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Ruminal degradation and *in vivo* digestibility of processed rapeseed meal

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Abstract. The digestibility and nutritive value of rapeseed meal processed in different ways were studied with adult rams fed on alkali-treated straw. The rumen degradability was determined by the nylon bag technique. The rapeseed meal feeds were:
1) untreated rapeseed meal, 2) heat-treated rapeseed meal (2—5 sec. at over 100°C), 3) heat-treated rapeseed meal + 5 % urea phosphate and 4) heat-treated rapeseed meal + 10 % rapeseed hulls.

The heat treatment reduced the rumen degradation and *in vivo* digestibility of the rapeseed meal, although not significantly ($P > 0.05$). Addition of urea phosphate to the heat-treated rapeseed meal increased the ruminal degradability of the crude protein and improved the digestibility of all the constituents of the rapeseed meal, especially that of crude fibre ($P > 0.05$). The rapeseed hulls had no noticeable effect on digestibility.

Introduction

Rumen microbes need a certain amount of rumen-degradable crude protein for maximal protein synthesis and fermentation activity. When the feed contains insufficient rumen-degradable protein for the microbes, digestion and protein synthesis are reduced, but presence of this protein in excess of the need for microbial synthesis can decrease the utilization of protein.

Reduction of rumen-degradable protein has been shown to have a beneficial effect with high-production animals, whose protein requirement is great (ANON. 1978, KAUFMANN, 1979, ANON. 1980). For instance, milk production and protein utilization were improved in dairy cows, when part of the silage protein was replaced with rapeseed meal protein of lower rumen-degradability (SYRJÄLÄ-QVIST and SETÄLÄ 1982). When untreated and formaldehyde-treated rapeseed meal was fed to high-production dairy cows, the treatment was found to reduce the ruminal NH_3-N concentration, but did not reduce the digestibilities of dry matter, nitrogen or fibre (INGALLS et al. 1983). Nor had it any effect on milk production.

The aim of the present experiment was to study the digestibility and nutritive value of

Index words: rapeseed meal, heat treatment, urea phosphate, digestibility rumen degradability

rapeseed meal when it is untreated and when its ruminal degradability has been modified by heat treatment. The effect of adding urea phosphate or rapeseed hulls to the heat-treated rapeseed meal was also examined.

Experimental procedures

The digestibility and nitrogen balance experiment was performed with four adult sheep according to a 4 × 4 Latin square. Each experimental period lasted two weeks, the second week being the total collection period. The rapeseed feeds used in experiment were as follows:

1) Untreated rapeseed meal
2) Heat-treated rapeseed meal (2—5 sec. at over 100°C)
3) Heat-treated rapeseed meal + 5 % urea phosphate
4) Heat-treated rapeseed meal + 10 % rapeseed hulls

The basic feed was alkali-treated straw, whose digestibility was known (Table 1). Each diet consisted of 400 g rapeseed feed and 550 g straw per animal and day plus mineral and vitamin mixtures and water. The feeding procedures, feed sampling, analyses and calculations were as described by SYRJÄLÄ et al. (1978).

The ruminal degradability of the rapeseed meal feeds was determined by the nylon bag

Table 1. The mean chemical composition, digestibility and nutritive value of the different feeds.

Feeds	Untreated rapeseed meal	Heat-treated rapeseed meal	Heat-treated rapeseed meal + urea phosphate	Heat-treated rapeseed meal + hulls	NaOH-treated straw
Dry matter, %	88.3	90.7	91.1	89.6	76.3
% of dry matter:					
Ash	7.7	7.5	9.2	7.4	10.6
Crude protein	36.4	36.1	39.9	34.6	2.8
Crude fat	3.8	4.2	4.0	5.6	0.8
Crude fibre	14.6	14.7	14.1	15.4	46.5
N-free extract	37.5	37.4	32.7	37.0	39.3
Digestibility, %					
Dry matter	75.1	71.9	74.8	73.5	57.4
Organic matter	76.5	73.5	76.8	74.3	58.5
Crude protein	79.7	78.4	81.3	77.7	—30.0
Crude fat	82.8	86.6	84.3	89.8	80.0
Crude fibre	50.3	45.6	53.6	49.7	71.6
N-free extract	80.2	76.4	78.3	76.7	50.6
N balance, g/day	2.1	1.6	1.9	1.7	
N secretion in urine, % of N supply	61.9	62.3	65.1	60.5	
N secretion in feaces, % of N supply	29.0	30.7	27.2	31.7	
kg/f.u.[1]	1.21	1.21	1.18	1.18	
DM kg/f.u.[2]	1.07	1.10	1.08	1.05	
DCP g/f.u.[3]	311[a]	310[a]	350[b]	283[a]	
DCP % in DM	29.0[a]	28.3[a]	32.4[b]	26.9[a]	

[1] f.u. = feed unit = 0.7 starch equivalent
[2] DM = dry matter
[3] DCP = digestible. crude protein
Statistical analysis applied only to digestibilities and feeding values. Different index letters in a vertical column show that there are significant differences between the averages at the 99.9 % levels of confidence.

tehnique (MEHREZ and ØRSKOV 1977), as described by SETÄLÄ (1983). The incubation periods were 2, 5 and 9 hours and the sheep used in the experiment received 1.5 kg hay per day.

Results and discussion

The heat-treatment decrease the *in vivo* digestibility of all the components of the rapeseed meal except that of crude fat (Table 1). The differences were, however, not significant ($P > 0.05$). Addition of urea phosphate to the heat-treated rapeseed meal improved the apparent digestibility, especially that of crude fibre, but not significantly. Addition of rapeseed hulls to the heat-treated rapeseed meal had also no significant effect.

The nitrogen balance of the sheep in different diets and the results describing the energy value of the different rapeseed feeds were about the same (Table 1).

In the untreated rapeseed meal the ruminal degradability of crude protein, organic matter and dry matter remained at the same level, about 40 % during the incubation periods of 2 and 5 hours, but after 9 hours it had increased to 56—58 % (Fig. 1). These values are about the same as those obtained for crude protein in other studies, (ANON. 1982, SETÄLÄ and SYRJÄLÄ-QVIST 1982), or lower (MATHERS et al. 1977, ANON. 1980). The method used in removing oil from seeds has been shown to affect the ruminal protein degradation (JOSEFFSON 1972) and this can be one reason for the variation in the results of different experiments. Heat treatment of the feeds has also been shown to decrease the degradation of feed protein in the rumen (MEHREZ and ØRSKOV 1977). In this experiment the degradation of crude protein with heat-treated rapeseed meal without urea phosphate was lower than with untreated meal during the incubation periods of 2 and 9 hours, but not during the incubation period of 5 hours. With heat-treated rapeseed meal the degradation of crude protein after 2, 5 and 9 hours incubation was 22, 43 and 46 %, respectively, and with untreated rapeseed meal it was 39, 41 and 55 %. Hence heat treatment slightly affected the rate of protein degradation in the rumen.

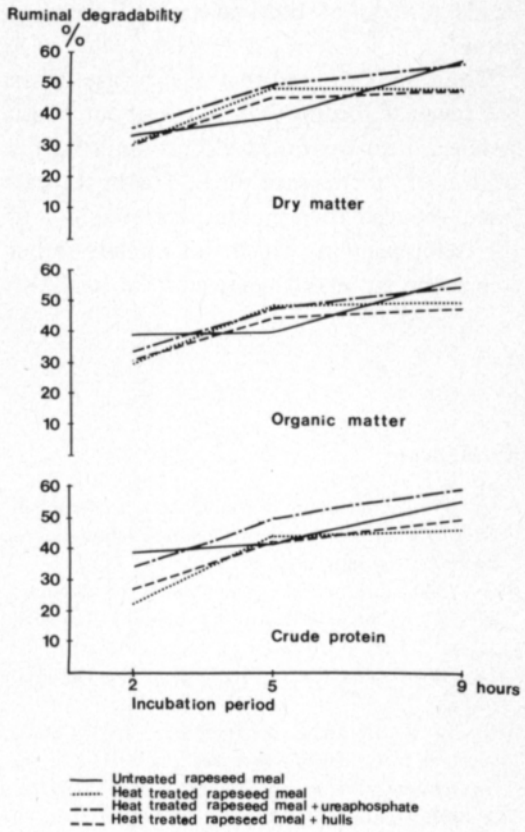

Fig. 1. Ruminal degradability of the rapeseed feeds in different incubation periods.

When the heat-treated rapeseed meal contained urea phosphate, the degradation of crude protein in the 2, 5 and 9 hour incubation periods was 12, 7 and 13 % units higher than with heat-treated rapeseed meal. The values were higher than those of untreated rapeseed meal in the incubation periods of 5 and 9 hours. The reason is the high solubility of urea in the rumen, though the rate of urea degradation is slown down when urea is given as urea phosphate (e.g. MCQUEEN et al. 1980).

Addition of rapeseed hulls did not have any marked effect on the ruminal degradability of the dry matter, organic matter or

crude protein of the heat-treated rapeseed meal.

The results showed that in this case, when the level of feeding was set at about maintenance, heat treatment did not improve the utilization of rapeseed meal. The heat treatment reduced the ruminal degradability of the crude protein, which was already rather low in the untreated rapeseed meal, and also tended to decrease the *in vivo* digestibility. As the heat-treated rapeseed meal was the only protein source, the rumen microbes probably did not have enough rumen-degradable protein for maximal activity, which led to reduced rumen fermentation activity. This conclusion is supported by the positive effect of urea on the digestibility of crude fibre.

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SELOSTUS

Prosessoidun rypsirouheen pötsihajoavuus ja *in vivo* sulavuus

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Lipeäolkea perusrehuna saaneilla täysikasvuisilla pässeillä määritettiin erilaisten rypsirehujen sulavuus ja ruokinta-arvo sekä heinäruokinnalla olleella pässillä samojen rypsirehujen pötsihajoavuus. Kokeissa käytetyt rypsirehut olivat seuraavat: 1) tavallinen rypsirouhe, 2) lämpökäsitelty rypsirouhe (2—5 sek. yli 100°C:ssa), 3) lämpökäsitelty rypsirouhe + 5 % ureafosfaattia, 4) lämpökäsitelty rypsirouhe + 10 % rypsinsiementen kuoria.

Lämpökäsittely vähensi rypsirouheen pötsihajoavuutta sekä alensi *in vivo* sulavuutta. Pötsimikrobistolle tuli tällöin todennäköisesti puutetta typellisistä aineista, mikä tässä kokeessa käytetyillä ruokinnoilla johti mikrobiaktiviteetin heikkenemiseen ja edelleen sulavuuden alenemiseen. Tätä osoitti myös se, että lisättäessä ureafosfaattia lämpökäsiteltyyn rouheeseen, pötsissä hajoavan valkuaisen osuus lisääntyi ja samalla myös sulavuus, varsinkin kuidun sulavuus parani. Siemenkuorilla sen sijaan ei ollut sanottavaa vaikutusta sulavuuteen.