic Potential

Weight, kg	15 – 30 [3]	30 - 60	60-95
Experimental Data[1]	8	3	4
Mean Weight in the Period, kg	22.5	45	77.5
Feed Intake, g/day	1128	1651	2416
Dig Lys intake, g/day	13.63	19.81	24.76
Lysine Maintenance, g/day[2]	0.390	0.576	0.906
Dig Lysine Weight Gain, g/day	13.240	19.237	23.853
Average Gain, kg/day	0.682	0.873	1.069
g Dig Lys / kg gain	19.414	22.095	22.431
Equation, g Lys / kg gain	19.375	21.324	22.469

Equation: $Y = 14.885 + 0.2282 \times (W) - 0.0017 \times (W)^2$ $R^2 = 0.88$
Where Y = g Dig Lys / kg gain; W = Average weight, kg.

[1] Total of 15 dose-response experiments with different lysine levels.
[2] Daily digestible lysine requirement for maintenance = 0.036 x (Av. weight)$^{0.75}$. Estimate based on the values obtained by Fuller et al. 1989 (British J. Nutr. 62:255).
[3] In this phase, experimental data of barrows and females were used



Graph 3.03 - Equation Estimating the Value, in Grams, of True Digestible Lysine/Kg Weight Gain of Entire Males as a Function of Weight (15 a 95 kg).

Table 3.06 - Equation Used to Estimate True Digestible Lysine (Dig. Lys) Requirements for Entire Males of High Genetic Potential

Dig Lys (g/day) = 0.036 x $W^{0.75}$ + (g. Dig. Lys / kg gain) x G

W = Average Body Weight in kg
g. Dig. Lys / kg gain = 14.885 + 0.2282 x (W) - 0.0017 x $(W)^2$
G = Gain / day in kg

Example: Entire Males

Av. weight = 70 kg, where $W^{0.75}$ = 24.200
g. Dig. Lys/kg gain = 14.885 + 0.2282 x (70) - 0.0017 x $(70)^2$ = 22.529 g.
G = 1.114 kg

Dig. Lys Req.(g/day) = 0.036 x 24.200 + (22.529 x 1.114) = 25.969 g.
Intake estimate = 2350 g/day
% Dig Lys in the diet = 1.105%

Table 3.07 - Digestible Lysine Requirements of Barrows of High Genetic Potential with Standard Performance Using the Equation on Table 3.02

Age, days	Weight kg	Gain kg/day	Dig Lys Req g/day	Intake kg/day	Cumulative Intake kg	ME intake Mcal/day[1]	Lys/ME Ratio %/Mcal	Dig Lys %
42	14.20	0.550	9.83	0.860	6.0	2.78	0.411	1.143
49	18.05	0.610	11.11	0.990	13.0	3.20	0.351	1.122
56	22.32	0.665	12.35	1.130	20.9	3.65	0.299	1.093
63	26.97	0.720	13.63	1.306	30.0	4.22	0.248	1.044
70	32.01	0.775	14.96	1.540	40.8	4.97	0.195	0.971
77	37.44	0.885	16.79	1.780	53.2	5.75	0.164	0.943
84	43.42	0.890	17.81	1.950	66.9	6.30	0.145	0.913
91	49.65	0.950	19.32	2.145	81.9	6.93	0.130	0.901
98	56.30	0.978	20.20	2.335	98.2	7.54	0.115	0.865
105	63.15	1.005	21.06	2.495	115.7	8.06	0.105	0.844
112	70.18	1.023	21.68	2.620	134.1	8.46	0.098	0.828
119	77.34	1.053	22.52	2.781	153.5	8.98	0.090	0.810
126	84.71	1.060	22.85	2.894	173.8	9.35	0.084	0.790
133	92.13	1.075	23.28	3.045	195.1	9.84	0.078	0.765
140	99.65	1.080	23.44	3.123	217.0	10.09	0.074	0.751
147	107.21	1.085	23.54	3.294	240.0	10.64	0.067	0.715
154	114.81	1.095	23.68	3.375	263.6	10.90	0.064	0.702
161	122.47	1.082	23.27	3.424	287.6	11.06	0.061	0.680
168	130.04	1.073	22.89	3.505	312.1	11.32	0.058	0.653

[1] Diets containing 3230 kcal ME / kg for the Starter, Grower and Finisher phases.

Table 3.08 - Digestible Lysine Requirements of Barrows of High Genetic Potential with High Performance Using the Equation on Table 3.02

Age, Days	Weight kg	Gain kg/day	Dig Lys Req g/day	Intake kg/day	Cumulative Intake kg	ME intake Mcal/day[1]	Lys/ME Ratio %/Mcal	Dig Lys %
42	15.30	0.629	11.27	0.900	6.3	2.91	0.431	1.252
49	19.70	0.671	12.30	1.030	13.5	3.33	0.359	1.194
56	24.40	0.729	13.63	1.180	21.8	3.81	0.303	1.155
63	29.50	0.786	15.00	1.360	31.3	4.39	0.251	1.103
70	35.00	0.800	15.60	1.490	41.7	4.81	0.218	1.047
77	40.60	0.943	18.66	1.905	55.1	6.15	0.159	0.980
84	47.20	0.971	19.61	2.070	69.5	6.69	0.142	0.947
91	54.00	1.014	20.82	2.290	85.6	7.40	0.123	0.909
98	61.10	1.029	21.45	2.460	102.8	7.95	0.110	0.872
105	68.30	1.086	22.91	2.640	121.3	8.53	0.102	0.868
112	75.90	1.100	23.45	2.750	140.5	8.88	0.096	0.853
119	83.60	1.143	24.54	2.925	161.0	9.45	0.089	0.839
126	91.60	1.157	24.97	3.050	182.4	9.85	0.083	0.819
133	99.70	1.171	25.33	3.200	204.8	10.34	0.077	0.792
140	107.90	1.157	25.02	3.260	227.6	10.53	0.073	0.768
147	116.00	1.143	24.64	3.350	251.0	10.82	0.068	0.735
154	124.00	1.121	24.04	3.400	274.8	10.98	0.064	0.707
161	132.20	1.107	23.53	3.450	299.0	11.14	0.061	0.682
168	140.50	1.100	23.10	3.510	323.5	11.34	0.058	0.658

[1] Diets containing 3230 kcal ME / kg for the Starter, Grower and Finisher phases.

Table 3.09 - Digestible Lysine Requirements of Gilts of High Genetic Potential with Standard Performance Using the Equation on Table 3.04

Age, Days	Weight kg	Gain kg/day	Dig Lys Req g/day	Intake kg/day	Cumulative Intake kg	ME Intake Mcal/day[1]	Lys/ME Ratio %/Mcal	Dig Lys %
42	14.13	0.542	9.71	0.830	5.8	2.68	0.437	1.170
49	17.92	0.596	10.93	0.990	12.7	3.20	0.345	1.104
56	22.10	0.639	12.01	1.120	20.6	3.62	0.296	1.073
63	26.57	0.686	13.21	1.260	29.4	4.07	0.258	1.049
70	31.37	0.775	15.26	1.480	39.8	4.78	0.216	1.031
77	36.80	0.829	16.71	1.695	51.6	5.47	0.180	0.986
84	42.60	0.843	17.43	1.780	64.1	5.75	0.170	0.980
91	48.50	0.900	19.02	1.950	77.7	6.30	0.155	0.975
98	54.80	0.929	20.05	2.070	92.2	6.69	0.145	0.969
105	61.30	0.957	21.08	2.260	108.0	7.30	0.128	0.933
112	68.00	0.986	22.11	2.450	125.2	7.91	0.114	0.902
119	74.90	1.000	22.80	2.600	143.4	8.40	0.104	0.877
126	81.90	1.071	24.72	2.860	163.4	9.24	0.094	0.864
133	89.40	1.029	24.08	2.900	183.7	9.37	0.089	0.831
140	96.60	1.014	24.01	3.050	205.1	9.85	0.080	0.787
147	103.70	1.000	23.87	3.200	227.5	10.34	0.072	0.746

[1] Diets containing 3230 kcal ME / kg for the Starter, Grower and Finisher phases.

Table 3.10 - Digestible Lysine Requirements of Gilts of High Genetic Potential with High Performance Using the Equation on Table 3.04

Age, Days	Weight kg	Gain kg/day	Dig Lys Req g/day	Intake kg/day	Cumulative Intake kg	ME Intake Mcal/day[1]	Lys/ME Ratio %/Mcal	Dig Lys %
42	14.31	0.550	9.86	0.805	5.6	2.60	0.471	1.226
49	18.16	0.616	11.30	0.950	12.3	3.07	0.387	1.188
56	22.47	0.679	12.76	1.109	20.0	3.58	0.321	1.151
63	27.22	0.721	13.91	1.282	29.0	4.14	0.262	1.085
70	32.27	0.759	15.02	1.459	39.2	4.71	0.219	1.030
77	37.58	0.813	16.46	1.624	50.6	5.24	0.193	1.014
84	43.27	0.873	18.08	1.812	63.3	5.85	0.171	0.998
91	49.38	0.926	19.61	1.974	77.1	6.38	0.156	0.994
98	55.86	0.959	20.76	2.112	91.9	6.82	0.144	0.983
105	62.57	0.976	21.56	2.240	107.6	7.24	0.133	0.963
112	69.40	1.008	22.67	2.400	124.4	7.75	0.122	0.944
119	76.46	1.023	23.37	2.490	141.8	8.04	0.117	0.939
126	83.62	1.054	24.41	2.650	160.3	8.56	0.108	0.921
133	90.99	1.063	24.91	2.750	179.6	8.88	0.102	0.906
140	98.43	1.060	25.10	2.790	199.1	9.01	0.100	0.900
147	105.86	1.048	25.00	2.840	219.0	9.17	0.096	0.880

[1] Diets containing 3230 kcal ME / kg for the Starter, Grower and Finisher phases.

Table 3.11 - Digestible Lysine Requirements of Entire Males of High Genetic Potential with Standard Performance Using the Equation on Table 3.06

Age, Days	Weight kg	Gain kg/day	Dig Lys Req g/day	Intake kg/day	Cumulative Intake kg	ME Intake Mcal/day[1]	Lys/ME Ratio %/Mcal	Dig Lys %
42	15.28	0.532	9.67	0.795	5.6	2.57	0.474	1.216
49	19.00	0.557	10.52	0.870	11.7	2.81	0.431	1.210
56	22.90	0.671	13.10	1.082	19.2	3.49	0.346	1.210
63	27.60	0.729	14.74	1.220	27.8	3.94	0.307	1.209
70	32.70	0.771	16.16	1.340	37.1	4.33	0.279	1.206
77	38.10	0.871	18.79	1.570	48.1	5.07	0.236	1.197
84	44.20	0.900	19.97	1.670	59.8	5.39	0.222	1.196
91	50.50	0.971	22.02	1.850	72.8	5.98	0.199	1.190
98	57.30	0.986	22.74	1.950	86.4	6.30	0.185	1.166
105	64.20	1.057	24.60	2.130	101.3	6.88	0.168	1.155
112	71.60	1.114	25.97	2.350	117.8	7.59	0.146	1.105
119	79.40	1.171	27.12	2.570	135.8	8.30	0.127	1.055
126	87.60	1.186	27.03	2.680	154.5	8.66	0.117	1.008
133	95.90	1.243	27.55	2.810	174.2	9.08	0.108	0.980
140	104.60	1.214	25.88	2.850	194.2	9.21	0.099	0.908
147	113.10	1.214	24.54	2.910	214.5	9.40	0.090	0.843

[1] Diets containing 3230 kcal ME / kg for the Starter, Grower and Finisher phases.

Table 3.12 - Equations Used to Estimate Available Phosphorus (Pav) and Digestible Phosphorus (Pdig) Requirements and Calcium:Phosphorus Ratio for Growing Pigs with High Genetic Potential[1]

AVAILABLE PHOSPHORUS REQUIREMENT

Barrows (Below Average, Standard and High Performance).
14 - 50 kg W: Y (g Pav/day) = 0.046 x $W^{0.75}$ + 5.81 x G
51 - 120 kg W: Y (g Pav/day) = 0.046 x $W^{0.75}$ + 5.33 x G

Females (Below Average, Standard and High Perform.) and Entire Males.

14-100 kg W: Y (g Pav/day) = 0.046 x $W^{0.75}$ + 5.96 x G

where: W= Av. weight in kg; G= Av. daily gain in kg.

Recommended total Ca:available P ratio: 2.03

TRUE DIGESTIBLE PHOSPHORUS REQUIREMENT

Barrows (Below Average, Standard and High Performance).
14 - 50 kg W: Y (g Pav/day) = 0.046 x $W^{0.75}$ + 5.60 x G
51 - 120 kg W: Y (g Pav/day) = 0.046 x $W^{0.75}$ + 5.30 x G

Females (Below Average, Standard and High Perform.) and Entire Males.

14-100 kg W: Y (g Pav/day) = 0.046 x $W^{0.75}$ + 5.75 x G

where: W= Av. weight in kg; G= Av. daily gain in kg.

Recommended total Ca:available P ratio: 2.08

Example of Digestible phosphorus Requirement of barrows:
W (Av. weight) : 84.71 kg;$W^{.75}$ = 27.922
G (Av. gain) : 1.060 kg / day
Av. Intake : 2894 g / day

Y (g Pdig/day) : 0.046 x $(84.71)^{0.75}$ + 5.3 x 1.060 = 6.902
% Pdig in the diet : (6.902 x 100) / 2894 = 0.238 %
% Ca in the diet : 0.238 x 2.08 = 0.495 %

[1] Daily phosphorus requirements for maintenance and gain were estimated according to the values obtained by Bunzen 2009 (PhD thesis, UFV), Jongbloed et al (1993) and performance data obtained at UFV.

Table 3.13 - Nutritional Requirements of Available Phosphorus, True Digestible Phosphorus, and Calcium of High Genetic Potential Barrows Using the Equation on Table 3.12

Age, days	Weight kg	Gain kg/day	Intake kg/day	Pav g/day	Pav %	Pdig g/day	Pdig %	Ca[1] %
Barrows - Standard performance								
42	14.20	0.550	0.860	3.532	0.411	3.416	0.397	0.830
56	22.32	0.665	1.130	4.336	0.384	4.196	0.371	0.776
70	32.01	0.775	1.540	5.122	0.333	4.959	0.322	0.672
84	43.42	0.890	1.950	5.949	0.305	5.762	0.295	0.617
98	56.30	0.978	2.335	6.158	0.264	6.129	0.262	0.541
112	70.18	1.023	2.620	6.568	0.251	6.537	0.250	0.514
126	84.71	1.060	2.894	6.934	0.240	6.902	0.239	0.491
140	99.65	1.080	3.123	7.207	0.231	7.175	0.230	0.473
154	114.81	1.095	3.375	7.450	0.221	7.417	0.220	0.453
Barrows - High performance								
42	15.30	0.629	0.900	4.010	0.446	3.878	0.431	0.900
56	24.40	0.729	1.180	4.741	0.402	4.587	0.389	0.812
70	35.00	0.800	1.490	5.310	0.356	5.142	0.345	0.721
84	47.20	0.971	2.070	6.470	0.313	6.266	0.303	0.632
98	61.10	1.029	2.460	6.490	0.264	6.459	0.263	0.541
112	75.90	1.100	2.750	7.046	0.256	7.013	0.255	0.525
126	91.60	1.157	3.050	7.529	0.247	7.494	0.246	0.506
140	107.90	1.157	3.260	7.707	0.236	7.672	0.235	0.485
154	124.00	1.121	3.400	7.684	0.226	7.651	0.225	0.463

[1] % Ca: average calculated by multiplying avail P %by the factor 2.03 and dig P% by the factor 2.08.

Table 3.14 - Nutritional Requirements of Available Phosphorus, True Digestible Phosphorus, and Calcium of High Genetic Potential Gilts and Entire Males Using The Equation on Table 3.12

Age, days	Weight kg	Gain kg/day	Intake kg/day	Pav g/day	Pav %	Pdig g/day	Pdig %	Ca[1] %
Gilts -Standard Performance								
42	14.13	0.542	0.830	3.566	0.430	3.452	0.416	0.869
56	22.1	0.639	1.120	4.277	0.382	4.143	0.370	0.772
70	31.37	0.775	1.480	5.229	0.353	5.066	0.342	0.715
84	42.6	0.843	1.780	5.791	0.325	5.614	0.315	0.658
98	54.8	0.929	2.070	6.463	0.312	6.268	0.303	0.632
112	68	0.986	2.450	6.966	0.284	6.759	0.276	0.575
126	81.9	1.071	2.860	7.635	0.267	7.411	0.259	0.540
140	96.6	1.014	3.050	7.461	0.245	7.248	0.238	0.495
Gilts - High Performance								
42	14.31	0.55	0.805	3.616	0.449	3.501	0.435	0.908
56	22.47	0.679	1.109	4.522	0.408	4.379	0.395	0.824
70	32.27	0.759	1.459	5.146	0.353	4.987	0.342	0.714
84	43.27	0.873	1.812	5.979	0.330	5.796	0.320	0.668
98	55.86	0.959	2.112	6.656	0.315	6.454	0.306	0.638
112	69.4	1.008	2.400	7.114	0.296	6.902	0.288	0.600
126	83.62	1.054	2.650	7.554	0.285	7.333	0.277	0.577
140	98.43	1.060	2.790	7.755	0.278	7.532	0.270	0.563
Entire Males - Standard Performance								
42	15.28	0.532	0.795	3.526	0.444	3.415	0.429	0.897
56	22.90	0.671	1.082	4.481	0.414	4.340	0.401	0.837
70	32.70	0.771	1.340	5.224	0.390	5.062	0.378	0.789
84	44.20	0.900	1.670	6.153	0.368	5.964	0.357	0.745
98	57.30	0.986	1.950	6.835	0.350	6.628	0.340	0.709
112	71.60	1.114	2.350	7.772	0.331	7.538	0.321	0.669
126	87.60	1.186	2.680	8.386	0.313	8.137	0.304	0.633
140	104.60	1.214	2.850	8.740	0.307	8.485	0.298	0.622

[1] % Ca: average calculated by multiplying avail P %by the factor 2.03 and dig P% by the factor 2.08.

Table 3.15 - Amino Acid / Lysine Ratios Used to Estimate Amino Acid Requirements of Growing Swine

Phase	Starter		Grower		Finisher	
Amino Acid	Digestible	Total	Digestible	Total	Digestible	Total
Lysine	100	100	100	100	100	100
Methionine	28	27	30	29	31	30
Methionine + Cystine	56	55	59	58	60	59
Threonine	63	67	65	69	67	71
Tryptophan	18	18	18	18	18	18
Arginine	42	40	41	39	32	30
Valine	69	70	69	70	69	70
Isoleucine	55	55	55	55	55	55
Leucine	100	97	100	97	100	97
Histidine	33	32	33	32	33	32
Phenylalanine	50	49	50	49	50	49
Phen + Tyr	100	98	100	98	100	98

Table 3.16 - Nutritional Requirements of High Genetic Potential Piglets in the Pre-Starter Phase - Barrows, Gilts and Entire Males[1]

Live Weight	kg	3.5 - 5.3	5.5 – 9	9.3 - 15
Age	Days	14 - 20	21 – 32	33 - 42
Metabolizable Energy	kcal/kg	3450	3400	3375
		Nutrient		
Protein	%	20.00	20.00	21.00
Calcium	%	0.888	0.850	0.825
Available Phosphorus	%	0.550	0.500	0.450
Digestible Phosphorus	%	0.500	0.450	0.410
Potassium	%	0.520	0.520	0.500
Sodium	%	0.280	0.280	0.230
Chlorine	%	0.250	0.250	0.220
		Digestible Amino Acid		
Lysine	%	1.520	1.450	1.330
Methionine	%	0.426	0.406	0.372
Methionine+Cystine	%	0.851	0.812	0.745
Threonine	%	0.958	0.914	0.838
Tryptophan	%	0.274	0.261	0.239
Arginine[1]	%	1.292	1.233	1.131
Valine	%	1.049	1.001	0.918
Isoleucine	%	0.836	0.798	0.732
Leucine	%	1.520	1.450	1.330
Histidine	%	0.502	0.479	0.439
Phenylalanine	%	0.760	0.725	0.665
Phenylalanine + Tyrosine	%	1.520	1.450	1.330
		Total Amino Acid		
Lysine	%	1.655	1.580	1.450
Methionine	%	0.447	0.427	0.392
Methionine+Cystine	%	0.910	0.869	0.798
Threonine	%	1.109	1.059	0.972
Tryptophan	%	0.298	0.284	0.261
Arginine[1]	%	1.374	1.311	1.204
Valine	%	1.159	1.106	1.015
Isoleucine	%	0.910	0.869	0.798
Leucine	%	1.605	1.533	1.407
Histidine	%	0.530	0.506	0.464
Phenylalanine	%	0.811	0.774	0.711
Phenylalanine + Tyrosine	%	1.622	1.548	1.421

[1] Recommended Digestible Arg: Lys ratio of 85% and Total Arg: Lys ratio of 83% are recommended.

Table 3.17 - Nutritional Requirements High Genetic Potential Barrows with Below Average Performance[1]

Phase	Starter		Grower				Finisher			
Live Weight, kg	15 - 30		30 - 50		50 - 70		70 - 100		100 - 120	
Age, days	44 - 70		71 – 95		96 - 117		118 - 148		149 – 171	
Av. Weight, kg	22.5		40		60		85		110	
Weight Gain, kg/day	0.590		0.861		0.954		0.989		0.920	
Intake, kg/day	1.094		1.880		2.475		2.980		3.495	
Avail P Req., g/day	3.90		5.73		6.08		6.56		6.47	
Dig. P Req., g/day	3.78		5.55		6.05		6.53		6.34	
Dig Lysine Req., g/day	11.01		17.06		19.90		21.39		20.13	
ME, Kcal/Kg	3230		3230		3230		3230		3230	
					Nutrient					
Protein, %	17.35		15.80		14.30		12.71		11.60	
Calcium, %	0.721		0.627		0.503		0.451		0.376	
Avail. Phosphorus, %	0.357		0.305		0.246		0.220		0.185	
Dig. Phosphorus, %	0.345		0.295		0.244		0.219		0.181	
Potassium, %	0.470		0.448		0.425		0.400		0.372	
Sodium, %	0.200		0.180		0.170		0.160		0.150	
Chlorine, %	0.190		0.170		0.160		0.150		0.140	
Amino Acid	Dig.	Total	Dig.	Total	Dig.	Total	Dig.	Total	Dig.	Total
Lysine, %	1.006	1.143	0.907	1.031	0.804	0.914	0.718	0.816	0.576	0.655
Methionine, %	0.282	0.309	0.272	0.299	0.241	0.265	0.223	0.245	0.179	0.196
Methionine + Cystine, %	0.563	0.629	0.535	0.598	0.474	0.530	0.431	0.481	0.346	0.386
Threonine, %	0.634	0.766	0.590	0.711	0.523	0.630	0.481	0.579	0.386	0.465
Tryptophan, %	0.181	0.206	0.163	0.186	0.145	0.164	0.129	0.147	0.104	0.118
Arginine, %	0.423	0.457	0.372	0.402	0.330	0.356	0.230	0.245	0.184	0.196
Valine, %	0.694	0.800	0.626	0.721	0.555	0.640	0.495	0.571	0.397	0.458
Isoleucine, %	0.553	0.629	0.499	0.567	0.442	0.503	0.395	0.449	0.317	0.360
Leucine, %	1.006	1.109	0.907	1.000	0.804	0.886	0.718	0.791	0.576	0.635
Histidine, %	0.332	0.366	0.299	0.330	0.265	0.292	0.237	0.261	0.190	0.209
Phenylalanine, %	0.503	0.560	0.454	0.505	0.402	0.448	0.359	0.400	0.288	0.321
Phenyl+ Tyrosine, %	1.006	1.120	0.907	1.010	0.804	0.895	0.718	0.800	0.576	0.641

[1] Nutrient percentage was determined using Tables 3.02 (dig. Lys requirement.), 3.15 (amino acid / lysine ratio) and 3.14 (phosphorus requirement). Total lysine requirement was calculated considering an average lysine true digestibility of 88%.

Table 3.18 - Nutritional Requirements of High Genetic Potential Barrows with Standard Performance[1]

Phase	Starter		Grower				Finisher			
Live Weight, kg	15 - 30		30 - 50		50 – 70		70 - 100		100 - 120	
Age, days	42 – 67		68 - 91		92 - 112		113 - 140		141 - 160	
Av. Weight, kg	22.5		40		60		85		110	
Weight Gain, kg/day	0.693		0.868		1.014		1.071		1.084	
Intake, kg/day	1.241		1.854		2.563		3.027		3.399	
Avail P Req., g/day	4.50		5.77		6.40		7.00		7.34	
Dig. P Req., g/day	4.36		5.59		6.37		6.96		7.31	
Dig Lysine Req., g/day	12.87		17.19		21.10		23.08		23.50	
ME, Kcal/Kg	3230		3230		3230		3230		3230	
					Nutrient					
Protein, %	18.13		16.82		15.43		13.83		12.39	
Calcium, %	0.733		0.630		0.512		0.474		0.443	
Avail. Phosphorus, %	0.363		0.311		0.250		0.231		0.216	
Dig. Phosphorus, %	0.351		0.302		0.248		0.230		0.215	
Potassium, %	0.470		0.448		0.425		0.400		0.372	
Sodium, %	0.200		0.180		0.170		0.160		0.150	
Chlorine, %	0.190		0.170		0.160		0.150		0.140	
Amino Acid	Dig.	Total	Dig.	Total	Dig.	Total	Dig.	Total	Dig.	Total
Lysine, %	1.037	1.178	0.927	1.053	0.823	0.935	0.763	0.867	0.691	0.785
Methionine, %	0.290	0.318	0.278	0.305	0.247	0.271	0.237	0.260	0.214	0.236
Methionine + Cystine, %	0.581	0.648	0.547	0.611	0.486	0.542	0.458	0.512	0.415	0.463
Threonine, %	0.653	0.790	0.603	0.727	0.535	0.645	0.511	0.616	0.463	0.558
Tryptophan, %	0.187	0.212	0.167	0.190	0.148	0.168	0.137	0.156	0.124	0.141
Arginine, %	0.436	0.471	0.380	0.411	0.337	0.365	0.244	0.260	0.221	0.236
Valine, %	0.716	0.825	0.640	0.737	0.568	0.655	0.526	0.607	0.477	0.550
Isoleucine, %	0.570	0.648	0.510	0.579	0.453	0.514	0.420	0.477	0.380	0.432
Leucine, %	1.037	1.143	0.927	1.022	0.823	0.907	0.763	0.841	0.691	0.762
Histidine, %	0.342	0.377	0.306	0.337	0.272	0.299	0.252	0.277	0.228	0.251
Phenylalanine, %	0.519	0.577	0.464	0.516	0.412	0.458	0.382	0.425	0.346	0.385
Phenylal+ Tyrosine, %	1.037	1.155	0.927	1.032	0.823	0.917	0.763	0.850	0.691	0.770

[1] Nutrient percentage was determined using Tables 3.02 (dig. Lys requirement.), 3.15 (amino acid / lysine ratio) and 3.14 (phosphorus requirement). Total lysine requirement was calculated considering an average lysine true digestibility of 88%.

Table 3.19 - Nutritional Requirements of High Genetic Potential Barrows with High Performance [1]

Phase	Starter		Grower		Grower		Finisher		Finisher	
Live Weight, kg	15 – 30		30 - 50		50 – 70		70 - 100		100 - 120	
Age, days	41 – 64		65 - 87		88 - 107		108 - 133		134 - 150	
Av. Weight, kg	22.5		40		60		85		110	
Weight Gain, kg/day	0.746		0.935		1.050		1.130		1.160	
Intake, kg/day	1.265		1.960		2.450		2.930		3.350	
Avail P Req., g/day	4.81		6.16		6.59		7.31		7.75	
Dig. P Req., g/day	4.65		5.97		6.56		7.28		7.71	
Dig Lysine Req., g/day	13.82		18.47		21.83		24.30		25.06	
ME, Kcal/Kg	3230		3230		3230		3230		3230	
					Nutrient					
Protein, %	19.24		18.25		17.07		15.53		13.92	
Calcium, %	0.768		0.635		0.552		0.512		0.474	
Avail. Phosphorus, %	0.380		0.314		0.269		0.250		0.231	
Dig. Phosphorus, %	0.368		0.304		0.268		0.248		0.230	
Potassium, %	0.470		0.448		0.425		0.400		0.372	
Sodium, %	0.200		0.180		0.170		0.160		0.150	
Chlorine, %	0.190		0.170		0.160		0.150		0.140	
Amino Acid	Dig.	Total	Dig.	Total	Dig.	Total	Dig.	Total	Dig.	Total
Lysine, %	1.093	1.242	0.943	1.072	0.891	1.013	0.829	0.942	0.748	0.850
Methionine, %	0.306	0.335	0.283	0.311	0.267	0.294	0.257	0.283	0.232	0.255
Met + Cys %	0.612	0.683	0.556	0.622	0.526	0.587	0.497	0.556	0.449	0.502
Threonine, %	0.689	0.832	0.613	0.739	0.579	0.699	0.555	0.669	0.501	0.604
Tryptophan, %	0.197	0.224	0.170	0.193	0.160	0.182	0.149	0.170	0.135	0.153
Arginine, %	0.459	0.497	0.387	0.418	0.365	0.395	0.265	0.283	0.239	0.255
Valine, %	0.754	0.869	0.651	0.750	0.615	0.709	0.572	0.659	0.516	0.595
Isoleucine, %	0.601	0.683	0.519	0.589	0.490	0.557	0.456	0.518	0.411	0.468
Leucine, %	1.093	1.205	0.943	1.039	0.891	0.982	0.829	0.914	0.748	0.825
Histidine, %	0.361	0.397	0.311	0.343	0.294	0.324	0.274	0.301	0.247	0.272
Phenylalanine, %	0.547	0.609	0.472	0.525	0.446	0.496	0.415	0.462	0.374	0.417
Phenyal+ Tyrosine, %	1.093	1.217	0.943	1.050	0.891	0.992	0.829	0.923	0.748	0.833

[1] Nutrient percentage was determined using Tables 3.02 (dig. Lys requirement.), 3.15 (amino acid / lysine ratio) and 3.14 (phosphorus requirement). Total lysine requirement was calculated considering an average lysine true digestibility of 88%.

Table 3.20 - Nutritional Requirements of High Genetic Potential Gilts with Below Average Performance [1]

Phase	Starter		Grower				Finisher	
Live Weight, kg	15 a 30		30 a 50		50 a 70		70 a 100	
Age, days	44 - 70		71 – 95		96 - 118		119 – 150	
Av. Weight, kg	22.5		40		60		85	
Weight Gain, kg/day	0.586		0.831		0.925		0.929	
Intake, kg/day	1.100		1.800		2.340		2.930	
Avail P Req., g/day	3.97		5.68		6.50		6.82	
Dig. P Req., g/day	3.84		5.51		6.31		6.63	
Dig Lysine Req., g/day	11.07		17.01		20.32		21.69	
ME, Kcal/Kg	3230		3230		3230		3230	
				Nutrient				
Protein, %	17.60		16.55		15.22		13.37	
Calcium, %	0.730		0.639		0.563		0.472	
Avail. Phosphorus, %	0.361		0.316		0.278		0.233	
Dig. Phosphorus, %	0.350		0.306		0.270		0.226	
Potassium, %	0.470		0.448		0.425		0.400	
Sodium, %	0.200		0.180		0.170		0.160	
Chlorine, %	0.190		0.170		0.160		0.150	
Amino Acid	Dig.	Total	Dig.	Total	Dig.	Total	Dig.	Total
Lysine, %	1.007	1.144	0.945	1.074	0.868	0.986	0.740	0.841
Methionine, %	0.282	0.309	0.284	0.311	0.260	0.286	0.229	0.252
Methionine + Cystine, %	0.564	0.629	0.558	0.623	0.512	0.572	0.444	0.496
Threonine, %	0.634	0.767	0.614	0.741	0.564	0.681	0.496	0.597
Tryptophan, %	0.181	0.206	0.170	0.193	0.156	0.178	0.133	0.151
Arginine, %	0.423	0.458	0.387	0.419	0.356	0.385	0.237	0.252
Valine, %	0.695	0.801	0.652	0.752	0.599	0.690	0.511	0.589
Isoleucine, %	0.554	0.629	0.520	0.591	0.477	0.543	0.407	0.463
Leucine, %	1.007	1.110	0.945	1.042	0.868	0.957	0.740	0.816
Histidine, %	0.332	0.366	0.312	0.344	0.286	0.316	0.244	0.269
Phenylalanine, %	0.504	0.561	0.473	0.526	0.434	0.483	0.370	0.412
Phenyal. + Tyrosine, %	1.007	1.121	0.945	1.052	0.868	0.967	0.740	0.824

[1] Nutrient percentage was determined using Tables 3.02 (dig. Lys requirement.), 3.15 (amino acid / lysine ratio) and 3.14 (phosphorus requirement). Total lysine requirement was calculated considering an average lysine true digestibility of 88%.

Table 3.21 - Nutritional Requirements of High Genetic Potential Gilts with Standard Performance [1]

Phase	Starter		Grower				Finisher	
Live Weight, kg	15 - 30		30 - 50		50 - 70		70 - 100	
Age, days	43 - 68		69 - 93		93 - 115		115 – 145	
Av. Weight, kg	22.5		40		60		85	
Weight Gain, kg/day	0.648		0.855		0.968		1.023	
Intake, kg/day	1.136		1.795		2.345		2.922	
Avail P Req., g/day	4.34		5.83		6.76		7.38	
Dig. P Req., g/day	4.20		5.65		6.56		7.17	
Dig Lysine Req., g/day	12.205		17.480		21.231		23.783	
ME, Kcal/Kg	3230		3230		3230		3230	
				Nutrient				
Protein, %	18.50		17.55		16.45		15.01	
Calcium, %	0.772		0.658		0.584		0.512	
Avail. Phosphorus, %	0.382		0.325		0.288		0.253	
Dig. Phosphorus, %	0.370		0.315		0.280		0.245	
Potassium, %	0.470		0.448		0.425		0.400	
Sodium, %	0.200		0.180		0.170		0.160	
Chlorine, %	0.190		0.170		0.160		0.150	
Amino Acid	Dig.	Total	Dig.	Total	Dig.	Total	Dig.	Total
Lysine, %	1.074	1.220	0.974	1.107	0.905	1.028	0.814	0.925
Methionine, %	0.301	0.330	0.292	0.321	0.272	0.298	0.252	0.278
Methionine + Cystine, %	0.601	0.671	0.575	0.642	0.534	0.596	0.488	0.546
Threonine, %	0.677	0.818	0.633	0.764	0.588	0.710	0.545	0.657
Tryptophan, %	0.193	0.220	0.175	0.199	0.163	0.185	0.147	0.167
Arginine, %	0.451	0.488	0.399	0.432	0.371	0.401	0.260	0.278
Valine, %	0.741	0.854	0.672	0.775	0.624	0.720	0.562	0.648
Isoleucine, %	0.591	0.671	0.536	0.609	0.498	0.566	0.448	0.509
Leucine, %	1.074	1.184	0.974	1.074	0.905	0.998	0.814	0.897
Histidine, %	0.354	0.391	0.321	0.354	0.299	0.329	0.269	0.296
Phenylalanine, %	0.537	0.598	0.487	0.542	0.453	0.504	0.407	0.453
Phenyal. + Tyrosine, %	1.074	1.196	0.974	1.085	0.905	1.008	0.814	0.907

[1] Nutrient percentage was determined using Tables 3.02 (dig. Lys requirement.), 3.15 (amino acid / lysine ratio) and 3.14 (phosphorus requirement). Total lysine requirement was calculated considering an average lysine true digestibility of 88%.

Table 3.22 - Nutritional Requirements of High Genetic Potential Gilts with High Performance[1]

Phase	Starter		Grower				Finisher	
Live Weight, kg	15 a 30		30 a 50		50 a 70		70 a 100	
Age, days	43 - 67		68 – 91		93 - 111		113 - 140	
Av. Weight, kg	22.5		40		60		85	
Weight Gain, kg/day	0.690		0.870		0.990		1.040	
Intake, kg/day	1.200		1.800		2.320		2.710	
Avail P Req., g/day	4.59		5.92		6.89		7.49	
Dig. P Req., g/day	4.44		5.73		6.68		7.27	
Dig Lysine Req., g/day	12.97		17.78		21.70		24.16	
ME, Kcal/Kg	3230		3230		3230		3230	
				Nutrient				
Protein, %	19.5		19.00		18.00		16.20	
Calcium, %	0.773		0.666		0.601		0.559	
Avail. Phosphorus, %	0.382		0.329		0.297		0.276	
Dig. Phosphorus, %	0.370		0.319		0.288		0.268	
Potassium, %	0.470		0.448		0.425		0.400	
Sodium, %	0.200		0.180		0.170		0.160	
Chlorine, %	0.190		0.170		0.160		0.150	
Amino Acid	Dig.	Total	Dig.	Total	Dig.	Total	Dig.	Total
Lysine, %	1.081	1.228	0.988	1.123	0.935	1.063	0.892	1.014
Methionine, %	0.303	0.332	0.296	0.326	0.281	0.308	0.277	0.304
Methionine + Cystine, %	0.605	0.676	0.583	0.651	0.552	0.616	0.535	0.598
Threonine, %	0.681	0.823	0.642	0.775	0.608	0.733	0.598	0.720
Tryptophan, %	0.195	0.221	0.178	0.202	0.168	0.191	0.161	0.182
Arginine, %	0.454	0.491	0.405	0.438	0.383	0.414	0.285	0.304
Valine, %	0.746	0.860	0.682	0.786	0.645	0.744	0.615	0.710
Isoleucine, %	0.595	0.676	0.543	0.618	0.514	0.584	0.491	0.558
Leucine, %	1.081	1.192	0.988	1.089	0.935	1.031	0.892	0.983
Histidine, %	0.357	0.393	0.326	0.359	0.309	0.340	0.294	0.324
Phenylalanine, %	0.541	0.602	0.494	0.550	0.468	0.521	0.446	0.497
Phenyal. + Tyrosine, %	1.081	1.204	0.988	1.100	0.935	1.041	0.892	0.993

[1] Nutrient percentage was determined using Tables 3.02 (dig. Lys requirement.), 3.15 (amino acid / lysine ratio) and 3.14 (phosphorus requirement). Total lysine requirement was calculated considering an average lysine true digestibility of 88%.

Table 3.23 - Nutritional Requirements of High Genetic Potential Entire Males with Standard Performance[1]

Phase	Starter		Grower				Finisher	
Live Weight, kg	15 – 30		30 - 50		50 - 70		70 - 100	
Age, days	42 – 66		67 - 90		91 - 110		111 – 134	
Av. Weight, kg	22.5		40		60		85	
Weight Gain, kg/day	0.680		0.900		1.070		1.186	
Intake, kg/day	1.110		1.650		2.283		2.710	
Avail P Req., g/day	4.53		6.10		7.37		8.36	
Dig. P Req., g/day	4.39		5.91		7.14		8.11	
Dig Lysine Req., g/day	13.40		19.74		24.80		27.10	
ME, Kcal/Kg	3230		3230		3230		3230	
				Nutrient				
Protein, %	19.5		19.00		18.00		16.20	
Calcium, %	0.825		0.747		0.653		0.624	
Avail. Phosphorus, %	0.408		0.369		0.323		0.308	
Dig. Phosphorus, %	0.395		0.358		0.313		0.299	
Potassium, %	0.470		0.448		0.425		0.400	
Sodium, %	0.200		0.180		0.170		0.160	
Chlorine, %	0.190		0.170		0.160		0.150	
Amino Acid	Dig.	Total	Dig.	Total	Dig.	Total	Dig.	Total
Lysine, %	1.207	1.372	1.196	1.359	1.087	1.235	1.000	1.136
Methionine, %	0.338	0.370	0.359	0.394	0.326	0.358	0.310	0.341
Methionine + Cystine, %	0.676	0.754	0.706	0.788	0.641	0.716	0.600	0.670
Threonine, %	0.760	0.919	0.777	0.938	0.707	0.852	0.670	0.807
Tryptophan, %	0.217	0.247	0.215	0.245	0.196	0.222	0.180	0.205
Arginine, %	0.507	0.549	0.490	0.530	0.446	0.482	0.320	0.341
Valine, %	0.833	0.960	0.825	0.951	0.750	0.865	0.690	0.795
Isoleucine, %	0.664	0.754	0.658	0.748	0.598	0.679	0.550	0.625
Leucine, %	1.207	1.330	1.196	1.318	1.087	1.198	1.000	1.102
Histidine, %	0.398	0.439	0.395	0.435	0.359	0.395	0.330	0.364
Phenylalanine, %	0.604	0.672	0.598	0.666	0.544	0.605	0.500	0.557
Phenyal. + Tyrosine, %	1.207	1.344	1.196	1.332	1.087	1.211	1.000	1.114

[1] Nutrient percentage was determined using Tables 3.02 (dig. Lys requirement.), 3.15 (amino acid / lysine ratio) and 3.14 (phosphorus requirement). Total lysine requirement was calculated considering an average lysine true digestibility of 88%..

Table 3.24 - Changes in Performance and True Digestible Lysine Requirements of Growing Pigs Fed Diets Containing Different Ractopamine Levels[1]

Days of Usage	Ractopamine Levels (ppm)				
	0	5	10	15	20
	Change in Weight Gain (g/day)				
21	0	+107	+123	+134	+139
28	0	+100	+115	+125	+130
	Change in Feed Intake (g/day)				
21	0	-43	-64	-96	-139
28	0	-40	-60	-90	-130
	Change in Dig Lysine Requirement (g/day)				
21	0	+3.9	+4.6	+5.0	+5.4
28	0	+3.7	+4.3	+4.7	+5.0
	Change in Dig Lysine Requirement (%)				
21	0	+0.139	+0.157	+0.178	+0.203
28	0	+0.123	+0.146	+0.167	+0.187

[1] Values estimated from two Theses of the Dept. of Animal Science of UFV and the model proposed by Schinckel et al. (J. Anim. Sci. 81:1106, 2003).

Table 3.25 - Example of Performance and Lysine and Phosphorus Requirements of Barrows with 107 Kg, Average Weight, Fed Diets with Different Ractopamine Levels [1]

Days of Usage	Ractopamine Level (ppm)				
	0	5	10	15	20
Weight Gain (g/day)					
21	1085	1192	1208	1219	1224
28	1085	1185	1200	1210	1215
Feed Intake (g/day)					
21	3300	3257	3236	3204	3161
28	3300	3260	3240	3210	3170
Average Available and Digestible Phosphorus Requirement (g/day)					
21	7.26	7.83	7.92	7.97	8.00
28	7.26	7.79	7.87	7.93	7.95
Average Available and Digestible Phosphorus Requirement (%)					
21	0.220	0.241	0.245	0.249	0.253
28	0.220	0.239	0.243	0.247	0.250
Digestible Lysine Requirement (g/day)					
21	23.54	27.44	28.14	28.54	28.94
28	23.54	27.24	27.84	28.24	28.54
Digestible Lysine Requirement (%)					
21	0.713	0.842	0.870	0.891	0.916
28	0.713	0.836	0.859	0.880	0.900

[1] Values calculated using : Table 3.24 (performance and requirement changes using different levels of Ractopamine) ; Table 3.02 (Dig Lysine requirement) and Table 3.14 (phosphorus requirement).

Nutritional Requirements of Swine Breeders

Swine Breeders – Gestation

Table 3.26 - Equation to Estimate Metabolizable Energy (ME) Requirement and Feed Intake of Primiparous Gilts and Sows (kcal/day or g/day)[1.2]

ME (kcal/day) = 106 $W^{0.75}$ + 4915 BWG + 1540 RWG

W= Body Weight in kg;
BWG= Body Weight Gain in kg/day;
RWG= Reproductive Weight Gain (uterus + mammary tissue = 2.26 (kg/piglet) in kg/day
Gestation = 114 days

Example:
W= 200 kg, where $W^{0.75}$ =53.18
BWG= Gestation 114 days and Total Gain of 30 kg = 30/114= 0.263kg/day
RWG= 11 Piglets x 2.26kg = 24.9kg/114 = 0.218kg/day

ME Req.=(106 x 53.18)+ (4915 x 0.263) + (1540 x 0.218)=7266 kcal/day

ME Gestation Diet = 3000 kcal/kg = 3.0 kcal/g

Recommended Feed Intake = 7266/3.0 = 2422 g/day

[1] Estimated from values obtained in Theses performed at UFV; NRC (1998); Close and Cole (2001) and Mejia et al (2007).
[2]. Environmental temperature and weather variables can affect energy requirements during gestation. For each 1ºC higher or lower than 20ºC, ME requirement changes approximately ± 280 kcal ME / head. The values presented here were calculated for an environmental temperature of 20ºC.

Table 3.27 - Equation to Estimate True Digestible Lysine (Dig. Lys) Requirement of Gestating Primiparous Gilts and Sows (g/day)[1]

Dig. lys(g/day) = 0.036 $W^{0.75}$ + 22.6 BWG + 22.6 RWG

W= Body Weight in kg;
BWG= Body Weight Gain in kg/day;
RWG= Reproductive Weight Gain (uterus + mammary tissue = 2.26 (kg/piglet) in kg/day
Gestation = 114 days

Example:
W= 200 kg, where $W^{0.75}$ =53.18
BWG= Gestation 114 days and Total Gain of 30 kg = 30/114= 0.263kg/day
RWG= 11 Piglets x 2.26kg = 24.9kg/114 = 0.218kg/day

Dig Lys Requirement =(0.036 x 53.18) + (22.6 x 0.263)+(22.6 x 0.218)=12.79 g/day

Intake Estimated = 2422g/day

% Dig. Lys in the Diet = 0.528%

[1] Estimated from values obtained in Theses performed at UFV; NRC (1998); Close and Cole (2001) and Mejia et al (2007).

Table 3.28 - Daily ME and Digestible Lysine Requirements and Feed Intake of Gestating Primiparous Gilts and Sows According to Body Weight, Weight Gain and Reproductive Gain (n°. of Piglets)

Gestation Days	Weight, kg	Weight Gain/day		Daily Requirement			Dig. Lys %
		Sow, kg	Reproduct., kg	ME, Kcal [1]	Dig. Lys[2], g	Diet[3], g	
Initial Weight = 125 kg - Weight Gain = 45 kg - Reproductive Gain = 25 kg (11 Piglets)							
0-14	129	0.55	0.00	6761	13.81	2254	0.613
14-42	139	0.46	0.08	6675	13.66	2225	0.614
42-70	154	0.41	0.14	6865	14.00	2288	0.612
70-92	169	0.38	0.35	7375	18.19	2458	0.740
92-114	185	0.22	0.51	7184	18.30	2395	0.764
Initial Weight = 185 kg - Weight Gain = 30 kg - Reproductive Gain = 27 kg (12 Piglets)							
0-14	188	0.38	0.00	7249	10.42	2416	0.431
14-42	196	0.34	0.09	7362	11.60	2454	0.473
42-70	209	0.30	0.15	7532	12.15	2511	0.484
70-92	221	0.21	0.38	7693	15.40	2564	0.600
92-114	234	0.10	0.54	7665	16.62	2555	0.650
Initial Weight = 245 kg - Weight Gain = 15 kg - Reproductive Gain = 30 kg (13 Piglets)							
0-14	246	0.25	0.05	7890	9.02	2630	0.343
14-42	251	0.22	0.10	7900	9.50	2633	0.361
42-70	260	0.15	0.20	7869	10.23	2623	0.390
70-92	267	0.07	0.42	7973	13.45	2658	0.506
92-114	280	0.01	0.54	8117	14.89	2706	0.555

1. Determined by the equation on Table 3.26.
2.Determined by the equation on Table 3.27.
3. Determined by dividing daily ME requirement by dietary energy level, considering 3000 kcal ME/kg diet

Table 3.29 - Amino Acid / Lysine Ratio Used to Estimate Amino Acid Requirements Gestating Swine Breeders

Amino Acid	Gestation	
	Digestible	Total
Lysine	100	100
Methionine	28	27
Methionine + Cystine	55	54
Threonine	74	78
Tryptophan	19	20
Arginine	100	97
Valine	72	73
Isoleucine	60	60
Leucine	100	97
Histidine	33	32
Phenylalanine	55	54
Phenylalanine+ Tyrosine	100	98

Table 3.30 - Daily Nutritional Requirements of Gestating Swine Breeders (kcal/day or g/day)

Gestation Period, days	Primiparous		Sows	
	0 - 70	70 - 114	0 - 70	70 – 114
Body Weight, kg	130	170	200	230
Weight Gain, kg/day	0.45	0.30	0.33	0.16
Reproductive Gain, kg/day	0.07	0.43	0.08	0.47
ME, kcal/day[2]	6400	7290	7382	7771
Intake[1], g	2133	2430	2461	2590
Crude Protein, g	300	360	285	345
Calcium, g	15.5	17.0	17.0	18.5
Available Phosphorus, g	8.3	9.1	9.1	10.0
Digestible Phosphorus, g	7.3	8.1	8.1	9.0
Potassium, g	7.0	7.5	8.0	8.6
Sodium, g	3.5	3.7	4.0	4.2
Chlorine, g	2.7	2.8	3.0	3.2

Amino Acid	Dig.	Total	Dig.	Total	Dig.	Total	Dig.	Total
Lysine[2], g	13.14	14.93	18.19	20.67	11.18	12.7	16.36	18.59
Methionine, g	3.68	4.03	5.09	5.58	3.13	3.43	4.58	5.02
Methionine + Cystine, g	7.23	8.06	10.00	11.16	6.15	6.86	9.00	10.04
Threonine, g	9.70	11.65	13.46	16.12	8.27	9.4	12.11	13.76
Tryptophan, g	2.50	2.99	3.46	4.13	2.12	2.54	3.11	3.72
Arginine, g	13.14	14.48	18.19	20.05	11.18	12.32	16.36	18.03
Valine, g	9.46	10.90	13.10	15.09	8.05	9.27	11.78	13.57
Isoleucine, g	7.88	8.96	10.91	12.4	6.71	7.62	9.82	11.15
Leucine. g	13.14	14.48	18.19	20.05	11.18	12.32	16.36	18.03
Histidine, g	4.34	4.78	6.00	6.61	3.69	4.06	5.40	5.95
Phenylalanine, g	7.23	8.06	10.00	11.16	6.15	6.86	9.00	10.04
Phenylalanine+ tyrosine, g	13.14	14.63	18.19	20.26	11.18	12.45	16.36	18.22

[1]. Diet with 3000 kcal ME/kg.

[2]. ME requirement was determined by the equation on Table 3.26, the amino acid requirements using Table 3.27 (Dig Lysine equation) and Table 3.29 (amino acid / lysine ratio). Total lysine requirement was calculated considering an average true lysine digestibility of 88%.

Table 3.31 - Nutritional Requirements of Gestating Swine Breeders (% of Diet)[1]

Gestation Period, Days	Primiparous		Sows	
	0-70	70-114	0-70	70-114
Body Weight, kg	130	170	200	230
Weight Gain, kg / day	0.45	0.3	0.33	0.16
Reproductive Gain, kg/day	0.07	0.43	0.08	0.47
ME, kcal/day	6400	7290	7382	7771
ME, kcal/kg	3000	3000	3000	3000
Intake, g	2133	2430	2461	2590
Crude Protein, %	14.06	14.81	11.58	13.32
Calcium, %	0.727	0.700	0.691	0.714
Available Phosphorus, %	0.389	0.375	0.370	0.386
Digestible Phosphorus, %	0.342	0.333	0.330	0.348
Potassium, %	0.328	0.309	0.325	0.332
Sodium, %	0.150	0.152	0.163	0.162
Chlorine, %	0.127	0.115	0.122	0.124

Amino Acid[1]	Dig.	Total	Dig.	Total	Dig.	Total	Dig.	Total
Lysine[2], %	0.616	0.700	0.749	0.851	0.454	0.516	0.632	0.718
Methionine, %	0.173	0.189	0.209	0.230	0.127	0.140	0.177	0.194
Methionine + Cystine, %	0.339	0.378	0.412	0.459	0.250	0.279	0.347	0.388
Threonine, %	0.455	0.546	0.554	0.663	0.336	0.402	0.468	0.560
Tryptophan, %	0.117	0.140	0.142	0.169	0.086	0.103	0.120	0.144
Arginine, %	0.616	0.679	0.749	0.825	0.454	0.501	0.632	0.696
Valine, %	0.444	0.511	0.539	0.621	0.327	0.377	0.455	0.524
Isoleucine, %	0.369	0.420	0.449	0.510	0.273	0.310	0.379	0.431
Leucine, %	0.616	0.679	0.749	0.825	0.454	0.501	0.632	0.696
Histidine, %	0.203	0.224	0.247	0.272	0.150	0.165	0.208	0.230
Phenylalanine, %	0.339	0.378	0.411	0.459	0.250	0.279	0.347	0.388
Phenylalanine+tyrosine, %	0.616	0.686	0.749	0.834	0.454	0.506	0.632	0.703

[1]. Nutrient percentage was determined using Table 3.30 (daily nutritional requirements) and daily intake. Total lysine requirement was calculated considering an average true lysine digestibility of 88%.

Swine Breeders - Lactation

Table 3.32 - Equation to Estimate Metabolizable Energy (ME) Requirement and Feed Intake of Lactating Primiparous Gilts and Sows (kcal/day or g/day)[1,2]

ME (kcal/day) = 106 $W^{0.75}$ + 6230 x LWG - 4600 BWL

W= Body Weight in kg;
LWG= Litter Weight Gain in kg/day;
BWL= Body Weight Loss in kg/day.

Example:

W= 220 kg, where $W^{0.75}$ = 57.124

LWG= litter = 11; piglet birth weight 1.5 kg;
Piglet weaning weight = 6.13kg; Lactation = 21 days

$$LWG = \frac{(6.13 - 1.5) \times 11}{21} = 2.4 \text{ kg/ day.}$$

BWL: Weight at start of lactation= 220 kg. Weight at end of lactation= 209.5 kg
Lactation = 21 days.
BWL= (220 – 209.5)= 10.5/21 = 0.5 kg/day.

ME Req = 106 x 57.124 + 6230 x 2.4 – 4600 x 0.5 =
ME Req = 6055 + 14952 – 2300 = 18707 kcal/day

ME Lactation Diet = 3400 kcal/kg= 3.4 kcal/g
Estimated Feed Intake = 18707/3.4= 5502 g/day.

[1] Estimated from values obtained in Theses performed at UFV; NRC (1998); Close and Cole (2001) and Mejia et al (2007).
[2]. Environmental temperature and weather variables can affect energy requirements during lactation. For each 1ºC higher or lower than 20ºC, ME requirement changes approximately ± 280 kcal ME / head. The values presented here were calculated for an environmental temperature of 20ºC.

Table 3.33 - Equation to Estimate True Digestible Lysine (Dig. Lys) Requirement of Lactating Primiparous Gilts and Sows (g/day)

Dig. lys(g/day) = 0.036 $W^{0.75}$ + 23.6 LWG – 7.0 BWL

W= Body Weight in kg;
LWG= Litter Weight Gain in kg/day;
BWL= Body Weight Loss in kg/day.

Example:

W= 220 kg, where $W^{0.75}$ = 57.124

LWG= litter = 11; piglet birth weight 1.5 kg;
Piglet weaning weight = 6.13 kg; Lactation = 21 days

$$LWG = \frac{(6.13 - 1.5) \times 11}{21} = 2.4 \text{ kg/ day.}$$

BWL: Weight at Start of Lactation= 220 kg. Weight at End of Lactation= 209.5 kg
Lactation = 21 days.
BWL= (220 – 209.5)= 10.5/21 = 0.5 kg/day.

Dig. lys req.= 0.036 x 57.124 + 23.6 x 2.4 - 7.0 x 0.5 =
Dig. lys req.= 2.056 + 56.64 – 3.5 = 55.2 g/day
Intake estimate = 5502 g/day
% Dig. Lys in the diet = 1.003%

[1] Estimated from values obtained in Theses performed at UFV; NRC (1998); Close and Cole (2001) and Mejia et al (2007).

Table 3.34 - Equation to Estimate Metabolizable Energy (kcal/day) and Digestible Lysine (g/day and %) Requirements and Intake (g/day) of Lactating Sows (21 days) as a Function of Performance[1]

Sow Weight, kg	180			220			260		
Litter Weight Gain, kg/day	2.0	2.4	2.8	2.0	2.4	2.8	2.0	2.4	2.8
Body Weight Loss, kg/day	ME Requirement (kcal/day) and Intake (g/day)								
0[2]	17669[3]	20161	22653	18515	21007	23499	19323	21815	24307
	(5197)[4]	(5930)	(6663)	(5445)	(6179)	(6911)	(5683)	(6416)	(7149)
- 0.5[2]	15369	17861	20353	16215	18707	21199	17023	19515	22007
	(4520)	(5253)	(5986)	(4769)	(5502)	(6235)	(5007)	(5740)	(6473)
- 1.0[2]	13069	15561	18.053	13915	16407	18899	14723	17215	19707
	(3844)	(4577)	(5310)	(4093)	(4826)	(5559)	(4330)	(5063)	(5796)
	Dig lysine Requirement (g/day) and Dietary dig Lys Level (%)								
0	49.0[5]	58.4	67.9	49.3	58.7	68.1	49.5	59.0	68.4
	(0.94)[6]	(0.98)	(1.02)	(0.90)	(0.95)	(0.99)	(0.87)	(0.92)	(0.96)
-0.5	45.5	54.9	64.4	45.8	55.2	64.6	46.0	55.5	64.9
	(1.01)	(1.045)	(1.08)	(0.96)	(1.00)	(1.04)	(0.92)	(0.97)	(1.00)
-1.0	42.0	51.4	60.9	42.3	51.7	61.1	42.5	52.0	61.4
	(1.09)	(1.12)	(1.15)	(1.03)	(1.07)	(1.10)	(0.98)	(1.03)	(1.06)

1. Determined by equations on Tables 3.32 (ME requirement) and 3.33 (Dig. Lys Requirement).
2. Corresponds to the loss 0, 10.5 and 21 kg body weight during 21 days of lactation, respectively.
3. Daily ME requirement in kcal
4. Intake estimate (g/day) determined by dividing ME requirement by dietary ME (3400 kcal/kg)
5. Dig Lys requirement (g/day)
6. Dig Lys requirement (%)

Table 3.35 - Amino Acid / Lysine Ratio Used to Estimate Amino Acid Requirements of Lactating Swine Breeders

Amino acid	Lactation	
	Digestible	Total
Lysine	100	100
Methionine	27	26
Methionine + Cystine	54	53
Threonine	64	68
Tryptophan	19	20
Arginine	69	66
Valine	78	79
Isoleucine	59	59
Leucine	114	114
Histidine	38	37
Phenylalanine	57	56
Phenylalanine+ Tyrosine	114	112

Table 3.36 - Nutritional Requirements of Lactating Sows (kcal/day or g/day)

Body Weight, kg	180		220		260			
Litter Weight Gain, kg/day	2		2.4		2.8		2.8	
Weight Loss, kg/day	-0.5		-0.5		-0.5		-1.0	
ME, kcal/day[1]	15369		18707		21199		19707	
Intake[2], g/day	4520		5502		6235		5796	
Crude Protein, g	897		1092		1280		1202	
Calcium, g	39.0		45.0		48.0		48.0	
Available Phosphorus, g	21.3		24.0		24.6		24.6	
Digestible Phosphorus, g	18.9		21.2		21.8		21.8	
Potassium, g	14.5		17.0		18.0		18.0	
Sodium, g	9.8		11.5		12.0		12.0	
Chlorine, g	8.9		10.5		11.0		11.0	
Amino Acid	Dig.	Total	Dig.	Total	Dig.	Total	Dig.	Total
Lysine[1], g	45.50	51.70	55.20	62.73	64.60	73.41	61.40	69.77
Methionine, g	12.29	13.44	14.90	16.31	17.44	19.09	16.58	18.19
Methionine + Cystine, g	24.57	27.40	29.81	33.25	34.88	38.91	33.16	36.98
Threonine, g	29.12	35.16	35.33	42.66	41.34	49.92	39.30	47.44
Tryptophan, g	8.65	10.34	10.49	12.55	12.27	14.68	11.67	13.95
Arginine, g	31.40	34.12	38.08	41.40	44.57	48.45	42.37	46.05
Valine, g	35.49	40.84	43.05	49.56	50.39	57.99	47.89	55.12
isoleucine, g	26.85	30.50	32.57	37.01	38.11	43.31	36.23	41.16
Leucine, g	51.87	58.94	62.93	71.51	73.64	83.69	70.00	79.54
Histidine, g	17.29	19.13	20.98	23.21	24.55	27.16	23.33	25.81
Phenylalanine, g	25.94	28.95	31.46	35.13	36.82	41.11	35.00	39.07
Phenylalanine+ Tyrosine, g	51.87	58.94	62.93	71.51	73.64	83.69	70.00	79.54

[1]. ME requirement was determined by the equation on Table 3.32, the amino acid requirements using Table 3.33 (Dig Lysine equation) and Table 3.35 (amino acid / lysine ratio). Total lysine requirement was calculated considering an average true lysine digestibility of 88%.

[2]. Diet with 3400 kcal ME/kg.

Table 3.37 - Nutritional Requirements of Lactating Sows (% of diet)

Body Weight, kg	180		220				260	
Litter Weight Gain, kg/day	2		2.4		2.8		2.8	
Weight Loss, kg/day	-0.5		-0.5		-0.5		-1.0	
ME, kcal/day[1]	15369		18707		21199		19707	
Dietary ME, kcal/kg	3400		3400		3400		3400	
Intake, g/day	4520		5502		6235		5796	
Dig Lysine, g/day	45.5		55.2		64.6		61.4	
Crude Potein, %	19.84		19.84		20.53		20.74	
Calcium, %	0.86		0.82		0.77		0.83	
Available Phosphorus, %	0.471		0.436		0.395		0.424	
Digestible Phosphorus, %	0.418		0.385		0.350		0.376	
Potassium, %	0.310		0.310		0.290		0.310	
Sodium, %	0.220		0.210		0.190		0.210	
Chlorine, %	0.200		0.190		0.180		0.190	
Amino acid[1]	Dig.	Total	Dig.	Total	Dig.	Total	Dig.	Total
Lysine[2], %	1.007	1.144	1.003	1.140	1.036	1.177	1.059	1.204
Methionine, %	0.272	0.297	0.271	0.296	0.280	0.306	0.286	0.313
Methionine + Cystine, %	0.543	0.606	0.542	0.604	0.559	0.624	0.572	0.638
Threonine, %	0.644	0.778	0.642	0.775	0.663	0.801	0.678	0.818
Tryptophan, %	0.191	0.229	0.190	0.228	0.197	0.235	0.201	0.241
Arginine, %	0.695	0.755	0.692	0.752	0.714	0.777	0.731	0.794
Valine, %	0.785	0.903	0.782	0.900	0.808	0.930	0.826	0.951
Isoleucine, %	0.594	0.675	0.592	0.673	0.611	0.695	0.625	0.710
Leucine, %	1.148	1.304	1.144	1.300	1.181	1.342	1.208	1.372
Histidine, %	0.382	0.423	0.381	0.422	0.394	0.435	0.402	0.445
Phenylalanine, %	0.573	0.640	0.572	0.638	0.590	0.659	0.604	0.672
Phenylalanine+ tyrosine, %	1.147	1.304	1.144	1.300	1.181	1.342	1.208	1.372

[1]. Nutrient percentage was determined using Table 3.36 (daily nutritional requirements) and daily intake. Total lysine requirement was calculated considering an average true lysine digestibility of 88%.

CHAPTER 4

Simplified Tables of Feedstuff Composition and Nutritional Requirements of Poultry and Swine

Table 4.01 - Chemical Composition and Energy Values of the Main Feedstuffs Used in Poultry and Swine (as Fed)

Feedstuffs	CP %	Calcium %	Phosphorus %			Sodium	ME, kcal/kg		Dig. Lysine, %		Dig. Met+Cys, %		Dig. Thr, %	
			Av	Dig Poultry	Dig Swine	%	Poultry	Swine	Poultry	Swine	Poultry	Swine	Poultry	Swine
Corn	7.88	0.03	0.06	0.10	0.11	0.02	3381	3340	0.19	0.18	0.29	0.29	0.27	0.26
Feather Meal (84%)	83.63	0.31	0.66	0.37	0.37	0.27	2761	2922	1.68	1.81	2.73	3.29	2.80	3.21
Meat & Bone Meal (41%)	40.83	13.07	5.88	4.05	4.18	0.51	1937	2068	1.64	1.47	0.65	0.65	0.93	0.93
Meat & Bone Meal (44%)	43.50	12.28	5.53	3.81	3.93	0.63	2177	2200	1.78	1.61	0.71	0.70	1.05	1.03
Poultry By-Product Meal	57.68	4.34	2.54	1.34	1.35	0.39	3241	3566	2.67	2.48	1.53	1.42	1.85	1.83
Rice Bran	13.13	0.11	0.24	0.48	0.47	0.04	2521	3111	0.49	0.46	0.38	0.36	0.35	0.35
Sorghum Low Tannin	8.97	0.03	0.08	0.09	0.09	0.02	3189	3315	0.17	0.16	0.26	0.25	0.25	0.24
Soybean Full-Fat Toasted	36.42	0.23	0.19	0.20	0.20	0.01	3263	3706	1.96	1.83	0.87	0.82	1.22	1.14
Soybean Meal (45%)	45.22	0.24	0.22	0.25	0.26	0.02	2254	3154	2.57	2.54	1.13	1.16	1.57	1.55
Soybean Oil	-	-	-	-	-	-	8790	8300	-	-	-	-	-	-
Wheat Bran	15.62	0.14	0.33	0.48	0.50	0.02	1795	2390	0.47	0.46	0.43	0.46	0.37	0.37
L-Lysine Hcl	85.8	-	-	-	-	-	3762	4599	78.8	77.5	-	-	-	-
Dl-Methionine	59.4	-	-	-	-	-	4858	5475	-	-	98.2	98.5	-	-
L-Threonine	78.1	-	-	-	-	-	3067	3802	-	-	-	-	96.1	94.7
Limestone	-	37.7	-	-	-	-	-	-	-	-	-	-	-	-
Dicalcium Phosphate	-	24.5	18.5	12.9	13.9	-	-	-	-	-	-	-	-	-
Salt		-	-	-	-	39.7	-	-	-	-	-	-	-	-

Table 4.02 - Nutritional Requirements of Standard Performance Male and Female Broilers (%)

Nutrients		Pre-starter	Starter	Grower I	Grower II	Finisher
	days	1-7	8-21	22-33	34-42	43-46
				Male Broilers		
Metabolizable Energy	kcal/kg	2.950	3.000	3.100	3.150	3.200
Protein Crude	%	22.20	20.80	1950	18.00	17.30
Calcium	%	0.920	0.819	0.732	0.638	0576
Available Phosphorus	%	0.470	0.391	0.342	0.298	0.269
Digestible Phosphorus	%	0.395	0.343	0.313	0.273	0.247
Sodium	%	0.220	0.210	0.200	0.195	0.190
Lysine Dig.	%	1.310	1.174	1.078	1.010	0.936
Methionine Dig.	%	0.511	0.458	0.431	0.404	0.374
Methionine + Cystine Dig	%	0.944	0.846	0.787	0.737	0.683
Threonine Dig	%	0.852	0.763	0.701	0.656	0.608
Tryptophan Dig	%	0.223	0.200	0.194	0.182	0.168
Arginine Dig	%	1.415	1.268	1.164	1.091	1.011
Glycine + Serine Dig	%	1.926	1.726	1.445	1.353	1.254
Valine Dig	%	1.009	0.904	0.841	0.788	0.730
Isoleucine Dig	%	0.878	0.787	0.733	0.687	0.636
				Female Broilers		
Metabolizable Energy	kcal/kg	2.950	3.000	3.100	3.150	3.200
Protein Crude	%	21.80	20.40	19.00	17.50	17.00
Calcium	%	0.920	0.809	0.683	0.566	0.506
Available Phosphorus	%	0.470	0.386	0.319	0.264	0.236
Digestible Phosphorus	%	0.395	0.339	0.292	0.242	0.217
Sodium	%	0.220	0.200	0.195	0.185	0.180
Lysine Dig	%	1.326	1.165	1.005	0.892	0.822
Methionine Dig	%	0.517	0.454	0.402	0.357	0.329
Methionine + Cystine Dig	%	0.954	0.839	0.733	0.651	0.600
Threonine Dig	%	0.862	0.757	0.653	0.580	0.534
Tryptophan Dig	%	0.225	0.198	0.181	0.161	0.148
Arginine Dig	%	1.432	1.258	1.085	0.963	0.888
Glycine + Serine Dig	%	1.949	1.713	1.346	1,195	1.101
Valine Dig	%	1.021	0.897	0.784	0.696	0.641
Isoleucine Dig	%	0.888	0.781	0.683	0.607	0.559

Table 4.03 - Nutritional Requirements of Replacement Layer Pullets, Quails, Layers, and Broiler Breeders

Weeks / Intake	Replacement Pullets White			Quails	Layers	Breeders
	Starter	Grower	Developer	Japanese		Hens
	1-6[1]	7-12[1]	13-16[1]	26.3[2]	103[2]	160[2]
ME, kcal/kg	2900	2900	2900	2800	2900	2750
Protein, %	18.00	16.00	14.00	18.8	16.02	13.1
Calcium, %	0.940	0.832	0.800	2.92	3.90	2.56
Available Phosphorus, %	0.437	0.392	0.310	0.304	0.291	0.250
Digestible Phosphorus, %	0.367	0.334	0.275	0.278	0.262	0.238
Sodium, %	0.180	0.160	0.150	0.146	0.218	0.156
Lysine Dig, %	0.876	0.621	0.483	1.097	0.777	0.552
Methionine Dig, %	0.350	0.273	0.217	0.494	0.389	0.265
Methionine + Cystine Dig, %	0.640	0.497	0.396	0.900	0.707	0.480
Threonine Dig, %	0.587	0.422	0.333	0.658	0.591	0.447
Tryptophan Dig, %	0.158	0.124	0.106	0.230	0.179	0.127
Arginine Dig, %	0.937	0.671	0.531	1.273	0.777	0.635
Glycine + Serine Dig, %	0.675	0.478	0.372	1.251	0.598	0.563
Valine Dig, %	0.666	0.497	0.396	0.823	0.738	0.497
Isoleucine Dig, %	0.604	0.466	0.372	0.713	0.591	0.497

1- Age in weeks. 2 - Intake (g/ day).

Table 4.04 - Nutritional Requirements of High Genetic Potential Barrows with Standard Performance (%)

Phase	Prestarter II	Starter	Grower I, II		Finisher I, II	
Weight,kKg	9.3 a 15	15 a 30	30 a 50	50 a 70	70 a 100	100 a 120
Age, days	33-42	42 – 67	68 - 91	92 - 112	113 - 140	141 - 160
ME, Kcal/Kg	3.375	3230	3230	3230	3230	3230
Protein, %	21.00	18.13	16.82	15.43	13.83	12.39
Calcium, %	0.825	0.733	0.630	0.512	0.474	0.443
Available Phosphorus, %	0.450	0.363	0.311	0.250	0.231	0.216
Digestible Phosphorus, %	0.410	0.351	0.302	0.248	0.230	0.215
Sodium, %	0.230	0.200	0.180	0.170	0.160	0.150
Lysine Dig, %	1.330	1.037	0.927	0.823	0.763	0.691
Methionine Dig, %	0.372	0.290	0.278	0.247	0.237	0.214
Met + Cist Dig, %	0.745	0.581	0.547	0.486	0.458	0.415
Threonine Dig, %	0.838	0.653	0.603	0.535	0.511	0.463
Tryptophan Dig, %	0.239	0.187	0.167	0.148	0.137	0.124
Arginine Dig, %	1.131	0.436	0.380	0.337	0.244	0.221
Valine Dig, %	0.918	0.716	0.640	0.568	0.526	0.477
Isoleucine Dig, %	0.732	0.570	0.510	0.453	0.420	0.380

Table 4.05 - Nutritional Requirements of Gestating and Lactating Sows (%)

Nutrient	Gestation		Lactation	
	0-70[2]	70-114[2]	2.4[3]	2.8[3]
Intake[1], g/day	2461	2590	5502	6235
Crude Protein, %	11.58	13.32	19.84	20.53
Calcium, %	0.691	0.714	0.820	0.770
Available Phosphorus, %	0.370	0.386	0.436	0.395
Digestible Phosphorus, %	0.330	0.348	0.385	0.350
Sodium, %	0.163	0.162	0.210	0.190
Lysine Dig, %	0.454	0.632	1.003	1.036
Methionine Dig, %	0.127	0.177	0.271	0.280
Methionine + Cystine Dig, %	0.250	0.347	0.542	0.559
Threonine Dig, %	0.336	0.468	0.642	0.663
Tryptophan Dig, %	0.086	0.120	0.190	0.197
Arginine Dig, %	0.454	0.632	0.692	0.714
Valine Dig, %	0.327	0.455	0.782	0.808
Isoleucine Dig, %	0.273	0.379	0.592	0.611

1. Diet with 3000 and 3400 kcal /kg in gestation and lactation, respectively.
2. Gestation, days.
3. Litter weight gain (kg/day); body weight loss of 0.5 kg/day.

CHAPTER 5

References

- UFV Dissertations and Theses -
- Other Literature References -

UFV Dissertations and Theses

ABREU, M. L. T. Níveis de Lisina Digestível em Rações Utilizando o Conceito de Proteína Ideal, para Suínos Machos Castrados de Alto Potencial Genético, dos 15 aos 95kg. Viçosa MG: UFV, 2005. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

AGOSTINI, P. D' Composição Química, Energia Metabolizável e Aminoácidos Digestíveis de Alguns Alimentos Para Aves. Viçosa MG: UFV, 2001. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

AGOSTINI, P. D' Exigências de Metionina + Cistina para Frangas de Reposição Leves e Semi Pesadas, nas Fases Inicial, Cria e Recria. Viçosa MG: UFV, 2005. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

ALBINO, L. F. T. Sistemas de Avaliação Nutricional de Alimentos e suas Aplicações na Formulação de Rações para Frangos de Corte. Viçosa MG: UFV, 1991. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

ALEBRANTRE, L. Fósforo Disponível para Suínos Mantidos em Diferentes Ambientes Térmicos dos 15 aos 30 kg. Viçosa MG: UFV, 2010. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

ALEBRANTE, L. Níveis de Lisina Digestível e Planos de Nutrição para Suínos Machos Inteiros Submetidos a Imunocastração. Viçosa-MG, 2010. Tese em Andamento (Doutorado em Zootecnia). - Universidade Federal de Viçosa.

AMARAL, A. M. Digestibilidade Ileal Aparente e Verdadeira de Aminoácidos em Alimentos Utilizados em Dietas para Suínos em Crescimento. Viçosa MG: UFV, 2001. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

AMBROZINI, S.R. Níveis de Energia Metabolizável e de Metionina + Cistina na Recria de Frangas Pesadas e seus Efeitos na Reprodução. Viçosa, UFV, 1991. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

APOLÔNIO, L. R. Digestibilidade Ileal de Aminoácidos de Alimentos Utilizados em Dietas para Suínos. Viçosa MG: UFV, 2001. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

APOLÔNIO, L. R. Níveis de Triptofano Digestível em Rações para Suínos dos 5 aos 60 kg. Viçosa MG: UFV, 2007. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

ARAÚJO, M. S. Níveis de Cromo Orgânico na Dieta de Codornas Japonesas, Mantidas sob Estresse por Calor, na Fase de Postura. Viçosa MG: UFV, 2005. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

ARAÚJO, M. S. Composição Química e Energética e Aminoácidos Digestíveis de Alguns Alimentos para Codornas Japonesas. Viçosa MG: UFV, 2008. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

ARAÚJO, W.A. Utilização do Farelo de Girassol em Dietas de Frangos de Corte, Poedeiras e Suínos em Crescimento. Viçosa MG: UFV, 2011. Tese em Andamento (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

ASSIS, A. P. Níveis de Fósforo Disponível em Rações para Frangos de Corte Machos de 8 aos 42 dias de Idade Mantidos em Diferentes Ambientes Térmicos. Viçosa MG: UFV, 2009. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

AZEVEDO, D. M. S. Fatores que Influenciam os Valores de Energia Metabolizável da Farinha de Carne e Ossos para Aves. Viçosa MG: UFV, 1997. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

BALBINO, E. M. Níveis de Lisina Digestível em Rações Suplementadas ou não com Aminoácidos Industriais para Frangos de Corte Mantidos em Diferentes Ambientes Térmicos. Viçosa MG: UFV, 2008. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

BARBARINO JR, P. Desempenho Produtivos e Econômicos e Avaliação da Carcaça de Frangos de Corte Submetidos à Restrição Alimentar Precoce. Viçosa MG: UFV, 1995. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

BARBARINO JR., P. Avaliação da Qualidade Nutricional do Milho pela Utilização de Técnicas de Análise Uni e Mutivariadas. Viçosa MG: UFV, 2001. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

BARBOSA, B.A.C. Exigências Nutricionais em Metionina + Cistina e Lisina para Poedeiras Leves e Semipesadas, no Segundo Ciclo de Produção. Viçosa MG: UFV, 1997. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

BARBOSA, R. J. Exigência de Metionina+Cistina para Frangos de Corte na Fase de Crescimento e Acabamento. Viçosa MG: UFV, 1998. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

BARBOZA, W. A. Balanço e Biodisponibilidade da Metionina Hidroxi Análoga - Ácido Livre Comparada com a DL - Metionina em Aves Submetidas a Estresse Calórico. Viçosa MG: UFV, 1995. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

BARBOZA, W. A. Exigências Nutricionais de Lisina para Duas Marcas Comerciais de Frangos de Corte. Viçosa MG: UFV, 1998. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

BARROS, J. M. S. Exigência Nutricional de Sódio para Frangos de Corte Machos e Fêmeas. Viçosa MG: UFV, 1999. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

BATISTA, R. M. Lisina Digestível para Suínos Machos Castrados de Alta Deposição de Carne Submetidos a Estresse por Calor. Viçosa MG: UFV, 2008. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

BENÍCIO, L. A. S. Estudo da Influência das Linhagens e de níveis Nutricionais sobre Desempenho, Rendimento de Carcaça e Avaliação Econômica em Frangos de Corte. Viçosa MG: UFV, 1995. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

BERNAL, L. E. P. Níveis de Treonina em Rações de Alta e Baixa Digestibilidade para Frangos de Corte, Criados em Cama Limpa e Reutilizada. Viçosa MG: UFV, 2004. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

BERNAL, L. E. P. Níveis Dietéticos de Lisina e de Metionina + Cistina Digestíveis para Frangos de Corte Cobb. Viçosa MG: UFV, 2008. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

BERNARDINO, V. M. P. Diferentes Relações Treonina : Lisina em Dietas para Frangos de Corte, Suplementadas com Glicina: Desempenho e Atividade Enzimática. Viçosa MG: UFV, 2008. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

BORGES, A. F. Níveis de Lisina para Frangos de Corte Mantidos em Ambiente de Alta Temperatura. Viçosa MG: UFV, 2000. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

BORGES, C. A. Q. Exigências Nutricionais de Proteína e de Energia Para Galos Reprodutores de Corte na Fase de Reprodução. Viçosa MG: UFV, 2001. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

BRITO, C. O. Avaliação de Dietas Formuladas com Aminoácidos Totais e Digestíveis e Estimativas do Crescimento e da Deposição de Nutrientes em Frangos de Corte. Viçosa MG: UFV, 2007. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

BRUGALLI, I. Efeito da Granulometria na Biodisponibilidade de Fósforo e nos Valore Energéticos da Farinha de Carne e Ossos e Exigência Nutricional de Fósforo pra Pintos de Corte. Viçosa MG: UFV, 1996. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

BRUMANO, G. Composição Química e Valores de Energia Metabolizável e de Aminoácidos Digestíveis de Alimentos Protéicos para Aves. Viçosa MG: UFV, 2005. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

BRUMANO, G. Níveis de Metionina + Cistina Digestíveis em Rações para Poedeiras Leves, nos Períodos de 24 a 40 e 42 a 58 Semanas de Idade. Viçosa MG: UFV, 2008. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

BUTERI, C. B. Efeitos de Diferentes Planos Nutricionais sobre a Composição e o Desenvolvimento Produtivo e Econômico de Frangos de Corte. Viçosa - MG. UFV. 2003. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

BUTERI, C. B. Níveis Nutricionais de Lisina Digestível no Desempenho Produtivo Econômico de Frangos de Corte. Viçosa MG: UFV, 2001. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

BUNZEN, S. Digestibilidade Aparente e Verdadeira do Fósforo de Alimentos Determinada com Suínos em Crescimento e Terminação. Viçosa MG: UFV, 2005. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

BUNZEN, S. Digestibilidade do Fósforo de Alimentos e Exigência de Fósforo Digestível de Aves e Suínos. Viçosa MG: UFV, 2009. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

CABRAL, G. H. Níveis de Cálcio em Rações para Frangos de Corte. Viçosa - MG: UFV, 1999. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

CALDERANO, A. A. Valores de Composição Química e de Energia de Alimentos de Origem Vegetal Determinados com Aves de Diferentes Idades. Viçosa MG: UFV, 2008. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

CAMPOS, A. M. A. Atualização da Proteína Ideal para Frangos de Corte: Arginina, Isoleucina, Triptofano e Valina. Viçosa MG: UFV, 2010. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

CAMPOS, P. F. Fósforo Disponível em Dietas Com ou Sem Ractopamina pra Fêmeas Suínas em Terminação Tardia. Viçosa MG: UFV, 2010. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

CARDOSO, C. C. Valores de Energia Metabolizável de Alguns Óleos e Gordura para Aves. Viçosa MG: UFV, 2000. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

CARÍSSIMO, A. P. G. Relação Aminoácidos Sulfurosos, Metionina + Cistina Digestível com Lisina Digestível em Dietas sem Antibiótico para Leitões desmamados aos 21 dias de idade. Viçosa MG: UFV, 2007. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

CARVALHO, D. C. O. Valor Nutritivo do Milho para Aves, Submetido a Diferentes Temperaturas de Secagem e Tempo de Armazenamento. Viçosa MG: UFV, 2002. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

CARVALHO, D. C. O. Biodisponibilidade de Fontes de Metionina e Exigências Nutricionais de Lisina e de Triptofano para Poedeiras Leves, Mantidas em Ambiente de Alta Temperatura, na Fase de Produção. Viçosa MG: UFV, 2005. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

CASTRO, A. J. Exigência de Triptofano para Frangos de Corte Machos e Fêmeas. Viçosa MG: UFV, 1997. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

CORTESE NETO, M. Efeito do Nível de Fósforo da Dieta sobre a Capacidade Reprodutiva e Integridade dos Ossos de Galos Reprodutores de Corte. Viçosa MG: UFV, 1991 Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

COSTA, C. H. R. Níveis de Fósforo e de Cálcio em Dietas para Codornas Japonesas em Postura. Viçosa MG: UFV, 2006. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

COSTA, C. H. R. Níveis de Cálcio e de Fósforo em Dietas para Codornas Japonesas de 45 A 57 Semanas de Idade. Viçosa MG: UFV, 2009. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

COSTA, F. G. P. Níveis Dietéticos de Lisina e Proteína Bruta para Frangos de Corte. Viçosa MG: UFV, 2000. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

COSTA, L. F. Determinação das Perdas Endógenas e Digestibilidade Ileal dos Aminoácidos com Suínos Utilizando Duas Técnicas. Viçosa MG: UFV, 2005. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

COTA, T. S. Níveis de Lisina em Ração de Lactação para Fêmeas Suínas Primíparas. Viçosa MG: UFV, 2002. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

COUTO, H. P. Alimentação de Leitões Desmamados aos 10 Dias de Idade Utilizando Ração Seca. Viçosa MG: UFV, 1991 Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

COUTO, H. P. Exigências Nutricionais de Proteína, Metionina+Cistina e Lisina de Galos Reprodutores de Corte. Viçosa MG: UFV, 1994. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

CUPERTINO, E. S. Exigências Nutricionais de Manganês para Frangos de Corte Machos e Fêmeas. Viçosa MG: UFV, 2002. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

CUPERTINO, E. S. Exigências Nutricionais de Lisina, de Metionina + Cistina e de Treonina para Galinhas Poedeiras no Período de 5 a 70 Semanas de Idade. Viçosa MG: UFV, 2006. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

D'AGOSTINI, P. Composição Química, Energia Metabolizável e Aminoácidos digestíveis de Alguns Alimentos para Aves. Viçosa MG: UFV, 2001. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

D'AGOSTINI, P. Exigencias de Metionina + Cistina para Frangas de Reposição Leves e Semipesadas nas Fases Inicial, Cria e Recria. Viçosa MG: UFV, 2005. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

DIONIZIO, M. A. Efeitos de Níveis Protéicos e da Suplementação Aminoacídica na Dieta de Frangos de Corte na Fase de Crescimento. Viçosa MG: UFV, 2005. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

DONZELE, J. L. Níveis de Proteína Bruta, Lisina e Energia Digestível em Rações Contendo Leite Desnatado em Pó para Suínos de 5 a 15 kg. Viçosa MG: UFV, 1991. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

FERREIRA, R. A. Avaliação da Redução da Proteína Bruta da Ração com Suplementação de Aminoácidos para Suínos de 15 a 60 kg Mantidos em Diferentes Ambientes Térmicos. Viçosa MG: UFV, 2001. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

FISCHER JR., A. A. Valores de Energia Metabolizável e de Aminoácidos Digestíveis de Alguns Alimentos para Aves. Viçosa MG: UFV, 1997. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

FONTES, D. O. Lisina para Leitoas Selecionadas Geneticamente para Deposição de Carne Magra na Carcaça. Viçosa MG: UFV, 1999. Tese (Doutorado em Zootecnia) – Universidade Federal de Viçosa.

FORTES, E.I. Níveis de Lisina Digestível e Planos de Nutrição para Suínos Machos Castrados de duas Linhagens Genéticas. Viçosa MG, 2009. Dissertação (Mestrado em Zootecnia). Universidade Federal de Viçosa.

GATTÁS, G. Níveis de Lisina Digestível em Dietas para Suínos dos 60 aos 100 Dias de Idade. Viçosa MG: UFV, 2008. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

GENEROSO, R. A. R. Composição Química, Energética e Aminoácidos Digestíveis de Alguns Alimentos para Aves. Viçosa MG: UFV, 2005. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

GIROTTO JÚNIOR, C. J. Redução de Proteína com Suplementação de Aminoácidos em Dietas para Leitões Desmamados aos 21 Dias de Idade. Viçosa MG: UFV, 2010. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

GONDIM, C. A. S. Níveis Nutricionais de Sódio e de Proteína e Fontes de Energia para Pintos de Corte na Fase Pré-Inicial. Viçosa MG: UFV, 2003. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

GOULART, C. C. Exigências Nutricionais em Lisina para Poedeiras Leves e Semi-Pesada. Viçosa - MG: UFV, 1997, 51p. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

HAESE, D. Níveis de Triptofano Digestível em Rações para Suínos Machos Castrados de Alto Potencial de Deposição de Carne Magra na Carcaça dos 60 aos 95 Kg. Viçosa MG: UFV, 2005. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

HAESE, D. Validação das Relações de Aminoácidos com Lisina Digestíveis e Avaliação de Diferentes Densidades Nutricionais em Rações para Porcas em Lactação. Viçosa MG: UFV, 2007. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

HASCHIMOTO, F. A. M. Composição e Digestibilidade de Alguns Alimentos para Suínos nas Fases de Crescimento e de Terminação. Viçosa MG: UFV, 2005. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

HASCHIMOTO, F. A. M. Níveis de Proteína para Porcas de Segunda e Terceira Gestação. Viçosa MG: UFV, 2001. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

HONMA, N. H. Efeito dos Níveis Nutricionais de Cálcio sobre a Capacidade Reprodutiva e Integridade dos Ossos de Galos Reprodutores de Corte. Viçosa MG: UFV, 1992. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

KIEFER, C. Exigência de Metionina Mais Cistina Digestíveis para Suínos dos 30 aos 60 Kg Mantidos em Diferentes Ambientes Térmicos. Viçosa MG: UFV, 2003. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

KIEFER, C. Níveis de Treonina Digestível para Porcas Lactantes. Viçosa MG: UFV, 2006. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

KILL, J. L. Níveis de Lisina e Planos de Nutrição, para as Fases de Crescimento e Terminação, para Leitoas de Alto Potencial Genético para Deposição de Carne Magra. Viçosa MG: UFV, 2001. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

KUANA, S. Exigências Nutricionais de Energia Metabolizável, Metionina+Cistina e de Lisina para Matrizes Pesadas. Viçosa MG: UFV, 1986 Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

LELIS, G. R. Atualização da Proteína ideal para Poedeiras Semi Pesadas: Treonina e Valina. Viçosa MG: UFV, 2010. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

LIMA, C. A. R. Níveis de Metionina + Cistina e de Lisina em Dietas para Matrizes Pesadas de 40 a 60 Semanas de Idade. Viçosa MG: UFV, 2001. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

LIMA, H. J. D. Uso da Enzima Fitase em Ração para Codornas Japonesas em Postura. Viçosa MG: UFV, 2008. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

LIMA, I. L. Disponibilidade de Fósforo e Flúor de Alguns Alimentos e Exigência Nutricional de Fósforo para Frangos de Corte. Viçosa MG: UFV, 1995. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

LIMA, K. R. S. Níveis de Proteína Bruta da Ração para Marrãs em Gestação. Viçosa MG: UFV, 2000. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

LIMA, K. R. S. Desempenho de Porcas Submetidas Durante a Gestação Do Primeiro ao Terceiro Parto a Dietas com Diferentes Níveis de Proteína Bruta. Viçosa MG: UFV, 2003. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

LOPES, T. H. C. Níveis de Proteína Bruta na Ração de Gestação para Porcas Pluríparas. Viçosa MG: UFV, 2003. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

LORA, G. A. Estudo de Estratégias Nutricionais para Frangos de Corte. Viçosa MG: UFV, 2008. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

MARSCARENHAS, A. G. Fontes Lipídicas e Níveis de Energia Digestível Para Suínos Machos Inteiros a Partir dos 60 kg. Viçosa MG: UFV, 2001. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

MELLO, H. H. C. Determinação dos Valores de Energia Metabolizável de Alimentos com Aves MOITA, A. M. S. Exigência de Proteína, Lisina, Metionina+Cistina e Níveis de Energia Digestível para Leitões de 12 a 28 Dias de Idade. Viçosa MG: UFV, 1994. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

MONTOYA, F.S. Efeito de Diferentes Níveis Dietéticos de Leucina, Fenilalanina + Tirosina e Histidina sobre o Desempenho de pintos de Corte. Viçosa MG: UFV, 2011.

MELLO, H. H. C. Exigência de Fósforo Disponível para Frangos de Corte Machos e Fêmeas Mantendo a Relação Cálcio:Fósforo Disponível em 2:1. Viçosa MG: UFV, 2010. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

MORATA, R. L. Valor Nutritivo de Alimentos, Deposição de Nutrientes e Desempenho de Frangos de Corte. Viçosa MG: UFV, 2008. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

MOREIRA, I. Valor Nutritivo e Utilização de Milho e Soja Integral Processados e Calor na Alimentação de Leitões. Viçosa MG: UFV, 1993. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

MORETO, V. Níveis de Lisina para Suínos de 15 a 30 kg de Peso. Viçosa MG: UFV, 1998 Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

MOURA, C.O. Exigências Nutricional de Sódio para Poedeiras Leves e Semipesadas no Período de Verão. Viçosa - MG: UFV, 1999. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

MOURA, J. O. Exigência de Metionina + Cistina Digestíveis para Leitões de 15 a 30 Kg de Peso. Viçosa MG: UFV, 2005. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

NARVÁEZ S., W. V. Exigências em Metionina + Cistina para Poedeiras Leves e Semi-pesada. Viçosa - MG: UFV, 1996. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

NASCIF, C. C. C. Níveis de Cálcio, de Fósforo e de Proteínas em Dietas para Poedeiras Leves na Fase de Pré-Postura. Viçosa MG: UFV, 2004. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

NASCIMENTO, A. H. Avaliação Química e Energética do Farelo de Canola e sua Utilização para Frangos de Corte. Viçosa MG: UFV, 1997. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa

NASCIMENTO, A. H. Determinação do Valor Nutritivo da Farinha de Vísceras e da Farinha de Penas para Aves, Utilizando Diferentes Metodologias. Viçosa MG: UFV, 2001. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

NEME, R. Digestibilidade Verdadeira e Biodisponibilidade da Lisina Sulfato e da Lisina Hcl Determinadas em Aves. Viçosa MG: UFV, 2000. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

NERY, L. R. Valores de Energia Metabolizável e de Aminoácidos Digestíveis de Alguns Alimentos para Aves. Viçosa MG: UFV, 2005. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

NERY, L. R. Uso de Anticoccidiano, de Glicina e de Glutamina / Glutamato em Dietas com Diferentes Relações Treonina / Lisina para Frangos de Corte Criados Sob Desafio Sanitário. Viçosa MG: UFV, 2009. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

NEVES, A. C. E. Estudo da Composição Química, da Digestibilidade, da Aditividade e dos Valore Energéticos de Alguns Alimentos para Suínos em Duas Fases. Viçosa MG: UFV, 1993. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

NOGUEIRA, E. T. Digestibilidade Ileal de Proteína e de Aminoácidos de Alimentos Protéicos Determinada pelas Técnicas da T-Cânula Simples e pela Anastomose Íleo-Retal com Suínos. Viçosa MG: UFV, 2000. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

NUNES, C. G. V. Níveis de Lisina em Rações para Fêmeas Suínas em Lactação e para Leitões Pós-Desmame. Viçosa MG: UFV, 2005. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

NUNES, R. V. Digestibilidade de Nutrientes e Valores Energéticos de Alguns Alimentos para Aves. Viçosa MG: UFV, 2003. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

OLIVEIRA NETO, A. R. Níveis de Aminoácidos Sulfurosos para Frangos de Corte Criados em Diferentes Ambientes Térmicos. Viçosa MG: UFV, 2003. Tese (Doutorado em Zootecnia) – Universidade Federal de Viçosa.

OLIVEIRA, G. A. Efeito da Temperatura Ambiente Sobre o Desempenho e as Características de Carcaça de Frangos de Corte dos 22 aos 42 Dias. Viçosa MG: UFV, 2001. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

OLIVEIRA, J. E. Exigência Nutricional de Potássio para Frangos de Corte. Viçosa MG: UFV, 2002. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

OLIVEIRA, V. A. F. Exigência de Treonina Digestível em Rações para Porcas em Lactação. Viçosa MG: UFV, 2006. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

OLIVEIRA, W. P. Redução do Nível de Proteína Bruta com Suplementação de Aminoácidos na Ração de Frangos de Corte Mantidos em Diferentes Ambientes Térmicos. Viçosa MG: UFV, 2008. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

ORLANDO, U. A. D. Nível de Proteína Bruta na Ração e Efeito da Temperatura Ambiente Sobre o Desempenho e Parâmetros Fisiológicos de Leitoas em Crescimento.Viçosa MG: UFV, 2000. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

ORLANDO, U. A. D. Níveis de Proteína Bruta e Suplementação de Aminoácidos em Rações para Leitoas Mantidas em Diferentes Ambientes Térmicos dos 30 aos 100 kg. Viçosa MG: UFV, 2003. Tese (Doutorado em Zootecnia) – Universidade Federal de Viçosa.

PAIVA, F. P. Lisina e Energia Digestível em Rações para Fêmeas Suínas Primíparas. Viçosa MG: UFV, 2004. Tese (Doutorado em Zootecnia) – Universidade Federal de Viçosa.

PASTORES, S. M. Níveis de Cálcio e Relação Cálcio/Fósforo em Rações para Poedeiras Leves de 42 a 58 Semanas de Idade. Viçosa MG: UFV, 2010. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

PENA, S. M. Relação Metionina + Cistina Digestível: Lisina Digestível em Dietas Suplementadas com Ractopamina para Suínos em Terminação. Viçosa MG: UFV, 2007. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

PENA, S. M. Efeitos de Estratégias Nutricionais sobre o Desempenho e a Excreção de Nutrientes para Suínos dos 30 aos 100 kg. Viçosa MG: UFV, 2010. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa

PEREIRA, A. A. Níveis de Triptofano Digestível em Rações para Suínos Machos Castrados de Alto Potencial Genético dos 97 aos 125 kg. Viçosa MG: UFV, 2007. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

PEREIRA, C. A. Exigência Nutricional de Cálcio para Codornas Japonesas Durante o Pico de Postura. Viçosa MG: UFV, 2004. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

PEREIRA, L. E. J. Digestibilidade de Nutrientes de Alimentos para Suínos com Diferentes Dietas Referenciais. Viçosa MG: UFV, 2004. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

PINHEIRO, S. R. F. Níveis de Triptofano em Dietas para Codornas Japonesas em Postura. Viçosa MG: UFV, 2006. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

PINTO, R. Exigências de Metionina + Cistina e de Lisina para Codornas Japonesas nas Fases de Crescimento e de Postura. Viçosa MG: UFV, 2002. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

POZZA, P. C. Valor Energético e Digestibilidade Ileal de Aminoácidos de Farinha de Carne e Ossos e de Farinha de Vísceras para Suínos. Viçosa MG: UFV, 2001. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

PUPA, J. M. R. Rações para Frangos de Corte Formuladas com Valores de Aminoácidos Digestíveis Verdadeiros, Determinados com Galos Cecectomizados. Viçosa MG: UFV, 1995. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

PUPA, J. M. R. Avaliação de Alimentos e Desenvolvimento de Dietas Líquidas para Leitões nas Fases Pré e Pós Desmame. Viçosa MG: UFV, 2000. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

REZENDE, W. O. Níveis de Energia Metabolizável e Relação Lisina Digestível por Caloria em Rações para Suínos Machos Castrados em Terminação. Viçosa MG: UFV, 2004. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

RIBEIRO, M. Efeitos de Fonte e Níveis de Nitrogênio Não-Específicos no Desempenho e Incidência de Anomalias nas Pernas de pintos de Corte. Viçosa MG: UFV, 1990 Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

RIGUEIRA, D. C. M. Exigências Nutricionais de Zinco para Frangos de Corte nas Fases Inicial, Crescimento e Terminação. Viçosa MG: UFV, 2003. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

RIGUEIRA, L. C. M. Aplicação do Conceito de Proteína Ideal em Dietas com Diferentes Níveis de Proteína para Frangos de Corte. Viçosa MG: UFV, 2005. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

RODRIGUEIRO, R. J. B. Exigência Nutricional de Lisina para Poedeiras Leves e Semipesadas em Crescimento. Viçosa MG: UFV, 2001. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

RODRIGUES, N. E. B. Níveis de Treonina em Rações para Suínos com Alto Potencial Genético para Deposição de Carne Magra. Viçosa UFV, 2000. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

RODRIGUES, P. B. Digestibilidade de Nutrientes e Valores Energéticos de Alguns Alimentos para Aves. Viçosa MG: UFV, 2000. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

ROCHA, T. C. Níveis de Lisina Digestível em Rações para Poedeiras Leves no Período de Produção. Viçosa UFV, 2010. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

ROSSONI, M. C. Exigência de Treonina Digestível para Suínos Machos Castrados, de Alto Potencial Genético, na Fase de Terminação. Viçosa MG: UFV, 2004. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

ROSSONI, M. C. Níveis de Lisina Digestível em Rações para Fêmeas Suínas dos 15 aos 95 kg. Viçosa MG: UFV, 2007. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

RUNHO, R. C. Exigência de Fósforo Disponível para Frangos de Corte Machos e Fêmeas. Viçosa MG: UFV, 1998. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

SÁ, L. M. Exigência Nutricional de Cálcio e sua Biodisponibilidade em Alguns Alimentos para Frangos de Corte Viçosa MG: UFV, 2001. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

SÁ, L. M. Exigências Nutricionais de Lisina, de Metionina + Cistina e de Treonina para Galinhas Poedeiras no Período de 34 a 50 Semanas de Idade. Viçosa MG: UFV, 2005. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

SABIONE, K. S. Níveis de Proteína Bruta na Dieta de Gestação para Fêmeas Suínas de 4° ou 5° Parto. Viçosa MG: UFV, 2004. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

SAKOMURA, N. K. Exigência Nutricionais de Energia Metabolizável para Reprodutoras Pesadas, Poedeiras Semipesadas e leves. Viçosa MG: UFV, 1989. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa

SALGUERO, S.C. Digestibilidade do Cálcio de Alimentos Avaliada em Frangos de Corte e em Suínos com Diferentes Métodos. Viçosa MG: UFV, 2009. Tese (Mestrado em Zootecnia) - Universidade Federal de Viçosa

SALGUERO, S.C. Avaliação da Enzima Fitase em Dietas de Milho e Soja com Diferentes Níveis de P e Digestibilidade do P de Diferentes Alimentos Determinada para Aves e Suínos. Viçosa MG: UFV, 2011. Tese em Andamento (Doutorado em Zootecnia em Andamento) - Universidade Federal de Viçosa

SANTOS, F. A. Exigência de Metionina + Cistina Digestíveis para Suínos Machos Castrados de Alto Potencial Genético, dos 60 aos 95 kg. Viçosa MG: UFV, 2005. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

SANTOS, F. A. Níveis de Lisina, Treonina e Metionina + Cistina Digestíveis em Rações para Suínos Machos Castrados de Alto Potencial Genético, dos 95 aos 25 kg. Viçosa MG: UFV, 2008. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

SCHMIDT, M. Níveis Nutricionais de Lisina, de Metionina + Cistina e de Treonina Digestíveis para Galinhas Poedeiras do 2º. Ciclo de Produção. Viçosa MG: UFV, 2006. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

SCHMIDT, M. Níveis Nutricionais de Cobre para Frangos de Corte Machos e Fêmeas nas Fases Inicial, Crescimento e Terminação. Viçosa MG: UFV, 2003. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

SARAIVA, A. Níveis de Fósforo Disponível em Rações para Suínos de Alto Potencial Genético para Deposição de Carne dos 15 aos 60 kg. Viçosa MG: UFV, 2007. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

SARAIVA, E. P. Exigência de Treonina para Leitoas dos 15 aos 60kg Mantidas em Diferentes Ambientes Térmicos. Viçosa MG: UFV, 2004. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

SARAIVA, E. P. Níveis de Proteína Bruta em Rações para Suínos Machos Castrados dos 15 aos 30 kg Mantidos em Ambiente de Baixa Temperatura. Viçosa MG: UFV, 2001. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

SILVA, C. R. Desempenho e Deposição de Nutrientes em Frangos de Corte Alimentados com Diferentes Níveis Dietéticos de Lisina. Viçosa MG: UFV, 2011. Tese em Andamento (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

SILVA, E. A. Valores de Energia Metabolizável e de Aminoácidos Digestíveis de Alguns Alimentos. Viçosa MG: UFV, 2010. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

SILVA, G. F. Digestibilidade Ileal de Aminoácidos de Soja Micromizada e de Farelo de Soja para Suínos e Avaliação de Acidificante em Dietas Para Leitões. Viçosa MG: UFV, 2004. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

SILVA, M. A. Exigências Nutricionais em Metionina + Cistina para Matrizes de Corte no Período de 0 a 23 Semanas de Idade. Viçosa MG: UFV, 2001. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

SILVA, M. A. Exigências Nutricionais em Metionina + Cistina para Frangos de Corte, em Função do Nível de Proteína Bruta da Ração. Viçosa MG: UFV, 1996. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

SILVA, M. D. Avaliação de Diversos Óleos na Ração de Galinhas Poedeiras sobre a Composição dos Lipídios da Gema do Ovo. Viçosa MG: UFV, 2004. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

SILVA, M. L. F. Exigências Nutricionais de Cálcio para Galinhas Reprodutoras de Corte. Viçosa MG: UFV, 1990 Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

SILVA, S. H. M. Exigências em Metionina + Cistina para Duas Marcas Comerciais de Frangos de Corte. Viçosa MG: UFV, 1997. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

SIQUEIRA, J. C. Níveis de Lisina Digestível da Ração e Temperatura Ambiente para Frangos de Corte em Crescimento. Viçosa MG: UFV, 2006. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

SOARES, R. T. R. N. Exigências de Treonina para Frangos de Corte. Viçosa MG: UFV, 1998. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

SOUZA, A. M. Exigências Nutricionais de Lisina para Suínos Mestiços, de 15 a 95 kg de peso. Viçosa MG: UFV, 1997. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

SOUZA, A. V. C. Composição Química e valor Nutritivo do Milho com Diferentes Níveis de Carunchamento para Suínos. Viçosa MG: UFV, 1999. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

SOUZA, L.P.O. Níveis de Lisina Digestível e Planos de Nutrição Baseados em Níveis de Lisina Digestível para Suínos Machos Castrados e Fêmeas, dos 18 aos 107 kg. Belo Horizonte, MG, 2009. Dissertação (Mestrado em Zootecnia) - Escola de Veterinária, Universidade Federal de Minas Gerais.

SOUZA, M.F. Níveis de Lisina Digestível e Planos de Nutrição para Suínos dos 21 aos 63 dias. Viçosa, MG, 2011. (Tese de Mestrado em Andamento) - Universidade Federal de Viçosa.

SOUZA, M. S. Comportamento, Bem Estar e Produtividade de Porcas Lactantes em Função do Tipo De Maternidade no Inverno. Viçosa MG: UFV, 2009. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

SOUZA, R. M. Equações de Predição dos Valores Energéticos de Alimentos para Aves. Viçosa MG: UFV, 2009. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

STRINGHINI, J. H. Efeito do Nível de Proteína na Ração Inicial e da Idade de Início de Restrição Alimentar sobre o Desempenho de Aves Reprodutoras Pesadas. Viçosa MG: UFV, 1990. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

TAVERNARI, F. C. Atualização da Proteina Ideal para Frangos de Corte: Valina e Isoleucina. Viçosa MG: UFV, 2010. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

TEIXEIRA, A. O. Biodisponibilidade e Fluxo do Fósforo pela Técnica de Diluição Isotópica e Utilização de Fontes de Fósforo para Suínos em Crescimento e Terminação. Viçosa MG: UFV, 2002. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

TEIXEIRA, M. P. Níveis de Lisina e Proteína Bruta para Suínos de Diferentes Sexos de 30 a 105 kg de Peso. Viçosa MG: UFV, 2003. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

TEJEDOR, A. A. Exigências Nutricionais de Metionina + Cistina, de Treonina e de Arginina para Frangos de Corte nas Diferentes Fases de Criação. Viçosa MG: UFV, 2002. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

TOLEDO, R. S. Exigência Nutricional de Lisina e de Proteína Bruta para Frangos de Corte Criados em Ambiente Limpo e Sujo. Viçosa MG: UFV, 2004. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

UMIGI, R. T. Níveis de Treonina para Codornas Japonesas no Pico de Postura. Viçosa MG: UFV, 2006. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

UMIGI, R. T. Redução da Proteína Utilizando-se o Conceito de Proteína Ideal e Níveis de Treonina Digestível em Dietas para Codorna Japonesa em Postura. Viçosa MG: UFV, 2009. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

VALÉRIO, S. R. Níveis de Lisina Digestível em Rações para Frangos de Corte Mantidos em Ambiente de Termoneutralidade e de Alta Temperatura. Viçosa MG: UFV, 2001. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

VARGAS JÚNIOR, J. G. Exigências de Cálcio e de Fósforo Disponível para Aves de Reposição Leves e Semi pesadas. Viçosa MG: UFV, 2002. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

VAZ, R. G. M. V. Exigência de Aminoácidos Sulfurados para Leitões Machos Castrados em Diferentes Ambientes Térmicos dos 15 aos 30 kg. Viçosa MG: UFV, 2003. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

VIANA, J. M. Biodisponibilidade de Fósforo em Fosfatos e Níveis de Fósforo Disponível para Suínos na Fase Inicial. Viçosa MG: UFV, 2008. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

VIANA, M. T. S. Fontes e Níveis de Metionina em Dietas para Frangos de Corte. Viçosa MG: UFV, 2006. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

VIEITES, F. M. Balanço Eletrolítico e Níveis de Proteína Bruta em Rações para Frangos de Corte de 1 a 42 Dias. Viçosa MG: UFV, 2003. Tese (Doutorado em Zootecnia) - Universidade Federal de Viçosa.

VIEITES, F. M. Valores Energéticos e de Aminoácidos Digestíveis de Farinhas de Carne e Ossos para Aves. Viçosa MG: UFV, 1999. Dissertação (Mestrado em Zootecnia) - Universidade Federal de Viçosa.

Other Literature References

ANTUNES, R.C.; RODRIGUEZ, N.M.; GONÇALVES, L.C. et al. Composição Bromatológica e Parâmetros Físicos de Grãos de Sorgo com Diferentes Texturas do Endosperma, Arq. Bras. Med. Vet. e Zootec. 59:1351-1354, 2007.

AROUCA, C.L.C.; FONTES, D.O.; VELOSO, J.A.F. et al. Exigências de Lisina, com Base no Conceito de Proteína Ideal, para Suínos Machos Castrados dos 96 aos 120kg, Selecionados para Eficiência de Crescimento. Arq. Bras. Med. Vet. e Zootec. 57:104-111, 2005.

AROUCA, C.L.C.; FONTES, D.O.; FERREIRA, W.M. et al. Exigências de Lisina, com Base no Conceito de Proteína Ideal, para Suínos Machos Castrados, de 95 a 122kg, Selecionados para Deposição de Carne Magra. Arq. Bras. Med. Vet. e Zootec.56:773-781, 2004.

BASTOS, A.O.; MOREIRA, I.; FURLAN, A.C. et al. Composição Química, Digestibilidade dos Nutrientes e da Energia de Diferentes Milhetos (Pennisetum glaucum (L.) R. Brown) em Suínos, R. Bras. Zootec. 2:520-528, 2005.

BELLAVER, C. ; COSTA, C.A.F.; AVILA, V.S. et al. Substituição de Farinhas de Origem Animal por Ingredientes de Origem Vegetal em Dietas para Frangos de Corte, Ciência Rural, Santa Maria. 34:671-677, 2005.

BORGES, F. M. O. Valores Energéticos e Aminoácidos Digestíveis do Grão de Trigo e seus Subprodutos para Aves. Tese (Doutorado em Zootecnia) - Universidade Federal de Minas Gerais. 1999

CANTARELLI, V. S.; GARBOSSA, C. A. P.; SILVEIRA, H. Atualização sobre o uso de Ractopamina em Suínos: Interações entre Níveis Energéticos, Linhagens Genéticas e Categoria Sexual. In: IV Congresso Latino Americano de Nutrição Animal- IV CLANA CBNA/AMENA- de 23 a 26 de novembro de 2010- Estância de São Pedro, SP-Brasil.

CARVALHO, A.D'ÁVILA; LOVATTO, P.A.; HAUSCHILD, L. et al. Processamento da Soja Integral e Uso em Dietas para Suínos: Digestibilidade e Metabolismo, R. Bras. Zootec. 36:2023-2028, 2007 (supl.)

CARVALHO, A.D'ÁVILA; ZANELLA, I.; LEHNEN, C.R. et al. Digestibilidade Aparente de Dietas e Metabolismo de Frangos de Corte Alimentados com Dietas Contendo Soja Integral Processada, Ciência Rural, Santa Maria. 38:477-483, 2008.

CARVALHO, C.B. de; JUNIOR, W.M.D.; REBELLO, C.BÔA-VIAGEM. et al. Avaliação Nutricional do Farelo de Algodão de Alta Energia no Desempenho Produtivo e Características de Carcaças de Frangos de Corte, Ciência Rural, Santa Maria. 40:1166-1172, 2010.

CARVALHO, T.A.; MOLINO, J.P.; DONZELE, J.L. et al. Níveis de Lisina para Suínos machos Inteiros entre 131 a 158 dias de Idade.submetidos à Primeira Dose de Imunocastração aos 130 dias de Idade. In: IV Congresso Latino Americano de Nutrição Animal -IV CLANA CBNA/AMENA- de 23 a 26 de novembro de 2010- Estância de São Pedro, SP – Brasil.

CLOSE, W.H. & D.J.A.COLE. Nutrition of Sows and Boars. Nottingham. Univ. Press. Nottinghan. UK, 2001, 377p.

COON, C.; LESKE, K. & SCO, S. The Availability of Calcium and Phosphorus in Feedstuffs. In: Poultry Feedstuffs Supply Comp. and Nutritive Value. p151 – 179. 2000.

DILGER, R. N AND ADEOLA, O. Estimation of True Phosphorus Digestibility and Endogenous Phosphorus Loss in Growing Chicks Fed Conventional and Low-Phytate Soybean Meals. Poult. Sci. 85:661–668. 2006.

D' MELLO, J. P. F. Amino Acid in Animal Nutrition. 2 nd ed. CABI Inter. Oxon U. K., 2003. 513 p.

FREITAS, E.R.; SAKOMURA, N.K.; NEME, R. et al. Valor Energético do Óleo Ácido de Soja para Aves. Pesq. Agrop. Bras., Brasília, 40:241-246, 2005.

GOMES, F.A.; FASSANI, É.J.; RODRIGUES, P.B. et al. Valores Energéticos de Alguns Alimentos Utilizados em Rações para Codornas Japonesas, R. Bras. Zootec. 36:396-402, 2007.

GOULART, C. C. et al. Exigência de Lisina Digestível para Frangos de Corte Machos de 1 a 42 Dias de Idade. R. Bras. Zootec. 37:876-882, 2008.

JANSSEN, W.M. European Table of Energy Values for Poultry Feedstuffs. Wageningen, Holanda. 1989, 104p.

JONGBLOED, E.W., H. EVERTS and P.E. KEMME. Phosphorus availability and requirements in pigs. In: Recent Development in Pig Nutrition 2. Ed. Cole, D.J.A, W. Haresing, P.C. Garnsworthy. Nottingan Univ. Press. UK. 1993 p.163-178.

JUNQUEIRA, O.M.; ANDREOTTI (in memoriam), M.O.; ARAÚJO, L.F. et al. Valor Energético de Algumas Fontes Lipídicas Determinado com Frangos de Corte, R. Bras. Zootec. 34:2335-2339, 2005 (supl.)

JUNQUEIRA, O.M.; DUARTE, K.F.; CANCHERINI, L. C. et al. Composição Química, Valores de Energia Metabolizável e Aminoácidos Digestíveis de Subprodutos do Arroz para Frangos de Corte, Ciência Rural, Santa Maria. 39:2497-2503, 2009.

KORIN L. LESKE, K and COON, C. A Bioassay to Determine the Effect of Phytase on Phytate Phosphorus Hydrolysis and Total Phosphorus Retention of Feed Ingredients as Determined with Broilers and Laying Hens. Poult. Sci. 78:1151–1157. 1999.

KIEFER, C.; DONZELE, J.L.; OLIVEIRA, R.F.M. Lisina Digestível para Suínos Machos não Castrados de Alto Potencial Genético em Fase de Crescimento. Ciência Rural, Santa Maria. 40:1630-1635, 2010.

KIM, S. W.; CHAYTOR, A.; SHEN, Y. et al. Application of Ideal Protein and Amino Acid Requirements for Gestating Sows. In: IV Congresso Latino Americano de Nutrição Animal - IV CLANA CBNA/AMENA - de 23 a 26 de novembro de 2010 – Estância de São Pedro, SP – Brasil.

KIM, S. W. Recent Advances in Sow Nutrition. R. Bras. Zootec. v.39:310, 2010 (Supl. Especial).

KLIS, J. D. VAN DER AND VERSTEGH, H. A. J. Phosphorus Nutrition in Poultry. In Wiseman, J. and Garnsworthy, P. C. (eds). In: Recent Development. In: Poultry Nutrition 2. Nottingham Univ. Press. Nottingham U. K. p. 309 – 320, 1999.

LARA, L.J.C.; BAIÃO, N.C.; AGUILAR, C.A.L. et al. Efeito de Fontes Lipídicas Sobre o Desempenho de Frangos de Corte, Arq. Bras. Med. Vet. e Zootec.57:792-798, 2005.

LESKE, K and COON, C. The Development of Feedstuff Retainable Phosphorus Values for Broilers. Poult. Sci. 81:1681–1693. 2002.

LIMA, A.L.; BATISTA, R.M.; OLIVEIRA, R.F.M. et al. Níveis de Lisina Digestível em Rações para Suínos Machos Castrados Selecionados para Deposição de Carne na Carcaça Mantidos a 22ºC. Zootec, Águas de Lindóia/SP, 18 a 22 de maio de 2009.

LONGO, F.A.; MENTEN, J.F.M.; PEDROSO, A.A. et al. Carboidratos na Dieta Pré-Inicial de Frangos de Corte, R. Bras. Zootec, 34:123-133. 2005.

MEJÍA, G.C.A.; C.J.A.CUARON; F.J.A. RENTERIA et al. Alimentación del Hato Reproductor Porcino. Centro Nacional de Investigacion Disciplínaria ou Fisiologua y Mejoramento Animal –IMIFAP. Queretaro, Mexico. 2007.216p.

MELLO, H.H. de C.; GOMES, P.C.; ROSTAGNO, H.S. et al. Valores de Energia Metabolizável de Alguns Alimentos Obtidos com Aves de Diferentes Idades, R. Bras. Zootec. 38:863-868, 2009.

MENTEN, J.F.M; ZAVARIZE, K.C.; SILVA, C.L. et al. Biodiesel: Oportunidades do Uso de Glicerina na Nutrição de Aves. In: IV Congresso Latino Americano de Nutrição Animal - IV CLANA CBNA/AMENA-23 a 26 de novembro de 2010 – Estância de São Pedro, SP- Brasil 43- 56.

MOLINO, J.P.; DONZELE, J.L.; ORLANDO, U.A.D. et al. Níveis de Lisina para Suínos machos Inteiros dos 60 aos 95 Dias de Idade. IV Congresso Latino Americano de Nutrição Animal-IV CLANA CBNA/AMENA- 23 a 26 de novembro de 2010- Estância de São Pedro, SP- Brasil.

MOLINO, J.P.; DONZELE, J.L.; ORLANDO, U.A.D. et al. Níveis de Lisina para Suínos machos Inteiros dos 60 aos 95 dias de Idade IV Congresso Latino Americano de Nutrição Animal - IV CLANA CBNA/AMENA - de 23 a 26 de novembro de 2010 – Estância de São Pedro, SP – Brasil.

MOREIRA, I.; GASPAROTTO, L.F.; FURLAN, A.C. et al. Exigência de Lisina para Machos Castrados de Dois Grupos Genéticos de Suínos na Fase de Terminação, com Base no Conceito de Proteína Ideal. R. Bras. Zootec. 31:96-103, 2002.

NECTA (ed). I Simpósio Internacional de Coturnicultura - Novos Conceitos Aplicados à Criação de Codornas. Lavras, MG – Brasil. 11 e 12 de Abril, 2002. 218 p.

NECTA (ed). Anais I Simpósio Internacional de Coturnicultura - Novos Conceitos Aplicados à Criação de Codornas. Lavras, MG-Brasil. 14 e 15 de Outubro, 2010. 285 p.

NRC-Nutrient Requeriments of Swine. 10th. Rev. Ed.NAS. Washington DC. 189p. 1998

NUNES, R.V.; POZZA, P.C.; NUNES, C.G.V. et al. Valores Energéticos de Subprodutos de Origem Animal para Aves, R. Bras. Zootec. 34:1217-1224, 2005.

NUNES, R.V.; POZZA, P.C.; SCHERER, C. et al. Efeito dos Teores de Cálcio para Poedeiras Semi Pesadas Durante a Fase De Pré-Postura e no Início da Postura, R. Bras. Zootec. 35:2007-2012, 2006.

NUNES, C.G.V.; OLIVEIRA, R.F.M.; DONZELE, J.L. et al. Níveis de lisina digestível para leitões dos 6 aos 15 kg. R. Bras. Zootec. 37:84-88, 2008.

NUNES, R.V.; POZZA, P.C.; SCHERER, C. et al. Efeito dos Teores de Cálcio para Poedeiras Semi pesadas Durante a Fase de Pré-Postura e no Início da Postura, R. Bras. Zootec. 35:2007-2012, 2006.

OLIVEIRA, A.L.S.; DONZELE, J.L.; OLIVEIRA, R.F.M. et al. Exigência de lisina digestível para suínos machos castrados de alto potencial genético para deposição de carne magra na carcaça dos 15 aos 30 kg. R. Bras. Zootec.35:2338-2343, 2006.

OLIVEIRA, W. P. et al. Níveis de Lisina para Frangos de Corte no Período de 08 a 21 Dias de Idade. In: ZOOTEC 2009, Anais... Águas de Lindóia, SP, 2009.

OST, P.R.; RODRIGUES, P.B.; FREITAS, R.T.F.DE. et al. Aminoácidos Digestíveis Verdadeiros de Alguns Alimentos Protéicos Determinados em Galos Cecectomizados e por Equações de Predição, R. Bras. Zootec. 36:1820-1828, 2007.

PETERSEN, G. I.;PEDERSEN, C.;LINDEMANN, M. D. et al. Relative bioavailability of phosphorus in inorganic phosphorus sources fed to growing pigs. J. Anim Sci. 89: 460-466. 2011

PETERSEN, G. I and STEIN, H. H. Novel procedure for estimating endogenous losses and measurement of apparent and true digestibility of phosphorus by growing pigs. J Anim Sci. 84:2126-2132. 2006.

RIEGER, C.; OLIVEIRA, V.; LOVATTO, P.R. et al. Características Químicas e Valores Energéticos de Farelos de Soja do Oeste E sudoeste do Paraná, Ciência rural, Santa Maria. 38:266 -269, 2008.

ROSTAGNO, H.S.; ALBINO, L. F. T. II Simpósio Internacional Sobre Exigências Nutricionais de Aves e Suínos. Viçosa, MG – Brasil. 29 a 31 de Março, 2005.

SAKOMURA, N.K.; ROSTAGNO, H.S. Métodos de Pesquisa em Nutrição de Monogástricos. 1ed Jaboticabal, SP : FUNEP, 2007. 283 p.

SAUVANT, D.; PEREZ, J. M.; TRAN, G. Tables of Composition and Nutritional Value of Feed Materials. 2°nd Edition. INRA-FRANCE, 2004. 304 p.

SCHINCKEL, N. RICHERT, N. LI. B.; PRECKEL, P. V. et al. Development of a Model to Describe the Compositional Growth and Dietary Lysine Requirements of Pigs Fed Ractopamine. J Anim Sci 81: 1106 – 1119, 2003.

SILVA, M.A.A.; FURLAN, A.C.; MOREIRA, I. et al. Avaliação Nutricional da Silagem de Raiz de Mandioca Contendo Soja Integral para Leitões na Fase Inicial, R. Bras. Zootec. 37:1441-1449, 2008.

SILVA, V.K.; AMOROSO, L.; FUKAYAMA, E.H. et al. Digestibilidade do Extrato de Leveduras em Frangos de Corte, R. Bras. Zootec. 38:1969-1973, 2009.

SILVA, J. H. V. Tabelas para Codornas Japonesas e Européias-Tópicos Especiais, Composição de Alimentos e Exigências Nutricionais. 2° ed. Jaboticabal, SP. FUNEP, 2009.106 p.

SIQUEIRA, J. C. Estimativas das Exigências de Lisina de Frangos de Corte pelos Métodos Dose Resposta e Fatorial. Jaboticabal, SP: UNESP, 2009. Tese (Doutorado em Zootecnia) – Universidade Estadual Paulista “Julio de Mesquita Filho”.

TAYLOR – PICKARD, J. A. and TUCKER, L. A. Re-defining Mineral Nutrition. Nottingham University Press 295 p. 2005.

TAVERNARI, F. C. Digestibilidade dos Aminoácidos e Valores Energéticos do Farelo de Girassol e sua Inclusão na Ração de Frangos de Corte. . Recife PE UFRPE, 2008. Dissertação (Mestrado em Zootecnia) - Universidade Federal Rural do Pernambuco.

TRINDADE NETO, M. A. et al. Níveis de Lisina Digestível para Frangos de Corte Machos no Período de 37 a 49 Dias de Idade. R. Bras. Zootec. 38:508-514, 2009.

TRINDADE NETO, M.A.; BERTO, D.A.; ALBUQUERQUE, R. et al. Relação Lisina Digestível e Energia Metabolizável para Leitões em Fase Pré-Inicial de Creche. R. Bras. Zootec. 38:1291-1300, 2009.

TRINDADE NETO, M.A.; PETELINCAR, I.M.; BERTO, D.A. et al. Níveis de Lisina para Leitões na Fase Inicial-1 do Crescimento Pós-desmame: Composição Corporal aos 11,9 e 19,0 kg. R. Bras. Zootec. 33:1777-1789, (Supl. 1), 2004.

TOLEDO, A.L. Lisina Digestível em Dietas de Frangos de Corte nos Períodos de 1 aos 11 e 23 aos 36 Dias de Idade: Desempenho e Composição Corporal. Pirassununga, SP: USP, 2006. Dissertação (Mestrado em Medicina Veterinária) – Faculdade de Medicina Veterinária e Zootecnia da Universidade de São Paulo.

ZANGERONIMO, M.G.; FIALHO, E.T.; LIMA, J.A.F. et al. Desempenho e Características de Carcaça de Suínos dos 20 aos 50kg Recebendo Rações com Reduzido Teor de Proteína Bruta e Diferentes Níveis de Lisina Digestível Verdadeira. Ciência Rural, Santa Maria. 39:1507-1513, ago, 2009.

ZANGERONIMO, M.G.; FIALHO, E.T.; MURGAS, L.D.S. et al. Desempenho e Excreção de Nitrogênio de Leitões dos 9 aos 25 kg Alimentados com Dietas com Diferentes Níveis de Lisina Digestível e Proteína Bruta. R. Bras. Zootec. 36:1382-1387, 2007.