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- Use sections to a maximum of three levels (including chapter level). Do not number the sections.

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World Health Organisation, 2004. Surveillance programme for control of foodborne infections and intoxications in Europe. Seventh report. The 1993–1998 Country reports. Available at: [http://www.bgvv.de/internet/7th\\_report/threp\\_fr.htm](http://www.bgvv.de/internet/7th_report/threp_fr.htm).

# Effect of dietary protein and carbohydrates on phenolic compounds formation in the large intestine of pigs

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## Abstract

Phenolic and indolic compounds, potentially toxic substances, are formed in the gut in bacterial degradation of the aromatic amino acids. The purpose of the present study was to assess the influence of different carbohydrates used as a source of energy for microflora on the processes of aromatic amino acid degradation in the large intestine of pigs. Two-factorial experiment was conducted on 36 castrated male pigs of initial body weight about 15 kg. Animals were divided into 6 groups receiving cereal feeds differing in the type of carbohydrates added to diets (cellulose, potato starch, pectin) and the type of protein (potato protein concentrate or casein). After two weeks of experiment pigs were slaughtered and samples of caecal and proximal, middle and distal colon digesta were collected and analysed for phenol, p-cresol and indole concentration using gas chromatography method. Neither type of carbohydrate nor type of protein in the diet affected concentration of phenol in all segments of the large intestine of pigs. In the caecum, proximal and distal colon concentration of p-cresol and indole was affected by the protein source in the diet. Potato protein concentrate increased concentration of these products. Potato starch in the diet resulted in increased concentration of p-cresol in the distal colon also in comparison with pectin.

**Keywords:** dietary protein, carbohydrates, large intestine, pigs

## Introduction

Phenolic and indolic compounds, potentially toxic substances, are formed in the gut in bacterial degradation of the aromatic amino acids e.g. phenol, p-cresol and phenylpropionate originate from tyrosine, phenylacetate from phenylalanine and indole, indole propionate and indole acetate from tryptophan (Hughes *et al.*, 2000). This process may be modified by feeding diet containing different carbohydrates and protein sources. The aim of the present study was to assess the influence of protein of animal or plant origin and three types of carbohydrates, used as an energy source for microflora, on the processes of aromatic amino acid degradation in the large intestine of pigs.

## Material and methods

A two-factorial experiment was conducted on 36 castrated male pigs of about 15 kg initial body weight. Animals were divided into 6 groups receiving cereal feeds differing in the type of carbohydrates added to diets (cellulose, potato starch, pectin) and the type of protein (potato protein concentrate or casein). After two weeks of experiment pigs were slaughtered and samples of caecal and proximal, middle and distal colon digesta were collected and analysed for phenol, p-cresol and indole concentration using the gas chromatography method.

## Results and discussion

Neither type of carbohydrate nor type of protein in the diet affected concentration of phenol in all segments of the large intestine of pigs. In the caecum, proximal and distal colon

concentration of p-cresol and indole was affected by the protein source in the diet. Potato protein concentrate increased concentration of these products, may be as a result of substantial amount of protein passing to the large intestine from ileum because of the apparent resistance of potato protein to enzymatic digestion (Tuśnio *et al.*, 2011). Type of carbohydrate in the diet affected quantity of indole in the caecum and proximal colon, and p-cresol in proximal and distal colon. Both products concentration in the proximal colon, as well as indole in the caecum were higher in pigs fed diets supplemented with cellulose compared to pectin. Potato starch in the diet resulted in increased concentration of p-cresol in the distal colon also in comparison with pectin. Microbial growth is stimulated by the presence of fermentable carbohydrate. This leads to an increased demand for amino acids by microorganisms, as may be suggested by reduced protein catabolism in the gut. Therefore, the production of potentially harmful compounds, such as phenolic compounds, would be less intensive in the presence of a carbohydrate source (Williams *et al.*, 2001).

Increased concentration of p-cresol and indole, resulting from microbial metabolism of protein, and enhanced by the presence of cellulose, a carbohydrate of low fermentation capability, may be reduced by the addition of highly fermentable pectin.

Table 1. Phenol, cresol and indol concentrations ( $\mu\text{M/g}$  of digesta) in the caecum (S), proximal (C25), middle (C50) and distal (C75) colon of pigs.<sup>1</sup>

		PPC			CAS			SEM	P-values		
		CEL	PEC	PS	CEL	PEC	PS		Protein	Carbohydrate	P×C
S	phenol	0.66	1.30	0.73	0.70	0.69	0.70	0.28	0.373	0.445	0.435
	cresol	1.30	1.76	1.22	0.90	0.88	0.73	0.28	0.013	0.456	0.654
	indole	0.08	0.02	0.04	0.04	0.01	0.02	0.01	0.007	0.000	0.426
C25	phenol	0.68	0.61	0.68	0.69	0.66	0.73	0.05	0.370	0.364	0.887
	cresol	2.32	1.23	1.95	0.95	0.88	1.11	0.22	0.000	0.022	0.064
	indole	0.09	0.02	0.05	0.03	0.01	0.03	0.01	0.001	0.001	0.042
C50	phenol	0.62	0.63	0.67	0.64	0.59	0.71	0.06	0.823	0.303	0.703
	cresol	2.08	1.85	2.03	1.10	0.89	1.39	0.26	0.000	0.368	0.732
	indole	0.07	0.05	0.04	0.03	0.01	0.02	0.01	0.000	0.062	0.331
C75	phenol	0.58	0.57	0.60	0.56	0.62	0.64	0.04	0.458	0.463	0.623
	cresol	3.20	2.46	4.43	2.94	2.14	3.47	0.62	0.307	0.039	0.821
	indole	0.09	0.06	0.04	0.05	0.04	0.05	0.01	0.223	0.130	0.233

<sup>1</sup> PPC = potato protein concentrate; CAS = casein; CEL = cellulose; PEC = pectin; PS = potato starch.

## Acknowledgements

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