GLUCOSINOLATE DEGRADATION OF RAPESEED MEAL IN THE RUMEN OF BULLS

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ABSTRACT

Nylon bags containing rape-seed meal were incubated in the rumen of bulls in order to assess glucosinolates degradation. After an incubation of 5 hours, all the glucosinolates were hydrolysed. Some degradation products of glucosinolates (4-pentenonitrile,3-hydroxy, vinyl oxazolidine thione, 1-butenyl,4-isothiocyanate) were also indentified by GC-MS.

INTRODUCTION

Rape-seed proteins have a well balanced amino acids pattern, and consequently, a high biological value (Eggum, 1981). However, the nutritive value of rape-seed meal is reduced by the presence of antinutritional constituents. The major antinutrients are thioglycosides so-called glucosinolates (Fenwick et al., 1983). Some of these compounds or their degradation products (nitriles, isothiocyanates, oxazolidine thiones) reduce the palatibility of the cake, interfere with the thyroïd functions, damage vital organs (liver, kidneys) or modify metabolic processes.

Hill (1991) published a review on the nutritive value of rape-seed meal in ruminant diets with particular emphoneson voluntary feed-intake, live weight gain, reproduction parameters, milk yield and composition. The lack of informations in this review and in the litterature concerning the degradation of glucosinolates in the rumen and the potential development of biodiesel from rape-seed with large amounts of rape meal as by products initiated a new study on this subject.

EXPERIMENTAL DESIGN

Eight bulls from the Belgian Blue breed with an approximative weight of 530 Kg have been used . They were fitted with a rumen canula. The bulls were offered a fattening diet based on sugar beet pulp, cereals and protein of vegetable originin. Rape-seed meal provided one third or two thirds of the proteins from the cakes. Nylon bags (12x7.5 cm) containing approximately 5g of rape-seed meal were incubated in the rumen for 1, 2, 3, 4 and 5 hours.

Glucosinolates and their breakdown products were measured on the residues of rape-seed meal incubated in the rumen. Glucosinolates were determined by HPLC according to an official method (ISO 9167-1). Breakdown products have been analysed by GC-MS.

RESULTS AND DISCUSSION

The glucosinolate content (μmol/g) of rape-seed meal was characterized as follow: progoitrin (8.76), glucobrassicanapin (1.00), gluconapoleiferin (0.42), glucobrassicin (0.22), gluconapin (3.55), gluconasturtin (0.75), 4-hydroxy glucobrassicin (2.01)(total : 16.71 μmol/g).

Hydrolysis of glucosinolates in the rumen of bulls (Table 1) was fast since after an incubation of 4-5 hours, progoitrin, gluconapin,gluconapoleiferin, gluconasturtin and the indolyl-glucosinolates contained in the meal were destroyed.

Table 1. Evolution of glucosinolate content in the diets during rumen incubation (μmol/g)

	Protein from rape-seed meal									
	33%					**66%**				
Time (hours)	1	2	3	4	5	1	2	3	4	5
Progoitrin	0.95	0.47	0.25	0.01	0.00	1.17	1.12	0.55	0.09	0.25
Gluconapoleiferin	0.05	0.06	0.02	0.00	0.00	0.06	0.06	0.04	0.01	0.00
Gluconapin	0.50	0.27	0.12	0.00	0.00	0.81	0.76	0.33	0.06	0.00
4-OH glucobrassicin	0.54	0.27	0.22	0.00	0.00	0.98	0.67	1.22	0.05	0.00
Glucobrassicanapin	0.28	0.08	0.06	0.00	0.00	0.20	0.19	0.06	0.02	0.00
Glucobrassicin	0.09	0.03	0.03	0.00	0.00	0.11	0.08	0.11	0.01	0.00
Gluconasturtin	0.15	0.02	0.01	0.00	0.00	0.14	0.09	0.05	0.08	0.00

Three compounds : 4-pentenonitrile,3-hydroxy, vinyl oxazolidine thione (VOT) and 1-butenyl,4-isothiocyanate were identified by GC-MS as breakdown products of glucosinolates. These compounds appeared after 1 hour and disappeared after 5 hours (Table 2).

The benzene propane nitrile, the benzene acetic and propanoic acids and the 1-H-indol,3-methyl had been also identified in the meal.

Table 2. Evolution of the breakdown products during rumen incubation ($\mu g/g$)

	Protein from rape-seed meal									
	33%					**66%**				
Time (hours)	1	2	3	4	5	1	2	3	4	5
4-pentenonitrile, 3-hydroxy	8.60	4.06	0.90	1.79	0.00	8.51	4.94	3.02	1.53	0.16
1-buten, 4-ITC	1.19	0.48	0.56	0.00	0.00	1.34	1.04	1.17	1.83	0.19
VOT	5.40	3.05	1.67	1.38	0.00	6.31	5.29	5.10	1.20	0.73
benzene propane nitrile	1.93	0.92	0.37	0.00	0.00	2.05	1.36	1.41	0.88	0.36
benzene propanoic acid	31.00	13.70	9.29	18.37	9.33	20.43	28.72	30.77	14.01	37.11
benzene acetic acid	4.87	1.83	1.09	1.34	0.81	2.53	2.32	2.46	0.00	1.30
1-H-indol, 3-méthyl	0.93	0.48	0.35	1.31	0.75	0.71	0.00	1.73	2.19	2.38

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