Comparison of glycinin and β-conglycinin in different soy protein sources and replacement of SBM and fish meal with soy protein concentrate in piglets

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Background

Soybean meal (SBM) is the most widely used protein source in non-ruminant feeds globally. However, the presence of glycinin and β-conglycinin along with trypsin inhibitor limits its use in nursery diets. Glycinin and β-conglycinin have allergenic effects that can cause gut inflammation, diarrhea and thus reduction in growth. Gut inflammation affects the immune system and the oxidative status by damaging the intestinal epithelium especially in young animals (Krishnan et al., 2009; Wang et al., 2010; Zhao et al., 2010; Taliercio and Kim, 2013). Animal protein sources have been largely used in nursery diets as source of protein without Anti nutritional factor (ANF) and with high bioavailability of amino acids (AAs) enhancing the growth and health in newly weaned pigs (Coffey and Cromwell, 2001; Weaver et al., 2014). The crude protein content in SPC is similar to animal protein ingredients. SPC has a low concentration of ANF. Therefore, SPC can be used in nursery diets replacing animal protein ingredients such as fish meal.

Objective

The study was proposed to determine the concentration of Glycinin and β-conglycinin in soy products (SPC and fermented soybean meal) by using ELISA, to compare the glycinin and B-conglycinin contents in SPC and other treated soybean meal sources.

Design of the study

In total 6 different sources (CJ SPC, A, B, C and D) of the soy protein concentrate were used including the SBM as a control treatment.

ELISA measurements

Triplicate samples were assayed two times to assure the repeatability of the kits. The concentration of Glycinin and β-conglicinin in the soybean products was measured using commercially available kits (BA-UBT002, BA-UBT001, Unibiotest, Wuhan, CHN) following the instructions of the manufacturer. The absorbance was measured using a plate reader (Synergy HT, BioTek Instruments, Winooski, VT). The concentrations were calculated based on a standard curve created from the concentration and absorbance of the respective standard. Glycinin and β-conglicinin concentrations were expressed as mg/g dry matter of SPC sample.

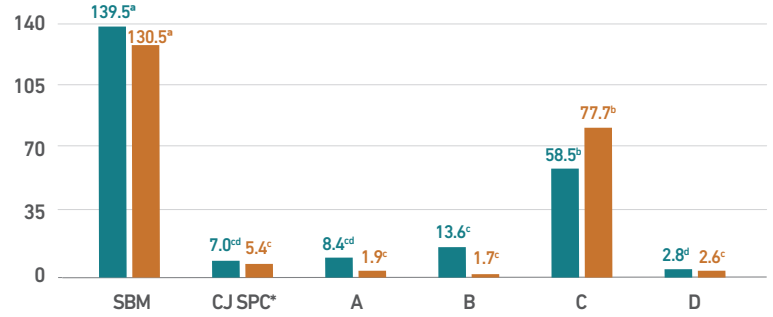
Statistical analysis

The data were analyzed using the proc Mixed in SAS (SAS Inc., Cary, NC, USA). Each soy product had six repetition (n = 6), and the soy products were the main effect. The means were calculated using the LSMEANS statement in SAS. A pairwise comparison was made using the PDIFF option in SAS. Statistical differences were considered significant with $P < 0.05$. Tendency was considered when $0.05 \leq P < 0.10$.

Results

The concentration of glycinin was significantly higher ($P < 0.05$) in SBM as compared with the other analyzed soy products (Table 1). Concentration of glycinin in C was greater ($P < 0.05$) than in CJ, A, B and D among the treated soybean meal sources. The concentration of β-conglycinin was greater ($P < 0.05$) in SBM compared with the other analyzed soy products. Concentration of β-conglycinin was greater in C ($P < 0.05$) compared with CJ, A, B and D. The concentration of gylcinin and β-conglycinin in CJ was not significantly different than A, B and D.

Concentration of proteins content in soy products (dry matter basis, mg/g)



a, b Means not sharing a common superscript within a same color are significantly different (P<0.05)
*CJ SPC was obtained from CJ Selecta (X-soy 200, Araguari, MG, BRA)

Figure 1. Concentration of glycinin and ß-conglycinin content in soy products (dry matter basis, mg/g)

X-soy can replace animal protein in weaned piglet feed

Animal protein is usually included in weanling pig diets to promote feed intake and to avoid ANF coming from SBM (Lenehan et al., 2007). SPC contains less ANF in comparison to SBM. Thus, inclusion of SPC in weanling pigs feed can improve the morphology of villi in the small intestine resulting in improved growth performance compared with pigs fed SBM (Li et al., 1991; Sohn et al., 1994). SPC inclusion in weaning diets improves piglets growth performance because of a reduction in dietary soy allergens (Resende et al., 2016). Especially CJ selecta SPC, X-soy, can replace animal protein sources without affecting growth performance and blood parameters (Casas et al., 2017). During phase 1 and phase 2 feed after weaning, ADG and G:F were not affected by experimental diets (Table 2). Thus, replacement of spray-dried plasma protein, fish meal or both with X-soy in diets fed during phase 1 and 2 had no negative impact on growth performance.

Table 2. Effects of replacement of spray dried plasma protein and fish meal with X-soy on growth performance of weanling pigs

Items	NO X-SOY	NO plasma	NO fish meal	X-SOY 200	P-value
Phase 1					
ADG, kg/d	0.146	0.149	0.135	0.140	0.744
G:F	0.689	0.726	0.699	0.673	0.722
Phase 2					
ADG, kg/d	0.504	0.546	0.507	0.525	0.524
G:F	0.761	0.736	0.738	0.746	0.553
Overall					
ADG, kg/d	0.325	0.347	0.321	0.332	0.593
G:F	0.743	0.741	0.725	0.728	0.829

Experimental diets were fed during phase 1 (0-14 day) and then a common feed was fed during phase 2 (14-28 days).

In case of blood parameters, concentration for TNF-a, PYY, IgG and BUN were not affected by dietary treatment (Table 3). However the concentration of total protein and Albumin in plasma had a tendency to be greater in piglets fed with X-soy diet. There were no significant differences between the other treatments. Thus, lack of effects on the concentrations of TNF-a and IgG when spray dried plasma protein, fishmeal, or both ingredients were replaced with X-soy indicates that the inflammatory immune response was not affected. Thus, X-soy can easily replace fish meal and spray dried blood plasma without compromising growth or health of weaned pigs.

Table 3. Effects of replacing spray dried plasma protein, fish meal or both with X-soy on blood parameters of weanling pigs

Items	NO X-SOY	NO plasma	NO fish meal	X-SOY 200	SEM	P-value
TNF-α, pg/ml	80.42	63.40	77.36	86.42	13.11	0.646
PYY, ng/ml	2.52	4.22	4.04	2.40	0.74	0.167
lgG, mg/ml	229	205	227	188	25.13	0.623
BUN, mg/dl	15.00	13.25	14.87	13.42	1.32	0.570
Protein, g/dl	4.50	4.75	4.62	4.95	0.12	0.078
Albumin, g/dl	2.85	2.98	2.73	3.10	0.1	0.082

* PYY=peptide YY;BUN=blood urea nitrogen.
No X-soy group includes both plasma and fish meal. X-soy group has neither plasma nor fish meal.
Each mean represents 8 observations.

Conclusion

Replacement of SBM with SPC products will reduce in feed ANFs. However, there are individual differences between SPC sources which needs to be taken into consideration. X-soy is among the most efficient SPC sources with the lowest ANF contents. In addition, diets based on SPC can be used to replace plasma and fish meal during initial 14 days post weaning without any negative effect on growth performance or pro-inflammatory immune responses.

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