Influence of 1-cyano-2-hydroxy-3-butene and intact glucosinolates on nutritional value of commercial rapeseed meal

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Introduction

The rapeseed meal /RSM/ was analysed for aglycones content in our laboratory. The results showed that commercial RSM contains compound with retention times on EGSS-X and Apiezon L GC chromatography columns similar to that of the 1-cyano-2-hydroxy-3-butene /unsaturated nitrile, CHB/. This compound was additionaly identified by GC-MS method. Earlier, Papas et al. /1978/ also found CHB in Tower RSM.

In the presented paper the effect of unsaturated nitrile and intact glucosinolates on growth of rats in two-weeks feeding trial is described.

Materials and methods

Dietary meals were prepared as follows. Commercial RSM from Janpol variety was extracted with four portions of 80% aqueous methanol in room temperature. The extracts were combined and from one third of it methanol was removed under vacuum. The remaining water phase was than extracted four times with methylene chloride. The methylene chloride extracts were pooled and the solvent was evaporated in a rotary evaporator. When about 100 ml of methylene chloride remained, one third of methanol extracted meal was added and the solvent evaporated. The water phase was also mixed with one third of the meal and dried under vacuum. The following RSM preparations were mixed in equal portions into the test diets: P_0 - untreated meal, P_1 - detoxified meal, P_2 - glucosinolate containing meal, P_3 - nitrile containing meal.

The unsaturated nitrile and intact glucosinolate content of these preparations as determined by GLC method of Daxenbichler et al. /1970/ is given in Table 1.

Weanling male and female Wistar rats weighing 45-50 g were divided into five experimental groups of 8 rats each /40 + 4°/. The animals were housed in individual cages and were fed ad libitum. The control group was fed with diet containing 10% protein from casein supplemented with

methionine. The groups 2,3,4 and 5 were fed the test diets containing the same level of rapeseed meal /20%/. Differences in protein content of the test diets were equalized up to 10% by casein supplementation.

The body weight and feed intake were recorded every 2 days. At the end of 2 weeks the rats were killed and thyroids and kidneys were removed and weighed.

Results and discussion

Results of the feeding test are given in Table 2. Feeding of meals P_0 and P_2 caused a very similar reduction in weight gain, feed intake and enlargement of thyroids and kidney of rats. Surprising results were obtained for CHB containing diet /P_3/ : weight gain and feed intake data of the growing rats were a little lower than on casein diet but the same as on detoxified meal P_1 and significantly higher in comparison with meals containing glucosinolates. The thyroid and kidney of rats were not significantly affected by consumption of the detoxified meal /P_1/ as well as nitrile-rich meal /P_3/.

The lack of toxicity of CHB to rats demonstrated in our experiment is in agreement with the results of Cansfield and Campbell /1980/. These authors showed that CHB was not toxic to poultry when fed as an individual compound in the level of 0.08% in the diet. For comparison in our feeding trial amount of CHB in the diet was 0.05%.

These above results are in conflict with informations published by VanEtten et al. /1969/ and Srivastava et al. /1975/. They reported that meals autolyzed to give nitriles were highly toxic to rats. However in experiment demonstrated by VanEtten and coworkers crambe seed meal autolyzed and freeze-dried was much more toxic than meal autolyzed and air-dried at 50°C, althought the amount of nitriles was not so much lowered during the air-drying /from 0.8% to 0.6%/. Weight gain of rats fed nitrile-rich meal on the level of 10% in the diet /0.06% of nitriles/ in Srivastava et al. experiment was more affected than in our. However aglycone composition in autolyzed meal is different than in meal used in our experiment. As it is known during autolysis some quantities of 5-vinylooxazolidine-2-thione are formed from the progoitrin. Additionaly, we found that in the autolyzed meal from Brassica napus 1-cyano-3,4-epithiobutene is formed from gluconapin insted of 3-butenyl-isothiocyanate. Similar enzymatic hydrolisis of gluconapin was observed by Kirk and MacDonald /1974/ in the meal from Brassica campestris. The differences in the results between the feeding trials with isolated CHB and autolyzed meal are probably caused by the content of 5-vinylooxazolidine-2-thione and split products of gluconapin and pungent tast of autolyzed meal.

It can be concluded that detrimental effect observed in feeding the commercial rapeseed meal is mainly due to its high intact glucosinolates content.

References

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Table 1. Glucosinolate content /mg/g/ in different preparations of commercial RSM /cv. Janpol/

	P_0	P_1	P_2	P_3
1. "As is" /without addition of myrosinase/				
1-cyano-2-hydroxy-3-butene	2.6	0.0	0.0	2.5
2. Hydrolysis products of intact glucosinolate /addition of myrosinase/				
5-vinylooxazolidine-2-thione	3.4	0.6	3.0	0.7
3-butenyl-isothiocyanate	1.2	0.2	1.1	0.2
4-pentenyl-isothiocyanate	0.2	0.0	0.2	0.0

Table 2. Influence of different preparations of rapeseed meal cv. Janpol on feed intake, body weight gain and enlargement of thyroid and kidney of rats.

Dietary groups	Body weight gain /g/day/	Feed intake /g/day/	Thyroid weight /mg/100g b.wt/	Kidney weight /g/100g b.wt/
1. Casein	3.0 ± 0.4[1],a	9.4 ± 0.6 a,b	6.1 ± 1.0 a	0.86 ± 0.04 a
2. Meal P_0	1.6 ± 0.3 b	8.5 ± 0.7 a	9.4 ± 0.9 b	1.03 ± 0.08 b
3. Meal P_1	2.5 ± 0.4 c	9.9 ± 0.9 b	7.6 ± 1.7 a	0.89 ± 0.06 a
4. Meal P_2	1.7 ± 0.3 b	9.0 ± 1.6 a,b	9.6 ± 1.5 b	1.03 ± 0.10 b
5. Meal P_3	2.6 ± 0.3 a,c	10.1 ± 1.6 b	6.6 ± 1.7 a	0.92 ± 0.06 a

[1] Mean ± standard deviation, a,b,c Values having different superscripts vary significantly from each other /p 0.05/