THE CHEMICAL COMPOSITION OF ORGANIC AND CONVENTIONAL MILK IN LATVIA

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Abstract

According to the data in literature, when changing the agricultural system, animal keeping conditions and feed composition, the content of the product are influenced to a great extent. Therefore the aim of the present study was to investigate the chemical composition of Latvian organic milk.

A total 55 samples of raw organic milk, 20 of raw transitional period from conventional to organic agriculture, 20 of raw conventional milk samples were collected from different regions of Latvia. The mean content of protein, fat and lactose in organic milk was calculated and compared with the data from Latvia's State Agency "Agricultural data centre". The concentration of calcium, thiamine and riboflavin compared to conventional milk samples and the data from literature. The data was processed using the SPSS software package SPSS 11.0. and MS EXCEL.

The content of fat (4.98±0.08%) and lactose (4.85±0.04%) in organic milk samples was significant higher ($p<0.05$). In 32% of organic milk samples the content of urea was for 29.6 mg kg^{-1} lower than the minimum limit 150 mg kg^{-1}. The content of thiamin in organic milk samples was significantly lower ($p<0.05$) in comparison with the data from literature and conventional milk. Statistically significant difference between the organic and conventional milk samples ($p<0.05$) was found in the content of riboflavin.

The concentration of separate nutrients, as fat, lactose, thiamin and riboflavin in organic milk is significant different compared with conventional milk.

Key words: organic and conventional milk, chemical composition.

Introduction

Organic agriculture as an independent sector in Latvia exists from the 20th century nineties. The aim of organic agriculture is to create an integrated, human and environmentally friendly, economically well – balanced agricultural system, which rests on renewable raw materials of a local origin. Organic agriculture protects the cultivated plants from pests and illnesses, and provides agricultural animals with high quality feed. By developing of organic agriculture it is possible to reduce the negative influence of agricultural technology on environment and to improve the quality of obtained products, because the use of pesticides, organic compounds, exciters for growing, veterinary drugs and antibiotics are restricted in organic agriculture. During the decrease of public trust to genetically modified products, as well as due to animal diseases, the demands for organic food and the interest in them increase.

During the last years, the demand for organic food and the number of consumers, who assign more attention for high quality food and would like to know how it is produced, are significantly increasing. Organic agriculture is characterized by clear basic principles and the transparency of product origin, production and processing. There are all the necessary conditions in Latvia for production of qualitative livestock products for the internal market and as well as for export: land suitable for agriculture, multi–breed animal herds and ecological situation.

Scientists from different countries have very contradictory opinions about the chemical composition of organic milk. The complex evaluation of chemical composition of organic milk and the comparison it with conventional milk has not been performed in Latvia. According to the data in literature, when changing the agricultural system, animal keeping conditions and feed composition, the content of the product are influenced to a great extent. Therefore the aim of the present study was to investigate the chemical composition of Latvian organic milk.

Materials and Methods

The organic milk, conventional milk and milk obtained during transitional period (in further – the transitional period milk) were obtained from the farms "Lejasrembeni", "Jaunbiteni", „Kalna Gaurini", "Alejas", „Cemuri", which are located in Keipenes rural district, Ogres

region. Individual milk samples were taken from Riga, Cesis, Jelgava and Bauska region's farmers.

Milk samples from different breeds of cows were used for the research: 61% of *Latvian Brown*, 2% of *Holsteins Black* and 37% crosses of *Latvian Brown* and *Holsteins Black*. There are sufficient researches about the influence of cow's breed on the milk composition and quality; therefore the factor of breed was not taken into consideration in this research. The milk was obtained from healthy similar age cows. The scheme of taking milk samples was elected in way to eliminate a possibility to analyse colostrums, milk obtained during the late lactation, and milk obtained from mastitis cows.

A total 55 samples of raw organic milk, 20 of raw transitional period from conventional to organic agriculture, 20 of raw conventional milk samples were analysed.

The content of protein, fat, lactose, calcium, thiamin, riboflavin and urea were detected according to the standard methods (see Table 1).

Table 1

The standards of analysis

Indicators	Standard
The content of lactose	LVS ISO 5765–1:2003
The content of protein	LVS EN ISO 8968–5:2002
The content of fat	LVS EN ISO 8968–5:2002
The content of urea	LVS ISO 2446:1976
The content of calcium	LVS EN ISO 8968–4:2002
The content of thiamin	ISO 12081:1998
The content of riboflavin	AOAC 986.27

To evaluate the significant difference, the parameters were randomly arranged; parameters were detected for three duplications, the mean value of parameters was calculated. The mean content of protein, fat and lactose in milk was calculated and compared to the data from Latvia's State Agency "Agricultural data centre". The concentration of calcium, thiamin and riboflavin compared to conventional milk samples and the data from literature.

The data was processed using the SPSS software package SPSS 11.0. and MS EXCEL.

Results and Discussion

The content of lactose, protein and fat in organic milk and conventional milk is given in Table 2.

Table 2

The content of lactose, protein and fat in organic and conventional milk

Parameter	Organic milk			Mean value of conventional milk, %
	Mean value±standard error, %	Value, %		
		Min	Max	
Protein	3.30±0.04	2.24	4.99	3.34
Fat	4.98±0.08	3.50	7.69	4.42
Lactose	4.85±0.04	4.19	5.88	4.67

The mean content of protein in organic milk was 3.30±0.04%, which is not significantly different from conventional milk ($p>0.05$). The research results relate with many authors conclusions (Haggar, 1996; Byström, 2002; Mogensen, 2002; Toledo–Alonzo, 2003; Ellis, 2005), that the content of protein in organic and conventional milk samples had not significant difference. The research results contradict with Olivo (2005) statement that the content of protein is higher in conventional milk samples. The reason for lower content of protein can be lack of sugar–rich juicy feed, which stimulates production of butyric acid used for protein synthesis.

The mean content of fat was 4.98±0.08%; which is significantly higher than in conventional milk samples. The research results contradict with many authors (Mogensen, 2002, Toledo–Alonzo, 2003; Olivo, 2005) statement that fat content is higher in conventional milk.
The higher content of fat in organic milk could be explained with the differences in keeping and feeding conditions: high quality feed, well balanced and rich in cellulose, not chopped, in sufficient amount was available in organic farms; cows were always milked.
The mean content of lactose in organic milk samples was 4.85±0.04%, it significantly differs ($p<0.05$) from those of conventional milk. The results of research relate to Olivo (2005) statement that the content of lactose in organic milk is significantly higher. The higher content of lactose in organic milk can be explained by the higher concentrations of sugar in feed grasses of organic farms.
The content of urea in organic milk samples is shown in Figure 1. The urea content in organic milk samples ranged between 64.90 and 252.56 mg kg^{-1}. The mean content of urea in the analyzed organic milk was 167.43±9.64 mg kg^{-1}, which fitted in the common limits set for milk – from 150 to 300 mg kg^{-1}. In 32% of organic milk samples the content of urea was lower than the minimum limit – 150 mg kg^{-1}.

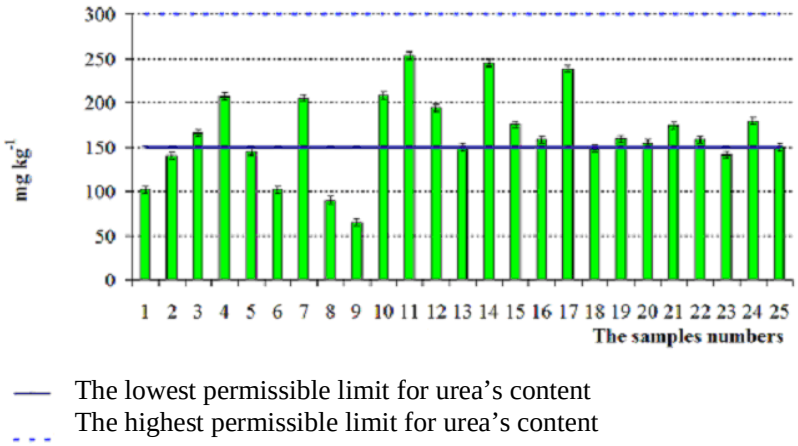

Figure 1. The content of urea in organic milk

The research results relate with Toledo–Alonzo (2003) results, where the author determines a significant difference in the content of urea in milk from different agricultural systems. The difference between the urea content in organic and conventional milk samples can be explained by stricter rules regarding to the amount of concentrate allowed in organic farms in comparison with the conventional farms.
The lower content of urea in organic milk samples could be explained by the influence of seasonal changes in milk. The lowest content of urea, according to Godden's (2001) published data, is from April to June.
The content of calcium in milk samples is shown in Table 3. The content of calcium in organic milk samples ranged between 20 and 25 mmol l^{-1}, the mean content of calcium was 21.90±0.22 mmol l^{-1}. However, a statistically significant difference in the content of calcium between the organic and the conventional milk samples was not found – 20.80±0.32 mmol l^{-1}.
The mean content of calcium in milk samples from different agricultural systems was significantly lower if compared with the data from literature ($p<0.05$)–30 mmol l^{-1}. Gorbatova (1997) mentions that the content of calcium in milk obtained in summer period, is lower in comparison with milk samples obtained in winter, it could explain the decreased calcium content in milk samples taken in summer and autumn months.

Table 3

The content of calcium in cows milk from different agricultural systems

Agricultural system	Number of samples	The content of calcium, mmol l^{-1}			
		Mean ±standard error	Min	Max	Neville *et al.*, 1994
Conventional agriculture	20	20.80±0.32	14.00	23.00	30.00
Transitional period agriculture	20	20.80±0.23	16.00	24.00	
Organic agriculture	20	21.90±0.22	20.00	25.00	

The cows kept in organic agriculture did not get mineral additives, so boosting of their immunity was connected only with facilitation of natural self–regulation processes. By means of that it is possible to achieve the same results as in the conventional agriculture, where animals are treated, without prophylaxis of any disease.
Within the framework of research the content of thiamin and riboflavin in milk was determined (see Figure 2).

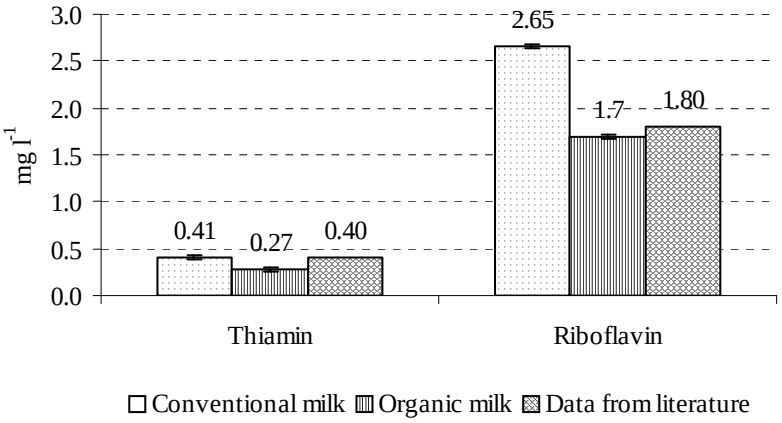

Figure 2. The content of thiamin and riboflavin in cows milk from different agricultural systems

The content of thiamin ranged between 0.20 to 0.32 mg l^{-1}. The content of thiamin in organic milk samples was for 34.1% lower if compared with the conventional milk and it was significantly lower ($p<0.05$) in comparison with the data from literature and conventional milk.
The content of riboflavin in organic milk ranged from 1.28 to 2.96 mg l^{-1}. The mean content of riboflavin in organic milk still was 1.70±0.10 mg l^{-1} and it was for 35.8% lower than in conventional milk, so a statistically significant difference between the organic and conventional milk samples ($p<0.05$) was found.
Many authors (Biesalski, 2002a; Biesalski, 2002b) have pointed that the content of thiamin and riboflavin do not vary in different seasons and that the feed composition has no significant influence on it. However there is still a possibility that feed can influence the content of thiamin and riboflavin in milk. While decreasing the dosage of concentrate allowed in organic farms, a lower concentration of thiamin and riboflavin in milk was established. Light contributes to decrease of the concentration of riboflavin in milk, therefore milking and pretreatment organization in organic farms is one of the most significant factors, which impact the concentration of this vitamin.

Conclusions

1. The concentration of separate nutrients in organic milk compared with conventional milk is different.
2. Statistically significant differences ($p<0.05$) between organic and conventional milk were found in content of largest milk component: fat and lactose.
3. The mean content of urea in organic milk was 167.4±9.6 mg kg^{-1}. In the 32% of organic milk samples the urea content was lower in comparison with the literature data – 150.0 mg kg^{-1}. It is explained with restrictions regarding to the amount of concentrate allowed, lower milk yields in organic farms and influence of season on milk chemical composition.
4. The concentration of thiamin and riboflavin was for 34.1% and 35.8% lower in comparison with conventional milk. It is explained with organisation of milking and milk storage process in farms and also with the low concentrate allowed used for feeding cows in organic herds.

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