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Fatty acid, retinol and carotene content of organic milk

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Abstract. The milk takes the second place, after meat, as preferences in food consumption. Considering this, the concern of the producers for increasing the quantities to cover the needs on the market, is permanently growing. This food product is one of the cheapest sources of animal protein with biological high value. In what it looks the production, processing and the quality of organic agri-food products, they intensified at the international level in the last years, especially in European Union. The specialists straightened their attention on both organic farming management and the quality of the obtained products. The consumption of milk and dairy products certified as being organic is increasing, due to recent research that emphasized the benefic characteristics of these products for health. The aim of this paper is to investigate possible differences in organic milk compounds due to seasonal variations, as the nutritional benefic effect of organic milk is especially due to the cattle feeding systems.
Key Words: organic milk, fatty acids, retinol, carotene.

Rezumat. Laptele ocupă al doilea loc, după carne, în preferinţele consumatorilor şi ţinând cont de acest aspect preocupările producătorilor pentru sporirea cantităţilor care să acopere necesarul de pe piaţă sunt iîn continuă creştere. Acest produs alimentar este una dintre cele mai ieftine surse de proteine de origine animală cu valoare biologică ridicată. In ceea ce priveşte producţia, procesarea şi calitatea produselor agro-alimentare ecologice, acestea s-au intensificat la nivel international în utlimii ani, în special în Uniunea Europeană, specialiştii îndreptându-şi atenţia atât asupra managementului fermelor ecologice cât şi asupra calităţii produselor obţinute. Scopul acestei lucrări este de a evidenţia unele diferenţe în ceea ce priveşte componentele laptelui ecologic, datorate în principal modificărilor sezoniere, efectul nutriţional benefic al laptelui ecologic fiind dat în special de sistemele de furajare.
Cuvinte cheie: lapte ecologic, acizi graşi, retinol, caroten.

Introduction. The milk production is differently organised from one European member state to another. There are enormous differences considering the size of the farms and the number of animals, as well as considering the production obtained (especially after EU extension in May 2004, which brought ten new members). However, in parallel with the development of dairy sector in the entire EU, a decreasing of discrepancies is noticed, considering the production and other technical factors – the less developed milk producers came up with those who passed earlier through the process of reorganization and modernization.

Milk cow breeding, a basic profession in the mountainous and rural area, ensures rhythmic incomes and performance for farmers. The support for an efficient collection of raw milk from small farms would offer them the possibility to invest. New equipments are necessary for delivering controllable products, with higher quality and superior shelf life. This occupation also ensures the stability of human populations in mountainous and rural areas. Through dairy farming, a superior using of fodder produced in natural system areas is ensured.

The deep changes that took place in Romanian agriculture after 1989 resulted in an overall diminution of milk production, in both big farms and small private properties.

Starting with the year 2000, Romania is enjoying a favourable legislative framework for the producing of organic food. Being at the beginning of the road, it is

obvious that a very small segment of agricultural market is involved in activities with organic products. Even if the land surfaces are large and the organic farms are numerous in Romania, for the moment the number of certified producers is still small. Remarkable is the fact that land areas and the effectives of animals under organic management are continuously increasing.

Bovine milk contains a variety of fatty acids (FA), some of them of potential benefit to human health, including polyunsaturated fatty acids (PUFA) in the n-3 (omega-3) FA group and the conjugated linoleic acid (CLA) isomer *cis*-9 *trans*-11 – C18:2 (Jensen 2002). The main n-3 FA in milk is *α*-linolenic acid (C18:3), along with smaller amounts of docosahexaenoic acid (C20:5) and eicosapentaenoic acid (C22:6). The n-3 FA have been linked to the protection against coronary heart disease (Hu & Willett 2002), and prevention of some forms of cancer (Rose & Connolly 1999; Saadatian-Elahi et al 2004).

There are many factors affecting the FA composition of bovine milk, including breed (White et al 2001), season (Lock & Garnsworthy 2003; Pentelescu & Mureşan 2004, 2008), geographical location (Thorsdottir et al 2004), access to fresh grazing (Hebeisen et al 1993; Kelly et al 1998), grazing sward type (Hauswirth et al 2004), silage type (Dewhurst et al 2003), cereal feeding (Wijesundera et al 2003), and oil supplementation of feed (Grummer 1991; Palmquist et al 1993; Offer et al 2001).

A recent research (Ellis et al 2006) concluded that milk FA composition is affected by the farming system, with organic milk consistently having a higher proportion of PUFA and n-3 FA, as well as a lower n-6:n-3 ratio.

Numerous studies reported the influence of retinol on ruminant reproduction. Deficiencies in retinol can decrease the reproductive capacity of the dairy cattle, by impairing the ovarian function and increasing the incidence of abortions. Retinol is also necessary for other functions such as vision, breeding and male fertility.

Besides retinol, other carotenoids also play a beneficial role in animal fertility (Hurley & Doane 1989).

It has been stated that a high content of carotenoids in milk contributes to the improvement of its nutritional value (Chew 1995). Although the major amount of carotenoids in the human diet comes from carrots and other vegetables and fruits, an increase of carotenoids content in the milk would lead to a broader demand of milk and dairy products. Carotenoids also play an important role in the stabilization of oxidative components of milk (Noziere et al 2006). An increased amount of retinol in milk could improve the health status of persons with vitamin A deficit.

Material and Method. Recent studies reported that milk from organic farms had a higher concentration of PUFA and n-3 FA, as compared to "conventional" milk, and that the proportion of FA was influenced by the system of breeding.

Under the national developmental program of cows breeding in small and middle farms, Dorna SA Company, Vatra Dornei initiated, as part of a vast project, the building of dairy farms with activity under organic management. Groups of cows from different breeds have been imported for the population of these farms: Austrian Spotted, Austrian Brown and Pinzgauer. In the present paper, we report the results obtained by investigating the milk of Brown Austrian cows.

The milk lipids were extracted with chloroform and methanol, according to the method of Bligh & Dyer (1959), with minor modifications concerning the volume of the sample and the using of solvents. The volatile components were dispersed in the chromatography column, in the direction of the temperature gradient, depending on their volatility.

The separation of FA methyl esters was performed in a SHIMADZU GC gas chromatograph equipped with a CHROMPACK capillary column with the length of 60 m and the diameter of 0.25 mm, the stationary phase being coated on the internal surface of the column, as a thin film of 0.2 μm. A FID detector was used, and the mobile phase was helium of 99.99% purity.

For retinol analysis, the standard solutions and the samples were injected in a HPLC system equipped with Shimadzu LC 20 pumps, Waters 990 detector with software

analyser, Rheodyne injector and a 25 cm Spherisorb column. The mobile phase was methanol 85:15 in an isocratic system.

Results and Discussion. The aim of the present research was to investigate the content of fatty acids in the milk obtained in organic farming systems. Two factors were identified to influence the FA content of milk: the strain and the variation of the feeding system in two different seasons – winter and summer.

Different peaks were obtained, depending on the molecular mass and consequently on the retention time of components. In Figures 1 and 2 are illustrated chromatograms of fatty acids with short and long chains, respectively.

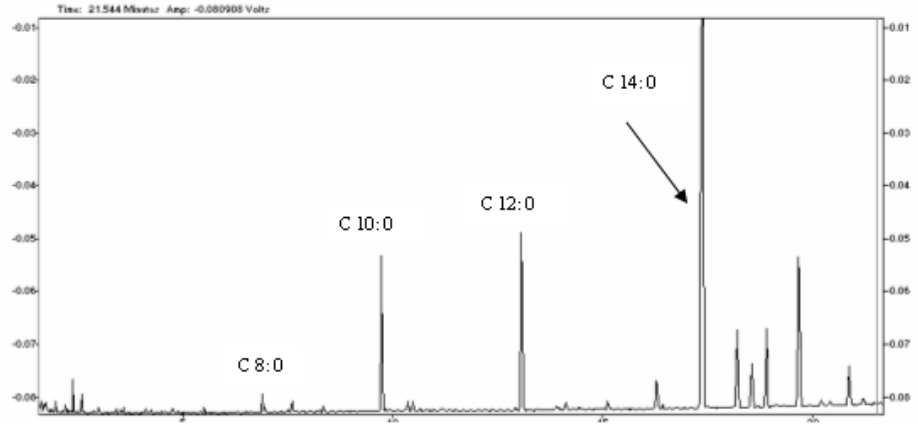

Figure 1. Gas chromatogram of milk fatty acids with short chain molecule

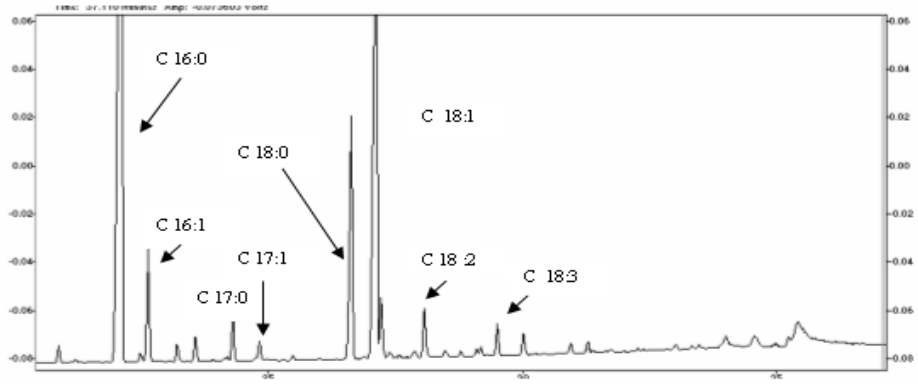

Figure 2. Gas chromatogram of milk fatty acids with long chain molecule

For certain fatty acids, the difference between the two seasons was very significant. Considering the proportion of saturated fatty acids, it was noticed a difference between seasons of 9.55%, a higher content being observed in winter. On the contrary, in the case of monounsaturated and polyunsaturated fatty acids, higher percents were noticed in summer (Table 1).

Table 1

Fatty acids composition of organic milk cow

Fatty acid common name	*Lipid number (C:D)*	*Retention time*	*Average %*	*Standard deviation*	*Average %*	*Standard deviation*
			Winter		Summer	
		Saturated fatty acids				
Caprilic	8:0	6.917	1.01	0.49	0.98	0.35
Capric	10:0	9.754	2.20	0.60	1.93	0.17
Lauric	12:0	13.086	2.70	0.23	2.07	0.17
Miristic	14:0	17.409	11.15	1.0	9.60	0.50
Palmitic	16:0	22.129	29.59	2.78	21.69	1.09
Margaric	17:0	24.329	0.68	0.10	0.77	0.13
Stearic	18:0	26.648	9.84	1.20	10.58	1.12
		Monoenoic fatty acids				
Palmitoleic	16:1	22.648	1.59	0.37	1.52	0.33
Heptadecenoic	17:1	24.850	0.50	0.19	0.57	0.13
Oleic	18:1	27.139	18.84	1.15	20.83	1.99
Vaccenic	18:1 is	27.234	2.39	0.22	2.40	0.19
		Polyunsaturated fatty acids				
Linoleic	18:2	28.099	2.22	0.16	2.20	0.08
α-linolenic	18:3 omega-3	29.527	0.56	0.12	0.75	0.10
Other fatty acids			16.71	2.88	24.12	3.78

The significance test showed distinct differences considering the miristic, linoleic and alfa-linolenic acids (Table 2).

Table 2

Signification test considering the amount of fatty acids between the two seasons

No.	*Fatty acid*	*Lipid number (C:D)*	*Winter vs. Summer*
1	Caprilic	8:0	ns.
2	Capric	10:0	ns.
3	Lauric	12:0	ns.
4	Miristic	14:0	***
5	Palmitic	16:0	ns.
6	Palmitoleic	16:1	**
7	Margaric	17:0	*
8	Heptadecenoic	17:1	ns.
9	Stearic	18:0	ns.
10	Oleic	18:1	**
11	Vaccenic	18:1 is	ns.
12	Linoleic	18:2	***
13	α-linolenic	18:3 omega-3	***
14	Other fatty acids		***

ns – not significant

As we expected, the concentration of carotene and retinol in the raw milk differed from winter to summer (Table 3); higher concentrations were found in the milk sampled in June, due to fresh grazing.

Table 3

Organic milk content in carotenoids and retinol

Product	*Sampling period*	*N*	*Carotene µg/100 ml*		*Retinol µg/100 ml*	
			Mean	Std. deviation	Mean	Std. deviation
Raw milk	February	15	18.84	4.96	37.6	11.83
	June	15	22.35	4.23	47.11	12.49

Conclusions. Quality has become a vital distinctive feature for competition in the world market of food products. To obtain a competitive end-product, quality is carefully managed along the whole production chain, from the supplier of raw materials to consumption. Striving for quality is not a free choice. Quality became for Romania one of the priorities of Chapter 7 of negotiations with European Union.

It has been demonstrated that FA and retinol contents in organic milk are superior, as compared to those in industrially processed milk. Significant seasonal differences in milk composition have also been reported.

Our results showed the seasonal variability in the composition of the raw milk collected from Dornelor Depression. The seasonal particularities demonstrated that the proportion of some milk constituents could be modified through a different nutritional balance. These results should encourage the farmers to consider converting to organic products.

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