Oilseeds as a Perspective in the Nutrition on Dairy Farm

Agnes Suli[1], Bela Beri[2], János Csapo[3], Elizabet Berecz[1]

[1]*University of Szeged, Faculty of Agriculture, H-6800 Hódmezővásárhely, Andrássy út 15. Hungary*
[2]*University of Debrecen, Faculty of Agriculture and Food Sciences and Environmental Management H-4032 Debrecen, Böszörményi út 138.*
[3]*University of Debrecen, Faculty of Agriculture and Food Sciences and Environmental Management H-4032 Debrecen, Böszörményi út 138.*
[3]*SAPIENTIA Hungarian University of Transylvania Faculty of Miercurea Ciuc RO 4100 Miercurea Ciuc, Piata Libertății, Romania*

Abstract
In the last decades many researches were made to change the milk product food's composition. The production of better fat-compound milk and dairy products became a goal in the name of health conscious nutrition. Our researches were motivated by non-adequate milk fat's compound. With the optimal supplement of the feed can be increased the proportion of the polyunsaturated fatty acids and can decreased the unsaturated fatty acids. The object of our experiment to study the effect of natural-based feed additives, such as oilseeds (whole linseed, extruded linseed, whole rapeseed) on the fatty acid composition of milk fat. Further information was gained about of oilseeds in specific amounts to be fitted into technology of an intensive dairy farm in practice. The feed supplements were whole, untreated rapeseed and linseed and cold extruded linseed as a part of total mixed ration. The level of the processing of feed supplements affected the fatty acid composition of milk fat. The effect of full fat linseed feed supplement was more significant than that of the cold extruded linseed, in the increase of the polyunsaturated fatty acids, with special regard to the increase of the α-linolenic acid proportion. Out of the full fat oilseeds the feeding of full fat rapeseed did not result in a considerable change in the fatty acid composition of milk fat. After applying full fat linseed as feed supplement, the proportion of α-linolenic acid, a conjugated linoleic acid, an eicosadienoic acid and a docosapentaenoic acid increased in the fatty acid composition of milk fat, while the concentration of many saturated fatty acids reduced.

Keywords: cold extruded linseed, holstein-friesian dairy farm, milk fatty acids, whole linseed, whole rapeseed

1. Introduction

In the last decades many researches were made to change the animal product food's composition. The production of better fat-compound milk and dairy products became a goal in the name of health conscious nutrition.
Dairy products suffer from a negative health image related to the nature of their lipid fraction, because of the predominant fatty acids in milk are the short-, and medium–chain saturated fatty acids (mainly 12:0, 14:0 and 16:0). Moreover milk fat, due to its relatively high proportion of saturated fatty acid has been associated with human cardiovascular health problems [1]. The positive influence of polyunsaturated fatty acids on cardiovascular diseases suggests it would be of benefit to increase such fatty acid in milk [2].
Diets of dairy cows containing full fat oilseeds or by-product of oilseeds can increased the proportion of the polyunsaturated fatty acids and can decreased the saturated fatty acids of milk fat. Cold extruded linseed, full fat linseed

* Corresponding author: Agnes Suli
Tel: +36706043922, E-mail: suli@mgk.u-szeged.hu

and full fat rapeseed are rich in polyunsaturated fatty acids, especially 18:3n3 and 18:1, but it is not commonly supplement on intensive dairy farms in Hungary. Feeding full fat oilseeds would be a less expensive option compared with treating oil with casein and formaldehyde as the latter requires more specialized equipments [3]. The animal products with an increased amount of n3 fatty acids might be a possibility to solve the problem of low n3 fatty acid consumption of Hungarian population [4]. A number of studies consider the use of oilseeds and their by-products may be perspective method in the animal nutrition [5, 6].

2. Materials and methods

When choose the appropriate feed supplement it was a priority to select a natural raw material high in polyunsaturated fatty acids. The experiment was carried out on two large, intensive dairy cattle farm located in Hungary. Hereafter the two farms will be referred to as „A" and „B". Holstein cows were blocked according production level on both farms. Twenty multiparous Holstein cows were assigned to be fed cold extruded linseed and twelve multiparous Holstein cows were assigned to be fed full fat oilseeds dietary supplements. Cows were fed maize silage before the experiment on both farms. In the experiment period they were fed maize silage supplemented with cold extruded linseed (2 kg/cow/day) on farm A and B (Tables 1 and 3).

Table 1. Ingredients of diets (cold extruded linseed)

Composition[1]	Farm A	Farm B
maize silage	20	18
alfalfa pre-wilted silage	5	3
alfalfa/grass hay	4.6	3
grass pre-wilted silage	3	-
DDGS	5	-
wet beet slices	-	4
brewers grains	-	4
cottonseed	-	1.2
concentrate	6.8	13
cold extruded linseed	2	2

[1]kg/cows/day

In the experiment period feeding full fat oilseeds they were fed maize silage supplemented with full fat linseed (1 kg/cow/day) on farm A, and full fat rapeseed (1 kg/cow/day) on farm B (Tables 2 and 3). The diets were fed as TMR (total mixed ration) three times a day on both farms. The energy supply if animals were leveled throughout the experiment.

Table 2. Ingredients of diets (full fat oilseeds)

Composition[1]	Farm A	Farm B
maize silage	18	17
alfalfa pre-wilted silage	3	3
alfalfa/grass hay	6.2	2.5
meadow-grass pre-wilted silage	4	-
DDGS	6	-
barley straw	0.4	-
wet beet slices	-	5
brewers grains	-	5
concentrate	-	-
full fat linseed	1	-
full fat rapeseed	-	1

[1]kg/cows/day

Table 3. Fatty acid composition of full fat linseed, full fat rapeseed and cold-extruded linseed

Fatty acids (%)[1]	Full fat linseed	Full fat rapeseed	Cold extruded linseed
12:0[2]	0	0.02	2.24
14:0[3]	0.07	0.1	0.05
16:0[4]	5.47	5.18	23.64
18:0[5]	3.01	1.93	12.76
C18:1[6]	18.53	57.39	15.65
C18:2[7]	14.96	19.6	10.80
C18:3[8]	55.98	8.06	25.75

[1]fatty acid methyl-esters relative % by weight, [2]lauric acid, [3]miristic acid, [4]palmitic acid, [5]stearic acid, [6]oleic acid, [7]linoleic acid, [8]α-linolenic acid

The experiment with cold extruded linseed and the different oilseeds was carried out 4 weeks. Milk samples were taken three times for each cows under the experiment period: at the start of the experiment, and at the end of the experiment. Forage samples were drawn weekly. Sample-taking was scheduled to the milking order every time, and they were taken at the same milking period.

The fatty acids composition of the milk fat was determined after precolumn derivatization in the form of fatty acid methyl esters by gas chromatography [7]. SPSS for Windows 22.0 program was used for the analysis.

3. Results and discussion

In our experiment the dietary treatments had a significant impact on proportion of several polyunsaturated fatty acids of milk fat.

The most significant change, more than one and a half times increase, was observed in the proportion of 18:3n3 and a 18:2c9,t11 in the experiment with cold extruded linseed on farm A (Table 4.). The concentration of 18:2 also increased, but the proportion of 20:4n6 a smaller decrease was observed on farm A. The total rate of the polyunsaturated fatty acids in milk fat showed an increase. On farm B feeding cold-extruded linseed (Table 5.) the proportion of 18:3n3 and the 18:2c9,t11 were increased. The total rate of the polyunsaturated fatty acids of milk fat was also higher in the post-experiment period than before.

Feeding full fat linseed as a supplement on farm A (Table 6) the proportion of a 18:2c9,t11 and the 18:3n3 the increase was considerable in the post-experiment period. Further differences were observed in the concentration of 22:5n3 acid after feeding the supplements.

However feeding full fat rapeseed on farm B (Table 7) there was no positive alteration neither in the proportion of the polyunsaturated fatty acids, nor in the total rate of the polyunsaturated fatty acids.

Table 4. The effect of cold extruded linseed on the polyunsaturated fatty acids of milk fat (Farm A)

Fatty acids (%)[1]	Before the experiment (n=20)	After the experiment (n=20)	P
18:2[2]	3.15 ±0.17	3.50 ±0.17	<5%
18:2c9,t11[3]	0.53 ±0.03	0.71 ±0.06	<5%
18:3n6[4]	0.5 ±0.02	0.02 ±0.01	ns
18:3n3[5]	0.37 ±0.04	0.51 ±0.03	<5%
20:4n6[6]	0.26 ±0.02	0.23 ±0.02	<5%
20:5n3[7]	0.03 ±0.00	0.04 ±0.00	ns
22:5n3[8]	0.08 ±0.01	0.07 ±0.01	ns
ΣPUFA[9]	4.72 ±1.00	5.27 ±1.12	<5%

[1]fatty acid methyl esters relative % by weight, [2]linoleic acid, [3]conjugated linoleic acid, [4]γ-linolenic acid, [5]α-linolenic acid, [6]eicosapentaenoic acid; [7]docosapentaenoic acid, [9] total polyunsaturated fatty acids

Table 5. The effect of cold extruded linseed on the polyunsaturated fatty acids of milk fat (Farm B)

Fatty acids (%)[1]	Before the experiment (n=20)	After the experiment (n=20)	P
18:2[2]	3.03 ±0.24	3.49 ±0.38	ns
18:2c9,t11[3]	0.31 ±0.05	0.67 ±0.12	<5%
18:3n6[4]	0.06 ±0.02	0.03 ±0.01	ns
18:3n3[5]	0.29 ±0.03	0.58 ±0.08	<5%
20:4n6[6]	0.27 ±0.03	0.23 ±0.01	ns
20:5n3[7]	0.03 ±0.01	0.02 ±0.01	ns
22:5n3[8]	0.07 ±0.02	0.07 ±0.01	ns
ΣPUFA[9]	4.30 ±0.96	5.30 ±1.11	<5%

[1]fatty acid methyl esters relative % by weight, [2]linoleic acid, [3]conjugated linoleic acid, [4]γ-linolenic acid, [5]α-linolenic acid, [6]eicosapentaenoic acid; [7]docosapentaenoic acid, [9] total polyunsaturated fatty acids

Table 6. The effect of full fat linseed on the polyunsaturated fatty acids of milk fat (Farm A)

Fatty acids (%)[1]	Before the experiment (n=12)	After the experiment (n=12)	P
18:2[2]	2.78 ±0.24	2.57 ±0.19	ns
18:2c9,t11[3]	0.52 ±0.04	0.62 ±0.05	<5%
18:3n6[4]	0.02 ±0.01	0.06 ±0.07	ns
18:3n3[5]	0.27 ±0.03	0.60 ±0.05	<5%
20:4n6[6]	0.17 ±0.02	0.18 ±0.03	ns
22:5n3[7]	0.01 ±0.00	0.05 ±0.03	<5%
ΣPUFA[8]	3.93 ±0.94	4.27 ±0.85	ns

[1]fatty acid methyl esters relative % by weight, [2]linoleic acid, [3]conjugated linoleic acid, [4]γ-linolenic acid, [5]α-linolenic acid, [6]eicosapentaenoic acid; [7]docosapentaenoic acid, [8] total polyunsaturated fatty acids

Table 7. The effect of full fat rapeseed on the polyunsaturated fatty acids of milk fat (Farm B)

Fatty acids (%)[1]	Before the experiment (n=12)	After the experiment (n=12)	P
18:2[2]	2,57 ±1.11	2.60 ±0.21	ns
18:2c9,t11[3]	0.33 ±0.01	0.49 ±0.12	ns
18:3n6[4]	0.03 ±0.01	0.05 ±0.04	ns
18:3n3[5]	0.39 ±0.01	0.45 ±0.09	ns
20:4n6[6]	0.25 ±0.03	0.24 ±0.03	ns
22:5n3[8]	0.07 ±0.01	0.06 ±0.03	ns
ΣPUFA[9]	3.85 ±0.85	3.95 ±0.86	ns

[1]fatty acid methyl esters relative % by weight, [2]linoleic acid, [3]conjugated linoleic acid, [4]γ-linolenic acid, [5]α-linolenic acid, [6]eicosapentaenoic acid; [7]docosapentaenoic acid, [9] total polyunsaturated fatty acids

4. Conclusions

Cold extruded linseed and oilseeds especially full fat linseed and full fat rapeseed can be added to the diet of dairy cows under large-scale technological conditions.

Reviewing data of mono- and polyunsaturated fatty acids from cold extruded linseed and full fat linseed supplement we found that, in accordance with our theory, the biggest differences were observed in the proportion of 18:3n3 on both farms.

The proportion of 18:2c9,t11 increased also after the cold extruded linseed and full fat linseed supplement.

Including full fat linseed in the diet of dairy cows (farm A) resulted higher proportion of 22:5n3 in milk fat.

Proportion of polyunsaturated fatty acids in milk fat was not affected by feeding full fat rapeseed.

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