

SOYA PROTEIN CONCENTRATE IN DIETS FOR EARLY WEANED PIGS

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SUMMARY

The nutritional value of modified soya protein concentrate was studied in experiments with piglets and rats. Dry matter digestibility, biological value, net protein utilization and digestible energy content of barley and wheat-based diets supplemented with milk, fish and soya protein were determined with rats. Piglets older than four weeks achieved satisfactory results with all diets. Animals younger than four weeks preferred animal protein to soya concentrate.

INTRODUCTION

Soybean meal is by far the leading protein supplement for pigs in the United States and Western Europe. In Australia, increasing amounts of soya protein are used in commercial diets for baby pigs.

Some problems have been experienced when soybean meal based diets were fed to very young piglets. Hartman et al. (1961) and Aumaitre (1972) have found that baby pigs during early stages of life do not develop enzymes essential for the digestion of vegetable proteins. Young animals fed on milk replacers containing soya develop antibodies against soya protein (Van Adrichem and Ferns 1965). Furthermore, the antitrypsins present in soybean meal retard the digestion of protein by blocking pancreatic trypsin and chymotrypsin. Herzog-Møller (1975) demonstrated that the growth-retarding substances present in soya protein can be removed by processing.

A modified soya protein concentrate (Danpro A) was used in two experiments designed to establish if a satisfactory performance can be achieved with piglets from two and four weeks of age. Soybean meal and some more traditional protein sources were also tested.

There is some evidence that piglets prefer wheat to other cereals (Nielsen, 1968) but the protein quality of wheat is usually inferior to barley due to lower levels of lysine and threonine (Eggum, 1968). Both barley and wheat-based diets were used in these experiments.

MATERIAL AND METHODS

Experiment 1

Two hundred and eight 2-week-old Danish Landrace piglets were used (26 litters were standardised to contain 4 gilts and 4 castrated boars each). One gilt and one castrate from every litter were allocated to each of the four treatment groups and fed diets shown in Table 1.

During the first two weeks the respective litter-mates were offered the feed in separate boxes twice a day for seventy minutes at a time and were then returned to sows. On reaching four weeks of age the piglets were weaned and placed permanently in small pens containing two litter-mates until they reached eight weeks of age. The feed was offered *ad libitum*. The diets used in these studies were steam pelleted and placed in deep-freeze storage. Each ration was sampled and analysed.

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A supplementary study with 100 rats was undertaken to determine dry matter digestibility, digestible energy, biological value and net protein utilization of diets used in this experiment. The experimental technique has been developed by Eggum (1973) and the results are applicable to growing pigs (Table 3).

TABLE 1 Composition of cereal-based diets supplemented with animal protein or soya protein concentrate (concentration g/kg DM)

Group (No. of pigs)	1 (52)	2 (52)	3 (52)	4 (52)
Soya protein concentrate	0	0	250	240
Skim milk powder	300	285	0	0
Fishmeal	100	100	0	0
Dry yeast	20	20	0	0
Barley	485	0	622	0
Wheat	0	499	0	632
Sugar	20	20	20	20
Lard	50	50	60	60
Min. and vit. supplement ^a	25	26	48	48
Crude protein ^a	230	230	230	231
Lysine ^a	14.6	14.0	11.5	10.8
Sulphur amino acids ^a	8.0	7.9	6.5	6.4
Digestible energy (MJ/kg) ^b	15.6	16.2	14.8	15.6

a: lab. analysis b: determined with rats

Experiment 2

One hundred and twenty 4-week-old weaners from 15 standardised litters were used in this experiment. The pigs were housed individually in small pens and each litter mate was offered a different diet ad libitum for six weeks. Soybean meal and whey powder were introduced to increase the variety of protein supplements.

TABLE 2 Composition of cereal-based diets containing different protein supplements (concentration g/kg DM)

Group (No. of pigs)	1 (15)	2 (15)	3 (15)	4 (15)	5 (15)	6 (15)	7 (15)	8 (15)
Barley	499	0	557	0	636	0	348	0
Wheat	0	499	0	557	0	636	0	348
Soya protein concentrate	0	0	0	0	207	207	200	200
Soybean meal	152	152	287	287	0	0	0	0
Skim milk powder	200	200	0	0	0	0	0	0
Fishmeal	40	40	40	40	40	40	40	40
Whey powder	0	0	0	0	0	0	300	300
Sugar	30	30	30	30	30	30	30	30
Lard	50	50	50	50	50	50	50	50
Min. and vit. supplement ^a	29	29	36	36	37	37	32	32
Crude protein ^a	224	229	219	225	226	232	228	232
Lysine ^a	13.9	13.5	12.2	11.8	12.6	12.2	13.4	13.2
Sulphur amino acids ^a	7.6	7.7	7.6	7.6	7.5	7.6	7.1	7.1
Digestible energy (MJ/kg) ^b	15.3	15.9	14.7	15.4	14.9	15.7	15.5	15.9

a: lab. analysis b: determined with rats

The data were analysed by multiple analysis of variance.

RESULTS AND DISCUSSION

Experiment 1

The results recorded in the study with rats have clearly shown that the dry matter digestibility of soya protein concentrate supplemented diets was higher than that of animal protein supplemented diets (Table 3). However, the biological value of soya protein concentrate was lower due to the inferior amino acid composition. The addition of 0.5 per cent of threonine to the wheat-soya protein concentrate ration increased the biological value to the level recorded with animal protein supplemented diets.

TABLE 3 Dry matter digestibility (DMD), biological value (BV) and net protein utilization (NPU) of experimental diets (determined with rats)

DIET	1	2	2 + Threonine	3	4	4 + Threonine
Treatment means + SE						
DMD%	88.4±0.39	90.0±0.22	90.5±0.23	92.4±0.54	93.2±0.51	93.2±0.40
BV%	85.9±0.42	84.2±0.38	84.5±0.23	79.7±0.31	79.2±0.40	84.2±0.33
NPU%	75.8±0.56	75.8±0.51	76.5±0.28	74.2±0.67	74.0±0.55	78.6±0.51

With piglets no health problems were experienced but the growth rates were less than expected. From two to four weeks of age the piglets consumed only small amounts of feed. Although the diets containing animal protein supplements were preferred to those with soya concentrate the daily gains were not affected by the intake of solid food during this period.

Diets supplemented with animal protein were also preferred after weaning when the higher voluntary intake was associated with a slight improvement in daily gain. Low growth rates and feed conversion ratios in the group fed soya protein concentrate-wheat ration were associated with the inferior protein quality (both major components are low in lysine and threonine) and low voluntary intakes.

TABLE 4 Mean values for daily gain and feed consumption for pigs in Experiment 1

DIET	1	2	3	4
Daily gain, g (2-4 weeks)	220	223	226	213
Feed/pig, kg (2-4 weeks)	0.8 ^a	0.8 ^a	0.4 ^b	0.3 ^c
Daily gain, g (4-8 weeks)	226 ^a	221 ^a	208 ^a	161 ^b
Feed/pig, kg (4-8 weeks)	9.0 ^a	9.5 ^a	8.6 ^b	7.5 ^c

a,b,c: means in the same row not having the same superscript are different ($P \leq 0.05$)

Experiment 2

The result of this experiment indicated that satisfactory performance could be achieved with all diets when fed to piglets older than four weeks. The high growth rates illustrate that soybean meal is a good source of protein for this category of piglets. Results for individual treatment groups are given in Table 5.

The mean growth rates of pigs fed soya protein concentrate were lower than those in other groups and were associated with low intake. This was particularly obvious in the case of rations containing soya protein concentrate and wheat. The performance of pigs fed soya protein concentrate did not support the original hypothesis that processing will result in increased animal performance. Addition of whey powder did not significantly improve the results. Unless the low intake is

improved the replacement of soybean meal with soya protein concentrate in diets for baby pigs is not warranted.

TABLE 5 Mean values for daily gain and feed consumption in groups fed different sources of protein

Group	1	2	3	4	5	6	7	8
Daily gain, g	449 ^a	425 ^{ab}	449 ^a	442 ^{ab}	443 ^{ab}	399 ^b	438 ^{ab}	425 ^{ab}
Feed/pig, kg	33.2 ^a	29.5 ^{bc}	31.6 ^{ab}	30.1 ^{bc}	30.8 ^{bc}	26.9 ^d	30.1 ^{bc}	28.1 ^{cd}
Feed/gain	1.78 ^a	1.68 ^b	1.68 ^b	1.63 ^{bc}	1.67 ^b	1.61 ^{bc}	1.69 ^b	1.58 ^c
DE/gain, (MJ/kg)	27.23	26.71	27.40	25.20	24.88	25.28	26.20	25.12

a,b,c,d: means in the same row not having the same superscript are different ($P \leq 0.05$)

The type of cereal used had only a marginal effect on growth rates. The differences are not significant but it should be noted that the pigs fed on barley-based diets always gained more than those fed on wheat-based diets of otherwise similar composition (1 vs 2; 3 vs 4; 5 vs 6; 7 vs 8).

The barley-based diets were also more readily accepted than the wheat-containing rations. This is in disagreement with previous findings of Nielsen (1968). Animals fed on higher energy wheat rations consumed less feed but the intake of digestible energy per kg of gain did not differ between groups.

The results of this study have shown that the soya protein concentrate is not as readily accepted as the soybean meal or animal protein supplements. As this product is more expensive than the other tested protein sources, the use in diets for baby pigs is not economically justified. Results achieved with barley-based diets suggest that barley could replace wheat in high energy, fat supplemented, diets for baby pigs. This replacement is warranted if the price of barley is less than 95% of the price of wheat.

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