DOES THE PROTEIN BOUND TO DIETARY FIBRE INFLUENCE THE NUTRITIONAL VALUE OF RAPESEED MEALS?

P.OCHODZKI, M.RAKOWSKA

Plant Breeding and Acclimatization Institute,
Radzików, 05-870 Błonie, Poland

ABSTRACT

The application of the Asp method for dietary fibre (DF) estimation in rapeseed showed high percent (~45%) of rape protein, resistant to digestion by animal proteases. The protein bound to the soluble fraction of fibre (SDF) was very rich in lysine and asparagine, differently to the insoluble fraction (IDF) and total rapeseed protein. Enzyme isolated fractions of SDF and IDF, added to casein standard diet in N-balance experiment on rats, suggest apparent character of DF influence on protein utilisation.

INTRODUCTION

Rapeseed meal is one of the best protein source for monogastric animal feeding. Decrease of the glucosinolate content, as the most limiting antinutritional factor, to the level of >10.0μM/g allowed to increase an amount of added rapeseed meal without any negative nutritional effects on pigs or rats to 20%-30% of diet, and to 10-20% on poultry [Bille, 1983; Clandinin, 1989]. The rapeseed protein, likewise many other feedstuffs of plant origin, is not completely digested by monogastric animals. This nondigested part of protein is associated with dietary fibre, and is resistant to hydrolysis in *in vitro* method [Asp et al., 1983]

The aim of this study was to estimate the influence of protein associated with dietary fibre fractions on biological value (BV), true digestibility (TD) and organic matter digestibility (DOM) in rats.

EXPERIMENTAL

Chemical character of fibre-associated protein

The content of associated protein was evaluated in 23 samples of rapeseed, divided in three groups: (1) 8 samples of double improved raw defatted seeds, (2) 4 samples of rapeseed cakes obtained by pressing, (3) 11 samples of meals after solvent extraction. In analysis of group 2 and 3, the Asp procedure was modified by the use of dialysis step instead of ethanol precipitation in soluble dietary fibre (SDF) determination procedure.

Table 1 shows the amount of protein associated with fibre fractions. Total amount of associated protein is similar in all groups: from 44.5% of total protein content in group 2, to 46.1% in group 1 and 47.8% in group 3.

Table 1. The content of protein bound to the dietary fibre in rapeseeds processed by different methods. Data are given in % of total protein.

Type of processing	Nondigested protein [%]
Group 1 - not processed (n=8)	46.1±5.4
Group 2 - pressed cake (n=4)	44.5±4.9
Group 3 - extracted (n=11)	47.8±5.5

Amino acid composition of meal and fibre fractions was analyzed in raw, not processed defatted seeds (Table 2) of 4 Polish double improved, winter type varieties

Table 2. The content of selected amino acids in protein associated with soluble (SDF) and insoluble fibre (IDF) [g/100 g a-a]] compared to rapeseed meal.

Amino acid	SDF	IDF	Meal
Cys	3.36	2.28	2.11
Asp	15.11	8.44	7.93
Met	0.94	1.87	2.24
Ser	7.09	5.82	4.69
Pro	3.39	6.72	8.16
His	4.84	3.07	3.22
Lys	12.74	6.26	6.18

The protein associated with IDF had the amino acid composition similar to that of rapeseed meal. On the contrary, protein associated with SDF differed markedly, being extremely high in lysine (12.7 g versus 6.2 g/100 g a-a), and asparagine (15.1 g versus 7.9 g/100 g a-a), whereas the level of cysteine, serine and histidine was only slightly elevated. Methionine and proline appeared in lower amounts compared to the level in rapeseed meal protein. The proteins in the SDF fraction are presumably of enzymatic origin of the seeds of rape.

Biological trial

The direct influence of isolated dietary fibre fractions was tested in N-balance experiment on rats. Diets contained insoluble (IDF) or soluble (SDF) dietary fibre fractions, isolated from 100 g of seed material, added to 500 g of a basal casein+1% methionine diet, N-free wheat starch, minerals and vitamins according to the requirements of rat. The casein+1% methionine diet was used as a control diet.

The results (Table 3) showed no influence of the SDF fraction on TD and OMD, whereas there was a pronounced negative effect on BV. Addition of IDF to the diet resulted in a markedly reduced TD and organic matter digestibility values, whereas the effect on BV was less pronounced. The distinct effect of SDF fraction on BV coefficient, with almost no influence on TD is connected with enhanced excretion of N in urine of rats (Table 3). From 89.6mg of nitrogen, bound to SDF and consumed by rat,

77 mg was excreted in urine, and only 16.6 mg in faeces. Protein bound to SDF, not digested in the upper part of intestine, presumably underwent the deamination by microphlora, resulting in high urea excretion

Table 3. The effect of addition of SDF and IDF, isolated from double low rapeseed varieties, to a standard diet of rats on protein digestion (TD), biological value (BV), organic matter digestibility (DOM), and fibre-bound nitrogen excretion

	Diet		
	Control casein	Control + SDF	Control + IDF
TD [%]	98.7±0.8	98.2±0.6	89.5±1.1
BV [%]	100	92.4±1.2	98.4±0.8
D.O.M. [%]	98.0±0.2	97.8±0.2	93.3±0.3
Faecal-N		16.6	88.0
Urine-N		77.0	2.0

The influence of IDF fraction added to casein diet induced the decrease of TD values by 9 units, while only by 1.6 unit of the BV values. From amount of 90 mg of N bound to IDF fraction, and consumed by rat, 88 mg were found in faeces. These data suggest that protein associated with insoluble fraction of fibre is hardly utilized.

ACKNOWLEDGEMENTS

The authors thank to Polish Committee of Scientific Research for financial support (project No 5/0243/91/01). The authors are grateful to Mr Cz. Guzik, A. Kozłowska, A. Jankowska and B. Ciepła for technical assistance.

REFERENCES

Asp, N.-G., Johansson, C.G., Hallmer, H., Siljeström, M., (1983). Rapid enzymatic assay of insoluble and soluble dietary fiber. *Journal of Agricultural and Food Chemistry*, 31, 476-482.

Bille,N., Eggum,B.O., Jacobsen,I., Olsen,O., Sørensen,H., (1983). The effects of processing on antinutritional rape constituents and the nutritive value of double low rapeseed meal. *Zeitschrift für Tierphysiology, Tierernährung und Futtermittelkde*. 49, 148-163.

Clandinin D.R., (1989). *Canola Meal for Livestock and Poultry*. Publication of Canola Council of Canada