Optimising soy protein concentrate use in pig diets

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Recent trials set out to determine the effect of particle size of soy protein concentrate on amino acid digestibility and concentrations of digestible and metabolisable energy of pigs. Whether soy protein concentrate has an effect on growth performance of weanling pigs was also explored.

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Inclusion of soybean meal in diets for weanling pigs is commonly limited because of the negative effects of anti-nutritional factors, such as glycinin, beta-conglycinin and trypsin inhibitors. However, further processing of soybean meal may result in a reduction of anti-nutritional factors, and therefore, increased quantities of processed soybean protein may be included in starter diets for pigs. Soy protein concentrate (SPC) is produced by removing the soluble carbohydrates and non-protein constituents from defatted soy flakes.

A reduction in particle size of soybean meal to 185 µm may increase the digestibility of most amino acids (AA). Likewise, increased digestible energy (DE) and metabolisable energy (ME) have been reported for corn if particle size is reduced. However, to our knowledge there are no data about the effects of reduction of particle size of SPC on digestibility of AA and energy.

Trial set-up

Therefore, three experiments which received financial support from Selecta, Brazil, were conducted to evaluate the effect of particle size of SPC on digestibility of AA and concentrations of DE and ME. The second objective was to determine the effects on growth performance and blood parameters of including SPC in diets fed to weanling pigs.

In the first experiment, the standardised ileal digestibility (SID) of crude protein (CP) and AA in soybean meal, fish meal, and three sources of SPC was determined. The three sources of SPC were ground to 70 µm, 180 µm and 2 mm (SPC-80, SPC-200, and SPC-600, respectively). The second experiment was designed to determine the apparent total tract digestibility (ATTD) of gross energy and the concentration of DE and ME

in soybean meal, corn, and SPC ground to 70 µm, 180 µm, or 2 mm.

In the third experiment, 160 pigs (initial BW: 7.06 ± 1.07 kg) were used to determine the effects on growth performance and blood characteristics of including SPC-200 at 5%, 8% or 13% in diets fed to weanling pigs at the expense of plasma protein and fish meal. A 2-phase feeding program was used, with weeks 1 and 2 as phase 1 and weeks 3 and 4 as phase 2. Pigs were fed one of four diets during phase 1, whereas all pigs were fed a common diet in phase 2.

On the last day of phase 1, two blood samples were collected from the jugular vein of one pig per pen. Tumor necrosis factor- α (TNF- α), IgG, and peptide YY (PYY) were measured in plasma samples. Daily feed allotments were recorded and data were summarised to calculate ADG, ADFI, and G:F ratio for each treatment group.

Results

The SID of Lys and Thr tended ($P < 0.10$) to be greater in SPC-200 compared with soybean meal (*Table 1*). Greater ($P < 0.05$) SID of Arg, Phe, and Tyr was observed in SPC-80 and SPC-200 compared with fish meal, but with the exception of Arg and Trp, there were no differences on SID of other AA among SPC-80, SPC-200, and SPC-600. However, a greater SID of CP and most AA was observed in SPC-80, SPC-200, and SPC- 600 than in SBM, indicating that AA in SPC ground at 80 µm, 200 µm or 2 mm are well digested by weanling pigs.

On an as-fed basis, the SPC-200 contained more ($P < 0.05$) DE than corn, soybean meal and fish meal, but no differences between SPC-200, SPC-80 and SPC-600 were observed (*Table 2*). However, on a DM basis, no differences among the six experimental ingredients were observed. The concentration of DE and ME of SPC calculated in this experiment were less than the values reported by Zhang *et al.* (2013) and NRC (2012), which may be a result of the greater concentration of ADF and NDF in the sources used in this experiment. The lack of differences in DE and ME among SPC-80, SPC-200, and SPC-600, indicated that the particle size used in this experiment did not affect DE and ME values.

Growth performance in young pigs

The growth performance of pig fed diets containing 5% SPC-200, 8% SPC-200, or 13.25% SPC-200 was not different. Likewise, replacing plasma protein, or fish meal or both plasma protein and fish meal by 5, 8, or 13.25% SPC-200 had no impact on growth performance in phase 1, in phase 2, or in the combined phase 1 and 2 (*Table 3*). The concentration of TNF-α, PYY, IgG, and BUN, were also not affected by the diets. Thus, results of the experiment indicate that SPC-200 may replace either blood plasma, fish meal, or both blood plasma and fish meal in diets fed to weanling pigs without affecting growth performance or indicators for pro-inflammatory immune parameters or general metabolism of pigs. Thus, it appears that diets based on soybean meal and SCP-200 may be used during the initial 2 weeks post-weaning and that no animal proteins are needed during this time if SPC-200 is included in the diet.

References available on request

Table 1 – Standardised ileal digestibility (SID) of crude protein (CP) and amino acids (AA) in soybean meal, SPC-80, SPC-200, SPC-600, and fish meal by weanling pigs.

Item	Soybean meal	SPC-80	SPC-200	SPC-600	Fish meal	SEM	P-value
CP	83.87c	90.52ab	91.53a	87.45abc	85.89bc	1.83	< 0.05
Indispensable AA							
Arg	94.45^{b}	97.37^{a}	97.77^{a}	94.81^{b}	92.73^{b}	1.01	< 0.01
His	87.79	92.26	93.40	90.11	89.47	1.53	0.090
Ile	87.11^{b}	91.45^{a}	92.47^{a}	89.54^{ab}	90.04^{ab}	1.25	< 0.05
Leu	86.83^{b}	91.53^{a}	92.56^{a}	90.84^{a}	91.27^{a}	1.14	< 0.05
Lys	85.34	90.33	92.74	89.94	91.07	1.74	0.078
Met	89.36	92.11	91.03	88.77	90.29	1.38	0.254
Phe	86.40^{c}	92.59^{a}	93.43^{a}	90.67^{ab}	88.70^{bc}	1.12	< 0.01
Thr	84.72	88.95	90.87	88.26	91.88	1.82	0.097
Trp	87.29^{c}	93.60^{ab}	94.52^{a}	89.84^{bc}	92.94^{ab}	1.42	< 0.05
Val	86.15	90.46	91.49	88.52	89.64	1.49	0.118
Mean	87.70	92.17	93.13	89.99	9085	1.33	0.052

$^{a-c}$ Within a row, means followed by the same or no superscript letter are not different (P > 0.05).

Table 2 – Concentration of digestible energy (DE) and metabolisable energy (ME) in corn, soybean meal, SPC-80, SPC-200, SPC-600, and fish meal.

	Ingredient							
Item	Corn	Soybean meal	SPC-80	SPC-200	SPC-600	Fish meal	SEM	P-value
As-fed basis								
DE, kcal/kg	3,407^{b}	3,618^{b}	3,750^{ab}	3,985^{a}	3,985^{a}	3,593^{b}	122	< 0.05
ME, kcal/kg	3,346	3,305	3,528	3,704	3,658	3,424	144	0.291
DM basis								
DE, kcal/kg	3,990	4,021	3,914	4,198	4,233	3,949	132	0.410
ME, kcal/kg	3,919	3,672	3,683	3,903	3,886	3,763	156	0.758

$^{a-c}$ Within a row, means without a common superscript letter are different (P < 0.05).

Table 3 – Growth performance of pigs fed the control diet or diets containing SPC-200[1].

Item,	Control	8% SPC-200	5% SPC-200	13% SPC-200	SEM	P – value
Phase 1, d 0 – 14						
ADG, kg	0.146	0.149	0.135	0.140	0.009	0.744
ADFI, kg	0.213	0.204	0.193	0.208	0.008	0.424
G:F	0.689	0.726	0.699	0.673	0.033	0.722
Phase 2, d 14 -28						
ADG, kg	0.504	0.546	0.507	0.525	0.022	0.524
ADFI, kg	0.661	0.728	0.686	0.702	0.024	0.303
G:F	0.761	0.736	0.738	0.746	0.012	0.553
Overall, d 0 – 28						
ADG, kg	0.325	0.347	0.321	0.332	0.014	0.593
ADFI, kg	0.437	0.469	0.443	0.455	0.015	0.453
G:F	0.743	0.741	0.725	0.728	0.016	0.829

[1]Each least squares mean represents 8 observations.

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