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Apparent ileal digestibility of amino acids in pig diets containing various sources of dietary fibre*

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ABSTRACT

The experiment was carried out in a cross-over design with 14 growing pigs fitted with a post-valvular T-ceacum (PVTC) cannula. Animals were fed on wheat-casein diets supplemented with 5% of different dried fibre by-products: apple pulp, apple pectin, beet pulp, potato pulp, artichoke offals or cellulose (control). Apparent ileal digestibility of protein and amino acids in experimental diets were high, similar to the control diet, and not affected by inclusion of fibre by-product to the diet.

KEY WORDS: dietary fibre, amino acids, ileal digestibility, pigs

INTRODUCTION

Many fibrous by-products of fruits and vegetables industry may be used in animal nutrition as the potential source of dietary fibre. Dietary fibre is often recommended to young pigs since it stimulates the passage of digesta and the development of beneficial microflora and improves health of the digestive tract. However, it is difficult to predict possible effects of raw dietary fibre, such as different fibrous by-products from foodstuffs industry, on protein and amino acids digestion and absorption in the small intestine in young pigs. According to Li et al. (1994) and Schulze et al. (1995) fibre by-products included into the diet increase ileal losses of total protein and amino acids in pigs.

The objective of the study was to determine effects of the fruit and vegetable by-products, differing in origin and composition of dietary fibre, on apparent ileal digestibility of protein and amino acids when added to a highly digestible wheat-casein diet.

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MATERIAL AND METHODS

Fibre by-products and diets

Six dried by-products orginating from different branches of food industry in Denmark, Spain and Poland were used. They comprised: potato pulp - the residuals after starch and protein extraction, apple pectin and apple pulp - the by-products of juice production, artichoke - the offals from artichoke canning, and sugar beet pulp - the residue after sugar extraction. Cellulose was used in the control diet as a fibre source.

Five percent of each product or cellulose was added to the diet containing, %: wheat 60, casein 13 and soyabean oil 2 as main ingredients. The diets were supplemented with minerals and vitamins to meet Nutrient Requirement of Pigs (1993). Chromic oxide was included in the diets as the marker for the determination of protein and amino acids digestibility.

Animals and experimental procedure

The experiment was carried out with 14 male pigs of initial 22 kg body weight fitted with a post-valvular T-ceacum (PVTC) cannula (van Leeuwen et al., 1991). Experimental diets were fed twice daily in equal meals (08.00 and 20.00) according to a change-over design; each diet was given to six animals. Pigs were individually fed 2.8 times maintenance requirement for ME. After a 6-day addaptation period, the ileal digesta was collected for 3 days, for 12 h per day between meals, pooled and frozen until analysis.

Analytical procedures

Crude protein, ether extract, and crude fibre in by-products were analysed using standard methods (AOAC,1990). The content of ADF and NDF were determined with Fibertec System M by methods of Van Soest and Wine (1967) and Van Soest (1973). The soluble (SDF) and insoluble (IDF) dietary fibre were determined according to Asp et al. (1983). Amino acid compositions in the diets and the ileal digesta were determined using amino acids analyser Beckman 6300. Statistical analysis of results was performed using SPSS ver. 11.5

RESULTS AND DISCUSSION

Used by-products differed in crude protein, ether extract, ADF, NDF and SDF and IDF dietary fibre content (Table 1). The proportions of ADF were similar in apple pulp and artichoke offals while about twice as high as that in sugar beet and

potato pulp. The NDF content was higher in the apple pulp than in remaining by-products. The contents of SDF and IDF differed even to greater extent: the apple pectin had very high SDF content, while in remaining by-products prevailed ADF (Table 1), which were the lowest in apple pulp and artichoke offals.

Table 1. Chemical composition of fibre by-products, g kg^{-1} DM

Item	Apple pectin	Apple pulp	Sugar beet pulp	Potato pulp	Artichoke offals
Crude protein	11.2	78.8	92.5	51.3	63.5
Ether extract	4.5	74.6	3.2	7.4	13.5
Ash	14.9	14.7	35.9	27.2	78.8
Crude fibre	-	327.9	196.7	205.2	290.3
ADF	-	440.0	236.1	262.5	451.3
NDF	3.6	561.6	490.4	462.3	448.1
Soluble fibre (SDF)	985	62	156	181	82
Insoluble fibre (IDF)	9	627	640	474	590

Table 2. Apparent ileal digestibility of crude protein (CP) and amino acids in pigs fed diets containing cellulose or various fibre by-products, % (mean ± SD, n = 6)

Item	Cellulose	Apple pectin	Apple pulp	Sugar beet pulp	Potato pulp	Artichoke offals
CP	82.9 ± 1.0	83.3 ± 6.3	82.2 ± 0.7	82.2 ± 0.6	82.0 ± 0. 9	80.2 ± 2.6
Lys	87.8 ± 1.0	86.9 ± 1.9	87.2 ± 0.4	87.9 ± 0.7	87.0 ± 0.8	86.9 ± 1.4
Met	89.8 ± 0.6	88.4 ± 1.6	89.7 ± 0.4	90.3 ± 0.7	89.1 ± 0.8	89.3 ± 0.6
Cys	74.6 ± 1.5	70.8 ± 2.9	72.8 ± 2.2	74.4 ± 1.5	72.0 ± 1.7	72.5 ± 2.7
Thr	77.7 ± 1.5	76.3 ± 3.0	77.1 ± 1.3	77.6 ± 1.0	75.8 ± 1.7	76.6 ± 2.7
Trp	83.3 ± 1.8	81.6 ± 2.6	82.4 ± 1.3	83.2 ± 1.5	81.0 ± 0.9	82.0 ± 2.2
Ile	81.7 ± 1.5	81.0 ± 2.7	81.9 ± 0.9	81.4 ± 0.8	80.5 ± 0.9	81.0 ± 1.5
His	89.8 ± 0.8	88.6 ± 1.5	88.9 ± 0.5	87.4 ± 0.5	88.6 ± 0.5	88.8 ± 1.2
Leu	89.9 ± 0.7	89.0 ± 1.5	89.0 ± 0.5	89.6 ± 0.5	88.5 ± 0.9	88.6 ± 1.0
Phe	87.7 ± 4.2	89.9 ± 1.5	89.9 ± 0.6	91.4 ± 0.3	89.0 ± 0.6	89.7 ± 0.9
Val	83.9 ± 1.0	82.8 ± 2.2	83.1 ± 0.8	83.6 ± 0.8	82.8 ± 0.7	83.2 ± 1.4

In spite of the differences in the chemical composition, none of the supplemented by-products affected the apparent ileal digestibility of protein and amino acids (Table 2). Protein digestibility was high and amino acids digestibility followed normal pattern being the lowest for threonine and cystine and the highest for methionine as showed by Święch and Buraczewska (2005).

Our data do not support the results of Dierick et al. (1983) who found that inclusion of 5% pectin to a semi-purified diet markedly decreased ileal digestibility of protein and amino acids. Mosenthin et al. (1994) also reported significant reduction in the apparent digestibility of protein and amino acids in pigs given

semi-purified diet with 7.5% pectin. However, Den Hartog et al. (1988) did not found any effect when 5% pectin was included in the diet formulated from natural ingredients such as maize, barley and soyabean meal. It may therefore suggest that the effect of pectin on digestion processes depends on diet composition.

CONCLUSIONS

The supplementation of pig diets with 5% of fruit and vegetable fibre by-products of different composition or with cellulose does not impaire the total protein and amino acid digestion in the small intestine. It indicates, that the by-products may be used in young pig nutrition.

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