Implications of soybean meal quality on swine and poultry production

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1. Abstract

Soybean meal is the main source of amino acids in poultry and swine diets. Although there are other sources of nutrients, soybean meal will maintain the same importance for several years, because the majority of the production systems are working on its basis. Therefore, animal producers have to explore this ingredient the best they can, since external markets have become a dark cloud to Brazilian swine and poultry production chains due to the millions of tons exported, in the last decade.

Corn, soybeans and any other grain are very susceptible to climate challenges, water stress, soil fertility, and insect and fungi attack. Besides, there are differences in the genetic potential of seeds and the consequences of harvesting and processing the grains. All these factors affect the final quality of grains and it happens in a different way for each batch. Therefore, the reduction in animal production costs starts with the detection of quality differences between batches of soybean meal and grains.

The objective of this paper is to discuss some of the aspects of control and improve nutritional quality of soybean for poultry and swine.

2. Introduction

The feed industry is one of the largest and most dynamic segments of Agriculture. The evolution of this industry in the American continent was linked to increased production of poultry, pigs and cattle. These sectors require more than 90% of feed produced. The expectation is for continuous growth in the coming years, as the domestic per capita meat and egg consumption is growing in developing countries. At the same time, there is a strong tendency to increase meat exports in the coming years, especially for Asian countries.

The development of quality concepts in production and the focus on customer satisfaction are already internalized in most companies, under the penalty of falling outside the market. In the case of grain producers in Brazil, the feed industry is the largest end customer, primarily swine and poultry productive chains. However, these two sectors do not always manifest contentment with the grains used in animal nutrition. There is a constant concern about problems that occur after the grain is harvested, such as insect attacks and fungi proliferation. Animal breeding improvements lead to the selection of animals that show higher rates of weight gain and feed efficiency, and these have forced the use of diets with a higher nutrient density. This demand is due not only to increased levels of nutrients required by the animals to increase protein synthesis, but also because there is a tendency to occur reducing voluntary feed intake when there is selection to best feed conversion animals. This drives the nutritionist to use ingredients with higher density of nutrients such as soybean oil and industrial amino acids that may or may not increase the feed and production costs.

There are many points that allow the improvement of grain quality between crop planting and the conversion of grains into meat and eggs. However, there is a strong influence of climatic factors and management of the grains that complicate the final quality.

The approach to quality improvement through exploitation of the genetic potential of grains has great potential for success, which may result in improved animal performance and increased profitability for both animal and grain producers. New cultivars with different characteristics reach the market annually, obtained either by quantitative conventional breeding or by the use of molecular biology techniques.

Grains with different quality characteristics, meeting the specific demands of buyer sector, such as the feed industry, have promoted changes in trade relations. These grains are no longer being considered just as commodities, sold in large lots, but they became specialized ingredients with characteristics desired by processors and producers.

Poultry, swine and grain productive chains have large areas of intersection and should seek common goals to address the growing of all these sectors together.

It has been observed a great variation in the nutritional quality of soybeans and soybean meal in Brazil. Few research projects, focusing on grain quality oriented to livestock needs, have been conducted in order to improve the nutritional quality of the grains used in diets.

However, not all the grain that nutritionists have available is of poor quality. A question must be asked: if we classify our final product such as pig carcasses, for example, why not classify both the corn and soybean meal used to feed the animals? With the use of NIR (near infrared reflectance spectrophotometry), classification of grains based on its nutritional value is not a utopia any more. It is up to managers and the ones responsible to buy grains for swine production to make viable the use of this tool. When this happens, everyone wins: grain farmers, poultry and swine producers, the Brazilian Agriculture and whole society.

3. The knowledge of the nutritional value of the ingredients

In order to have greater accuracy in formulating diets for poultry and pigs, it is necessary to know the composition and energy content of each used ingredient, as well as their limitations. Research has been undertaken with the objective of updating the nutritional values of the traditionally used ingredients in diet formulation. Besides enabling the formation and training of technical personnel, the ultimate goal is to optimize the utilization of nutrients by allowing animals to reduce costs and increase the competitiveness of the production system. Soybean meal have been extensively studied and today there is a great amount of information on their composition.

4. Chemical composition tables of ingredients

It is well recognized that the most valuable information regarding the composition of ingredients should be obtained locally, with the previous analysis of the ingredient that will be used for feeding animals. However, analysis of each batch of ingredient is expensive and difficult to handle. Therefore, summarizing data in tables is useful for nutritionists. Nutritionists usually develop nutritional programs based on tables such as NRC (2012), FEDNA (2003), INRA (2004) and the Brazilian Tables (2011), in addition to the recommendations of the feeding and management manuals of commercial lines, provided by companies of genetic material.

In the past, the main problem to use the foreign tables was the difference between table values and the chemical composition of ingredients available in Brazil. Investment in quality control laboratories and in research institutions led to knowledge that provided better decisions and greater safety in feed formulation.

Currently, nutritionists have several sources of information on feedstuffs composition to assist in the development of nutritional programs. It is up to them, however, to identify the most appropriate to their work conditions. Tables of feed ingredient composition have greater utility when variations in nutrient levels of raw materials are small.

5. Variability of Soybean Strains

Soy is a legume cultivated in China since five thousand years ago. It was in the early twentieth century that it started to be grown commercially in the United States. In Brazil, the grain arrived with the first Japanese immigrants in 1908; however, the expansion happened in the 70s, with the growing interest of the oil industry and international market demand (Embrapa Soja, 2006).

Until 1975, the culture was produced in Brazil with seeds and technology brought from the United States, where climatic conditions are quite different from here. Therefore, it was only produced on a commercial scale in the Southern states, where Americans cultivars found similar conditions (Teixeira, 2003). From this stage, researchers have developed varieties adapted to cultivation in different latitudes, soil and climatic conditions, which allowed planting in all regions of the country.

Currently, it is found in the market numerous varieties of soybeans obtained after years of research in plant breeding. Table 1 shows the composition of the soybean and its parts, which according to Liu (1997) depends on many factors such as variety, planting date, geographic location and climate.

Table 1. Composition of soy and parts of grain

	Percent of grand total	Chemical Composition (% dry matter)			
		Protein	Carbohydrate	Oil	Ash
Grain	100	42	20	33	5
Cotyledon	90	43	23	29	5
Tegument	8	8.8	1	86	4.3
Hypocotyl	2	41	11	43	4.4

Adapted from Liu (1997)

Soybean grain has high nutritional value, because it contains sufficient amount of almost all essential amino acids in its proteins (Costa and Miya, 1972). Most cultivars of soybean have 30 to 45% protein, 15 to 25% oil, 20 to 35% carbohydrates and nearly 5% ash (Moreira, 1999).

Paula (2007), working with 34 different soybean genotypes, evaluated the concentrations of protein, oil, ash and carbohydrates in order to use the best cultivars in a soybean breeding program, observed that the percentage of protein and oil showed a negative correlation, which shows that selection for a particular character can cause a decline in another, constituting a problem to obtain materials with high concentrations of oil and protein (Table 2).

Table 2. Composition of soybean cultivars (natural matter basis)

Cultivar	Crude protein (%)	Oil (%)	Ash (%)	Carbohydrates (%)
Monarca	41.43[a]	19.76[c]	4.47[c]	23.63[b]
Elite	41.30[a]	18.72[c]	5.00[a]	23.80[b]
CS 801	38.26[c]	23.20[a]	4.40[c]	23.37[b]
CS 02449	37.31[c]	22.39[b]	4.63[b]	25.00[a]

Means followed by different letters in the same column differ (P <0.05). Adapted from Paula (2007)

Sinova Coca et al. (2008) evaluated soybean meal from Argentina, Brazil, Spain and USA. These authors observed significant differences in apparent digestibility of dry matter and amino acids for broilers according to the place of production (Table 3). It is important to emphasize that, in this case, the observed differences were due to factors others than inherent from the plant. The main reasons for differences were caused by the conditions under which the different sources of soybeans were grown, but above all, the soybean meal processing. In the case of soybean meal produced in Argentina and Brazil had higher fiber content as a function of the amount of soybean hulls added, reducing the digestibility.

Table 3. Composition and nutrient digestibility of soybean meal produced from 4 different countries

Component		Argentina	Brazil			Spain	USA
		Rosario	Ilheus	Paranagua	Santos		
DM	%	88.9	88.2	88.4	88.5	89.4	90.2
EE	%	1.3	1.9	2.1	1.9	0.8	1.1
FDN	%	9.7	10.8	8.2	10.8	7.6	1.0
CP	%	46.1	45.5	47.2	45.2	50.6	48.6
Lys total	%	6.01	5.87	6.09	5.51	5.83	6.26
Met total	%	1.36	1.32	1.31	1.34	1.25	1.35
Cys total	%	1.41	1.46	1.48	1.45	1.49	1.47
TIA[1]	mg/g	6.5	5.1	4.1	5.1	2.4	1.8
AU[2]	mg/g	0.03	0.01	0.02	0.04	0.00	0.00
IDP[3]		12	14	12	15	11	10
KOH[4]	%	80.9	80.5	84.2	81.6	85.2	84.3
Coefficient of apparent ileal digestibility							
DM	%	75.6[b]	75.2[b]	76.7[b]	76.8[b]	81.8[a]	82.3[a]
N	%	77.9[c]	79.0[bc]	79.2[bc]	77.3[c]	82.1[ab]	85.5[a]
Lys	%	80.9[b]	83.5[a]	84.4[a]	77.8[c]	84.0[a]	85.1[a]
Met	%	84.1[c]	85.7[bc]	86.5[b]	81.9[d]	86.3[b]	88.8[a]
Cys	%	55.1[b]	55.5[b]	56.4[b]	56.9[b]	62.9[a]	65.8[a]

[1]Trypsin inhibitory activity
[2]Ureatic activity
[3]Index of protein dispersion
[4]KOH solubility
[a, b, c, d]Means with different letters in the same row differ by Tukey test (P ≤ .05). Sinova Coca et al. (2008).

6. Breeding to Improve Amino acid Composition of Soy Protein

Genetic improvement of soybean cultivars with the objective of increasing the total protein in the seed brought doubts about to the amino acid profile in soy proteins. Although research shows the amino acid profile of the protein is maintained almost constant, recent reports with various cultivars, showed some differences in the percentage of amino acids in relation to total protein.

Yaklich (2001) compared soybean lines and varieties of high protein and concluded that although there was increase in protein content, the amino acid profile kept a steady relationship. However, Moraes et al. (2006) analyzed the chemical composition of two strains selected for high protein content and a strain with normal protein. The authors found that the content of amino acids differed among strains, except for the amino acids glycine, alanine, tyrosine and methionine (Table 4).

Table 4. Content (%) of protein and amino acids of defatted soybean lines UFVTN 105 and Isolinha 1 and 2 [(1)] on as dry matter basis

Amino acid	UFVTN 105		Isolinha 1		Isolinha 2		
	AAF	AAP	AAF	AAP	AAF	AAP	F test
Protein[1]	40.68		47.78		46.56		*
Lysine	3.20	6.83	3.65	7.11	3.30	6.56	*
Methionine	0.62	1.31	0.67	1.31	0.66	1.30	Ns
½ Cystine	0.48	1.03	0.50	0.97	0.54	1.06	Ns
Threonine	2.17	4.62	2.22	4.33	2.22	4.41	*
Valine	1.91	4.07	2.42	4.71	2.35	4.67	*
Arginine	3.45	7.37	4.14	8.08	3.77	7.48	*
Isoleucine	1.98	4.23	2.48	4.83	2.38	4.73	*
Ac. glutamic	8.59	18.34	8.58	16.73	8.76	17.4	*
Glycine	2.15	4.58	2.35	4.58	2.37	4.71	Ns

1 Mean values of two replicates; AAF: percentage of the amino acid in the defatted flour; AAP: percentage of the amino acid in the protein; ns = not significant; * = Significant at 5% probability, F test.
Adapted from Moraes et al. (2006)

These results show the importance of monitoring the chemical composition of raw materials that will be used in the feed. Therefore, this information will help to get the precise formulation of animal diets to meet their requirements without loss in animal performance and providing best economic results in the production.

6.1. Soy Proteins

The total protein fraction of soybean and other legumes is a complex mixture of globulins (40-60%), albumin (8-20%), prolamines and glutelines. Globulins and albumins are the main components (Bhatty, 1982) and their proportions vary among species and cultivars (Neves, 1995). In soybean, this fraction is known as reserve and metabolic proteins. The metabolic proteins include enzymes and structural proteins, and they are related to common cellular activities, including the synthesis of other proteins. The storage proteins, along with oil deposits, are formed during grain development. Most of the soy proteins belong to reserve type (Muller, 1981) and they belong to the globulin group.

Soy protein is inferior in quality when compared to animal protein in relation to the content of sulfur amino acids, which are present in this legume in limiting amounts. Globulins contain high levels of the amino acid glutamine, asparagine and arginine, but containing low levels of sulfur amino acids methionine and cysteine (Smith and Grierson, 1982).

The proteins glycinin and β-conglycinin constitute approximately 70% of soybean storage proteins. Generally glycinin and β-conglycinin constitute approximately 40% and 30% of soy protein, respectively (Nielsen et al. 1989; Harada et al. 1989).

Research has shown that the β-conglycinin is more deficient in sulfur amino acids compared to glycinin, and there are differences in the contents of components (subunits) of these proteins in soybean lines with high protein concentration (Yaklich, 2001).

Fehr et al. (2003) studied different soybean cultivars in order to evaluate the influence of genotype, location and environment on the protein components of soybean glycinin, β-conglicine and their relationship. Crop year and local of planting did not affect significantly protein components, but the environment has changed significantly the protein components as well as the relationship glycinin / β-conglycinin, which ranged from 1.26 to 2.10, illustrating the importance of the environment on the composition of soybeans.

According Imsande (2001), genetic selection for soybean genotypes with higher percentages of methionine and cysteine has been significant. According to the author, it has been possible to increase up to 22% methionine and 28% cysteine in certain genotypes when compared to the content of methionine plus cysteine of the control genotype (Table 5).

Table 5. Amino acid composition of soybean seeds and improved control (as % of protein)

Amino acid	Genotype 1	Genotype 2	Genotype 3	Control
Lysine	7.19	6.27	6.06	7.14
Methionine	1.49	1.85	1.83	1.51
Cysteine	1.86	1.68	1.69	1.32
Threonine	4.65	3.53	3.55	4.71
Glycine	7.00	6.87	7.41	7.46

Adapted from Imsande (2001)

Krishnan (2005), in a review of the comparisons of the amino acid content of storage proteins in soybean glycinin and β-conglycinin, showed that the content of sulfur amino acids methionine and cysteine, present in glycinin, is substantially larger than the β-conglycinin (Table 6). Several researches have established that the accumulation of β-subunit of β-conglycinin is promoted by excess nitrogen or the sulfur deficiency (Paek et al., 2000; Imsande, 2003). Increase in the accumulation of β-conglycinin lowers the content of methionine and cysteine protein of soybean which seems to change the nutritional quality. However the content of lysine may have increased.

Table 6. Amino acid composition of some of the storage proteins of soybean β-conglycinin and glycinin (% protein)

	β- Conglycinin			Glycinin				
Amino acid	α'	α	B	Gγ1	Gγ2	Gγ3	Gγ4	Gγ5

	%							
Lysine	7.2	6.2	4.8	5.0	3.9	3.9	4.8	3.7
Methionine	0.3	0.2	0.0	1.3	1.5	1.1	0.4	0.6
Cysteine	0.8	0.9	0.0	1.7	1.7	1.7	1.1	1.2
Threonine	2.0	1.9	2.4	4.2	3.9	3.9	3.5	3.9
Valine	4.5	4.1	5.8	4.8	5.6	5.4	6.5	7.1
Glycine	4.7	4.1	4.3	7.4	7.3	7.3	6.3	7.9

Adapted from Krishnan (2005)

Nakasathien et al. (2000) evaluated the possibility of increasing the protein concentration of soybean seeds with nitrogen supplementation. According to the authors, during the stage of plant development, it is possible to increase the concentrations of seed protein by supplementing with super-optimal nitrogen doses. The increase would be the β subunits with a reduction in the ratio of reserve proteins Glycine / β-conglycinin. Paek et al. (1997) also found changes in the composition of soybean seed proteins when they studied different forms of nitrogen supplementation.

Therefore, it would be desirable if the soy used as food for humans contained larger amounts of glycinin in relation to β-conglycinin, due to be essential amino acid methionine. In the case of poultry nutrition, although methionine is the first limiting amino acid, when improved cultivars with higher content of sulfur amino acids are compared to standard cultivars, there are not major differences in feed costs, due to the negative correlation between lysine and methionine in the studies. Whereas most diets are based on corn and soybean meal, these ingredients complement each other. In this way, deficiency of soybean meal methionine is supplied in part by corn, and the lysine deficiency of corn is supplied by soybean meal.

7. Soy Processing

The nutritional quality of soybeans and its co-products can be improved with proper heat treatment which reduces the activity of the protease inhibitor and lectin. In general, the magnitude of which these inhibitors can be inactivated by heating is a function of temperature, heating time, used pressure, humidity and particle size. The control of all these variables requires extreme care in order to obtain a product of excellent nutritional value.

Neto (1992) described seven methods of processing the whole soybean: toasting in rotating drum, toasting by wet steam, toasting by dry steam, jet exploder, micronization, wet or dry extrusion and microwave. The extrusion is a very effective type of processing; it causes disruption of cell walls providing greater exposure of the nutrients and causing gelatinization of the starch component, protein denaturation and shear and restructuring of expanded products. In the processing of toasting, cooking is done using a heat source. The cooking time and temperature soybean vary according to the type of equipment used, requiring grinding of the final product. Micronization is the process where the raw soybean is subjected to indirect heating by steam at a temperature of ± 165 ° C for 2 to 3 minutes. After heating, the shell is removed from soybean grain which is then subjected to a milling process rolls (micronization) to achieve a final particle size ± 30 microns.

8. Nutrient Composition of Soy Products

The main source of protein and amino acids in poultry and swine diets is soybean meal. Because of its high quality protein, soybean meal is used as a comparative standard in the evaluation of alternative protein ingredients.

The nutritional quality of soybean products is not determined solely by the amount and availability of amino acids. However, it is highly affected by the processing conditions used to obtain these products.

Tables 7 to 13 present the major soy products and their nutritional values referenced in different composition tables.

Table 7. Composition of roasted whole soybean (on natural basis)

Nutrient	NRC 94-98	INRA 04	Degussa 06	UFV 11
DM (%)	90.00	88.60	88.00	89.94
CP (%)	35.20	35.20	35.89	36.42
EE (%)	15.00	19.20	-	18.32
CF (%)	-	5.60	-	6.03
ME Poultry kcal/kg	3300	3277/ 3373[1]	-	3263
ME Swine kcal/kg	3660	3636/ 3923[2]	-	3706
Total amino acids (%)				
Lysine	2.22	2.18	2.17	1.96
Methionine	0.53	0.53	0.47	0.45
Met + Cys	1.08	1.10	1.00	0.87
Tryptophan	0.45	0.45	0.48	0.47
Threonine	1.41	1.42	1.40	1.22
Arginine	1.66	2.60	2.64	2.45
Valine	1.66	1.68	1.70	1.47
Isoleucine	1.61	1.62	1.62	1.46

[1]Chickens and Roosters respectively

[2]Growing pigs and sows, respectively

Table 8. Composition of extruded whole soybean (on natural basis)

Nutrient	INRA 04	Degussa 06	UFV 11
DM (%)	88.10	88.00	89.94
CP (%)	34.80	35.79	36.42
EE (%)	17.90	-	18.32
CF (%)	5.20	-	6.03
ME Poultry kcal/kg	3349/ 3445[1]	-	3409
ME Swine kcal/kg	3564/ 3852[2]	-	3913
Total amino acids (%)			
Lysine	2.16	2.18	2.04
Methionine	0.53	0.48	0.46
Met + Cys	1.09	1.04	0.90
Tryptophan	0.44	0.48	0.50
Threonine	1.40	1.40	1.27
Arginine	2.57	2.61	2.51
Valine	1.66	1.70	1.56
Isoleucine	1.61	1.60	1.51

[1]Chickens and Roosters respectively

[2]Growing pigs and sows, respectively

Table 9. Composition of micronized soybean (on natural basis)

Nutrient	Biasi[1]	UFV 11
DM (%)	93.48	92.62
CP (%)	38.53	39.14
EE (%)	23.23	21.50
CF (%)	0.10	1.36
ME Poultry kcal/kg	-	3660
ME Swine kcal/kg	4136	4330
Total Amino acids (%)		
Lysine	2.31	2.26
Methionine	0.52	0.53
Met + Cys	1.05	0.97
Tryptophan	-	0.47
Threonine	1.53	1.31
Arginine	2.78	2.86
Valine	1.98	1.74
Isoleucine	1.87	1.71

[1]Informative Perdigão

Table 10. Composition of soy protein concentrate (on natural basis)

Nutrient	NRC 98	Degussa 06	UFV 11
DM (%)	90.00	88.00	90.22
CP (%)	64.00	62.55	63.07
EE (%)	3.00	-	0.45
CF (%)	-	-	2.77
ME Poultry kcal/kg	-	-	2621
ME Swine kcal/kg	3180	-	3586
Total Amino acids (%)			
Lysine	5.26	3.92	3.77
Methionine	0.90	0.84	0.85
Met + Cys	1.90	1.71	1.69
Tryptophan	0.65	0.81	0.80
Threonine	3.17	2.45	2.29
Arginine	3.40	4.67	5.02
Valine	3.40	3.00	2.85
Isoleucine	3.30	2.85	2.75

Table 11. Composition of soybean meal 45% (on natural basis)

Nutrient	NRC 94-98	INRA 04	Degussa 06	UFV 11
DM (%)	89.00	87.80	88.00	88.75
CP (%)	43.80	45.30	46.29	45.22
EE (%)	1.50	1.90	-	1.69
CF (%)	7.00	6.00	-	5.30
ME Poultry kcal/kg	2230	2573/ 2273[1]	-	2254
ME Swine kcal/kg	3380	3205/ 3373[2]	-	3154
Total Amino acid (%)				
Lysine	2.83	2.78	2.81	2.57

Methionine	0.61	0.64	0.62	0.55
Met + Cys	1.41	1.31	1.30	1.13
Tryptophan	0.61	0.59	0.63	0.58
Threonine	1.73	1.77	1.81	1.57
Arginine	2.06	3.36	3.37	3.17
Valine	2.06	2.18	2.18	1.97
Isoleucine	1.99	2.09	2.07	1.92

[1]Chickens and Roosters respectively

[2]Growing pigs and sows, respectively

Table 12. Composition of soybean meal 48% (on natural basis)

Nutrient	NRC 94-98	INRA 04	Degussa 06	UFV 11
DM (%)	90.00	87.60	88.00	89.18
CP (%)	47.50	47.20	47.64	48.10
EE (%)	3.00	1.50	-	1.45
CF (%)	-	3.90	-	4.19
ME Poultry kcal/kg	2240	2320/ 2368[1]	-	2295
ME Swine kcal/kg	3500	3301/ 3421[2]	-	3253
Total Amino acids (%)				
Lysine	4.20	2.89	2.85	2.71
Methionine	0.90	0.66	0.61	0.60
Met + Cys	1.90	1.35	-	1.22
Tryptophan	0.90	0.61	0.63	0.61
Threonine	2.80	1.83	1.83	1.65
Arginine	3.40	3.50	3.46	3.26
Valine	3.40	2.28	2.22	2.08
Isoleucine	3.30	2.17	2.12	2.05

[1]Chickens and Roosters respectively

[2]Growing pigs and sows, respectively

Table 13. Composition of soybean hulls (on natural basis)

Nutrient	INRA 04	Degussa 06	UFV 11
DM (%)	89.40	88.00	89.13
CP (%)	12.00	13.24	13.88
EE (%)	2.20	-	3.00
CF (%)	34.20	-	32.70
ME Poultry kcal/kg	-	-	858
ME Swine kcal/kg	1866/ 2488[1]	-	2207
Total Amino acids (%)			
Lysine	0.71	0.83	0.54
Methionine	0.14	0.15	0.11
Met + Cys	0.33	0.36	0.19
Tryptophan	0.14	0.15	0.06
Threonine	0.43	0.47	0.24
Arginine	0.59	0.74	0.65
Valine	0.51	0.60	0.38
Isoleucine	0.44	0.50	0.34

[1] Growing pigs and sows, respectively

8.1. True digestibility coefficients

The values of true digestibility coefficients are usually found in the tables of feed composition. However, due to the variation in experimental conditions (animal age, genotype, and feeding level) many of these tables present different information, which suggests the need to use suitable values obtained on Brazilian conditions to allow expression of the maximum growth potential of the animals (Table 14). The nutritional value of a feed protein depends on the amino acid composition, the digestibility and availability.

Table 14. True digestibility of amino acids of roasted soybean (ST), extruded soybeans (ES) and of soybean shelled (FS) for chickens[1]

Amino acids	NRC 94	INRA 04			UFV 11		
	FS	ST	ES	FS	ST	ES	FS
Lysine	91.00	81.00	88.00	91.00	86.8	90.4	92.5
Methionine	92.00	82.00	86.00	91.00	86.8	89.6	92.5
Met + Cys	87.00	79.00	81.00	88.00	83.6	86.0	89.8
Tryptophan	-	-	-	-	84.9	90.3	90.9
Threonine	88.00	79.00	88.00	89.00	83.6	87.4	88.7
Arginine	92.00	85.00	91.00	92.00	91.4	93.6	93.8
Valine	91.00	77.00	86.00	91.00	84.2	88.8	90.1
Isoleucine	93.00	79.00	87.00	92.00	86.8	89.8	90.8

[1]Coefficient expressed in %.

The composition and classification of Brazilian soybean meal according to the Brazilian Compendium of Animal Nutrition (2005) is presented in Table 15.

Table 15. Composition and classification of Brazilian soybean meal according the crude protein.

Composition	Soy bean meal (% CP)					
	42	44	45	46	47	48
Dry matter, min.	87.50	87.50	87.50	87.5	87.50	87.5
Crude protein, min.	42.00	44.00	45.00	46.00	47.00	48.00
Crude fiber, max.	9.00	8.00	7.00	6.00	4.50	3.50
Mineral matter, min.	8.00	7.00	7.00	7.00	6.00	6.00
Urea activity, max.	0.20	0.15	0.15	0.15	0.15	0.15
Solubility KOH, min.	80.00	80.00	80.00	80.00	80.00	80.00

9. Conclusions.

- Part of the variation in performance of the animals is caused by the lack of adjustment of the composition of ingredients;
- Currently, they are found in the market numerous varieties of soybeans. The composition of soybean grain depends on many factors such as genetics, fertilization management, geographic location and climate.

- The products from the soybean grain must be properly processed to obtain high biological value protein and digestible.
- The control of food quality allows formulating rations more efficient and economic.

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