RAPESEED PRODUCTS AS FEED FOR DAIRY COWS

PRELIMINARY RESULTS FROM A LONGTERM STUDY

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INTRODUCTION

In Sweden rapeseed (Brassica Napus and Brassica Campestris) is the most important crop, that can be used both as a protein- or an energy supplement in concentrates for dairy cows. Unextracted, crushed rapeseed is high in crude fat, contains no starch and would therefore be a valuable source of energy for high producing cows, in early lactation. Rapeseed meal, the remainder when the fat has been extracted, is well balanced for the different amino acids and is also a good feedstuff for dairy cows.

The use of rapeseed products in feed rations has, however been restricted, mainly because of the glucosinolates, compounds that might have a negative effect on animal health and fertility. Double low rapeseed (i.e. with low levels of erucic acid and glucosinolates) was introduced by plant breeders in the early seventies. Since then several short term experiments have been conducted feeding these new varieties of rapeseed meal (LGRM) to dairy cows. Results from some of these studies have been summarized by Thomke (1981). This review, as well as some later short term experiments (Laarveld et al., 1981a; Sanchez and Claypool, 1983; DePeters and Bath, 1985) conclude that up to 3 kg LGRM can be fed per day, without negative effects, neither on milkproduction, nor on the thyroid gland (Laarveld et al., 1981b).

Information about long term effects by feeding rapeseed products, with low levels of glucosinolates is limited. A study was therefore initiated in 1982, at the University's Research Station in Uppsala, with the intention to study the effects on animal performances, fertility and health in general when feeding high levels of rapeseed products during three consecutive lactations. Some results from this study will be presented in this paper.

MATERIAL AND METHODS

The experiment commenced 1982, when 47 primiparous cows were introduced. In the fall of 1983 another 48 1st lactation cows were introduced. All cows were of the Swedish Red and White Breed. They were randomly allotted to one of the three feeding regimes, RR, RS or SS with different types of protein supplements included in the concentrates. The cows remained in the same treatment-group for three consecutive lactation periods.

Both rapeseed meal (RM) and whole (i.e. unextracted) heat treated, crushed rapeseed (WR) were fed. The glucosinolate content has varied between 7-36 μmole/g fatfree meal.

The cows in group RR were fed up to 3 kg per day of rapeseed products, calculated as fatfree meal (i.e. about 2.5 kg RM and 1.0 kg WR) and in group RS they were fed a maximum amount of 1.5 kg rapeseed products. These maximum levels were fed at a milk production of about 30 kg 4% fat corrected milk (FCM). The cows in group SS did not receive any rapeseed at all. The rapeseed meal was primarily replaced by soybean meal, and the rapeseed fat replaced by animal-, cottonseed- and coconut fat.

The cows were fed a constant amount of concentrates during lactation weeks 4-13, depending on their individual milk yield during the first 3 weeks. Thereafter they were fed according to milk production (Swedish standard, Eriksson et al., 1976).

All cows were fed equal amounts of grass silage, 6.5-7.5 kg dry matter and 1.5-2.5 kg of grass hay. The three diets were kept isonitrogenous and isocaloric. The crude fat content in the total ration increased with increasing milk production. At a milk production of e.g. 35 kg FCM, the total ration contained about 4.5% crude fat (ether extract).

Feed samples were analysed for content of estrogenic substances and fatty acids, besides all common nutritional analyses.

Milk samples were tested weekly for fat, protein and solids and 5 times/lactation for iodine, thiocyanate, urea, fatty acids and taste.

The reproductive status of each cow was monitored by clinical gynaecological examinations once a week from calving until first artificial insemination (AI). Simultaneously whole milk samples were collected for analysis of progesterone (RIA-kit, Farmos, Turku, Finland). During the first 10 weeks of lactation weekly milk samples were analysed for ketone bodies by the FIA-method (Marstorp et al., 1983).

Heat signs were recorded three times daily by the heardsmen.

TRH-tests (Thyroid Releasing Hormone) for the assessment of thyroid function were performed at approximately 90 and 300 days after calving during each lactation (Laarveld et al., 1981b).

RESULTS AND DISCUSSION

For the primiparous cows, no significant differences in feed consumtion what so ever has been found (Table 1). This seems to be true also for the cows in their 2nd and 3rd lactation, although these data have not yet been statistically analysed. These results show that inclusion of double low rapeseed products in the grain mixture does not negatively affect the palatability of the mixture.

Table 1. Daily feed intake and intake related to kg FCM for the different dietary groups. Standard error of means within parenthesis

	Dietary group		
	SS	RS	RR
Dry matter, kg /day	15.2(0.18)	15.2(0.18)	15.3(0.18)
Concentrate, kg DM/day	7.2(0.17)	7.2(0.16)	7.2(0.16)
Metabolisable energy, MJ/day	179 (2.3)	180 (2.3)	180 (2.4)
Digestible crude protein, g/day	1892(29.1)	1894(26.2)	1907(28.9)
Crude fat, kg/day	0.74(0.014)	0.76(0.013)	0.76(0.014)
Digestible crude protein, g/kg FCM[1]	68.8(0.83)	68.7(0.70)	69.0(0.70)
MJ/kg FCM[1]	5.3(0.048)	5.3(0.040)	5.4(0.042)

[1] above maintenance, corrected for changes in weight and predicted foetal growth

There were no statistically significant differences, for primiparous cows, neither in the initial weight nor in the changes in live weight, during any of the different stages of lactation. At about 12 weeks after calving they had all gained what they had lost during the first part of the lactation.

Preliminary comparisons of total disease incidence, showed no differences between the three groups.

Table 2. Milk production and composition, during the first 44 weeks of lactation (Least square means) for all primiparous cows that have fullfilled a whole lactation

Diet	Milk yield, kg	4% FCM, kg	butter-fat, kg	protein, kg	butter-fat, %	protein, %
SS	5671	6144	258	181	4.58	3.22
RS	6051	6591	278	196	4.60	3.26
RR	5875	6386	269	195	4.61	3.35

For the first lactation cows diet had no significant effect ($p>0.05$), neither on total milk production nor on kg FCM, although it tended to be higher when rapeseed was fed. Fat yield and milk fat percentages were not affected by diet, but the protein content was significantly higher ($p<0.05$) in the RR-group compared to the SS-group. When expressed as kg protein, the two "rapeseed groups" both differed ($p<0.1$) from the SS-group (Table 2). These tendencies towards a higher milk production when rapeseed is included in the diet continued the two following lactations (Table 3). The results related to milk quality aspects are further reported, Barrefors et al. (1987).

Table 3. Milk production (arithmetic mean values) during the first 44 weeks of the lactation, for second- and third-calvers. Standard error of means within parenthesis

Diet	Milk yield, kg	4% FCM, kg	butter-fat, kg	protein, kg
2nd calvers				
SS	6290(234)	6840(260)	288(11.2)	204(7.3)
RS	6780(197)	7400(235)	312(10.6)	222(6.7)
RR	6890(211)	7480(216)	315(9.3)	228(6.3)
3rd calvers				
SS	7250(249)	7880(297)	332(13.6)	238(8.1)
RS	7640(251)	8310(297)	350(13.6)	252(8.3)
RR	7420(229)	8030(252)	337(10.9)	248(7.4)

The interval from calving to conception (CC-interval) was significantly (Student's t-test, $p<0.05$) longer for the RR-group compared to the SS-group, among the primiparous animals (Table 4). There is also a tendency (though not statistically significant) towards an increasing number of AI per pregnancy and a longer calving interval with increasing amounts of rapeseed in the ration. Among the 2nd calvers the only measure that indicates a similar trend is the calving interval. For the 3rd calvers, the number of AI per pregnancy seems to be higher for the two groups fed rapeseed. At this stage however, the numbers of animals are small and this measure should be regarded with cautiosness.

The release of thyroid stimulating hormone (TSH) after stimulation with thyroid releasing hormone (TRH) is significantly greater (Student's t-test, $p<0.05$) for the RR-group compared to the SS-group among both the 1st- and 2nd-calvers. The release of TSH for the RS-group was at the same level as for the RR-group, but the standard deviation was higher. The observed changes in thyroid function, when high as well as low levels of rapeseed were fed, were also related to increased levels of thiocyanate in the milk. The increase in the thiocyanate level was of the same magnitude in both the RR-group and the RS-group.

Table 4. Fertility data, arithmetic means per group. Standard error of means within parenthesis

Diet	Days from calving to conception	No of AI per conception	Calving interval (days)	No of cows: With at least one AI	No of cows: Conceived
1st calvers					
SS	96.2(7.3)	1.89	377(8.2)	29	28
RS	98.5(7.4)	1.89	379(8.0)	29	27
RR	115.0(7.7)	2.39	398(8.1)	27	26
2nd calvers					
SS	111.3(9.7)	2.17	384(9.2)	25	24
RS	108.4(8.5)	2.23	390(8.6)	25	23
RR	112.4(8.7)	2.00	397(8.8)	24	22
3rd calvers					
SS	101.1(8.6)	1.55	-	19	18
RS	113.1(10.2)	2.32	-	21	19
RR	100.7(9.0)	2.06	-	20	17

It is still too early to draw any definite conclusions from this experiment. However, the risks with feeding high levels of rapeseed products from double low varities seem to be small. Tendencies towards some disturbances on the fertility exist, but are not consistent, since it seems like only the primiparous cows were affected. Still, the thyroid function was affected to about the same degree, in the first two lactations, when rapeseed was included. The responses of the different fertility parameters also differ between years. There are, however, some indications that this could partly be explained by some sort of interferences with periods of bad quality of the silages.

It is surprising that the thyroid functions were affected by these low levels of glucosinolates that were actually fed, especially since all the rapeseed was heat treated. This result does, however, support what has been found, or indicated in other studies, that there are microbial species inhabiting the gastrointestinal tract that are degrading the intact glucosinolates during the passage through the tract (e.g. Lo & Hill, 1972; Bille et al., 1982; Eyre & Smithard, 1983)). This is an area that really needs to be further investigated.

Effects of different fat sources, heat treated or not, on rumen metabolism and digestibility have been studied more closely in an other experiment at the department of Animal Nutrition and management. The results have not yet been statistically analysed and interpreted.

However, it can be concluded that there were no major differences in how the triglycerides were hydrolysed in the rumen between heat treated and untreated rapeseed. Nor were there any differences in apparent digestibility, VFA-production or rumen pH. In these respects there should be no major advantage to heat treat the fullfat rapeseed before feeding it to dairy cows and the farmer would be able to use his own rapeseed produced on the farm.

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