IMPROVEMENTS IN MILK TASTE OBTAINED WITH RAPE SEED PRODUCTS

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The most frequent taste defects of milk are oxidized, rancid and unclean flavours. The acceptability of oxidized flavour is low, while rancidity, and in particular so called unclean flavours to a greater extent are identified with the flavour of milk. Rancidity is noted together with fat lipolysis in milk. Lipolytic enzyme level is high in milk, and the activity is affected by activation either through agitation or temperature changes. Screening of milk producers samples of milk shows presently 1-2% descrete rancid milk deliveries, and it is the most frequent of the defects. The oxidized flavour defect has varied, beeing at its peak in the late fifties in Norway. It was found that feeding rapeseeds and meal improved degree and frequency of this taste defect of the milk.

<u>The effect of feeding rape seeds and meal upon oxidized flavour of milk</u>. Rapeseeds and rape seed meal was compared with linseed and soybeans in experiments with milk cows (Meldinger fra Norges landbrukshøgskole <u>45</u>, No 7, 1966). The two first experiments both had a latin square switch over design, while the third experiment was a group trial. The coarse feed was supplied as 4 kg hay and 16 kg alkali digested straw, and covered the maintenance requirement of energy. Barley was used to balance requirement of energy for production. The feeding of oil seeds and meal is given in Table 1.

Table 1. Experimental treatment in feeding milk cows rape seeds and meal

Exp. No.	I	II	III
No of animals	12	12	12
Length of period, wks.	2	3	6
Soybeans, kg	2.5	2.5	2.5
Rapeseed + meal, kg	1.2+1.8	1.0+0.0	1.0+1.0
Rapeseed meal, kg		2.9	
Linseed, kg	1.0		1.5

The rations were balanced between groups also to give equal supply of protein, carbohydrates and fat. Animals were past mid lactation yielding between 15 and 20 kg milk. Milk was judged by 4 judges, 3 students and an expert judge, on randomized samples stored 48 hrs at 4°C. A scale from 0 (without defect) till 6 was used. The results of expert judge scorings are seen in Table 2.

Table 2. Effect of feeding rape seeds and meal to milk cows upon the oxidized flavour in milk

Exp. No.	I	II	III
Soybeans	2.30	3.21	2.09
Rape seed + meal	1.13[a]	1.42[a]	1.15[a]
Rape meal		1.54[a]	
Linseed	3.92[a]		2.82[a]

a) Score significant different ($P < 0.01$) from control.

Rape seed or rape meal feeding, both gave less oxidized flavour in milk than when feeding either linseeds or soybeans. The mechanism by which rape seed products brought about this improvement is not quite clear. Changes in milk composition was multiple. There was a tendency toward lower polyenoic acid content and lower TBA aldehyde values in butter oil. Buttermilk contained less Cu and more membrane proteins. Milk contained more vitamin A and E and xanthine oxidase. Milk also had a higher pH. Any of these changes when feeding rape products are likely to improve milk oxidation stability. It was suggested that the resulting polyenoic acid content of the milk would be the most important single change.

The multiple changes resulting with rape seed feeding were also seen in correlation studies of milk from the University district (Meldinger fra Norges landbrukshøgskole 45, No 8, 1966). Such changes were seen from early to late lactation, from younger to older cows or in cows with and without administration of thyroxine (Meldinger fra Norges landbrukshøgskole, 45, No 22, 1966).

Thyroxine to cows had been found to increase oxidized flavour in milk (Nature 198, 192-193, 1963). It is possible that the goitrogen properties of rape seed in part was responsible for the improvement in taste, and the changes in milk composition. Other rape seed components, however, may have contributed to the regulation and brought about milk resistency to oxidized flavour.

Rancid flavour in milk when feeding rape seed products. Milks produced on good summer feeds are low in both rancid and oxidized flavour. Rancid flavour and oxidized flavour are seldom present together. Oxidized flavour occurs early in lactation and the rancid flavour often appears in late lactation. Oxidized flavour increased when protected vegetable oils were fed, while rancidity was reduced in the same milk (Milchwiss. 34, 290-291, 1979). Feeding protected low level erucic acid rape seed oil, however, was able to improve rancidity of milk, without increasing oxidized flavour (J. Dairy Res. 47, 287-294, 1979).

Improvement of rancid flavour in milk, with protected rape seed oil in the feed. Feeding protected low erucic rape seed oil to cows in negative energy balance acted against rancidity brought about by under-feeding. The 24 cows were assigned to 8 blocks, based on yields of a 4 week preliminary period. Concentrates were adjusted each week to retain energy differences. The experimental period lasted 7 weeks and all animals were in the middle of their lactation period. The 3 groups were given the treatments:

A. Control ration i.e. energy allowances according to Norw. standards.

B. Underfeeding i.e. 2 feed units for fattening (FFU) below control or standard/d.

C. Underfeeding i.e. 3.5 FFU below control level + 440 g protected rape seed oil/d.

Results are seen in Table 3.

Table 3. Effect of feeding protected rapeseed oil to underfed cows upon milk rancidity through 7 weeks

Groups	A	B	C
mM FFA in milk	1.0	1.6	1.1
rancid flavour score	1.4	2.4	1.9

Lipolysis increased from 1.0 to 1.6 mM FFA, and rancid flavour scores from 1.4 to 2.4 in underfed group (B). Lipolysis and rancid flavour scores were reduced from 1.6 to 1.1 and from 2.4 to 1.9, respectively, when protected rape seed oil was fed (C). The effect of rape seed oil may have substituted the lipoprotein lipase in compensating the low energy supply.

Rape seed and rancid flavour. A 7 week experiment with rape seed to 8 cows compared with 8 cows in control did not show any effect of rape seeds on rancidity in milk. The animals were given 20% crushed rapeseeds in the concentrate. Control group was fed soybean meal as only protein. 20% barley was given to compensate energy of fat. Results showed average content of free fatty acids to be 0.90 mM in control and 0.78 mM in rapeseed meal group. Also flavour scores came out equal. The seeds were Swedish grown with little erucic acids but normal content of glycosinolates.

Rape seed meal and rancid flavour. Normal Swedish glucosinolate containing meal and Canadian low level glucosinolate meal (Canola) was compared with soybean meal with 8 cows in the groups. The rapeseed groups got 2.6 kg meal, the control 2.0 kg soybean meal. Barley was used to cover energy requirement for production. The cows yielded 21 kg milk at start. Roughage and maintenance requirement was covered by 3 FFU grass silage and 1 FFU ammoniated barley straw. The experimental feeding lasted 6 weeks with 4 weeks for and after periods. Milk was scored and analyzed by an expert judge, as previously.

Table 4. Average differences in flavour scores, free fatty acids and fat corrected milk between experimental and control periods of the groups

	Soybean meal	Swedish meal	Canadian meal
Unclean, score	-0.18	0.08	0.27
Rancid, score	-0.64	-0.79	-0.69
mM FFA	-0.01	0.03	-0.03
FCM, kg	-0.21	-0.04	0.12

Except for the lowered rancid taste score for all groups, there were no statistical significant differences. The response of the meals were equal between the groups.

<u>Rancidity of milk in thyroxine treatment</u>. Twice a day 100 mg of thyroxine put on the concentrates for 5 days caused a spontaneous reduction in rancid flavour in milk. The effect was still present the week after the supplement. This effect was highly significant for rancid flavour score, content of free fatty acids and FCM.

The results are indirect indications, only, of increased rancidity when feeding goitrogenic supplements.

Table 5. The effect of thyroxine upon milk FCM, FFA and taste

	kg FCM	mM FFA	Flavour scores		
Week			Rancid	Unclean	Oxidized
1	18.9	1.28	1.32	1.07	0
2	18.1	1.46	1.53	1.23	0
3 Thyroxine	21.2	0.76	0.54	1.08	0.30
4	19.1	1.26	0.80	1.17	0.14
5	16.8	1.50	2.29	1.30	0
6	16.1	1.44	1.36	1.53	0

<u>Unclean and unspecified tastes in milk in rapeseed feeding</u>. The exact nature of unclean taste is not known and is usually graded together with unspecified offtaste of milk. In one of the early experiments with thyroxine (Meldinger fra Norges landbrukshøgskole, <u>45</u>, No 22, 1966). Rape seed feeding (1.25 kg) when tested against linseed and linseed + thyroxine produced a small but significant increase in unclean taste.

Table 6. The effect of rape seed upon unclean taste

	Control	Thyroxine	Rape seed
Oxidized flavour score	1.75	2.58	1.25
Unclean flavour score	0.58	0.33	1.33

An unspecified off flavour was obtained by Orth and Kaufmann (Kiel Milchwirt. Forsch. Ber. 16, 245-250, 1964) when feeding mustard oil. An off flavour on milk was reported with double low (Erglu) meal by Just (NJF seminar, Göteborg 1980, Proc. 69-82).

Conclusion. Rape seed protects against oxidized flavour in milk. Protected rape seed oil acted against rancid flavour in milk.

Experiments with rape seeds and with rape seed meal did not produce significant increase in rancid flavour. Unclean taste was noted in one experiment with rape seed feeding, and not in others. Unclean taste and unspecified off flavours with rape seed feeding may occur, but is obviously not persistant, not easily detectable, and thus of less significance, particularly in situations where rape seeds is used against oxidized flavour.

ZINC AVAILABILITY IN UNHEATED AND HEATED SEEDS OF BRASSICA JUNCEA CV RLM 198

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INTRODUCTION

Temperature is a key-factor in the processing of Brassica oil seeds. During recovery of oil, seeds are submitted to increasing temperatures varying considerably in magnitude and duration depending on the proceedure applied (1,2,3). In a small scale village process the increase in temperature is moderate and may last for some hours. In larger processing units the temperature may approach 100°C and the duration in time may differ from minutes up to hours. The amount of water present during the temperature increase will also vary considerably in different processes.

Temperature, time and amount of water have a great impact on the quality of the seed products in terms of toxicity, availability of nutrients and acceptance in food and feed Antinutritional factors of Brassica seeds have been identified as hydrolysis products derived from glucosinolates. Furthermore phytic acid and other substances interfere with trace mineral availability. The biological activity of these seed factors is very much dependent on processing conditions and will impaire the utilization of energy and nutrients in growing and pregnant animals (4,5,6). The acceptance in foods and feeds is generally reduced by hydrolysis products from glucosinolates. However, for a particular group of Indian consumer of mustard and rapeseed oil, some of the toxic principals, so far not identified will enhence the acceptance of the oil. The significance of this toxicity for the Indian consumer is at present unknown.

Elevated temperatures in the presence of water is commonly reducing the dietary availability of zinc in Brassica napus and campestris (6,7,8,9). In any attempt to improve a process for the recovery of Brassica seed nutrients for food and feed utilization temperature, time and water are parameters of vital importance.

Recently Indian mustard Brassica juncea cv RLM 198, high in glucosinolates, has been demonstrated to possess unique properties with respect to availability of dietary zinc even at elevated temperatures (8). In order to separate different seed constituents and biologically identify those determining the availability of trace minerals, toxicity has to be controled within certain limits to permit succesful feeding trials. The present study was undertaken to find temperature, time and water conditions for minimum influence on bioavailability of seed zinc.

MATERIAL AND METHODS

Preparation of seed meals: Seeds of Indian mustard Brassica juncea cv RLM 198 were lyophilized and grind twice in a roller mill at 20°C (Fig.1). The seed meal was deoiled in hexane at 20°C as described before (6) and stored at -20°C. Three batches of the deoiled meal were heated in deionized water at 90°C for 2, 4 and 8 minutes respectively. Meal to water ratio was 1:20. Meal and water mixture was cooled by adding ice and then frozen and lyophilized.

Chemical analysis: Zinc in meal and serum was analyzed by atomic absorption spectroscopy after wet ashing in perchloric acid and hydrogen peroxide (1:2).

Bioassay: Weanling male rats of the Sprague-Dawley strain from a commercial breedar (Anticimex, Sollentuna, Sweden) were housed in polypropylene cages with an open-grill stainless steel floor. Lighting, humidity and temperature were controled. Deionized water and food were given ad libitum for 7 days. Diets were formulated to contain 1.5, 3.0, 4.5, 6.0 and 9.0 ppm of zinc from seed meal or $ZnSO_4 \cdot 7H_2O$. Adequate amounts of other nutrients were incorporated in the diets as described elsewhere (10). Blood was obtained from the tail and linear correlation was calculated between serum zinc and dietary zinc. Percent available zinc was obtained from the ratio between slope of sample and slope of pure zinc sulphate.

Statistical analysis: Statistical evaluation of the slope-ratio assay was performed as described elsewhere (10).