Anti-nutritional factors in soy proteins – the view of the nutritionist

Danish based AgroKorn manufacture ingredients and feed for young animals, including the popular AlphaSoy 530 product. Anti-nutritional factors (ANF) in soy are often blamed for the poor performance in young animals. There are potentially several ANF in soy, in varying amounts and young animals do not always respond as nutritionists expect – as recent AgroKorn tests reveal.

by Dr Mai Anh Ton Nu, Nutritionist, AgroKorn, Denmark.
www.agrokorn.com

Soybean is considered an excellent protein source for animals. However, trials show that its use may lead to higher frequency of diarrhoea in young animals. This is commonly explained by the presence of some anti-nutritional factors in soybeans interfering with the nutrient utilisation in the young animal.

In newly weaned piglets, their immature digestive tract and stress during weaning makes them especially sensitive to even intermediate ANF levels in processed soy products like soybean meal or soybean flour.

Consequently, the reduction of ANF has been the ultimate target for the improvement of soy products using processes such as fermentation, enzyme-treatment, soy hydro-thermal treatment and fractionation. However, there seems to be no clear answer as to whether it is necessary to reduce ANF in soy completely or if there is a safe level of ANF that young animals can tolerate.

One answer to this seems that these ANF are a very heterogeneous group of compounds and consist of various gut compromising compounds such as enzyme (trypsin) inhibitors, antigens (lectins, glycinins) and oligosaccharides (stachyose, raffinose).

Table 1 demonstrates that the further refinement of common soybean and meal products reduces the ANF level significantly for all parameters but still illustrates a large range within the different ANF. But how do these compounds affect digestion in the immature gut of young animals?

Trypsin inhibitors reduce protein digestibility

Trypsin inhibitors (TI) are one of the most abundant and well understood ANF in soybeans. As the name suggests, TI inhibits the activity of enzymes that digest protein in the digestive tract such as trypsin and chymotrypsin.

They may also impact the function of the pancreas by affecting feedback mechanisms regulating enzyme production. TIs, however, are heat labile and therefore can be destroyed by processing with higher temperatures.

From common soy products to refined soy proteins there is a clear drop in the TI activity (Table 1).

Table 1. The anti-nutritional factors present in various soybean products

Anti-nutritional factors	Raw soy	Soybean meal	AlphaSoy 530	Soy protein concentrate
Trypsin inhibitor (mg/g)	50	8	1.5	2
Lectins (%)	3.5	<0.1	<0.1	<0.1
Glycinin (mg/g)	209	50	26	<0.1
β-conglycinin (mg/g)	76	14	6	<0.1
Stachyose (%)		4-5	3.9	1.4
Raffinose (%)		1-2	1.4	0.2

References available on request

Among refined soy protein products, fermented and enzyme treated soy proteins have the lowest TI activity, but this is mainly due to the additional heat treatment steps and not by the fermentation or enzyme treatment itself.

However, using heat treatment to reduce TI should be approached with care as severe heat treatment can eliminate TI completely but may reduce digestibility of soy protein and consequently reduce protein utilisation in animals at the same time.

Antigens and gut health

Many young animals, and piglets in particular, are hypersensitive to certain immunologically active soybean proteins, such as glycinin and β-conglycinin. In raw soy these proteins may constitute 50% of the storage protein fraction.

Many studies show that soy antigens cause intestinal disturbances, reduce nutrient absorption and consequently decrease growth performance in piglets.

It is likely that they are denatured, and therefore much less allergenic, at high temperatures. Fermentation, enzyme treatment and extraction (by water and ethanol) are also effective at reducing these soy antigens.

This explains why refined soy proteins mostly use one or combinations of these processing steps to lower the level of soy antigens (Table 1).

Stachyose and raffinose are the main oligosaccharides in soy. They are comprised of galactose, glucose and fructose and like most oligosaccharides, are indigestible by the animal's endogenous enzymes and are therefore fermented, potentially by unwanted species, in the large intestine.

This may cause poor energy digestibility and flatulence.

This can be a challenge in young animals with an undeveloped large intestine. Although they have long been considered ANF, there is significant recent evidence to suggest they may actually exert some beneficial effects on fermentation and act as a prebiotic.

It is likely that older animals, with a mature

Continued on page 8

Continued from page 7
digestive tract can probably cope better with such ANF than very young animals with immature digestive tracts. The literature currently lacks clear regression analysis allowing a correct understanding of 'good' and 'bad' ANF-levels for young, growing and adult animals.

AgroKorn have recently conducted a number of trials to assess processed soy products and help customers make informed decisions.

In theory, the complete elimination of soy's ANF would improve nutrient utilisation and therefore result in better growth performance in animals.

However, a new study with 3,600 piglets at Skjoldborg test station found that feeding a processed soy protein (AlphaSoy 530) to weaned pigs significantly improved ADG in comparison with soy protein concentrate at day 28 ($P<0.05$, Fig. 1).

This positive effect of AlphaSoy on average daily gain also resulted in a higher average body weight by 0.55kg per pig compared to soy protein concentrate at day 28 and even this benefit carried on to the later growing period.

AlphaSoy 530 has a higher ANF level compared with soy protein concentrate. This finding may indicate that it is not necessary to remove ANF in soy completely but to reduce them to a safe level.

For example, TI at below 3TIU/mg in diets has been shown to not give any negative effect on young animals' growth performance. Indeed, as mentioned above, the severe processing of soy may minimise ANF in soy but also modify the digestibility of soy amino acids and reduce the value to animal diets.

Recently, some Australian studies suggested the 'prebiotic' effect of soy oligosaccharides could support gut health in young animals.

Therefore, the elimination of soy oligosaccharides in some products will not benefit from this extra effect.

In this context, AlphaSoy seems to successfully minimise the level of ANF and still maintain the high quality of soy protein to gain positive effects on growth and gut health in young animals.

In general, the traditional thinking of ANF reduction in soy to promote growth performance and gut health in young animals may require a new approach.

The focus may not be to eliminate soy ANF completely but to determine the safe level of ANF in soy products in relationship with growth performance and gut health in young animals and even turn ANF into an added value feature of processed soy products. ■

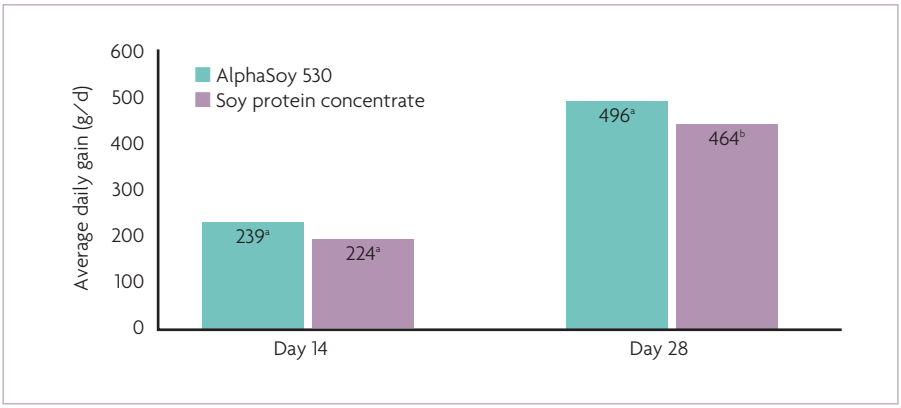

Fig. 1. Daily weight gain of weaned pigs fed AlphaSoy 530 vs. soy protein concentrate. Different superscript means significant difference between treatments ($P<0.05$).