Macedonian Journal of Animal Science, Vol. **2**, No. 3, pp. 313–320 (2012)
122 In print ISSN 1857 – 6907
Received: July 3, 2009 On line ISSN 1857 – 7709
Accepted: December 10, 2009 UDC: 637.146.3 : 006.73
Professional paper

THE STUDY OF HACCP IN DAIRY – YOGURT PRODUCT

Alush Musaj[1], Bizena Bijo[2], Ardita Hoxha[3], Valdet Gjinovci[4]

[1]*University of Prishtina, MMF, Food Engineering, Mitrovica, Kosovo*
[2]*University of Agriculture of Tirana, Albania*
[3]*University of Prishtina, Faculty of Agriculture, Kosovo*
[4]*Agency of Veterinary, Prishtina, Kosovo*
alush_m@yahoo.com

The program of HACCP was successfully applied in a dairy, for a period of 18 months based on Codex Alimentarius, Food hygiene basic text, third edition (2003), and CA 1-1696 rev. 3 (1997, amended 1999). The system was applied based on the applicable laws, regulations and other standards. The manager of the dairy HACCP began to see it as a working tool, by creating conditions for program implementation. Initially, the HACCP team made a balance to determine the scope of the enterprise and the aims towards successful implementation of the program. The program was led in the preparation of HACCP for the production and all measures of risk control were separately documented. In this study the receipt of fresh milk and pasteurization were identified as critical control points. For the verification of the program, microbiological, physical and chemical analyses were conducted periodically. The samples were taken in different phases of the process of production of yogurt and were analyzed before and after the implementation of the HACCP program. The implementation of HACCP in a microbiological aspect has had an influence of the fresh milk as raw material. The results were also affected by the successful implementation of GMP, GHP. The program positively influenced the microbiological quality in the assessment of the final product. The implementation of the system resulted in the decrease of complaints from the customers in terms of quality of safety of the product.

Key words: HACCP; fresh milk; production process; pasteurization; Coliform; *E. coli*

ПРОУЧУВАЊЕ НА HACCP ВО МЛЕКАРСТВОТО (ПРОИЗВОДСТВО НА ЈОГУРТ)

Во млекарството беше успешно аплицирана програмата HACCP во период од 18 месеци, базирана на Codex Alimentarius, Food hygiene basic text, трето издание (2003), и CA 1-1696 rev. 3 (1997, дополнето 1999). Системот беше аплициран врз основа на применливите закони, регулативи и други стандарди. Менаџерот во млекарството HACCP почнува да го гледа како работна алатка, креирајќи ги условите за имплементација на програмата. Најпвин тимот на HACCP направи баланс за одредување на целите на претпријатието насочени кон успешна имплементација на програмата. Програмата беше насочена кон подготовката на HACCP за производството и сите мерки за контрола на ризикот беа одделно документирани. Во ова истражување свежото млеко и пастеризацијата беа идентификувани како критични контролни точки. За потврдување на програмата периодично беа спроведувани микробиолошки, физички и хемиски анализи. Пробите беа земани во различни фази на процесот на производство на јогурт и беа анализирани пред и по имплементацијата на програмата HACCP. Имплементацијата на HACCP од микробиолошки аспект имаше влијание врз свежото млеко како необработен материјал. На резултатите исто така имаше влијание успешната имплементација на GMP, GHP. Програмата позитивно влијаеше врз микробиолошкиот квалитет на финалниот продукт. Имплементацијата на системот резултираше во намалувањето на поплаките од страна на потрошувачите во поглед на квалитетот и безбедноста на продуктот.

Клучни зборови: HACCP; свежо млеко; производствен процес; колиформни бактерии: *E. coli*

INTRODUCTION

HACCP has become accepted internationally as the best means of ensuring food safety. In 2004, the European Union (EU) adopted several new regulations on the hygiene of foods, including one (852/2004/EC) mandating that effective January 1, 2006 all food business operators implement procedures based on the HACCP principles. Other government authorities across the globe, including Canada, Australia and Japan, have adopted or are adopting the HACCP-based food safety control system (Scott and Stevenson, 2006).

Why HACCP?

The foodborne diseases continue to be one of the biggest problems for public hearth throughout the world. The data of the Center for Control of Diseases in USA show that every year 76 million of people suffer foodborne infection, of whom 15% undergo hospitalization (Bijo and Malaj 2008).

Foodborne disease can be classified as either infectious or intoxicatious (Taylor, 2002). Outbreaks involving more common foodborne pathogens are also more likely to be confirmed than those involving less common pathogens, in part because the laboratory may not be knowledgeable in the detection of all foodborne pathogens. More over, some foodborne illnesses are caused by as yet unidentified pathogens. Many of the pathogens of most interest today were not recognized as foodborne disease agents prior to 1980, e.g., *E. coli* 0157:H7, *L. monocytogenes* and *Campylobacter*. Some states may have better surveillance of foodborne illness compared to others, because of greater interest, expertise and resources. This can result in a further underestimation of the size of the foodborne disease problem from those states that do not have a good surveillance program (Scott and Stevenson, 2006).

The risk related to the production of food products can be reduced to an acceptable level or eliminated through the application of HACCP methodology. The objective of this methodology is to guarantee food safety.

Also in Kosovo diseases with food origin stated to become a serious problem, even though very often are unknown. The main reason for this point is missing information about food safety and hygiene. In Kosovo, as in the other countries in development, food safety is not priority yet.

In Kosovo the implementation of the HACCP system is not obligated with food regulation. But regulation should not be the only reason to start implementing.

MATERIAL AND METHOD OF STUDY

The case study was taken in the dairy Industry "Bylmeti" in Kosovo. The Council Directive 93/43/EEC "On food hygiene" was used as a basis for the requirements of the object for the implementation of the HACCP system. Codex Alimentarius CAC/RCP 1-1969, Rev. 2 (1997) amended in 1999, was used as the basis for the HACCP system, for the adoption, implementation, management and functional control of risks in the operators of food business in order to raise the food safety. The HACCP manual, updated throughout the project, was created in order to enable the development of the project. The management had decided to develop the HACCP program in the process of the product Jogurt 3.2 % fat (diluted jogurt). One of the main reasons was that this product was most demanded in the market. The samples for analysis were taken by a specialized internal team of IKSHP with which "Bylmeti" company has a work contract. The microbiological criteria of the milk (for use and processing) were in accordance with the applicable standards of the former YU JUS (g.z. nr. 55/78) harmonized with the respective EU standards (Council Directive 93/43/EEC, 852/2004 "on the hygiene of food products, Annex 1 primary production", 853/2004 paragraph IX non-pasteurized milk and milk products and 2073/2005 microbiological criteria for food product). The second sample in the same conditions for verification, was taken to the Microbiological Laboratory in Skopje Laboratory DOO. The samples for the microbiological analysis were taken aseptically and were held at temperature of 5^{o}C until they were analyzed within the required time of the Institute. During the process of verification we used the method of phenolphthalein as an indicator for the assessment of the level of purification in the production process.

The steps for the application of the HACCP program followed in this study are presented in Diagram 1.

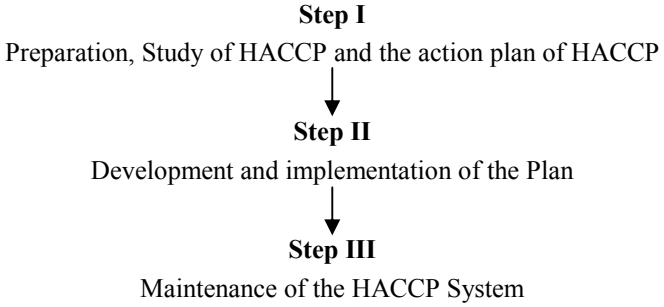

Diagram 1. Three steps through which the HACCP application needs to go

Elements that were taken for the basis in the preparation of the work plan (phase 1) were:

– Conclusions reached during the study of the microthesis "Good working practices in "Bylmeti" factory, an opportunity for the implementation of HACCP in the milk industry", for the preparation of HACCP in the factory.

– Identification of object requirements for the application of HACCP based on the Council Directive 93/43/EEC "On food hygiene".

– Control of efficiency of PMP on the infrastructure and equipments.

In order to have information on the real state of the mentioned subjects, the HACCP team inspected all activities in the dairy company through a control list, according to:

a) inspection list for cleaning and disinfection,

b) inspection list for the plan of the pest control, in accordance with Directive 93/43/EEC related to the food hygiene (Based on the Hygiene Code).

The action plan was prepared through description of subactivities, responsibilities, schedule and was based on the 12 steps of application of the HACCP principles, recommended by Codex Alimentarius. This period covers phase II of the HACCP application. In Diagram 2 the application steps are described: (step 1) …HACCP team, (step 2)… Product description, (step 3)… Identification aim of use, (step 4)… Flow diagram of the process, (step 5)… Confirmation of the flow diagram, (step 6)… Risk analyses, (step 7)… CCP, (step 8)…Implementation of critical limits, (step 9)… Implementation of the monitoring system, (step 10)… Implementation of corrective measures, (step 11)… System of verification, (step 12)…Documentation (CA 2003).

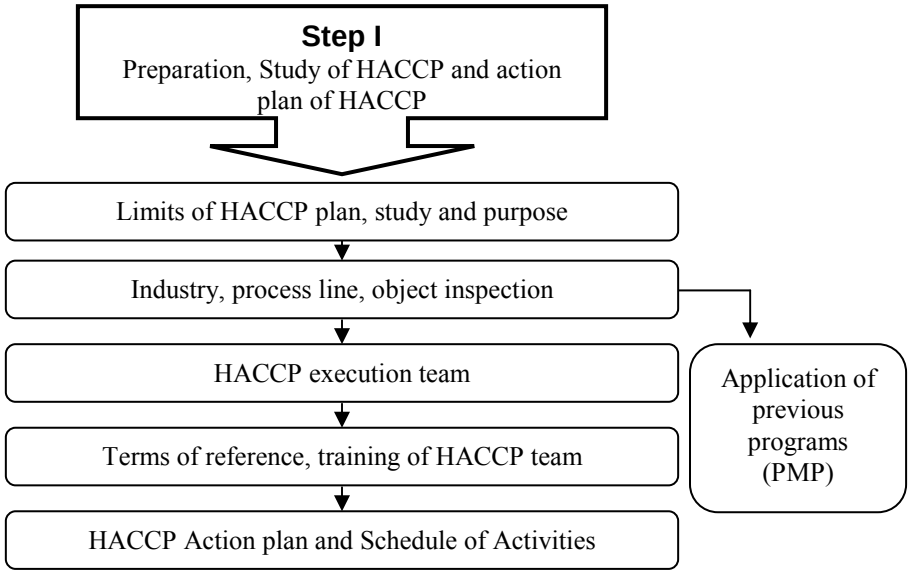

Diagram 2. Step I: Preparation, Study of HACCP and action plan of HACCP

After the HACCP study was completed we ensured that the CCP were monitored and that HACCP was assembled in time, the team took the measures of maintenance and verification. In Diagram 3 the data based on the step three for the implementation of the HACCP system are presented:

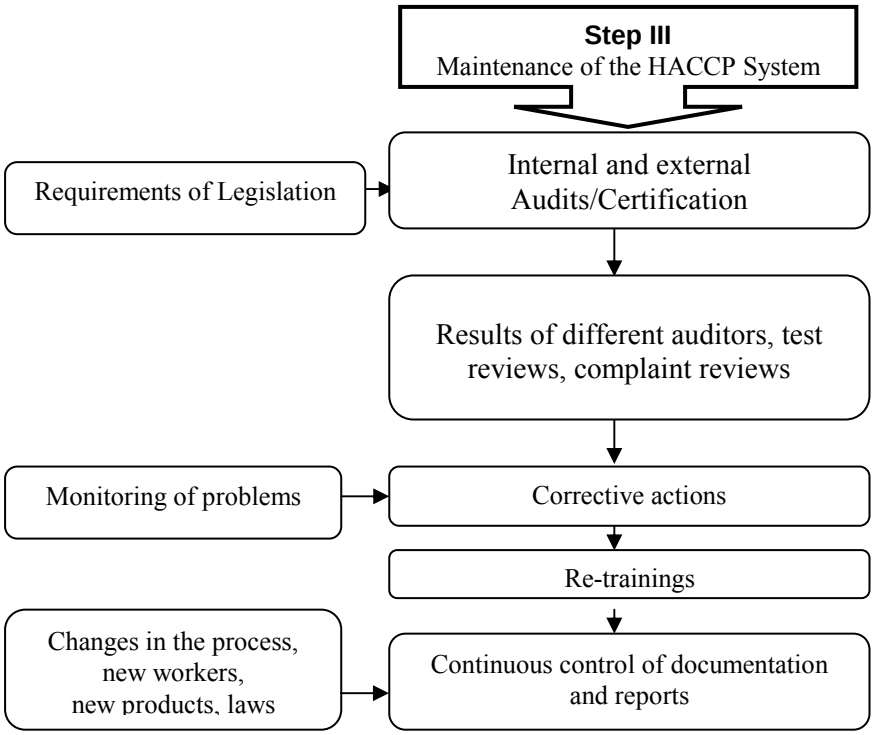

Diagram 3. Step III: Maintenance of the HACCP system

RESULTS AND THEIR DISCUSSION

Implementation of the HACCP plan

The HACCP plan was drafted and implemented on the basis of the methodology provided in the section Material and Method. Before the implementation of the HACCP system we identified 8 CCP which were: receipt of fresh milk (CCP1), filtration (CCP2), separator (CCP3), pasteurization (CCP4), fermentation (CCP5), filling of cups (CCP6), packaging (CCP7), preservation (CCP8). These PKK were considered numerous, which rendered a non-qualitative product and often disputed by the consumers. As in any type of food industry in this factory our aim was also the implementation of HACCP in order to functionalize each concrete link in the best possible manner starting from the supply with raw material of the high quality to continue with its adaptation in order to avoid contamination from all kinds of hazards during the production process until the final product. Identification of critical points during the entire production process and drafting of programs for monitoring were carried out by experts of each field. Not only HACCP team but the entire personnel of OBF were informed for the implementation of HACCP and undertook the training according to the work process. In the HACCP team managers and monitors of production were included because it was rightly judged that the quality of the raw material should be preserved and improved during the production (Scott and Stevenson, 2006). Following staff members have been involved in the HACCP team. As a base organogram of the dairy company was used. In the team were engaged: production manager/senior scientist of microbiology (team leader), shift manager (deputy team leader), production technologist/specialist of food technology, chemical engineer/laboratory technician and quality controller, quality assurance manager (technical secretary), enterprise engineer/ maintainer of the technology equipment. Job/responsibility description of the HACCP team: proceeding of the implementation project, coordination between groups, application of the HACCP system, system maintenance after the implementation, assistance and provision of cognition for the

employees, documentation of activities of the team and the persons in charge. The team made the full description of the product with necessary data on the manner of use, content, composition of raw material (microbiological, chemical), conditions of processing, packaging, storage, distribution and time limit for its use. Based on the technical data the HACCP team confirmed the flowing diagram of the production process. For us the drafting of a full flowing diagram was very important since it would serve us to determine the risk analysis (Gaze, 2003). The diagram also included all incomes and outcomes based on ISO 9004-4 (Merx, 2007). Initially the schemes of the flow of basic production process were prepared, separately for the studied product, yogurt, presented in Diagram 4:

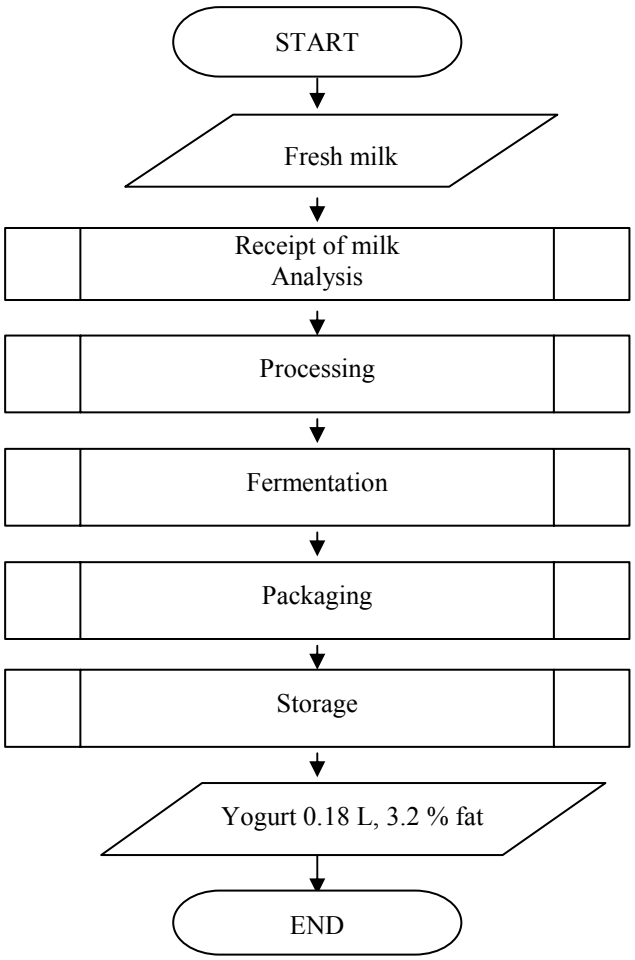

Diagram 4. Main diagram of the product flow: Yogurt 0.18

The engagement of the entire HACCP team in the identification and analysis of each step of the production process separately from the raw material until the storage of the final product resulted in total of 8 CCP. This work period matched the time for adaptation of the HACCP plan. These CCP were considered numerous which rendered a non-qualitative product and often disputed by the consumers. Based on the analyzed microbiological results of the final products the HACCP team came up with the following results of the system verification: The pasteurizer has these shortcomings: a) lack of thermograph, it does not ensure 100% record of parameters of the pasteurization process; b) non-functioning of the returning valve; c) lack of measurement equipment to confirm the pressure difference. In order to improve the bacteriological condition of the studied products, to reach the stated quality of the product, to comply with the external requirements for the factory, and to apply the HACCP system in accordance with the standards of Codex Alimentarius, the plant for the production process should be supplemented with an automation of pasteurizer and technologi-

cal equipment. Photo 1 presents the changes in the technological process of production, setting up the automated process with a new pasteurizer and data printed from the thermograph on temperature, time and pressure.

Photo 1. a) Old pasteurizer.
b) Automation of pasteurization process

After the changes in the technological process of production, the HACCP team analyzed all steps of the process from the raw material to the final product, in total 24. All changes from the risk analysis were ascertained by the team and placed in the documentation archive. After many sessions and after studying every step of the process the team came to the conclusion that the operator of the food business activity "Bylmeti" had PKK when receiving the fresh milk and when pasteurizing it (pasteurizer) on which a qualitative control could be applied to prevent a risk to the safety of the product.

Evaluation of the HACCP plan

The implementation of the HACCP plan in the "Bylmeti" factory was considered as one of the most important actions taken by the work team because of the very encouraging results yielded especially in terms of assessment of microbiological situation of the final product, which was immediately confirmed after the implementation of the HACCP system. This fact is presented in Table 1. We tested the microbiological situation before and after the implementation of the HACCP application. For this reason before the application of the HACCP system we took 10 samples from the final product in the period from July 2007 to November 2007 (two samples per month), which resulted in the average presence of *E. coli* (cfu/g) from 30 to 300/g, and Coliforme (cfu/g) isolated >300/0.01 g. In this table the isolated bacteria are provided whereas *Salmonella*, *S. aureus*, *C. sulfidoredukuese*, *Proteus*, *Maya and Molds* were also researched. The situation had a slight improvement after the application of the HACCP system, where out of 6 samples taken in the peroid from April 2008 to June 2008 (period of setting up the new pasteurizer) the results were within the national norms. It did not result in the presence of patogenics as before even after the implementation of the HACCP system.

Undoubtedly the new favorized microbiological situation that we discovered in yogurt would have an impact on the longevity of the product and on its organic-leptic quality as well as reduction of the complaints of its consumers.

The presence of these bacteria in the final products before the application of HACCP (Table 1) is a significative indicator that demonstrates that the conditions of the process of milk processing were insufficient to guarantee a qualitative microbiological situation of yogurt. It should be stressed that the microbiological groupation that we discovered rarely has the origin of the animal breast. Their source is mainly the outer environment (soil, water, food and non-treatment of milk with appropriate pasteurization temperature) (Bijo & Andoni, 2001). The coliform bacteria are destroyed by the pasteurization, that is why they can be called tested microorganisms for the usual bacteriological control of the milk quality (Bijo & Andoni, 2001).

Table 1

Presentation of results from the samples of the final product, before and after the application of HACCP

Sample	*Escherichia coli* cfu/ml g			*Coliforme* cfu/ml g		
	Before the HACCP application					
	25.07.2007	05.09.2007	26.11.2007	25.07.2007	05.09.2007	26.11.2007
"Yogurt"/3.2% y	>2.500	30	>300	>300	>300	>300
	>300	50	>300	>2.500	>300	>300
	After the HACCP application					
	09.04.2008	07.05.2008	10.06.2008	09.04.2008	07.05.2008	10.06.2008
	<10	–	<10	<10	<10	<10
	–	–	<10	<10	–	–
Standard	0<10			0 <10,		

> 300 (number that can nout be counted)

During the process of verification we used the method of phenolphthalein as an indicator, to assess the level of purification during the production process. In the Photo 2 some of the activities of the applied method are presented.

Photo 2 Verification of purification of the process by the method of phenolphthalein as an indicator

This method was used to verify the level of purification of the production process. After the production process, water is taken for testing from the last phase of the pasteurization process. Phenolphthalein of 2 % is used as an indicator of residues of disinfection substrate used in the purification. Then in the tested water natrium is administered to verify the remains of acid. According to work procedures, for purification the factory uses nitric acid (HNO_3) and natrium hydroxide. If the testing is negative, the purification is done in accordance with the work procedures, whereas when the result is positive and after the testing the water acquires an ultraviolet color it means that the entire process of purification was not done in accordance with the norms or the purification process was not done accordingly.

The program positively influenced the microbiological quality in the assessment of the final product. The implementation of the system resulted in the decrease of complaints from the customers in terms of quality of safety of the product.

CONCLUSIONS

– The studied case guaranteed us that the technological process plays an important role in the application of the HACCP system since the result was very obvious: CCP were reduced from 8 to 2 and this enabled the monitoring of CCP with a low cost but with a food security in accordance with food standards.

– In this study the receipt of fresh milk and pasteurization were identified as Critical Control Points. The implementation of procedures and verification steps to ensure that the CCP activities are in compliance with the requirements of HACCP system resulted crucial.

– Microbiological results before the implementation of HACCP in all periods of analyses conducted, resulted beyond the limits of the national standard.

– Results after the implementation of HACCP are favorable and within the limits of the national standard.

– Pasteurizer was considered as an important production phase that slightly affected the quality of product because of the manifested shortcoming.

– The setting up of a new pasteurizer improved the microbiological situation of milk in the factory and guaranteed that the process is under control.

– Rise in the quality of product, successful management of control points and CCP, reduction of complains by consumers, enhancement of market, rise in the reputation of the company, are some benefits that the company will acquire in order to return its investments made in the adaptation, implementation and change in the production process with new technology up to system certification and maintenance.

REFERENCES

[1] Bijo B., Andoni V. (2001): *Control and hygiene-sanitary assessment of milk and its subproducts*, 23–26. Tirane.

[2] Bijo B., Malaj Z. (2008): *Systems of ensuring quality in food industry and supporting legislation*, 115–152, Tirane.

[3] Codex Alimentarius CAC/RCP 1-1696 Rev. 3 (1997): Amended 1999.

[4] Codex Alimentarius (2003): *Food Hygiene Basic Texts*, Third Edition.

[5] Đorđević, J. (1982): *Mleko – Hemija i fizika mleka*, str. 246–262, Beograd.

[6] European Council Directive 93/43/EEC (1993): on hygiene of food stuffs.

[7] European Parliament and Council Regulation (EC) No. 178/2002 on the general principles and requirements of food safety, establishing the European food safety authority and laying down procedures in matters of food safety.

[8] Gaze R. (2006): HACCP Workshop, CCFRA, UK.

[9] Gruič R., Radovanovič R. (2001): *Primjena HACCP u kontrolli namirnica*. 12–13. Banja Luka.BiH.

[10] Gaze R. (2003): *HACCP: A Practical Guide*, Third edition. Campden & Chorleywood Food Research Association, Guideline No. 42, UK.

[11] Prifti D. (2007): *Food Microbiology*, pp. 217–238, Tiranë.

[12] Sini K. (2003): *Food Microbiology and Hygiene*, 249–336, Tiranë.

[13] Mayes T., Mortimore S. (2001): *Making the most of HACCP*, first published, UK.

[14] *Manual for milk processing* (2003): Office E+E of United Stated Agency for International Development (USAID).

[15] Ostojić M. (1995): *Proizvodnja i primarna obrada mleka*, Beograd.

[16] Richard J. H., M. Merx (2006): *Implementation of HACCP system in the factory of milk products*, Material from training course, Prishtinë.

[17] Vlado M. (2004): *HACCP u praksi*. Zagreb.

[18] Williams A. (2006): *HACCP Prerequisite Programmes*, CCFRA, UK.

[19] YU-JUS applicable standards (Official Gazette no. 55/78).