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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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## 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”

Themes	Number of hours LV/UZB/TJ			
	Total	Lectures	Practical works	Independent work of the student
Theme 1. Chemical composition and quality of milk.	55/58/52	11/12/8	11/12/8	33/34/36
Theme 2. Milk processing – different treatment methods, milk and cream.	45/48/44	8/8/6	10/12/8	27/28/30
Theme 3. Fermented dairy products: production and quality evaluation.	53/56/48	9/10/6	12/14/8	32/32/34
Theme 4. Butter and ice cream: production technology and quality evaluation.	38/42/38	6/6/4	8/10/8	24/26/26
Theme 5. Cheese: classification, production technology, quality assessment.	82/74/72	12/14/8	12/12/12	50/48/52
Theme 6. Milk products with long shelf-life.	22/24/20	4/4/2	4/6/4	12/14/14
Theme 7. By-products: quality parameters, processing options.	36/36/30	6/8/4	7/8/6	20/20/20
Theme 8. HACCP in dairy processing companies.	20/22/20		8/8/6	12/14/14
<b>TOTAL</b>	<b>324/360/324</b>	<b>56/62/38</b>	<b>72/82/60</b>	<b>196/216/226</b>

## Thematic Study Plan for module “Milk Processing Technology”

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

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

	Seminar (2h)	Cheese variation students reports.	Dr.sc.ing. Assoc.prof. J. Zagorska
16 <sup>th</sup> day	Lecture (2h)	Cheese production technology, biochemical processes for cheese ripening.	Dr.sc.ing. Assoc.prof. J. Zagorska
	Laboratory work (4h)	Preparation of cheese, evaluation of cheese quality and microflora.	Dr.sc.ing. Assoc.prof. J. Zagorska
17 <sup>th</sup> day	Lecture (4h)	Packing, types, materials, equipment of preserved butter, cheese and milk.	Dr.sc.ing. Assoc.prof. J. Zagorska S. Dr.sc.ing. Professor S.Muižniece-Brasava
	Laboratory work (3h)	Fresh cheese production.	Dr.sc.ing. Assoc.prof. J. Zagorska
	Laboratory work (2h)	Product packaging solutions.	Dr.sc.ing. Professor S. Muižniece-Brasava
18 <sup>th</sup> day	Lecture (4h)	Principles, methods, standards for the sensory evaluation of milk products.	Dr.sc.ing. Professor E. Straumite
	Laboratory work (3h)	Sensory evaluation of dairy products.	Dr.sc.ing. Professor E. Straumite
19 <sup>th</sup> day	Excursion	Visit to milk processing company: cheese production	Dr.sc.ing. Assoc.prof. J. Zagorska
<b>Theme 6 Milk products with long shelf-life</b>			
20 <sup>th</sup> day	Lecture (4h)	Milk conservation technology, plants.	Dr.sc.ing. Assoc.prof. J. Zagorska Dr. sc.ing. Professor S. Muižniece-Brasava
	Laboratory work (4h)	Operation of evaporation and drying equipment, newest solutions. Evaluation of the quality of condensed milk.	Dr.sc.ing. Assoc.prof. J. Zagorska
<b>Theme 7 By-products: quality parameters, processing options</b>			
21 <sup>th</sup> day	Lecture (2h)	By-products of the milk industry, processing technologies and plants.	Dr.sc.ing. Assoc.prof. J. Zagorska
	Laboratory work (3h)	Principles for the operation of membrane equipment and use of derived products to create new products.	Dr.sc.ing. Assoc.prof. J. Zagorska
<b>Theme 8 HACCP in dairy processing companies</b>			
22 <sup>th</sup> day	Practical work (8h)	Product safety, definition and monitoring of control and critical control points.	Mg.tqf. lecturer E. Sproģe



# **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, enterobacteria, 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**

1. Крусъ, 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.

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

### **Issues to be covered in the lectures**

1. Mechanical (cooling, filtration, separation, bacto-fugation, microfiltration, standardisation, 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**

1. 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**

6. Dairy processing handbook (1995), Sweden: TetraPak.  
<https://archive.org/details/DairyProcessingHandbookTetrapak>
7. Крусъ, Г.Н, Храмцов, А. Г., Волокитина, Э. В., Карпычев, С. В. (2006). Технология молока и молочных продуктов. Колос.
8. Бредихин С.А., Космодемьянский Ю.В. (2003). Технология и техника переработки молока. Колос.
9. Востроилов, А.В., Семёнова, И.Н. (2010). Основы переработки молока и экспертиза качества молочных продуктов. ГИОРД.
10. Qo'chqarov O'.R (2003) Chorvachilik mahsulotlarining davlat standartlariga mosligini aniqlash asoslari. Cho'lpon.
11. 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 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 fermented products.

#### **Themes of independent work**

1. Evaluation of laboratory works results: temperature, starter amount and cultures influence on final product quality, analysis of pasteurisation temperatures and coagulation technics on whey synereses 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**

1. Dairy processing handbook (1995), Sweden: TetraPak.  
<https://archive.org/details/DairyProcessingHandbookTetrapak>
2. Крусъ, Г.Н, Храмцов, А. Г., Волокитина, Э. В., Карпычев, С. В. (2006). Технология молока и молочных продуктов. Колос.
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4. Востроилов, А.В., Семёнова, И.Н. (2010). Основы переработки молока и экспертиза качества молочных продуктов. ГИОРД.
5. Qo'chqarov O'.R (2003) Chorvachilik mahsulotlarining davlat standartlariga mosligini aniqlash asoslari. Cho'lpon.
6. Fayziyev, J.S. (2019). *Sut va sut mahsulotlari texnologiyasi*. Toshkent.
7. 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**

12. Dairy processing handbook (1995), Sweden: TetraPak.  
<https://archive.org/details/DairyProcessingHandbookTetrapak>
13. Крусъ, Г.Н, Храмцов, А. Г., Волокитина, Э. В., Карпычев, С. В. (2006). Технология молока и молочных продуктов. Колос.
14. Бредихин С.А., Космодемьянский Ю.В. (2003). Технология и техника переработки молока. Колос.
15. Востроилов, А.В., Семёнова, И.Н. (2010). Основы переработки молока и экспертиза качества молочных продуктов. ГИОРД.
16. Qo'chqarov O'.R (2003) Chorvachilik mahsulotlarining davlat standartlariga mosligini aniqlash asoslari. Cho'lpon.
17. 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 un discussions about usual mistakes during cheese production and possibilities to solve it.
2. Students reports about Cheese variation.
3. Explore the cheeses packaging solutions.

### **Literature and data bases on the theme**

1. Dairy processing handbook (1995), Sweden: TetraPak.  
<https://archive.org/details/DairyProcessingHandbookTetrapak>
2. Крусъ, Г.Н, Храмцов, А. Г., Волокитина, Э. В., Карпычев, С. В. (2006). Технология молока и молочных продуктов. Колос.
3. Бредихин С.А., Космодемьянский Ю.В. (2003). Технология и техника переработки молока. Колос.
4. Востроилов, А.В., Семёнова, И.Н. (2010). Основы переработки молока и экспертиза качества молочных продуктов. ГИОРД.
5. Qo'chqarov O'.R (2003) Chorrachilik mahsulotlarining davlat standartlariga mosligini aniqlash asoslari. Cho'lpon.
6. Fayziyev, J.S. (2019). *Sut va sut mahsulotlari texnologiyasi*. Toshkent.
7. 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**

18. Dairy processing handbook (1995), Sweden: TetraPak.  
<https://archive.org/details/DairyProcessingHandbookTetrapak>
19. Крусъ, Г.Н, Храмцов, А. Г., Волокитина, Э. В., Карпычев, С. В. (2006). Технология молока и молочных продуктов. Колос.
20. Бредихин С.А., Космодемьянский Ю.В. (2003). Технология и техника переработки молока. Колос.
21. Востроилов, А.В., Семёнова, И.Н. (2010). Основы переработки молока и экспертиза качества молочных продуктов. ГИОРД.
22. Qo'chqarov O'.R (2003) Chorvachilik mahsulotlarining davlat standartlariga mosligini aniqlash asoslari. Cho'lpon.
23. 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**

24. Dairy processing handbook (1995), Sweden: TetraPak.  
<https://archive.org/details/DairyProcessingHandbookTetrapak>
25. Крусъ, Г.Н, Храмцов, А. Г., Волокитина, Э. В., Карпычев, С. В. (2006). Технология молока и молочных продуктов. Колос.
26. Бредихин С.А., Космодемьянский Ю.В. (2003). Технология и техника переработки молока. Колос.
27. Востроилов, А.В., Семёнова, И.Н. (2010). Основы переработки молока и экспертиза качества молочных продуктов. ГИОРД.
28. Qo'chqarov O'.R (2003) Chorvachilik mahsulotlarining davlat standartlariga mosligini aniqlash asoslari. Cho'lpon.
29. 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**

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



### Literature sources

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### 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	<p>Compilation and explanation of the data obtained in laboratory work with theoretically learned material, clarifying the differences.</p> <p>Analysis of problem situations from the point of view of the fruit and vegetable processing industry</p>