Ministry of Education and Science of Ukraine

Sumy National Agrarian University

Faculty of Food Technology

Food Technology Department

Syllabus of an educational component

# EC 9 SCIENTIFIC BASIS OF WASTE-FREE TECHNOLOGIES OF FOOD INDUSTRY

Under implementation in within the educational programs **«Food technologies»**

by specialty **181 «Food technologies»**

at the second (master's) level higher education

**Sumy – 2024**

Developer: _____ **Dmytro BIDIUK,** Ph.D., Senior Lecturer, Food Technology Department
(signature) (surname, initials) (academic degree and title, position)

| | |
|---|---|
| Reviewed, approved and ratified at the meeting of the Food Technology Department ( name departments ) | Protocol No. 19 by 31.05.2024 |
| | Head of the Department _____ ( signature) Oksana MELNYK ( last name , initials ) |

**Approved:**

Guarantor of educational program _____ Fedir PERTSEVOY
(signature) (first name LAST NAME)

Dean of the faculty,
where the educational program is implemented _____ Natalia BOLGOVA
(signature) (first name SURNAME)

Review of the work program (attached) provided: _____ Oksana MELNYK
(signature) (first name LAST NAME)

_____ Olena KOSHEL
(signature) (first name SURNAME)

Methodologist of the Department of Educational,
Quality, Licensing and Accreditation _____ Hagda Bapanka
(signature) (first name LAST NAME)

Registered in the electronic database: date: 07.07.2024

Information on reviewing the work program (syllabus):

| Academic year, in which changes are made | The number of the appendix to the work program with description changes | The changes have been reviewed and approved | | |
|---|---|---|---|---|
| | | Date and number of the Protocol of the meeting of the departments | Head of Department | Guarantor of the educational programs |
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## 1. GENERAL INFORMATION ABOUT THE EDUCATIONAL COMPONENT

<table>
<tr><td>1.</td><td>Name of Educational Component</td><td colspan="4">Scientific foundations of waste-free technologies in the food industry</td></tr>
<tr><td>2.</td><td>Faculty / Department</td><td colspan="4">Food technology / Food technology</td></tr>
<tr><td>3.</td><td>Status of Educational Component</td><td colspan="4">Mandatory</td></tr>
<tr><td>4.</td><td>EK can be offered for (filled for selective EK) )</td><td colspan="4">Educational program : Food technology / specialty:181 «Food technology»</td></tr>
<tr><td>5.</td><td>An educational component may be offered for</td><td colspan="4">241 «Hotel and restaurant business»</td></tr>
<tr><td>6.</td><td>National Qualifications Framework Level</td><td colspan="4">7 level</td></tr>
<tr><td>7.</td><td>Semester and duration study</td><td colspan="4">Third semester<br>Duration study – 15 weeks</td></tr>
<tr><td>8.</td><td>Number loans ECTS</td><td colspan="4">5 loans</td></tr>
<tr><td rowspan="3">9.</td><td rowspan="3">General amount of hours and their distribution</td><td colspan="3">Contact work ( classes )</td><td rowspan="2">Independent work</td></tr>
<tr><td>Lectures</td><td>Practise / seminars</td><td>Lab</td></tr>
<tr><td>2</td><td>-</td><td>0</td><td>148</td></tr>
<tr><td>10.</td><td>Language of education</td><td colspan="4">English</td></tr>
<tr><td>11.</td><td>Teacher / Coordinator educational component</td><td colspan="4">Dmytro BIDIUK</td></tr>
<tr><td>11.1</td><td>Contact information</td><td colspan="4">Working place: room 212 m, Mechanization Building<br>tel. +38 (050) 781-20-27<br>E-mail: d.bidiuk@snau.edu.ua</td></tr>
<tr><td>12.</td><td>General description of the educational component</td><td colspan="4">Within the framework of this educational component, an idea of modern technologies for the extraction of valuable biologically active substances from by-products of the food industry is provided. The student will be familiarized with the optimization of food processing technologies to minimize the formation of food waste, by-products of the food industry, using them to create useful products with added value for food and non-food purposes. The discipline reviews the problems associated with food waste, considers ways to dispose of food waste, by-products of the food industry, taking into account global environmental standards and as a means of achieving sustainable development goals.</td></tr>
<tr><td>13.</td><td>Thr goal of educational component</td><td colspan="4">Familiarization with the latest research and practice in the field of waste-free, resource-saving technologies for food production, areas of processing and utilization of food waste and by-products of the food industry into valuable products, taking into account global environmental requirements.</td></tr>
<tr><td>14.</td><td>Prerequisites for studying the educational component, connection with other educational components of the educational program</td><td colspan="4">The educational component has connection with others educational components « Theoretical foundations food productions ", " Food quality and safety management "</td></tr>
<tr><td>15.</td><td>Academic Integrity Policy</td><td colspan="4">If copying or plagiarism is detected, the student's work is canceled and re-done.</td></tr>
<tr><td>16.</td><td>Link to the course in the system Moodle</td><td colspan="4">https://cdn.snau.edu.ua/moodle/enrol/index.php?id=5044</td></tr>
<tr><td>17.</td><td>Keywords</td><td colspan="4">Waste-free technologies, circular economy, sustainable development, food waste, by-products, environmental requirements</td></tr>
</table>

## 2. RESULTS TEACHING BY EDUCATIONAL COMPONENT AND THEIR CONNECTION WITHSOFTWARE LEARNING OUTCOMES

| **Learning outcomes for the educational component:** After studying the educational component, the student is expected to be able to…» | Program learning outcomes | | | | | | How is academic discipline assessed? |
|---|---|---|---|---|---|---|---|
| | Learning Outcome 1 | Learning Outcome 3 | Learning Outcome 5 | Learning Outcome 7 | Learning Outcome 13 | Learning Outcome 14 | |
| LOE 1. Find, systematize and critically analyze modern scientific data, regulatory documents and production practices on waste-free technologies, formulate problems and research directions. | X | | | | | | Oral defense of lab Multiple choice test (modular assessment) Differential credit |
| LOE 2. Use modern laboratory and production equipment, specialized software and research methods to analyze and optimize the processes of processing and using food products. | | X | | | | | |
| LOE 3. Develop and justify innovative technological solutions for processing by-products in production with added value, assessing their social, economic and environmental efficiency. | | | X | | | | |
| LOE 4. Integrate knowledge about global trends in sustainable development, environmental requirements and innovative approaches in the field of waste-free technologies for making professional decisions. | | | | X | | | |
| LOE 5. Present the results of their own research and technological developments, and communicate them in a reasoned manner both to the professional community and to a wider audience, contributing to the development of a culture of sustainable food production. | | | | | X | | |
| LOE 6. Apply the principles of the circular economy in the practical activities of food industry enterprises, in particular in the areas of recycling household products, implementing new methods of storage, preservation, and biopackaging. | | | | | | X | |

## 3. CONTENT OF THE EDUCATIONAL COMPONENT (CURRICULUM)

| Topic.<br>List questions that will be considered within topics | Distribution in within general budget time | | | Recom-mended literature |
|---|---|---|---|---|
| | Auditorium work | | Indepen-dent work | |
| | Lectures | Lab | | |
| **Topic 1. Side effects products food industry and their using**<br>1. Waste food industry and related products for industrial use application .<br>2. By-products of the meat and poultry processing industry.<br>3. By-products of the dairy industry<br>4. Modern approaches to the implementation of waste-free technologies in the food industry: theoretical foundations and practical solutions<br>Independent study 1. By-products from the grain processing industry. Fruit and vegetable by-products. By-products from seafood processing.<br>Laboratory lesson 1. Study of organoleptic, physicochemical and functional and technological indicators of by-products of the food industry | 2 | - | 28 | [1-7] |
| **Topic 2. Bioprocessing of waste from beef, pork, chicken and egg production**<br>1. Various by-products and waste from beef and pork processing.<br>2. By-products and waste generated during the processing of chicken meat and eggs.<br>3. Valorization of waste from beef and pork processing.<br>Independent study 2. Chicken waste processing by-products . Valorization of egg waste.<br>Laboratory lesson 2. Use of food industry by-products in food products | - | - | 30 | [1-7] |
| **Topic 3. Bioprocessing of beverage industry waste.**<br>1. Coffee processing. By-products and waste from coffee processing. Disposal of coffee by-products and waste.<br>2. Tea processing and production. Tea by-products and waste and their disposal.<br>Independent study 3. Fruit juice and soft drinks. Alcoholic beverages. Beer production. By-products and wastes of the brewing industry and their use. Wine production.<br>Laboratory lesson 3. Use used up coffee oil cake in technology biodegradable food packaging products | - | - | 30 | [1-7] |
| **Topic 4. By-products of fruit processing.**<br>1. Phenolic compounds as functional food.<br>2. Fruit sources of by-products.<br>3. Agro-industrial by-products.<br>Independent study 4. Fiber-rich foods. Hemicelluloses. Pectins. Value-added products from fruit processing by-products.<br>Laboratory lesson 4. Receiving extracts and zest flour citrus fruits and their use in technology food products | - | - | 30 | [1-7] |
| **Topic 5. Utilization of plant waste.**<br>1. Biogas and electricity production from plant waste.<br>2. Plant waste as biohumus .<br>3. Biofuels and biochar from plant waste.<br>4. Fish food from plant waste.<br>5. Aquaponics using plant waste.<br>6. Waste as animal feed.<br>7. Biodegradable plastic.<br>8. Plant waste as substrates in citric acid production<br>Independent study 5. Extraction of biologically active compounds from plant waste. Methods of extraction of biologically active compounds . Dietary fiber from plant waste. Resistant starch from plant waste. Activated carbon from plant waste.<br>Plant waste as substrates in citric acid production<br>Laboratory lesson 5. Study process composting food waste | - | - | 30 | [1-7] |
| **Total** | **2** | **-** | **148** | |

## 4. TEACHING AND LEARNING METHODS

| Learning outcomes by educational component | **Methods teaching** (work to be carried outteacher during classroom lessons , consultations ) | **Number ofhours** | **Methods teaching** ( which typeseducational activities has perform student independently ) | **Number of hours** |
|---|---|---|---|---|
| LOE 1. Find, systematize and critically analyze modern scientific data, regulatory documents and production practices on waste-free technologies, formulate problems and research directions. | Lectures with elements of problem-based presentation; work with scientific and technical literature and databases; discussions with analysis of articles and cases; tasks for searching and analyzing sources in electronic databases. | 10 | Independent literature search in scientific databases (Scopus, Web of Science, Google Scholar), compiling bibliographic reviews, comparative analysis of articles. | 20 |
| LOE 2. Use modern laboratory and production equipment, specialized software and research methods to analyze and optimize the processes of processing and using food products. | Laboratory classes with demonstration of equipment operation; mini-projects for studying technological processes in the laboratory; individual consultations on the methodology of experiments. | 8 | Performing laboratory tasks and experiment protocols, processing and interpreting experimental results, writing reports on laboratory work. | 16 |
| LOE 3. Develop and justify innovative technological solutions for processing by-products in production with added value, assessing their social, economic and environmental efficiency. | Project tasks for modeling production processes, individual development of mini-projects; lectures with analysis of innovative cases; consultations on the methodology of feasibility studies. | 8 | Individual project work; preparing technological schemes, searching for analogues of innovations in world practice, performing a case study with real or simulated production data. | 16 |
| LOE 4. Integrate knowledge about global trends in sustainable development, environmental requirements and innovative approaches in the field of waste-free technologies for making professional decisions. | Lectures with elements of interactive discussion, analysis of international practices, consultations on the integration of knowledge into research work. | 8 | Independent study of international strategies, preparing analytical essays, comparative analysis of the experience of different countries, developing recommendations for Ukrainian realities. | 16 |
| LOE 5. Present the results of their own research and technological developments, and communicate them in a reasoned manner both to the professional community and to a wider audience, contributing to the development of a culture of sustainable food production. | Student presentations of completed works with further discussion, seminars with public speeches, individual consultations on presentation skills. | 8 | Preparing multimedia presentations, training public speaking in small groups. | 16 |
| LOE 6. Apply the principles of the circular economy in the practical activities of food industry enterprises, in particular in the areas of recycling household products, implementing new methods of storage, preservation, and biopackaging. | Problem-oriented lectures, analysis of cases of international and Ukrainian enterprises, modeling of development strategies in laboratory classes, individual consultations on assessing economic and environmental efficiency. | 8 | Analysis of production cases (zero waste, upcycling); developing own models of waste-free production cycles, independently preparing proposals for enterprises. | 16 |

## 5. ASSESSMENT BY EDUCATIONAL COMPONENT

### 5.1. Summative assessment

#### 5.1.1. For the assessment of expected learning outcomes, the following is provided:

| № | Methods of summative assessment | Points / Weight in the overall score | Date of compilation |
|---|---|---|---|
| 1 | Performance and defense of lab (5 Lab of 5 points) | *25 points / 25%* | Within a week after the LR |
| 2 | Module 1 - multiple choice test | *25 points / 25%* | According to the approved schedule |
| 3 | Independent work within module 1, completion of an individual task | *15 points / 15%* | By the end of module 1 according to the approved schedule |
| 4 | Module 2 - multiple choice test | *25 points / 25%* | According to the approved schedule |
| 5 | Independent work within module 2, completion of an individual task | *10 points / 10%* | By the end of module 2 according to the approved schedule |

#### 5.1.2. Evaluation criteria

| **Component** | **Unsatisfactorily** | **Satisfactorily** | **Good** | **Exellent** |
|---|---|---|---|---|
| 1. Performance and defense of lab | *0 points* | *1-2 points* | *3-4 points* | *5 points* |
| | Laboratory work not completed. | Laboratory work tasks partially completed, no conclusions and personal recommendations. | Laboratory work tasks fully completed, no conclusions and personal recommendations. | Laboratory work tasks fully completed and comprehensive answers provided, conclusions and personal recommendations made. |
| 2. Module 1 - multiple choice test | The test includes 25 questions, each of which is worth 1 point | | | |
| 3. Independent work within module 1, individual task | *<5 points* | *5-9 points* | *10-14 points* | *15 points* |
| | Independent work is performed at a very low level, there is no scientific justification for the tasks and recommendations on the problem under consideration | Independent work is performed at a satisfactory level, there is no scientific justification for the tasks, no personal recommendations are provided on the problem under consideration | Independent work is performed at a sufficient level, the tasks are partially justified, brief personal recommendations are provided on the problem under consideration | Independent work is performed at a professional level, the tasks are scientifically justified, a personal vision and recommendations are provided on the problem under consideration |
| 4. Module 2 - multiple choice test | The test includes 25 questions, each of which is worth 1 point | | | |
| 5. Independent work within module 1, individual task | *<4 points* | *4-6 points* | *7-9 points* | *10 points* |
| | Independent work is performed at a very low level, there is no scientific justification for the tasks and recommendations on the problem under consideration | Independent work is performed at a satisfactory level, there is no scientific justification for the tasks, no personal recommendations are provided on the problem under consideration | Independent work is performed at a sufficient level, the tasks are partially justified, brief personal recommendations are provided on the problem under consideration | Independent work is performed at a professional level, the tasks are scientifically justified, a personal vision and recommendations are provided on the problem under consideration |

### 5.2. Formative assessment:

To assess current progress in learning and understand areas for further improvement

| № | Elements of formative assessment | Date |
|---|---|---|
| 1. | Oral survey after completing lab | Within a week after the Lab |
| 2. | Feedback in the form of a discussion of testing within the modules | According to the approved schedule |
| 3. | Feedback in the form of a discussion of the completed individual task | Until the end of module 2 according to the approved schedule |

## 6. EDUCATIONAL RESOURCE (LITERATURE)

### 6.1. Basic sources

1. Cecchi F., De Carolis M. Biobased Products from Food Sector Waste: Bioplastics, Biocomposites, and Biocascading. – 1st ed. – Cham: Springer, 2021. – 245 p. – ISBN 978-3-030-xxxxx-x.

2. Kumar Garg V., Kataria N. (Eds.) Bioeconomy for Sustainability. – Singapore: Springer, 2024. – 412 p. – ISBN 978-981-99-xxxxx-x.

3. Rahman M. et al. Transforming plant-based waste and by-products into valuable products using various “Food Industry 4.0” enabling technologies: A literature review // Science of the Total Environment. – 2024. – Vol. 923. – Art. 172373. – DOI: 10.1016/j.scitotenv.2024.172373.

4. Ali A., Yusof N., Zulkifli R. et al. A comprehensive review of food waste valorization for the sustainable management of global food waste // RSC Sustainable Food Technology. – 2024. – Vol. 4. – P. 1335–1355. – DOI: 10.1039/D3FB00156C.

5. Chaudhary A., Singh P., Verma S. et al. Valorization of food waste: A comprehensive review of individual technologies for producing bio-based products // Journal of Environmental Management. – 2024. – Vol. 356. – Art. 120239. – DOI: 10.1016/j.jenvman.2024.120239.

6. Gupta S., Prakash A., Singh R. et al. Sustainability in food-waste reduction biotechnology: a critical review // Bioresource Technology. – 2022. – Vol. 360. – Art. 127602. – DOI: 10.1016/j.biortech.2022.127602.

7. Zhang H., Li Y., Wang J. et al. A sustainable waste-to-protein system to maximise waste resource utilisation for developing food- and feed-grade protein solutions // arXiv preprint. – 2022. – arXiv:2208.07703. – URL: https://arxiv.org/abs/2208.07703.

### 6.2. Information resources

8. Food Waste and Byproducts: An Opportunity to Minimize Malnutrition and Hunger in Developing Countries [Electronic resource] / Access mode: https://www.frontiersin.org/articles/10.3389/fsufs.2018.00052/full

9. Review: Food Industry By-Products used as a Functional Food Ingredients [Electronic resource] / Access mode: https://www.longdom.org/open-access/review-food-industry-byproducts-used-as-a-functional-food-ingredients-2252-5211-1000248.pdf

10. Agro -Food Byproducts as a New Source of Natural Food Additives [Electronic resource] / Access mode: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6471601/

11. Utilization of food processing by-products [Electronic resource] / Access mode: https://www.hilarispublisher.com/proceedings/utilization-of-food-processing-byproducts-8455.html

12. Valorization of Food Processing By-Products [ Electronic resource ] / Mode Access : https://www.semanticscholar.org/paper/Valorization-of-Food-Processing-By-Products-Chandrasekaran/f936da50bcdf015a83201e398faabc6f2db857ea

13. Food Byproducts as Sustainable Ingredients for Innovative and Healthy Dairy Foods [Electronic resource] / Access mode: https://pubmed.ncbi.nlm.nih.gov/30249001/