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ORGANIC VERSUS CONVENTIONAL FOOD PRODUCTS: PHYSICO - CHEMICAL AND MICROBIOLOGICAL COMPARATIVE ANALYSIS

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Abstract

The importance of organic agriculture has increased in recent years. Therefore, many studies have been done, trying to analyze the differences between organic and conventional food products, especially in terms of chemical composition, microbiological and sensory quality characteristics. Some studies have reported higher values of nutrients in organic foods compared to conventional ones. Development of results is difficult and generalization of findings must be made with great caution. In this respect, the present study meets current requirements in oriented food, free of pollutants and healthy, try aiming to highlight the advantages of organic products. Materials have been used, such as sheep cheese, tomatoes, peppers and cucumbers, to compare the quality of product with its conventional organic one. All samples were analyzed from physico - chemical and microbiological point of view. The results obtained have shown that organic products have a higher degree of safety correlating microbiological, physico - chemical and heavy metal content. Therefore is recommended to increase the production and consumption of organic food.

Key words: *descriptive analysis, organic and conventional, vegetables, cheese*

INTRODUCTION

Numerous studies, done both at a national and international level, have concluded that ecologically obtained products are not inferior to those obtained in a conventional system, from the quality point of view under all its forms: technological quality, visual and taste quality, agronomical quality, nutritional quality, sanitary quality, ecological quality, ethical quality, global. [2, 3]

AFNOR, France, gives the following definition to quality:"*quality is the ensemble of measurable or un-measurable characteristics of a product or service that confers the ability to satisfy the expressed or implied needs of its user*''. [2, 3]

The consumer appreciates the quality of a product by appearance, taste, smell, color, shelf life, behavior during processing, etc., in consequence, by some specific physical, chemical, and technological characteristics. [4, 5]

In ecological agriculture we emphasize the hygienic and biological quality of the product that is intended to commercial use. [5]

In ecological agricultural systems we try to obtain optimal productions, not maximal productions that are most commonly obtained with the abusive usage of resources and have, as a consequence, the degradation of the environment.

Thereby, through the practice of ecological agriculture we are looking to obtain high quality agricultural products, without the usage of residues and pesticides, with a balanced content of nutrients (proteins, fats, and carbohydrates), organic acids, vitamins, and mineral salts. [5, 6]

Following the revision of more than 150 articles, more exactly 162, which were the subjects of studies that investigated the content in nutrients of ecological and conventional products, the American Society for Nutrition suggests that ecological products are comparable to conventional products, on 10 out of 13 categories of analyzed nutrients,

significant differences being recorded at the production methods. [1]

MATERIAL AND METHOD

Experimental research and analysis regarding the determination of physico – chemical characteristics were conducted microbiological analysis for ecological and conventional samples within the laboratories of the National Institute for Research and Development for Alimentary Bio-Resources IBA Bucharest, and in the laboratories of the Faculty of Biotechnology within the University of Agronomic Science and Veterinary Medicine Bucharest.

Within the experiments conducted we used as work mater products from the dairy area such as sheep salty cheese samples from both categories: ecological cheese and conventional cheese. From the vegetable range we chose tomatoes, cucumbers, and peppers, ecological and conventional samples. These samples were chosen considering that they are representative for the Romanian market.

The salty cheese is obtained out of integral sheep milk obtained in ecological and classical processing conditions, on the production lines of an acknowledged and certified company (S.C. Asinature SRL Sibiu). This assures on one hand all the conditions for ecological processing, and on the other hand the necessary conditions for comparing the samples.

From a technological point of view, the analyzed cheese samples represent maturated salty cheese made out of integral pasteurized sheep milk (ecological and conventional), with addition of selected lactic acid bacteria cultures, preserved in salty acidified whey.

The tomatoes, cucumber and peppers were obtained by the Research and Development Society for Vegetable Growth Bacau, in both ecological and conventional systems. This Society is recognized both national and international and certified for research for the production realized in biological agriculture conditions and the modern technologies for obtaining vegetables and plants in ecological and conventional systems. The obtaining of vegetables in ecological systems was realized in accordance with the European and Romanian legislations in use.

The determined physico – chemical characteristics that reflect an important part of the elements that define the quality of ecological and conventional samples are: dry matter content, water content, water activity index, pH value, acidity, protean substance content, fat content, salt content, dry soluble substance content. [8, 9, 10, 17]

The comparative characterization of ecological and conventional samples, from a micro-biological point of view, was realized by solving the following indices: the total plate count (TPC), yeast and mold number, number of bacteria *E-coli/coliforms,* presence or absence of *Salmonella* and the number of *Enterobacteriaceae*.

RESULTS AND DISCUSSIONS

The experimental results were analyzed through the comparison between the ones of the ecological and the conventional samples, and reported to the standard recommended values, the specific literature, and the technological requirements imposed by the certified products used in the experiments.

The physico – chemical analysis and microbiological results for the ecological and conventional salty sheep cheese samples (BTE and BTC) are described in the following article.

The median values described in the following article illustrates the arithmetic mean of the obtained values, following the multitude of determinations, successive and in parallel realized for the same group of products (ecological and conventional), for each indicator or characteristic separately.

The mean values of the physico – chemical characteristics determined for the ecological and conventional salty cheese samples are described in Table 1.

Table 1. The results of the physico – chemical analysis of conventional BTC and ecological BTE salty sheep cheese

Sample	Dry matter content. (%)	Humidity content (%)	a_w	pH at 25°C	Acidity (°T)	Protein content (%)	Fats (%)	Fats content / dry matter.* (%)	Salt (%)
BTC	56.36	43.65	0.96	4.90	164.0	20.81	29.40	52.17	2.00
BTE	58.44	41.57	0.96	4.66	205.5	20.87	30.83	52.76	1.93

Note: a_w – water activity index

The experimental samples were coded as follows: the conventional salty sheep cheese as BTC and the ecological salty sheep cheese as BTE.

The mean values determined for the dry matter and humidity content were 56.36% and 43.65% for conventional samples, and 58.44% and 41.57% for ecological samples.

As described in the graph in Fig 1 the mean values of dry matter content as well as the mean values of water content, for both conventional and ecological cheese samples fit the recommended guidelines. The dry matter content is higher than the minimum of 45%, and the humidity is below the maximum limit of 55%.

Comparing the average results obtained for both cheese groups, we realize that the ecological salty cheese have a greater dry matter content with about 3.75 than the conventional one.

Moreover, the water content is smaller with about 4.76% at the ecological samples than the conventional ones. The difference between the water content of the two sample groups, is also reflected in the observed differences regarding the water activity in both samples.

As described in Fig. 1 the mean value of the water activity index a_w is smaller for ecological cheese.

As the recommended value for water activity index is 0.96 we concluded that both samples have a water activity that is appropriate, from a technological and preserving point of views.

For the acidity, on the basis of the mean pH and acidity determined values, has been concluded that both sample groups have pH and acidity values within the recommended values, respectively the acidity is above 150 Thörner degrees (205.5˚T for ecological samples and 164.0˚T for conventional samples).

As described in Fig 1 the mean values determined for acidity are 25.3% larger in the case of ecological cheese compared with the conventional cheese.

The protein and fat content have recommended values in the case of salty sheep cheese of minimum 16% and 50% (to dry matter).

The mean values of both determined characteristics for ecological and conventional cheese samples are above the minimum recommended values. Indeed the protein content is 20.87% for ecological cheese, and 20.81% in the case of conventional cheese, both values being larger than the minimum allowed value of 16%. Similarly, the fat content reported to the dry matter is in both cases greater than the minimum allowed limit of 50%. Also in this case the ecological cheese has a higher fat content than the conventional one with 1.13%.

The mean values determined for the salt content for both ecological and conventional samples were well below the maximum allowed value of 4%.

From the salt content point of view, at the ecological cheese samples the mean values of this indicator were smaller compared with the conventional samples (with approx. 3.5%).

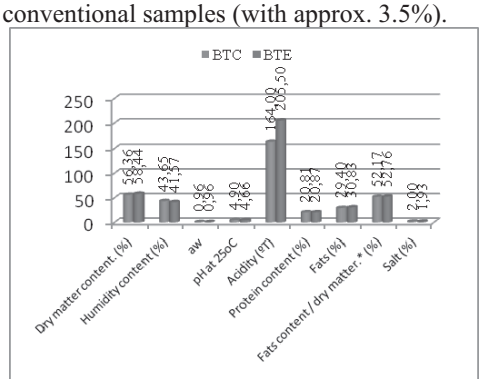

Fig. 1. The mean values determined for physico – chemical characteristics of ecological and conventional cheese samples

The evaluation of the results of analysis and measurements for all microbiological indicators was done in correlation with the imposed or recommended values for salt matured cheese made out of pasteurized and unpasteurized milk, foreseen in the CE Rulebook no. 2073/2005 and in the national standards SR ISO 7954/2001: Microbiology. The general directives for counting yeast and mold. The technique of counting colonies at 25˚C; SR ISO 5541/1-94: Milk and Dairy products. The establishment of the number of *Coliform* bacteria, Part 1: the method for counting colonies at 30˚C; SR12824/2001: the microbiology of food and forage. Horizontal method for counting the *Salmonella* germs.

Some microbiological criteria were established in the Regulation CE no. 2073/2005 that provides a guideline regarding the acceptable characteristic of dairy products and obtaining processes. It also provides rules of manipulation and distribution of these products that have to be reexamined and, by case revised or completed in order to keep up with the evolution in the food safety and the microbiology of the food products.

Following the realization of the tests and experimental determinations, the data in Table 2 was obtained.

Table 2. The results of microbiological analysis on the salty sheep cheese processed in conventional system BTC and in ecological system BTE

Sample	TPC (CFU/g)	Yeast and Mold (CFU/g)	*E. coli* (CFU/g)	Coliforms (CFU/g)	*Salmonella* (CFU/g)	*Enterobacteriaceae* (CFU/g)
BTC	57.500	15.050	-	0.15	-	0.35
BTE	39.000	11.250	-	4.9	-	2.25

From comparing the mean values obtained for the total number of aerobic mesophilic germs, has been concluded that the germs load is smaller in the case of ecological cheese in comparison with the conventional cheese (Fig.2). Indeed the mean value TPC is 39.0 CFU/g for ecological cheese and 57.5 CFU/g for conventional cheese i.e. the microbiological load is 32.17% smaller in the case of ecological cheese.

The smaller values of the total plate count (TPC), yeast and molds for ecological salty cheese in comparison with the conventional one has been evidenced. This fact is explained by a development media that is improper for microorganisms, which causes better preservation of the product.

The same comparative situation exists in the case of the load of yeast and molds. The number of yeast and molds that was determined following the analysis of the samples was: in the case of ecological samples 11.25CFU/g and in the case of conventional samples 15.05CFU/g.

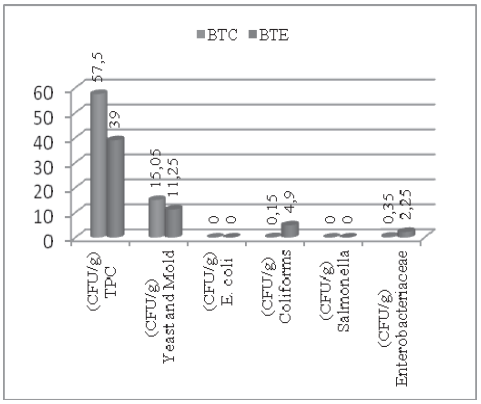

Fig. 2. The microbiological load for ecological and conventional cheese samples

The total number of coliforms resulted from the analysis is 4.9 CFU/g for ecological cheese samples and 0.19 CFU/g for conventional cheese samples. As described in the graph from Fig. 2, for both ecological and conventional samples the number of coliforms is below the maximum allowed limit of 10 CFU/g, as it is foreseen in the legislation.

From the performed analysis we found out that Salmonella is absent in both cheese sample cases (Fig.2).

In this way, the yeast and mold load is 25.24% lower in the case of ecological salty cheese in comparison with conventional cheese.

In both cases the yeast and mold number is a lot smaller than the maximum allowed limit of 1000 CFU/g foreseen in the European Regulation no. 2073/2005.

The contamination with *Escherichia coli* is absent for both ecological and conventional cheese, thus fulfilling the microbiological

norm of absent foreseen in the national and European standards (Fig.2).

For the microbiological indicator *Enterobacteriaceae*, mean values of 2.25 CFU/g resulted in the case of ecological cheese and 0.35 CFU/g in the case of conventional cheese (Fig. 2).

In Table 3 the mean values resulted from the determination of the quality of ecological and conventional vegetable samples (tomatoes, cucumbers and peppers cultivated ecologically and conventionally) are described.

Table 3. The results of physico – chemical analysis on tomatoes, cucumbers and cayenne obtained conventionally MFQ, KBV, DRA and ecologically HAY, QAF, EAI

Sample	Dry matter content (%)	Humidity content (%)	pH	a_w	Acidity (ml NaOH)	Soluble dry matter content (ºR, at 20 ºC)
Eco. tomatoes	5.21	94.79	4.11	1.00	0.36	5.60 ºR
Conv. tomatoes	4.90	91.62	4.70	0.91	0.47	5.20 ºR
Eco. cucumbers	4.65	95.35	5.52	1.00	0.05	3.90 ºR
Conv. cucumbers	3.68	96.32	5.56	0.99	0.08	1.50 ºR
Eco. peppers	5.50	94.50	5.88	1.00	0.14	3.05 ºR
Conv. peppers	3.98	96.02	5.78	1.00	0.17	3.00 ºR

Note: A_w- water activity index

The dry matter content of the vegetables has a direct influence on their preservation ability. In our case, by analyzing the mean values determined for the dry matter content, we observe that the ecological samples have a greater dry matter content than the conventional samples, and in conclusion a longer preservation period (Fig 3).

Comparing the mean results for both tomato samples, we realize that the ecological tomatoes have greater water content, having 3.46% more water than the ecological ones.

For the cucumber and peppers the mean value for humidity is higher in conventional samples than in ecological ones (see Fig. 3).

A pH value between 0 and 7, shows an acidic pH, a pH value of 7 is a neutral value, a pH value between 7 and 14 shows an alkaline pH.

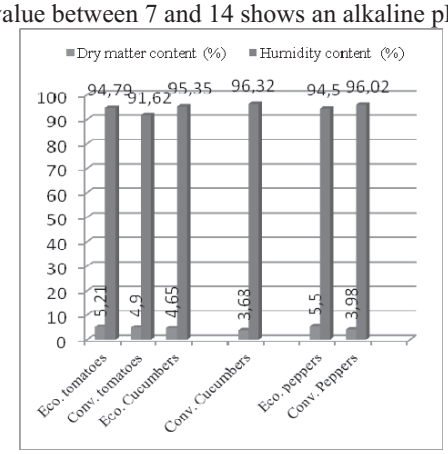

Fig. 3. The mean values of the dry matter and humidity content for the ecological and conventional vegetables samples

In our case the ecological and conventional cucumber samples and ecological and conventional peppers samples display pH values between 5 and 6 which mean that they are slightly acidic. The mean value of the pH for ecological and conventional tomato samples are below 5 and it is safe to state that we have an acidic pH value (Fig 4).

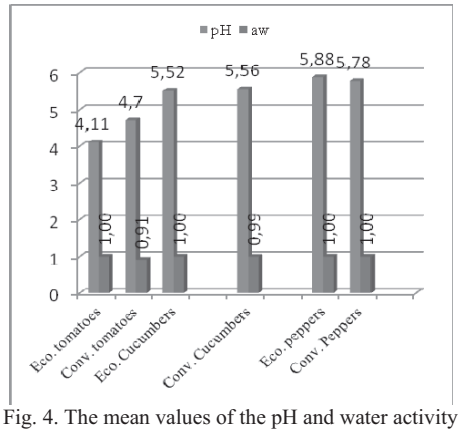

Fig. 4. The mean values of the pH and water activity for the ecological and conventional vegetables samples

The median value of the water activity index a_w for ecological tomato and cucumber samples is 9.1% for tomatoes and 0.3% for cucumbers, greater than the value of the same physico - chemical indicator of the

conventional tomato and cucumber samples. The pepper ecological and conventional samples have the same water activity value of 0.997 (Fig. 4).

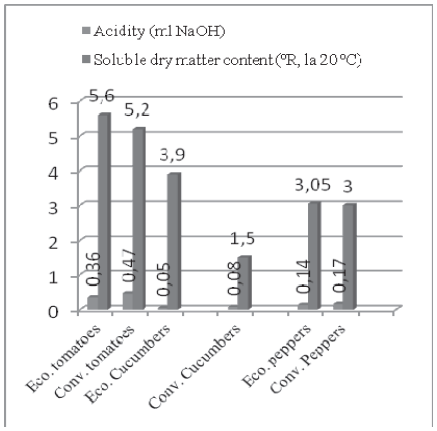

Fig. 5. The mean values of the acidity and soluble dry matter content for the ecological and conventional vegetables samples

The acidity of the conventional tomato samples is about 30.5% greater in comparison with the ecological and conventional cucumber and pepper samples. The tomatoes presented high acidity values, which in fact was expected (Fig. 5).

The dry soluble matter in the ecological vegetable samples was greater than the one in the conventional one proving that ecological vegetables have a greater enzyme, ascorbic acid, carotene, mineral substances, and vitamins content (see Fig 5).

All these physico – chemical characteristics are important because they influence the texture of the vegetable, their nutrient value, their aspect, and microorganism activity.

The microbiological indicators determined in the case of ecological and conventional tomato, cucumber and pepper samples, were the following ones: TPC, yeast and molds Y+M, *Escherichia coli* and *Enterobacteriaceae.*

The evaluation of the obtained results for all mentioned microbiological indicators was correlated with the values foreseen in the CE Regulation no. 2073/2005, with the last modifications.

The results of experimental determination for the vegetable samples (ecological and conventional peppers, cucumber and tomato) are given in Table 4.

Table 4. The results of microbiological analysis of vegetables in ecological and conventional samples

Sample	Microbiological indicators			
	TPC (CFU/g)	Yeasts and molds (CFU/g)	*Escherichia coli* (CFU/g)	*Enterobacteriaceae* (CFU/g)
Eco. Tomatoes	0	0	0	-
Conv. Tomatoes	0	0	0	-
Eco. Cucumber	17	750	0	-
Conv. Cucumbers	2400	5450	141.5	-
Eco. Peppers	16	2	0	-
Conv. Peppers	2	0	0	-

While analyzing the results described in table 4 we observed that the microbiological load in the tomato samples is absent. In the case of ecological and conventional cucumbers regarding the germs load, medium values of 16 CFU/g were obtained for ecological samples and 2 CFU/g for conventional samples. For yeast and mold contamination 2 CFU/g values were obtained. Overall it can say that the vegetables are edible, from a microbiological point of view.

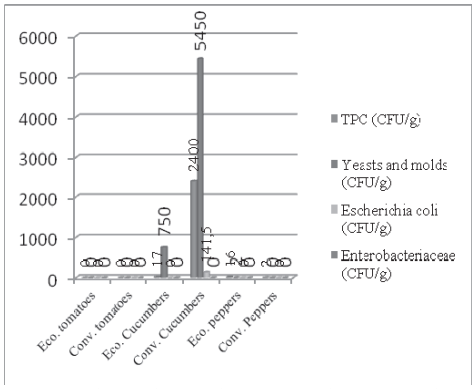

Fig. 6. The medium values obtained following the determination of the microbiological contamination of ecological and conventional vegetables

In the case of cucumber samples the germ load is smaller for ecological samples (17 CFU/g) while for conventional samples the mean value of the germ load is 2400 CFU/g.

Regarding the yeast and mold content of ecological cucumbers (having a value of 750 CFU/g) and conventional cucumbers (with a value of 5450 CFU/g) the obtained values are well above the maximum allowed limit.
Regarding the contamination with *Escherichia coli,* only one sample of conventional cucumber where found having a load of 141.5 CFU/g, in all other samples this bacteria being absent.
All six vegetable samples (tomatoes, cucumbers and peppers, ecological and conventional samples) did not show any trace of contamination with the *Enterobacteriaceae*.

CONCLUSIONS

The obtained results suggest that ecologically obtained products and the ones obtained conventionally can be comparable even though there are significant differences between their production methods.
Analyzing from a physico - chemical characteristics and a microbiological load point of view, the mean values determined for ecological samples comparative with the conventional ones, the ecological samples of cheese, tomatoes cucumbers and peppers demonstrated a bit better quality than the conventional ones. Further research will be carry out on analyzing above mentioned samples from a heavy metal contamination and sensorial point of view in order to see if other requirements for food have similar behavior.

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