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Features of the HACCP plan development of the curd production

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Abstract: *Background: The introduction of the HACCP system into the production of curd is an effective tool for ensuring the safety of the dairy product. The description of the finished product has been carried out in accordance with the requirements of DSTU 4554: 2006«Curd. Specifications».*

MaterialsandMethods: Under the processing and development of the HACCP plan for the production of curds in accordance with the principles of HACCP, the provisions and recommendations of the state standards were followed: DSTU 4161: 2003 «Safety Management Systems for Food Products. Requirements» (Article 21. Requirements for the use of constantly operating procedures based on the principles of the HACCP system).

Results: For all products that are the subject of the HACCP system, it is necessary to create a scheme of production (technological) process - block diagram. The production process is a set of interconnected operations and activities from the moment of material resources receiving to the delivery of finished products to the consumer.

Conclusions: The development and implementation of the HACCP plan for the production of curds will provide Ukrainian dairy processing enterprises with a number of benefits: improving of the safety and quality of curds; confirmation of the product's conformity with normative and technical documentation; possibility to realize dairy product at the European market; increasing of consumers' confidence in the quality and safety of curds.

Keywords:*HACCP plan, curd, safety, biological hazards, chemical hazards, physical hazards, critical control points (CCP).*

INTRODUCTION

World community knows such quality assurance and food safety systems as: ISO 9000:2000 «Qualitymanagementsystems»; HACCP«Hazard Analysis Critical Control Points» (Risk Analysis System at Critical Control Points). The implementation of these systems in Ukraine is based on harmonized with international standards and national ones DSTU ISO 9001: 2001 «Quality Management Systems Requirements», (Bohatko et al. 2018;Dyman and Mazur2011).

Guidelines for the application of ISO 9001: 2001 and DSTU ISO 22000: 2007 «Food Safety Management Systems. Requirements to any organization of the food chain», DSTU 4161: 2003 «Safety Management Systems for Food Products. Requirements» refer to strategic decisions of the top management of the enterprise in order to increase the safety and competitiveness of domestic food products, which protects the interests and health of consumers, promotes expansion of markets in the domestic and world economic space, increases the credibility and image of Ukraine as a whole (Bohatko et al. 2018).

Nowadays the system of HACCP is the most effective system in the world, which makes it possible to guarantee the safety and quality of food products. The HACCP system is a preventive system for evaluating the control of dangerous factors (biological - B; chemical - Ch; physical - Ph) for the production of food products along the entire food chain, which greatly reduces the risks of life and health hazards (Burykina et al. 2003).

The HACCP plan is based on modern proven scientific data and available information, and is interrelated with a specific product and process.

The principles of the HACCP system, recommended for practical application by the Codex Alimentarius Commission, are mandatory for all food businesses.

Particularly relevant is the implementation of the HACCP system at dairy processing enterprises in connection with the peculiarities of dairy raw materials. Firstly, milk is a product of short-lived animal origin. Secondly, its storage and methods of making dairy products have their own specifics, different from other types of food products

Curds due to technological features of production is the product which is the most exposed to the development of a foreign micro flora. The purpose of the work was to develop a HACCP plan for the production of curds with a clear indication of the stages of the manufacturing process and the general classes of hazardous factors, which will guarantee the production of safe and high-quality food products.

MATERIALSANDMETHODS

ThematerialforresearchanddevelopmentoftheHACCPplanwasthecurds, thetechnologicalregimesofproductionandtheinvolvedtechnologicalequipment

Under the processing and development of the HACCP plan for the production of curds in accordance with the principles of HACCP, the provisions and recommendations of the state standards were followed: DSTU 4161: 2003 «Safety Management Systems for Food Products. Requirements»(Article 21. Requirements for the use of constantly operating procedures based on the principles of the HACCP system), DSTU ISO 22000: 2007 «Food Safety Management Systems. Requirements to any organization of the food chain», DSTU 4554: 2006 «Curds. Specifications».

RESULTS AND DISCUSSION

Curds is made by fermentation of pasteurized cow's milk, buttermilk or their mixture with fermentation agents using acid, acid-rennet or acid-heat coagulation of protein (DSTU 4554: 2006 «Curds. Specifications»).

Important qualitative characteristics and safety indicators of the finished product of curd are given in Table 1.

For all products that are the subject of the HACCP system, it is necessary to create a scheme of production (technological) process - block diagram (Yatsenko et al. 2016). The production process is a set of interconnected operations and activities from the moment of material resources receiving to the delivery of finished products to the consumer. In the block diagram (Fig. 1), all stages of the technological process of curd production are shown.

The next stage of the HACCP implementation is the identification, analysis and description of hazardous factors, which were carried out for three types of hazards (biological, chemical and physical). Risk analysis is a process that evaluates the degree of potential hazard and the possibility of its occurrence. Just these processes that determine the importance of this stage of research for the safety of curds (Galstyan andHarutyunyan 2016).

Under the production of curd simultaneously with starter cultures, the residual microorganisms of milk breed. Particularly undesirable is the development of heat-resistant lactobacillusi. As a result of their development, the acidity of curd increases to a greater extent than the development of mesophilic lactococci and the quality of the product is reduced (Holovko andRublenko2010;Berhilevych et al. 2010). Also, other harmful bacteria may get from technological equipment, which leads to the occurrence of flaws in curds of culture milk microbial origin (Table 2).

Table1Description of the finished product

1. 1.	2. Name of the product	Curds
3. 2.	4. Regulations	DSTU 4554: 2006 «Curds. Specifications»
5. 3.	6. Important characteristics	Consistency - soft, viscous or friable; Taste and smell – typical for culture milk, without foreign flavors and odors; The color is white or with a creamy shade, uniform along the whole weight. Mass fraction of fat is over 2 % to 18 % Bulk protein content is not less than 14 % Mass fraction of moisture is from 65 up to 80 % Acidity is titrated in the range from 170 °T up to 250 °T
7. 4.	8. Demands of safety	Number of lactic acid bacteria, CFU in 1 g of product, not less than $1 \cdot 10^6$; Bacteria of the colon bacillus group (coliform): in 0,001 g of product with a shelf life not exceeding 72 hours; in 0,01 g of product with a shelf life of more than 72 hours is not allowed; the amount of mold fungus, CFU in 1 g of product, not more than 50; amount of yeast, CFU in 1 g of product, not more than 100; Pathogenic microorganisms, in particular Salmonella, in 25 g of product is not allowed; *Staphylococcusaureus*in 0,01 g of the product is not allowed. Toxic elements, mg / kg, not more than: Lead – 0,3; Cadmium – 0,2; Arsenic – 0,2; Mercury – 0.02
4.	Direction for the product has to be used	It is designated for direct food and production of other food products
5.	Packing (consumers' andtare)	Parchment of brand B; aluminum foiled paper; polyethylene film; cups of polymer or composite material; metal flasks; carton and polymer boxes
6.	Conditions and terms of storage	In refrigerators or refrigerating chambers at a temperature not exceeding 6 °C: – Packed in flasks, bottles, boxes - no more than 36 hours; – In the case of parchment packaging - no more than 3 days; – In the case of packaging in consumer containers of polymeric materials, aluminum foiled paper and polyethylene film – no more than 7 days.
7.	Mode of the product's realization	In retail and dining facilities

8.	Instructions for marking	Name of the product which indicates the mass fraction of fat, the name and address of the manufacturer and place of manufacture, the net weight of the packaging unit, the composition of the product in the order of the benefits of the ingredients, information data about the nutritional and energy value of 100 grams of the product, the final date of consumption "Take up" or date of production and expiration date, storage conditions, marking standard, trademark (if any), EAN bar code from DSTU 3147
9.	Proof of safety	Availability of a qualitative certificate

To allocate a dangerous factor at a certain stage of production, it is necessary to use the «decision tree» (A manualforsmallandmediumenterprisesofthedairyindustryonthepreparationandimplementationof a foodsafetymanagementsystembasedontheconceptof HACCP, 2010), which provides a thorough analysis of the production condition, in particularanalysis of the definition of risks in raw materials (Fig. 2).

Milk receiving

↓

Cleaning, cooling, storage of whole milk,

t–(4±2) °C, τ=not more than 6 hours

↓

Heating, separation, standardization according to the weight fraction of fat, taking into account the mass fraction of protein

↓

Pasteurization of standardization or skimmed milk,

t–(78±2) °C with an exposure of 20–30 c

↓

Cooling to the temperature of fermentation,

t-28-30 °C – during the warm period of the year;

t-30-32 °C – during the cold period of the year

Addition of starter culture(1-5% of the milk volume) and 30–40% $CaCl_2$ solution (400 g of anhydrous salt per 1000 kg of milk)

↓

Fermentation,

τ=8–12 hours prior getting of clot with acidity (75–85) °T

↓

Processing of curd clot: cutting into cubes with dimension at the edge of about 2cm or mixing, warming the clot up to t-55-60 °C with an exposure of 30-50 minutes

↓

Wheying-off and protein mass pressing

↓

Cooling of curds,t–3–8 °C

↓

Prepacking, packaging

↓

Storage of curds,t–4±2 °C

↓

Realization

Fig. 1. Block diagram of the technological process of curds production

Milk is an ideal nutrient medium for microorganisms, so breaking of the technological regimes of its processing helps to increase the amount of bacteria. Dairy raw materials may contain different amounts of microorganisms that have different properties and belong to different systematic groups. However, at the next stages of milk processing, microorganisms die during heating and pasteurization, that is, their development can be limited by the action of high temperature. Therefore, the answer to the second question about the danger of growth of a dangerous factor in dairy raw materials is negative. At the next stages, the level of milk contamination will also decrease.

Chemicals can get into raw materials for dairy products at the stage of obtaining and primary processing, that is, raw milk and in the process of processing. The source of chemical danger at the stage of obtaining raw milk may be washing and disinfection of milking equipment, residues of medicinal preparations, pesticides, heavy metals, nitrates, nitrites, and so on. Chemical hazards that may occur at the stage of production of curds: the use of additional permitted substances in excess doses (nutritional additions, stabilizers, etc.); application of chemical agents at inappropriate concentrations; improper operation of technological equipment and equipment (lubricants, metal dust, etc.) (Hachak and Slyvka 2017).

Table 2. Biological hazards of curd production

Bakteria flora	Characteristic
Microorganisms after pasteurization	Heat-resistant lactobacillusi
Microorganisms which have got from the technological equipment	Thermophilic lactobacillusi, acetic acid bacteria, bacteria of the intestinal stem, spore and nonspore-forming putrefactive bacteria
Sanitary-demonstrative	Mesophilic aerobic and optional anaerobic microorganisms (MAOAnM), bacteria of the E. coli group (BECG)
Conditionally pathogenic	Staphylococcus, Clostridium
Pathogenic	Salmonella enteritidis, Listeria monocytogenes
Bacteria flora of starter cultures and probiotics in products with normalized levels of biotechnological bacteria flora	Mesophyllactococci, aroma-forming leuconostocs, thermophilic streptococci, propionic acid bacteria, yeast, bifidobacteria, acidophilic bacteria

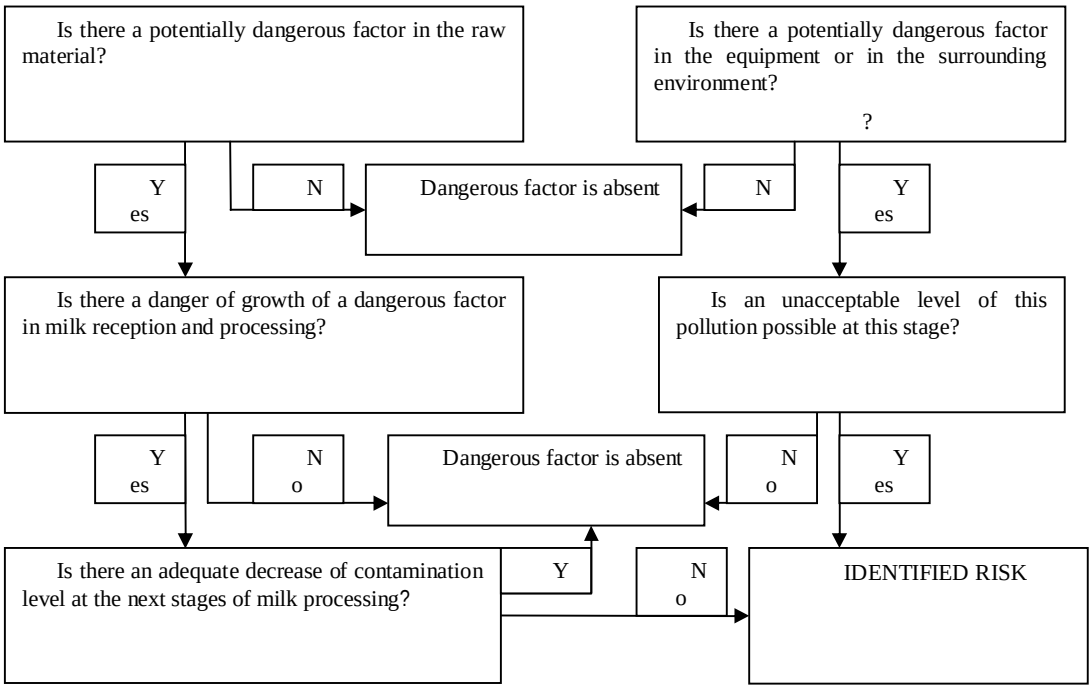

Fig. 2. The «Tree of decision-making» to determine the risks in dairy raw materials

Physical dangers arising within the production of dairy products, in particular, curds, may be the consequence of inadequate hygienic and production practices of the personnel, improper removal of packaging waste, lack of protection against insects and rodents (Mardar et al. 2018).

After identification and hazardous factors grouping, critical control points are considered and identified. Critical Control Point (CCP) – is the place, stage or step (raw material, process operation, product recipe, or process) that can be monitored to prevent, eliminate or reduce the risk of food hazards to an acceptable level (Mikiychuk andOstapjuk2017). Control is required at all points during the technological process, but critical points are only those where there is a threat to product safety.

The establishing of critical control points determines whether hazards are completely controlled by the general hygiene standards and rules with the help of the following questions (Yatsenko et al. 2016, Millan et al. 2016) (Table 3).

Table 3. Determination of critical control points in the production of curds

Input Process / Stage of the Process	Type and identified danger	Question 1	Question 2	Question 3	Question 4	CCP number
Milk taking, refining, cooling of raw milk	B - contamination by microorganisms from equipment, other raw materials	Yes	N/A*	Yes	No	CCP 1B
	Ch- antibiotics, pesticides, disinfectants and detergents	Yes	N/A*	Yes	No	CCP 1Ch
	Ph - harmful and foreign impurities	Yes	N/A*	Yes	No	CCP 1Ph
Backing of raw milk	B - contamination by microorganisms from the equipment	Yes	No	Yes	No	CCP 2B

	Ch – disinfectant and cleaning agents	Yes	No	No	No	CCP 2Ch
	Ph - harmful and foreign impurities	Yes	No	No	Yes	CCP 2Ph
Heating, separation, standardization	B - contamination by microorganisms during contact with other raw materials, equipment	Yes	Yes	No	Yes	CCP 3B
	Ch – disinfectant and cleaning agents	Yes	No	Yes	No	CCP 3Ch
	Ph - harmful and foreign impurities	Yes	Yes	Yes	No	CCP 3Ph
Pasteurization	B-thermo tolerant microorganisms, spore-forming bacteria, enterococci, bacteriophages	Yes	Yes	No	No	CCP 4B
	Ch – disinfectant and cleaning agents	Yes	Yes	Yes	No	CCP 4Ch
	Ph - harmful and foreign impurities	No	No	No	No	–
Cooling, addition of starter culture, fermentation in curds-making baths	B-thermo-tolerant microorganisms (Lactobacillus), bacteriophages, microorganisms from the curds-making bath	Yes	No	Yes	No	CCP 5B
	Ch – disinfectant and cleaning agents	Yes	No	Yes	No	CCP 5Ch
	Ph - harmful and foreign impurities	Yes	No	Yes	No	CCP 4Ph
Curdclot treatment	B - bacteriophages, microorganisms from the equipment	Yes	No	Yes	No	CCP 6B
	Ch – disinfectant and cleaning agents	Yes	No	Yes	No	CCP 6Ch
	Ph - harmful and foreign impurities	Yes	No	Yes	No	CCP 5Ph
Wheying-off and protein mass pressing, cooling of the curd	B – bacteria flora of starter culture, microorganisms from the equipment	Yes	No	Yes	No	CCP 7B
	Ch – disinfectant and cleaning agents	Yes	No	Yes	No	CCP 7Ch
	Ph - harmful and foreign impurities; violation of temperature regimes	Yes	No	Yes	No	CCP 6Ph
Packing and packaging of curd	B -contamination of microorganisms from packing equipment and packing material	Yes	No	Yes	No	CCP 8B
	Ch – disinfectant and cleaning agents	Yes	No	Yes	No	CCP 8Ch
	Ph - harmful and foreign impurities; violation of temperature regimes	Yes	No	Yes	No	CCP 7Ph

Storage of the finished product	Ph - violation of temperature regimes	Yes	Yes	Yes	No	CCP 8Ph

Note: *N/A – not applicable

Question 1: Are there precautionary measures?

Question 2: Is the operation specifically designed to eliminate or reduce the possibility of a dangerous factor to an acceptable level?

Question 3: Can contamination from the identified hazards exceed acceptable levels, or whether they can increase to unacceptable levels?

Question 4: Will the next operation remove the identified hazards or lower the possibility of its occurrence to an acceptable level?

Development of HACCP plan also includes establishing of critical limits, monitoring and corrective actions (Table 4).

CONCLUSIONS

The development and implementation of the HACCP plan for the production of curds will provide Ukrainian dairy processing enterprises with a number of benefits: improving of the safety and quality of curds; confirmation of the product's conformity with normative and technical documentation; possibility to realize dairy product at the European market; increasing of consumers' confidence in the quality and safety of curds.

Education is a core of the public life, including cultural, which unites and cements the society, indicates the future development and ensures this development enables the society to have protected its competitive place in the global division of labor that maintains social stability. The system of education is a complex social instrument of solving social problems, modernization and optimization of public life, integration of the entire community, the continuity of the educational process throughout life, providing competitive advantage and appropriate future for each subject of the educational space.

The methodological basis of research are scientific notions of universal connection and mutual conditionalism of phenomena, the basis of which pedagogical artistry should be considered as a whole, which combines acting, directing skills, personal and professional quality, professional ability. For the content and structure analysis of pedagogical artistry of high schools teachers were used a system-structural, personal approach that allowed us to reflect the diversity of the studied phenomenon.

The development of different aspects of the problem of pedagogical artistry was in-volved in such famous scientists as I. V. Adoevtseva [1], O. S. Bulatova [2], V. I. Zagvyazinsky [3], etc. At the beginning of the XX century A. S. Makarenko [4], S. T. Shatsky [5] considered the artistry of the teacher as a combination of actors and directors skill in pedagogical activity.

Great domestic representatives of the theatrical art [6, 7, 8] were not only brilliant writers, directors and actors, but also great educators, who in their writings laid down the basic approaches to the formation of creative personality. It should be noted that in the last decade had appeared psychological researches aimed at the formation of the pedagogical artistry of students, who will be teachers in future [9, 10].

Gender features of formation and development of personality in education have been researched by such scholars as J. B. Bagicheva [11], E. N. Kamenskaya [12], I. F. Igropoulo& U. V. Sorokopud [13], L. N. Nadolinskya[14], Z. N. Dyuldina& A. Y. Skorobogatova [15], L. A. Lukinskaya& V. A. Shupina [16], T. N. Vepreva [17], R. R. Saifullova et al. [18] and etc. However, the problem of gender- sexual aspect of pedagogical artistry of high school teachers remains in educational psychology least developed.

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