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Open Food Innovation University (OFINU)

DESCRIPTION OF STUDY MODULE
“MILK PROCESSING TECHNOLOGY”

2024

Summary

The study course is elaborated within the project “Open Food Innovation University" (OFINU), being in implementation with support of the European Union Erasmus+ Programme.

Overall objective of the project - to modernise food innovation and technology related higher education in Uzbekistan and Tajikistan, thereby increasing the quality and ensuring relevance of the higher education to the needs of the socio-economic growth of the countries concerned and especially of their regions.

Full partners:

- Lead partner: Latvia University of Life Sciences and Technologies
- Uzbekistan: Samarkand Agro-innovations and Research University, Andijan Institute of Agriculture and Agro-technologies
- Tajikistan: Technological University of Tajikistan, Kulob Institute of Technology and Innovation Management, Isfara Branch of the Technological University of Tajikistan
- Slovakia: Slovak University of Agriculture in Nitra

Associated partners in Uzbekistan:

- A group of companies "AGROMIR"
- "Navigul" MCHJ QK
- “Samarqand don mahsulotlari” JC (Samarkand grain products)

Associated partners in Tajikistan:

- CJSC “Combinati Shiri Dushanbe”
- LTD "Orion Rustam"
- Association of Entrepreneurs of Khatlon

The project implementation period: 01/02/2024 - 31/01/2027.

Funded by the European Union. Views and opinions expressed are however those of the authors only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

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P2 SAMARU. Samarkand Agroinnovations and Research University

Shakhista Ishniyazova - milk processing technology.

Jurabek Nuraliev - dairy processing equipment.

P3 AIAA. Andijan Institute of Agriculture and Agro-technologies

Rakhim Mirzaev - milk processing technology.

P4 TUT. Technological University of Tajikistan

Khurshed IKROMI - milk processing technology.

P5 KITIM. Kulob Institute of Technology and Innovation Management

Mirzo AZIZOV - milk processing technology.

P6 BTUTI. Branch of the Technological University of Tajikistan in the city of Isfara

Kimyohon Musayamova - milk processing technology.

P7 SUA. Slovak University of Agriculture in Nitra

Miroslav Šlosár - microbiology of dairy products.

INTRODUCTION

Study module "**Milk processing technology**" has been developed for bachelor, master students and for people who are involved in milk processing branch.

Aim and objectives of the study subject is to create an understanding of the modern production of dairy products. Particular attention is devoted to the development of practical skills for testing of sensory, physicochemical and microbiological quality parameters for dairy products; understanding the causes of product defects; learning the operational principles of technological equipment used in the manufacture of dairy products, including packaging, and measures for product safety monitoring.

Learning outcomes:

- ***Knowledge*** Will be familiar with the essential information on the manufacturing technologies for dairy products, the operation of technological equipment, packaging technologies and materials for the period of validity.
- ***Skills*** Will be able to explain the causes of product defects and their prevention capabilities by linking milk composition, quality and technological processes, competence in the quality control and risk management of dairy products, development of innovative products.
- ***Competence***. Will be capable of: collecting and analysing the information obtained; addressing problems related to the dairy sector; accepting appropriate, acting individually and within the team.

Study Plan for module “Milk processing technology” in Uzbekistan

Themes	Number of hours			
	Total	Lectures	Practical works	Independent work of the student
Theme 1. Chemical composition and quality of milk.	58	12	12	34
Theme 2. Milk processing – different treatment methods, milk and cream.	48	8	12	28
Theme 3. Fermented dairy products: production and quality evaluation.	56	10	14	32
Theme 4. Butter and ice cream: production technology and quality evaluation.	42	6	10	26
Theme 5. Cheese: classification, production technology, quality assessment.	74	14	12	48
Theme 6. Milk products with long shelf-life.	24	4	6	14
Theme 7. By-products: quality parameters, processing options.	36	8	8	20
Theme 8. HACCP in dairy processing companies.	22	-	8	14
TOTAL	360	62	82	216

Study Plan for module “Milk processing technology” in Tajikistan

Themes	Number of hours			
	Total	Lectures	Practical works	Independent work of the student
Theme 1. Chemical composition and quality of milk.	52	8	8	36
Theme 2. Milk processing – different treatment methods, milk and cream.	44	6	8	30
Theme 3. Fermented dairy products: production and quality evaluation.	48	6	8	34
Theme 4. Butter and ice cream: production technology and quality evaluation.	38	4	8	6
Theme 5. Cheese: classification, production technology, quality assessment.	72	8	12	52
Theme 6. Milk products with long shelf-life.	20	2	4	14
Theme 7. By-products: quality parameters, processing options.	30	4	6	20
Theme 8. HACCP in dairy processing companies.	20	-	6	14
TOTAL	324	38	60	226

Thematic Study Plan for module "Milk Processing Technology"

Date, Time	Study form	Theme	Lecturer
Theme 1 Chemical composition and quality of milk			
1st day	Lecture (1h)	1. L. Preliminary lecture. Introduction in the study course	
	Lecture (2h)	Synthesis and secretion of milk, composition (milk of different agricultural animals), production (breakdown by country, production volumes, prices)	
	Laboratory work (3h)	Analysis of the chemical composition of milk (protein, fat, lactose, dry matter content by different methods).	
2nd day	Lecture (4h)	Characteristics of individual milk ingredients (water, protein (distribution techniques), lipids, lactose, vitamins, minerals, enzymes, bactericides and antibodies).	
	Laboratory work (3h)	Milk protein coagulation techniques.	
3rd day	Lecture (2h)	Milk quality, regulatory legislation, internal company standards and requirements.	
	Laboratory work (2h)	Microbiological quality analysis (total, enterobacteria, lactic acid bacteria) and milk storage temperature.	
4th day	Lecture (2h)	Milk sensory, physicochemical, and microbiological indicators, quality factors. Quality control needs and capabilities.	
	Laboratory work (2h)	The importance of milk quality (acidity, pH determination, freezing temperature, antibiotic presence with different method).	
	Seminar (1h)	Evaluation of results obtained during laboratory work	
Theme 2 Milk processing – different treatment methods, milk and cream			
5th day	Lecture (2h)	Mechanical (cooling, filtration, separation, bactofugation, microfiltration, standartisation, decontamination) and heat treatment (types, meaning, affecting milk ingredients) of milk.	
	Laboratory work (3h)	Milk separation, standartisation, calculations, determination of fat content, preparation of normalized mixture, homogenisation.	
6th day	Lecture (3h)	General equipment (tanks, meters, pumps, washing). Machinery for mechanical and thermal treatment of milk, principle of operation.	

	Laboratory work (3h)	Machinery for mechanical and thermal treatment of milk, principle of operation.	
7th day	Lecture (2h)	Acquisition of heat-treated milk and cream.	
	Laboratory work (5h)	Calculation of heat treatment regimes, verification of effectiveness and impact on milk quality.	
Theme 3 Fermented dairy products: production and quality evaluation			
8th day	Lecture (3h)	Characteristics of technology, main components of acid milk drinks.	
	Laboratory work (5h)	Verification of starter and the effects of various factors on the quality of acid milk products, analysis of lactic acid bacteria.	
9th day	Lecture (2h)	Manufacture of dairy products.	
	Laboratory work (3h)	Assessment of factors affecting whey syneresis, assessment of the quality of cottage cheese.	
	Laboratory work (1h)	Sensory evaluation of fermented dairy products.	
10th day	Lecture (2h)	Equipment for production fermented products.	
	Laboratory work (2h)	Equipment for production fermented products.	
	Seminar (2 h)	Evaluation of laboratory works results, discussion.	
11th day	Excursion	Visit to milk processing company: fermented dairy products.	
Theme 4 Butter and ice cream: production technology and quality evaluation			
12th day	Lecture (2h)	Packaging materials, equipment, principles for dairy products (liquid and paste).	
	Laboratory work (2h)	Selection and machinery of packaging materials for products.	
13th day	Lecture (3h)	Classification of ice cream, raw materials, recipes, calculations, production, ice cream equipment.	
	Laboratory work (1h)	Ice cream preparation and quality assessment.	
	Laboratory work (2h)	Principles for the operation of refrigeration and refrigeration equipment.	
14th day	Lecture (3h)	Classification, quality and production of butter and its products, butter-making facilities.	
	Laboratory work (3h)	Preparation and quality assessment of butter.	
Theme 5 Cheese: classification, production technology, quality assessment			
15th day	Lecture (6h)	Cheese, manufacturing processes, assistive products, equipment.	
	Seminar (2h)	Cheese variation students reports.	

16th day	Lecture (2h)	Cheese production technology, biochemical processes for cheese ripening.	
	Laboratory work (4h)	Preparation of cheese, evaluation of cheese quality and microflora.	
17th day	Lecture (4h)	Packing, types, materials, equipment of preserved butter, cheese and milk.	
	Laboratory work (3h)	Fresh cheese production.	
	Laboratory work (2h)	Product packaging solutions.	
18th day	Lecture (4h)	Principles, methods, standards for the sensory evaluation of milk products.	
	Laboratory work (3h)	Sensory evaluation of dairy products.	
19th day	Excursion	Visit to milk processing company: cheese production	
Theme 6 Milk products with long shelf-life			
20th day	Lecture (4h)	Milk conservation technology, plants.	
	Laboratory work (4h)	Operation of evaporation and drying equipment, newest solutions. Evaluation of the quality of condensed milk.	
Theme 7 By-products: quality parameters, processing options			
21th day	Lecture (2h)	By-products of the milk industry, processing technologies and plants.	
	Laboratory work (3h)	Principles for the operation of membrane equipment and use of derived products to create new products.	
Theme 8 HACCP in dairy processing companies			
22th day	Practical work (8h)	Product safety, definition and monitoring of control and critical control points.	

Themes and their summary in study module “Milk processing technology”

Theme 1. Chemical composition and quality of milk

Issues to be covered in lectures

1. Synthesis and secretion of milk, composition (milk of different agricultural animals), production (breakdown by country, production volumes, prices).
2. Characteristics of individual milk ingredients (water, protein (distribution techniques), lipids, lactose, vitamins, minerals, enzymes, bactericides and antibodies).
3. Milk quality, regulatory legislation, internal company standards and requirements.
4. Milk sensory, physicochemical and microbiological indicators, quality factors. Quality control needs and capabilities.

Issues to be covered in the practical or laboratory works

1. Analysis of the chemical composition of milk (protein, fat, lactose, dry matter content by different methods).
2. Milk protein coagulation techniques.
3. Microbiological quality analysis (total, enterobacterea, lactic acid bacteria) and milk storage temperature.
4. The importance of milk quality (acidity, pH determination, freezing temperature, antibiotic presence with different method).

Topics of independent work:

1. Evaluation of laboratory works results, comparison quality parameters of raw milk with legislation, data analysis and evaluation.

Literature and data bases on the theme

- Крусь, Г.Н, Храмцов, А. Г., Волокитина, Э. В., Карпычев, С. В. (2006). Технология молока и молочных продуктов. Колос.
- Бредихин С.А., Космодемьянский Ю.В. (2003). Технология и техника переработки молока. Колос.
- Востроилов, А.В., Семёнова, И.Н. (2010). Основы переработки молока и экспертиза качества молочных продуктов. ГИОРД.
- Qo‘chqarov O‘.R (2003) Chorvachilik mahsulotlarining davlat standartlariga mosligini aniqlash asoslari. Cho‘lpon.
- Fayziyev, J.S. (2019). *Sut va sut mahsulotlari texnologiyasi.* Toshkent.

Theme 2. Milk processing – different treatment methods, milk and cream

Issues to be covered in the lectures

1. Mechanical (cooling, filtration, separation, bactofugation, microfiltration, standartisation, decontamination) and heat treatment (types, meaning, affecting milk ingredients) of milk
2. General equipment (tanks, meters, pumps washing).
3. Machinery for mechanical and thermal treatment of milk, principle of operation.
4. Acquisition of heat-treated milk and cream.

Issues to be covered in the practical or laboratory works

1. Milk separation, standardisation, calculations, determination of fat content, preparation of normalized mixture, homogenisation.
2. Machinery for mechanical and thermal treatment of milk, principle of operation (3 h, T.e.,T.eL).
3. Calculation of heat treatment regimes, verification of effectiveness and impact on milk quality.

Themes of independent work

Evaluation of laboratory works results, evaluation and analysis of data about standardisation procedure, , conclusions about heat treatment influence on milk quality parameters, comparison with data from literature.

Literature and data bases on the theme

- Dairy processing handbook (1995), Sweden: TetraPak. https://archive.org/details/DairyProcessingHandbookTetrapak
- Крусь, Г.Н, Храмцов, А. Г., Волокитина, Э. В., Карпычев, С. В. (2006). Технология молока и молочных продуктов. Колос.
- Бредихин С.А., Космодемьянский Ю.В. (2003). Технология и техника переработки молока. Колос.
- Востроилов, А.В., Семёнова, И.Н. (2010). Основы переработки молока и экспертиза качества молочных продуктов. ГИОРД.
- O‘.R (2003) Chorvachilik mahsulotlarining davlat standartlariga mosligini aniqlash asoslari. Cho‘lpon.
- Fayziyev, J.S. (2019). *Sut va sut mahsulotlari texnologiyasi.* Toshkent.

Theme 3. Fermented dairy products: production and quality evaluation

Issues to be covered in the lectures

1. Characteristics of technology, main components of acid milk drinks.
2. Manufacture of dairy products.
3. Equipment for production of fermented products.

Issues to be covered in the practical or laboratory works

1. Verification of starter and the effects of various factors on the quality of acid milk products, analysis of lactic acid bacteria.
2. Assessment of factors affecting whey synereses, assessment of the quality of cottage cheese.
3. Sensory evaluation of fermented dairy products.
4. Analysis of equipment for production of fermented products.

Themes of independent work

Evaluation of laboratory work results: temperature, starter amount and cultures influence on final product quality, analysis of pasteurisation temperatures and coagulation techniques on whey syneresis process and quality of cottage cheese. Comparison cottage cheese quality parameters obtained using chemical methods and sensory evaluation of the final product.

Literature and data bases on the theme

- Dairy processing handbook (1995), Sweden: TetraPak. https://archive.org/details/DairyProcessingHandbookTetrapak
- Крусь, Г.Н, Храмцов, А. Г., Волокитина, Э. В., Карпычев, С. В. (2006). Технология молока и молочных продуктов. Колос.
- Бредихин С.А., Космодемьянский Ю.В. (2003). Технология и техника переработки молока. Колос.
- Востроилов, А.В., Семёнова, И.Н. (2010). Основы переработки молока и экспертиза качества молочных продуктов. ГИОРД.
- Qo‘chqarov O‘.R (2003) Chorvachilik mahsulotlarining davlat standartlariga mosligini aniqlash asoslari. Cho‘lpon.
- Fayziyev, J.S. (2019). *Sut va sut mahsulotlari texnologiyasi.* Toshkent.
- CHR Hansen, part of novonesis (2024, October 3). https://www.chr-hansen.com

Theme 4. Butter and ice cream: production technology and quality evaluation

Issues to be covered in the lectures

1. Packaging materials, equipment, principles for dairy products (liquid and paste).
2. Classification of ice cream, raw materials, recipes, calculations, production, ice cream equipment.
3. Classification, quality and production of butter and its products, butter-making facilities.

Issues to be covered in the practical or laboratory works

1. Selection and machinery of packaging materials for products.
2. Ice cream preparation and quality assessment.
3. Principles for the operation of refrigeration and refrigeration equipment.
4. Preparation and quality assessment of butter.

Topics of independent work

1. Evaluation of butter quality results obtained during laboratory work and comparison with legislation and data on butter labels; explore butter and other similar products evaluable in the market and detect differences in chemical composition.
2. Explore the dairy packaging market

Literature and data bases on the theme

- Dairy processing handbook (1995), Sweden: TetraPak. https://archive.org/details/DairyProcessingHandbookTetrapak
- Крусь, Г.Н, Храмцов, А. Г., Волокитина, Э. В., Карпычев, С. В. (2006). Технология молока и молочных продуктов. Колос.
- Бредихин С.А., Космодемьянский Ю.В. (2003). Технология и техника переработки молока. Колос.
- Востроилов, А.В., Семёнова, И.Н. (2010). Основы переработки молока и экспертиза качества молочных продуктов. ГИОРД.
- Qo‘chqarov O‘.R (2003) Chorvachilik mahsulotlarining davlat standartlariga mosligini aniqlash asoslari. Cho‘lpon.
- Fayziyev, J.S. (2019). *Sut va sut mahsulotlari texnologiyasi.* Toshkent.

Theme 5. Cheese: classification, production technology, quality assessment

Issues to covered in the lectures

1. Cheese, manufacturing processes, assistive products, equipment.
2. Cheese production technology, biochemical processes for cheese ripening.
3. Packing, types, materials, equipment of preserved butter, cheese and milk.
4. Principles, methods, standards for the sensory evaluation of milk products.

Issues to be covered in the practical or laboratory works

1. Preparation of cheese, evaluation of cheese quality and microflora.
2. Fresh cheese production.
3. Sensory evaluation of dairy products.

Topics of independent work

1. Evaluation of laboratory work “Preparation of cheese” results, explanation, obtained data analysis in discussions about usual mistakes during cheese production and possibilities to solve it.
2. Students report about Cheese variation.
3. Explore the cheese packaging solutions.

Literature and data bases on the theme

- Dairy processing handbook (1995), Sweden: TetraPak. https://archive.org/details/DairyProcessingHandbookTetrapak
- Крусь, Г.Н, Храмцов, А. Г., Волокитина, Э. В., Карпычев, С. В. (2006). Технология молока и молочных продуктов. Колос.
- Бредихин С.А., Космодемьянский Ю.В. (2003). Технология и техника переработки молока. Колос.
- Востроилов, А.В., Семёнова, И.Н. (2010). Основы переработки молока и экспертиза качества молочных продуктов. ГИОРД.
- Qo‘chqarov O‘.R (2003) Chorvachilik mahsulotlarining davlat standartlariga mosligini aniqlash asoslari. Cho‘lpon.
- Fayziyev, J.S. (2019). *Sut va sut mahsulotlari texnologiyasi.* Toshkent.
- CHR Hansen, part of novonesis (2024, October 3). https://www.chr-hansen.com

Theme 6. Milk products with long shelf-life

Issues to be covered in the lectures

1. Milk conservation technology, plants, equipment.
2. Milk powder.
3. Condensed milk with sugar.
4. Canned milk.

Issues to be covered in the practical or laboratory works

1. Evaluation of the quality of condensed milk, milk powder

Topics of independent work

1. Operation of evaporation and drying equipment, newest solutions

Literature and data bases on the theme

- Dairy processing handbook (1995), Sweden: TetraPak. https://archive.org/details/DairyProcessingHandbookTetrapak
- Крусь, Г.Н, Храмцов, А. Г., Волокитина, Э. В., Карпычев, С. В. (2006). Технология молока и молочных продуктов. Колос.
- Бредихин С.А., Космодемьянский Ю.В. (2003). Технология и техника переработки молока. Колос.
- Востроилов, А.В., Семёнова, И.Н. (2010). Основы переработки молока и экспертиза качества молочных продуктов. ГИОРД.
- Qo‘chqarov O‘.R (2003) Chorvachilik mahsulotlarining davlat standartlariga mosligini aniqlash asoslari. Cho‘lpon.
- Fayziyev, J.S. (2019). *Sut va sut mahsulotlari texnologiyasi.* Toshkent.

Theme 7. By-products: quality parameters, processing options

Issues to be covered in the lectures

1. By-products of the milk industry, processing technologies and plants.

Issues to be covered in the practical or laboratory works

1. Principles for the operation of membrane equipment and use of derived products to create new products.

Themes of independent work:

1. Analysis of the products, which will be possible to produce from by-products.
2. Calculations of new type product development.

Literature and data bases on the theme

- Dairy processing handbook (1995), Sweden: TetraPak. https://archive.org/details/DairyProcessingHandbookTetrapak
- Крусь, Г.Н, Храмцов, А. Г., Волокитина, Э. В., Карпычев, С. В. (2006). Технология молока и молочных продуктов. Колос.
- Бредихин С.А., Космодемьянский Ю.В. (2003). Технология и техника переработки молока. Колос.
- Востроилов, А.В., Семёнова, И.Н. (2010). Основы переработки молока и экспертиза качества молочных продуктов. ГИОРД.
- Qo‘chqarov O‘.R (2003) Chorvachilik mahsulotlarining davlat standartlariga mosligini aniqlash asoslari. Cho‘lpon.
- Fayziyev, J.S. (2019). *Sut va sut mahsulotlari texnologiyasi.* Toshkent.

Theme 8. HACCP in dairy processing companies

Issues to be covered in the lectures

1. Product safety, definition and monitoring of control and critical control points.

Issues to be covered in the practical or laboratory works

1. Examples of monitoring of control and critical control points.

Literature sources

1. Крусь, Г.Н, Храмцов А. Г., Волокитина, Э. В., Карпычев, С. В. (2006). *Технология молока и молочных продуктов*. Колос.
2. Бредихин, С.А., Космодемьянский, Ю.В. (2003). *Технология и техника переработки молока*. Колос.
3. Востроилов, А.В., Семёнова, И.Н. (2010). *Основы переработки молока и экспертиза качества молочных продуктов*. ГИОРД.
4. Qo‘chqarov O‘.R (2003). Chorvachilik mahsulotlarining davlat standartlariga mosligini aniqlash asoslari. Cho‘lpon
5. Fayziyev, J.S. (2019). Sut va sut mahsulotlari texnologiyasi. Toshkent.
6. Journal of Dairy Science (2024, October 3). https://www.journalofdairyscience.org/
7. CHR Hansen, part of novonesis (2024, October 3). https://www.chr-hansen.com
8. Dairy processing handbook (1995), TetraPak. https://archive.org/details/DairyProcessingHandbookTetrapak

Materials needed for the implementation of the study course program

No.	Material resources and equipment	Quantity / description
1.	pH meter	
2.	water bath	
3.	incubator	
4.	cheese vat	
5.	separator	
6.	ice cream making machine	
7.	oven	
8.	freeze dryer	
9.	milkoscan or other similar equipment	
10.	microscope	
11.	centrifuge	
12.	butter churn	
13.	membrane filtration	

Methods used for the implementation of the study course program

No.	Types	Methods possible to be applied
1	Interactive tools	Use of interactive technologies and educational programs to educate students, such as computer simulations, virtual laboratories, and online courses.
2	Lectures	Presentation of theoretical material by the teacher. Lectures may include basic concepts, principles and technologies of the studied theme
3	Laboratory works	Working with equipment and tools, conducting experiments, tasting and analysing fruit and vegetable samples and their

		product samples. Practical classes help students consolidate theoretical knowledge in practice.
4	Seminars	Compilation and explanation of the data obtained in laboratory work with theoretically learned material, clarifying the differences. Analysis of problem situations from the point of view of the fruit and vegetable processing industry