ACTA SCIENTIFIC NUTRITIONAL HEALTH

Volume 4 Issue 1 January 2020

Research Article

Study on Physicochemical Analysis of Milk Samples During Organic Product Conversion and Certification

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Received: November 18, 2019; **Published:** December 05, 2019

Abstract

Education of the population on healthy lifestyles and awareness of the importance of good eating habits for the health of the body brought to market organic products began to replace some of the conventional diet of many people. Consumption of organic food has beneficial effects on health through high content of many nutrients and reduced pesticide or other chemicals. Supporters of organic products consider to contain fewer harmful chemicals are better for the environment and can have a greater nutritional potential. The aim study is the conversion of cattle farms from conventional farming to organic farming. Regarding quality raw milk produced in the 5 farms studied, the results obtained in the determinations physicochemical and microbiological covering the years 2016, 2017 and 2018 and for each year analyzed 50 samples, 10 samples for each farm. In 2016 it was analyzed conventional raw milk, in 2017 was analyzed in converting raw milk and in 2018 were carried out determinations for organic raw milk, so, each year took in study, conducted chemical determinations for raw milk produced in each farm, the aim being to highlight the existence of differences in terms of quality between conventional milk (2016), milk conversion (2017) and organic milk (2018).

Keywords: Milk; Conversion; Conventional; Organic; Physicochemical Determinations

Introduction

Organic farming has a very well established and important part that all it tends to be as automated as tech, without taking into account however the quality of finished food products and the effects in time on the human body and the environment surrounding. Therefore, the role of organic farming system is to produce good, cleaner food, more appropriate human metabolism, in full correlation with environmental preservation and development. Milk quality is determined by the physical, chemical and bacteriological characteristics of its. Basically, once milking, the milk can have different qualities usually, milk quality is determined by its content into its components (proteins, fats, carbohydrates, dry substance, etc.), cells derived from cow udders or microbial coming from stable or udder. Considering the components that give milk quality means that a milk quality is achieved by carefully considering each of the aforementioned components [1-3].

Biological material

The study conducted pursued the conversion of cattle farms from conventional farming to organic farming. To achieve the research were selected five small farms (with a total of more than 20 animals) farms located in Romania.

In terms of quality raw milk produced in the 5 farms studied, the results obtained in the determinations physicochemical and microbiological covering the years 2016, 2017 and 2018 and for each year analyzed 50 samples, 10 samples for each farm.

Thus, in 2016 it was analyzed conventional raw milk, in 2017 was analyzed in converting raw milk and in 2018 were carried out determinations for organic raw milk.

Also, each year took in study, conducted chemical determinations for raw milk produced in each farm, so in summer and in

winter, the aim being to highlight the existence of differences in terms of quality between conventional milk (2016), milk conversion (2017) and organic milk (2018) [4-7].

Analysis methods

Physico-chemical determinations for all milk samples which are subject of this paper were performed in the physicochemical laboratory.

Methods of analysis for milk raw materials are in line with the quality standards in force and determinations were performed according to Romanian standards SR ISO 2446:2009, SR EN ISO 5764:2003, SR 143: 2008, SR 2418: 2008, STAS 8201-82, STAS-6352/1-88, ISO 6731:2010, ISO 8968-1:2000 and SR EN ISO 5943:2009, SR ISO/TS 17837:2009.

Determination of fat content

The fat content of raw milk analyzed was determined in accordance with SR ISO 2446: 2009.

The fat content of raw milk, according to the method mentioned above is calculated with the following formula [8]:

(1) Fat = B-A,%

where:

A: Value corresponding to the lower point of the column fat percentage;

B: Point value corresponding to the upper point of the column fat percentage.

Determination of protein

Protein samples of raw milk by Kjeldahl method for determining nitrogen content and calculation of crude protein, standardized by ISO/TS 17837: 2009.

The protein content is determined in accordance with the above-mentioned method, the following formula:

(2) wN = 1.4007 (VS-VB) Ct/m

where:

Ct: Concentration of the HCl in mol/l, expressed to 4 decimal places;

VB: The volume in milliliters of hydrochloric acid used in the blank titration (approximated 0.05);

VS: The volume in milliliters of hydrochloric acid used in titration of the sample (approximated 0.05);

M: Mass of sample in grams (with accuracy of 1 milligram).

Determining the total number of germs

The total number of mesophilic aerobic germ is an indicator of cleanliness provided throughout the flow, from milking until the milk reception in the factory. In general, the analysis is performed according to EN ISO 4833-2003, method involves seeding Petri plates and counting the total number and mesophilic aerobic germ.

Determinarea antibiotic residues

Determination of residues of antibiotics was conducted using rapid test Beta Star Combo. Beta Star Combo is a receptor test for a quick determination of ß-lactam class antibiotics and the tetracycline class widely used to prevent and treat mastitis cows.

Statistical analysis

The statistical interpretation of the results obtained for the raw milk was performed using Fisher and Tukey test.

Regarding the fat content to determine the degree of variability of each farm over the three years of study has calculated the coefficient of variation for each sample and showed that its value for any farm was less than 15% result confirms that the average calculated for each farm is representative of the entire statistics population.

To determine whether significant differences between the three years in terms of fat content averages, Fisher's exact test was used.

Fisher determined value (2.277) is higher than the spreadsheet (1.61). In this situation, it was continued with Tukey test to see between that year and farms there are significant differences on the fat content of raw milk.

Tukey test involves the calculation of own statistics, denoted by w equal to $w = q(p, GL; \alpha) \times S\bar{X}$.

w value calculated is a difference limit for the significance level $1 - \alpha$, so any difference between the averages of samples greater than this value is significant for the level $1 - \alpha$.

Comparing the differences between averages obtained by the value w, it can be concluded that there are significant differences between farm F3 în results for 2017 and the results of the farm F5, for 2018.

Regarding protein content to determine the degree of variability of each firm over the three years of study has calculated the coefficient of variation for each sample and showed that its value for any firm was less than 15% result confirms that the average calculated for each farm is representative of the entire population statistics.

To determine whether significant differences between the three years in terms of protein content averages, Fisher's exact test was used.

Fisher determined value (2.383) is higher than the spreadsheet (1.61). In this situation, it was continued with Tukey test to see between that year and farms there are significant differences on the protein content of raw milk.

Comparing the differences between averages obtained by the value w, it can be concluded that there are significant differences between farm F4 results for 2016 and the results of the farm F1 for 2017.

To determine whether significant differences between the three years in terms of total content averages of germs, Fisher's test was used.

Fisher determined value (59.361) is much higher than the spreadsheet (1.61). In this situation, it was continued with Tukey test to see between that year and farms there are significant differences on the total content of germs of raw milk.

Results and Discussion

Analysis of results between five farm studied, between all years studied regarding fat content of raw milk

Cow milk contains normal from 3% to 6% fat depending on several factors: race, stage of lactation, lactation number, nutrition.

Milk-fat content in raw material is of great importance in the manufacture of dairy technology. The most caloric component of milk fat largely conditions and the calorific value of the finished product.

By comparing the results obtained for all years studied, in the same geographical region was desirable to bring în evidence of any differences between fat content of raw milk during conversion thereof from milk classed as milk and conventional to a organic milk.

Thus, in Table 1 can be seen average values obtained for the fat content of raw milk farms, throughout the study.

During the three years of study, performances for the fat content of raw milk farms from Romania ranged between 3.638 g/100 g milk and 3.889 g/100 g milk.

Year	Farm	$\bar{x} \pm S\bar{x}$	S^2	S	CV
2016	F1	3,741 ± 0,048	0,023	0,150	4,019
	F2	3,752 ± 0,055	0,030	0,173	4,599
	F3	3,834 ± 0,065	0,043	0,207	5,389
	F4	3,871 ± 0,038	0,014	0,119	3,087
	SF5	3,826 ± 0,020	0,004	0,064	1,663
2017	F1	3,807 ± 0,058	0,034	0,184	4,828
	F2	3,756 ± 0,045	0,020	0,141	3,747
	F3	3,644 ± 0,028	0,008	0,089	2,452
	F4	3,674 ± 0,024	0,006	0,076	2,078
	F5	3,799 ± 0,075	0,056	0,236	6,214
2018	F1	3,638 ± 0,028	0,008	0,089	2,437
	F2	3,691 ± 0,043	0,018	0,135	3,660
	F3	3,840 ± 0,089	0,079	0,281	7,320
	F4	3,731 ± 0,075	0,056	0,238	6,371
	F5	3,889 ± 0,051	0,026	0,161	4,145

Table 1: Comparative analysis of the average fat content for farms, 2016-2018.

Comparative analysis of protein content of raw milk

The protein content of the milk has an average value of 3.3%, according to the literature. The protein content is an important criteria that affects milk quality, so protein content we provide information about the integrity of raw milk and the establish the destination of milk processing.

A very important report is about the casein weight of the protein. For example, Holstein and Montbeliarde were 3.09 and 3.22% protein and casein/protein ratio is 81.1% and 81.7%. At the Holstein, Jersey and Brown Swiss casein weight may be higher with 3.0% and 3.5%.

The size of this report is especially important when milk is intended for the manufacture of cheese.

In terms of average content of casein of raw milk analyzed, it highlights the fact that the average values varies between hard 2.468 g/100 g milk and 2.779 g/100 g milk, the minimum value being recorded in within the farm F3 în 2016 and maximum value was registered for F2 in 2017.

Analysis of results between five farms studied for each year concerning the protein content of raw milk.

By comparing the results obtained for all years studied, in the same geographical region was meant highlighting of any differences between protein content of raw milk during converting it from a conventional milk to a organic milk.

Thus, in Table 2 can be seen average values obtained for the protein content of raw milk farms, throughout the entire study.

Year	Farm	$\bar{x} \pm S\bar{x}$	S^2	S	CV
2016	F1	3,253 ± 0,058	0,034	0,185	5,681
	F2	3,359 ± 0,062	0,039	0,198	5,883
	F3	3,363 ± 0,044	0,019	0,139	4,128
	F4	3,437 ± 0,031	0,010	0,099	2,890
	F5	3,312 ± 0,020	0,004	0,062	1,871
2017	F1	3,208 ± 0,050	0,025	0,159	4,961
	F2	3,430 ± 0,038	0,015	0,121	3,541
	F3	3,296 ± 0,021	0,004	0,067	2,034
	F4	3,287 ± 0,020	0,004	0,062	1,892
	F5	3,311 ± 0,044	0,019	0,138	4,181
2018	F1	3,299 ± 0,026	0,007	0,084	2,534
	F2	3,275 ± 0,020	0,004	0,063	1,927
	F3	3,281 ± 0,038	0,015	0,121	3,684
	F4	3,308 ± 0,047	0,022	0,147	4,449
	F5	3,379 ± 0,054	0,029	0,170	5,039

Table 2: Comparative analysis of the average protein content for farms, 2016-2018.

During the three years of study, performances for the protein content of raw milk farms ranged between 3.208 g/100 g milk and 3.437 g/100 g milk.

Comparative analysis concerning total germ content of raw milk

Further, by comparing the results obtained for all years studied, in the same geographical region was meant highlighting of any differences between the total germ content of raw milk during converting it from a conventional milk and an organic milk.

Thus, in Table 3 can see the average values for the total germ content of raw milk farms, throughout the entire study.

During the three years of study, performances for the total germ content of raw milk farms ranged between 22,1 x1000/ml milk (F1 2018) and 494.1 x1000/ml milk (F2 2016).

Comparing the differences between averages obtained by the value w, it can be concluded that there are significant differences between results for:

- Farm F2 in 2016 and all four farms, for 2017 and 2018;
- F4 farm in 2016 and all four farms, for 2017 and 2018;
- F5 farm in 2016 and all four farms, for 2017 and 2018;
- Farm F1 in 2016 and all four farms, for 2017 and 2018;
- Farm F3 in 2016 and all four farms, for 2017 and 2018;
- Farm F4, in 2017 and any farms F1, F2, F4, F5 for 2018;
- Farm F2 in 2017 and farm F1 for 2018.

Year	Farm	$\bar{x} \pm S\bar{x}$	S^2	S	CV
2016	F1	286,600 ± 16,811	2826,044	53,161	18,357
	F2	494,100 ± 39,795	15836,544	125,843	25,469
	F3	279,000 ± 12,203	1489,111	38,589	13,831
	F4	372,300 ± 28,767	8275,344	90,969	24,434
	F5	309,800 ± 27,122	7356,178	85,768	27,685
2017	F1	42,200 ± 8,180	669,067	25,866	61,295
	F2	118,000 ± 15,320	2347,111	48,447	41,057
	F3	51,300 ± 12,272	1506,011	38,807	75,648
	F4	147,400 ± 23,142	5355,600	73,182	49,649
	F5	68,800 ± 13,595	1848,178	42,990	62,486
2018	F1	22,100 ± 6,476	419,433	20,480	92,670
	F2	44,600 ± 5,991	358,933	18,946	42,479
	F3	62,300 ± 25,627	6567,567	81,041	130,081
	F4	45,300 ± 10,864	1180,233	34,355	75,838
	F5	47,100 ± 7,775	604,544	24,587	52,203

Table 3: Comparative analysis of the average total number of germs content for farms, 2016-2018.

Determination of antibiotic residues

Substances that are removed by milk sick cows and treated with substances are called residues. Antibiotic residues are dangerous to human health, especially for children, because they can induce resistance to antibiotics. Basically, the antibiotic in milk, consumed with milk, can make ineffective a possible antibiotic treatment required with that when its use is vital. Also, this drug residues in milk can trigger anaphylactic reactions, sometimes fatal [7-10].

One of the conditions mentioned by legislative norms for acceptance of raw milk at treatment and/or processing units is that milk must come from animals that have not been treated with substances dangerous or likely to be dangerous to human health that are transmissible to milk, unless the milk is collected after an official waiting period, according to the provisions veterinary legislation in force [11,12].

If we are in the waiting period established for an antibiotic which has been treated animal it is mandatory milking must be carried out separately, and the resulting milk discard and do not mix with the milk coming from healthy animals nor gives to consumption (no person or an animal). It is important that the equipment used for milking these cows to be washed, cleaned and disinfected thoroughly before use in milking healthy cows.

The results for organic milk from Romania, over the three years of study in terms of antibiotic residue levels for all analyzed samples was negative.

Conclusion

Looking at the overall results of the quality of raw milk, we highlight the following conclusions;

Registration and processing of statistical data on the fat content in raw milk has highlighted significant differences between hard results in the following:

- Intra annually between hard farm values F1 (3,648%) compared farm F5 (3.889%), in 2018.
- Inter annual farm F3 (3,644%) in 2017 with the farm F5 (3.889%) in 2018.

Regarding the results for the protein content of raw milk, we see a variation of the values obtained, highlighted by significant differences occurred in the following statistical interpretations:

- Between the farm averages F1 (3.208%) compared F2 (3.430%) in 2017 and between farm F1 (3.208%) in 2017 compared farm F4 (3.437%) in 2016.
- Comparing the differences between averages obtained by the value w, it can be concluded that there are significant differences between results in the farm F4 (3.437%) for 2016 and results from the farm F1 (3.208%) for 2017.

There have been improvements in terms of hygiene in farms studied, this being confirmed by the results for total germs. In 2016 all the average values were above the limit of 100,000/ml milk (maximum recorded was 494,1x1000/ml milk), while next year values decreased, falling within the limits that define a quality milk.

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