

# Total and ileal digestibility of protein and amino acids of soyabean meal extruded at 140 and 160°C by pigs

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## ABSTRACT

Solvent soyabean meal was extruded at 140 or 160°C. Three semi-synthetic diets containing 38% non-extruded or extruded meals were fed to barrows with post valve T-caecum cannulas, and their protein and amino acid apparent digestibilities in the small intestine (AID) and in the whole gastrointestinal tract, were determined. The AID of protein and the majority of amino acids was lower in extruded than in non-extruded meals and was negatively affected by the increase of the extrusion temperature.

KEY WORDS: pig, digestibility, soyabean, amino acids, extrusion, protein

## INTRODUCTION

In pig nutrition, solvent soyabean meal (SBOM) is the most widely used high-protein feed. Extrusion is commonly applied to improve the nutritive value of protein feeds, including solvent meals. The process results in structural changes of the product, gelatinization of starch, and reduction of the concentration of a number of antinutritional substances (Grochowicz, 1996). Bearing in mind the importance of the protein value of extruded feeds, it is essential to determine the amount of protein and amino acids digested in the small intestine (ileal digestibility) and to the end of the digestive tract (total digestibility).

The objective of the experiment was to determine the apparent ileal and total (faecal) digestibility of the protein and amino acids of soyabean meal subjected to extrusion at two temperatures.

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## MATERIAL AND METHODS

The commercial soyabean meal (SBM) used in the experiment contained 41.4% crude protein and 5.81 g/16 g N lysine. Two batches of the meal were extruded in an INSTA-PRO-2000R extruder under the conditions usually recommended by the producers: 40 sec, 20% humidity and 140 or 160°C. Three complete semisynthetic diets were prepared containing 38 % SBM that was either not extruded or extruded at 140 or 160°C. The remaining dietary components included: maize starch, sugar, rapeseed oil and PT-1 premix. The diets were isoproteinous and isoenergetic and contained: 14.1 MJ ME/kg, 15.80% crude protein, 0.81% lysine, 0.35% methionine with cystine. Chromium oxide (0.3%) was added as a marker.

Three-breed hybrid castrated males of 28 kg body weight were prepared with post valve T-caecum cannulae according to van Leuwen et al. (1991). Twelve animals were divided into three groups, kept in metabolic crates and fed on experimental diets at the rate of 2.2 kg/day, divided into two equal portions, given in the morning and afternoon. The experiment was split into an initial and experimental period, each lasting seven days. The experimental period consisted of two sub-periods: a four-day collection of faeces and three-day collection of digesta.

Statistical calculations were performed with SAS (1996).

## RESULTS

The two meals subjected to extrusion had lower levels of crude fibre and ADF, increased quantities of nitrogen-free extractives and NDF, unchanged level of protein, practically unchanged amino acid composition (data not shown). The apparent ileal digestibility of protein in the meal decreased after extrusion (Table 1). The digestibility of the majority of amino acids, e.g., lysine, methionine, histidine, isoleucine, phenylalanine, proline and tyrosine also decreased. As a rule, a greater decrease in amino acid apparent digestibility was observed when the meal was extruded at 160°C.

The apparent total protein digestibility decreased only when the meal was extruded at 160°C. Moreover, apparent total digestibility of lysine decreased at both levels of extrusion temperatures, as did that of methionine when the meal was extruded at 160°C (not shown).

The apparent ileal digestibilities were lower than the apparent total digestibilities of protein and most amino acids of the evaluated soyabean meals.

## DISCUSSION

Determination of ileal digestibility provides the most precise assessment of the quantity of available amino acids for pigs (Frankiewicz, 1999; Urynek and Buraczewska, 2003).

Until recently, the majority of researchers investigated the extrusion of whole soyabean seeds and not meals (Fan et al., 1995). There is no data, however, concerning digestibility changes of protein and amino acids in meals subjected to extrusion (Rhone Poulenc Animal Nutrition Guide, 1993; NRC, 1998). The ileal digestibility coefficients for protein and amino acids from non-extruded soyabean meal obtained in our study are similar to values reported by Knabe et al. (1989), Buraczewska et al. (1999) and Frankiewicz (1999). The results from the present investigations point to deterioration of the apparent ileal digestibility of protein and amino acids in soyabean meal extruded at a temperature of 140 and, in particular, 160°C. Also in studies quoted in AmiPig (2000), a decrease in the ileal digestibility of amino acids was reported in soyabean meal subjected to extrusion. According to Lahaye et al. (2004) extrusion of meals and seeds after previous heat treatment causes further destruction of antinutritional substances.

Table 1. Mean ileal apparent digestibility of protein and amino acids in soyabean meal, non-extruded and extruded at 140 and 160°C, % (means  $\pm$  SD)

Items	Non-extruded	Extruded at	
		140° C	160° C
Crude protein	78.2 $\pm$ 0.85	74.5 $\pm$ 1.48 <sup>b</sup>	72.5 $\pm$ 0.56 <sup>b</sup>
ALA	86.5 $\pm$ 0.98	68.5 $\pm$ 2.30	67.1 $\pm$ 1.39
ARG	88.6 $\pm$ 0.80 <sup>a</sup>	86.7 $\pm$ 2.05 <sup>a</sup>	79.7 $\pm$ 1.35 <sup>b</sup>
ASP	78.2 $\pm$ 0.61	81.8 $\pm$ 1.11	74.9 $\pm$ 3.70
CYS	75.8 $\pm$ 1.78	74.5 $\pm$ 1.51	66.8 $\pm$ 4.63
GLU	84.0 $\pm$ 0.87	82.2 $\pm$ 3.09	80.5 $\pm$ 2.10
GLY	63.6 $\pm$ 0.99 <sup>b</sup>	69.9 $\pm$ 1.68 <sup>a</sup>	68.9 $\pm$ 2.58 <sup>ab</sup>
HIS	77.2 $\pm$ 0.56 <sup>a</sup>	69.2 $\pm$ 1.02 <sup>b</sup>	65.9 $\pm$ 2.98 <sup>b</sup>
ILE	75.5 $\pm$ 1.24 <sup>a</sup>	72.7 $\pm$ 0.68 <sup>ab</sup>	70.5 $\pm$ 1.24 <sup>b</sup>
LEU	77.5 $\pm$ 1.22 <sup>a</sup>	67.5 $\pm$ 4.30 <sup>b</sup>	70.7 $\pm$ 0.78 <sup>ab</sup>
LYS	82.3 $\pm$ 0.90 <sup>a</sup>	77.1 $\pm$ 4.06 <sup>ab</sup>	73.1 $\pm$ 1.61 <sup>b</sup>
MET	88.6 $\pm$ 1.00 <sup>a</sup>	77.0 $\pm$ 2.47 <sup>b</sup>	75.6 $\pm$ 0.85 <sup>b</sup>
PHE	78.1 $\pm$ 2.22 <sup>a</sup>	66.1 $\pm$ 2.30 <sup>b</sup>	62.9 $\pm$ 0.89 <sup>b</sup>
PRO	75.8 $\pm$ 3.20 <sup>a</sup>	65.1 $\pm$ 4.17 <sup>b</sup>	64.4 $\pm$ 1.07 <sup>b</sup>
SER	76.4 $\pm$ 0.69	71.7 $\pm$ 1.90	71.7 $\pm$ 1.59
THR	72.0 $\pm$ 0.53	68.9 $\pm$ 4.16	66.4 $\pm$ 3.45
TYR	79.6 $\pm$ 3.12 <sup>a</sup>	71.4 $\pm$ 1.99 <sup>b</sup>	67.8 $\pm$ 0.98 <sup>b</sup>
VAL	70.7 $\pm$ 1.08 <sup>a</sup>	65.5 $\pm$ 0.56 <sup>b</sup>	64.6 $\pm$ 1.28 <sup>b</sup>

means with the same letter are not significantly different <sup>a,b</sup> -  $P \leq 0.05$

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## STRESZCZENIE

### **Ogólna i jelitowa strawność białka i aminokwasów śruty sojowej ekstrudowanej w temperaturze 140 i 160°C oznaczona na świnia**

Poekstrakcyjną śrutę sojową ekstrudowano w temp. 140 i 160°C. Trzy półsyntetyczne diety, zawierające 38% śrutę nieekstrudowanej lub ekstrudowanej, podawano wieprzkom z prostymi przetokami założonymi do jelita ślepego (post valve T-caecum cannula) i oznaczano ogólną i jelitową strawność białka i aminokwasów. Strawność jelitowa białka i większości aminokwasów dawek z ekstrudowaną śrutą była gorsza niż ze zwykłą; ujemny wpływ na strawność miała ekstruzja w temp. 160°C w porównaniu z 140°C.