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HYGIENIC SANITATION IN THE DAIRY INDUSTRY IN THE PRODUCTION OF COW YELLOW CHEESE AS A FACTOR FOR OBTAINING HYGIENICALLY PROPER PRODUCTS IN ACCORDANCE WITH THE EU STANDARDIZATION AND CERTIFICATION STANDARDS

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Abstract

Hygienic sanitation processes in the dairy industry are a major factor in obtaining hygienically healthy dairy products. The subject of the analysis is the production equipment, human resources and the produced finished product – cow yellow cheese, in which different procedures for sanitation are used due to the application of various technologies at work.

Studies have shown that hygienic sanitation gives satisfactory results. The responsibility and positive influence of the employees has been confirmed. The results of the examined bacteriological correctness of the equipment showed a greater and better effect when performing the machine compared to the manual cleaning. From the analysis of the key parameters in the CIP (Cleaning-In-Place) system it was found that the shorter duration of cleaning is correlated with a faster flow and a higher temperature and concentration of the agents. From the recirculating agents, the base and the acid, more clouding occurs in the base material. Finally, from the examined bacteriological correctness of the finished product – yellow cheese, it has been confirmed that the product is completely hygienically proper and healthy for consumption.

Hygienic sanitation in the dairy industry is the most critical operation in the milk processing processes and it is of great importance for obtaining a quality, healthy and hygienically straightforward finished product.

Key words: *CIP system, human resources, production equipment, finished product*

INTRODUCTION

In their composition milk and dairy products are food rich with protein, fat and milk sugar as their specific products, and then with mineral substances and vitamins, necessary for the growth and development of organisms. Hence the fact that milk in its foodstuffs is a product in which people find relatively inexpensive, full-time, easily digestible and suitable food, children are the best replacement for breast milk, and the sick and elderly foods that favourably affect their health.

As a result of certain economic changes and technical achievements, the rapid pace of the development of dairy in the real sense of the word is closely related to the rapid industrial development in the first half of the 19th century, a period characterized by large industrial rise caused by a number of significant inventions of the field the technique, and especially the machine area.

A key challenge facing all segments of the food processing industry is how to apply reproducible and consistent cleaning methods with proper process control, monitoring, as well as a series of documents that are needed to meet the requirements for validity. Contemporary dairy industries, as well as many other industries, are characterized by

revolutionary changes, as well as accelerated transformation and continuous upgrading of their technologies. All these changes during the functioning of a whole necessitate the constant monitoring of a number of parameters, their constant control and improvement. In order to extract the maximum in the working process, in the framework of the modern milk production, constantly improves the production process. The improvement of the same is done both in terms of quality production of individual products and utilization of the capacities, where all this should be done in accordance with the world requirements for good manufacturing and good hygiene practice, the implementation of the ISO standard and the HACCP system. This involves the continued engagement and performance of the staff, the use of appropriate equipment and appliances that enable a high degree of effectiveness and record ability of all individual phases in the course of production.

In the framework of such a modern dairy processing facility, besides the basic starting point for the production of a different product range, the equipment should meet the envisaged conditions for use in a specific production process. The purpose of such requests is to obtain finished product that is completely upright, not only organoleptic, but also from the food and microbiological aspect. In this way, there is a need to use a new modern technology that stands out as one of the most important components in the production chain. In line with what has been said so far, the link which stands out as an element of special importance is the microbiological hygienic correctness during the whole production process which is in direct dependence on the maintenance of the hygiene of all the equipment and apparatus involved in the transformation of the starting raw material to the finished product. This implies continuous control of the working conditions and the parameters envisaged for the respective operations, as a first step during the whole day and as the last step after the completion of the production, which would ensure the production of safe food and satisfy the needs and expectations of the consumers.

There are four main cleaning processes that are used within production processes:

- CIP (Cleaning-in Place)
- COP (Cleaning-out-of-place)
- Manual cleaning
- Cleaning with immersion

All these cleaning techniques have their own characteristics, and in order to meet all the necessary requirements, standards and regulations, they should constantly be perfected and complement each other. Starting from this fact, it is necessary to pay great attention to each separate segment that participates in the process, especially the sanitation which is one of the most critical moments of production and all this in order to maintain consumer confidence and to avoid negative publicity due to failures related to food safety, as well as to prevent economic losses in the operations arising as a result of inadequate execution of the procedures and procedures for maintaining the technological and microbiological quality of the food products.

The quality parameters of food products are made according to standard and prescribed methods according to the applicable national Rulebooks and EU Directives.

MATERIAL AND METHODS

The role of human resources in the process of hygienic sanitation was examined and determined that is a significant factor in the purification and production processes.

The three basic parameters of the CIP system - time, flow and concentration used in the dairy were examined, because of their significance in machine cleaning of the equipment.

The extent of changes in the recycling solvents-base and acid, which was used to perform the machine cleaning of the equipment, was investigated. The success of the cleaning of production equipment, both on the one that has been cleaned manually and on the equipment that is cleaned by machine, has been fully investigated.

The bacteriological correctness of the cleaned surfaces was also examined. In addition, five points were taken for taking swabs from the equipment that was cleaned manually and the same as the equipment cleaned by machine.

Finally, the bacteriological correctness of the finished products – cow yellow cheese - was examined.

Test Material

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All experimental samples were correctly and timely taken for analysis. The sampling time was accurately observed, and the control points for the effectiveness and success of the hygienic sanitation regime applied were laid down in the rulebooks used during the work. The results obtained are comparable with the results of other researchers

RESULTS AND DISCUSSION

Table 1 shows the habit of hand washing at the workplace among employees, according to 4 subcategories which are described in more detail in the table itself.

Table 1. Habit of hand washing, expressed in (%).

I wash my hands in the workplace	Reply %
-upon arrival	36.4
-before and after leaving	15.2
-after brushing nose, sneezing, coughing	27.3
-after touching the hair / skin	21.3

Table 2. Frequency for changing work clothing at the workplace, expressed in (%).

I change my work clothes	Reply %
-every day	25
-more times a day	16,7
-2-3 times a week	58,3
-once a week	0

From the result of the Table 2 it was confirm that each of the employees in production and the employees in charge of sanitary hygienic sanitation change their work clothes depending on the nature of the work tasks.

According to the results of comparison of the duration of each phase of cleansing with the CIP system in the US and Macedonia, shown in Table 3, it has been established that cleansing with CIP in the United States lasts (75 min) and in the Republic of North Macedonia (60 min) that in North Macedonia, it saves time, and the necessary cleaning effect is achieved.

Table 3. Comparison of the duration of each phase of cleansing with the CIP system in the Republic of North Macedonia and the US.

Comparison of duration							
Phases of the CIP system	I Phase		II Phase	III Phase	IV Phase	V Phase	Total duration (min)
	I sub-phase - cold tap water (min)	II sub-phase - hot water (min)	Base Wash (min)	Interphase rinse (min)	Wash with acid (min)	Final rinse (min)	
R. N. Macedonia	5	5	12.5	10	12.5	15	60
US	5	5	30	5	20	7.5	75

Table 4 shows that the flow of CIP cleaning in the Republic of N. Macedonia is (3m/s), and in the United States (1.5m/s), where it is determined that the flow velocity and duration of each phase in these two countries is inversely proportional, and the necessary effect with different parameters is achieved.

Table 4. Comparison of flow through pipes in each phase of cleansing with the CIP system in the United States, and Republic of North Macedonia.

Comparison of duration							
Phases of the CIP system	I Phase		II Phase	III Phase	IV Phase	V Phase	Total duration (min)
	I sub-phase - cold tap water (min)	II sub-phase - hot water (min)	Base Wash (min)	Interphase rinse (min)	Wash with acid (min)	Final rinse (min)	
R. N. Macedonia	3	3	3	3	3	3	3
US	1.5	1.5	1.5	1.5	1,5	1.5	1.5

From the comparison of the solubility of the solutions shown in Figure 1, it can be concluded that the blurring of the solution is greater with the base cleaning agent, which is probably due to the daily use immediately after the end of the production processes due to the milk deposits that have not been removed during rinsing with water, which is performed as a first step. While the acidification of the acid cleaning agent is much smaller than that of the base solution, since the acid as the agent is used after having been previously treated with a base agent, and furthermore it is characterized by a smaller number of recycled ones, once a week or about four times for thirty days.

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From the results shown in Figures 2 and 3, after the analysis, it can be determined that the colour of the litmus paper used as an indicator fully corresponds to the anticipated tint for a successful cleaning process, from which it can be concluded that the requirements for manual and machine cleaning of the production equipment.

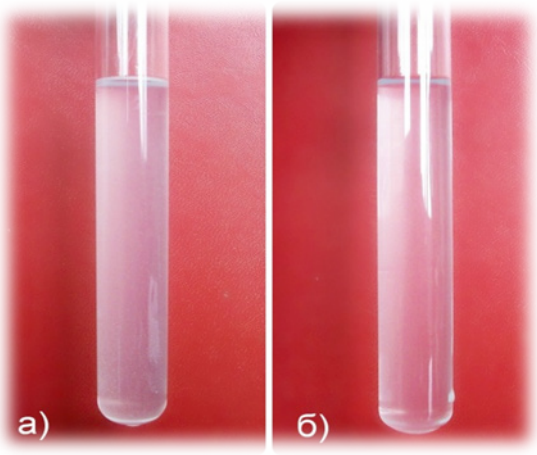

Figure1. Comparison of recycled solutions: (a) base solution and (b) acid solution.

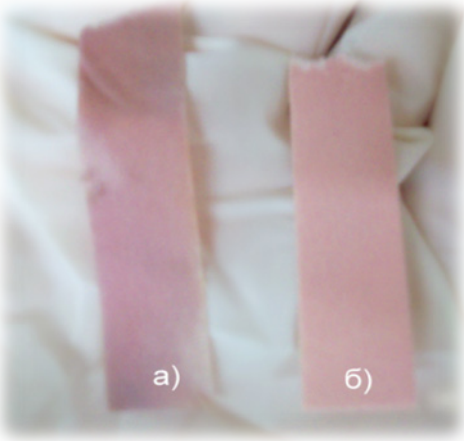

Figure 2. The litmus paper used for verification of manual cleaning, (a) after and (b) before the test.

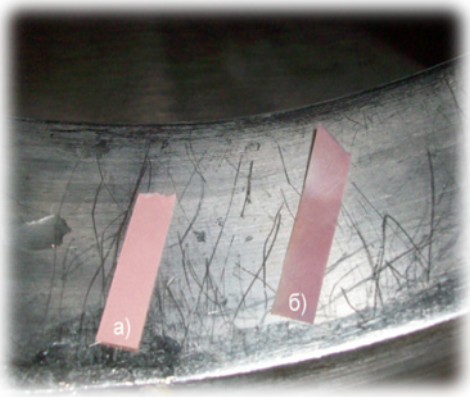

Figure 3. The litmus paper used to verify machine cleaning, (a) before (b) after the test.

Table 5. Presence of total number of bacteria and Enterobacteriaceae on areas subjected to manual cleaning (CFU / cm^2).

Working surfaces-cleaned manually	Type of bacteria	N	(CFU/cm2)	Sd	Min (CFU/cm2)	Max (CFU/cm2)	Cv (%)
Work desk	Total number of bacteria		5.7	7.4	0	14	130.1
	Enterobacteria	3	0	0	0	0	0
Molds	Total number of bacteria		1.3	1.2	0	2	86.6
	Enterobacteria	3	0	0	0	0	0
Prominent wheelbarrows	Total number of bacteria	3	2.7	2.9	1	6	108.3
	Enterobacteria		0	0	0	0	0
Stalk	Total number of bacteria	3	1.7	2.1	0	4	124.9
	Enterobacteria	3	0	0	0	0	0

From the results of the Table 5, it can be concluded that in none of the examined surfaces - work desk, moulds, prominent wheelbarrows and stalks treated with manual cleaning, contamination with Enterobacteriaceae has not been established. Regarding the total number of bacteria found on the investigated surfaces, it is noted that there is a certain number of occurrences, but within the permitted limits according to the milk policy.

Table 6: Presence of total number of bacteria and Enterobacteriaceae on surfaces subjected to machine cleaning (CFU / cm^2).

Working surfaces - cleaned by machine	Type of bacteria	N	(CFU/cm2)	Sd	Min (CFU/ cm2)	Max (CFU/ cm2)	Cv (%)
Machine / unit	Total number of bacteria		1.7	2.9	0	5	173.2
	Enterobacteria	3	0	0	0	0	0
Pasterizator	Total number of bacteria		0	0	0	0	0
	Enterobacteria	3	0	0	0	0	0
Filter	Total number of bacteria		0.3	0.6	0	1	173.2
	Enterobacteria	3	0	0	0	0	0
Vehicle tank	Total number of bacteria	3	0.7	0.6	0	1	86.6
	Enterobacteria		0	0	0	0	0
Raw milk storage tank	Total number of bacteria	3	0.7	1.2	0	2	173.2
	Enterobacteria		0	0	0	0	0

From the results of the Table 6, it can be concluded from none of the tested surfaces - machine / aggregate, pasteurizer, filter, vehicle tank, crude milk storage tank, which are treated with machine cleaning, as well as in the manual cleaning procedure, contamination with Enterobacteriaceae has not been established. Regarding the total number of bacteria found on the investigated areas, it is noted that there is an insignificant number within the permitted limits according to the milk policy.

From the obtained results of the microbiological analysis of the yellow cheese in the form of a finished product, it can be concluded that none of the analysed yellow cheese has not been established the presence of bacteria and therefore the quality of the product fully corresponds to the Rulebook of specific requirements for food safety in terms of microbiological criteria, Official Gazette of RM No. 78 of 2008.

The legal matter regulating the behaviours, the manner and the methods of production is regulated and certified as follows:

- Determination of fat content in milk (ISO 2446: 1976, ISO 488: 1983)
- 32008R1020, REGULATION OF THE COMMISSION (EC) No 1020/2008 of 17 October 2008 amending Annexes II and III to Regulation (EC) 2076/2005 of the European Parliament for the placing on the market of milk products
- Rulebook on the special requirements for safety and hygiene and the manner and procedure for performing official controls of milk and milk products-Official Gazette of RM 151/07 and Official Gazette of RM 93 from 12.07.2010
- Determination of acidity of milk (Rulebook on methods of physical and chemical analysis of milk and milk products Official Gazette of the SFRJ, No. 32/83)
- Determination of dry matter of milk (Rulebook on Methods of Physical and Chemical Analysis of Milk and Milk Products Official Gazette of the SFRJ, No. 32/83)

CONCLUDING REMARKS

The production of dairy products as a sector that our country participates with a good percentage in the gross domestic product, as well as the developed production capacities and products thereof, are subject of certification, standardization and regulation in accordance with the European positively applicable norms and directives. From the above stated it was necessary our rules, regulations and laws to become compatible with the European ones.

Hygienic sanitation in the dairy industry is the most critical operation in the milk processing processes and is extremely important for the complex production of hygienic products. Quality hygienic sanitation is conducted in accordance with the HACCP system and ISO standards, and for the best performing operations manual cleaning is increasingly being replaced by machine. In addition, with the CIP system, cleaning is carried out faster, with less labour and with reduced chemical risk for human health. In manual cleaning, visual inspection of the performed operation is provided, but it is necessary to increase the share of human labour. Finally, the overall sanitation of the plant, and hence the quality of the products implies continued engagement.

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ХИГИЕНСКАТА САНИТАЦИЈА ВО МЛЕКАРСКАТА ИНДУСТРИЈА ПРИ ПРОИЗВОДСТВО НА КРАВЈИ КАШКАВАЛ КАКО ФАКТОР ЗА ДОБИВАЊЕ НА ХИГИЕНСКИ ИСПРАВНИ ПРОИЗВОДИ ВО СОГЛАСНОСТ СО СТАНДАРДИТЕ НА ЕУ ЗА СТАНДАРДИЗАЦИЈА И СЕРТИФИКАЦИЈА

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Резиме

Процесите на хигиенска санитација во млекарската индустрија се носечки фактор за добивање на хигиенски исправни млечни производи.

Предмет на анализа се производната опрема, човечките ресурси и произведениот готов производ – кравји кашкавал, при чие производство поради примената на различните технологии на работа се користат различни постапки за санитација.

Испитувањата покажаа дека хигиенската санитација дава задоволителни резултати. Потврдени се одговорноста и позитивното влијание на вработените. Резултатите од испитуваната бактериолошка исправност на опремата покажаа поголем и подобар ефект при спроведување на машинското во споредба со рачното чистење. Од анализата на клучните параметри во CIP (Cleaning-In-Place) системот е утврдено дека пократкото времетраење на чистењето е во корелација со побрз проток и повисока температура и концентрација на средствата. Од рециркулирачките средства, база и киселина поголемо заматување се јавува кај базното средство. На крај, од испитуваната бактериолошка исправност на готовиот производ - кашкавал е потврдено дека производот е потполно хигиенски исправен и здрав за консумација.

Хигиенската санитација во млекарската индустрија е најкритична операција при млекопреработувачките процеси и има големо значење за добивање на квалитетен, здрав и хигиенски исправен готов производ.

Клучни зборови: *CIP-систем, човечки ресурси, производна опрема, готов производ.*