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OFINU

The project
“Open Food Innovation University" - OFINU
No.101128855

SEVEN INNOVATIVE STUDY MODULES
(D2.1)

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2024

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EXECUTIVE SUMMARY

The deliverable has been elaborated within the project “Open Food Innovation University" – OFINU, No.101128855, being in implementation of the consortium of Uzbekistan, Tajikistan, European Union universities, as well as private sector partners from the involved Central Asia countries. The project is in implementation with financial support from the European Union Erasmus+ Programme. The period of the Grant agreement covers time period from 1st February 2024 till 31st January 2027.

The study modules included in this document are as following:

- Module No.1 Milk Processing Technology
- Module No.2 Meat Processing Technologies
- Module No.3 Fruit and vegetable processing technologies
- Module No.4 Cereal Technology
- Module No.5 Food Safety Management
- Module No.6 New Food Product Development
- Module No.7 Academic writing

The target groups of the study modules are (1) full-time and part-time students, and (2) external learners – or listeners of food technology study curricula. In particular, existing specialists of food companies or persons seeking education in food technology who are studying in the Open University format for this purpose.

Study modules may be integrated into study programmes related to the primary production and processing of food.

Short name of the OFINU project partner	*Title of the study programme/curricula where new modules will be integrated*	*Study level*
P2 SAMARU	Food technology	Bachelor
	Technology of Cultivation and Processing of Medicinal Plants	Bachelor
	Technology of Storage and Primary Processing of Agricultural Products	Bachelor
	Agro-chemistry	Master
P3 AIAA	Technologies of storage and processing of agricultural products	Bachelor
P4 TUT	Metrology, standardization and certification	Bachelor
	Metrology, standardization and certification	Master
P5 KITIM	Production, storage and processing of plant products	Bachelor
P6 BTUTI	Technology of storage and processing of food plant raw materials	Bachelor
	Technology of the production of bread and bakery products	Bachelor

***Study modules description includes*:** (1) Study plan, (2) Thematic study plan describing study form, thematic, (3) Themes, describing issues to be covered in lectures, issues to be covered in practical or laboratory works, topics of independent work, (4) Literature and data source list, (5) Materials needed and methods to be used, (6) List of the project staff (per partner) involved in elaboration of each particular study module. Number of hours for each type of activity (lectures, practical works, and independent work) has been adjusted for each partner country (Uzbekistan, Tajikistan), according to the country-level requirements and regulations.

Contents of the study modules in brief:

Module No.1. Milk Processing Technology module aims 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.

Module No.2. Meat Processing Technologies module will provide knowledge about the technological processes of meat production, product packaging possibilities, quality requirements, and assurance, including sensory evaluation and quality management assurance in the meat processing.

Module No.3. In the module **Fruit and Vegetable Processing Technologies** students obtain the knowledge about the chemical composition and physical properties of fruits and vegetables. They acquire the basic knowledge about fruit and vegetable processing and about physical, biochemical, and microbiological processes during the production of these products. They also get information

about defects of fruit and vegetable products and possibilities to avoid them. Obtain the sensory evaluation principles of fruit and vegetable processing products. Get acquainted with special equipment used in this industry, product packaging solutions, and product risk and safety assessment.

Module No.4 The aim of the module **Cereal Technology** is to deepen the knowledge about the chemical composition, properties, and quality of grain, to learn the basics of grain processing technology and the introduction of innovations, and to understand the physical, biochemical, and microbiological processes that take place during production. Gain knowledge of flour, groats, pasta, and bread quality assessment methods and safety. To get acquainted with the special equipment used in food production, its structure, and operating principles. In the laboratory, students acquire practical skills in quality control of grain, flour, and other raw materials for the development of bread and special products.

Module No.5. Food Safety Management. The module is based on the principles that are common to ISO management system standards. Generally recognized key elements: interactive communication; system management; prerequisite programmes; hazard analysis, and critical control point (HACCP) principles. The individual parts of the module are built on the thematic: context of the organization, leadership, planning, support, operation, performance evaluation, and improvement. Adopting a food safety management system (FSMS) is a strategic decision for an organization that can help improve its overall performance in food safety therefore, students will apply the acquired knowledge in solving problem situations or realizing their interests.

Module No.6. New Food Product Development provides knowledge of the new product development process and the role of enterprises and research. Acquainted with the idea generation methods, product prototype development, and testing methods. As part of the commercialization phase, it creates the design of new products and finds the most relevant and appropriate sales methods and opportunities. This model includes an innovative learning method, the hackathon, which involves entrepreneurs as mentors and ensures the creation of synergies and strengthening of connections with food producers.

Module No.7. Academic Writing includes principles of academic writing, manuscript preparation according to the requirements of various publishers, as well as manuscript submission and communication with scientific editors and reviewers. Students will acquire knowledge about the structure of a scientific article (IMRaD), the most common mistakes, skills to choose a suitable journal for article publication, critically select literature for the preparation of the introduction, correctly describe materials and methods, prepare the results and discussion part, draw conclusions, and edit the manuscript. They will also obtain the competence to prepare a manuscript for submission to a specific scientific journal and communicate with the scientific editor and reviewers. In the study course, the topics about types of publications, structure of the article, elements of academic language, English terms and phrases commonly used in academic writing, preparation of visual material, and the use of statistical analysis are included. The theoretical background will be delivered in lectures, and practical skills and competences will be acquired through practical assignments and preparation of the manuscript for submission.

TABLE OF CONTENTS

P.s. The numbering in the table of contents corresponds to the numbering of the PDF document. At the same time, each module stores its specific corresponding page numbering, because study modules in practice are used independently. Readers are kindly required not to take into consideration this separate numbering in the common document.

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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.

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Partner universities and their academic staff, involved in the development of the study course:

P1 LBTU. Latvia University of Life Sciences and Technologies

Jelena Zagorska - milk processing technology.

Tatjana Kince - dairy processing equipment.

Evita Straumite - sensory evaluation of dairy products.

Egita Sproge - HACCAP.

Sandra Muižniece-Brasava - dairy processing equipment; packaging.

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

Co-funded by the European Union

OFINU

Open Food Innovation University (OFINU)

DESCRIPTION OF STUDY MODULE

“MEAT PROCESSING TECHNOLOGIES”

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.

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Partner universities and their academic staff, involved in the development of the study course:

P1 LBTU. Latvia University of Life Sciences and Technologies

Ilze Gramatina - meat processing technologies.
Sandra Muizniece-Brasava - packaging of meat and meat products.
Normunds Puzulis - meat processing equipment.
Evita Straumite - sensory evaluation of meat and meat products.
Egita Sproge - HACCAP.

P2 SAMARU. Samarkand Agroinnovations and Research University

Elnara Devletshaeva - technology of storage and processing of livestock products.
RahmatilloTashmanov - technology of storage and processing of agricultural products.

P3 AIAA. Andijan Institute of Agriculture and Agro-technologies

Rakhim Mirzaev - technology of storage and processing of agricultural products.
Kholdarov Shukhratjon - technology of storage and processing of agricultural products.

P5 KITIM. Kulob Institute of Technology and Innovation Management

Amrudin Rustamov - technology of meat and meat products.
Safar Odinaev - technology of meat and meat products.

P7 SUA. Slovak University of Agriculture in Nitra

Miroslava Kačániová - microbiologist.

INTRODUCTION

Study modules “Meat processing technologies” have been developed for the students can obtain the knowledge about criteria for estimation chemical composition, physical properties of meat quality. Students also receive a basic knowledge about physical, biochemical and microbiological processes in meat production, necessary equipment and packaging. They gain knowledge about the reasons for defects in various meat products, food safety requirements for the production of meat products.

Aim and objectives of the study subject is to provide knowledge about the technological processes of meat productions, product packaging possibilities, quality requirements and assurance. The students can obtain the knowledge and understanding about technological processes of meat and meat products production and equipment, various packaging materials, meat quality and safety issues, when preparation for seminars, practical and laboratory works.

Learning outcomes

- ***Knowledge*** – is able to understand the key concepts and regularities of the industry, to decide on more suitable production processes, equipment and to find solutions for new product development;
- ***Skills*** – perform innovative and research activities in formulating and analysing the problems of meat processing industry, is able to explain and do reasonable discussion of the meat processing problems.
- ***Competence*** – is able to independently obtain, select and analyse information, make decisions and solve problems in the quality assurance of production of meat products and in the development of innovations.

Study Plan for module “Meat Processing Technologies” in Uzbekistan

Themes	Number of hours			
	Total	Lectures	Practical works	Independent work of the student
Theme 1. Meat and its general characteristics, and quality	34	4	0	30
Theme 2. Biochemical and microbiological processes in meat	54	8	12	34
Theme 3. The slaughter process of animals and birds	50	6	10	34
Theme 4. Meat preservation methods	70	20	16	34
Theme 5. Meat products	76	16	26	34
Theme 6. Canned meat products	40	4	6	30
TOTAL	**324**	58	70	196

Study Plan for module "Meat Processing Technologies" in Tajikistan

Themes	Number of hours			
	Total	Lectures	Practical works	Independent work of the student
Theme 1. Meat and its general characteristics, and quality	40	4	0	36
Theme 2. Biochemical and microbiological processes in meat	50	6	8	36
Theme 3. The slaughter process of animals and birds	50	4	8	38
Theme 4. Meat preservation methods	60	10	10	40
Theme 5. Meat products	76	14	22	40
Theme 6. Canned meat products	48	6	6	36
TOTAL	**324**	44	54	226

Thematic Study Plan for module "Meat Processing Technologies"

Date, Time	Study form	Theme	Lecturer
Theme 1. Meat and its general characteristics, and quality			
1st day	Lecture (1h)	Introductory lecture in the study course.	
	Lecture (3h)	Morphological structure of meat (*Technology)*.	
		Meat quality, chemical composition and nutritional value (*Technology)*.	
	Lecture (1h)	The most suitable packaging materials for fresh meat (*Packaging*).	
	Lecture (1h)	Meat safety and risk assessment (*Quality*).	
2nd day	Laboratory work (8h)	1st Laboratory work – evaluation of the chemical composition of meat using physico-chemical quality analysis methods (*Technology*).	
Theme 2. Biochemical and microbiological processes in meat			
3rd day	Lecture (2h)	Biochemistry and microbiological developments in meat. Meat rigor-mortis, maturation and breaking down (*Technology*).	
	Lectures (2h)	Characteristics of main technological equipment (*Equipment*).	
	Lecture (3h)	Intensification of the maturation process. Meat maturation, PSE and DFD defective meat (*Technology*).	
	Lecture (1h)	Contamination, safety and risk assessment (*Microbiology*).	
4th day	Laboratory work (8h)	2nd Laboratory work – assessment of meat freshness using sensory, physic-chemical and microbiological quality analysis methods (*Technology*).	
Theme 3. The slaughter process of animals and birds			

5th day	Laboratory work (1h)	Microbiological testing of chilled meat (*Microbiology*).	
	Lecture (3h)	Preparation of animals, birds for processing, and slaughtering. Animals and birds carcass division (*Technology*).	
	Lecture (1h)	By-products, use and processing (*Technology*).	
		Intestinal structure and treatment (*Technology*).	
6th day	Laboratory work (8h)	3rd Laboratory work – evaluating the quality of food fat by analysing changes in the sensory and physical-chemical quality indices (*Technology*).	
Theme 4. Meat preservation methods			
7th day	Lecture (2h)	Meat preservation methods. Chilling and storage of meat (*Technology*).	
	Lecture (1h)	Quality indicators of meat (*Sensory evaluation*).	
	Seminar (2h)	Sensory evaluation of meat (*Sensory evaluation*).	
	Lecture (1h)	Chilled and frozen meat safety and risk assessment (*Quality*).	
8th day	Lecture (2h)	Meat freezing, changes in quality indicators during storage (*Technology*).	
	Lecture (2h)	Characteristics of equipment (*Equipment)*.	
	Lecture (1h)	Package selection for preserved meat (*Packaging*).	
	Practical work (3h)	Safety and risk assessment of meat (*Quality*).	
9th day	Lecture (2h)	Meat salting types, storage and characterisation of quality indicators (*Technology*).	
	Lecture (1h)	Contamination risks of preserved meat (*Microbiology*).	
	Laboratory work (2h)	Microbiological testing of semi-finished meat products (*Microbiology*).	
	Practical work (2h)	Mechanical equipment for meat processing (*Equipment*).	
10th day	Lecture (2h)	Meat smoking, smoking methods, changes in quality indicators (*Technology*).	
	Lecture (2h)	Meat product drying methods, quality indicators and their changes (*Technology*).	
	Lecture (1h)	Optimal packaging solutions for preserved meat products (*Packaging*).	
11th day	Lecture (1h)	Security and risks of salted, smoked and dried products (*Quality*).	
	Seminar (3h)	Optimal packaging solutions for preserved meat products (*Packaging*).	
Theme 5. Meat products			

12th day	Lecture (2h)	Classification of semi-finished meat products (*Technology*).	
	Lecture (3h)	The main raw materials for meat products production and their characterisation (*Technology).*	
	Lecture (1h)	Sensory quality indicators of meat products and their changes during storage (*Sensory evaluation*).	
13th day	Laboratory wok (8h)	4th Laboratory work – preparation of semi-dry and cooked sausages, determination and analysis of sensory, physical-chemical, microbiological quality indicators (*Technology*).	
14th day	Lecture (2h)	Characteristics of the main equipment used in the processing of meat products (*Equipment*).	
	Laboratory work (2h)	Microbiological evaluation of processed meat products (*Microbiology*).	
	Lecture (4h)	Meat cooking technologies (*Technology*).	
15th day	Seminar (3h)	Sensory evaluation of meat products (*Sensory evaluation*).	
	Lecture (1h)	Microbiological quality indicators of meat products and their changes during storage (*Microbiology*).	
	Lecture (1h)	Meat product safety and risks (*Quality*).	
16th day	Laboratory works (8h)	5th Laboratory work – preparation of semi-finished products and liver pate or liver sausages, determination and analysis of sensory, physical-chemical, and microbiological quality indicators (*Technology*).	
17th day	Lecture (3h)	Most important meat products sensory, physical-chemical, microbiological methods of analysis and equipment (*Technology*).	
	Seminar (3h)	Sensory evaluation of meat products (*Sensory evaluation*).	
	Lecture (1h)	Meat product safety and risk assessment (*Quality*).	
	Laboratory work (1h)	Microbiological evaluation of meat processing products (*Microbiology*).	
Theme 6. Canned meat products			
18th day	Lecture (3h)	Canned meat technology. Changes during heat treatment, and quality indicators (*Technology*).	
	Lecture (1h)	Meat products contamination risks (*Microbiology*).	
	Lecture (1h)	Most value packaging types and materials for canned meat products (*Packaging*).	
19th day	Seminar (3h)	Package as added value of meat products (*Package*).	
	Practical work (3h)	Meat product safety and risk assessment (*Quality*).	
	Practical work (2h)	Thermal equipment for meat processing (*Equipment*).	

Themes and their summary in study module "Meat processing technologies"

Theme 1. Meat and its general characteristics, and quality

Issues to be covered in the lectures

1. Morphological structure of meat - muscle, fat and connective tissue, bone and cartilages.
2. Meat quality, chemical composition (water, proteins, fat, carbohydrates) and nutritional value.
3. The most suitable packaging materials for fresh meat.
4. Meat safety and risk assessment.

Issues to be covered in the practical or laboratory works and seminars

1. Evaluation of the chemical composition of meat using physico-chemical quality analysis methods.

Topics of independent work

1. Study the morphological composition of meat of various animals.
2. Study the chemical composition of meat and nutritional value of various types of slaughtered animals.
3. Packaging materials for meat products.

Literature and databases on the theme

1. Heinz, G., & Hautzinger, P. (2007). Meat processing technology. Bangkok: Food and Agriculture Organization. https://openknowledge.fao.org/server/api/core/bitstreams/4cfabbd3-16aa-47f8-ac6f-b54a48cb8abd/content
2. Toldra, F. (2010). Handbook of meat processing. Wiley-Blackwell https://onlinelibrary.wiley.com/doi/book/10.1002/9780813820897
3. Винникова, Л. Г. (2006). Технология мяса и мясных продуктов. ИНКОС.
4. Рогов, И.А., Жаринов, А.И., Текутъева, Л.А., Шепелъ, Т.А. (2009). Биотехнология мяса и мясопродуктов. ДеЛи принт.
5. Лисицын, А.Б., Липатов, Н.Н., Кудряшов, Л.С., Алексахина, В.А., & Чернуха, И.М. (2008). Технология и практика переработки мяса. Эдиториал сервис.
6. Yaranoglu, B., Zengin, M., Gokce, M., Varol Avcilar, O., Berhun Postaci, B., Erdogan, C., Odabas, E. (2023). Chemical composition of meat from different species of animals. International Journal of Agriculture, Environment and Food Sciences, 7(3), 581-587. https://dergipark.org.tr/en/download/article-file/3287716

Theme 2. Biochemical and microbiological processes in meat

Issues to be covered in the lectures

1. Biochemistry and microbiological developments in meat. Meat rigor-mortis, maturation and breaking down.
2. Characteristics of main technological equipment.
3. Intensification of the maturation process. Meat maturation, PSE and DFD defective meat.
4. Contamination, safety and risk assessment.

Issues to be covered in the practical or laboratory works and seminars

1. Assessment of meat freshness using sensory, physic-chemical and microbiological quality analysis methods.

Topics of independent work

1. Biochemical changes during freezing.
2. Microbiological changes during storage.
3. Methods of freezing meat. Advantages and disadvantages of various methods of freezing meat.

Literature and databases on the theme

1. Heinz, G., & Hautzinger, P. (2007). Meat processing technology. Bangkok: Food and Agriculture Organization. https://openknowledge.fao.org/server/api/core/bitstreams/4cfabbd3-16aa-47f8-ac6f-b54a48cb8abd/content
2. Toldra, F. (2010). Handbook of meat processing. Wiley-Blackwell. https://onlinelibrary.wiley.com/doi/book/10.1002/9780813820897
3. Винникова, Л. Г. (2006). Технология мяса и мясных продуктов. ИНКОС.
4. Рогов, И.А., Жаринов, А.И., Текутъева, Л.А., Шепелъ, Т.А. (2009). Биотехнология мяса и мясопродуктов. ДеЛи принт.
5. Лисицын, А.Б., Липатов, Н.Н., Кудряшов, Л.С., Алексахина, В.А., Чернуха, И.М. (2008). Технология и практика переработки мяса. Эдиториал сервис.
6. Алимардонова, М. (2009). Биохимия мяса и мясных продуктов. Фолнат. https://library.tou.edu.kz/fulltext/buuk/a260.pdf
7. Normahmatov. R. (2013). Oliy o'quv yurtlari talabalari uchun darslik. Tafakkur.

Theme 3. The slaughter process of animals and birds

Issues to be covered in the lectures

1. Preparation of animals, birds for processing, and slaughtering. Animals and birds carcass division.
2. By-products, use and processing. Intestinal structure and treatment.

Issues to be covered in the practical or laboratory works and seminars

1. Microbiological testing of chilled meat.
2. Evaluating the quality of food fat by analysing changes in the sensory and physico-chemical quality indices.

Topics of independent work

1. Main changes and technological aspects of slaughtering livestock and poultry on an industrial scale.
2. Modern technology for slaughtering cattle.
3. Poultry slaughter technology.

Literature and databases on the theme

1. Heinz, G., & Hautzinger, P. (2007). Meat processing technology. Bangkok: Food and Agriculture Organization.

https://openknowledge.fao.org/server/api/core/bitstreams/4cfabbd3-16aa-47f8-ac6f-b54a48cb8abd/content
2. Toldra, F. (2010). Handbook of meat processing. Wiley-Blackwell. https://onlinelibrary.wiley.com/doi/book/10.1002/9780813820897
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4. Рогов, И.А., Жаринов, А.И., Текутъева, Л.А., Шепелъ, Т.А. (2009). Биотехнология мяса и мясопродуктов. ДеЛи принт.
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6. Алимардонова, М. (2009). Биохимия мяса и мясных продуктов. Фолнат. https://library.tou.edu.kz/fulltext/buuk/a260.pdf
7. Normahmatov. R. (2013). Oliy o'quv yurtlari talabalari uchun darslik. Tafakkur.

Theme 4. Meat preservation methods

Issues to be covered in the lectures

1. Meat preservation methods. Chilling and storage of meat.
2. Quality indicators of meat.
3. Chilled and frozen meat safety and risk assessment.
4. Meat freezing, changes in quality indicators during storage.
5. Characteristics of equipment.
6. Package selection for preserved meat.
7. Meat salting types, storage and characterisation of quality indicators.
8. Contamination risks of preserved meat.
9. Meat smoking, smoking methods, changes in quality indicators.
10. Meat product drying methods, quality indicators and their changes.
11. Optimal packaging solutions for preserved meat products.
12. Security and risks of salted, smoked and dried products.

Issues to be covered in the practical or laboratory works and seminars

1. Sensory evaluation of meat.
2. Safety and risk assessment of meat.
3. Microbiological testing of semi-finished meat products.
4. Mechanical equipment for meat processing.
5. Optimal packaging solutions for preserved meat products.

Topics of independent work

1. Preservation of meat and products by exposing them to chemicals.
2. Preserving meat by salting.
3. Canning at high temperatures.

Literature and databases on the theme

1. Heinz, G., & Hautzinger, P. (2007). Meat processing technology. Bangkok: Food and Agriculture Organization.
2. https://openknowledge.fao.org/server/api/core/bitstreams/4cfabbd3-16aa-47f8-ac6f-b54a48cb8abd/content
3. Toldra, F. (2010). Handbook of meat processing. Wiley-Blackwell.
4. https://onlinelibrary.wiley.com/doi/book/10.1002/9780813820897

5. Винникова, Л. Г. (2006). Технология мяса и мясных продуктов. ИНКОС.
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Theme 5. Meat products

Issues to be covered in the lectures

1. Classification of semi-finished meat products.
2. The main raw materials for meat products production and their characterisation.
3. Sensory quality indicators of meat products and their changes during storage.
4. Characteristics of the main equipment used in the processing of meat products.
5. Meat cooking technologies.
6. Microbiological quality indicators of meat products and their changes during storage.
7. Meat product safety and risks.
8. Most important meat products sensory, physico-chemical, microbiological methods of analysis and equipment.
9. Meat product safety and risk assessment.

Issues to be covered in the practical or laboratory works and seminars

1. Preparation of semi-dry and cooked sausages, determination and analysis of sensory, physico-chemical, microbiological quality indicators.
2. Microbiological evaluation of processed meat products.
3. Sensory evaluation of meat products.
4. Preparation of semi-finished products and liver pate or liver sausages, determination and analysis of sensory, physico-chemical, and microbiological quality indicators.
5. Sensory evaluation of meat products.
6. Microbiological evaluation of meat processing products.

Topics of independent work

1. Meat products classification.
2. Sausages and its classifications.
3. Canned meat and smoked meats products.

Literature and databases on the theme

1. Heinz, G., Hautzinger, P. (2007). Meat processing technology. Food and Agriculture Organization. https://openknowledge.fao.org/server/api/core/bitstreams/4cfabbd3-16aa-47f8-ac6f-b54a48cb8abd/content
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4. Зонин, В.Г. (2007). Современное производство колбасных и солено-копченых изделий. Профессия.

5. Васюкова, А., Славянский, А., Куликов., Д. (2019). Оборудование пищевых предприятий. Кнорус.
6. Рогов, И.А., Жаринов, А.И., Текутъева, Л.А., & Шепелъ, Т.А. (2009). Биотехнология мяса и мясопродуктов. ДеЛи принт.
7. Лисицын, А.Б., Липатов, Н.Н., Кудряшов, Л.С., Алексахина, В.А., Чернуха, И.М. (2008). Технология и практика переработки мяса. Эдиториал сервис.
8. Алимардонова, М. (2009). Биохимия мяса и мясных продуктов. Фолнат. https://library.tou.edu.kz/fulltext/buuk/a260.pdf
9. Normahmatov. R. (2013). Oliy o'quv yurtlari talabalari uchun darslik. Tafakkur. 515.

Theme 6. Canned meat products

Issues to be covered in the lectures

1. Canned meat technology. Changes during heat treatment, and quality indicators.
2. Meat products contamination risks.
3. Most value packaging types and materials for canned meat products.

Issues to be covered in the practical or laboratory works and seminars

1. Package as added value of meat products.
2. Meat product safety and risk assessment.
3. Thermal equipment for meat processing.

Topics of independent work

1. Classification of canned products.
2. Processes occurring during canning of meat.
3. The influence of packaging material on the quality of canned products.

Literature and databases on the theme

1. Heinz, G., Hautzinger, P. (2007). Meat processing technology. Bangkok: Food and Agriculture Organization. https://openknowledge.fao.org/server/api/core/bitstreams/4cfabbd3-16aa-47f8-ac6f-b54a48cb8abd/content
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3. Винникова, Л. Г. (2006). Технология мяса и мясных продуктов. ИНКОС.
4. Зонин, В.Г. (2007). Современное производство колбасных и солено-копченых изделий. Профессия.
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6. Рогов, И.А., Жаринов, А.И., Текутъева, Л.А., Шепелъ, Т.А. (2009). Биотехнология мяса и мясопродуктов. ДеЛи.
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Materials needed for the implementation of the study course program

Nr.	Material resources and equipment	Quantity / description
1.	Textbooks on technology of meat and meat products	1. Алимардонова, М. (2009). *Биохимия мяса и мясных продуктов.* Учебное пособие. - Астана: Фолнат. 2. Normahmatov. R. (2013). *Oliy o'quv yurtlari talabalari uchun darslik*. T.: Tafakkur. 515 bet. 3. Бахромов, А.Б. (1996). *Товаршунослик асослари.* Тошкент ТХХИ.
2.	Calibrators and measuring instruments	
3.	Devices for determining pH	For measuring the samples pH
4.	Microscope	For analysing the microorganisms type
5.	Thermostats	For samples incubation
6.	Oven for samples drying from 90-150 ºC temperature	For moisture content determination
7.	Scales with a precision of 0.01 and 0.0001 grams	
8.	Water bath for samples heating at 70 to 75 ºC temperature	For fat content determination
9.	Centrifuge with 800 to 1000 rpm	For fat content determination
10.	Muffle for samples heating at 600 to 800 ºC temperature	For ash content determination

Nr.	Material resources and equipment	Quantity / description
11.	Kjeldahl apparatus (mineralization block and distillation unit)	For protein content determination
12.	Meat grinder with different mesh sizes of grinder	For meat samples preparation
13.	Microorganisms colony counter	For microorganism cony count
14.	Bag mixer	For sample preparation for microbiology
15.	Products packaging equipment	For meat and meat products packaging
16.	Meat sausages stuffing equipment	For sausages making
17.	Blender	For liver pate making

Methods used for the implementation of the study course program

No.	Types	Methods possible to be applied
1.	Lectures	Presentation of theoretical material by the teacher in front of the audience. Lectures may include basic concepts, principles and technologies of meat processing.
2.	Practical work	Working with equipment and tools, conducting experiments, tasting and analysing meat samples. Practical classes help students consolidate theoretical knowledge in practice.
3.	Use of visual and interactive materials	Presentations, video tutorials, interactive websites, and simulations that help visualise and explain key concepts and processes.
4.	Case method	Study real-life cases and examples from the meat processing industry to analyse problems, make decisions and develop strategies.

Co-funded by
the European Union

Open Food Innovation University (OFINU)

DESCRIPTION OF STUDY MODULE

“FRUIT AND VEGETABLE PROCESSING TECHNOLOGIES”

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.

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Partner universities and their academic staff, involved in the development of the study course:

P1 LBTU. Latvia University of Life Sciences and Technologies

Assistant professor, Ph.D. Liene Ozola - fruit and vegetable processing technology; microbiological evaluation.

Professor, Dr.sc.ing. Tatjana Ķince: fruit and vegetable processing equipment.

Associate professor, Dr.sc.ing. Evita Straumīte - sensory evaluation of fruit, vegetables and their processing products.

Professor, Dr.sc.ing. Sandra Muižniece-Brasava - product packaging materials and technology.

Quality manager, Mg TQM Egita Sproģe - food safety QM systems.

P2 SAMARU. Samarkand Agroinnovations and Research University

Assistant teacher, MSc Elnara Devletshaeva - technology of storage and processing of agricultural products.

Ph.D. Haitmurod Tilavov - technology of storage and processing of agricultural products.

P3 AIAA. Andijan Institute of Agriculture and Agro-technologies

Associate Professor, Ph.D Oybek Egamberdiev - technology of storage and processing of agricultural products.

Assistant teacher MSc, Dekhkonova Shakhnozaxon - technology of storage and processing of agricultural products.

P4 TUT. Technological University of Tajikistan

Assistant Professor, Ph.D. in Tech. Sc. Gulmahmad Mirzozoda- technological equipment for canning production; technology and equipment of vegetable oil production.

Assistant Professor, Ph.D. in Tech. Sc. Maksudakhon Abdullaeva - fruit and vegetable processing technologies; new food product development.

P5 KITIM. Kulob Institute of Technology and Innovation Management

Assistant Professor, Ph.D. in Tech. Sc. Ziyodullo Obidov - physico: chemical and biochemical foundations of food production; physico-chemical analysis of food products.

Senior lecturer, Saidislom Jangov - fruit and vegetable processing technologies; new food product development.

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

Senior lecturer, Sirojiddin Boboev - fruit and vegetable processing technology; microbiological evaluation; food safety QM systems.

Senior lecturer, Sunatullo Qodirov - fruit and vegetable processing equipment.

Senior lecturer, Turanboy Turanboev - sensory evaluation of fruit, vegetables and their processing products; product packaging materials and technology.

P7 SUA. Slovak University of Agriculture in Nitra

doc. Ing.Ph.D Ivana Mezeyová - vegetable technology.

doc. Ing.Ph.D Miroslav Šlosár - vegetable technology.

doc. Ing.Ph.D Oleg Paulen - fruit technology.

doc. Ing.Ph.D Ján Mezey - fruit technology.

INTRODUCTION

The study module “Fruit and vegetable processing technologies” has been developed for students to get them acquainted with basic knowledge on fruit and vegetable processing technologies as well as new product development.

The aim and objectives of the study subject are to provide knowledge about technological processes of fruit and vegetable processing, the equipment used and packaging options, and product quality requirements. Students obtain knowledge about the chemical composition and physical properties of fruits and vegetables. They acquire basic knowledge about fruit and vegetable processing and physical, biochemical and microbiological processes during the production of these products. They also get informed about defects of fruit and vegetable products and possible options to avoid them. They obtain the sensory evaluation principles of fruit and vegetable processing products. Get acquainted with special equipment used in this industry, product packaging solutions, and product risk and safety assessment.

Learning outcomes:

- ***Knowledge*** – about processing principles of different fruit and vegetable products, including physical, biochemical and microbiological processes during the production of these products; the innovation possibilities and development of new products.
- ***Skills*** – to evaluate the quality parameters of fruits and vegetables and their processing products, to lead and control the technological processes of different fruit and vegetable processing products; independently organise a new product development process.
- ***Competences*** – to analyse and explain the physical, biochemical and microbiological processes during the production of different fruit and vegetable products.

Study Plan for module “Fruit and Vegetable Processing Technologies” in Uzbekistan

Themes		Number of hours			
		Total	Lectures	Practical works	Independent work
1.	Chemical composition and physical properties of fruits, vegetables, and mushrooms. Fruit and vegetable classification.	31	4	8	19
2.	Classification of fruit and vegetable processing products.	20	2	8	10
3.	Fresh, minimally processed fruits and vegetables.	19	2	0	17
4.	Packaging equipment and special packaging materials and methods used in fruit and vegetable product production	22	2	0	20

5.	Technological equipment for fruit and vegetable processing	27	2	8	17
6.	Fermented fruit and vegetable production.	25	2	8	15
7.	Assessment of the Safety and Risks of Fruit, Vegetable Products (HACCP).	24	2	0	22
8.	Microbiological aspects of fruit and vegetable processing	25	2	8	15
9.	Production technology of frozen fruits and vegetables.	27	2	8	17
10.	Sensory aspects of fruit and vegetable processing products	30	2	8	20
11.	Thermally processed vegetable preserves.	29	2	8	19
12.	Thermally processed fruit and berry preserves.	31	2	8	21
13.	Vegetable oils	25	2	8	15
14.	Dried fruit and vegetable products.	25	2	6	17
TOTAL		**360**	**30**	**86**	**244**

*The practical part is included in other topics, see Thematic Study plan

Study Plan for module "Fruit and Vegetable Processing Technologies" in Tajikistan

Themes		**Number of hours**			
		Total	Lectures	Practical works	Independent work
1.	Chemical composition and physical properties of fruits, vegetables, and mushrooms. Fruit and vegetable classification.	34	10	6	18
2.	Classification of fruit and vegetable processing products.	13	3	*	10
3.	Fresh, minimally processed fruits and vegetables.	26	2	7	17
4.	Packaging equipment and special packaging materials and methods used in fruit and vegetable product production	24	4	*	20
5.	Technological equipment for fruit and vegetable processing	21	4	*	17
6.	Fermented fruit and vegetable production.	20	1	4	15

7.	Assessment of the Safety and Risks of Fruit, Vegetable Products (HACCP).	26	2	2	22
8.	Microbiological aspects of fruit and vegetable processing	12	2	*	10
9.	Production technology of frozen fruits and vegetables.	20	2	2	16
10.	Sensory aspects of fruit and vegetable processing products	19	2	*	17
11.	Thermally processed vegetable preserves.	43	8	16	19
12.	Thermally processed fruit and berry preserves.	32	5	8	19
13.	Vegetable oils	17	3	2	12
14.	Dried fruit and vegetable products.	17	1	2	14
TOTAL		**324**	**49**	**49**	**226**

*The practical part is included in other topics, see Thematic Study plan

Thematic Study Plan for module
"Fruit and Vegetable Processing Technologies"

Date, Time	Study form	Theme	Lecturer
Theme 1. Chemical composition and physical properties of fruit, vegetables, and mushrooms. Fruit and vegetable classification			
Day 1	Lecture (2h)	*Introduction lecture about the study course.* Chemical composition and physical properties of fruit and vegetables.	
	Laboratory work (3h)	Chemical composition of fruit, berries and vegetables.	
	Lecture (1h)	Fruit and vegetable classification.	
	Lecture (1h)	Mushrooms - structure and chemical composition.	
Day 2	Lecture (4h)	Chemical composition and quality aspects of herbs, wild and domesticated fruit and berries. Nuts, their chemical composition and quality characteristics. Citrus fruits, their chemical composition.	
	Laboratory work (3h)	Natural pigments and their detection, quality changes in fruit, berries and vegetables.	
Day 3	Lecture (1h)	Structure and chemical composition of potato tubers.	
	Laboratory work (2h)	Chemical composition and quality parameters of potato tubers.	
Theme 2. Classification of fruit and vegetable processing products			
Day 3	Lecture (1h)	Introduction to the fruit, berry and vegetable processing industry in "Your Country".	
	Lecture (2h)	Fruit and vegetable storage conditions. Methods of preserving fruits, berries and vegetables.	
Theme 3. Fresh, minimally processed fruit and vegetables			
Day 4	Lecture (1h)	Production of fresh, minimally processed fruits and vegetables.	
Theme 4. Packaging equipment and special packaging materials and methods used in fruit and vegetable product production			

Day 4	Lecture (4h)	Packaging equipment and special packaging materials and methods used in fruit and vegetable product production.	
	Laboratory work (3h)	*Connected and a continuation of Theme 3* Preparation of fresh, cut and packaged vegetables (1st part).	
Theme 5. Technological equipment for fruit and vegetable processing			
Day 5	Lecture (4h)	Overview of technological equipment for fruit and vegetable processing.	
Theme 6. Fermented fruit and vegetable production			
Day 5	Lecture (1h)	Fermented vegetables - technological aspects of preparation and product quality with focus on sauerkraut production).	
	Laboratory work (2h)	Preparation of sauerkraut (1st part).	
Theme 7. Assessment of the Safety and Risks of fruit and vegetable products (HACCP)			
Day 8	Lecture (2h)	Assessment of Safety and Risks of fruit and vegetable products (HACCP).	
	Practical work / Seminar (4h)	Assessment of Safety and Risks of fruit and vegetable products (HACCP).	
Day 9	Excursion	Excursion to a local fruit and vegetable processing company.	
Theme 8. Microbiological aspects of fruit and vegetable processing			
Day 10	Lecture (2h)	Microbiological aspect in fruit and vegetable processing.	
Continuation of laboratory work from Day 4 and in the context of Themes 3, 4 and 8			
Day 10	Laboratory work (2h)	Microbiological evaluation of fresh, cut and packaged vegetables (2nd part).	
	Laboratory work (4h)	Quality evaluation of fresh, cut and packaged vegetables (3rd part).	
Theme 9. Production technology of frozen fruits and vegetables			
Day 11	Lecture (2h)	Production of frozen fruit and vegetables	
	Laboratory work (1h)	Freezing of fruit and vegetables (1st part)	

Theme 10. Sensory aspects of fruit and vegetable processing products			
Day 11	Lecture (2h)	Fruit, berry and vegetable and their product sensory evaluation.	
Continuation of Themes 6			
Day 12	Laboratory works (2h)	Microbiological evaluation of prepared sauerkraut (2nd part).	
	Laboratory work (2h)	Packaging and storage of sauerkraut. Product treatment in sous-vide. (3rd part)	
Continuation of Day 10 and conclusion of Theme 3			
Day 15	Laboratory work (1h)	Data collection of microbiological assessment of fresh, cut and packaged vegetables.	
	Seminar (1h)	*Conclusion of Theme 3.* Seminar on obtained data and evaluation of laboratory works.	
Continuation of Day 12 and conclusion of Theme 6			
Day 15	Laboratory work (1h)	Data collection of microbiological assessment of prepared sauerkraut.	
	Laboratory work (2h)	Sensory evaluation of sauerkraut.	
	Laboratory work (2h)	Quality evaluation of prepared sauerkraut.	
	Seminar (1h)	*Conclusion of Theme 6.* Seminar on obtained data and evaluation of laboratory works.	
Theme 11. Thermally processed vegetable preserves			
Day 16	Lecture (2h)	Natural preserves. Testing of canned food sterility.	
	Lecture (4h)	Processing of tomatoes. Production of acidified vegetable preserves.	
Day 17	Laboratory work (6h)	Preparation of tomato concentrates and sauces using different technologies.	
Day 18	Laboratory work (2h)	Quality assessment of prepared tomato products.	
	Laboratory work (2h)	Sensory evaluation of prepared tomato products.	

	Lecture (2h)	Potato processing products and technologies, needed equipment, and their characteristics.	
Day 19	Laboratory work (4h)	Preparation and analysis of potato processing using different technologies - French fries.	
	Laboratory work (2h)	Preparation and analysis of potato processing using different technologies – chips -Preparation stage.	
Day 22	Laboratory work (2h)	Preparation and analysis of potato processing using different technologies - chips- Analysis stage.	
	Laboratory work (1h)	Sensory evaluation of potato chips.	
	Seminar (1h)	*Conclusion of Theme 11.* Seminar on obtained data and evaluation of laboratory works.	
Continuation of Day 12 and conclusion of Theme 9			
Day 22	Laboratory work (3h)	Quality analysis of frozen fruit, berries and vegetables (2nd part). *Conclusion of Theme 9.* Seminar on obtained data and evaluation of laboratory works.	
Theme 12. Thermally processed fruit and berry preserves			
Day 23	Lecture (2h)	Classification of fruit and berry processing products. The technology and equipment of preparation of compotes and jams, purees.	
	Laboratory work (2h)	Apple compote preparation (1st part).	
	Lecture (2h)	The technology of fruit and berry marmalade production.	
	Laboratory work (1h)	Preparation of fruit and berry marmalades using different gelling agents.	
Day 24	Laboratory work (2h)	Quality evaluation of apple compotes.	
	Laboratory work (1h)	Sensory analysis of fruit and berry marmalades.	
	Laboratory work (2h)	Quality analysis of fruit and berry marmalades	

	Lecture (2h)	Fruit, berry and vegetable juices, their division and juice production technologies, and equipment.	
Day 25	Laboratory work (5h)	Fruit, berry and vegetable juice production (preparation of samples) and quality evaluation.	
	Seminar (1h)	*Conclusion of Theme 12.* Seminar on obtained data and evaluation of laboratory work.	
Theme 13. Vegetable oils			
Day 26	Lecture (3h)	Oils, their division and extraction methods.	
	Laboratory work (2h)	Quality analysis of vegetable oils. *Conclusion of Theme 13.* Seminar on obtained data and evaluation of laboratory work.	
Theme 14. Dried fruit and vegetable products			
Day 29	Lecture (1h)	Drying of fruits, berries and vegetables.	
	Laboratory work (5h)	Apple drying using different technologies.	
Day 30	Laboratory work (2h)	Quality evaluation of dried apples. *Conclusion of Theme 13.* Seminar on obtained data and evaluation of laboratory works.	
	Excursion	Excursion to a local fruit and vegetable processing company.	

Themes and their summary in study module "Fruit and Vegetable Processing Technologies"

Theme 1. Chemical composition and physical properties of fruits, vegetables, and mushrooms. Fruit and vegetable classification

Issues to be covered in the lectures

1. Overall chemical composition and properties of fruits and vegetables.
2. Classification of fruits and vegetables.
3. Chemical composition and description of various wild fruits and berries.
4. Chemical composition and description of various herbs.
5. Classification, chemical composition and description of nuts.
6. Chemical composition and description of citrus fruit.
7. Structure and chemical composition and quality parameters of potato tubers.
8. Classification, description and chemical composition of mushrooms.

Issues to be covered in the practical or laboratory works

1. Chemical composition of fruits, berries and vegetables.
2. Natural pigments and their detection, quality changes in fruits, berries and vegetables.
3. Chemical composition and quality parameters of potato tubers.

Topics of independent work

1. Comparative analysis of phytochemical profiles and antioxidant activity in organic vs conventionally grown produce.
2. Impact of post-harvest processing on nutrient retention and textural properties of fruits/ vegetables/ mushrooms.
3. Exploring the role of mushrooms as functional foods: bioactive compounds and health benefits.

Literature and data bases on the theme

1. Hui, Y. H. (Ed.). (2010). Handbook of fruit and vegetable flavors. Wiley.
2. Yahia, E. M. (Ed.). (2019). Postharvest physiology and biochemistry of fruits and vegetables. Woodhead Publishing.
3. Mérillon, J.-M., & Ramawat, K. G. (Eds.). (2018). Bioactive molecules in food. Springer.
4. Lim, T. K. (2012). Edible medicinal and non-medicinal plants: Volume 1, fruits. Springer.
5. Jaiswal, A. K. (Ed.). (2020). Nutritional composition and antioxidant properties of fruits and vegetables. Academic Press.

Theme 2. Classification of fruit and vegetable processing products

Issues to be covered in the lectures

1. Introduction to the fruit, berry and vegetable processing industry in 'Your Country'.
2. Fruit and vegetable storage conditions.
3. Methods of preserving fruits, berries and vegetables.

Issues to be covered in the practical or laboratory works

The topics discussed in this theme of the study course 'Fruit and vegetable processing technologies', from a practical point of view, are discussed in combination and according to other themes directly connected with fruit and vegetable processing product production.

Topics of independent work

1. Emerging technologies in fruit and vegetable processing: Classification and impact on product quality.
2. Classification and nutritional evaluation on plant-based food alternatives from fruits and vegetables.
3. Volarization of fruit and vegetable by-products: classification, processing and application.

Literature and data bases on the theme

1. Fellows, P. J. (2017). Food processing technology: Principles and practice (4th ed.). Woodhead Publishing.
2. Jongen, W. (Ed.). (2002). Fruit and vegetable processing: Improving quality. Woodhead Publishing.
3. Sinha, N. K., Hui, Y. H., Evranuz, E. Ö., Cano, M. P., Barta, J., & Siddiqi, J. I. (Eds.). (2012). Handbook of fruits and fruit processing. Wiley-Blackwell.

Theme 3. Fresh, minimally processed fruits and vegetables

Issues to be covered in the lectures

1. Fresh and minimally processed fruit and vegetable production. Physico-chemical changes, enzymatic, microbiological and other external factor impact on product quality.
2. Fresh and minimally processed fruit and vegetable packaging and storage conditions to ensure product quality.

Issues to be covered in the practical or laboratory works

1. Fresh, cut and packaged vegetable preparation.
2. Quality evaluation of fresh, cut and packaged vegetables.
3. Microbiological assessment of fresh, cut and packaged vegetables.

Topics of independent work

1. Exploring the impact of edible coating on the shelf life and quality of fresh fruits and vegetables.
2. Innovative packaging solutions for minimally processed fruits and vegetables: sustainability perspective.

Literature and data bases on the theme

1. Ahvenainen, R. (Ed.). (2003). Novel food packaging techniques. Woodhead Publishing.
2. Bahrami, A., Moosavi-Nasab, M., Ghanbarzadeh, B., & Khodaiyan, F. (2020). Application of edible films and coatings in fresh fruits and vegetables. Food Science & Nutrition, 8(12), 5240–5254. https://doi.org/10.1002/fsn3.1877
3. Barrett, D. M., Somogyi, L. P., & Ramaswamy, H. S. (Eds.). (2004). Processing fruits: Science and technology (2nd ed.). CRC Press.
4. Martin-Belloso, O., & Soliva-Fortuny, R. (Eds.). (2010). Advances in fresh-cut fruits and vegetables processing. CRC Press.

Theme 4. Packaging equipment and special packaging materials and methods used in fruit and vegetable product production

Issues to be covered in the lectures

1. Characteristics of packaging materials suitable for fruits, vegetables and berries (fresh and processed).
2. Packaging Equipment that allows fruit/vegetables to be packaged in different packaging technologies (in AIR, Vacuum packaging, EMAP packaging).
3. Control of gases inside the package above the products.

Issues to be covered in the practical or laboratory works

The topics discussed in this theme of the study course 'Fruit and vegetable processing technologies', from a practical point of view is discussed in combination and according to other themes directly connected with fruit and vegetable processing product production.

1. How do packaging materials affect the delivery time of fruits, vegetables and berries?
2. How packaging technologies affect the delivery time of fruits, vegetables and berries?
3. Packaging as an element of added value.

Topics of independent work

1. Describing fruit and vegetable packages and packaging technologies.
2. Analyze scientific literature on fruit, berry and vegetable packaging solutions.
3. Optimization of packaging towards sustainability.

Literature and data bases on the theme

1. Mavinkere, S., Rangappa, P. J., Senthil M. K., Thiagamani, S. K., Suchart, S. (2020) Food Packaging: Advanced Materials, Technologies, and Innovations (1st ed.). CRC Press.
2. Chonhenchob, V., Singh, P., Singh, J. (2016) Packaging & Distribution of Fresh Fruits & Vegetables. Destech Pubns Inc.
3. Tanweer, A. (Ed.). (2022). Packaging and Storage of Fruits and Vegetables Emerging Trends (1st ed.). Apple Academic Press.

Theme 5. Technological equipment for fruit and vegetable processing

Issues to be covered in the lectures

1. Washing and sorting: washing machine, water transport, inspection equipment, calibration equipment, optical sorter.
2. Peeling, chopping: vegetable peeling machine, apple peeling and cutting machine, cherry pitting machine, vegetable chopping machine, berry crushing machine, masher.
3. Mixers, homogenizers.
4. Juicers.
5. Filters, membrane technologies.
6. Juice concentration: vacuum vaporizer, membrane filters.
7. Thermal treatment: blanching machine, vacuum cooking pots, frying equipment, pasteurizers, sterilisers (autoclaves).
8. Drying: convective, freeze driers, infrared, vacuum.
9. Cooling equipment.
10. Freezing equipment.

Issues to be covered in the practical or laboratory works

The topics discussed in this theme of the study course 'Fruit and vegetable processing technologies', from a practical point of view is discussed in combination and according to other themes directly connected with fruit and vegetable processing product production.

Topics of independent work

1. Advancements in non-thermal processing technologies: evaluating the impact on nutritional and sensory quality of fruits and vegetables.
2. energy-efficient technologies for fruit and vegetable drying: innovations and sustainability.

Literature and data bases on the theme

1. Barrett, D. M., Somogyi, L. P., & Ramaswamy, H. S. (Eds.). (2004). Processing fruits: Science and technology (2nd ed.). CRC Press. ISBN: 978-1-56676-931-3
2. Brennan, J. G. (Ed.). (2006). Food processing handbook. Wiley-VCH. ISBN: 978-3-527-31379-3
3. Fellows, P. J. (2017). Food processing technology: Principles and practice (4th ed.). Woodhead Publishing. ISBN: 978-0-08-101907-8
4. Lozano, J. E. (Ed.). (2006). Fruit manufacturing: Scientific basis, engineering properties, and deterioration behavior. Springer. ISBN: 978-0-387-26014-8
5. Saravacos, G. D., & Kostaropoulos, A. E. (2016). Handbook of food processing equipment (2nd ed.). Springer. ISBN: 978-1-4939-3115-3

Theme 6. Fermented fruit and vegetable production

Issues to be covered in the lectures

1. Types of fermented plant-based products.
2. Production technology of sauerkraut. Key elements of successful fermentation.
3. Differences between untreated sauerkraut and pasteurised, including nutritional benefits.

Issues to be covered in the practical or laboratory works

1. Preparation of sauerkraut.
2. Packaging and storage of sauerkraut. Product treatment in sous-vide.
3. Microbiological evaluation of prepared sauerkraut.
4. Sensory evaluation of sauerkraut.
5. Quality evaluation of prepared sauerkraut.

Topics of independent work

1. Microbial diversity and functional properties of fermented fruit and vegetable products.
2. Innovative fermentation techniques for enhanced flavour and nutritional value.
3. Utilization of by-products from fermented fruit and vegetable production: value addition and sustainability.

Literature and data bases on the theme

1. Marco, M. L., Heeney, D., Binda, S., Cifelli, C. J., Cotter, P. D., Foligné, B., Gänzle, M., Kort, R., Pasin, G., Pihlanto, A., Smid, E. J., Hutkins, R., & Ventura, M. (2017). Health benefits of fermented foods: Microbiota and beyond. Current Opinion in Biotechnology, 44, 94-102. doi:10.1016/j.copbio.2016.11.010
2. Speranza, B., Bevilacqua, A., Corbo, M. R., Sinigaglia, M., & Campaniello, D. (2018). Microbial dynamics during fermentation of an Italian fermented vegetable product as revealed by metagenomic analysis. LWT - Food Science and Technology, 92, 541-547. doi:10.1016/j.lwt.2018.03.019
3. Tamang, J. P., & Kailasapathy, K. (Eds.). (2010). Fermented foods and beverages of the world. CRC Press.
4. Tamang, J. P., Shin, D. H., Jung, S. J., & Chae, S. W. (2016). Functional properties of microorganisms in fermented foods. Frontiers in Microbiology, 7, 578. doi:10.3389/fmicb.2016.00578

Theme 7. Assessment of the Safety and Risks of fruit, vegetable products (HACCP)

Issues to be covered in the lectures

1. What is Food Safety?
2. How many and Which principles are used to build HACCP system?
3. Please describe prerequisite programs and their role in HACCP system?

Issues to be covered in the practical or laboratory works

1. How is Matrix that we use for risk assessment build?
2. What is the difference between Matrix and decision tree?
3. For what/why do we use records of CCP monitoring?

Topics of independent work

1. How to identify - whether the supplier is low, medium or high risk?
2. Description of known so far counterfeiting of fruit and vegetables.

Literature and databases on the theme

1. Wallace, C. A., Sperber, W. H., & Mortimore, S. E. (2018). Food safety for the 21st century: Managing HACCP and food safety throughout the global supply chain (2nd ed.). Wiley.
2. Codex Alimentarius. (n.d.). Retrieved from http://www.fao.org/fao-who-codexalimentarius/en/
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4. BRCGS. (n.d.). Global standard for food safety issue 9. Retrieved from https://www.brcgs.com/our-standards/food-safety/issue-9-revision/

Theme 8. Microbiological aspects of fruit and vegetable processing

Issues to be covered in the lectures

1. Classification of microorganisms (overview).
2. Most commonly found microorganisms and causes for microbiological spoilage of fruits, vegetables and their processing products.
3. Causes of microbiological spoilage defects in canned goods.
4. Pathogens found in canned fruit and vegetable products.
5. Local and European legislative regulations regarding microbiological contamination of fruits, vegetables and their processing products.

Issues to be covered in the practical or laboratory works

The topics discussed in this theme of the study course 'Fruit and vegetable processing technologies', from a practical point of view is discussed in combination and according to other themes directly connected with fruit and vegetable processing product production.

Topics of independent work

1. Microbial biofilms in fruit and vegetable processing: formation, control and implications for food safety.
2. Bio preservation strategies for extending shelf life and enhancing safety of fresh-cut fruits and vegetables.

Literature and data bases on the theme

1. Food Science Source. (n.d.). Retrieved from https://www.ebsco.com/products/research-databases/food-science-source
2. PubMed. (n.d.). Retrieved from https://pubmed.ncbi.nlm.nih.gov/
3. European Parliament and Council. (2023). Regulation (EU) 2023/988 on general product safety. Official Journal of the European Union.
4. European Parliament and Council. (2011). Regulation (EU) No 1169/2011 on the provision of food information to consumers. Official Journal of the European Union.
5. Samelis, J. (Ed.). (2014). *Foodborne pathogens: Hazards, risk analysis and control* (2nd ed.). Woodhead Publishing.

Theme 9. Production technology of frozen fruits and vegetables

Issues to be covered in the lectures

1. Production technology of frozen fruits and vegetables.
2. Types of freezing mechanisms.
3. Quality parameters of fruits and vegetables suitable for freezing.
4. Fruit and vegetable pre-treatment methods before freezing.

Issues to be covered in the practical or laboratory works

1. Freezing of fruits and vegetables.
2. Quality analysis of frozen fruits and vegetables.

Topics of independent work

1. Energy-efficient freezing techniques.
2. Sustainable packaging solutions for frozen produce.
3. Blockchain technology for traceability and quality assurance.

Literature and data bases on the theme

1. Fellows, P. (2009). Food processing technology: Principles and practice (3rd ed.). Woodhead Publishing.
2. Sun, D.-W. (Ed.). (2005). Emerging technologies for food processing. Elsevier Academic Press.
3. Расулов, А. (1995). Сабзавот, картошка ва полиз ма\сулотларини саклаш. Мехнат.
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6. Буриев, Х., & Ризаев, Р. (1996). Мева, узум махсулотлари биокимёси ва технологияси. Мехнат.

Theme 10. Sensory aspects of fruit and vegetable processing products

Issues to be covered in the lectures

1. Changes in sensory properties of fruit and vegetables in technological processes.
2. Characteristics of sensory properties - appearance, colour, aroma, texture, taste and aftertaste.
3. Sensory methods used in the evaluation of processed fruits and vegetables.

Issues to be covered in the laboratory works

The topics discussed in this theme of the study course 'Fruit and vegetable processing technologies', from a practical point of view, are discussed in combination and according to other themes directly connected with fruit and vegetable processing product production.

1. What sensory properties should be evaluated for fruits and vegetables and their processing products?
2. What sensory methods can be used to evaluate fruits and vegetables and their processed products?
3. How to present and analyse the results obtained in sensory evaluation?

Topics of independent work

1. Analysis of obtained results.
2. To find a more theoretical background of sensory quality parameters of fruits and vegetables.

Literature and data bases on the theme

1. OECD. (n.d.). International standards for fruit and vegetables. Retrieved from https://www.oecd-ilibrary.org/agriculture-and-food/international-standards-for-fruit-and-vegetables_19935668?page=1
2. Fruitrop. (n.d.). Quality defects. Retrieved from https://www.fruitrop.com/en/Articles-by-subject/Quality-defects

Theme 11. Thermally processed vegetable preserves

Issues to be covered in the lectures

1. Natural preserves.
2. Testing of canned food quality.
3. Processing of tomatoes.
4. Production of acidified vegetable preserves.
5. Potato processing products and technologies, needed equipment, and their characteristics.

Issues to be covered in the practical or laboratory works

1. Preparation and analysis of potato processing products using different technologies - French fries.
2. Preparation and analysis of potato processing products using different technologies – chips.
3. Sensory evaluation of potato chips.
4. Preparation of tomato concentrates and sauces using different technologies.
5. Quality assessment of prepared tomato products.
6. Sensory evaluation of prepared tomato products.

Topics of independent work

1. Impact on thermal processing on nutritional quality and safety of products.
2. Consumer acceptance and market trend of thermally processed vegetable preserves.
3. Sustainability and environmental impact of thermally processed vegetable preserves.
4. Study of the influence of various methods of heat treatment on the preservation of nutrients in canned vegetables.
5. Comparison of preservation methods: heat treatment, sterilization, pasteurization.
6. Assessment of changes in the content of vitamins, minerals and antioxidants after various types of heat treatment.

Literature and data bases on the theme

1. Barbosa-Cánovas, G. V., & Gould, G. W. (Eds.). (2000). Innovative food processing technologies. CRC Press.
2. Gould, G. W. (Ed.). (2012). New methods of food preservation. Springer Science & Business Media.
3. Ramaswamy, H. S., & Marcotte, M. (2006). Food processing: Principles and applications. CRC Press.
4. Расулов, А. (1995). Сабзавот, картошка ва полиз ма\сулотларини саклаш. Мехнат.
5. Орипов, Р. О., & бошкалар. (1991). Кишлок хужалиги махсулотларини саклаш ва кайта ишлаш технологияси. Мехнат.
6. Широков, С. П. (1978). Технология хранения и переработки плодов и овощей. Колос.
7. Буриев, Х., & Ризаев, Р. (1996). Мева, узум махсулотлари биокимёси ва технологияси. Мехнат.

Theme 12. Thermally processed fruit and berry preserves

Issues to be covered in the lectures

1. Classification of fruit and berry processing products.
2. The technology and equipment of preparation of compotes and jams, purees.
3. The technology of fruit and berry marmalade production.
4. Gelling agents used in fruit and berry product production.
5. Fruit, berry and vegetable juices, their division and juice production technologies and equipment.

Issues to be covered in the practical or laboratory works

1. Apple compote preparation.
2. Quality evaluation of apple compotes.
3. Preparation of fruit and berry marmalades using different gelling agents.
4. Quality analysis of fruit and berry marmalades.
5. Sensory analysis of fruit and berry marmalades.
6. Principles of production of fruit and vegetable juices, evaluation of prepared juices.

Topics of independent work

1. Impact of thermal processing on nutritional quality and bioactive compounds.
2. Consumer preferences and market trends for thermally processed fruit and berry preserves.
3. Study of the main stages of production, including preparation of raw materials, heat treatment, packaging and preservation.
4. Analysis of the content of vitamins, minerals, antioxidants and other nutrients in canned fruits and berries.
5. Research on methods for controlling the microbiological composition of canned food, preventing the growth of bacteria, mold and yeast.

Literature and data bases on the theme

1. Ashurst, P. R. (Ed.). (2016). Chemistry and technology of soft drinks and fruit juices (3rd ed.). Wiley-Blackwell.
2. Silva, C. L. M., & Oliveira, F. A. R. (Eds.). (2008). Thermal food processing: New technologies and quality issues. CRC Press.
3. Tressler, D. K., Joslyn, M. A., & Marsh, G. L. (1968). The chemistry and technology of fruit and vegetable juice production. AVI Publishing Company.
4. Расулов, А. (1995). Сабзавот, картошка ва полиз ма\сулотларини саклаш. Мехнат.
5. Орипов, Р. О., & бошкалар. (1991). Кишлок хужалиги махсулотларини саклаш ва кайта ишлаш технологияси. Мехнат.
6. Широков, С. П. (1978). Технология хранения и переработки плодов и овощей. Колос.
7. Буриев, Х., & Ризаев, Р. (1996). Мева, узум махсулотлари биокимёси ва технологияси. Мехнат.

Theme 13. Vegetable oils

Issues to be covered in the lectures

1. Vegetable oil division and extraction methods.
2. Essential quality parameters of oils.
3. Production of vegetable oils.

Issues to be covered in the practical or laboratory works

1. Vegetable oil analysis.

Topics of independent work

1. Chemical and nutritional analysis of different vegetable oils.
2. Sustainability and environmental impact of vegetable oil production.
3. Market trends and consumer preferences in the vegetable oil industry.
4. Comparative analysis of the physical, chemical and nutritional properties of various types of vegetable oils.
5. Study of technologies for the production of vegetable oils, including extraction and purification methods.
6. Analysis of the environmental impact of vegetable oil production, including issues of sustainable agriculture and potential negative impacts on ecosystems.

Literature and data bases on the theme

1. Gunstone, F. D. (Ed.). (2011). Vegetable oils in food technology: Composition, properties, and uses (2nd ed.). Wiley-Blackwell.
2. Hamm, W., Hamilton, R. J., & Calliauw, G. (Eds.). (2013). Edible oil processing (2nd ed.). Wiley-Blackwell.
3. Shahidi, F. (Ed.). (2005). Bailey's industrial oil and fat products (6th ed., Vols. 1-6). Wiley-Interscience.
4. Расулов, А. (1995). Сабзавот, картошка ва полиз ма\сулотларини саклаш. Мехнат.
5. Орипов, Р. О., & бошкалар. (1991). Кишлок хужалиги махсулотларини саклаш ва кайта ишлаш технологияси. Мехнат.
6. Широков, С. П. (1978). Технология хранения и переработки плодов и овощей. Колос.
7. Буриев, Х., & Ризаев, Р. (1996). Мева, узум махсулотлари биокимёси ва технологияси. Мехнат.

Theme 14. Dried fruit and vegetable products

Issues to be covered in the lectures

1. Drying methods of fruits, berries and vegetables.
2. Key elements to dried product quality, specific to the dehydration method.

Issues to be covered in the practical or laboratory works

1. Apple drying using different technologies.
2. Quality evaluation of dried apples.

Topics of independent work

1. Nutritional and chemical changes during drying consumer preferences and market trends in dried fruit and vegetable products.
2. Sustainability and environmental impact of dried fruit and vegetable product production.
3. Methods of production of dried fruits and vegetable products.
4. Nutritional value of dried fruits and vegetable products.
5. Research of modern drying and packaging technologies aimed at preserving the taste and nutritional value of products.

Literature and data bases on the theme

1. Baird-Parker, T. C., Gould, G. W., & Lund, B. M. (Eds.). (2000). *Microbiological safety and quality of food* (Vol. 1). Springer.
2. Mujumdar, A. S. (Ed.). (2014). *Handbook of industrial drying* (4th ed.). CRC Press
3. Sinha, N. K., Sidhu, J. S., Barta, J., Wu, J. S. B., & Cano, M. P. (Eds.). (2012). *Handbook of fruits and fruit processing* (2nd ed.). Wiley-Blackwell.
4. Расулов, А. (1995). Сабзавот, картошка ва полиз ма\сулотларини саклаш. Мехнат.
5. Орипов, Р. О., & бошкалар. (1991). Кишлок хужалиги махсулотларини саклаш ва кайта ишлаш технологияси. Мехнат.
6. Широков, С. П. (1978). Технология хранения и переработки плодов и овощей. Колос.
7. Буриев, Х., & Ризаев, Р. (1996). Мева, узум махсулотлари биокимёси ва технологияси. Мехнат.

Literature sources

1. Ahvenainen, R. (Ed.). (2003). *Novel food packaging techniques*. Woodhead Publishing.
2. Ashurst, P. R. (Ed.). (2016). *Chemistry and technology of soft drinks and fruit juices* (3rd ed.). Wiley-Blackwell.
3. Bahrami, A., Moosavi-Nasab, M., Ghanbarzadeh, B., & Khodaiyan, F. (2020). Application of edible films and coatings in fresh fruits and vegetables. *Food Science & Nutrition, 8*(12), 5240–5254. https://doi.org/10.1002/fsn3.1877
4. Baird-Parker, T. C., Gould, G. W., & Lund, B. M. (Eds.). (2000). *Microbiological safety and quality of food* (Vol. 1). Springer.
5. Barbosa-Cánovas, G. V., & Gould, G. W. (Eds.). (2000). *Innovative food processing technologies*. CRC Press.
6. Barrett, D. M., Somogyi, L. P., & Ramaswamy, H. S. (Eds.). (2004). *Processing fruits: Science and technology* (2nd ed.). CRC Press.
7. Brennan, J. G. (Ed.). (2006). *Food processing handbook*. Wiley-VCH.
8. Wallace, C. A., Sperber, W. H., & Mortimore, S. E. (2018). *Food safety for the 21st century: Managing HACCP and food safety throughout the global supply chain* (2nd ed.). Wiley.
9. Codex Alimentarius. (n.d.). Retrieved from http://www.fao.org/fao-who-codexalimentarius/en/
10. European Commission. (2022). EU COMMISSION NOTICE on the implementation of food safety management systems covering Good Hygiene Practices and procedures based on the HACCP principles. Official Journal of the European Union. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022XC0916%2801%29
11. Fellows, P. (2009). *Food processing technology: Principles and practice* (3rd ed.). Woodhead Publishing.
12. Fellows, P. J. (2017). *Food processing technology: Principles and practice* (4th ed.). Woodhead Publishing.
13. Rangappa, S. M., Jyotishkumar, P., Thiagamani, S. M. K., Krishnasamy, S., & Siengchin, S. (2020). *Food packaging: Advanced materials, technologies, and innovations*. CRC Press.
14. Food Science Source. (n.d.). Retrieved from https://www.ebsco.com/products/research-databases/food-science-source
15. BRCGS. (n.d.). *Global standard for food safety issue 9*. Retrieved from https://www.brcgs.com/our-standards/food-safety/issue-9-revision/
16. Gould, G. W. (Ed.). (2012). *New methods of food preservation*. Springer Science & Business Media.
17. Gunstone, F. D. (Ed.). (2011). *Vegetable oils in food technology: Composition, properties, and uses* (2nd ed.). Wiley-Blackwell.
18. Hamm, W., Hamilton, R. J., & Calliauw, G. (Eds.). (2013). *Edible oil processing* (2nd ed.). Wiley-Blackwell.
19. Fruitrop. (n.d.). Quality defects. Retrieved from https://www.fruitrop.com/en/Articles-by-subject/Quality-defects
20. Hui, Y. H. (Ed.). (2010). *Handbook of fruit and vegetable flavors*. Wiley.
21. Jaiswal, A. K. (Ed.). (2020). *Nutritional composition and antioxidant properties of fruits and vegetables*. Academic Press.
22. Jongen, W. (Ed.). (2002). *Fruit and vegetable processing: Improving quality*. Woodhead Publishing.
23. Lim, T. K. (2012). *Edible medicinal and non-medicinal plants: Volume 1, fruits*. Springer.

24. Lozano, J. E. (Ed.). (2006). *Fruit manufacturing: Scientific basis, engineering properties, and deterioration behavior*. Springer.
25. Marco, M. L., Heeney, D., Binda, S., Cifelli, C. J., Cotter, P. D., Foligné, B., Gänzle, M., Kort, R., Pasin, G., Pihlanto, A., Smid, E. J., Hutkins, R., & Ventura, M. (2017). Health benefits of fermented foods: Microbiota and beyond. *Current Opinion in Biotechnology, 44*, 94–102. https://doi.org/10.1016/j.copbio.2016.11.010
26. Martin-Belloso, O., & Soliva-Fortuny, R. (Eds.). (2010). *Advances in fresh-cut fruits and vegetables processing*. CRC Press.
27. Mérillon, J.-M., & Ramawat, K. G. (Eds.). (2018). *Bioactive molecules in food*. Springer.
28. Mujumdar, A. S. (Ed.). (2014). *Handbook of industrial drying* (4th ed.). CRC Press.
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30. Chonhenchob, V., Singh, P., & Singh, J. (2016). *Packaging & distribution of fresh fruits & vegetables*. Destech Pubns Inc.
31. Alam, T. (Ed.). (2022). *Packaging and storage of fruits and vegetables: Emerging trends*. Apple Academic Press.
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35. European Parliament and Council. (2011). Regulation (EU) No 1169/2011 on the provision of food information to consumers. Official Journal of the European Union.
36. Samelis, J. (Ed.). (2014). *Foodborne pathogens: Hazards, risk analysis and control* (2nd ed.). Woodhead Publishing.
37. Saravacos, G. D., & Kostaropoulos, A. E. (2016). *Handbook of food processing equipment* (2nd ed.). Springer.
38. Shahidi, F. (Ed.). (2005). *Bailey's industrial oil and fat products* (6th ed., Vols. 1–6). Wiley-Interscience.
39. Silva, C. L. M., & Oliveira, F. A. R. (Eds.). (2008). *Thermal food processing: New technologies and quality issues*. CRC Press.
40. Sinha, N. K., Hui, Y. H., Evranuz, E. Ö., Cano, M. P., Barta, J., & Siddiqi, J. I. (Eds.). (2012). *Handbook of fruits and fruit processing* (2nd ed.). Wiley-Blackwell.
41. Sinha, N. K., Sidhu, J. S., Barta, J., Wu, J. S. B., & Cano, M. P. (Eds.). (2012). *Handbook of fruits and fruit processing* (2nd ed.). Wiley-Blackwell.
42. Speranza, B., Bevilacqua, A., Corbo, M. R., Sinigaglia, M., & Campaniello, D. (2018). Microbial dynamics during fermentation of an Italian fermented vegetable product as revealed by metagenomic analysis. *LWT - Food Science and Technology, 92*, 541–547. https://doi.org/10.1016/j.lwt.2018.03.019
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46. Tressler, D. K., Joslyn, M. A., & Marsh, G. L. (1968). *The chemistry and technology of fruit and vegetable juice production*. AVI Publishing Company.
47. Yahia, E. M. (Ed.). (2019). *Postharvest physiology and biochemistry of fruits and vegetables*. Woodhead Publishing.
48. Расулов, А. (1995). *Сабзавот, картошка ва полиз ма\сулотларини саклаш*. Мехнат.
49. Орипов, Р. О., & бошкалар. (1991). *Кишлок хужалиги махсулотларини саклаш ва кайта ишлаш технологияси*. Мехнат.
50. Широков, С. П. (1978). *Технология хранения и переработки плодов и овощей*. Колос.
51. Буриев, Х., & Ризаев, Р. (1996). *Мева, узум махсулотлари биокимёси ва технологияси*. Мехнат.

Materials needed for the implementation of the study course program

No.	Material resources and equipment	Quantity / description
1	Laboratory equipment, refrigerators, freezers, canning and drying equipment, scales, thermometers etc.	Equipment for demonstration and practical training
2	Kitchen equipment for conducting practical classes on preparing dishes from fruits and vegetables.	Equipment for demonstration and practical training
3	Chemicals, acids and alkalis for canning, indicators for measuring pH and others.	Equipment for demonstration and practical training
4	Digital refractometer	1 (at least)
5	pH meter	1 (at least)
6	Light microscope	1 (at least)
7	Structure analyser	1
8	Vacuum cooker	1
9	Convective dryer	3
10	Freeze-dryer	1
11	Microwave vacuum dryer	1
12	Flash freezer	1
13	Contact plate freezer	1
14	Thermostat	3
15	Slow rotation type juicer	1
16	Steamer	1
17	Evaporation of juice in a diffusion pot	1
18	Mechanical juicer	1
19	Sterilizer (autoclave)	1
20	Colour analyser	1
21	Gas composition detector	1

22	Bag mixer	Solid sample homogenizer for microbiology – 1
23	Deep fryer	1
24	Rotary-type vacuum evaporator	1

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

Co-funded by the European Union

OFINU

Open Food Innovation University (OFINU)

DESCRIPTION OF STUDY MODULE
“CEREAL 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.

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Partner universities and their academic staff, involved in the development of the study course:

P1 LBTU. Latvia University of Life Sciences and Technologies

Dace Klava - cereal processing technology.

Tatjana Ķince - cereal processing equipment.

Evita Straumite - sensory evaluation of cereal products.

Sandra Muizniece-Brasava - packaging of cereal products.

Egita Sproge - HACCAP.

P2 SAMARU. Samarkand Agroinnovations and Research University

RahmatilloTashmanov - cereal processing technology.

Temurbek Mikhliev - cereal processing technology.

Yigitali Tashpulatov - cereal processing equipment.

Babur Eshonkulov - cereal processing technology.

Kamoliddin Bozorov - quality management of cereal products.

P3 AIAA. Andijan Institute of Agriculture and Agro-technologies

Murodjon Atajanov - cereal processing technology.

Muhammad Zahiriddin Zaynobiddinov - cereal processing equipment.

Oybek Egamberdiev - quality management of cereal products.

P4 TUT. Technological University of Tajikistan

Mavzuna SHARIPOVA - cereal processing technology.

P5 KITIM. Kulob Institute of Technology and Innovation Management

Iskandar HAKIMOV - cereal processing technology.

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

Zokirkhoja Soliev - cereal processing technology.

P7 SUA. Slovak University of Agriculture in Nitra

Eva Ivanišová - cereal processing technology.

INTRODUCTION

Study module **"Cereal Technology "** has been developed for the open university sessions. Every audience from the university, both students and lecturers, from the middle and higher-level specialists of the food industry, as well as anyone interested who wants to learn about cereal processing, bread making and flour confectionery can participate. The study module is designed based on the basic principles of student-centred training using the latest training methods. The module includes the following topics: technological process and equipment, packaging material and equipment, raw materials and product quality evaluation, including sensory evaluation. Quality management assurances in the grain processing. The training of the module is organised in 50% theoretical lessons and 50% practical lessons. During the practical lessons, professional problem situations are solved. Students with different knowledge, professional experience, but with a high degree of interest ensure mutual communication and the learning process by learning from each other.

Aim and objectives of the study subject

The study course aims to deepen the knowledge about the chemical composition, properties, and quality of grain, to learn the basics of grain processing technology and the introduction of innovations, and to understand the physical, biochemical, and microbiological processes during production. To gain knowledge of flour, groats, pasta, and bread quality assessment methods and safety. To get acquainted with the special equipment used in food production, their structure, and operating principles. In the laboratory work, students acquire practical skills in quality control of grain, flour, and other raw materials and the development of bread and special products.

Learning outcomes:

- ***Knowledge*** - knowledgeable about the raw materials of grain processing and bread production, the basic principles of product technology process, and special knowledge of processes, quality assurance, and control. Able to explain the most important terms about grain processing products, their properties, and quality management.
- ***Skills*** to perform quality assessment of raw materials and products, necessary calculations, perform research work, and describe the quality monitoring of grain processing products.
- ***Competence*** to independently obtain, select, and analyse information on the impact of individual raw materials on product quality, and take part in the development and evaluation of new products.

Study Plan for module "Cereal Technology" in Uzbekistan

	Themes	Number of hours			
		Total	Lectures	Practical / Laboratory works	Independent work of the student
1.	Cereals, their characteristics and quality	50	10	12	28
2.	Grain processing - flour, groats, flakes	46	6	12/	28
3.	Pasta production and quality evaluation	42	2	12	28
4.	The basics of bread making	42	6	8	28
5.	Wheat bread technology	48	6	14	28
6.	Wholegrain and traditional bread technology	50	10	12	28
7.	Flour confectionery and traditional confectionary	46	10	8	28
	TOTAL	**324**	50	78	196

Study Plan for module "Cereal Technology" in Tajikistan

	Themes	Number of hours			
		Total	Lectures	Practical / Laboratory works	Independent work of the student
1.	Cereals, their characteristics and quality	50	16	12	23
2.	Grain processing - flour, groats, flakes	46	10	12	23
3.	Pasta production and quality evaluation	43	3	12	23
4.	The basics of bread making	43	10	9	23
5.	Wheat bread technology	48	10	15	23
6.	Wholegrain and traditional bread technology	50	16	12	24
7.	Flour confectionery and traditional confectionary	46	16	9	23
	TOTAL	**324**	81	81	162

Thematic Study Plan for module "Cereal Technology"

Date, Time	Study form	Theme	Lecturer
Theme 1 - Cereals, their characteristics, and quality			
1st day	Lecture (1h)	Introduction lecture about the study course.	
	Lecture (3h)	Grains and their characteristics.	
		Types of grains, chemical composition - carbohydrates, proteins, lipids, their properties, vitamins, minerals, pigments, water. Physical properties of grains. Developmental processes in grains.	
	Laboratory work (4h)	Analysis of grain mechanical and physical properties (thousand grain weight, bulk density, first class proportion, moisture content, hardness, trial milling).	
2nd day	Lecture (2h)	Equipment for receiving and pre-treatment grain.	
	Laboratory work (4h)	Determination of grain quality parameters (Organoleptic, TTA, pH, ash content, moisture).	
	Practical work (2h)	Equipment for receiving and pre-treatment grain.	
3rd day	Lecture (3h)	Quality management in the grain processing industry.	
	Practical work (2h)	Quality management in the grain processing industry.	
4th day	Excursion	Visit to grain processing factory or grain production farm.	
Theme 2 - Grain processing: flour, groats, flakes			
5th day	Seminar (1h)	Grains and quality.	
	Lecture (2h)	Flour production. Production of semolina, couscous, semolina and flakes.	
	Lecture (1h)	Equipment and lines for the production of flour, semolina, and flakes.	
6th day	Laboratory work (3h)	Flour and breakfast flake quality assessment.	
	Practical work (2h)	Packaging of flour and flakes and evaluation of the quality of flakes and muesli.	
7th day	Laboratory work (3h)	Flour quality analysis (determination of ash, protein, Zeleny index, acidity, falling number, quantity and quality of gluten, rheological properties).	

	Lecture (2h)	Sensory evaluation of flour and flakes.	
	Laboratory work (2h)	Sensory evaluation of breakfast cereals, granola and muesli.	
Theme 3 - Pasta production and quality evaluation			
8th day	Seminar (1h)	Flour production and quality.	
	Lecture (2h)	Characteristics of pasta. Technological process of pasta production.	
	Lecture (1h)	Pasta production equipment.	
9th day	Laboratory work (4h)	Pasta production in laboratory condition. Evaluation of pasta quality (cooking ability, water absorption, volume).	
	Practical work (2h)	Packaging of pasta.	
10th day	Laboratory work (4h)	Sensory evaluation of pasta.	
11th day	Excursion	Visit to pasta processing factory or mill.	
Theme 4 - The basics of bread making			
12th day	Seminar (1h)	Pasta in the world.	
	Lecture (3h)	Characteristics of bread industry and tendencies. Characteristics and quality requirements of raw materials used in bread baking. Sourdough role in bread preparation.	
	Lecture (2h)	Equipment for wheat bread making.	
	Lecture (2h)	Sensory evaluation of bread.	
13th day	Laboratory work (2h)	Quality evaluation of raw materials.	
	Laboratory work (1h)	Microbiology analyses of raw materials.	
	Laboratory l work (2h)	Sourdough preparation (1st stage) of sourdough and quality evaluation.	
	Laboratory work (1h)	Microbiology analyses of sourdough (1st stage).	
14th day	Laboratory work (2h)	Sourdough preparation (2nd stage) of sourdough and quality evaluation. Microbiology analyses of sourdough (2nd stage).	
	Laboratory work (2h)	Sourdough preparation (3rd stage) of sourdough and quality evaluation. Microbiology analyses of sourdough (3rd stage).	

Theme 5 - Wheat bread technology			
15th day	Lecture (2h)	Wheat dough processing (dividing, rounding, pre-fermentation, shaping, baking).	
	Lecture (2h)	Equipment for wheat bread making.	
	Laboratory work (2h)	Microbiology analyses of raw materials – results. Microbiology analyses of sourdough 1st stage, microbiota identification of sourdough.	
	Laboratory work (2h)	Baking test of wheat bread with sourdough (kneading dough and fermentation time not less than 8 h).	
16th day	Laboratory work (2h)	Baking test of wheat bread with sourdough.	
	Lecture (2h)	Freeze technologies in wheat bread making.	
	Laboratory work (2h)	Microbiology analyses of sourdough 2nd and 3rd stage, microbiota identification of sourdough 1st stage results.	
17th day	Laboratory work (5h)	Wheat bread with yeast - baking test and freezing processes.	
	Laboratory work (1h)	Microbiota identification of sourdough 1st stage results.	
	Practical work (2h)	Wheat bread packaging.	
18th day	Lecture (2h)	Sensory evaluation of different types of bread.	
	Laboratory work (2h)	Sensory evaluation of different types of bread.	
	Laboratory work (2h)	Evaluation of wheat bread quality.	
	Laboratory work (2h)	Evaluation of wheat bread microbiology quality.	
19th day	Excursion	Visit to bread bakery.	
Theme 6 - Wholegrain and traditional bread technology			
20th day	Seminar (1h)	Nutrition aspects of wheat bread.	
	Lecture (3h)	Ways of preparing rye (wholegrain) dough. Dividing, shaping, and fermentation of rye (wholegrain) dough. Baking rye (wholegrain) bread.	
	Lecture (3h)	Quality management in a bread bakery.	
21th day	Laboratory work (8h)	Baking test of wholegrain bread with sourdough.	
22th day	Practical work (2h)	Packaging and pasteurisation of rye (wholegrain) bread.	
	Laboratory work (2h)	Sensory evaluation of bread.	

	Seminar (2h)	Presentation of analysis of bread faults and their reasons.	
	Laboratory work (2h)	Evaluation of rye bread microbiology quality.	
	Practical work (2h)	Quality management in the bread bakery.	
Theme 7 - Flour confectionery and traditional confectionary			
23th day	Seminar (1h)	Bread around the world.	
	Lecture (4h)	Characteristics of raw materials used in flour confectionery. Types and differences of dough. Fillings and their variety in confectionery.	
	Laboratory work (4h)	Creating new ideas for traditional desserts/cakes - new versions. Preparation of innovative desserts/cakes.	

Themes and their summary in the study module "Cereal technology"

Theme 1. Cereals, their characteristics and quality

Issues to covered in the lectures

1. Grains, their characteristics.
2. Types of grains, chemical composition - carbohydrates, proteins, lipids, their properties, vitamins, minerals, pigments, water.
3. Physical properties of grains. Developmental processes in grains.
4. Equipment for receiving and pre-treatment grain.
5. Quality management in the grain processing industry.
6. Technological equipment for grain pre-treatment (grain driers, removal of impurities, grain surface treatment, grain conditioning, grain cleaning: separators, de-stoners, decontamination plant, grain washing machine; grain storage: warehouses, elevators, grain silo).

Issues to covered in the practical or laboratory works

1. Analysis of grain mechanical and physical properties (thousand grain weight, bulk density, first class proportion, moisture content, hardness).
2. Determination of grain quality parameters (Organoleptic, TTA, pH, Ash content, Falling number; Gluten for wheat).
3. Quality management in the grain processing industry.
4. Opportunities for the development of cereal processing. Preparation of a batch of grain intended for grinding (calculation).

Topics of independent work

1. Which cereals and why will you use gluten-free product development?
2. Which cereals are grown, processed and exported the most in World, EU, Latvia Central Asia?
3. Are quinoa and amaranth grown in Central Asia and EU, what is valuable in these pseudo-cereals?
4. What are the quality requirements of wheat grain in Uzbekistan, Tajikistan and Latvia?
5. How is the volumetric weight of grains and the absolute (1000) grain weight determined and what is characterized?
6. What are the quality requirements of rye grain in Uzbekistan, Tajikistan and Latvia?
7. How is the amount of gluten and the quality of gluten determined and what is characterized?
8. How is the falling number determined and what is it characterized by?

Literature and databases on the theme

1. Rosentrater, K. A., Evers A.D. (2018). Kent's Technology of Cereals: An Introduction for Students of Food Science and Agriculture. A volume in Woodhead Publishing Series in Food Science, Technology and Nutrition (5th ed.). Elsevier Ltd.
2. International Association for Cereal Science and Technology. (2024, July). https://icc.or.at/publications/icc-standards

3. Solgajová M. (2014) Technology of foodstuffs of plant origin. Slovak University of Agriculture in Nitra.

Theme 2. Grain processing - flour, groats, flakes

Issues to covered in the lectures

1. Flour production.
2. Production of semolina, couscous, semolina and flakes.
3. Equipment and lines for the production of flour, semolina and flakes
4. Sensory evaluation of flour, flakes; granola: Sensory parameters of flour - appearance, colour and taste. Possible defects. Sensory evaluation of flakes - dry flakes and with water, structure, colour, taste and aftertaste
5. Technological equipment for flour, groats and flakes production: overview of grain mill constructions, types of mills (rolling, hummer, rotor, disc, pneumatic), groats production equipment, oats flakes production line from groats, aspiration column, grooving plant, steamers, grain flakers construction.

Issues to covered in the practical or laboratory works

1. Preparation of flour, flakes, muesli
2. Packaging of flour and flakes and evaluation of the quality of flakes and muesli
3. Flour quality analysis (determination of ash, Zeleny index, acidity, quantity and quality of gluten, rheological properties).
4. Sensory evaluation of breakfast cereals, granola and muesli.
5. Flour obtaining. Evaluation of fiscal properties of obtained flour and commercial breakfast flakes.

Topics of independent work

1. What cereals are used in the production of flour?
2. Classification of flour according to the amount of grain sheaths.
3. What are the by-products of flour production?
4. What kind of products is barley used in?
5. What products are oats used in production?
6. What is the market demand for breakfast cereals in the EU and Central Asia?
7. Protein extraction from legumes.
8. Resistant starch, its types and production.
9. Types of extrusion and characteristics of the obtained products
10. Types of flour used in the production of extruded products.

Literature and data bases on the theme

1. International Association for Cereal Science and Technology. (2024, June). https://icc.or.at/publications/icc-standards
2. Rosentrater, K. A., Evers A.D. (2018). Kent's Technology of Cereals: An Introduction for Students of Food Science and Agriculture. A volume in Woodhead Publishing Series in Food Science, Technology and Nutrition (5th ed.). Elsevier Ltd.
3. Solgajová M. (2014) Technology of foodstuffs of plant origin. Slovak University of Agriculture in Nitra.

Theme 3. Pasta production and quality evaluation

Issues to covered in the lectures

1. Characteristics of pasta.
2. Technological process of pasta production.
3. Pasta production equipment.
4. Sensory evaluation of pasta: appearance, colour, structure, aroma, taste and aftertaste.
5. Technological equipment for extruded product obtaining: types of extrusion, extruders constructions, screw variations, matrix variations, dry components mixers, pasta drying equipment.

Issues to covered in the practical or laboratory work

1. Pasta production.
2. Packaging of pasta.
3. Sensory evaluation of pasta.
4. Pasta obtaining and quality evaluation.

Topics of independent work

1. What types of flour can be used in the production of gluten-free pasta?
2. What are the quality requirements for gluten-free pasta?
3. Analysis of demand for gluten-free pasta in EU and Central Asian countries.
4. Latest trends in pasta production.

Literature and databases on the theme

1. International Association for Cereal Science and Technology. (2024, June). https://icc.or.at/publications/icc-standards
2. Rosentrater, K. A., Evers A.D. (2018). Kent's Technology of Cereals: An Introduction for Students of Food Science and Agriculture. A volume in Woodhead Publishing Series in Food Science, Technology and Nutrition (5th ed.). Elsevier Ltd.
3. Solgajová M. (2014) Technology of foodstuffs of plant origin. Slovak University of Agriculture in Nitra.
4. Kill R., Turnbull K. (2001) Pasta and Semolina Technology (1st ed.), Wiley-Blackwell.

Theme 4. The basics of bread making

Issues to covered in the lectures

1. Characteristics of the bread industry and tendencies.
2. Characteristics and quality requirements of raw materials used in bread baking.
3. Sourdough role in bread baking.
4. Equipment for wheat bread making.
5. Sensory evaluation of bakery products.

Issues to covered in the practical or laboratory works

1. Quality evaluation of raw materials.
2. Microbiology analyses of raw materials.
3. Sourdough preparation (1st stage) of sourdough and quality evaluation.

4. Microbiology analyses of sourdough (1st stage).
5. Sourdough preparation (2nd stage) of sourdough and quality evaluation.
6. Microbiology analyses of sourdough (2nd stage).
7. Sourdough preparation (3rd stage) of sourdough and quality evaluation.
8. Microbiology analyses of sourdough (3rd stage).
9. Microbiology analyses of raw materials – results.
10. Microbiology analyses of sourdough 1st stage, microbiota identification of sourdough.

Topics of independent work

1. Ways of making bread sourdough.
2. What biotechnological processes occur during sourdough fermentation?
3. The importance of sourdough in the production process of different types of bread.

Literature and data bases on the theme

1. Kulp K. (Ed.). (2000). Handbook of cereal science and technology. New York: Basel: Marcel Dekker.
2. Gobbetti M., Ganzle M. (Ed). (2023). Handbook on Sourdough Biotechnology (2nd ed.). Springer Cham.
3. Ауэрман, Л. Я. (2005). Технология хлебопекарного производства (9-е изд.). Пищевая промышленность.

Theme 5. Wheat bread technology

Issues to covered in the lectures

1. Wheat dough processing (dividing, rounding, pre-fermentation, shaping, baking).
2. Equipment for wheat bread making.
3. Freezing technologies in bread making.
4. Sensory evaluation of different types of bread.

Issues to covered in the practical or laboratory work

1. Test baking of wheat bread with sourdough - kneading dough and fermentation time not less than 8 h and baking.
2. Wheat bread with yeast test baking and freezing process.
3. Wheat bread packaging.
4. Sensory evaluation of different types of bread.
5. Evaluation of wheat bread quality.
6. Evaluation of wheat bread microbiology quality.

Topics of independent work

1. Nutritional characteristics of wheat bread.
2. Describing the technological methods of increasing the nutritional value of wheat bread.
3. Describing the possibilities of increasing the nutritional value of wheat bread by using different plant and animal raw materials.
4. The latest trends in wheat bread production.
5. Raw materials used in the production of gluten-free bread, their differences compared to whole wheat flour.
6. Differences between the gluten-free bread production process and the traditional wheat bread production technology.

Literature and data bases on the theme

1. Cauvain S.P. (Ed.). (2012). Breadmaking: improving quality (2nd ed.). Woodhead.
2. Ауэрман, Л. Я. (2005). Технология хлебопекарного производства (9-е изд.). Пищевая промышленность.

Theme 6. Wholegrain bread and traditional bread technology

Issues to covered in the lectures

1. Ways of preparing rye (wholegrain) dough.
2. Dividing, shaping, and fermentation of rye (wholegrain) dough.
3. Baking wholegrain or rye bread.
4. Traditional bread technologies.
5. Quality management in the bread bakery.

Issues to covered in the practical or laboratory works

1. Test baking of wholegrain bread with sourdough.
2. Packaging and pasteurization of rye (wholegrain) bread.
3. Evaluation of wholegrain bread quality.
4. Evaluation of wholegrain bread microbiology quality.
5. Sensory evaluation of bread (quality evaluation of bread as experts).
6. Presentation of analysis of bread faults and their reasons.

Topics of independent work

1. Characteristics of traditional types of bread in Latvia and Central Asian countries.
2. Nutritional characteristics of whole wheat bread.
3. Differences in technological processes in the production of whole wheat bread.

Literature and data bases on the theme

1. Garcia – Vaquero M., Pastor K., Orhun G. E., McElhatton Rocha F.J.M. (Eds.) (2023). Traditional European breads. Springer Cham.

Theme 7. Flour confectionery and traditional confectionary

Issues to covered in the lectures

1. Characteristics of raw materials used in flour confectionery.
2. Types and differences of dough.
3. Fillings and their variety used in confectionery.

Issues to covered in the practical or laboratory work

1. Creating new ideas for traditional desserts/cakes new version.
2. Prepare innovative desserts/cakes.

Topics of independent work

1. Describing traditional desserts in Latvia, Uzbekistan and Tajikistan.
2. Describing traditional flour confectionery products in Latvia, Uzbekistan and Tajikistan.
3. What are the trends in the production of flour confectionery products?

Literature and databases on the theme

1. Puratos. (2024, June). Food innovations for Good. https://www.puratos.com
2. Wakerhauser C. (2017). Modern French Pastry: Innovative Techniques, Tools and Design. Page Street Publishing.

Literature sources

1. Cauvain S.P. (Ed.). (2012). Breadmaking: improving quality (2nd ed.) Woodhead.
2. Wakerhauser C. (2017). Modern French Pastry: Innovative Techniques, Tools and Design. Page Street Publishing.
3. Aizikovich L.E., Khortsev B.N. (1968). Flour production technology. Kolos.
4. Webster F. (2011). Oats: Chemistry and Technology (2nd ed.). American Association of Cereal Chemists.
5. Kulp K., Ponte J.G. (Eds.). (2000). Handbook of cereal science and technology. Marcel Dekker.
6. Poutanen K., Aman P. (2016). Rye and Health (1st ed.). American Association of Cereal Chemists.
7. Khan K. (2009). Wheat: Chemistry and Technology (4th ed.). American Association of Cereal Chemists.
8. Garcia – Vaquero M., Pastor K., Orhun G. E., McElhatton Rocha F.J.M. (Eds.) (2023) Traditional European breads. Springer Cham.
9. Rosentrater, K. A., Evers A.D. (2018). Kent's Technology of Cereals: An Introduction for Students of Food Science and Agriculture. A volume in Woodhead Publishing Series in Food Science, Technology and Nutrition (5th ed.). Elsevier Ltd.
10. Gobbetti M., Ganzle M. (Ed). (2023). Handbook on Sourdough Biotechnology (2nd ed.). Springer Cham.
11. Shewry P.R.S., Ullrich E. (2016). Barley: Chemistry and Technology. American Association of Cereal Chemists.
12. Kill R., Turnbull K. (2001). Pasta and Semolina Technology (1st ed.). Willey-Blackwell.
13. Solgajová M. (2014) Technology of foodstuffs of plant origin. Slovak University of Agriculture in Nitra.
14. Kuprits Y.N., Demidov G.P. (1977). Technology of grain processing. Kolos.
15. Glukhikh M.A. (2024). Technology of storage and processing of grain and seeds. Publishing House.
16. Ауэрман, Л. Я. (2005). Технология хлебопекарного производства (9-е изд.). Пищевая промышленность.

Materials needed for the implementation of the study course program

Nr.	Material resources and equipment	Quantity / description
1.	Laboratory scales, calculator of seeds, beakers, watch glass	10/for weighting of samples
2.	Hygroscope	10/for quick determination of moisture content
3.	Hectolitre scale	5/for determination of bulk density
4.	Round sieves	5/automatically separation of grains according size (parameters of sieves 2,5 x 20 mm and 2,2 x 20 mm

5.	Calculator of seeds	5/automatically calculation of thousand grains for thousand grain weight determination
6.	Beakers	20/glass volume 200 ml
7.	Watch glass	20/125 mm, laboratory
8.	Pipettes	20/glass volume 10 ml
9.	Pipette attachment	20/for safety pipette of solution
10.	NaOH p.a.	5 of 1kg/p.a.
11.	Viscometer/Visco Analyser	1/for falling number, from Perten company
12.	Tube for Viscometer/Visco Analyser	30/glass compatible with Viscometer/Visco Analyser
13.	Brabender mill	1/Brabender: Quadrumat Junior for trial milling
14.	Thermostat	2/classical thermostat for incubation of samples
15.	Equipment for sedimentation/Zeleny index	2/Sedimentation Shaker - Flour Mixing Test
16.	Special Zeleny cylinder with stopper	20/glass with accordance to Sedimentation Shaker - Flour Mixing Test
17.	Volumetric flask	20/glass, volume 100 ml
18.	Farinograph	1/BRABENDER Farinograph
19.	Extensograph	1/BRABENDER Extensograph
20.	Amylograph	1/BRABENDER Amylograph
21.	Muffle oven	1/Laboratory muffle over (furnace) max. 1000℃
22.	Porcelain crucible for ash determination	50/Porcelain Crucibles are used with Muffle Furnaces for loss-on-ignition (LOI) testing of cement, fly ash, and soil materials. They are temperature-rated to (1 000 °C). They have a high-form design and are glazed inside and out, except for the outside bottom and rim. The crucibles are available in three sizes and are sold in packages of five, volume 50 ml.

23.	Automatic Kjeldahl analyzer	1/automatic device integrating distillation and titration functions and it is designed based on classic Kjeldahl nitrogen determination method.
24.	Special tubes for Automatic Kjeldahl analyzer	30/digestion tube 250 ml straight
25.	Fresh pasta maker	2/heavy duty construction, water cooler, produces pasta of different shapes, production: 25 kg per hour, with dough cutter, safety switch on the tank and lid, stainless steel tank and stirrer.
26.	Cylinder	5/glass 1000 ml
27.	Plates	30/classical kitchen white plate
28.	Pots	20/pot stainless steel, 6,6 L
29.	Sieve	10/ Kitchen metal sieve, medium 18cm, stainless steel, silver
30.	Cooker	10/Induction electric cooker, 1200 W, body stainless steel
31.	Extruder	For pasta obtaining
32.	Texture analyser	For determination of pasta and flakes textural properties
33.	Water activity analyser	For determination of water activity of cereals products
34.	Schive	For flour separation for 160 microns, 250 microns, 315 microns and 450 microns.
35.	Incubator	For sourdough development and microorganism evaluation
36.	Dough mixer	For bread preparation
37.	Dough proofer	Bread baking
38.	Bread baking rotation Oven	Bread baking
39.	Shock freezer	Bread freezing
40.	Freezer	Bread freezing
41.	Packaging equipment.	Flour, pasta, bread packaging

Methods used for the implementation of the study course program

Nr.	Types	Methods possible to be applied
1.	Interactive teaching 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

Co-funded by
the European Union

Open Food Innovation University (OFINU)

DESCRIPTION OF STUDY MODULE
“FOOD SAFETY MANAGEMENT”

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.

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Partner universities and their academic staff, involved in the development of the study course:

P1 LBTU. Latvia University of Life Sciences and Technologies

Egita Sproge - HACCAP.

P2 SAMARU. Samarkand Agroinnovations and Research University

Hayitmurod Tilavov - food safety.

Shakhista Ishniyazova - food safety, standardization and certification of livestock and crop products.

P3 AIAA. Andijan Institute of Agriculture and Agro-technologies

P4 TUT. Technological University of Tajikistan

Gafurjon Hakimov - Food Safety Management.

Shuhratjon Nazarov - Food Safety Management.

P5 KITIM. Kulob Institute of Technology and Innovation Management

Bobokhon Qurbonzoda - food safety.

Isso Rajabov - food safety.

Shomuddin Zuhurov - food safety management.

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

Sirojiddin Boboev - food safety.

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Jozef Čapla - Food safety management system.

Simona Kunová - food hygiene and safety.

Peter Zajác - HACCP system, food safety management system.

Group of companies "AGROMIR" (UZ)

Irina Krasilnikova - Quality management.

INTRODUCTION

Study module "Food Safety Management" One of the most important assets of a food company is the trust of its customers and consumers. As such, over and above being a legal obligation, food safety constitutes one of the most fundamental and vital aspects of any food operation. It is the backbone of consumer trust.

However, ensuring food safety in today's world has become a daunting task as, on the one hand, the food industry is confronted with a very broad range of chemical, microbiological and physical hazards that may find their way into the food supply at any stage of the food chain. On the other hand, measures taken to protect consumers are often intertwined with other considerations. In addition to food safety, a successful food business must also meet an array of other expectations. These vary with lifestyle, values, culture, and level of education and perception of a population. Today, a wide range of measures are applied in food industries to assure food safety. These measures can take place at different levels including: product development and research, supplier management (eg, auditing suppliers, developing specifications), management of people (training, job description, performance evaluation, and career path), production, consumer and customer contacts, marketing and distribution (eg, auditing transporters and retailers), incident and crisis management, and management review.

Aim and objectives of the study subject is to acquaint students with food safety systems throughout the food chain, to explain the prerequisite of health and consumer protection and to acquaint students with preventive measures against chemical and biological risks in food production.

Learning outcomes

- Knowledge: The student will gain knowledge of new food safety systems applied throughout the food chain, understand the practical application of food safety systems at the level of the food company.
- Skills: The student acquires and applies knowledge of food safety in risk prevention, acquires knowledge and analyzes the consequences of food crises and their impacts.
- Competences: The student is able to demonstrate critical, independent and analytical thinking and has extensive expertise in the field of food safety management systems and their use in practice. She/he is able to identify potentially dangerous products, food or suspicious producers.

Study Plan for module "Food Safety Management" in Uzbekistan

Themes	**Number of hours** SK/UZB/TJ			
	Total	Lectures	Practical works	Independent work of the student
1. Introduction to food safety	14	4	0	10
2. Rapid Alert System for Food and Feed (RASFF)	18	4	2	12
3. Biological safety	20	4	4	12
4. Food Hygiene and safety	16	2	4	10
5. Food-borne diseases (Zoonoses)	12	2	2	8
6. Food fraud and food authenticity	10	2	2	6
7. Chemical safety	12	4	0	8
8. Food labelling	10	2	2	6
9. Novel food	10	2	2	6
10. Sanitation in food industry	12	4	0	8
11. Disinfection methods	16	4	2	10
12. Sanitation program	16	2	4	10
13. Microbial biofilms in food industry	10	2	0	8
14. Genetically modified foods	6	2	0	4
15. Detection of contamination	18	2	4	12
16. Pest control in food industry	8	2	0	6
17. Personal hygiene	12	2	0	10
18. HACCP system	14	6	0	8
19. Preparation of the HACCP plan	30	0	16	14

20. Food safety management system	14	6	0	8
21. Management systems – documentation	30	0	20	10
22. Legislative requirements for food of animal and plant origin	18	2	6	10
TOTAL	**326**	60	70	**196**

Study Plan for module "Food Safety Management" in Tajikistan

Themes	**Number of hours** SK/UZB/TJ			
	Total	Lectures	Practical works	Independent work of the student
1. Introduction to food safety	14	4	2	8
2. Rapid Alert System for Food and Feed (RASFF)	18	4	2	12
3. Biological safety	20	4	4	12
4. Food Hygiene and safety	16	2	4	10
5. Food-borne diseases (Zoonoses)	12	2	2	8
6. Food fraud and food authenticity	10	2	2	6
7. Chemical safety	12	4	2	6
8. Food labelling	10	2	2	6
9. Novel food	11	2	2	7
10. Sanitation in food industry	12	4	2	6
11. Disinfection methods	16	4	2	10
12. Sanitation program	16	2	4	10
13. Microbial biofilms in food industry	10	2	2	6
14. Genetically modified foods	6	2	2	2
15. Detection of contamination	18	2	4	12

16. Pest control in food industry	8	2	2	4
17. Personal hygiene	12	2	2	8
18. HACCP system	14	6	2	6
19. Preparation of the HACCP plan	30	2	16	12
20. Food safety management system	14	4	4	6
21. Management systems – documentation	30	2	18	10
22. Legislative requirements for food of animal and plant origin	18	2	6	10
TOTAL	**326**	60	70	**196**

Thematic Study Plan for module "Academic Writing"

Date, Time	Study form	Theme	Lecturer
	1. Introduction to food safety		
1st day	Lectures (3 h)	Food Safety Introduction and historical perspective	
	Practical works (2 h)	Major challenges of food safety	
	2. Rapid Alert System for Food and Feed (RASFF)		
2nd day	Lectures (2 h)	Rapid Alert System for Food and Feed (RASFF) - How does RASFF work	
	Lecture (1 h)	The RASFF Window	
	Practical work (3h)	The RASFF Consumers' Portal - working with portal	
	3. Biological safety		
3rd day	Lectures (2 h)	Biological safety - definition	
	Lectures (2 h)	Biological hazards in food - dividing of biological hazards, causes, examples	
	Practical work (4h)	Types of biological hazards in food and feed	
	4. Food Hygiene and safety		

4th day	Lectures (2h)	Food Hygiene Management of Food Safety and Hygiene	
	Practical works (3 h)	Consumer Perceptions of Risks from Food	
	5. Food-borne diseases (Zoonoses)		
5th day	Lectures (2 h)	Food-borne diseases	
	Practical works (2 h)	Challenges in Emerging Food-Borne Diseases	
	6. Food fraud and food authenticity		
6th day	Lecture (1 h)	Food fraud and food authenticity – definitions, examples of food fraud	
	Practical works (1 h)	Food authentication methods – food authenticity databases	
	7. Chemical safety		
7th day	Lectures (2 h)	Chemical safety – chemical hazards in food	
	Lectures (2 h)	Contaminants Residues of veterinary medicinal products	
	Lecture (1h)	Food Contact Materials	
	8. Food labelling		
8th day	Lecture (1h)	Food supplements. Addition of vitamins and minerals	
	Lecture (1h)	Food information to consumers - legislation	
	Practical work (2 h)	Labelling - Food Labelling Information System	
	9. Novel food		
9th day	Lecture (1h)	Novel Food, authorisations and legislation	
	Lecture (1 h)	Nanomaterials in food	
	Practical work (2h)	Novel Food status Catalogue	
	10. Sanitation in food industry		
10th day	Lectures (2 h)	Sanitation – introduction, definitions	
	Lectures (2 h)	Cleaning and disinfection	
	11. Disinfection methods		
11th day	Lectures (2 h)	Chemical methods of disinfection – application advantages, disadvantages	
	Lectures (1 h)	Physical methods of disinfection – application advantages, disadvantages	

	Practical work (2 h)	Examples of disinfection. Choosing the appropriate disinfectant	
	12. Sanitation program		
12th day	Lectures (2 h)	Sanitation program - content and methodology of the sanitation program	
	Practical work (4 h)	Preparing of Sanitation program	
	13. Microbial biofilms in food industry		
13th day	Lectures (2 h)	Biofilm risks in food processing Biofilm Formation on Food Processing Surfaces	
	Lecture (1 h)	Biofilm removal methods	
	14. Genetically modified foods		
14th day	Lectures (2 h)	Genetically modified foods – safety and risks	
	15. Detection of contamination		
15th day	Lectures (2 h)	Surface Sampling and the Detection of Contamination	
	Practical work (3 h)	Detection of contamination	
	16. Pest control in food industry		
16th day	Lectures (2h)	Pest control in food industry - rodent control, insect control. Prevention, methods of pest control	
	17. Personal hygiene		
17th day	Lectures (2h)	Personal hygiene rules	
	18. HACCP system		
18th day	Lectures (6 h)	HACCP System and Implementation	
	19. Preparation of the HACCP plan		
19th day	Practical work (8 h)	Preparation of the HACCP plan	
20th day	Practical work (8 h)	Preparation of the HACCP plan	
	20. Food safety management system		
21st day	Lecture (1h)	Food safety management system. Food safety management systems – introduction, basic terms and definitions, process principle	
	Lecture (5h)	Food safety management system – Context of the organisation, leadership, planning, support, operation, performance evaluation, improvement	
	21. Management systems – documentation		

22nd day	Practical work (4h)	Food safety management system – documentation	
23rd day	Practical work (8h)	Management systems - documentation. Solving practical tasks.	
24th day	Practical work (8h)	Management systems - documentation. Solving practical tasks.	
	22. Legislative requirements for food of animal and plant origin		
25th day	Lectures (2 h)	Legislative requirements for food of animal and plant origin	
26th day	Practical work (4 h)	Laboratory examination of meat products	
	Practical work (3 h)	Laboratory examination of milk and dairy products	

Themes and their summary in study module "Food Safety Management"

Theme 1. Introduction to food safety

Issues to be covered in the lectures

1. Significance of food safety.
2. Historical perspective of food safety.
3. A public health priority and a global responsibility.
4. Regulatory framework and standards.

Issues to be covered in the practical or laboratory works and seminars

1. The best way to address food safety.
2. Questionnaire on food safety.

Topics of independent work

1. Designing solutions for deficiencies in food safety.
2. Preparation and evaluation of questionnaires related to the issue of food safety.

Literature and data bases on the theme

1. Ahmad, R. S. (2023). Food safety - new insights. In *IntechOpen eBooks*. https://doi.org/10.5772/intechopen.111039
2. Bricher, J. L. (2022). Introduction. In *Elsevier eBooks* (pp. 1–3). https://doi.org/10.1016/b978-0-12-816011-4.00012-4
3 . Kasuga, F. (2022). Climate change: food safety challenges in the near future. In *Elsevier eBooks* (pp. 1113–1124). https://doi.org/10.1016/b978-0-12-819470-6.00019-6
4. Vasiyev, M.G. (2012). Fundamentals of food technology.
5. Karimov, N.Q., Muhamadiyev, Sh., Karimova, M. (2019). Food chemistry.Textbook. - Samarkand: SamDU. https://arm.ssuv.uz/frontend/web/books/6423d7da89efd.pdf
6. Abdug'aniyev A., Abdug'aniyev A.A. (2004). Agrarian policy and food security - (textbook) - T.: TDIU.

Theme 2. Rapid Alert System for Food and Feed (RASFF)

Issues to be covered in the lectures

1. What is RASFF?
2. Why is RASFF important?
3. How does RASFF work?
4. RASFF notification

Issues to be covered in the practical or laboratory works and seminars

1. RASFF window.
2. The RASFF Consumers' Portal.

Topics of independent work

1. Individual work with RASFF portal.
2. Comparison of RASFF reports between individual countries.

Literature and data bases on the theme

1. RASFF. (n.d.). Food Safety. https://food.ec.europa.eu/safety/rasff_en#Related
2. BVL - The European Rapid Alert System for Food and Feed (RASFF) (bund.de)
3. Nogales, A., Mora-Cantallops, M., Morón, R. D., & García-Tejedor, Á. J. (2022). Network analysis for food safety: Quantitative and structural study of data gathered through the RASFF system in the European Union. *Food Control*, *145*, 109422. https://doi.org/10.1016/j.foodcont.2022.109422
4. Орипов, Р.О. ва бошкалар. (1991). Кишлок хужалиги махсулотларини саклаш ва кайта ишлаш технологияси.
5. Расулов, А. (1995). Сабзавот, картошка ва полиз ма\сулотларини саклаш.
6. Х-Буриев, Р.Ризаев, Р. (1996). Мева, узум махсулотлари биокимёси ва технологияси.

Theme 3. Biological safety

Issues to be covered in the lectures

1. Biological hazards in food.
2. Types of biological hazards.
3. Where are biological hazards commonly found?
4. What can biological hazards in food cause?

Issues to be covered in the practical or laboratory works and seminars

1. Types of biological hazards in food (Food of animal origin, Food of non-animal origin).
2. Examples of biological hazards in food.
3. Which food safety practice will help prevent biological hazards?

Topics of independent work

1. Evaluation of biological safety at food production.
2. Proposal of preventive measures against biological hazards.

Literature and data bases on the theme

1. Biological safety. Biological safety - European Commission (europa.eu)
2. 4 Major Biological Hazards in Food: Causes, Examples, Prevention Tips. 4 Major Biological Hazards in Food: Causes, Examples, Prevention Tips (fooddocs.com)
3. Latronico, F., Correia, S., Da Silva Felicio, T., Hempen, M., Messens, W., Ortiz-Pelaez, A., Stella, P., Liebana, E., & Hugas, M. (2017). Challenges and prospects of the European Food Safety Authority biological hazards risk assessments for food safety. *Current Opinion in Food Science*, *18*, 50–55. https://doi.org/10.1016/j.cofs.2017.10.013
4. Hu, X., Xu, B., Xiao, Y., Liang, S., Zhang, C., & Song, H. (2022). Overview and prospects of food biosafety. *Journal of Biosafety and Biosecurity*, *4*(2), 146–150. https://doi.org/10.1016/j.jobb.2022.11.001
5. Khujam, N.A, Davronov K.D. (2014). Biotechnology of food and feed products. Textbook.
6. Karimov, M., Muhamadiyev, N.Q., Karimova, Sh.M. (2019). Food chemistry. Textbook. https://arm.ssuv.uz/frontend/web/books/6423d7da89efd.pdf
7. Vasiyev, M. G'., Dadayev, Q.O., Isaboyev, I.B., Sapayeva, Z. Sh. (2012). G'ulomova Tashkent "Voris Nashriyot". Fundamentals of food technology.

Theme 4. Food hygiene and safety

Issues to be covered in the lectures

1. Principles of food hygiene.
2. Primary production.
3. Environmental control.
4. Hygienic production.

Issues to be covered in the practical or laboratory works and seminars

1. How can you maintain food safety and hygiene?
2. Food handling practices for food – practical tasks.

Topics of independent work

1. Proposal of preventive measures related to food hygiene.
2. Determination of physical, chemical and microbiological risks in food production and the possibilities of their removal.

Literature and data bases on the theme

1. Redmond, E. C., & Griffith, C. J. (2004). Consumer perceptions of food safety risk, control and responsibility. *Appetite*, *43*(3), 309–313. https://doi.org/10.1016/j.appet.2004.05.003
2. General principles of food hygiene (2011). fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXC%2B1-1969%252FCXC_001e.pdf
3. Motarjemi, Y. (2016). The Starting Point. In *Elsevier eBooks* (pp. 1–11). https://doi.org/10.1016/b978-0-08-100155-4.00001-7

4. Shayxova G.I., Bahritdinov Sh.S., Salomova F.I., Alimova R.R., G ‘ulomova Sh.X., Ermatov N.J., Shovaliyev I.X., Cho'lponov I.R., Azizova F.L., Kuriyazova S.M., Toshmatova G., Ibragimov T.I., Qurbanova X.A., Otajonov I.O. (2012). Food hygiene. https://e-library.namdu.uz/50%20%D0%A2%D0%B8%D0%B1%D0%B1%D0%B8%D0%B9%20%D1%84%D0%B0%D0%BD%D0%BB%D0%B0%D1%80/Ovqatlanish%20gigiyenasi.%20Shayxova%20G.I.pdf
5. Erbo’tayev I. (2005). General food sanitation and hygiee. https://www.ziyouz.com/books/kollej_va_otm_darsliklari/tibbiyot/Umimiy%20ovqatlanish,%20sanitariya%20va%20gigiyena%20(I.Erbo'tayev).pdf
6. Shukurov, Sh.T. Maksumov, Z.M. Bazarov. (2021). Sanitation and hygiene, 2021, https://kitob.sies.uz/frontend/web/kitob/kitob_0061933f9c50f82.pdf

Theme 5. Food-borne diseases (Zoonoses)

Issues to be covered in the lectures

1. What are zoonoses.
2. Monitoring of zoonoses in food and animals.

Issues to be covered in the practical or laboratory works and seminars

1. Examples of zoonoses.
2. Antimicrobials - control against food borne pathogens.

Topics of independent work

1. Study of materials about foodborne diseases.
2. Preparation of a proposal for preventive measures against zoonoses.

Literature and data bases on the theme

1. *Food-borne diseases (Zoonoses).* (n.d.). Food Safety. https://food.ec.europa.eu/safety/biological-safety/food-borne-diseases-zoonoses_en
2. *Food, Nutrition and Agriculture 2000 - 26*. (n.d.). https://www.fao.org/3/X7133M/x7133m02.htm
3. Farid, N., Waheed, A., & Motwani, S. (2023). Synthetic and natural antimicrobials as a control against food borne pathogens: A review. *Heliyon*, *9*(6), e17021. https://doi.org/10.1016/j.heliyon.2023.e17021
4. Dadayev, S. (2006). Parasitology, 2006, 210 p.
5. Musaboyev,A.I., Bayjanov, A.Q. (2007). Infectious disease epidemiology and parasitology, 504 p.

Theme 6. Food fraud and authenticity

Issues to be covered in the lectures

1. Definition of food fraud.
2. Types of food fraud.
3. Reasons of food fraud.
4. Examples of food fraud.
5. The most common food fraud.

Issues to be covered in the practical or laboratory works and seminars

1. Methods of food authenticity – food authenticity databases.

Topics of independent work

1. Study of theoretical materials.
2. Work with PC – most often ways of food fraud.
3. Work with food authenticity databases.

Literature and data bases on the theme

1. Karoui, R. (2020). Food authenticity and fraud. In *Elsevier eBooks* (pp. 579–608). https://doi.org/10.1016/b978-0-12-813266-1.00013-9
2. Pustjens, A. M., Weesepoel, Y., & Van Ruth, S. M. (2015). Food Fraud and Authenticity. In *Elsevier eBooks* (pp. 3–20). https://doi.org/10.1016/b978-1-78242-447-5.00001-0
3. Knowledge Centre for Food Fraud and Quality. https://knowledge4policy.ec.europa.eu/food-fraud-quality_en
4. Normakhmatov, R. (2013). Food and goods quality expertise, 2013, 512p. https://book.iiau.uz/book?id=18403
5. Khudoy, T., Muhammadiev, N., Muminov, N., Shukurov, I. (2009). Basics of food production, 356p.
6. Abdug'aniyev A., Abdug'aniyev A.A. (2004). Agrarian policy and food security - (textbook) - T.: TDIU, 304 pages.

Theme 7. Chemical safety

Issues to be covered in the lectures

1. Chemical hazards in food.
2. Dividing contaminants in food.
3. Residues of veterinary medical products.
4. Food contact materials.

Topics of independent work

1. Study of theoretical materials.

Literature and data bases on the theme

1. *Chemical safety*. (n.d.). Food Safety. https://food.ec.europa.eu/food-safety/chemical-safety_en
2. Groh, K. J., Geueke, B., Martin, O., Maffini, M., & Muncke, J. (2020). Overview of intentionally used food contact chemicals and their hazards. *Environment International*, *150*, 106225. https://doi.org/10.1016/j.envint.2020.106225.
3. *Types of chemical hazards in food - a white paper from Campden BRI*. (n.d.). https://www.campdenbri.co.uk/white-papers/chemical-hazards-food.php
4. Majidov, Q.X., Maxmudov, R.A., Maxmudov, Q.YU., Majidova. N.Q. (2020). Food chemistry and biochemistry, 244p.

Theme 8. Food labelling

Issues to be covered in the lectures

1. What is food labelling information system?
2. Food supplements.
3. Levels of vitamins and minerals in food supplements.
4. Law on food information to consumers.

Issues to be covered in the practical or laboratory works and seminars

1. Food labelling information system.

Topics of independent work

1. Work with labelling information system.
2. Study of food labelling information system.

Literature and data bases on the theme

1. *Food Labelling Information System (FLIS)*. (n.d.). Food Safety. https://food.ec.europa.eu/food-safety/labelling-and-nutrition/food-labelling-information-system-flis_en
2. *Food information to consumers - legislation*. (n.d.). Food Safety. https://food.ec.europa.eu/food-safety/labelling-and-nutrition/food-information-consumers-legislation_en
3. Albert, J. (2010). Innovations in food labelling. ISBN 978-1-84569-759-4, 174 p.
4. Орипов, Р.О. ва бошкалар. (1991). Кишлок хужалиги махсулотларини саклаш ва кайта ишлаш технологияси.
5. Расулов. А. (1995). Сабзавот, картошка ва полиз ма\сулотларини саклаш.
6. Х-Буриев, Р.Ризаев, Р. (1996). Мева, узум махсулотлари биокимёси ва технологияси.
7. Широков, С.П. (1978). Технология хранения и переработки плодов и овощей.

Theme 9. Novel food

Issues to be covered in the lectures

1. What is novel food?
2. Request for a novel food authorisation.
3. Nanomaterials in food.

Issues to be covered in the practical or laboratory works and seminars

1. Novel food status catalogue.

Topics of independent work

1. Study of legislation about novel food.
2. Work with novel food catalouge.

Literature and data bases on the theme

1. *Authorisation*. (n.d.). Internal Market, Industry, Entrepreneurship and SMEs. https://single-market-economy.ec.europa.eu/sectors/chemicals/reach/authorisation_en
2. *Novel Food*. (n.d.). Food Safety. https://food.ec.europa.eu/food-safety/novel-food_en
3. *Nanomaterials*. (n.d.). Food Safety. https://food.ec.europa.eu/food-safety/novel-food/nanomaterials_en
4. Орипов, Р.О. ва бошкалар. (1991). Кишлок хужалиги махсулотларини саклаш ва кайта ишлаш технологияси.
5. Расулов, А. (1995). Сабзавот, картошка ва полиз ма\сулотларини саклаш.
6. Х-Буриев, Р.Ризаев, Р. (1996). Мева, узум махсулотлари биокимёси ва технологияси.
7. Широков, С.П. (1978). Технология хранения и переработки плодов и овощей.

Theme 10. Sanitation in food industry

Issues to be covered in the lectures

1. Sanitation – definitions.
2. What is cleaning?
3. Dividing of cleaning.
4. Disinfection – dividing.
5. Factors affecting sanitation.

Topics of independent work

1. Study of materials about sanitation.

Literature and data bases on the theme

1. Stier, R. F. (2024, September 11). The basics of cleaning and sanitation in food plants. *Foodengineeringmag*. https://www.foodengineeringmag.com/articles/98657-the-basics-of-cleaning-and-sanitation-in-food-plants
2. Djukic, D., Veskovic Moracanin, S., Milijasevic, M., Babic, J., Faculty of Agronomy Cacak, University of Kragujevac, Cara Dusana 34, 32000 Cacak, Serbia, Institute of Meat Hygiene and Technology, Belgrade, Kacanskog 13, 11000 Belgrade, Serbia, & IMLEK AD, Tolminska 10, 24000 Subotica, Serbia. (2002). Food Safety and Food Sanitation [Review paper]. *Journal of Hygienic Engineering and Design*. https://keypublishing.org/jhed/wp-content/uploads/2020/07/03.-Dragutin-%C4%90uki%C4%87.pdf
3. Shayxova G.I., Bahritdinov Sh.S., Salomova F.I., Alimova R.R., G ‘ulomova Sh.X., Ermatov N.J., Shovaliyev I.X., Cho'lponov I.R., Azizova F.L., Kuriyazova S.M., Toshmatova G., Ibragimov T.I., Qurbanova X.A., Otajonov I.O. (2012). Food hygiene.
2. Erbo’tayev I. (2005). General food sanitation and hygiene 2005, 80p.
3. Shukurov, I.X., Maksumov, Sh.T., Bazarov, Z.M. (2021). Sanitation and hygiene, 260 p.

Theme 11. Disinfection methods

Issues to be covered in the lectures

1. Chemical methods of disinfection – advantages, disadvantages.
2. Physical methods of disinfection - advantages, disadvantages.
3. Mechanism of action.

Issues to be covered in the practical or laboratory works and seminars

1. Examples of chemical and physical disinfection.
2. Selection of disinfection based on the material to be disinfected and the degree of contamination.

Topics of independent work

1. Study of chemical and physical methods of disinfection.
2. Choice of disinfectants for different surfaces.
3. Proposal of disinfection method in the conditions of food processing operations.

Literature and data bases on the theme

1. Artasensi, A., Mazzotta, S., & Fumagalli, L. (2021). Back to Basics: Choosing the Appropriate Surface Disinfectant. *Antibiotics*, *10*(6), 613. https://doi.org/10.3390/antibiotics10060613
2. Prestes, F. S., Yotsuyanagi, S. E., Alonso, V. P. P., & Nascimento, M. S. (2024). Dry sanitization in the food industry: A review. *Current Opinion in Food Science*, 101166. https://doi.org/10.1016/j.cofs.2024.101166

3. Holah, J. (2014). Cleaning and disinfection practices in food processing. In *Elsevier eBooks* (pp. 259–304). https://doi.org/10.1533/9780857098634.3.259
4. Орипов, Р.О. ва бошкалар. (1991). Кишлок хужалиги махсулотларини саклаш ва кайта ишлаш технологияси.
5. Расулов, А. (1995). Сабзавот, картошка ва полиз ма\сулотларини саклаш.
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Theme 12. Sanitation program

Issues to be covered in the lectures

1. Sanitation methodology.
2. Content of sanitation program.
3. Keeping documentation on sanitation.
4. Responsibility for the implementation of sanitation.

Issues to be covered in the practical or laboratory works and seminars

1. Preparation of sanitation program.

Topics of independent work

1. Study of sanitation methodology.
2. Preparation sanitation program.

Literature and data bases on the theme

1. Schmidt, R. H. & Food Science and Human Nutrition Department. (1997). Basic Elements of a Sanitation Program for Food Processing and Food Handling. In *Fact Sheet FS15* [PDF]. Florida Cooperative Extension Service. https://ucfoodsafety.ucdavis.edu/sites/g/files/dgvnsk7366/files/inline-files/26500.pdf
2. Hygiene and sanitation handbook. (2018). In *TABLE of CONTENTS*. https://ec.europa.eu/programmes/erasmus-plus/project-result-content/908fceb3-6d8d-43a0-bc76-d780aeb1a13b/Hygiene-Sanitation-Handbook_ENG.pdf
3. Shayxova G.I., Bahritdinov Sh.S., Salomova F.I., Alimova R.R., G ‘ulomova Sh.X., Ermatov N.J., Shovaliyev I.X., Cho'lponov I.R., Azizova F.L., Kuriyazova S.M., Toshmatova G., Ibragimov T.I., Qurbanova X.A., Otajonov I.O. (2012). Food hygiene. https://e-library.namdu.uz/50%20%D0%A2%D0%B8%D0%B1%D0%B1%D0%B8%D0%B9%20%D1%84%D0%B0%D0%BD%D0%BB%D0%B0%D1%80/Ovqatlanish%20gigiyenasi.%20Shayxova%20G.I.pdf
4. Erbo’tayev I. (2005). General Food sanitation and hygiene, 80 p.
5. Shukurov, Sh.T. Maksumov, Z.M. Bazarov. (2021). Sanitation and hygiene, 2021, https://kitob.sies.uz/frontend/web/kitob/kitob_0061933f9c50f82.pdf

Theme 13. Microbial biofilms in food industry

Issues to be covered in the lectures

1. What are biofilms?
2. Formation of biofilm in the food industry.
3. Microorganisms in biofilms.
4. Strategies for controlling biofilm formation.
5. Methods of biofilm removal.

Topics of independent work

1. Study of materials about biofilms in food industry and methods of biofilms removal.

Literature and data bases on the theme

1. Olanbiwoninu, A., & Popoola, B. (2022). Biofilms and their impact on the food industry. Saudi Journal of Biological Sciences, 30(2), 103523. https://doi.org/10.1016/j.sjbs.2022.103523
2. Zhu, T., Yang, C., Bao, X., Chen, F., & Guo, X. (2022). Strategies for controlling biofilm formation in food industry. Grain & Oil Science and Technology, 5(4), 179–186. https://doi.org/10.1016/j.gaost.2022.06.003
3. Lu, J., Hu, X., & Ren, L. (2022). Biofilm control strategies in food industry: Inhibition and utilization. Trends in Food Science & Technology, 123, 103–113. https://doi.org/10.1016/j.tifs.2022.03.007
4. Орипов, Р.О. ва бошкалар. (1991). Кишлок хужалиги махсулотларини саклаш ва кайта ишлаш технологияси.
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Theme 14. Genetically modified organisms

Issues to be covered in the lectures

1. What are GMO?
2. History of GMO.
3. Concepts related to GMO.
4. Risks of genetically modified products.
5. Benefits of genetically modified products.
6. Marking of genetically modified products.

Topics of independent work

1. Study of materials related with GMO.

Literature and data bases on the theme

1. *Genetically Modified Organisms*. (n.d.). Food Safety. https://food.ec.europa.eu/plants/genetically-modified-organisms_en
2. Singh, R. B., Mishra, S., Saxena, P., Saxena, M., Priya, N., Smail, M. M., & Velluri, S. R. (2021). Genetically modified organisms and foods: perspectives and challenges. In *Elsevier eBooks* (pp. 493–505). https://doi.org/10.1016/b978-0-12-819815-5.00041-0
3. Zhang, C., Wohlhueter, R., & Zhang, H. (2016). Genetically modified foods: A critical review of their promise and problems. *Food Science and Human Wellness*, *5*(3), 116–123. https://doi.org/10.1016/j.fshw.2016.04.002
4. Karimov, N.Q., Muhamadiyev, Sh., Karimova, M. (2019). Food chemistry.Textbook. - Samarkand: SamDU. https://arm.ssuv.uz/frontend/web/books/6423d7da89efd.pdf

Theme 15. Detection of contamination

Issues to be covered in the lectures

1. Cleanliness, Microbial Growth and Cross-Contamination.
2. Cleaning and the role of surface sampling.
3. Surface Sampling and Assessing Cleanlines.
4. Nonmicrobiological surface sampling.
5. Microbiological surface sampling.

Issues to be covered in the practical or laboratory works and seminars

1. Detection of contamination with microbiological methods – laboratory work.
2. Using direct and indirect methods (swabs, Petrifilm plates).
3. Evaluation of the results.

Topics of independent work

1. Study of materials about detection of contamination.
2. Preparation of contamination detection methodology.

Literature and data bases on the theme

1. Griffith, C. (2016). Surface Sampling and the Detection of Contamination. In *Elsevier eBooks* (pp. 673–696). https://doi.org/10.1016/b978-0-08-100155-4.00044-3
2. Ferone, M., Gowen, A., Fanning, S., & Scannell, A. G. M. (2020). Microbial detection and identification methods: Bench top assays to omics approaches. *Comprehensive Reviews in Food Science and Food Safety*, *19*(6), 3106–3129. https://doi.org/10.1111/1541-4337.12618
3. Орипов, Р.О. ва бошкалар. (1991). Кишлок хужалиги махсулотларини саклаш ва кайта ишлаш технологияси.
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Theme 16. Pest control in food industry

Issues to be covered in the lectures

1. The Importance of Pest Management.
2. Strategies of Effective Pest Control.
3. Rodent control – characterisation of rodents, preventive and repressive methods.
4. Insect control - characterisation of rodents, preventive and repressive methods.

Topics of independent work

1. Characterisation of pests in food industry.
2. Study of materials.

Literature and data bases on the theme

1. Battersby, S., Chartered Institute of Environmental Health, & National Pest Advisory Panel. (2009). Pest control procedures in the food industry. In *Pest control procedures in the food industry* (p. 2). https://fumapest.com.au/pdf/Pest%20Control%20in%20the%20Food%20Premises%20-%20UK%20Chartered%20Institute%20of%20Environment%20Health.pdf
2. Theadmin. (2023, August 1). *Critical Pest Management in the Food Industry*. Kassar Group. https://kassargroup.com/2023/02/13/critical-pest-management-in-the-food-industry/
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6. Х-Буриев, Р.Ризаев, Р. (1996). Мева, узум махсулотлари биокимёси ва технологияси.
7. Широков, С.П. (1978). Технология хранения и переработки плодов и овощей.

Theme 17. Personal hygiene

Issues to be covered in the lectures

1. Definition of personal hygiene.
2. People as sources of contamination.
3. Management practices for controlling contamination.

Topics of independent work

1. Study of theoretical materials.

Literature and data bases on the theme

1. Margas, E., & Holah, J. (2014). Personal hygiene in the food industry. In *Elsevier eBooks* (pp. 408–440). https://doi.org/10.1533/9780857098634.3.408
2. Xun, Y., Shi, Q., Yang, N., Yang, N., Li, Y., Si, W., Shi, Q., Wang, Z., Liu, X., Yu, X., Zhou, Q., Yang, M., & Chen, Y. (2021). Associations of hand washing frequency with the incidence of illness: a systematic review and meta-analysis. *Annals of Translational Medicine*, *9*(5), 395. https://doi.org/10.21037/atm-20-6005
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3. Shukurov, I.X., Maksumov, Sh.T., Bazarov, Z.M. (2021). Sanitation and hygiene, 260 p.

Theme 18. HACCP system

Issues to be covered in the lectures

1. What is the HACCP system, and what are its primary objectives in food safety management?
2. Describe the seven principles of HACCP.
3. Explain the role of critical control points in a HACCP plan.

Issues to be covered in the practical or laboratory works and seminars

1.How do you identify hazards in a HACCP plan?
2. What are the criteria for determining critical control points in a food production process?
3. Discuss the methods for monitoring critical control points.
4. Provide an example of a corrective action in a HACCP system.

Topics of Independent Work

1. Study of the impact of hazard analysis on food safety in a HACCP system.

Literature and Data Bases on the Theme

1. CAC/RCP 1: 2003 Recommended international code of practice – General principles of food hygiene. www.codexalimentarius.net/download/standards/23/cxp_001e.pdf.
2. Gombas, D.E., Stevenson,K.R. (2000). HACCP Verifikation and Validation: An Advanced HACCP Workshop. Washington DC – USA, Food Processors Institute, p. 27-31.
3. Hulebak, K., Schlosser, W. (2002). Hazard Analysis and Critical Control Point (HACCP) History and Conceptual Overview. In *Risk Analysis*, 22(3), p. 547-552. ISSN 0272-4332.
4. Орипов, Р.О. ва бошкалар. (1991). Кишлок хужалиги махсулотларини саклаш ва кайта ишлаш технологияси.
5. Расулов, А. (1995). Сабзавот, картошка ва полиз ма\сулотларини саклаш.
6. Х-Буриев, Р.Ризаев, Р. (1996). Мева, узум махсулотлари биокимёси ва технологияси.
7. Широков, С.П. (1978). Технология хранения и переработки плодов и овощей.

Theme 19. Preparation of HACCP plan

Issues to be covered in the lectures

1. What are the preliminary steps necessary for developing a HACCP plan?
2. Discuss the importance of assembling a HACCP team and describe the roles of its members.
3. How do you conduct a hazard analysis for a HACCP plan?

Issues to be covered in the practical or laboratory works and seminars

1. Create a flow diagram for a selected food process and identify potential hazards.
2. Define critical limits for one of the critical control points identified in your flow diagram.
3. Describe the verification processes used in HACCP to ensure the plan's effectiveness.
4. Develop a record-keeping system suitable for documenting a HACCP plan.

Topics of independent work

1. Case study analysis of an existing HACCP plan in a local restaurant or food manufacturing plant.
2. Design a HACCP plan for a new food product from concept to market.
3. Evaluate the effectiveness of different monitoring and verification strategies in various HACCP plans.

Literature and Data Bases on the Theme

1. Griffiths, A.O. (2005). HACCP Works, Doncaster - England - Highfield.co.uk Ltd, (110 p). ISBN 1 904 544 363.
2. Guidelines for the Application of a HACCP System" by Codex Alimentarius.
3. Access to the HACCP database through SUA, focusing on case studies and regulatory requirements.

Theme 20. Food safety management system

Issues to be covered in the lectures

1. What is a Food Safety Management System (FSMS), and why is it critical in the food industry?
2. Explain the role of ISO 22000 standards in food safety management.
3. Describe the integration of HACCP principles within a broader FSMS.

Issues to be covered in the practical or laboratory works and seminars

1. Assess the current food safety policies of a local food service establishment and suggest improvements.
2. Design a basic FSMS plan for a small-scale food production unit, incorporating critical control points.
3. Role-play an audit process to verify compliance with food safety standards.
4. Develop a training session for employees on effective food safety practices.

Topics of independent work

1. Analyze the differences between FSMS certifications such as ISO 22000, FSSC 22000, and BRC.
2. Conduct a case study on the implementation challenges of FSMS in developing countries.
3. Evaluate the impact of FSMS on consumer trust and business sustainability.

Literature and data bases on the theme

1. Arvanitoyannis, I. S., Palaiokostas, C., & Panagiotaki, P. (2008). A Comparative Presentation of Implementation of ISO 22000 Versus HACCP and FMEA in a Small Size Greek Factory Producing Smoked Trout: A Case Study. *Critical Reviews in Food Science and Nutrition*, *49*(2), 176–201. https://doi.org/10.1080/10408390701856058.
2. STN EN ISO 22000: 2018. Food safety management systems. Requirements for food chain organizations.
3. ISO/TS 22003 Food safety management systems – Requirements for bodies providing audit and certification of food safety management systems.
4. Орипов, Р.О. ва бошкалар. (1991). Кишлок хужалиги махсулотларини саклаш ва кайта ишлаш технологияси.
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7. Широков, С.П. (1978). Технология хранения и переработки плодов и овощей.

Theme 21. Management systems - documentation

Issues to be covered in the lectures

1. What are the key components of documentation in management systems?
2. How does effective documentation support compliance and operational efficiency in organizations?
3. Discuss the role of digital tools and software in the management of system documentation.

Issues to be covered in the practical or laboratory works and seminars

1. Create a document control procedure for a hypothetical management system.
2. Analyze a set of existing management documents and identify areas for improvement.
3. Simulate the process of document revision and approval in a management system.
4. Develop a training module on the importance and use of documentation for new employees.

Topics of Independent Work

1. Case study on the evolution of documentation practices in management systems over the last decade.
2. Design a digital dashboard for tracking and updating critical documents in a management system.
3. Research on the impact of poor documentation practices on organizational risk and quality management.

Literature and data bases on the theme

1. Foundation for food safety certification. (2008). Food Safety System Certification 22000 – FSSC 22000. Certification scheme for food safety systems of Food manufacturing based on ISO 22000: 2005 and BSI-PAS 220: 2008. Part IV. Requirements for the board of stakeholders.1st edition.. Gorinchem, the Netherlands [online]. Foundation for Food Safety Certification www.fssc22000.com. http://www.fssc22000.com/downloads/partIV.pdf .

2. STN EN ISO 22000: 2018. Food safety management systems. Requirements for food chain organizations.
3. ISO/TS 22003 Food safety management systems – Requirements for bodies provideing audit and certification of food safety management systems.
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Theme 22. Legislative requirements for food of animal and plant origin

Issues to be covered in the lectures

1. Hygiene rules for food of animal origin.
2. Meat hygiene.
3. Milk hygiene.
4. Table eggs hygiene.
5. Safety of honey.
6. Safety of food of plant origin.

Issues to be covered in the practical or laboratory works and seminars

1. Laboratory examination of meat and meat products – analyse of salts, microbial examination.
2. Laboratory examination of milk and dairy products.

Topics of independent work

1. Study of theoretical materials.
2. Preparing of protocols from analyses.

Literature and data bases on the theme

1. *Hygiene rules for food of animal origin | EUR-Lex*. (n.d.). https://eur-lex.europa.eu/EN/legal-content/summary/hygiene-rules-for-food-of-animal-origin.html
2. *Products of animal origin for human consumption*. (n.d.). Food Safety. https://food.ec.europa.eu/animals/animal-products-movements/products-animal-origin-human-consumption_en
3. Lin, X., Duan, N., Wu, J., Lv, Z., Wang, Z., & Wu, S. (2023). Potential food safety risk factors in plant-based foods: Source, occurrence, and detection methods. *Trends in Food Science & Technology*, *138*, 511–522. https://doi.org/10.1016/j.tifs.2023.06.032
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Literature sources

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2. Bricher, J. L. (2022). Introduction. In *Elsevier eBooks* (pp. 1–3). https://doi.org/10.1016/b978-0-12-816011-4.00012-4
3 . Kasuga, F. (2022). Climate change: food safety challenges in the near future. In *Elsevier eBooks* (pp. 1113–1124). https://doi.org/10.1016/b978-0-12-819470-6.00019-6
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6. Abdug'aniyev A., Abdug'aniyev A.A. (2004). Agrarian policy and food security - (textbook) – T.: TDIU.
7. RASFF. (n.d.). Food Safety. https://food.ec.europa.eu/safety/rasff_en#Related
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9. Nogales, A., Mora-Cantallops, M., Morón, R. D., & García-Tejedor, Á. J. (2022). Network analysis for food safety: Quantitative and structural study of data gathered through the RASFF system in the European Union. *Food Control*, *145*, 109422. https://doi.org/10.1016/j.foodcont.2022.109422
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13. Biological safety. Biological safety - European Commission (europa.eu)
14. 4 Major Biological Hazards in Food: Causes, Examples, Prevention Tips. 4 Major Biological Hazards in Food: Causes, Examples, Prevention Tips (fooddocs.com)
15. Latronico, F., Correia, S., Da Silva Felicio, T., Hempen, M., Messens, W., Ortiz-Pelaez, A., Stella, P., Liebana, E., & Hugas, M. (2017). Challenges and prospects of the European Food Safety Authority biological hazards risk assessments for food safety. *Current Opinion in Food Science*, *18*, 50–55. https://doi.org/10.1016/j.cofs.2017.10.013
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25. Dadayev, S. (2006). Parasitology, 2006, 210 p.
26. Musaboyev,A.I., Bayjanov, A.Q. (2007). Infectious disease epidemiology and parasitology, 504 p.
27. Erbo'tayev I. (2005). General food sanitation and hygiene. https://www.ziyouz.com/books/kollej_va_otm_darsliklari/tibbiyot/Umimiy%20ovqatlanish,%20sanitariya%20va%20gigiyena%20(I.Erbo'tayev).pdf
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Materials needed for the implementation of the study course program

Nr.	Material resources and equipment	Quantity / description
1.	Internet access	
2.	Access to databases	Scopus, Web of Science, Science Direct, PubMed
3	Literature sources (list provided)	

Methods used for the implementation of the study course program

Nr.	Themes	Methods possible to be applied
1.	Food Safety, Biological, chemical hazards in Food	Work with Internet. Finding solutions to food safety issues.
2.	Food authentication methods – food authenticity databases	Work with Authenticity databases
3.	Labelling and novel food	Work with Food Labelling Information System
4.	Sanitation program	Preparation of sanitation program
4.	Detection of contamination	Microbial methods of detection of contamination
5.	HACCP system	Preparation of HACCP plan
6.	Food safety management system	Work with computer
7.	Laboratory examination of food	Physical, chemical and microbiological analysis of milk and meat
8.	Quality assessment of foodstuffs	Organoleptic, physico-chemical, microbiological, laboratory examination methods
9.	Quality analysis of foodstuffs	Laboratory examination methods: refractometer, areometer, turbotimer

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OFINU

Open Food Innovation University (OFINU)

DESCRIPTION OF STUDY MODULE
"NEW FOOD PRODUCT DEVELOPMENT"

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.

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P5 KITIM. Kulob Institute of Technology and Innovation Management

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

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INTRODUCTION

Study module "**NEW FOOD PRODUCT DEVELOPMENT**" has been developed for the open university sessions. Every audience from the university - students and lecturers, from food industry (the middle and higher-level specialists) and anyone interested who wants to learn about the development process of new food products, can participate. The study module is designed based on the basic principles of student-cantered training using the latest training methods.

The training of the module is organized in 20% theoretical lessons and 80% practical lessons. During the practical lessons, professional problem situations are solved and solutions for new ideas and products are found. Students with different knowledge, professional experience, but with a high degree of interest ensure mutual communication and the learning process by learning from each other.

Aim and objectives of the study module

The study module aims to provide knowledge of the new product development process and the role of enterprises and research. Acquainted with idea generation methods, product prototype development, and testing methods. As part of the commercialization phase, it creates the design of the new product and learns the sales methods and opportunities.

Learning outcomes

Knowledge and understanding of the new product development process in enterprises or research, as well as an understanding of key concepts and regularities.
Skills Ability to develop new food product development concepts, and discuss and justify new product needs and quality requirements.
Competence to collect and analyze information, deal with the industry and product development-related problems, and make decisions on new product development progress of the work team: practical works, independent work, and final workshop.

Study Plan for module "NEW FOOD PRODUCT DEVELOPMENT" in Uzbekistan.

Themes	Number of hours			
	Total	Lectures	Practical works / seminars	Independent works
Innovation role in science and entrepreneurship	36	4	4	28
Idea generation	52	8	16	28
Product development	52	4	20	28
Commercialization	42	4	10	28
Evaluation of new product development process.	41	4	10	27
Hackathon "InnoFood"	47	0	24	23
TOTAL	270	24	84	162

Study Plan for module "NEW FOOD PRODUCT DEVELOPMENT" in Tajikistan.

Themes	Number of hours			
	Total	Lectures	Practical works / seminars	Independent works
Innovation role in science and entrepreneurship	31	9	2	22
Idea generation	54	12	22	22
Product development	49	8	20	22
Commercialization	42	9	11	22
Evaluation of new product development process.	34	5	8	21
Hackathon "InnoFood"	50		24	21
TOTAL	260	43	87	130

Thematic Study Plan for module "NEW FOOD PRODUCT DEVELOPMENT"

Date, Time	Study form	Topic	Lecturer
Theme 1. Role of innovation in science and entrepreneurship			
Day 1	Lecture (1h)	Introduction to the course, participants and awareness of innovation.	
	Lecture (3h)	Innovation, types of innovation and their differences. Innovation in a European and global context. Role of development of new products in food industry and research institutes. Development of new products in research centres and their role in the development of the food production sector. The European Union support system for innovation development, differences with local market approach. Transfer of knowledge and technology in a collaborative model science - production - science. Process of developing new products in a food production company. Role of innovation in product life cycle and business development. Strategic and conceptual modelling of new products in a company. **HW** Tendencies in Food industries and Food science – each student finds and describes 5 new trends and creates a presentation.	
Theme 2. Idea generation			
Day 2	Seminar (4h)	Discussion about new trends in food industries in a European and global context.	
	Lecture (1h)	New product development process - idea, prototype, development, and commercialisation. Creative thinking methods and their application in new product development. Implementing a conceptual approach to new product development.	

	Practical work (2h)	Group work - develop a product concept.	
Day 3	Lecture (1h)	Consumer role in the new product development process. Business Model Canva as a tool for idea development.	
	Practical work (2h)	Consumer profile development. Evaluation of consumer needs and value of new products using Business Model Canva.	
	Practical work (4h)	Ideas generation techniques. Using Ideas generation techniques, e.g., brainstorming, analogical reasoning, random name, etc. for new ideas.	
Day 4	Practical work (4h)	Evaluation and selection of ideas. Description of ideas.	
	Lecture (2h)	Architecture and design of the new idea, appropriately of actuality in the food industry. Prototyping techniques and methods used in development stages. **HW** New product architecture and design development.	
Day 5	Seminar (1h)	Presentation and discussion of new product design.	
	Lecture (2h)	Food product sensory properties (appearance, aroma, taste, consistency / structure) as food design elements. Identification of consumer expectations, needs and benefits. Consumer methods for food product sensory evaluation (line scale, hedonic scale, CATA, RATA, Just about Right, Mapping/Napping u.c.).	
	Practical work (2h)	Sensory evaluation methods used in consumer studies. **HW** - Study of scientific articles about sensory evaluation methods used in consumer studies.	
	Seminar (1h)	A discussion about sensory evaluation methods used in consumer studies.	
	Lecture (1h)	Emotions in creating and choosing new products. Principles of organisation of sensory evaluation (definition of aim, selection of samples, selection of panellists, etc.). Sensory claims as a provider of information to the consumer. Food pairing.	
Theme 3. Product development			

Day 6	Lecture (3h)	Product development process. Developing the required documentation for the new product. Intellectual property rights protection.	
	Practical work (5h)	Developing technology documents.	
Day 7	Practical work (5h)	Development of a label and packaging sample for the new product.	
	Seminar (2h)	Presentation of packaging and label sample.	
Day 8	Practical work (4h)	The prototype evaluation phase. Developing, testing and finalising prototypes.	
	Seminar (2h)	A discussion about the product's technological documentation.	
Theme 4. Commercialisation			
Day 9	Lecture (4h)	The commercialisation phase of new products. Product sales strategy. Integrated marketing for sales.	
	Practical work (3h)	Communication elements for marketing. **HW** Development of a plan of sales activities for the new product.	
Day 10	Practical work (4h)	Content of marketing communication. Marketing activities plan.	
	Seminar (3h)	A discussion about marketing activities plan.	
Theme 5. Evaluation of new product development process.			
Day 11	Lecture (2h)	SWOT analysis for new product development. Risk identification and evaluation. Using criticism to improve your product.	
	Practical work (4h)	SWOT analysis for project evaluation.	
	Seminar (2h)	A discussion about SWOT analysis.	
Theme 6. Hackathon "InnoFood"			
Day 12 (24h)	Hackathon "**InnoFood**" - to solve a problem or identify new opportunities for food industry.		

Themes and their summary in study module
"NEW FOOD PRODUCT DEVELOPMENT"

Theme 1. Role of innovation in science and entrepreneurship

Issues to be covered in the lectures

1. Innovation, types of innovation and their differences. Innovation in a European and global context. Role of development of new products in food industry and research institutes.
2. Development of new products in research centres and their role in the development of the food production sector. Support system for innovation development, differences with the local market approach. Transfer of knowledge and technology in a collaborative model science - production - science.
3. Process of developing new products in a food production company. Role of innovation in product life cycle and business development. Strategic and conceptual modelling of new products in a company.

Issues to be covered in the seminar

1. Discussion about new tendencies in food industries in a European and global context.
2. New tendencies in Food Sciences.
3. The common and the different in food product innovations in Central Asia, Europe and the World.
4. The common and the different in food industry and research area.

Topics of independent work

1. The latest trends in various food industries (milk processing, beverage production, meat processing, grain processing, fruit and vegetable processing).
2. Gathering information about circular economy possibilities in the development of new products.
3. Gathering information from scientific articles about fermentation processes in food production.
4. Gathering information from scientific articles on protein sources and uses in the food industry.
5. The use of by-products in the development of new functional products

Literature and data bases on the theme

1. Law of the Republic of Uzbekistan, dated 24.07.2020. No. LRU-630 "On Innovative Activity"
2. Science Direct, research article data base (2024, June). https://www.sciencedirect.com
3. Scopus, research article database (2024, June). https://www.scopus.com/search/form.uri?display=basic&zone=header&origin=searchbasic#basic
4. EIT Food accelerates innovation to build a future (2024, June). https://www.eitfood.eu

Theme 2. Idea generation

Issues to be covered in the lectures

1. New Product Development Process - idea, prototype, development, commercialization. Creative thinking methods and their application in new product development. Implementing a conceptual approach to new product development.
2. Consumer role in the new product development process. Business Model Canva as a tool for idea development.
3. Ideas generation techniques, applying them for potential developments.
4. Architecture and design of the new idea, appropriately of actuality in the food industry.
5. Food product sensory properties (appearance, aroma, taste, consistency / structure) as food design elements. Identification of consumer expectations, needs and benefits. Consumer methods for food product sensory evaluation (Line scale, hedonic scale, CATA, RATA, Just about Right, Mapping/Napping u.c.).
6. Emotions in creating and choosing new products. Principles of organization of sensory evaluation (definition of aim, selection of samples, selection of panelists, etc.). Sensory claims as a provider of information to the consumer. Food pairing.

Issues to be covered in the practical works

1. Using a context map and developing a product development plan.
2. Consumer profile development for new product development.
3. Using Ideas generation techniques (Brainstorming, Analogical Reasoning, Random Name, etc) for new ideas.
4. Evaluation and selection of ideas. Description of ideas.
5. Evaluate consumer need and value of new products ideas using Business Model Canva.
6. Sensory evaluation methods used in consumer studies.

Topics of independent work

1. Analyse the differences, needs and pains of various target market groups.
2. To study the application possibilities for the design development of food products.
3. Study of scientific articles about sensory evaluation methods used in consumer studies.

Literature and data bases on the theme

1. Biró, B., Sipos, M.A., Kovács, A., Badak-Kerti, K., Pásztor-Huszár, K.; Gere, A. (2020). Cricket-Enriched Oat Biscuit: Technological Analysis and Sensory Evaluation. Foods.
2. Głuchowski, A., Czarniecka-Skubina, E., Kostyra, E., Wasiak-Zys, G., Bylinka, K. (2021). Sensory Features, Liking and Emotions of Consumers towards Classical, Molecular and Note by Note Foods. Foods.
3. Grasso, S., Jaworska, S. (2020). Part Meat and Part Plant: Are Hybrid Meat Products Fad or Future?. Foods.
4. Guzek, D., Głabska, D., Sajdakowska, M., Gutkowska, K. (2020) Analysis of Association between the Consumer Food Quality Perception and Acceptance of Enhanced Meat Products and Novel Packaging in a Population-Based Sample of Polish Consumers. Foods.
5. Kalumbi, M., Matumba, L., Mtimuni, B., Mwangwela, A., Gama, A.P. (2019). Hydrothermally Treated Soybeans Can Enrich Maize Stiff Porridge (Africa's Main Staple) without Negating Sensory Acceptability. Foods.

6. Kumar, R., Chambers, E., Chambers, D., Lee, J. (2021). Generating New Snack Food Texture Ideas Using Sensory and Consumer Research Tools: A Case Study of the Japanese and South Korean Snack Food Markets. Foods.
7. Ruiz-Capillas, C., Herrero, A., Pintado, T., Delgado-Pando, G. (2021). Sensory Analysis and Consumer Research in New Meat Products Development. Foods.
8. Silva, F., Duarte, A.M., Mendes, S., Borges, P., Magalhães, E., Pinto, F.R., Barroso, S., Neves, A., Sequeira, V., Vieira, A.R. (2020). Adding Value to Bycatch Fish Species Captured in the Portuguese Coast—Development of New Food Products. Foods.
9. Swiader, K., Florowska, A., Konisiewicz, Z., Chen, Y.-P. (2020). Functional Tea-Infused Set Yoghurt Development by Evaluation of Sensory Quality and Textural Properties. Foods.
10. Swiader, K., Marczewska, M. (2021). Trends of Using Sensory Evaluation in New Product Development in the Food Industry in Countries That Belong to the EIT Regional Innovation Scheme. Foods.
11. Szymandera-Buszka, K., Waszkowiak, K., Jedrusek-Golinska, A., He´s, M. (2020) Sensory Analysis in Assessing the Possibility of Using Ethanol Extracts of Spices to Develop New Meat Products. Foods.
12. Tao, R., Cho, S. (2020). Consumer-Based Sensory Characterization of Steviol Glycosides (Rebaudioside A, D, and M). Foods.

Theme 3. Product development

Issues to be covered in the lectures

1. Product development process. Developing the required documentation for the new product.
2. Prototyping techniques and methods used in development stages.
3. Intellectual Property Rights Protection.
4. Develop a label and requirements of information for consumer.
5. Sensory evaluation methods for new product development.

Issues to be covered in the practical works

1. Description of Technology process and quality control of new product.
2. The prototype development phase. Developing, testing and finalizing prototypes.
3. Develop a label and packaging sample for the new product.

Topics of independent work

1. Analyse (ingredients, nutrients, design, producers etc.) labelling and packaging of different food products group.
2. Latest food technology process for food innovations.
3. Quality assessment of food products (organoleptic, textural, chemical, microbiological parameters), their importance and necessity for safe food production.

Literature and data bases on the theme

1. Bennett, A. G. (2023). Critical Mapping for Sustainable Food Design: food security, equity, and justice. Routledge.
2. Jeantet, R., Croguennec T., Schuck, P., Brulé G. (2016). Handbook of Food Science and Technology 3. Food Biochemistry and Technology. Wiley Online Library.
3. David B. Audretsch, D.B. (Ed.). (2011). Handbook of research on innovation and entrepreneurship. Edward Elgar Publishing.
4. Ghosh, D., Raton, B. (Eds.). (2013). Innovation in healthy and functional foods. CRC press.

Theme 4. Commercialization

Issues to be covered in the lectures

1. The commercialization phase of new products. Strategy, business analysis, market research, marketing plan.
2. Product sales strategy. Market Mix (Product, promotion, place, price, people).
3. Integrated marketing for sales.

Issues to be covered in the practical works

1. Communication elements for marketing plan. Branding, Public reactions, Digital marketing, Content marketing.
2. Content of marketing communication.
3. Marketing activities plan.

Topics of independent work

1. Research and analysis of communication elements of other food companies - website, labels, advertising, publicity, etc.
2. Conduct market research on the product and the use of communication elements in sales.
3. Study digital tools for developing communication elements, such as Canva.com, Microsoft Publisher etc.

Literature and data bases on the theme

1. Design and books. (2024, June). www.canva.com
2. Fuller, G.W. (2011). New Food Product Development. CRC Press.
3. Kotler, Ph. (2010). Marketing 3.0: From Products to Customers to the Human Spirit (1st ed.). Wiley.

Theme 5. Evaluation of new product development process.

Issues to be covered in the lectures

1. SWOT analysis of new product development.
2. Risk identification and evaluation.
3. Using criticism to improve one's product.

Issues to be covered in the practical works

1. SWOT analysis of the new product and suggestions for improvement.
2. Strengths and weaknesses of new product.
3. Opportunities and threats of new product.

Topics of independent work

1. To study project evaluation methods and their suitability in the development of new products.
2. Search for and evaluate samples of SWOT analysis of other food innovation products.
3. Find external factors as examples of opportunities and threats.

Literature and data bases on the theme

1. Kotler, Ph. (2010). Marketing 3.0: From Products to Customers to the Human Spirit (1st ed.). Wiley.
2. Calicchio, S. (2020). Swot Analysis in 4 Steps: How to Use the SWOT Matrix to Make a Difference in Career and Business. Stephano Calicchio.
3. Speth, C. (2015). The SWOT Analysis: Develop Strengths to Decrease the Weaknesses of Your Business. 50Minutes.com.

Theme 6. Hackathon "InnoFood".

Issues to be covered in the Hackathon

Issues are coordinated individually with food producers on current topics.

Topics of independent work

According to the major topic and problem, students should find information about:

1. Topicality.
2. Possible solutions in other countries.
3. Possible solutions from a scientific point of view.
4. Latest competing solutions.

Literature and data bases on the theme

1. EIT Food accelerates innovation to build a future. (June 2024). https://www.eitfood.eu
2. Marketing & Innovation Magazine. (June 2024). https://issuu.com/eurest/docs/the_workplace_reimagined_2023 4.EitFood https://www.eitfood.eu
3. Science Direct. (June 2024). Research article data base. https://www.sciencedirect.com
4. Scopus (June 2024). Research article data base. https://www.scopus.com/search/form.uri?display=basic&zone=header&origin=searchbasic#basic

Literature sources

1. Baran, R. J., (2017) Customer relationship management: The foundation of contemporary marketing strategy (2nd ed.). Routledge/Taylor & Francis Group.
2. Bennett, Audrey G., Vokoun, J., Oxon, A. (2023). Critical Mapping for Sustainable Food Design: food security, equity, and justice. Routledge.
3. Porretta, S., Moskowitz, H., Gere, A. (2021). Consumer-based New Product Development for the Food Industry. Royal Society of Chemistry.
4. MacFie, H. (Ed.). (2007). Consumer-led food product development. Woodhead Publishing.
5. Dent, A. (2014). Product design. Thames & Hudson.
6. Ebster, C., Garaus, M. (2011). Store design and visual merchandising: Creating store space that encourages buying. Business Expert Press.
7. Fuller, G.W. (2011). New Food Product Development. CRC Press.
8. Fuller, G.W. (2016). New Food Product Development: From Concept to Marketplace, (3rd ed.). CRC Press.
9. Handbook of research on innovation and entrepreneurship / edited by David B. Audretsch ... [et al.]. Cheltenham, UK ;Northampton, MA : Edward Elgar ; c2011. xvi, 510 p. ISBN 9781848440876.
10. Audretsch, D.B. (2011). Handbook of research on innovation and entrepreneurship. Edward Elgar Publishing.
11. Healthy and Sustainable Food by EIT Food. (2014, June). https://www.eitfood.eu
12. Passos, M.L., Ribeiro, C. P., Raton, B. (2010). Innovation in food engineering: new techniques and products. CRC Press.
13. Ghosh, D., Raton, B. (2013). Innovation in healthy and functional foods. CRC Press.
14. Knorr, D. (Ed.) (2024). Innovative Food Science and Emerging Technologies. Elsevier.
15. Lorenzo O., Kawalek P., Wharton L. (2018). Entrepreneurship, innovation and technology: a guide to core models and tools. Routledge.
16. Marketing & Innovation Magazine. (2024, June). https://innovation-mag.com
17. Mailgard, H. R., Morten, C., Carr, T. B., Civille, G.V. (2006). Sensory and consumer research in food product design and development. CRC Press, Taylor&Francis Group.
18. Daim, T. (Ed.). (2019). R&D management in the knowledge era: challenges of emerging technologies. Springer.
19. Calicchio, S. (2020). Swot Analysis in 4 Steps: How to Use the SWOT Matrix to Make a Difference in Career and Business. Stephano Calicchio.
20. The European Federation of Food Science and Technologies. (2024, June). https://www.effost.org/default.aspx
21. Speth, C. (2015). The SWOT Analysis: Develop Strengths to Decrease the Weaknesses of Your Business. 50Minutes.com.
22. Toldra, F., Yada, R.Y. (Eds.). (2024). Trends in Food Science & Technology. Elsevier.

Materials needed for the implementation of the study course programme

Nr.	Material resources and equipment	Quantity / description
1.	Computer or laptop	
2.	White Board and flipchart	
3.	Data bases and books	

Methods used for the implementation of the study course programme

Nr.	Types	Methods possible to be applied
1.	Lectures	Lecture, discussion, questions - answers
2.	Practical works	Team work, brain storming, Random word, Analogies, discussion, SWOT analyse
3.	Seminars	Discussion and evaluation of data
4.	Hackathon	Planning, team work - hands – on technologies

Co-funded by
the European Union

Open Food Innovation University (OFINU)

DESCRIPTION OF STUDY MODULE
“ACADEMIC WRITING”

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.

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Partner universities and their academic staff, involved in the development of the study course:

P1 Latvia University of Life Sciences and Technologies

Ruta Galoburda - professor.

Zanda Kruma - tenure professor.

P7 Slovak University of Agriculture in Nitra

Miroslava Kačániová - professor.

P2 SAMARU. Samarkand Agroinnovations and Research University

Shavkat Hasanov - professor.

Sherzod Babakholov - PhD.

Azamat Ismailov - MSc, Senior Lecturer.

Shakhista Ishniyazova - professor.

Yigitali Tashpulatov - PhD.

Kamoliddin Bozorov - PhD.

P3 AIAA. Andijan Institute of Agriculture and Agro-technologies

Bahodirjon Nosirov - Associated Professor.

Murodjon Atajanov - Associated Professor.

Sanjarbek Iskandarov - Associated Professor.

Muhammad Zahiriddin Zaynobiddinov - MSc Senior Lecturer.

Turgunbay Khalmatov - MSc, Senior Lecturer.

P4 TUT. Technological University of Tajikistan

Khurshed Ikromi - professor.

Muhabbat Ikromi - assoc.professor.

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

Zokirkhoja Soliev - professor.

CONTENT

Introduction

Study module "Academic Writing" has been developed for researcher training. For many researchers, writing is the hardest skill to learn. This study module explores the definition of academic writing, examines its key components in-depth, and offers tips for improving academic writing. Writing that disseminates concepts, data, and research to a broader academic audience is known as academic writing. Academic writing can be classified into two categories: expert academic writing, tailored for publication in scholarly journals or books, and student academic writing, integral to academic assessment in universities and schools as a precursor to higher education. The same criteria apply to both student and expert academic writing, which can be challenging for students to learn.

The aim and objectives of the study subject are to acquaint students with the principles of academic writing, manuscript preparation according to the requirements of various publishers, manuscript submission and communication with scientific editors and reviewers, and the basics of the presentation.

Learning outcomes

- Knowledge about the principles of academic writing, the structure of a scientific article, and the most common mistakes.
- Skills in selecting a suitable journal for publishing an article, choosing and critically analysing literature for the introduction, correctly describing materials and methods, preparing the results and discussion part supported by statistical data treatment and concluding, editing the manuscript, and preparing a presentation.
- Competence to prepare a manuscript for submission to a specific scientific journal, communicate with the scientific editor and reviewers, and present research results.

Study plan for module "Academic Writing" in Uzbekistan

Themes	Number of hours			
	Total	Lectures	Practical works	Independent work of the student
1. Introduction to article types and publishing	10	2	2	6
2. The structure of a scientific article (IMRaD)	16	2	6	8
3. Selection and critical analysis of articles	14	2	4	8
4. Elements of academic language	20	4	6	10
5. Visual elements for statistically based data presentation in manuscript	38	4	12	22
6. Preparing, editing, and submitting manuscripts	38	4	12	22
7. Presenting scientific results	14	2	4	8
TOTAL	**150**	**20**	**46**	**84**

Study plan for module “Academic Writing” in Tajikistan

Themes	Number of hours			
	Total	Lectures	Practical works	Independent work of the student
1. Introduction to article types and publishing	8	2	2	4
2. The structure of a scientific article (IMRaD)	16	4	4	8
3. Selection and critical analysis of articles	12	3	3	6
4. Elements of academic language	20	5	5	10
5. Visual elements for statistically based data presentation in manuscript	32	8	8	16
6. Preparing, editing, and submitting manuscripts	40	10	10	20
7. Presenting scientific results	16	4	4	8
TOTAL	**144**	**36**	**36**	**72**

Thematic Study Plan for module "Academic Writing"

Date, Time	Study form	Theme	Lecturer
1. Introduction to article types and publishing			
1st day	Lectures (3 h)	Types of scientific articles. Citation and impact factors. Criteria and tools for journal selection. Thematic area of the journal. Publication costs, funding sources. Instructions for authors. Copyright and its transfer. Article authorship and sequence of authors. Scientific ethics and acknowledgments.	
	Practical work (2 h)	Choice of journal for manuscript submission. Searchable journal databases available.	
2. The structure of a scientific article (IMRaD)			
2nd day	Lectures (2 h)	Writing process. The structure of a scientific article (IMRaD). Use of other authors' works. Automatic reference management tools.	
	Practical work (4 h)	Analysis of scientific articles. Automatic reference management tools.	
3. Selection and critical analysis of articles			
3rd day	Lectures (2 h)	Working with databases. Critical analysis of articles.	
	Practical work (3 h)	Preparation of background information for scientific article, making library with possible references. Presentation of the selected journals.	
4. Elements of academic language			
4th day	Lectures (2 h)	The key elements of academic writing. Word choice. English terms and phrases commonly used in academic writing. Paragraph unity and coherence. The most common errors in cases where the language of the manuscript is not the native language of the author.	
	Practical work / seminar (4 h)	The use of different terms in English. Error recognition. Presentation of the manuscript outline.	
5. Visual elements for data presentation in manuscript			
5th day 6th day	Lectures (4 h)	Preparation and design of visual material	
	Practical works (12 h)	Analysis of possible visual elements from literature. Drafting and preparation of visual elements.	
6. Preparing, editing, and submitting manuscripts			
7th day	Lectures (3 h)	Preparing, editing, and submitting manuscripts. Editing the manuscript before submission. Language editing.	

Date, Time	Study form	Theme	Lecturer
		Communication with editors and reviewers. Communication with scientific editor and reviewers. Preparation of the article, CREDiT, back matter, selection of possible reviewers, and cover letter. Second cover letter. Responses to reviewers. Revision, and resubmission of manuscript. Language editing, language improvement services. Proofreading approval.	
	Practical work (4 h)	Formatting manuscripts according to the publisher's requirements. Preparation of cover letter. Responding to the reviewer. Reviewing manuscripts submitted by other students.	
7. Presenting scientific results			
8th day	Lectures (2 h)	Poster presentation. Oral presentation.	
	Practical works (4 h)	Poster preparation based on the manuscript. Preparation of oral presentation based on the manuscript. Presentations.	

Themes and their summary in the study module "Academic Writing"

Theme 1. Introduction to article types and publishing

Issues to be covered in the lectures

1. Why do researchers publish?
2. Pre-requisites for scientific paper.
3. Article types. Original research article. Review. Short communication.
4. Citation index. H-index. SNIP etc. metrics.
5. Scope and aim of journals.
6. Subscription journals. Embargo period. Open Access.
7. Predatory journals.
8. References. Copyright.
9. Ethics regarding human and animal research.
10. Conflict of interests.
11. Funding. Acknowledgment.

Issues to be covered in the practical work

1. Journal selection for manuscript submission.
2. Use of the available searchable journal databases.

Topics for independent work

1. Write an abstract on your topic and search for three possible journals where you could publish your research. Explain, why you have selected these journals.
2. If you do not have material to publish, use the abstract provided by the teacher.
3. Select five scientific articles on your topic and save them for further reading.

Literature and databases on the theme

1. Elsevier Ethics in Research & Publication. Available at: ethics.elsevier.com
2. Sciencedirect.com
3. Scopus.com
4. For more information on Research metrics and publishing please visit Monash University library at https://guides.lib.monash.edu/research-metrics-publishing/home
5. Rele, S., Kennedy, M., Blas, M. (2017). Journal Evaluation Tool. LMU Librarian Publications & Presentations. 40. https://digitalcommons.lmu.edu/librarian_pubs/40

Useful reading for teachers

1. For journal ranking see Scopus, Web of Science or Scimago Journal and Country Rank https://www.scimagojr.com/.
2. Beall's list of potential predatory journals and publishers. Available at: https://beallslist.net/
3. Get your manuscript ready for journal editors. Available at: https://beta.springernature.com/pre-submission/what-editors-look-for?journalId=13197
4. Monavarian, M. (2021). Basics of scientific and technical writing. MRS BULLETIN, vol. vol. 46. Available at: https://link.springer.com/article/10.1557/s43577-021-00070-y
5. Author tutorials. Available at: https://www.springernature.com/gp/authors/campaigns/writing-in-English

6. Zaumanis, M. (2021). Write an impactful research paper: A scientific writing technique that will shape your academic career. Peer recognized series Book no. 1. 2021. (https://peerrecognized.com)
7. Journal suggesters
   https://journalfinder.elsevier.com/
   https://journalsuggester.springer.com/
   https://journalfinder.wiley.com/search?type=match
   https://authorservices.taylorandfrancis.com/publishing-your-research/choosing-a-journal/journal-suggester/
   https://www.mdpi.com/about/journalselector
   https://researcher.life/

Theme 2. The structure of a scientific article (IMRaD)

Issues to be covered in the lectures

1. Anatomy of the scientific article.
2. Authorship. CREDiT roles.
3. Permission to use figures, tables, long texts etc.
4. Plagiarism and Cross Ref. Paraphrasing /revision of sentences (https://englishreadingwriting.blogspot.com/p/paraphrasing.html#.Y9PM5HZBy00)
5. EndNote, Mendeley, Zotero etc.

Issues to be covered in the practical work

1. Analysis of scientific articles.
2. Use of automatic reference management tools (upload selected articles into the reference management system and do citations).

Topics for independent work

1. Highlight or underline the aim, and write down what tasks are completed to achieve the aim (use one of the articles selected in the previous theme).
2. Add more articles to the reference manager, and check the correctness of entries (correct, if necessary).

Literature and databases on the theme

1. A Practical Guide to Academic Writing for International Students A ROUTLEDGEFREEBOOK. Taylor & Francis. Retrieved June 16, 2024 from https://www.routledge.com/rsc/downloads/A_Practical_Guide_to_Academic_Writing_for_International_Students-A_Routledge_FreeBook-_FINAL_VERSION_.pdf
2. EndNote: Help Guides, Getting Started Guides and Manuals. https://support.clarivate.com/Endnote/s/article/EndNote-Help-Guides-Getting-Started-Guides-and-Manuals?language=en_US
3. Guides. Explore Mendelay. Available at: https://www.mendeley.com/guides
4. Meo, S.A. (2018). Anatomy and physiology of a scientific paper. *Saudi Journal of Biological Sciences*, 25, 1278-1283. doi: 10.1016/j.sjbs.2018.01.004.
5. Moeller, K., Baxter, J. (2014). Anatomy of an Article. Arizona State University School of Life Sciences. Ask A Biologist. https://askabiologist.asu.edu/explore/anatomy-of-an-article
6. Zotero: Documentation. Available at: https://www.zotero.org/support/

Useful reading for teachers

1. Allen, L., O'Connell, A., Kiermer, V. (2019). How can we ensure visibility and diversity in research contributions? How the Contributor Role Taxonomy (CReDiT) is helping the shift from authorship to contributorship. *Learned Publishing.* 32, 1-100. https://onlinelibrary.wiley.com/doi/epdf/10.1002/leap.1210
2. CHEM: Intro to Scientific Literature. (2023). Anatomy of a scientific article. Accessed on June 13, 2024. Available at: https://library.citadel.edu/c.php?g=615326&p=4280193
3. Cook, D. A. (2016). Twelve tips for getting your manuscript published, Medical Teacher, 38(1), 41-50, DOI: 10.3109/0142159X.2015.1074989
4. CRediT author statement. Elsevier Accessed on June 13, 2024. Available at: https://www.elsevier.com/authors/policies-and-guidelines/credit-author-statement
5. Hartley, J. (2008). Academic Writing and Publishing: A practical handbook. London, New York, Routledge, Taylor & Francis. https://doi.org/10.4324/9780203927984
6. Huffman, S., Cotos, E., Becker, K. (2023). Exploring the Anatomy of a Research Article / Preparing to publish. Iowa State University. Digital Press. Accessed on June 13, 2024. Available at: https://iastate.pressbooks.pub/preparingtopublish/chapter/exploring-the-anatomy-of-a-research-article/
7. Human Nutrition: Reading Scientific Articles. Windward Community College. A part of University of Hawaii system. Accessed on June 13, 2024. Available at: https://library.wcc.hawaii.edu/nutrition/reading
8. Important points to consider when critically evaluating published research papers. The Open University, OpenLearn. Accessed on June 13, 2024. Available at: https://www.open.edu/openlearn/mod/oucontent/view.php?id=64126&section=1
9. Pun, M. (2021). Plagiarism in Scientific Writing: Why It Is Important to Know and Avoid. *Journal of Political Science*, 21, 109-118. 10.3126/jps.v21i0.35269
10. See Research Paper Outline with Key Sentence Skeleton described by M.Zaumanis. Available at: https://peerrecognized.com/research-paper-outline-with-key-sentence-skeleton-paper-template/
11. Strange, K. (2008). Authorship: why not just toss a coin? American Journal of Physiology-Cell PhysiologyVolume 295, Issue 3. https://doi.org/10.1152/ajpcell.00208.2008

Policies and Guidelines by various publishers

- Elsevier
  Policies & guidelines. Available at: https://beta.elsevier.com/researcher/author/policies-and-guidelines

CRediT author statement. Available at: https://www.elsevier.com/authors/policies-and-guidelines/credit-author-statement

- John Wiley & Sons
  Author Guidelines. Available at: https://onlinelibrary.wiley.com/page/journal/10970037/homepage/forauthors.html#_4._EDITORIAL_POLICIES
- Sage
  Sage Editorial Policies. Available at: https://us.sagepub.com/en-us/nam/publishing-policies
- Springer
  Authorship Principles. Available at: https://www.springer.com/us/editorial-policies/authorship-principles
- Taylor and Francis
  Taylor and Francis Editorial Policies. Available at: https://authorservices.taylorandfrancis.com/editorial-policies/

Theme 3. Selection and critical analysis of articles

Issues to be covered in the lectures

1. Working with databases.
2. Critical analysis of articles.

Issues to be covered in the practical work

1. Application of Scopus Artificial Intelligence (AI) or other AI tools for the first overview of the topic.
2. The presentation of five relevant articles.

Topics for independent work

1. Active reading - read the selected articles - highlight useful phrases for future writing.
2. Start drafting manuscript on your topic. Prepare outline of the results and discussion part (what you would include - data, tables, figures, etc. - make section headings).

Literature and databases on the theme

1. Academic Writing Guide. Torrens University, Australia. Accessed on June 13, 2024. Available at: https://library.torrens.edu.au/academicskills/apa/writing_guide
2. Sheehy, M., Wray, C., Fay, F., Laoghaire, D., Lynch, M., Neylon, J., O'Donnell, T., O'Donovan, C., Quinlan, C. (2019). Academic Writing Handbook for Learners. In the further education and training (FET) sector. Accessed on June 13, 2024. Available at: https://www.fess.ie/images/stories/ResourcesForTutors/AcademicWritingHandbookForLearnersInTheFETSector.pdf

Useful reading for teachers

1. Hartley, J. (2008). Academic Writing and Publishing: A practical handbook. London, New York, Routledge, Taylor & Francis. https://doi.org/10.4324/9780203927984
2. Full OWL Resources for Grades 7-12 Students and Instructors. (2024) The On-Campus Writing Lab & The OWL at Purdue and Purdue University. Accessed on June 13, 2024. Available at: https://owl.purdue.edu/owl/resources/writing_instructors/grades_7_12_instructors_and_students/index.html

Theme 4. Elements of academic language

Issues to be covered in the lectures

1. Paragraph unity and coherence.
2. Active vs passive voice, subject and verb agreement, verb tense.
3. Articles.
4. Spaces in the text.
5. Prepositions.
6. Capitalization.
7. Signposting, hedging words.
8. Punctuation.
9. Measurement units.

10. British vs American spelling.
11. Words with similar sounds but different meanings.

Issues to be covered in the practical work

1. Adding words to glossary and phrase book (for example, 5 verbs in each group to replace verbs to look at, to compare, to show, to find out), extracting useful phrases for describing various issues).
2. Tasks on paragraph unity (find and cross out the sentences, break paragraph unity; arrange sentences and make coherent paragraphs).
3. Language editing (MS Word, Grammarly, real person, artificial intelligence).

Topics for independent work

1. Write a first draft of the manuscript

Literature and databases on the theme

1. Oshima, A., Hogue, A. (2007). Introduction to Academic Writing. Wait Plains: Pearson Education, Longman. Available at: https://edisciplinas.usp.br/pluginfile.php/3928474/mod_resource/content/1/Introduction%20to%20Academic%20Writing.pdf
2. Reporting Verbs. Explore different ways of referring to literature and foregrounding your voice. Academic Skills Kit. Newcastle University. Accessed on June 13, 2024. Available at: https://www.ncl.ac.uk/academic-skills-kit/writing/academic-writing/reporting-verbs
3. Signposting. Explore different ways of guiding the reader through your assignment. Academic Skills Kit. Newcastle University. Accessed on June 13, 2024. Available at: https://www.ncl.ac.uk/academic-skills-kit/writing/academic-writing/signposting
4. The key elements of writing. Accessed on June 13, 2024. Available at: https://pdfweb.truni.sk/e-ucebnice/eap/data/48a425aa-ce1c-4f6e-a68b-37b05785b0d8.html?ownapi=1
5. Zemach, D.E., Rumisek, L. A. (2005). Academic writing from paragraph to essay. Oxford; Macmillan Publishers Limited.

Useful reading for teachers

1. Academic style. Explore the key features that make up academic style. The University of Melbourne. Accessed on June 13, 2024. Available at: https://students.unimelb.edu.au/academic-skills/resources/developing-an-academic-writing-style/key-features-of-academic-style
2. Active Versus Passive Voice. The On-Campus Writing Lab & The OWL at Purdue and Purdue University. Accessed on June 13, 2024. Available at: https://owl.purdue.edu/owl/general_writing/academic_writing/active_and_passive_voice/active_versus_passive_voice.html
3. Drew, C. (2023). *28 Cohesion Examples*. Helpful Professor. Accessed on June 13, 2024. Available at: https://helpfulprofessor.com/cohesion-examples/
4. Language Used in Academic Writing. StudySmarter. Accessed on June 13, 2024. Available at: https://www.studysmarter.co.uk/explanations/english/5-paragraph-essay/language-used-in-academic-writing/
5. Paragraph Structure. Rochester Institute of Technology. Accessed on June 13, 2024. Available at: https://www.rit.edu/ntid/sea/processes/paragraph/process/body

6. Paragraph unity and coherence. (2009) Wheaton College Writing Center. Accessed on June 13, 2024. Available at: https://www.wheaton.edu/academics/services/writing-center/writing-resources/paragraph-unity-coherence-and-development/
7. Paragraph Unity and Coherence. American University, Academic Support Center, Writing Lab, updated 2009 Accessed on June 13, 2024. Available at: https://www.american.edu/provost/academic-access/upload/paragraph-unity-and-coherence.pdf
8. Paragraph Unity. Accessed on June 13, 2024. Available at: https://iuuk.mff.cuni.cz/~andrew/EAP/KaneCh13.pdf
9. Paragraphs. University College, University of Toronto. Accessed on June 13, 2024. Available at: https://www.uc.utoronto.ca/paragraphs
10. Sheffield, N. (2011). The Next Level. Duke Graduate School Scientific Writing Resource. Accessed on June 13, 2024. Available at: https://sites.duke.edu/scientificwriting/the-next-level/
11. The 4 things (that examiners love…) Part 2: Coherence and Cohesion. ILTS University. Accessed on June 13, 2024. Available at: https://www.ieltsuniversity.com/4-things-examiners-love-coherence-cohesion/
12. Transitions. Wheaton College. Accessed on June 13, 2024. Available at: https://www.wheaton.edu/academics/services/writing-center/writing-resources/transitions/
13. Using keywords to write your title and abstract. Taylor and Francis Author Services. Accessed on June 13, 2024. Available at: https://authorservices.taylorandfrancis.com/publishing-your-research/writing-your-paper/using-keywords-to-write-title-and-abstract/
14. Wallwork, A. (2013). English for Research: Usage, Style, and Grammar. New York: Springer Science+Business Media. (available also at: https://www.infomed.hlg.sld.cu/lecturas_avanzadas/English_for_Research_Usage_Style_and_Grammar.pdf)
15. Weber, R., Stolley, K. (2018). Transitional Devices. *Purdue University Online Writing Lab (OWL)*, 2 owl.english.purdue.edu/owl/resource/574/02/.
16. What Is Hedging in Academic Writing? (2023) Enago Academy. Accessed on June 13, 2024. Available at: https://www.enago.com/academy/hedging-in-academic-writing

Links to YouTube videos on paragraph unity, coherence and cohesiveness

- Writing better. Available at: https://www.youtube.com/watch?v=vbMtBjoBalQ
- Writing better: Sentences, paragraphs and essays. Available at: https://www.youtube.com/watch?v=Ubj1gjPvwKU
- Writing better: How to write an Introduction Paragraph with Thesis Statement. Available at: https://www.youtube.com/watch?v=XSmVvkRKCdw
- Writing better: How to Write Body Paragraphs for an Essay. Available at: https://www.youtube.com/watch?v=hi9-acR3AgY
- Unity in Academic Writing. Available at: https://www.youtube.com/watch?v=HT1FkC0XZ8w

Theme 5. Visual elements for data presentation in manuscript

Issues to be covered in the lectures

1. The aim of visual elements.
2. Types of visual elements (bar charts, histograms, box plots, scatter plots, heatmaps etc.).
3. Tables, figures formatting.
4. Basic statistics used for visual elements for article (descriptive and concluding statistics).
5. Common flaws in data presentation.

Issues to be covered in the practical work

1. Basics of statistical analysis for data presentation.
2. Preparation and formatting of tables.
3. Preparation and formatting of graphs. Graph components.
4. Figures.
5. Introduction to statistical data presentation with visual elements.

Topics of independent work

1. Descriptive statistics as a tool for data presentation in article. Calculation of parameters based on own data or dataset provided by teacher.
2. Analyses of visual elements found in scientific articles based on concluding statistics methods.
3. Selection and preparation of the appropriate visual elements for article using formatting guidelines (own data or dataset provided by teacher)

Literature and databases on the theme

1. King, L. (2018). Preparing better graphs. *Journal of the Public Health and Emergency*; 2:1. doi: 10.21037/jphe.2017.12.03
2. Figure Preparation. Wiley Author Services. Accessed on June 13, 2024. Available at: https://authorservices.wiley.com/author-resources/Journal-Authors/Prepare/manuscript-preparation-guidelines.html/figure-preparation.html
3. Instructions to Authors. Accessed on June 13, 2024. Available at: https://sciendo-parsed-data-feed.s3.eu-central-1.amazonaws.com/PLUA/Instructions_to_Authors.pdf

Useful reading for teachers

1. Elsevier. Guide for authors: Your Paper Your Way. Accessed on June 13, 2024. Available at: https://www.elsevier.com/subject/next/guide-for-authors
2. Manuscript preparation. Springer Nature. Accessed on June 13, 2024. Available at: https://www.springer.com/gp/authors-editors/book-authors-editors/your-publication-journey/manuscript-preparation

Theme 6. Preparing, editing, and submitting manuscripts

Issues to be covered in the lectures

1. Writing tools for collaboration (Google docs, MS Word online).
2. Instructions to authors, templates.
3. Electronic submission systems (editorial management systems). Elsevier, MDPI, Wiley, Springer, Thomson Reuters, De Gruyter etc.
4. Examples of cover letters.
5. Selection of possible reviewers.
6. Tools for language improvement.
7. Review process.
8. The questions addressed by reviewers.

Issues to be covered in the practical works

1. Formatting the manuscript according to the publisher's requirements.
2. Preparing the cover letter.

Topics of independent work

1. Reviewing manuscripts submitted by other students.
2. Responding to the reviewer.

Literature and data bases on the theme

1. A Practical Guide to Academic Writing for International Students A ROUTLEDGEFREEBOOK. Taylor & Francis. Accessed on June 13, 2024. Available at: https://www.routledge.com/rsc/downloads/A_Practical_Guide_to_Academic_Writing_for_International_Students-A_Routledge_FreeBook-_FINAL_VERSION_.pdf
2. Academic Writing Guide. Future Academic Support. UCEN, Manchester. Accessed on June 13, 2024. Available at: https://www.ucenmanchester.ac.uk/media/filer_public/c9/2f/c92fdc28-a5da-4098-917f-49c1f76940bf/ucen-academic-writing-booklet.pdf
3. Academic Writing Guide. Torrens University, Australia. Accessed on June 13, 2024. Available at: https://library.torrens.edu.au/academicskills/apa/writing_guide
4. Academic Writing Guide. University of Sussex. Sussex Centre for Language Studies. Accessed on June 13, 2024. Available at: http://www.sussex.ac.uk/languages/files/awg/
5. Academic Writing Handbook – Guidance for students. London School of Hygiene & Tropical Medicine. (2020) Accessed on June 13, 2024. Available at: https://www.lshtm.ac.uk/sites/default/files/academicwritinghandbook.pdf
6. Academic Writing Handbook for Learners. In the further education and training (FET) sector (2019). Sheehy M., Wray C., Fay F., Laoghaire D., Lynch M., Neylon J., O'Donnell T., O'Donovan C., Quinlan C. Accessed on June 13, 2024. Available at: https://www.fess.ie/images/stories/ResourcesForTutors/AcademicWritingHandbookForLearnersInTheFETSector.pdf
7. Academic writing: a Practical Guide. University of York. Accessed on June 13, 2024. Available at: https://subjectguides.york.ac.uk/academic-writing

8. Bak, N. (2003). Guide to Academic Writing. University of the Western Cape. Accessed on June 13, 2024. Available at: https://www.researchgate.net/publication/236229397_Guide_to_Academic_Writing.
9. Guide for authors. Elsevier. Accessed on June 13, 2024. Available at: https://www.elsevier.com/subject/next/guide-for-authors
10. Guide to Academic Writing ENGLISH AND AMERICAN STUDIES [November 2019] Bayreuth University, Germany. Accessed on June 13, 2024. Available at: https://www.amerikanistik.uni-bayreuth.de/pool/dokumente/Guide-to-Academic-Writing_2019-11-07.pdf
11. Instructions for Authors. MDPI. Accessed on June 13, 2024. Available at: https://www.mdpi.com/journal/resources/instructions
12. Moh, H. (2018). Basic Academic Writing. STKIP PGRI Bangkalan. Accessed on June 13, 2024. Available at: https://stkippgri-bkl.ac.id/wp-content/uploads/2019/11/Basic-Academic-Writing.pdf
13. Quick guide to academic writing. University of Cumbria, UK. Accessed on June 13, 2024. Available at: https://my.cumbria.ac.uk/media/MyCumbria/Documents/Library/Quick-guide-to-Academic-writing.pdf
14. Whitaker, A. (2009). Academic Writing Guide. A Step-by-Step Guide to Writing Academic Papers. CityUniversity of Seattle. Bratislava, Slovakia. Accessed on June 13, 2024. Available at: https://www.vsm.sk/Curriculum/academicsupport/academicwritingguide.pdf
15. Writing for research. Elsevier Researcher Academy. Accessed on June 13, 2024. Available at: https://researcheracademy.elsevier.com/writing-research

Theme 7. Presenting scientific results

Issues to be covered in the lectures

1. Poster presentation.
2. Oral presentation.

Issues to be covered in the practical works

1. Poster preparation based on the manuscript.
2. Preparation of oral presentation based on the manuscript.
3. Presentations.

Topics of independent work

1. Preparation of poster on the topic, covered in the manuscript.
2. Preparation of oral presentation on the topic, covered in the manuscript.

Literature and data bases on the theme

1. Academic Presentations and Posters: Recommendations and Resources. The Graduate School, University of North Carolina. Accessed on June 13, 2024. Available at: https://gradschool.unc.edu/academics/resources/postertips.html
2. How to Make Good Figures for Scientific Papers. Simplified Science Publishing. Accessed on June 13, 2024. Available at: https://www.simplifiedsciencepublishing.com/resources/how-to-make-good-figures-for-scientific-papers

3. Schoeberl, M., Toon, B. Ten Secrets to Giving a Good Scientific Talk. Accessed on June 13, 2024. Available at: https://web.archive.org/web/20151026082537/http://www.cgd.ucar.edu/cms/agu/scientific_talk.html

Useful reading for teachers

1. 18 tips for giving a horrible presentation. Retraction Watch. Accessed on June 13, 2024. Available at: https://retractionwatch.com/2016/11/30/18-tips-giving-horrible-presentation/
2. Better Posters. Accessed on June 13, 2024. Available at: https://betterposters.blogspot.com/2011/04/critique-breast-cancer-inhibition.html
3. IvyPanda. Tips for Giving Clear Talks. Accessed on June 13, 2024. Available at: https://ivypanda.com/blog/tips-for-giving-clear-talks/
4. Sodano, L., Di Dio, A. (2010). Scientific papers' presentations: methods and useful suggestions. Conference: Training project "English readings: scientific papers' presentations and discussion" Accessed on June 13, 2024. Available at: https://www.researchgate.net/publication/268745598_Scientific_papers'_presentations_methods_and_useful_suggestions
5. Williams, J. B. W. (2009). How to Give a Sensational Scientific Talk. Accessed on June 13, 2024. Available at: https://web.archive.org/web/20150918164351/http://chem.virginia.edu/wp-content/uploads/2009/05/talk_in_pdf.pdf

Literature sources

1. A Practical Guide to Academic Writing for International Students A ROUTLEDGEFREEBOOK. Taylor & Francis. Accessed on June 13, 2024. Available at: https://www.routledge.com/rsc/downloads/A_Practical_Guide_to_Academic_Writing_for_International_Students-A_Routledge_FreeBook-_FINAL_VERSION_.pdf
2. Academic Writing Guide. Future Academic Support. UCEN, Manchester. Accessed on June 13, 2024. Available at: https://www.ucenmanchester.ac.uk/media/filer_public/c9/2f/c92fdc28-a5da-4098-917f-49c1f76940bf/ucen-academic-writing-booklet.pdf
3. Academic Writing Guide. Torrens University, Australia. Accessed on June 13, 2024. Available at: https://library.torrens.edu.au/academicskills/apa/writing_guide
4. Academic Writing Guide. University of Sussex. Sussex Centre for Language Studies. Accessed on June 13, 2024. Available at: http://www.sussex.ac.uk/languages/files/awg/
5. Academic Writing Handbook – Guidance for students. London School of Hygiene & Tropical Medicine. (2020) Accessed on June 13, 2024. Available at: https://www.lshtm.ac.uk/sites/default/files/academicwritinghandbook.pdf
6. Academic Writing Handbook for Learners. In the further education and training (FET) sector (2019) Sheehy M., Wray C., Fay F., Laoghaire D., Lynch M., Neylon J., O'Donnell T., O'Donovan C., Quinlan C. Accessed on June 13, 2024. Available at: https://www.fess.ie/images/stories/ResourcesForTutors/AcademicWritingHandbookForLearnersInTheFETSector.pdf
7. Academic writing: a Practical Guide. University of York. Accessed on June 13, 2024. Available at: https://subjectguides.york.ac.uk/academic-writing
8. Bak, N. (2003). Guide to Academic Writing. University of the Western Cape. Accessed on June 13, 2024. Available at: https://www.researchgate.net/publication/236229397_Guide_to_Academic_Writing.
9. Guide for authors. Elsevier. Accessed on June 13, 2024. Available at: https://www.elsevier.com/subject/next/guide-for-authors
10. Guide to Academic Writing ENGLISH AND AMERICAN STUDIES [November 2019] Bayreuth University, Germany. Accessed on June 13, 2024. Available at: https://www.amerikanistik.uni-bayreuth.de/pool/dokumente/Guide-to-Academic-Writing_2019-11-07.pdf
11. Instructions for Authors. MDPI. Accessed on June 13, 2024. Available at: https://www.mdpi.com/journal/resources/instructions
12. Moh, H. (2018). Basic Academic Writing. STKIP PGRI Bangkalan. Accessed on June 13, 2024. Available at: https://stkippgri-bkl.ac.id/wp-content/uploads/2019/11/Basic-Academic-Writing.pdf
13. Quick guide to academic writing. University of Cumbria, UK. Accessed on June 13, 2024. Available at: https://my.cumbria.ac.uk/media/MyCumbria/Documents/Library/Quick-guide-to-Academic-writing.pdf
14. Whitaker, A. (2009). Academic Writing Guide. A Step-by-Step Guide to Writing Academic Papers. CityUniversity of Seattle. Bratislava, Slovakia. Accessed on June 13, 2024. Available at: https://www.vsm.sk/Curriculum/academicsupport/academicwritingguide.pdf
15. Writing for research. Elsevier Researcher Academy. Accessed on June 13, 2024. Available at: https://researcheracademy.elsevier.com/writing-research

Additional literature at AIAA

Literature on conducting field experiments and analyzing the obtained results

1. Dospexov B.A. Field experiment methodology. 1987. (in Russian).
2. Methods of agrochemical, agrophysical and microbiological research in irrigated cotton areas. (in Russian).
3. Mirzajonov Q., Xasanova F. And others. Methods of field experiments. Tashkent, 2007. (in Uzbek).

Literature on methods of research:

1. Determination of volume mass of soil by N.A. Kachinsky method.
4. Determination of water permeability of the soil by the methods of S.I. Dolgov and S.N. Rizhov.
5. Humus in the soil (by the Tyurin method), gross nitrogen, total phosphorus (by the Malseva, Gritsenko method), nutrients in mobile form in the soil, nitrate nitrogen (colorometric, by the Granwald-Lyaju method), mobile phosphorus (by the Machigin method), exchangeable potassium (by the Protasov method).
6. Mathematical statistical analysis Microsoft Excel computer program.
7. Soil granularity, aggregate composition according by the method of N.I. Savvinov.

Additional literature at BTUTI

1. АСОСҲОИ ТАДИҚОТИ ИЛМӢ: Дастури таълимӣ/ Муаллифон:Ҳакимов Ғ.Қ., Яминзода З.А. Душанбе-2020, 196 сањ. (FUNDAMENTALS OF SCIENTIFIC RESEARCH: Educational manual/ Authors: Hakimov G.K., Yaminzoda Z.A. Dushanbe-2020, 196 pages.).
2. Лудченко А.А., Лудченко Я.А., Примак Т.А. Основы научных исследований: Учеб. пособие / Подред. А.А. Лудченко. — 2-е изд., стер. — К.: О- во "Знания", КОО, 2001. — 113 с. (Ludchenko A.A., Ludchenko Ya.A., Primak T.A. Fundamentals of scientific research: Textbook. allowance / Ed. A.A. Ludchenko. — 2nd ed., erased. - K.: Society "Knowledge", KOO, 2001. - 113 p.).

Materials required for the implementation of the study course program

Nr.	Material resources and equipment	Quantity / description
1.	Internet access	
2.	Access to databases	Necessary for scientific literature search.
3.	Moodle based e-study environment	Used for practical task assignments and communication between students and teachers.

Methods used for the implementation of the study course program

No.	Types	Possible methods to be used
1.	Lectures	Presentation of theoretical material by the teacher in front of the audience. Lectures include a theoretical background of academic writing.
2.	Practical works	Use of visual and interactive materials: Presentations, video tutorials, interactive websites. Drafting manuscript following practical guidance of teacher.
3.	Seminars	Presenting prepared poster and oral presentation. Discuss with classmates and teacher.
4.	Independent work	Assignments for independent studies are described with each topic.