VARIATION OF THE WATER QUALITY PARAMETERS DEPENDING ON THE WATER SUPPLY SOURCE OF THE FOOD UNITS

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Abstract

The potable water supply is a target of interesting in the context of occurrence and development of new human settlements or expansion of existing ones. The paper present the comparative assessing of the water quality from two food units with different water supply source. Drinking water samples were collected from the tap located at the entrance of the food units represented by a milk factory and a meat factory, both localized in the Bihor County. The milk factory has a centralized source of drinking water and the meat factory supplies from its own source. The statistical interpretation of the results was made with the ANOVA test which compare the effects of the water supply source on the variation of the quality of the potable water parameters. The statistical interpretation of the mean differences between the physical, chemical and microbiological parameters of drinking water samples revealed that they varied significantly depending by the type of the water supply source.

Keywords: water, quality, food industry, water supply.

INTRODUCTION

The quality and the characteristics of the potable water from the food industry may vary as a result of the chemical contamination with pesticides, nitrates and nitrites depending on the water supply source. The presence of nitrates and nitrites in the water in areas of intensive farming is the main problem of water quality and sanitation.

Nitrates in the water come from the ground, especially after the mineralization of organic pollutants, pesticides or fertilizers containing nitrogen. Excessive water hardness can have economic implications. If the pH is lower, the water is acidic and has an aggressive character. Acidic and aggressive water attack damage the pipeline systems, causing corrosion. The pH of water varies slightly from a neutral pH due to the presence of CO_2, bicarbonates and carbonates (Romocea, 2013).

After a contact of 30 minutes between chlorine and water remains excess of chlorine in water that is called residual chlorine. The presence of residual chlorine in the water subjected to disinfection indicates a sufficient amount of chlorine to ensure disinfection and the integrity of the water distribution network (The Water Supply Regulations, 2002).

The national and European legislation provides maximum limits for the hazardous contaminants in drinking water. The allowed concentrations ranges starting from the value 0 to microorganisms potentially dangerous, such as fecal coliforms and arrive at different concentrations for other parameters, according to their significance to health or to variations of organoleptic characteristics of the water induced by these microbial agents (WHO, 1993).

MATERIAL AND METHODS

In the period 06.07.2014 – 15.02.2015 drinking water samples were collected from the tap located at the entrance of two food units represented by a milk factory with a centralized source of drinking water and a meat factory supplies from its own source. The both food units are placed in Bihor County. The samples were processed in the laboratory in order to determine the quality of the physical, chemical and microbiological parameters to certify their values in the maximum permissible norms laid down by the regulations in force.

The concentration of the nitrites was determined with the molecular absorption spectrometry method (SR EN 26777/C91/2006). The nitrate content was determined with the spectrometric method according to the standard SR ISO 7890-1/1998. The total hardness of the drinking water was determined according to the standard SR EN ISO 6059/2008 and the pH values according to ISO 10523:1997. For the determination of the residual chlorine the iodometric method was used according to SR EN ISO 7393-2/2002. The coliforms were counted with the membrane filter method (SR EN ISO 6222-2004).

The statistical interpretation of the results was made with the ANOVA test which compare the effects of the water supply source on the variation of the quality of the potable water parameters. The ANOVA results were generated using the software GraphPad Prism version 5.5 (GraphPad Software, San Diego, CA) (Quinn, 2002; Abdi, 2010).

RESULTS AND DISCUSSION

The statistical interpretation of the results with the two-way ANOVA method (analysis of variance)

In the Table 1 are presented the results of the studied drinking water parameters as mean±standard deviation to reflect the statistically significant differences between the mean values according to the bifactorial ANOVA analysis with the factor *type of the water supply source*.

Table 1

Comparison of the average values for the physical, chemical and microbiological parameters of the drinking water for the factor *type of the water supply source*

Factor Type: Water supply source	Meat factory (own source)	Milk factory (central source)
$N\text{-}NO_2$ (mg/l)	0.22 a ±0.10	0.01 b ±0.01
$N\text{-}NO_3$ (mg/l)	29.36 a ±3.43	1.92 b ±0.96
Total hardness (german degrees) (Tot_Hard)	12.50 a ±1.52	5.74 b ±1.14
pH	8.24 b ±0.73	8.45 a ±0.35
Residual chlorine (mg/l) (Resid_CL)	0.16 a ±0.07	0.03 b ±0.01
Coliforms (ColiForms) (cells/ml)	66.00 b ±134.73	5820.00 a ±9630.78

The statistical significance of the comparisons are shown by letters from ANOVA and Tukey's test for multiple comparisons (P=0.05, N=3). The statistical differences are significant for the mean values accompanied by different letters along the columns (Table 1).

The Table 1 presents the statistical significant differences between the mean values of the physical, chemical and microbiological parameters of the drinking water collected from the meat factory with own source of the water supply and also the mean values of the physical, chemical and microbiological parameters of the drinking water collected from a milk factory with central source of the water supply.

The statistical significance of the comparisons are shown with letters from ANOVA and Tukey's test for multiple comparisons (P=0.05; N=3). Different letters designate statistically significant differences between the corresponding mean (Table 1).

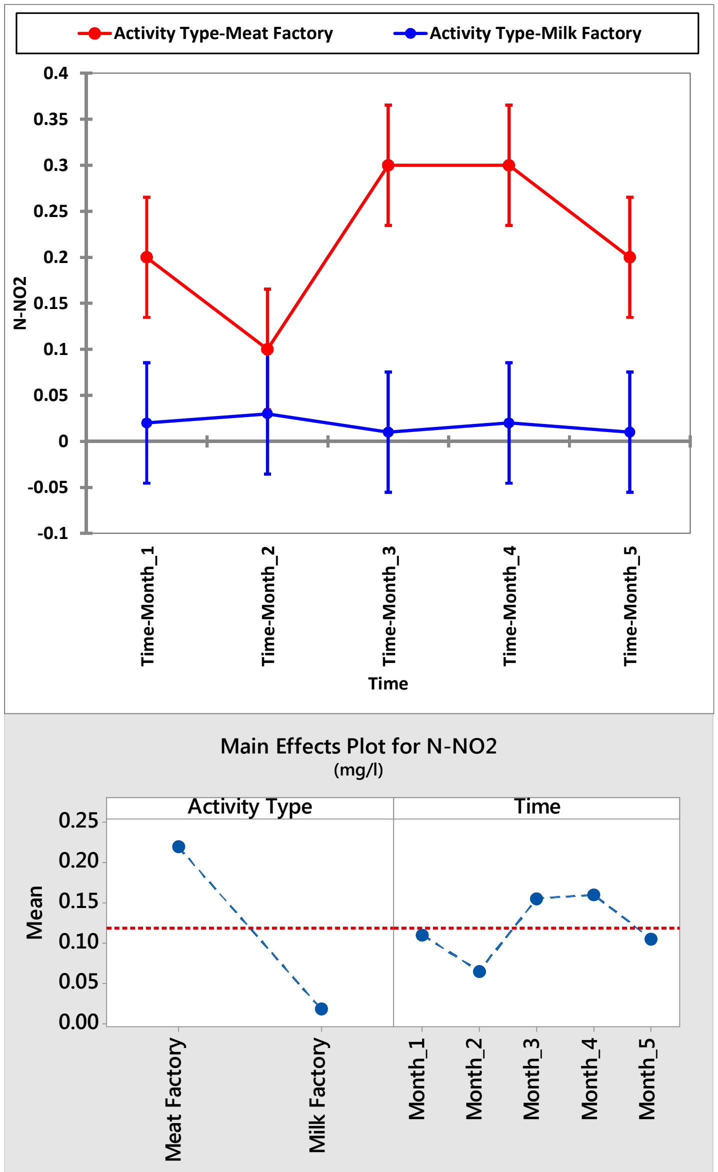

Fig. 1 Interval plot (upper) and main effects (bottom) plot for concentrations of NO_2 (mg/l) parameter.

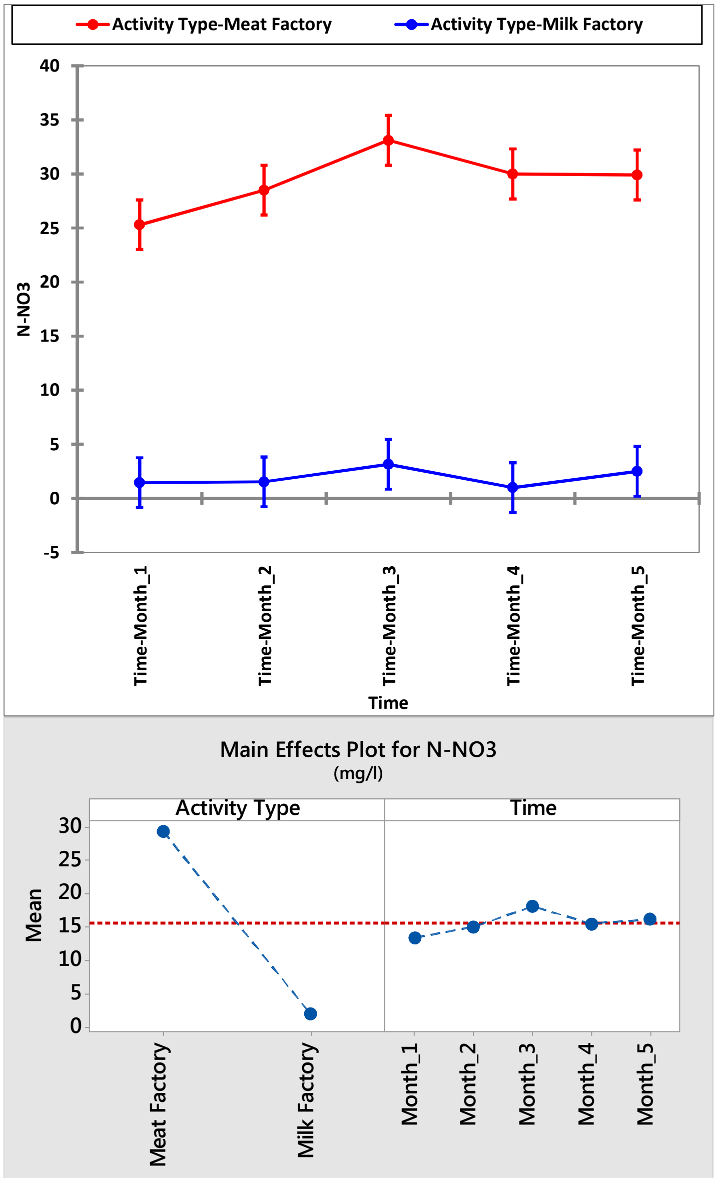

Fig. 2 Interval plot (upper) and main effects (bottom) plot for concentrations of NO_3 (mg/l) parameter.

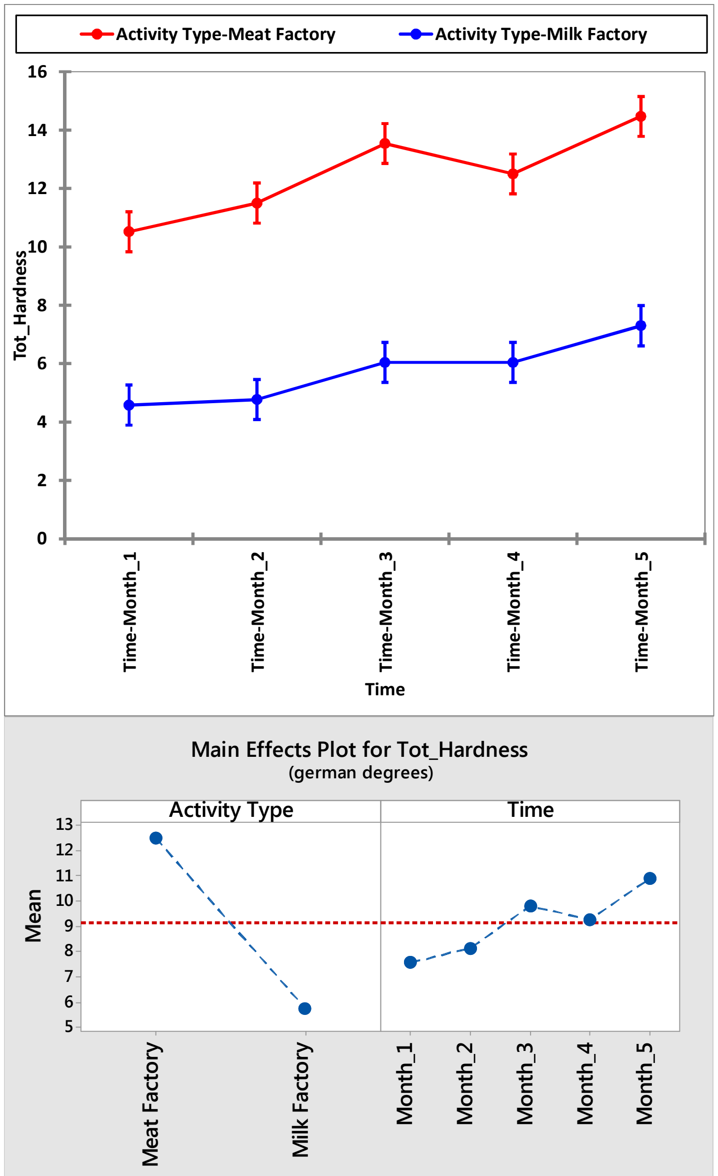

Fig. 3 Interval plot (upper) and main effects (bottom) plot for concentrations of Tot_Hardness (german degree) parameter.

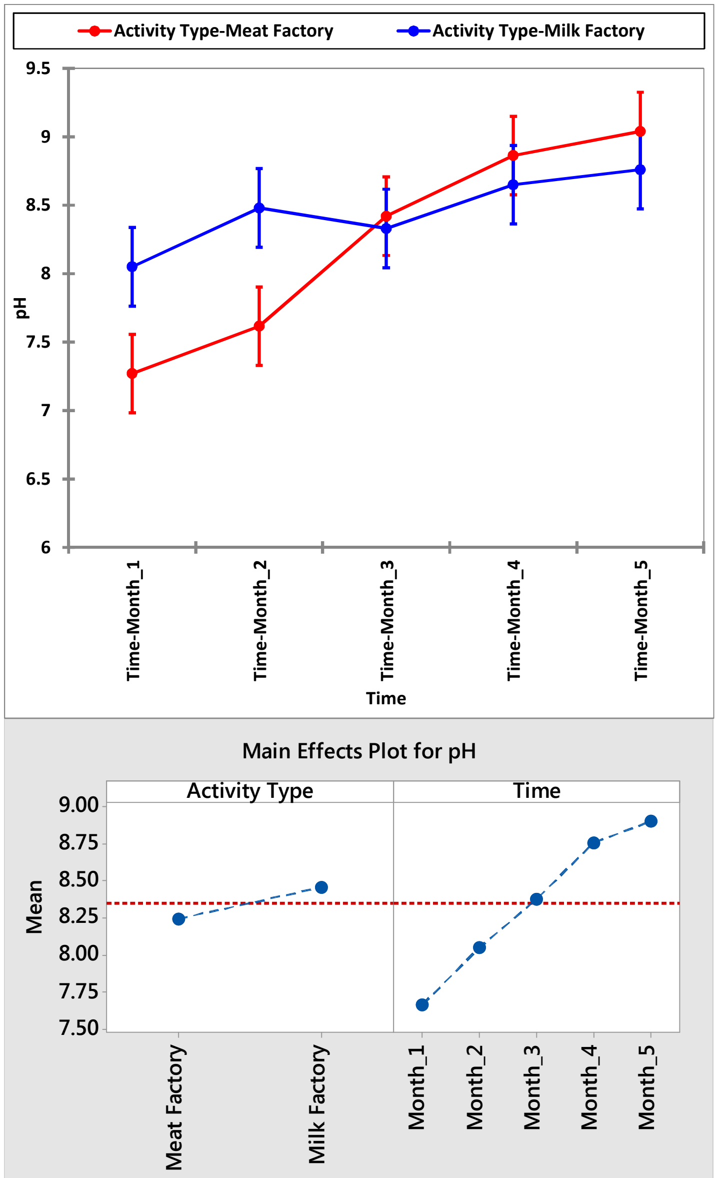

Fig. 4 Interval plot (upper) and main effects (bottom) plot for concentrations of pH parameter.

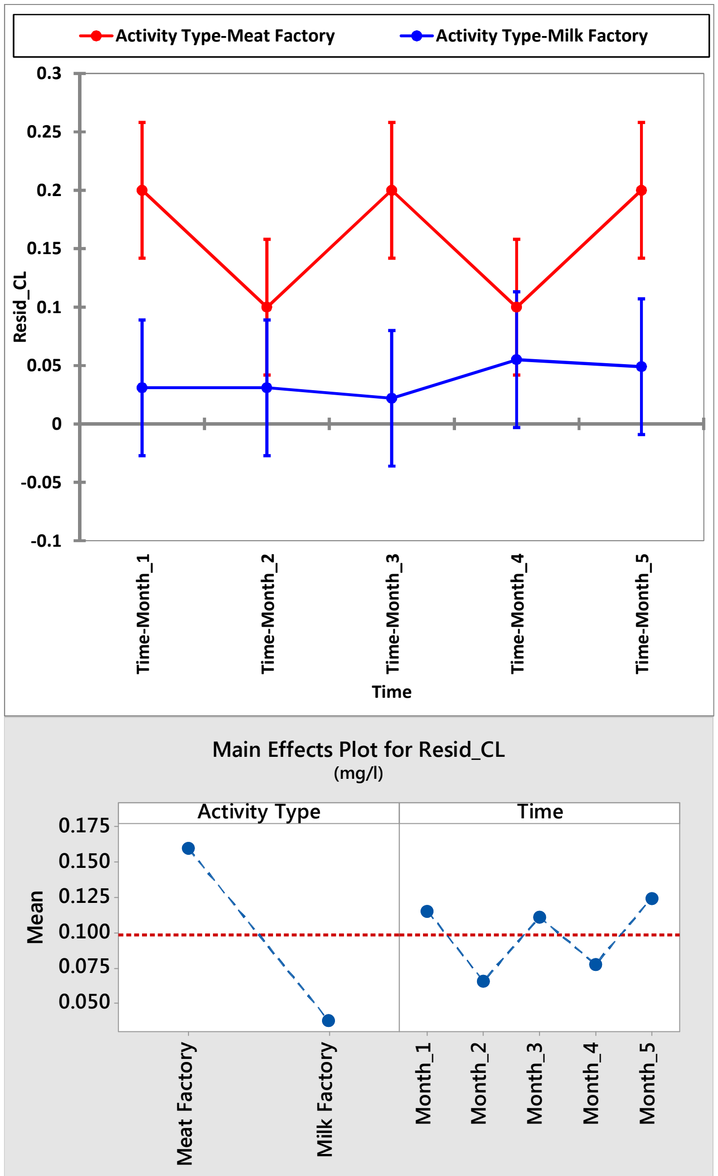

Fig. 5 Interval plot (upper) and main effects (bottom) plot for concentrations of Resid_CL (mg/l) parameter.

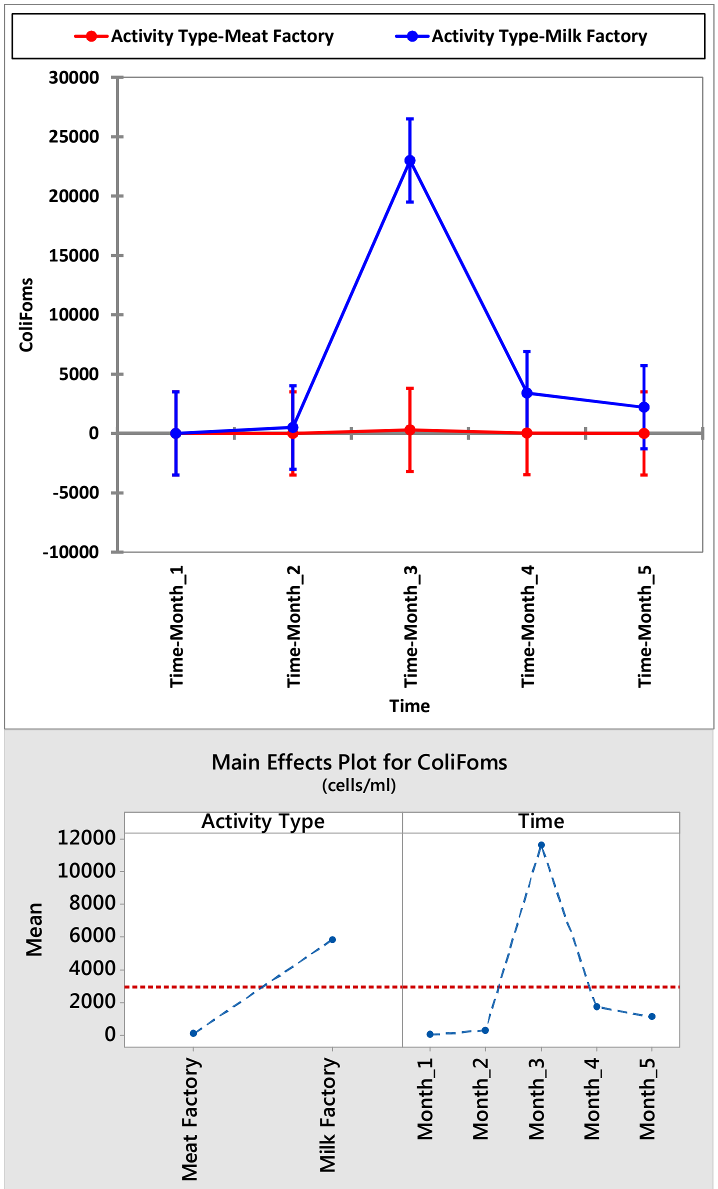

Fig. 6 Interval plot (upper) and main effects (bottom) plot for concentrations of coliforms (cells/ml) parameter.

In terms of the water hardness, NO_2 and NO_3 concentrations, the water samples not registered exceedance of the maximum permissible norms (Figures 1, 2, 3). Water samples collected from the monitored units presented neutral toward basic pH values but all these values were within the permitted limits under the rules in force. Concentrations of the residual chlorine from water samples taken from milk and meat factory were below the maximum permissible limit of 0.5 mg/l (Figures 4, 5 6).

The microbiological analyses carried out during the last three monitoring processes regarding the total coliforms shows the maximum permissible limit exceeding concerning the microbial load of the water used in the food industry which provides the absence of coliforms/100 ml water sample. This situation denotes that the disinfection process was conducted inappropriately.

The results show statistically significant differences between all the analyzed parameters (N-NO_2, N-NO_3, Tot_Hardness, pH, Resid_CL and ColiForm) (Table 1, Figures 1-6).

Drinking water taken from meat factory presented the highest values of nitrites, nitrates, total hardness and residual chlorine and the monitored drinking water from the dairy showed higher values of pH and coliform bacteria. The physical and chemical parameters of drinking water samples taken from the both units in the food industry which have varied significantly depending on the time factor were total hardness, pH and coliform bacteria.

CONCLUSIONS

The statistical interpretation of the mean differences between the physical, chemical and microbiological parameters of the drinking water samples taken from meat and milk factory, revealed that they varied significantly depending on the type of the water supply source factor and time.

The concentration of nitrites, nitrates and residual chlorine varied significantly depending on the water supply source of the food units while the parameters pH, total hardness and coliforms were influenced by the time factor with high variation amplitude.

The both studied factors, water supply source and time presented a dominant effect in terms of the variation of the potable water parameters.

REFERENCES

1. Abdi H., Lynne J. Williams, 2010, Principal Component Analysis. John Wiley & Sons, Inc. WIREs Comp Stat 2010 2: 433-459.
2. Aurel P., Mirela C., 2009, The microbiological quality of water used in bakery industry in Dolj County, Journal of University of Craiova, vol. 14, pages 93-96;
3. Bogart, D. 2006, Cleaning and Sanitizing Short Course: Prerequisite Programs as a Basis for Ensuring Food Safety, sponsored by the Institute of Food Technologists. Orlando, FL. June 23-24.
4. Council Directive 80/777/EEC of 15 July 1980 on the approximation of the laws of Member States relating to the exploitation and marketing of natural mineral waters. Official Journal of the European Communities, 30.8.80, L229/1-L229/9.
5. Council Directive 96/70/EC of 28 October 1996 amending Council Directive 80/777/EEC on the approximation of the laws of Member States relating to the exploitation and marketing of natural mineral waters. Official Journal of the European Communities, 23.11.96, L299/26-L299/28.
6. Collettee, B., et al. 2000, Sanitation Control Procedures for Processing Fish and Fishery Products. Chapter 1: Safety of Water. Florida Sea Grant Program, Gainesville, FL..
7. FDA. Procedures for the Safe and Sanitary Processing and Importing of Fish and Fishery Products. *CFR,* Title 21 Parts 123 & 1240. Dec. 18, 1995.
7. FDA. Hazard Analysis and Critical Control Point (HAACP), 2001, Procedures for the Safe and Sanitary Processing and Importing of Juice. *CFR,* Title 21 Part 121.
8. Köteles N., 2014, Hidrologie, Editura Universităţii din Oradea.
9. Moza (Pereş) Ana Cornelia, 2008, Noţiuni teoretice şi practice de poluare micotoxicologică, Editura Universităţii din Oradea.
10. Oneţ Aurelia, 2012, Environmental Management, University of Oradea Publishing House.
11. Oneţ Cristian, Oneţ Aurelia, 2010, Monitoring of the untreated wastewater quality produced by food industry, Natural Resources and Sustainable Development, University of Oradea Publishing House.
12. Oneţ Cristian, Oneţ Aurelia, 2011, Dynamics of water usage in food industry according to technological process, Anals of University of Oradea, Fascicula de Protecția Mediului.
13. Oneţ Cristian, Oneţ Aurelia, 2011, Management of the wastewater discharged by the milk and meat processing factories, Anals of University of Oradea Fascicula de Protecția Mediului.
14. Oneţ Cristian, Oneţ Aurelia, 2011, Enumeration of bacteria in water used in milk industry, Analele Universitati din Oradea, Fascicula Protectia Mediului, vol. XVII, Anul 16, Editura Universităţii din Oradea.
15. Oneţ Cristian, Oneţ Aurelia, 2012, Determination of the quality parameters of drinking water used in bakery industry, Analele Universitati din Oradea, Fascicula Protectia Mediului, vol. XIX, Anul 17, Editura Universităţii din Oradea.
16. Oneţ Cristian, Oneţ Aurelia, 2013, Quality parameters of drinking water and wastewaters from food industry assessemen, Natural Resources and Sustainable Development, University of Oradea Publishing House.
17. Oneţ Cristian, 2014, Research on the monitoring activity improvement of the water quality from food industry, Analele Universitati din Oradea, Fascicula Protectia Mediului, vol. XXIII, Anul 19, Editura Universităţii din Oradea.
18. Pantea Emilia Valentina, Mirel I., Romocea Tamara, Mitrasca Mihaela,

2007, Wastewater treatment tehnologies of beer industry of Romania, HU-ISBN: 978-963-473-054-5, RO-ISBN: 978-973-759-298-9 Joint International Conference on Long-term Experiments, Agricultural Research and Natural Resources, HU-ISBN: 978-963-473-054-5, RO-ISBN: 978-973-759-298-9,pp 593-598 Debrecen-Nyirlugos, 31 may-1 June, W.agr.unideb.hu/colar/download/colar program.pdf.
19. Pantea Emilia, Romocea Tamara, Ghergheles Carmen, Ioana Blaj, 2013, Comparison Of Efficiency Of Diferent Type Systems For Wastewater Treatment, International Symposium ”Risk Factors for Environment and Food Safety”, vol.XX1, Anul 18, pg.665 Oradea.
20. Qyvind Hammer, David A. T. Harper, 2005, Paleontological Data Analysis, Wiley-Blackwell Publishing, Malden, MA, USA, ISBN: 978-1-4051-1544-5, pg. 368.
21. Romocea Tamara, Pantea Emilia, Groza Lidia, 2013, Research on the quality of water consumed by rural areas inhabitants of Bihor county,International Symposium ”Risk Factors for Environment and Food Safety”,vol.XX1, Anul 18, Oradea.
22. Romocea Tamara, Oneț Cristian, 2013, Water in Food Industry, University of Oradea Publishing House.
23. Şerban, Eugenia, 2012, Protecţia şi monitoringul mediului. Volumul I: Protecţia şi monitoringul aerului şi apei, Edit. Universităţii din Oradea, Oradea, ISBN: 978-606-10-0959-6, 218 p.
24. The Water Industry Act, 1991, Stationery Office Ltd..
25. The Water Supply (Water Quality) Regulations, 2000, Statutory Instrument 2000 No. 3184, Stationery Office Ltd.
26. The Private Water Supply Regulations, 2002.
27. The Water Supply (Water Quality) Regulations, 1989, Statutory Instrument 1989 No. 1147, Stationery Office Ltd.
28. The Natural Mineral Water, Spring Water and Bottled Drinking Water Regulations, 1999, Statutory Instrument 1999 No. 1540. Stationery Office Ltd.
29. WHO, 1993, Guidelines for Drinking Water Quality, Volume 1 Recommendations, Second edition. Geneva, World Health Organisation.