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THE EFFECT OF RAPESEED MEAL ON THE THYROID GLAND IN CATTLE *

K. Iwarsson and L. Ekman

Rapeseed meal (RSM) constitutes an important domestic protein source for cattle in Sweden. In 1971-1972 the total consumption of RSM for livestock was about 85,000 tons of which about 75,000 tons were used in rations for cattle (ROBERTSSON, 1972). Swedish RSM originates mainly from winter rape (Brassica napus L.), but at present the seed meal of rape and turnip rape (Brassica campestris L.) are not differentiated in the Swedish trade.

In order to evaluate the biological and economic effects of increased amounts of Swedish RSM in rations for cattle, in 1969 long-term experiments with growing bulls (baby-beef) and dairy cows were initiated in Sweden. The aspects of these experiments related to production have been or will be reported separately (GUDMUNDSSON and EVERITT, 1971; LINDELL and KNUTSSON, 1974). Studies on the effect of feeding RSM on the health of the animals as revealed by certain hematological, clinical chemical and morphological parameters have been reported by IWARSSON et al. (1973) and IWARSSON (1973). Contrary to earlier reports on the effect of feeding RSM to cattle, a marked goitrogenicity of RSM was demonstrated in growing bulls (IWARSSON et al., 1973). Furthermore, experiments with dairy cows revealed a depressant effect of RSM on the secretion of iodine in milk (IWARSSON, 1973). In general RSM-fed cows yielded milk with lower total iodine and higher thiocyanate ion (SCN^-) concentration than control cows. The observations of a marked thyroid hypertrophy in growing bulls and a depressant effect on the secretion of iodine in milk in dairy cows after feeding concentrate mixtures containing RSM were confirmed in recently finished long-term feeding experiments. The present article summarizes our studies on the effect of RSM on the thyroid gland and iodine metabolism in cattle.

Material and methods

The feeding experiments were organized by the Swedish Farmers' Purchasing and Selling Association (Experiment I) and the Department of Animal Husbandry, Agricultural College of Sweden (Experiments II-IV) with the intention to compare Swedish RSM and soybean meal (SBM) as protein supplements for cattle.

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Growing bulls:

Experiment I consisted of a total of 95 bulls of the Swedish Friesian Breed (SLB) and the Swedish Red and White Breed (SRB) which from an age of about six months up to slaughter at about 12 months of age had free access to concentrate mixture (Table 1), hay and water. The RSM-group (47 animals) was fed 15 % commercially available Swedish RSM as protein supplement in the concentrate mixture while the control group (48 animals) received 10 % SBM instead of RSM.

Experiment II used 14 intensively fed growing SRB bulls, which received a concentrate mixture (Table 1) containing 10 % Swedish RSM of solely Brassica napus-type and 15 bulls a concentrate mixture containing 7 % SBM (controls). The rations contained no iodine supplementation.

Before slaughter blood samples were taken from all animals for determination of the serum levels of protein-bound iodine (PBI) and total cholesterol as well as the erythrocyte uptake in vitro of $Na^{131}I$-labelled L-3,5,3'-triiodothyronine (EU). Immediately after slaughter the thyroid glands were weighed and specimens for histological examination obtained. The morphological evaluation of the thyroid glands was performed identically to that of NYBERG (1970) and the same definitions were used. The term goitre was used in this study for glands which were manifestly enlarged, i.e. glands with an absolute thyroid weight above the mean weight plus two standard deviations of histologically normal glands in the control groups. According to this classification the goitre limit was 27.0 g in Experiment I and 27.1 g in Experiment II.

Dairy cows:

Three groups of 10 SLB cows in each were fed hay, sugar beet tops silage, minerals, iodized salt and concentrates (Table 1) according to milk yield for two lactations (Experiment III). The concentrate ration contained 0, 4.2 or 8.05 % commercially available Swedish RSM, while soybean meal (SBM) replaced RSM completely in the oilcake mixture of the concentrates in the control group and partially in the 4 % RSM group. In all groups the iodine intake was calculated to be 2 - 4 mg per cow and day.

In Experiment IV two groups of 12 SLB cows each received concentrates (Table 1) containing 0 (SBM) and 10 % RSM, respectively, for two lactations. The cows received about 10 mg supplemental iodine per day via iodized minerals included in the rations.

In both experiments individual milk samples for determination of the total iodine and SCN^- concentrations were collected once a month and in addition blood samples for chemical analyses were taken every fourth month.

Table 1: Percentage composition of the concentrate mixtures used in feeding experiments with growing bulls and dairy cows

Growing Bulls:

Ingredients	Experiment I		Experiment II	
	SBM (controls)	15 % RSM	SBM (controls)	10 % RSM
oats (rolled)	73.0	36.5	41.5	40.0
barley (rolled)	5.0	36.5	41.5	40.0
dried beet pulp	10.0	10.0	10.0	10.0
soybean meal	10.0	-	7.0	-
rapeseed meal	-	15.0 a)	-	10.0 b)
minerals	0.7	0.7	- c)	- c)
fodder lime	0.7	0.7	- c)	- c)
iodized salt d)	0.4	0.4	-	-
vitamin concentrate	0.2	0.2	- c)	- c)

Dairy Cows:

Ingredients	Experiment III			Experiment IV	
	SBM (controls)	4 % RSM	8 % RSM	SBM (controls)	10 % RSM
oats (rolled)	30.00	29.50	28.50	31.00	30.00
barley (rolled)	30.00	29.50	28.50	31.00	30.00
cottonseed cake	8.00	8.40	9.20	5.40	6.00
peanut expeller	5.00	5.25	5.75	3.60	4.00
rapeseed meal e)	-	4.20	8.05	-	10.00
soybean meal	7.00	3.15	-	9.00	-
dried beet pulp	20.00	20.00	20.00	20.00	20.00

a) Commercially available Swedish rapeseed meal.
b) Seed meal of Brassica napus, winter type (Sinus). A randomly selected sample contained 3.5 mg isothyocyanates and 10.5 mg oxazolidinethiones per g dry matter of the meal.
c) Minerals, fodder lime and vitamin concentrate added separately.
d) Iodine content: 50 mg KI/kg.
e) Commercially available Swedish rapeseed meal containing on an average (Exp. III) 4.1 mg isothiocyanates and 9.7 mg oxazolidinethiones per g dry matter of the meal.

Results and Discussion

Experiments with growing bulls

Concentrate mixtures containing 15 % commercially available Swedish RSM (Experiment I) and 10 % RSM solely of Brassica napus-type (Experiment II) when fed ad libitum to growing bulls for about six months, resulted in incidences of goitre of 93 % and 85 %, respectively, as compared to the control groups fed concentrates based on SBM. RSM-fed bulls showed mean absolute thyroid weights of about twice that in the control groups (Fig. 1, Table 2). Complete results of the morphological evaluation of the thyroid glands are given in Table 3. As judged from the chemical analyses of blood (Table 4) RSM-fed bulls were euthyroid, indicating adequate compensatory growth of the thyroid glands. The question remains as to whether

Figure 1: Frequency diagrams and mean values of absolute thyroid weights in SLB and SRB bulls of the control (SBM) and rapeseed meal groups in Experiment I (15 % RSM) and II (10 % RSM)

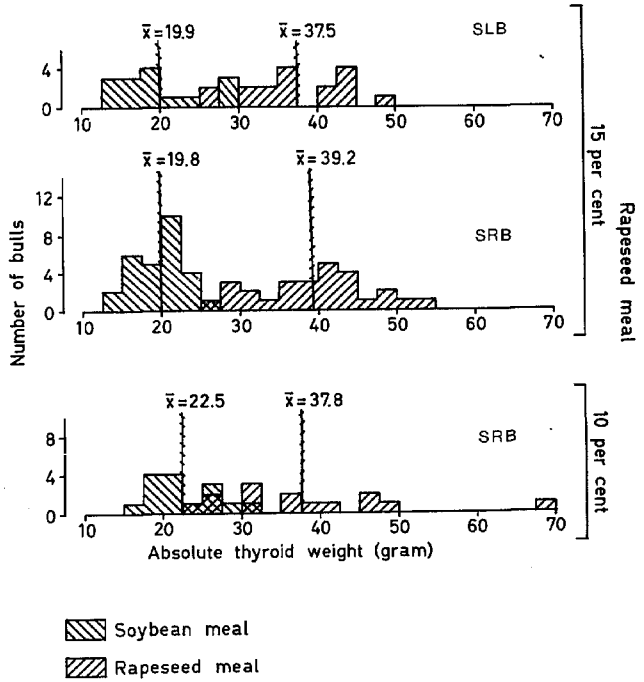

Table 2: Absolute thyroid weights (g) for SLB and SRB bulls fed concentrate mixtures containing soybean meal (controls) and rapeseed meal respectively. The number of bulls, mean values, standard deviation and ranges are given for each group

Experiment no.	I (15 % rapeseed meal)				II (10 % rapeseed meal)	
Group	Soybean meal		Rapeseed meal		Soybean meal	Rapeseed meal
Breed	SLB	SRB	SLB	SRB	SRB	SRB
n	15	28	17	27	15	14
m.	19.9	19.8	37.5	39.2	22.5	37.8
s	5.5	3.2	6.6	7.6	4.3	11.9
range	14.6-29.1	13.0-25.9	26.0-48.7	25.8-56.9	16.8-31.7	23.7-68.9

Table 3: Absolute und relative frequency of morphologically normal and abnormal thyroid glands of growing bulls in Experiments I and II. The classification is made according to the histological picture as well as to the weight of the glands.

Group	Breed	Thyroid Morphology																	
		Normal		Interfollicular Adenomatosis						Intrafollicular proliferation				Goitre					
				mild		moderate		marked		papillary		papillomatous solidification		colloid		parenchymatous		colloid and parenchymatous	
		no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
Experiment I:																			
SBM	SLB + SRB	8	18.6	5	11.6	19	44.2	5	11.6	2	4.7	1	2.3			1	2.3	2	4.7
RSM	SLB + SRB	1	2.3	1	2.3	1	2.3							16	36.4	1	2.3	24	54.7
Experiment II:																			
SBM	SRB	11	73.3			2	13.3							2	13.3				
RSM	SRB	1	7.7			1	7.7							11	84.6				

Table 4: The concentration of protein-bound iodine (PBI) and total cholesterol in blood serum and the erythrocyte uptake in vitro of 131-I labelled L-3,5,3'-triiodothyronine (EU) in growing bulls and dairy cows. All blood samples were taken in the latter part of the experiments i.e. after about 6 months (bulls) and two years (cows) experimental feeding respectively. The number of animals, mean values and standard deviations are given.

Growing Bulls:

Experiment no.		I				II	
Group		SBM		15 % RSM		SBM	10 % RSM
Breed		SLB n=5	SRB n=11	SLB n=4	SRB n=11	SRB n=15	SRB n=14
PBI	m.	5.2	5.5	4.9	5.7	5.7	5.8
µg/100 ml	s	0.8	0.8	0.4	0.9	0.7	0.5
Total cholesterol	m.	85	83	101	88	79	87
mg/100 ml	s	12	15	24	19	13	19
EU	m.	7.1	7.4	7.5	7.4		
%	s	0.8	0.8	0.4	0.9		

Dairy Cows:

Experiment no.		III			IV	
Group		SBM n=9	4%RSM n=8	8%RSM n=10	SBM n=9	10 %RSM n=11
PBI	m.	3.8	3.7	3.6	4.3	4.3
µg/100 ml	s	0.5	0.4	0.4	0.5	0.3
Total cholesterol	m.	130	131	128	154	142
mg/100 ml	s	30	22	23	25	35
EU	m.	8.5	8.5	8.8	6.7	6.1
%	s	1.0	0.8	1.0	1.3	1.2

a hypothyroid condition would appear during longer periods of feeding. The general condition of the animals during the experiments appeared to be normal. From the point of view of beef production similar or even superior results were obtained for animals fed RSM in comparison to controls. The occurrence of goitre in RSM-fed bulls is interpreted as being due to glucosinolate split products with a thiouracil-like effect on the thyroid gland. No such effect of RSM has been reported before. A relative iodine deficiency caused by glucosinolate split products of SCN^- type can not be excluded as a contributory factor to the occurrence of goitres.

In experiments in progress with growing bulls fed concentrates containing 12 % Swedish RSM of Brassica napus-type, about 20 times higher SCN^- concentration was found in blood serum in comparison to controls receiving concentrates based on SBM (cf. Table 5). In this experiment the bulls receive an increased iodine supplementation (6 - 10 mg per animal and day) in comparison to Experiments I and II in order to counteract the effect of SCN^- on the iodine metabolism.

Table 5: The SCN^- concentration (Bowler's method) in blood serum of cattle fed concentrate mixtures containing different levels of rapeseed meal (RSM)

Animals	Per cent RSM in concentrate mixture	Number of animals	SCN^- concentration (mg/l)	
			Mean value *	Range
Dairy cows	0 (SBM)	9	0.5 (0.1)	0.4- 0.9
	4	9	2.0 (0.6)	0.9- 3.4
	8	10	2.7 (0.8)	1.2- 4.4
	10	9	5.7 (2.0)	4.5- 8.2
Growing bulls	0 (SBM)	13	0.3	0.1- 0.9
	12	13	6.5	4.4-11.2

* Values within brackets denote mean values for SCN^- in milk

Experiments with dairy cows

No clinico-chemical signs of a functional disturbance of the thyroid gland were noted in dairy cows fed concentrates containing up to 10 % RSM during two lactations. This was in accordance with the results obtained in experiments with growing bulls. The results of chemical analysis of blood (Table 4) revealed no statistically significant differences between groups and were within the normal range at all samplings. The general condition of the cows appeared to be normal and no illness due to the experimental conditions was recorded. It has to be pointed out however, that the present study did not include evaluation of the fertility status of the cows.

RSM-fed cows generally yielded milk with lower total iodine and higher SCN^- concentrations in comparison to the control groups. The SCN^- concentration (cf. Table 5) was considered to reflect the content of SCN^- or SCN^- yielding substances in the RSM used. The lowered iodine concentration in milk was interpreted as secondary to the increased intake of SCN^-. The occurrence of substances metabolized to SCN^- in connection to feeding RSM is further illustrated by the levels of SCN^- in blood serum of RSM-fed animals (Table 5).

The increased iodine supplementation during Experiment IV led to a general increase of the iodine levels in milk but at all samplings during the two experimental lactations of Experiment IV the 10 % RSM group showed an iodine concentration in milk about half that noted for the control group. To counteract the action of SCN^- or other goitrogens in cows fed high levels of RSM, iodine supplementation seems desirable for the animals' health and from the milk consumers' point of view.

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