INCREASING AMOUNTS OF EXPANDED RAPESEED EXPELLERS IN THE FEEDING OF DAIRY COWS

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ABSTRACT

Increasing amounts of expanded rapeseed expellers (RSE) were fed to dairy cows in a change over design. The experiment of five diets was carried out in four periods of four weeks with six Friesian cows. Amounts of RSE were 0, 1, 2, 3 or 4 kg/d per day with grain mixture. The total amount of concentrate fed was 10kg/d. Wilted grass silage was fed *ad lib.* Content of ether extracts of RSE was 116 g/kg DM. The effective protein degradability of RSE was low, c. 50 % due to the expanding procedure. Silage intake increased with RSE, 9.7, 9.4, 10.6, 11.1 and 10.9 kg silage dry matter/d on different diets, respectively (linear effect, P=0.006). The highest amount of RSE resulted in some refusals. Milk yield increased with RSE linearly (P<0.005): 27.4, 27.6, 29.3, 31.1 and 29.2 kg milk/d. There were no significant differences in milk fat, protein or lactose contents. Milk fat content was 46.5, 45.2, 49.0, 43.4 and 48.9 g/kg and protein content 31.6, 31.8, 32.3, 33.0 and 31.8 g/kg. Milk urea content increased linearly (P<0.004). The proportion of C16 fatty acid of milk fat decreased with increasing RSE levels (31.8, 30.9, 29.7, 28.2, 28.7 %, linear effect P=0.04). RSE increased the proportions of C18:0 in milk fat (P<0.001): 11.0, 11.8, 11.9, 13.6 and 12.6 %. The increase in C18:1 was not significant, the effect of RSE on C18:1 *trans* and on conjugated C18:2 was negligible. The other higher fatty acids increased only slightly. RSE had a favourable effect on the renneting properties of milk. The K20 value (time required to form a 20 mm wide formagramme) was 8.0, 5.4, 5.0 4.6 and 5.7 min. (linear effect P=0.016). RSE had no effect on the organoleptic properties of milk. Values for milk flavour with increasing RSE were 3.7, 4.1, 3.9, 3.8 and 3.6, respectively.

INTRODUCTION

Rapeseed products are the most important protein concentrates, which are possible to cultivate and produce in Finland. Rapeseed expellers have a higher oil content compared to extracted rapeseed meal. The higher amounts of oil may have an adverse effect on the rumen digestion of fibre and protein content in milk (Murphy *et al.* 1990, Tesfa *et al.* 1992). Unsaturated oil increases the proportion of long chain fatty acids in milk, but also the proportion of *trans* and conjugated acids (Kankare *et al.* 1989). In this experiment the purpose was to examine the effects of the large amounts of expanded oil rich rapeseed expellers on the performance of dairy cows.

EXPERIMENTAL

Materials and methods

In a change over design with five diets, four periods and 6 cows the effect of increasing amounts of rapeseed expellers (RSE) was tested on the performance of dairy cows. The cows were Friesian breed. The length of period was four weeks, performance data are calculated from the last ten days. Milk yield was recorded daily, samples were taken during the last week on four successive milkings. Wilted grass silage was fed *ad lib.*, concentrate was fed at a fixed rate of 10 kg daily. Concentrate consisted of grain mixture (oat-barley) and 0, 1, 2, 3 or 4 kg RSE. Rapeseed expellers used in the experiment were finnish 00-variety of "Kulta", and expanded according to Öpex®-method by Mildola Co.

Feed consumption was measured individually. Feed samples were analysed by standard methods. Protein degradation of the feeds was measured with the nylon bag method using three rumen fistulated cows. The milk composition was determined using a

standard IR-method (Milko Scan 605). Renneting properties of milk were assessed with Foss Electric Formograph. Milk flavour was evaluated by a test panel. The fatty acid content of milk fat was determined using gaschromatography (Antila & Kankare 1983). However, milk samples for fatty acid determinations were only taken for the 3 last periods. Least square means and effect of contrasts were calculated using the GLM-procedure of the SAS statistical program.

Table 1. Composition of the feeds, g/kg DM

	DM, %	Ash	Crude protein	Ether extracts	Crude fibre	NDF	ADF	ME,MJ/ kg DM
Grain mixt.	88	53	116	48	77	249	79	12.6
RSE	91	77	343	116	114	276	162	12.8
Silage	26	79	127	41	263	465	264	10.5

Effective protein degradation of feeds: oats 81.8, barley 83.4, RSE 50.2 and silage 94.1 %. Corrections for N-loss in particles (concentrates) and correction for microbial-N contamination (silage) are included. k_p: 0.02 for silage, 0.03 for grain, 0.04 for RSE.

Results and discussion

The main results are presented in Tables 1-3. The intake of oil in expellers was c. 350 g/d (4.3 % of the concentrate DM) in the highest RSE group (4 kg/d). In this group leftovers of RSE were higher, too. RSE was given on the top of the grain, and even after handmixing of feeds the cows were able to separate RSE from grain. RSE increased silage intake and milk and protein yield. In this experiment the proportion of RSE in concentrate needed for maximum yield was 20-30 %. This is higher than observed with RSM, 12-16 % in concentrate (Tuori 1992). However, the crude protein content of grass silage was quite low, which, with low degradable expellers, may have caused shortage of degradable protein in the rumen of groups 1 and 2. Utilization of ME in milk production was similar on all diets. Despite the fact that RSE increased yield of milk protein, the protein yield per crude protein decreased with increasing RSE.

Table 2. Feed intake and performance of the cows

	Rapeseed expellers, kg						Significance	
	0	1	2	3	4	SE[1)]	linear	quadratic
Intake, kg DM/d								
Grain mixt.	8.80	7.92	7.04	6.16	5.28	0.001		
RSE	0	0.96	1.78	2.59	3.06	0.159		
Silage	9.66	9.35	10.56	11.07	10.89	0.822	0.04	0.77
Total	18.45	18.23	19.38	19.83	19.23	0.766	0.02	0.31
ME, MJ/d	212	211	222	227	220	7.9		
CP, kg/d	2.27	2.46	2.78	3.02	3.06	0.088		
RDP, kg/d	2.01	2.06	2.25	2.36	2.34	0.084		
EE, kg/d	0.82	0.88	0.98	1.05	1.05	0.028		
Milk yield, kg/d	27.4	27.6	29.3	30.1	29.2	1.18	0.005	0.18
ECM, kg/d	29.0	29.0	32.0	30.9	32.1	1.94	0.017	0.61
Protein, g/d	855	871	940	989	927	40.0	0.001	0.03
Milk fat, g/kg	46.5	45.2	49.0	43.4	48.9	5.62	0.73	0.66
Milk prot., g/kg	31.6	31.8	32.3	33.0	31.8	0.94	0.27	0.13
Urea-N,mg/100ml	16.3	17.9	20.2	21.0	24.2	3.50	0.004	0.78
Milk prot./CP	0.38	0.36	0.34	0.33	0.30	0.020	0.0001	0.66
LW change,kg/d	0.12	0.04	0.51	0.44	0.13	0.231	0.26	0.03
Live weight,kg	659	651	658	658	658	7.7		

[1)] standard error of estimate; EE = ether extracts

Table 3. Effect of rapeseed expellers on fatty acid content and some properties of milk

	Rapeseed expellers, kg						Significance	
	0	1	2	3	4	SE[1)]	linear	quadratic
C4-10	12.14	13.25	13.14	13.53	12.08	0.787	0.90	0.05
C12:0	3.86	4.53	4.41	4.56	3.71	0.511	0.79	0.07
C14:0	11.77	12.33	12.27	12.39	11.61	0.807	0.86	0.25
C16:0	31.82	30.93	29.66	28.15	28.72	1.829	0.04	0.57
C16:1	1.52	1.22	1.30	1.10	1.40	0.167	0.28	0.06
C18:0	10.98	11.78	11.90	13.59	12.57	0.356	0.0003	0.05
C18:1	18.78	17.07	18.28	17.64	20.38	2.542	0.45	0.29
C18:2	1.27	1.34	1.46	1.23	1.54	0.262	0.40	0.83
C18:3	0.34	0.38	0.43	0.32	0.42	0.086	0.55	0.91
C20:0	0.26	0.23	0.14	0.42	0.19	0.252	0.90	0.94
C16:1*trans*	0.30	0.32	0.31	0.28	0.31	0.012	0.92	0.81
C18:1*trans*	1.27	1.27	1.34	1.50	1.61	0.436	0.30	0.78
C18:2*trans*	0.30	0.26	0.27	0.25	0.28	0.036	0.47	0.38
C18:2conj.	0.36	0.31	0.33	0.34	0.36	0.159	0.92	0.71
r	10.4	9.1	9.5	9.1	9.7	1.59	0.54	0.31
K20	8.0	5.4	5.0	4.6	5.7	1.27	0.016	0.006
Milk flavour	3.7	4.1	3.9	3.8	3.6	0.37	0.39	0.21

[1)]Standard error of estimate; r = rennet clotting time, K20 = time from addition of rennet until the width of 20 mm is reached. Scale of milk flavour 1-5

The proportion of palmitic acid decreased and that of stearic acid increased significantly (Table 3). Changes were at the same level that Kankare et al. (1989) noticed, when concentrate contained 5 % of added oil. Contrary to Kankare's observations, the increase of C18:1*trans* and conjugated C18:2 was negligible. The renneting properties improved with RSE, especially K_{20}. The effect was however quadratic, and the tinme taken to reach the the of 20 mm wide formagramme was shortest at 3 kg of RSE. RSE had no effect on the flavour of milk.

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REFERENCES

Antila, V. and Kankare, V. (1983). The fatty acid composition of milk lipids. *Milchwissenschaft,* **48**, 478-481.

Kankare, V., Antila, V., Väätäinen, H., Miettinen, H. and Setälä, J. (1989). The effect of calsium salts of fatty acids added to the feed of dairy cows on the fatty acid composition of milk fat. *Finnish Journal of Dairy Science,* **47**, 1-9.

Murphy,J.J., McNeill, G.P., Connolly, J.F. and Gleeson, P. (1990). Effect on cow performance and milk fat composition of including full fat soyabeans and rapeseeds in the concentrate mixture for lactating dairy cows. *Journal of Dairy Research,* **57,** 295-306.

Tesfa, A.T., Tuori, M., Syrjälä-Qvist, L. and Kaustell, K. (1992). Effects of partial replacement of barley with rapeseed oil or birch wood in comparison to barley and oats on the performance and blood metabolites of lactating cows. *Agricultural Science in Finland,* **1**, 255-265.

Tuori, M. (1992). Rapeseed meal as a supplementary protein for dairy cows on grass silage-based diet, with the emphasis on the Nordic AAT-PBV feed protein evaluation system. *Agricultural Science in Finland,* **1**, 367-439.