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Nutritional quality and safety assessment of ingredients and feed given to pregnant swine and piglets

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Abstract

The assessment of the nutritional composition and quality of feed is of fundamental importance, as feed represents a large percentage of animal production cost. Changes in feed composition can alter metabolisms, reduce digestive capacity and growth, hence affecting the production performance and profits which are more critical in smaller swine farms. In this paper we report on an evaluation of the nutritional quality [proteins, lipids, carbohydrates, fibre, calcium (Ca) and phosphorus (P)] and safety [mycotoxins, moisture content (mc) and water activity (a_w)] of feed ingredients and final products in pregnant swine (gilts/sows) and off-spring (piglets) from a small production farm in Southern Brazil. From the nutrition quality data obtained, feed ingredients such as *soybean meal, rice meal* and *corn* presented protein average content of 46.35%, 13.94% and 8.88%, respectively. As far as antinutritional factors are concerned, the urease level in the *soybean meal* used for swine feed production was of 0.03% (0.01 to 0.09). For the two different swine formulations analysed, the fibre values obtained were 1.74% and 2.14% for piglet and pregnancy feed, respectively. The Ca and P levels found in the two formulation samples were 0.499 & 0.715% and 0.753 & 0.963%, respectively. As far as the samples' *safety* parameters are concerned, the average mc & a_w obtained were 12.30% & 0.66% for corn, 9.77% & 0.64 for rice meal and 12.93% & 0.67% for soybean meal. In addition to this, the moisture levels found were high enough for fungi proliferation and mycotoxin production. 10% of samples showed some contamination by mycotoxins (AFLs and ZON). OTA and EST were not found in any of the tests performed (LOD: 1; LOQ: 2µg/kg). Our results demonstrated that small farms are able to produce animal feed within the recommended nutritional standards. However, the implementation of quality assurance practices, to prevent nutritional fluctuations are necessary and can contribute to improving the production process and then enhancing its profitability.

Keywords: nutritional quality, feed, protein, carbohydrates, lipids, mycotoxins, swine.

Avaliação da qualidade nutricional e segurança alimentar de ingredientes e rações fornecidos para suínos gestantes e leitões

Resumo

A avaliação da composição nutricional e da segurança alimentar de rações é de fundamental importância, pois a alimentação representa uma vasta percentagem dos custos da produção animal. Mudanças na composição podem alterar o metabolismo, reduzir a capacidade digestiva e crescimento, afetando o desempenho animal e a lucratividade, o que pode ser muito crítico, especialmente em pequenas propriedades rurais. Neste trabalho nós avaliamos a qualidade nutricional [proteínas, lipídeos, carboidratos, fibra, cálcio (Ca) e fósforo (P)] e a segurança alimentar [micotoxinas, umidade (mc) e atividade de água (a_w)] de ingredientes e rações fornecidos para suínos gestantes e leitões de uma pequena propriedade rural do Sul do Brasil. Com relação à qualidade nutricional, os dados obtidos demonstraram que farelo de soja, farelo de arroz e milho apresentam, em média, 46.35%, 13.94% e 8.88% de proteína, respectivamente. Com relação a fatores antinutricionais, o nível de urease presente no farelo de soja usado para alimentar suínos foi de 0.03% (0.01 a 0.09). Para as duas diferentes formulações de rações analisadas, os valores de fibra obtidos foram de 1.74% e 2.14% para leitões e animais em gestação, respectivamente. Os níveis de Ca e P encontrados nestas duas formulações de rações foram de 0.499 e 0.715% e de 0.753 e 0.963%, respectivamente. Os parâmetros da segurança alimentar foram avaliados quantificando-se a mc e a_w. Os dados obtidos revelaram níveis de mc e a_w de 12.30% e 0.66% para milho, 9.77% e 0.64 para farelo de arroz e 12.93% e 0.67% para farelo de soja. Os níveis de mc encontrados foram altos o suficiente para poder induzir proliferação de fungos e produção de micotoxinas. 10% das amostras apresentaram contaminação por micotoxinas (AFLs e ZON), sendo que OTA e EST não foram encontradas em nenhuma das amostras analisadas (LOD: 1; LOQ: 2 µg/kg). Nossos resultados demonstraram que pequenas propriedades são capazes de produzir ração animal respeitando os padrões nutricionais recomendados. Porém, a implementação de práticas de qualidade e segurança alimentar com o intuito de prevenir variações nutricionais são necessárias, as quais podem contribuir para melhorar o processo de produção e, consequentemente, aumentar a lucratividade.

Palavras-chaves: qualidade nutricional, alimentação, proteína, carboidratos, lipídeos, micotoxinas, suínos

INTRODUCTION

Swine growth performance depends upon numerous factors including genetics, management practices, health status and type of diet (Kil and Stein, 2010). Swine production reached about 100 million tons worldwide and Brazil is one of the world´s largest producers (ABIPECS, 2012). Swine feed accounts for the highest cost of the swine production system (Landero et al., 2011) and its nutritional requirements vary according to the genetic potential, age, sex and weight of the animal.

Ingredients used in feed, such as corn, are considered excellent sources of metabolized energy for swine (Yong et al., 2010; Prandini et al., 2011). Likewise, soybean meal is the main source of vegetable protein used in animal feed (Jezierny et al., 2010; Song et al., 2010)**.** Despite being high in protein, soybean meal has antinutritional factors such as trypsin inhibitors, which may alter the digestive process and affect animal growth. These pernicious effects can be eliminated by heat and can be measured the enzyme urease assessment. Fibre-rich feed prevents gastric lesions. Minerals generally constitute 4 to 6% of animal body and calcium (Ca) and phosphorus (P), apart from being important for their bone structure, can boost the immune system and, thus, improve the animal's health.

Therefore, the quality of ingredients used in feed processing can significantly affect the quality of pork at the end of the production chain. Alteration in the feed's chemical composition, the presence of fungi and/or mycotoxins can affect animal metabolism, interfere with the digestive process and affect animal development and health. Animal nutrition has a major impact on the lipid levels found in pork (Alonso et al., 2010). Much research has been conducted to evaluate the impact of a wide range of feed ingredients and feed additives on various aspects of gut health and development in swine (Lange et al., 2010). However, little is known about the actual quality of the ingredients that are purchased by small swine producing farms from feed suppliers or of the quality and safety of feed prepared on their premises.

The aim of this study is to evaluate the quality and safety of feed ingredients and final products for pregnant (gilt/sow) and piglets in a small swine producing farm from Southern Brazil over a period of 7 months

MATERIALS AND METHODS

Samples: Two types of swine feed samples were collected for analysis *feed ingredients* (*grain*: corn; *meal*: soybeans and rice) used feed *final products* for pregnant swine (gilts/sows) and piglets from a small farm, located in Southern Brazil. Table 1 shows the swine daily feeding routine.

Reagents, solvents and standards: *Reagents* - ammonium molybdate vanadate, ammonium oxalate, ammonium sulphate, celyte, copper carbonate, copper sulphate, ferric chloride, methyl red, orthophosphate, potassium chloride, potassium sulphate, potassium permanganate, sodium hydroxide, oxalic acid, sulfuric acid, formic acid, chloric acid and acetic acid, all from Vetec (Rio de Janeiro, Brazil); *solvents* - acetone, chloroform, ethyl acetate, methanol, and toluene, all from Carlo Erba (Milano, Italy); *standards:* AFLs (AFB_1, AFB_2, AFG_1 and AFG_2), ZON, EST and OTA, all from Sigma (Steinheim, Germany).

Table 1. Swine daily feeding routine

Feed type	Feeding		Feed composition (%)			
	Quantity (kg)	**Periodicity (times per day)**	**Corn**	**Soybean meal**	**Rice meal**	**Other***
Pregnant						
Gilts	2.5	2	65	16	15	4
Sows	2.5	2	65	16	15	4
Off-springs						
Piglets	1.0	all the time	60	29	5	6

*mix of *minerals* (Ca, P, sodium, chrome, copper, iron, cobalt, selenium) and *vitamins* (B_1, B_2, B_6, B_{12}, D_3, K_3)

Sample collection and preparation**:** *Collection* - samples were collected from August 2010 to February 2011 in a small farm located in Santa Catarina state, Southern Brazil, at Doutor Pedrinho town. They were collected from silos (stored in bulk/loose) and storehouses (stored in bags). Corn and soybean meal were collected from silos of 50 and 20 ton capacity, respectively. Rice meal from local suppliers and feed for *pregnant* swine and piglets prepared on the premises were collected from 25 kg bags. 200 g of each sample type were gathered from different collection points to get a total sample of 1 kg (composite sample) of each ingredient and feed (Figure 1). *Preparation* - each sample was homogenized and divided into smaller portions (analytical samples) for analysis of proximate composition (lipids, fibre, ash, protein, Ca, P), mc, a_w, urease and mycotoxins (AFLs, ZON, EST and OTA).

Evaluation of swine feed nutritional quality: analysis of lipids, fibre, Ca, P, ash and urease activity were performed according to standard number 108 of the Ministry of Agriculture of Brazil - MAPA (Brazil, 1993). Protein and mc analyses were performed by the AOAC method (2005). *Protein:* analysed by sample digestion with sulphuric acid catalysed by copper sulphate and potassium sulphate to accelerate the reaction. A portion of the sample was transferred to Kjeldahl flask with catalyst mixture and sulphuric acid. The sample was cooled and, after addition of water and sodium hydroxide, was distilled. Next, distilled water and sulphuric acid were added. Excess acidity was corrected with sodium hydroxide solution (AOAC, 2005).

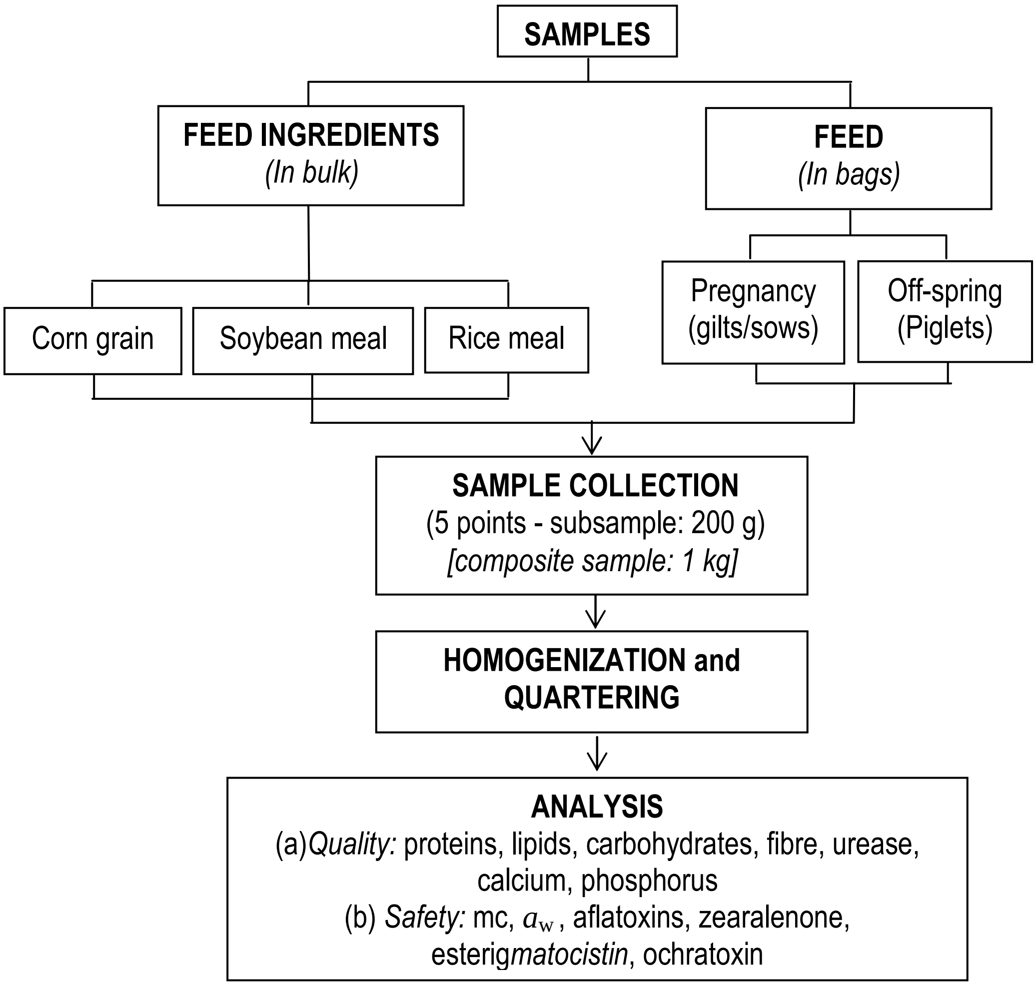

Figure 1. Flowchart of swine ingredients and feed sample collection and analysis

Carbohydrate: carbohydrate content was obtained by subtracting the sum of the contents of proteins, lipid, fibre, mc and ash from one hundred. *Lipids:* the fraction extraction was performed by vapour drag. The sample was transferred to a cartridge extractor and dried at 105°C. The condenser was adjusted and sufficient amount of solvent was kept throughout the process. Calculations were based on the difference in weight and percentage (Brazil, 1993). *Fibre:* determined by analysing the insoluble organic residue of the sample, after acid (sulfuric acid) and alkaline (sodium hydroxide) digestion. Performed by a reflux system, filtration (vacuum in a Buchner funnel) and incineration in a muffle (550°C). Calculations were performed as suggested by MAPA (Brazil, 1993).

Ash: the method is based on the elimination of volatile organic and inorganic matter at a high temperature (550 to 600°C). The residue is called ash. The percentage of ash is calculated by the difference in sample weight, before and after three hour incineration, (Brazil, 1993)
Calcium: the analysis was based on the precipitation of Ca from the solution obtained from the ashes of the sample in the presence of ammonium oxalate. The resulting precipitate (Ca oxalate) is dissolved in chloric acid to form oxalic acid, which is analysed by oximetry (through titration with sulfuric acid, potassium permanganate and methyl red). *Phosphorus:* the amount of P determinant by colorimetry. From a reaction of the acid solution of orthophosphate with ammonium molybdate vanadate, a yellow complex is formed, which is measured colorimetrically. The absorbance was compared to a standard curve previously prepared (Brazil, 1993). *Urease activity: calculated by observation of* pH variation, resulting from the ammonia released by the enzymatic action of urease (Brazil, 1993).

Evaluation of swine feed safety: *Determinations of AFLs, OTA, ZON and EST:* was performed by the method described by Soares and Rodrigues-Amaya (1989). Briefly, each sample was extracted with methanol and potassium chloride (4%), filtered and, after that, ammonium sulphate (30%) was added, followed by moderate stirring and filtration. The resulting filtrate was transferred to a separation funnel, and toxins were extracted with chloroform. Extracts were collected in a beaker and submitted to solvent evaporation. Extracts were re-suspended in 200 µL of toluene and immediately subjected to thin layer chromatography. The analyses was performed in cuba saturated with the following solvent system: toluene – ethyl acetate – formic acid (60:40:0.5). The toxins were detected under UV light and quantified by comparation to toxin standards (λ: 256 & 365 nm). The limits of quantification (LOQ) and determination (LOD) were 2 and 1 µg/L, respectively. *Moisture content:* performed according to AOAC (2005), which consists of drying the sample in an oven at 110°C (± 5 °C). *Water activity:* determination was carried out by the Aqualab 4 method.

Statistic analysis: performed by variance analysis (ANOVA) and Turkey´s test, to evaluate significant differences among the means of Ca, P and urease activity ($P<0.05$) using GraphPad Prism 4.0 software. The results were expressed as the mean values and standard errors.

RESULTS AND DISCUSSION

The data obtained showed that the nutritional quality and safety of feed ingredients and final products (for pregnant swine and piglets), used for feeding swine in a small farm in Southern Brazil, showed little variation over the standards established by NRC (1998) and Rostagno (2011). The quality (proximate composition, sample collection details, feed formulation standards) and the safety (mycotoxins, mc and a_w) data are shown in Tables 2 and 3.

Table 2. Ingredients proximate composition used for swine feed formulation

Feed Ingredient	Number of samples	Composition (%)						a_w	Collection date	
		Protein	Carbohydrate	Lipids	Fibre	Ashes	Mc		Month	Year
Corn										
	12	8.27	74.41	2.64	1.47	1.14	12.07	0.67	Aug	2010
		8.03	73.21	3.09	1.57	0.98	13.12	0.64	Aug	
		7.80	73.75	3.53	1.48	1.13	12.31	0.71	Sept	
		8.00	73.69	3.76	1.13	1.08	12.34	0.66	Sept	
		8.11	74.57	3.82	0.68	1.08	11.74	0.69	Oct	
		7.99	76.09	3.68	0.83	0.96	10.45	0.69	Nov	
		7.86	74.94	3.90	0.53	1.23	11.54	0.63	Nov	
		7.66	73.20	3.69	0.78	1.03	13.64	0.69	Dec	
		7.37	74.19	3.34	1.45	1.14	12.51	0.65	Dec	
		20.22	56.25	3.64	1.09	6.24	12.56	0.60	Jan	2011
		7.83	73.92	3.41	1.34	1.12	12.38	0.67	Jan	
		7.41	73.80	3.64	1.12	1.09	12.94	0.67	Feb	
	Average:	8.88	72.67	3.51	1.12	1.52	12.30	0.66	NA	
	Max:	20.22	76.09	3.90	1.57	6.24	13.64	0.71	NA	
	Min:	7.37	56.25	2.64	0.53	0.96	10.45	0.60	NA	
	Standard	7.9-8.3	NS	3.6-3.9	1.7	1.3	NS	NS	NA	
Rice										
	12	14.13	44.50	17.99	6.03	8.21	9.14	0.68	Aug	2010
		13.28	40.15	20.38	7.49	8.94	9.76	0.61	Aug	
		14.13	40.11	19.81	8.18	7.98	9.79	0.68	Sept	
		14.34	36.68	21.35	7.20	8.23	9.26	0.68	Sept	
		13.33	42.24	15.38	8.69	9.59	10.77	0.64	Oct	
		14.25	38.83	20.72	7.45	9.02	9.73	0.69	Nov	
		12.87	42.57	22.08	5.91	7.97	8.60	0.68	Nov	
		12.20	46.18	16.65	7.21	7.32	10.44	0.66	Dec	
		14.07	40.40	21.60	5.95	8.12	9.86	0.63	Dec	
		14.14	36.38	22.24	8.13	8.84	10.27	0.54	Jan	2011
		15.36	35.20	23.16	6.76	10.02	9.50	0.58	Jan	
		15.13	36.68	21.86	6.04	10.23	10.06	0.66	Feb	
	Average:	13.94	39.99	20.27	7.09	8.71	9.77	0.64	NA	
	Max:	15.36	46.18	23.16	8.69	10.23	10.77	0.69	NA	
	Min:	12.20	35.20	15.38	5.91	7.32	8.60	0.54	NA	
	Standard	13.1-13.3	NS	13-14.5	8.1	9.0	NS	NS	NA	
Soybean										
	12	44.06	31.82	2.29	3.32	6.03	12.48	0.70	Aug	2010
		47.14	26.56	2.94	3.54	5.67	14.15	0.66	Aug	
		46.86	27.54	3.09	3.49	5.68	13.34	0.70	Sept	
		46.94	28.82	2.76	3.68	5.86	11.94	0.69	Sept	
		45.86	28.48	2.42	3.56	5.94	13.74	0.65	Oct	
		46.23	29.67	1.81	4.29	6.05	11.95	0.67	Nov	
		47.15	28.83	1.72	4.11	6.25	11.94	0.67	Nov	
		46.83	27.99	1.90	3.45	6.11	13.72	0.69	Dec	
		46.30	27.75	3.27	4.15	5.89	12.64	0.69	Dec	
		45.22	29.52	2.93	3.64	5.74	12.95	0.63	Jan	2011
		46.52	27.09	3.03	3.72	5.99	13.65	0.66	Jan	
		47.14	29.00	1.97	3.33	5.93	12.63	0.68	Feb	
	Average:	46.35	28.59	2.51	3.69	5.93	12.93	0.67	NA	
	Max:	47.15	31.82	3.27	4.29	6.25	14.15	0.70	NA	
	Min:	44.06	26.56	1.72	3.32	5.67	11.94	0.63	NA	
	Standard	44-45	NS	1.5-1.7	5.3	5.8	NS	NS	NA	
Total general:	36									

NA: not applicable; NS: not specified; Standard: Rostagno (2011) and NRC (1998)

Table 3. Proximate composition of feed for pregnant swine and piglets

Feed	Number of samples	Composition (%)						a_w	Collection date	
		Protein	Carbohytrates	Lipids	Fibre	Ashes	Mc		Month	Year
Pregnancy										
	12	16.53	61.97	1.01	2.04	6.55	11.90	0.92	Aug	2010
		14.60	58.44	5.61	2.50	6.31	12.54	0.68	Aug	
		14.84	61.89	3.76	1.99	5.28	12.24	0.76	Sept	
		15.48	61.35	5.04	1.80	5.09	11.24	0.72	Sept	
		14.83	61.08	4.98	1.99	5.43	11.69	0.65	Oct	
		14.81	60.28	5.98	2.04	5.60	11.29	0.68	Nov	
		14.81	61.54	5.88	1.89	5.27	10.61	0.66	Nov	
		15.00	58.66	5.46	2.54	5.70	12.64	0.68	Dec	
		14.13	59.04	5.85	2.63	5.44	12.91	0.67	Dec	
		15.18	59.96	6.02	1.90	5.61	11.33	0.55	Jan	2011
		14.84	59.84	6.10	1.81	5.62	11.79	0.62	Jan	
		16.33	58.87	5.19	2.57	5.19	11.85	0.67	Feb	
	Average:	15.12	60.24	5.07	2.14	5.59	11.84	0.68	NA	
	Max:	16.53	61.97	6.10	2.63	6.55	12.91	0.92	NA	
	Min:	14.13	58.44	1.01	1.80	5.09	10.61	0.55	NA	
Off-spring										
	12	25.40	54.73	0.60	1.60	5.68	11.99	0.91	Aug	2010
		20.89	58.07	2.62	1.72	4.73	11.97	0.64	Aug	
		19.78	58.81	2.63	1.59	4.32	12.87	0.74	Sept	
		20.97	57.78	3.24	1.80	4.27	11.94	0.69	Sept	
		18.78	58.19	2.30	1.73	4.96	14.04	0.73	Oct	
		20.58	58.87	3.18	1.54	4.31	11.52	0.68	Nov	
		19.65	59.91	3.41	1.89	4.41	10.73	0.65	Nov	
		19.38	57.61	3.66	1.81	4.44	13.10	0.68	Dec	
		20.13	57.30	3.10	2.18	4.77	12.52	0.66	Dec	
		20.54	57.65	3.73	1.62	4.55	11.91	0.59	Jan	2011
		20.50	57.98	3.34	1.65	4.49	12.04	0.65	Jan	
		19.63	58.50	3.53	1.80	4.40	12.14	0.66	Feb	
	Average:	20.52	57.95	2.95	1.74	4.61	12.23	0.69	NA	
	Max:	25.40	59.91	3.73	2.18	5.68	14.04	0.91	NA	
	Min:	18.78	54.73	0.60	1.54	4.27	10.73	0.59	NA	
Total general:	24									

NA: not applicable; NS: not specified

Ingredient and feed proximate composition

Protein: The protein content of the soybean meal samples evaluated ranged from 44.06 to 47.15%. Those values were higher than those reported for protein by Karr-Lilienthal (2005) (29.0 to 42.2%). The protein content of rice meal samples was lower than that of soybean (12.20 to 15.36). These values are in agreement with those published by Huang (2005), which reported crude protein values from 15.7 to 17.2% for rice meal. The protein content of corn samples ranged from 7.37 to 20.22%. Corn contains a relatively low concentration of protein (8%) compared with wheat and barley (11%) (Cowieson et al., 2005). The values for protein found in all ingredients (corn, soybean and rice meal) were in agreement with NRC (1998) and Rostagno (2011), with the sole exception of one corn sample that showed a higher protein content.

Carbohydrates: Of the feed ingredients evaluated, soybean meal showed an average carbohydrate content of 28.59% followed by rice meal with 39.99% and corn with 72.67%, values that are in agreement with those reported in the literature (Karr-Lilienthal et al., 2005; Amissah et al., 2003; Kereliuk et al., 1995). Only one corn sample showed 56.25% of carbohydrate, which is lower than the average (76.8%), proposed by Kereliuk (1995).

Lipids: the lipid content of corn samples ranged between 2.64 and 3.90, lower than found by Aisha (2004) (from 4.9 to 6.2%). This may reflect factors such as: corn variety, growing conditions, drying temperature, starch structure, lipid starch matrices and the presence of various anti-nutritive factors (Cowieson et al., 2005). The lipid content in rice meal samples ranged from 15.38 to 23.16, values similar to those reported by Huang (2005)(23.3 to 24.9%). However, they are higher than those recommended by NRC (1998) and Rostagno (2011). The lipid content found in soybean meal ranged from 1.72 to 3.27%. Feed for pregnant swine had higher lipid content (5.07%) than that of piglets (2.95%).

Fibre: corn samples had the lowest amount of crude fibre (1.12%). Soybean meal also showed low fibre content, averaging 3.69%. Rice meal showed the highest values averaging 7.09%. Fibre content values were lower than recommended in corn, rice meal and in soybean samples (NRC, 1998; Rostagno, 2011). Fibre values obtained for pregnant swine and piglets were 2.14 % and 1.74%, respectively.

Ash: The average ash content value for rice meal was 8.71%, similar to that found by Huang (2005), (9.2 to 11.3%). Corn and soybean meal samples showed lower values, ranging from 0.96 to 6.24 and 5.67 to 6.25, respectively. Piglet feed had a lower percentage (4.61%) of ash in relation to pregnant swine feed (5.59%), which is consistent with the different metabolic needs of the animals. Nutrient requirements (per unit of diet) of P, decreases with increasing age and body weight (NRC, 1998). The average content of P was found to be 0.499 and 0.715% for piglets and pregnant swine feed, respectively (Figure 2, a). Dietary P deficiencies not only affect growth, but also adversely affect bone mineralisation (Varley et al., 2011). The average content of Ca was found to be 0.753 and 0.963% for piglets and pregnant swine feed, respectively (Figure 2, b). The values of P and Ca found match the requirements considered ideal for these life stages of the animals (NRC, 1998).

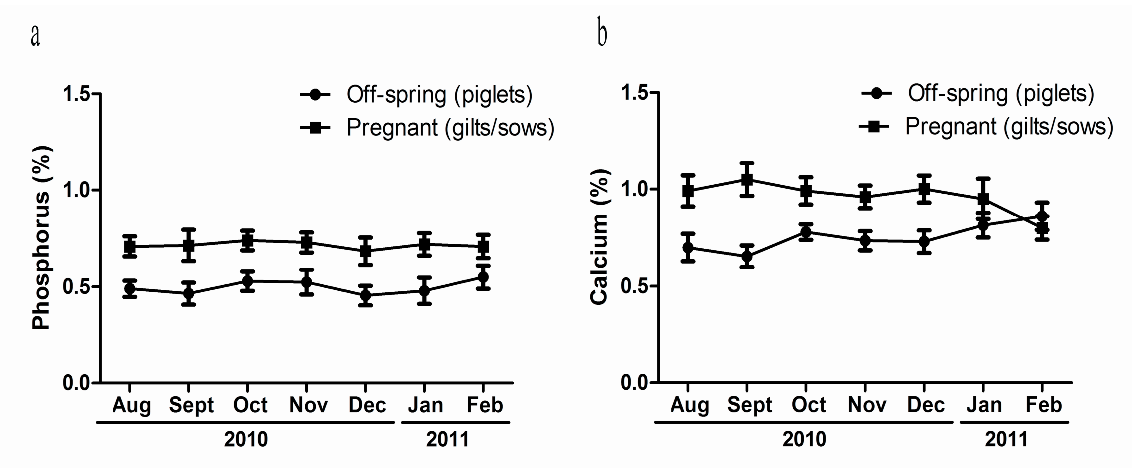

Figure 2. Average of (a) *phosphorus* and (b) *calcium* levels detected in feed for *piglets* and pregnant swine (P>0.05).

Urease: urease activity in soybeans can detect the presence of toxic factors such as trypsin inhibitors (White et al., 2000). The urease activity of soybeans in the current study ranged from 0.01 to 0.09, with and average of 0.03 (Figure 3). The values found were in agreement with Drew (2007) who considered an urease activity of 0.05 to 0.30 as ideal.

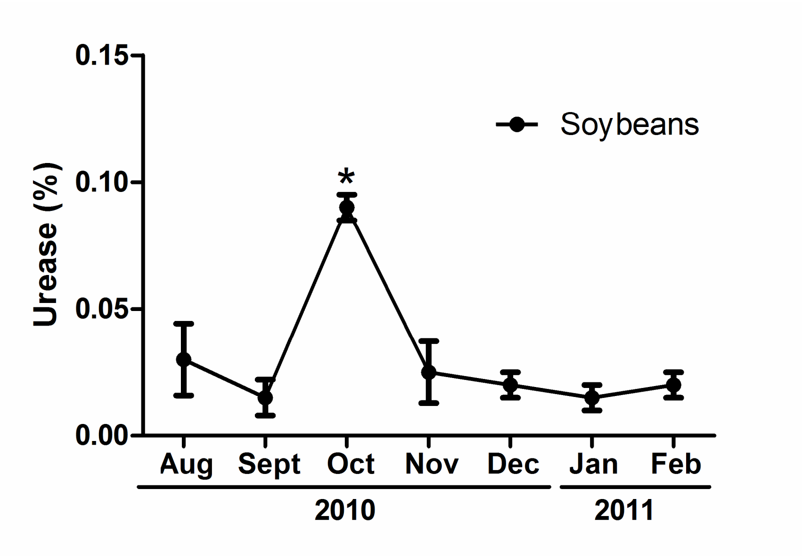

Figure 3. Urease activity of soybean samples (*P<0.05).

Ingredients and swine feed safety

Mc and aw: high mc grains can be stored with maintenance of the nutrient content (Pieper et al., 2011). However, excess mc may facilitate the spread of fungi and thus lead to the development of mycotoxins that could harm livestock. The mc levels of samples were 9.77, 12.30, 12.93%, for rice meal, corn and soybeans meal, respectively. Samples of feed for piglets and pregnant swine showed mc 12.23 and 11.84%, respectively. Our data showed an mc value above the ideal, which may contribute to the presence of mycotoxins in feed and consequent generation of health problems. According to Scussel et al (2002), mc should be below 12% for grains to prevent the proliferation of fungi and production of mycotoxins.

Regarding a_w, feed for piglets and pregnant swine displayed mean values of 0.69 and 0.68, respectively. The values were similar to those found by Rosa et al. (2009) (0.628). Of the 60 samples analysed, only four (6.66%) presented a_w lower than 0.6 (minimum a_w limit for fungi growth). Two samples showed values of a_w greater than 0.9. No significant quantities of mycotoxins are produced for a_w below 0.95 (Nielsen, 2003).

Mycotoxin: of the total number of samples analysed, 5 (8.33%) presented some AFLs contamination [rice meal (1), corn (1) off-spring feed (3)] and only one (pregnancy feed, 64.10 μg/kg) by ZON. The levels of AFLs presented in samples were 83.33, 34.52 and 49.31 μg/kg for rice meal, corn, off-spring feed, respectively. Pereyra et al. (2008) reported 33.33% of AFLs contamination in samples of swine feed at levels of 30 to 70 μg/kg. In the present study, 25% of samples had AFLs contamination, at levels between 182 and 311 μg/kg. Other studies also reported some contamination by AFLs, OTA e ZON in swine feed (Thieu et al., 2008; Rosa et al., 2009). EST and OTA were not found in any of the samples analysed. The ingredients and swine feed were compared against existing regulations of Chile, United State of America, Estonia and Mexico, which tolerate levels of AFLs contamination of 100-300 μg/kg (FAO, 2004). Likewise, the ingredients and feed were considered safe, due to the absence of OTA and ZON values below those recommended by international legislation (maximum levels for OTA and ZON are 20-2000 μg/kg e 20-3000 μg/kg, respectively) (FAO, 2004).

CONCLUSION

Although most of the nutrient data obtained in this work were in accordance with the standards established in Brazil (Rostagno, 2011) and in the rest of the world (NRC, 1998), some of them were not in accordance with recommended levels (fibre and lipids). We must consider that the chemical and nutritional constituents of animal feeds are important for livestock nutrition and growth, but are only part of the animal feed matrix. Other points relating to management, genetics and animal health must be taken into consideration. The presence of mycotoxin in feed requires periodic monitoring in order to prevent the occurrence of mycotoxicosis in animal production, and thus reducing economic losses and minimizing hazards to swine health. Small farms are capable of producing animal feed within the recommended nutritional standards. However, the implementation of quality assurance practices, aimed at preventing nutritional fluctuations, is highly recommended. The emergence of laws aimed at standardizing the specific nutritional values of these foods may be alternatives to improve production and profitability

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