Chemical properties of raw milk from conversion period in organic production*

Anka Popović-Vranješ, Radovan Pejanović, Milan Krajinović, Anka Kasalica, David Cvetanović, Aleksandar Kralj

1 University of Novi Sad, Faculty of Agriculture, Department of Animal Husbandry, Trg D. Obradovića 8, Novi Sad, Phone: 0637501364, e-mail: anka.popovic@gmail.com
2 University of Novi Sad, Faculty of Agriculture, Department of Agricultural Economics and Rural Sociology, Trg D. Obradovića 8, Novi Sad.
3 University of Novi Sad, Faculty of Agriculture, Department of Animal Husbandry, Trg D. Obradovića 8, Novi Sad
4 Institute of Dairy, Autoput za Zagreb 3, Belgrade
5 Research Associate, University of Novi Sad, Faculty of Agriculture, Department of Animal Husbandry, Trg D. Obradovića 8, Novi Sad.
6 University of Banja Luka, Faculty of Agriculture.

Abstract

Conversion period is the period of time determined by the Regulation of Organic Production that is required for the transition from conventional to organic production. Products from the conversion period may be marked as “products of organic agriculture in process of transition”, after one year from the date of application for inclusion in organic production. The paper describes the chemical and hygienic quality of milk from the farm of the Agricultural School in Futog that has been in transition period from the last May. According to the standards for organic production, animals are provided with enough space for feeding, resting and movement and free access to water and food. Feeding of animals is adapted to the physiological requirements with maximum use of available nutrients. Most of the time the animals spend on pasture. Animal health protection is maintained respecting the principles of "prevention before treatment" and does not use medicals and chemicals (antibiotics, hormones) except in certain cases.

Physico-chemical composition (fat, protein, lactose and minerals, fat-free dry matter) showed that raw milk meets EU requirements. Examination of unsaturated fatty acids especially omega 3 and omega 6 showed some progress compared to milk from conventional production. Due to the higher content of fatty acids in organic milk it is considered as to be less risky for heart disease than conventional milk. The results of analyzes on the chemical properties of raw milk (acidity, pH, fermentation and rennet-fermentation tests, etc.) showed that milk from the transition period has certain advantages in terms of safety in the production of cheese and other dairy products.

Keywords: organic milk, conversion time, quality, health

Introduction

Milk production in the transition period was started in Agricultural School in Futog throughout transition from conventional to organic production. It is milk that can be labeled as “product of the transition period”, produced from livestock and plant production according to the prin-
Principles of organic farming. Production of organic milk and other organic products are showing a high degree of environmental responsibility and contributes to the transition from conventional to sustainable, organic agriculture in Serbia. Organic milk production involves a complex system of keeping cows based on strict principles and rules of organic production. Animals welfare is a major requirement of organic farming (Savić et. al. 2009). Dairy cows in organic milk production are fed with organic food, produced under the rules of plant organic production. In order to organic livestock production be successful a good knowledge about the interaction of genotype and environmental factors (G x E) which occur in the organic farming system are necessary. In organic milk production priority is given to local races adapted for greater resistance to certain diseases (Lazarević, 2008).

Transition from conventional to organic farming leads to change in the diet composition of the dairy cows and the methods of their production (from cultivation, seeding, fertilization, protection and harvest). Animal food in organic production is based on a forage. Only a small part of diet are concentrated nutrients. To estimate the proper balance of diet, urea and protein content in milk can be used and the relationship of fat and proteins (Senčić et. al. 2011.). This control can play an important role in the optimization of nutrition, because an excessive intake of crude protein may have a negative effect on reproduction and milk production as well as on profitability of production. Finally, and probably the most important reason to improve nitrogen utilisation in dairy cattle is in relation to environment concern. In the EU countries, dairy farms are seen as potentially major sources of nitrogen pollution.

According to the standards, animals must have enough space to rest and movement, access to water and food must be free. The standards define certain categories of animals per hectare (maximum number of cattle, depending on age).

The quality of milk and dairy products from organic production is reflected in the higher content of polyunsaturated fatty acids and linoleic acid (Popović et. al., 2010) and higher content of vitamins A, C and α-tocopherol (Popović et. al., 2011). Better milk quality from organic production is associated with a diet that is largely oriented to pasture, then on open way of keeping and better condition of animals.

**Material and methods**

Aggregate milk samples were collected of evening and morning milking, once a month of the cows in transition period (n = 13). Determination of the chemical composition of milk was performed, using infra-red spectrometry (FTIR) on instrument MilkoScan™ FT +, Foss, Denmark. The extraction of milk fatty acids from milk was done using heptane. The esterification process was performed according to the method SRPS EN ISO 5509:2007. Fatty acids were identified through comparison of retention times with standard fatty acids. Alcohol stability of milk was estimated using methodology proposed by Carić et al. (2000).

**Results and discussion**

Raw milk produced during the conversion period fully fits the requirements of Regulation on the quality of raw milk (Off. Gazz., 21/2009) and EU regulations (No 605/2010) for raw milk quality, which is shown in the table 1.
Table 1. Important chemical quality parameters of raw milk produced during the transition period

<table>
<thead>
<tr>
<th>Month</th>
<th>Protein %</th>
<th>MUN</th>
<th>Casein %</th>
<th>Lactose %</th>
<th>DMWF %</th>
<th>Dry Matter %</th>
<th>Fat %</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>3,16</td>
<td>48,7</td>
<td>2,41</td>
<td>4,46</td>
<td>8,47</td>
<td>12,01</td>
<td>3,64</td>
</tr>
<tr>
<td>II</td>
<td>3,21</td>
<td>49,9</td>
<td>2,44</td>
<td>4,48</td>
<td>8,53</td>
<td>12,09</td>
<td>3,61</td>
</tr>
<tr>
<td>III</td>
<td>3,19</td>
<td>47,3</td>
<td>2,45</td>
<td>4,53</td>
<td>8,61</td>
<td>12,23</td>
<td>3,72</td>
</tr>
<tr>
<td>IV</td>
<td>3,19</td>
<td>48,63</td>
<td>2,43</td>
<td>4,49</td>
<td>8,54</td>
<td>12,11</td>
<td>3,66</td>
</tr>
</tbody>
</table>

Legend: MUN- milk urea nitrogen, DMWF – dry matter without fat

Table 2. Important physico-chemical parameters of raw milk produced during the transition period

<table>
<thead>
<tr>
<th>Month</th>
<th>pH</th>
<th>Acidity (ºSH)</th>
<th>Freezing point</th>
<th>Alc. stability, 72%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>6,8</td>
<td>7,0</td>
<td>0,525</td>
<td>stable</td>
</tr>
<tr>
<td>II</td>
<td>6,63</td>
<td>6,8</td>
<td>0,524</td>
<td>stable</td>
</tr>
<tr>
<td>III</td>
<td>6,76</td>
<td>7,11</td>
<td>0,534</td>
<td>stable</td>
</tr>
<tr>
<td>IV</td>
<td>6,73</td>
<td>6,97</td>
<td>0,527</td>
<td>stable</td>
</tr>
</tbody>
</table>

Milk was stable at 72% alcohol and acidity/pH was in range for normal raw milk. Urea nitrogen in milk (MUN) in observed period was from 47.3 to 49.9 mg/100 ml, with respect to the normal values of urea content in milk, which range from 15-30 mg/ 100 ml. Urea is considered as normal ingredient of cow’s milk as part of non-protein nitrogen (NPN). Urea in milk serves as a indicator of cow’s meal balance in relation to energy and protein.

Urea level, the single most important factor in controlling heat stability at the natural pH of milk, can be affected by dietary manipulation (Thomas, 1984; Horne and Muir, 1990). Rennet clotting time and curd firmness may also be related to the urea content in milk (Grandison, 1985).

Recommendations specifically related to nutrition and nitrogen utilization in dairy cows can be summarized in: (1) reducing nitrogen content of animal feeds by adjusting diets according to animal requirements to obtain optimal nutrition for each stage of animal development (2) decreasing labile rumen nitrogen levels by reducing the degradation of dietary protein and (3) improved relation of energy: protein levels in the rumen to improve the capture efficiency of ruminally degraded nitrogen through microbial protein synthesis.

Table 3. The ratio of protein and urea in cow’s milk by class (Senčić et. al. 2011.)

<table>
<thead>
<tr>
<th>Protein (%)</th>
<th>4,4</th>
<th>4,2</th>
<th>4,0</th>
<th>3,8</th>
<th>3,6</th>
<th>3,2</th>
<th>3,0</th>
<th>2,8</th>
<th>2,6</th>
</tr>
</thead>
<tbody>
<tr>
<td>High supply of energy</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Low supply of protein</td>
<td>High supply of energy</td>
<td>Optimal supply of protein</td>
<td>Optimal supply of protein</td>
<td>Optimal supply of protein</td>
<td>Optimal supply of protein</td>
<td>Optimal supply of protein</td>
<td>Optimal supply of protein</td>
<td>Optimal supply of protein</td>
<td></td>
</tr>
<tr>
<td>Urea content in milk (mg/100 ml)</td>
<td>0</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>35</td>
<td>40</td>
</tr>
</tbody>
</table>
With regard to milk protein content (around 3.2%) and higher urea level in milk, it can be estimated that the supply of protein from food is improper and that meal must be properly balanced. Since ruminants are capable of synthesis of omega-3 and omega-6 fatty acids, those can be found in milk and meat. The emergence of particular important conjugated linoleic acid in the body of ruminants is directed to nutrition from the pastures, rich with this fatty acids which ruminants converts into conjugated linoleic acid (CLA). These fatty acids are built into the milk by different biochemical pathways. Therefore, milk from organic production is important for the daily supply of this fatty acid that is very important to the health of consumers (anticancer).

Table 4. Proportion of major fatty acids in milk from transition period

<table>
<thead>
<tr>
<th>Month</th>
<th>SFA, %</th>
<th>UFA, %</th>
<th>MUFA, %</th>
<th>PUFA, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>2.324</td>
<td>1.013</td>
<td>1.186</td>
<td>0.163</td>
</tr>
<tr>
<td>II</td>
<td>2.397</td>
<td>0.905</td>
<td>1.139</td>
<td>0.134</td>
</tr>
<tr>
<td>III</td>
<td>2.365</td>
<td>0.951</td>
<td>1.159</td>
<td>0.14</td>
</tr>
<tr>
<td>Average</td>
<td>2.362</td>
<td>0.956</td>
<td>1.161</td>
<td>0.146</td>
</tr>
</tbody>
</table>

SFA - saturated fatty acids; UFA - unsaturated fatty acids; MUFA- monounsaturated fatty acids; PUFA - polyunsaturated fatty acids.

Table 5. Content of major fatty acids in milk

<table>
<thead>
<tr>
<th>Fatty acids</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butyric (4:0)</td>
<td>1.56</td>
</tr>
<tr>
<td>Caprylic (8:0)</td>
<td>0.93</td>
</tr>
<tr>
<td>Caproic (6:0)</td>
<td>1.88</td>
</tr>
<tr>
<td>Capric (10:0)</td>
<td>2.67</td>
</tr>
<tr>
<td>Lauric (12:0)</td>
<td>3.38</td>
</tr>
<tr>
<td>Myristic (14:0)</td>
<td>10.44</td>
</tr>
<tr>
<td>Palmitic (16:0)</td>
<td>27.97</td>
</tr>
<tr>
<td>Stearic (18:0)</td>
<td>7.98</td>
</tr>
<tr>
<td>Oleic (18:1n9c)</td>
<td>18.57</td>
</tr>
<tr>
<td>Linoleic (18:2n6c)</td>
<td>3.47</td>
</tr>
</tbody>
</table>

The most important principles of animals health care in organic farming are:

– prevention measures prior to treatment;
– cultivation of adapted and resistant breeds, which develops natural immune protection of animals;
– diet and keeping conditions in accordance with the standards of organic livestock production (zoohygienic measures, placement and movement);
– implementation of alternative therapies based on herbal medicines, homeopathic remedies and other;
– if the therapy does not help - synthetic drugs can be used. In these cases, treatment focuses on reducing and eliminating pain and discomfort of the animals, and then treatment of disease, when in case of emergency, conventional drugs can be applied (Savić et. al. 2010).
Conclusions

Animal breeding in organic milk production is based on the etiological and physiological needs of animals and it is not allowed forced feeding of animals. Raw milk from transition period was within allowable parameters in the terms of physical and chemical characteristics. The higher urea content in milk demonstrates the need to adjust the composition of diet and to reduce intake of proteins. Huge amount of urea in milk has a negative effect on reproduction performances and animal health, and increase environmental pollution.

Acknowledgements

*The work is part of the research project No. TR31095, Ministry of Science and Education of the Republic of Serbia.

References


Pravilnik o kvalitetu sirovog mleka (“Sl. glasnik RS”, br. 21/2009).

Pravilnik o kvaliteti sirovog mleka (“Sl. glasnik RS”, br. 21/2009).


