REQUIREMENTS TO THE QUALITY OF OILSEED RAPE WHICH CAN BE USED WITHOUT PROBLEMS IN DIETS TO MINK (Mustela vison Screb.)

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ABSTRACT

The value of oilseed rape as an oil and protein source in diets to mink (Mustela vison) has been investigated. Seeds and meal of different oilseed rape varieties have been exposed to various methods of processing. The products have been used at different levels in the diets. Both long-term studies of the effects on productive results including numbers and size of kits, and studies of nutritive and toxic effects on young growing mink including effects on mink fur quality have been performed.

Evaluation of the nutritive value has in addition been based on proximate analyses, amino acid composition and comparison with results obtained in nitrogen balance trials with young growing rats. The oilseed rape and products thereof as well as the diets used in the trials have also been examined for presence of antinutritional and/or toxic factors like tannin, phenolic choline esters, glucosinolates and activity of myrosinase.

The protein quality of the investigated rape products was excellent with a well balanced amino acid pattern and a high biological value, and oilseed rape seems to be a promising oil and protein source to mink. However, the glucosinolates and degradation products thereof limit the possibilities of an optimal utilization.

Organ weights and pathological and histological studies revealed the presence of antinutritional and/or toxic constituents. The processing procedures applied could not completely eliminate the effects of these compounds in agreement with results obtained with other animals.

It is concluded that the requirements to the quality of oilseed rape and products thereof, especially the levels of glucosinolates and degradation products thereof, are quite high. Only the highest quality of double low oilseed rape is recommendable if antinutritional and toxic problems have to be avoided.

INTRODUCTION

Mink require diets with a high content of protein, which most often is from fish, meat or other animal products, e.g., offal from such sources. During the recent years appreciable interest has been devoted to the possibilities of partial substitution of the traditional protein sources with plant protein.

Rapeseed meal has a high protein content with a well balanced amino acid composition (Bille et al., 1983a). Of spe

cial interest for the fur production is the relatively high content of sulfur containing amino acids in these proteins. Feeding experiments with different animals have shown that the high quality of rapeseed protein can result in high biological values and feed utilization (Eggum et al., 1983; Eggum et al., 1985a; Andersen and Sørensen, 1985). The requirements are, however, that a sufficiently low content of glucosinolates and/or degradation products thereof, are present in the meal (Bille et al., 1983b; Bjerg et al., 1986a). Processing can improve the quality and nutritive value of rapeseed meal, but it can not solve all of the problems caused by rapeseed with a high content of glucosinolates (Eggum et al., 1985b).

Comprehensive experiments based on pure glucosinolates (Bjerg et al., 1986b) and isolated myrosinases (ß-thioglucoside glucohydrolase, EC 3.2.3.1)(Buchwaldt et al., 1986) have been performed. The individual glucosinolates ± myrosinases have been added to standard diets, which have been fed to rats in N-balance trials. Ten different glucosinolates have been investigated in such trials (Bille et al., 1983b; Bjerg et al., 1986b). The results obtained have revealed that different glucosinolates cause different types and degrees of antinutritional, physiological and/or toxic effects (Sørensen, 1986).

Optimal utilization of oilseed rape is only possible when it is realized that there are different quality requirements for feeds used to various animals at different developmental stages(Bjerg et al., 1987a). Information about these requirements are lacking with respect to mink. Based on the information available from the research mentioned above, investigations on the requirements to the quality of oilseed rape,which can be used without problems in diets to mink, have now been initiated (Mortensen and Sørensen, 1986). Results from these investigations will be presented and briefly discussed.

MATERIALS AND METHODS

The double low rape varieties (Brassica napus L. cultivars), pea

(Pisum sativum L. cv. Bodil) and faba bean (Vicia faba L. cv. Troy) were grown in Denmark. Rapeseed meal and soybean meal were obtaiend from Aarhus Oil Factory, Denmark. Processing procedures including myrosinase inactivation, toasting, and extraction of low molecular weight constituents with methanol-water (7:3) were performed in laboratory scale ("Pilot-plant"). Detailed description of materials and methods have been presented elsewhere (refs. 1-5,9,13).

The experiments now reported have comprised male (♂) and female (♀) mink (Mustela vison Screb.) of both Pastel and Standard type. The trials have been performed with minor groups (24 mink per group) as well as relatively large groups (140 mink per group).

As controls were used corresponding groups of mink fed a traditional mink-diet. Such diets contain about 30% DM with 40-44% protein in DM; 15-20% fat in DM; ca. 30% carbohydrates in DM and ca. 10% ash in DM. In the trials with the rapeseed, rapeseed meal or the other plant protein sources 5, 10 or 20%, respectively, of these products replaced a corresponding amount of protein from cod-offal and carbohydrates from barley in such a way that the protein, Stoldt fat and carbohydrate content were at the same level in the control diet and the diets with the plant protein sources used in the different trials. The methods of analysis used in the present studies have been described elsewhere (Bille et al., 1983a). The content of glucosinolates, aromatic choline esters and myrosinase activity in the rapeseed, rapeseed meal and diets containing these products have been determined by the methods of analysis described previously (Bjerg and Sørensen, 1987b; Bille et al., 1983a; Buchwaldt et al., 1986).

RESULTS AND DISCUSSION

Preliminary trials were performed with relatively large groups of mink (vide supra) to study the long term (February -December) effects of rapeseed meal with different levels of glucosinolates (Table 1).

The results obtained with mink fed on diets containing 10% of A, B or C (Table 1), respectively, showed that the rapeseed meals cause some palatability problems when fed to mink at the applied levels. For the diets containing B and especially C appreciable effects on the litter size were observed for both Pastel and Standard mink. This is shown by the mean values obtained:

Control	groups;	5.58	kits	per litter
Diet A	groups;	5.59	-	- -
Diet B	groups;	5.22	-	- -
Diet C	groups;	5.05	-	- -

Weight gain of growing mink fed diets B and C were low during the summer-autumn period. For the mink fed diet C it was so low that the trials were finished in October.

Table 1. Chemical composition (%DM) of rapeseed products and their content of glucosinolates (μmole/g DM) and aromatic choline esters (μmole/g DM)

	Rapeseed meal							Rapeseed
	A	B	C	D	E	F	G	H
Protein (N x 6.25)	39.6	39.7	39.8	42.2	40.5	47.3	39.5	22.8
Stoldt fat	4.1	4.2	4.1	4.5	4.4	4.5	2.8	46.9
RHC	10.4	11.8	12.9	13.8	12.9	3.6	14.4	8.1
Crude fibre	14.4	14.4	14.4	14.7	14.4	18.5	15.3	9.2
Ash	7.8	7.8	7.8	8.7	8.3	10.0	8.1	4.9
Sinapine (μmole/g)	22.2	21.8	20.3	21.2	19.2	7.2	25.7	17.5
Other aromatic choline esters	5.8	5.7	5.5	6.4	7.2	0.8	6.2	2.4
Glucosinolates (μmole/g):								
Glucoraphanin	0.1	0.3	0.3	0.1	0.1	-	0.3	0.1
Glucoalyssin	0.2	0.5	0.5	0.2	0.2	-	0.5	0.2
Progoitrin	5.1	27.4	56.3	5.8	5.3	2.2	4.1	2.5
Napoleiferin	0.1	1.9	4.4	0.3	0.2	-	0.5	0.2
Gluconapin	3.7	11.1	15.2	3.3	2.6	1.2	2.7	2.0
Glucobrassicanapin	1.5	2.5	3.0	0.8	0.7	-	1.4	0.5
4-Hydroxyglucobrassicin	0.3	0.7	0.9	1.3	1.2	0.2	1.1	4.5
Glucobrassicin	0.2	0.4	0.4	0.3	0.3	-	0.8	0.6
Other	0.2	1.4	0.9	0.9	0.9	0.4	1.1	0.8
Total	11.4	46.2	81.9	13.0	11.5	4.0	12.5	11.4

Table 2. Production results obtained for mink fed rapeseed meal with different glucosinolate content compared with results for the control group.

		Diets (see Materials and Methods + Table 1)			
		Control	5% A	10% A	10% B
Final weight (g): Standard	♂	2.137	2.151	1.923	1.891
(mean values) -	♀	1.211	1.194	1.128	1.182
Pastel	♂	2.094	2.046	1.858	1.863
-	♀	1.116	1.109	1.103	1.068
Quality of the fur	Standard	8.4	8.3	10.5	11.6
(relative values 1-15):	Pastel	8.4	8.2	9.5	8.1
Size of the fur (cm):	Standard	72.6	73.5	70.1	69.2
	Pastel	71.9	72.1	68.6	68.3

Table 2 shows production results obtained with mink fed diets containing 5% A, 10% A and 10% B compared with those on the control diet.

The rapeseed meal seems to have a positive effect on the mink fur quality, but for the diets containing 10% A and especially the diet containing 10% B have appreciable nega-

tive effects on the final weights of the mink.

As previously described for corresponding trials with other animals (Bille et al., 1983a; Eggum et al., 1985a; Andersen and Sørensen, 1985), the effects on some internal organs and the serum thyroxine level have been investigated. Some selected results are shown in Table 3.

Table 3. Mean values for organ weights (relative weights in % of body weight) and plasma thyroxine of mink fed rapeseed meal containing different levels of glucosinolates (see Materials and Methods and Table 1). Standard deviations shown in bracket.

		Diet with 10% A	Diet with 10% C
Kidneys	♂	0.54 (0.06)[a]	0.61 (0.13)[a]
	♀	0.60 (0.03)[a]	0.59 (0.15)[b]
Liver	♂	2.60 (0.26)[a]	3.62 (0.57)[b]
	♀	2.80 (0.25)[a]	3.44 (0.41)[b]
Heart	♂	0.57 (0.09)[a]	0.57 (0.07)[a]
	♀	0.59 (0.05)[a]	0.57 (0.07)[a]
Thyroid	♂	0.007(0.001)[a]	0.015(0.004)[b]
	♀	0.001(0.001)[a]	0.013(0.003)[b]
Plasma thyroxine (nmole/l) (for mink and control diet; ♂ 22.9; ♀ 21.5)	♂	14.3	10.2
	♀	16.8	15.8

a), b) Within comparison the different groups, mean values with different letters were significantly ($P < 0.05$) different according to Students' t-distribution test (t-Test).

As previously found for other animals (Bille et al.,1983a; Bjerg et al., 1987a) the rapeseed glucosinolates result also in hyperplasia of the mink thyroid (Figure 1).

The trials with growing mink have been repeated with use of 10% D or 10% G (Table 1) with and without 10% of pea or soybean meal included in the diets, 10% E (D toasted at 100°C in 10 min.), 10% F (extracted D) as well as 10% H (toasted seed). The results obtained in the above mentioned trials by use of rapeseed meal with different levels and compositions of glucosinolates and processed with inactivation of the myrosinases as the result (E, F and H; Table 1), reveal that mink have even higher requirements than pigs to the rapeseed quality (Bjerg et al., 1987a). The rapeseed meal containing diets have been analyzed for aromatic choline esters and glu-

cosinolates as described elsewhere for diets used in sow trials (Danielsen et al., 1987). As found in these trials the majority of the compounds originally present in the rapeseed meal were also found in the diets used to mink.

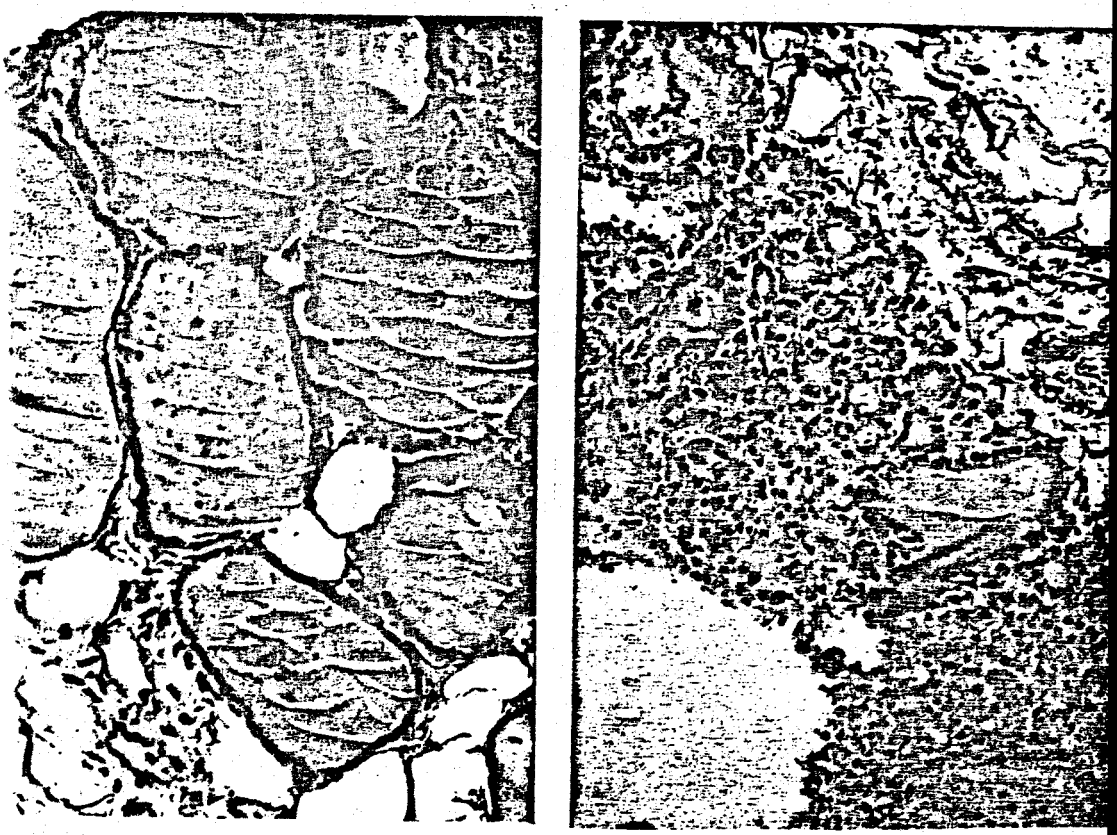

Figure 1. Thyroid from a mink fed the control diet, on the left (x250), compared to a thyroid, on the right (x250), from a mink fed a diet with 10% rapeseed meal (A). The pictures show hyperplasia, hypertrophy and reduced follicle lumen in the thyroid on the right.

In conclusion, rapeseed meal seems to be a promising protein source to mink. However, the requirements to the quality of rapeseed which can be used without problems in diets to mink are rather high especially with respect to

the content of glucosinolates and/or degradation products thereof (Bjerg et al., 1987a).

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