

Feeding trial

Comparison of different protein sources in nursery diets

Use of HP 300 in nursery diets reduces oxidative stress and improves gut health when compared to SBM, SPC, FSBM and FM



Summary

In modern pig production, pigs are abruptly weaned from high digestible sow milk to less digestible plant-based solid diets at an early age, which challenges their immature digestive system. This dietary change induces oxidative stress and intestinal disturbances, leading to impaired growth. In addition, the gut of weaned piglets grows at a rapid pace making gut health crucial. Soybean meal (SBM) is the vegetable protein source of choice in nursery diets due to its excellent amino acid profile. However, SBM contains anti-nutritional factors (ANFs) such as the antigen beta-conglycinin, which is known to further impair

piglet performance. HP 300 is an enzyme-treated soybean meal with a reduced content of ANFs. In the present study, **replacing part of SBM by HP 300 in nursery diets, reduced oxidative stress in piglets and improved their antioxidant capacity. Use of HP 300 also resulted in less damage to intestinal villi, leaving a larger functional surface.** With this improvement in gut health the foundation is laid for high performance later in life.

Objective(s)

To compare the effect of different protein sources (HP 300, SBM, FSBM, SPC and FM) on oxidative stress, antioxidant capacity and intestinal epithelium damage in weaned piglets.

Results

- HP 300 in feed D0-14 post-weaning significantly improved total antioxidant capacity (T-AOC) of piglets compared with SBM by 49% (figure 1). This effect was also observed when HP 300 replaced SBM in diets D0-28.
- The antioxidant capacity was improved by HP 300 in nursery diets when compared to any other soy-based protein sources and was similar to FM.
- Oxidative stress was reduced by HP 300 D14 and D28

compared to SBM evident by a significantly lower serum concentration of malondialdehyde (MDA), a product of lipid peroxidation (table 1).

- HP 300 fed D0-14 improved villus height compared to SBM (figure 2A) indicating less damage to the intestinal epithelium. Further improvements in villus height and villus height to crypt depth ratio (VH:CD) were observed by feeding HP 300 for four weeks (D0-28) compared to only 2 weeks (D0-14).
- FM showed good antioxidative properties in this trial, but also contained 59 ppm ethoxyquin, a preservative with strong antioxidant capacity commonly added to FM to increase its shelf life. HP 300 does not contain any preservatives.



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Improved antioxidant capacity with HP 300 compared with other vegetable protein sources

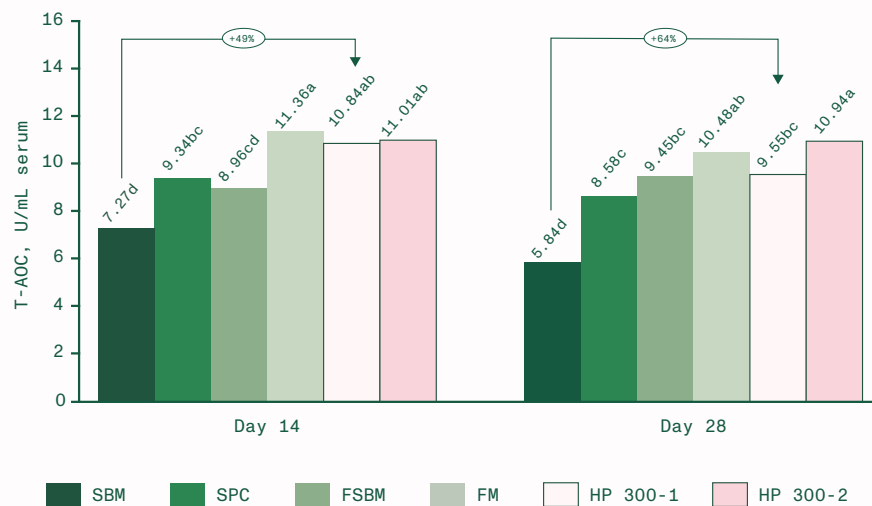


Figure 1 Serum total antioxidant capacity (T-AOC; U/mL) in piglets fed one of six dietary treatments: A diet containing SBM, partial replacement of SBM D0-14 by SPC, FSBM, FM or HP 300 (HP 300-1) or by partial replacement of SBM by HP 300 D0-28 (HP 300-2). Different letters within interval indicate significant difference ($p < 0.05$).

HP 300 alleviated intestinal stress resulting in greater surface area

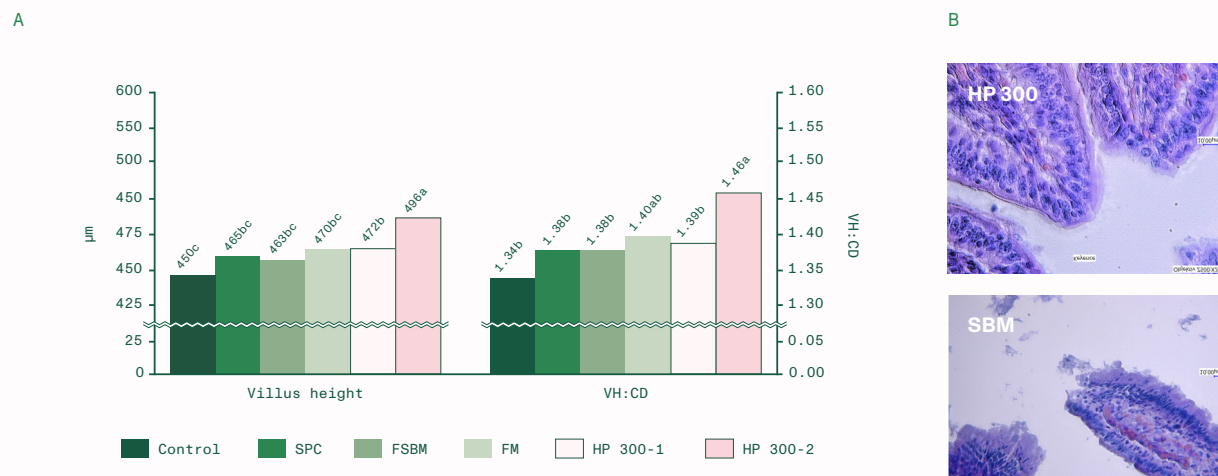


Figure 2 A) Morphology of the duodenum at day 29: Villus height (μm) and villus height to crypt depth ratio (VH:CD) in piglets fed one of six dietary treatments: A diet containing SBM, partial replacement of SBM D0-14 by SPC, FSBM, FM or HP 300 (HP 300-1) or by partial replacement of SBM by HP 300 D0-28 (HP 300-2). Different letters within interval indicate significant difference ($p < 0.05$). **B)** Histological picture of duodenal villi when fed HP 300 and when fed SBM (lens Z500:X2000).

HP 300 reduces oxidative stress compared to other soy protein sources

Table 1 Serum concentration of SOD, GSH-Px and MDA in piglets fed one of six dietary treatments: A diet containing SBM, partial replacement of SBM D0-14 by SPC, FSBM, FM or HP 300 (HP 300-1) or by partial replacement of SBM by HP 300 D0-28 (HP 300-2).

	SBM	SPC	FSBM	FM	HP 300-1	HP 300-2
Day 14						
SOD, U/ML	102.76 ^d	125.32 ^c	127.90 ^{bc}	141.54 ^a	137.08 ^{abc}	139.36 ^{ab}
GSH-Px, U/mL	723.14	764.56	742.92	750.87	808.09	838.26
MDA, nmol/mL	5.84 ^a	3.80 ^b	3.68 ^b	2.96 ^b	3.12 ^b	3.05 ^b
Day 28						
SOD, U/ML	113.52 ^c	125.80 ^{bc}	128.35 ^b	134.25 ^{ab}	136.41 ^{ab}	146.33 ^a
GSH-Px, U/mL	692.63 ^c	739.17 ^{bc}	792.65 ^b	871.52 ^a	877.61 ^a	895.31 ^a
MDA, nmol/mL	4.46 ^a	3.69 ^{ab}	3.77 ^{ab}	2.99 ^b	3.07 ^b	2.75 ^b

^{a,b,c,d} Different superscript letters within a row indicate significant difference ($p < 0.05$).
SOD (superoxide dismutase); GSH-Px (glutathione peroxidase); MDA (malondialdehyde)

Materials and methods

A total of 216 cross-bred [(Danish Landrace x Yorkshire) x Duroc] weaned, mixed sex piglets (14.75 ± 2.18 lbs) were used.

Dietary treatments:

- Day 0-14: 1) Corn-SBM-based diet, partial replacement of SBM by 2) 7.5% soy protein concentrate (SPC), 3) 9.8% fermented soybean meal (FSBM), 4) 7.4% fish meal (FM), 5) 9.0% HP 300 day (HP 300-1) or 6) 9.0% HP 300 (HP 300-2). Each protein ingredient contributed with the same amount of crude protein to the final diet.
- Day 14-28, all piglets were fed the same corn-SBM based diet. For the HP 300-2 group, SBM was partially replaced by 7.5% HP 300.

Day 0-14 and day 14-28 diets were iso-energetic at 6.44 and 6.35 MJ ME/lb, respectively, iso-nitrogenous at 19% and 17.7% crude protein, respectively, and contained 1.35% and 1.23% digestible lysine, respectively.

For this trial 6 replicates per experimental group, 6 pigs (3 barrows and 3 gilts) per replicate were used.

Blood samples were collected from the same (1) pig in each pen via the jugular vein at day 14 and 28 post-weaning. Intestinal tissue samples were collected from the same (1) pig in each pen at day 29.

Location: China Agricultural University, China, 2017.

The data of this trial were published in a peer-reviewed journal:
Ma, X., Shang, Q., Hu, J., Liu, H., Brøkner, C., Pia, X. 2019. Effects of replacing soybean meal, soy protein concentrate, fermented soybean meal or fish meal with enzyme-treated soybean meal on growth performance, nutrient digestibility, antioxidant capacity, immunity and intestinal morphology in weaned pigs. Livestock Science. 225, 39-46.



