

Description of the discipline
"Technology of storage and processing of crop products"

The discipline is studied in the final year of the Bachelor's degree program for specialists in agricultural science, after students have already learned the agronomy of growing various cereal, legume, groat, oilseed, technical, vegetable, and fruit crops. The program includes technology for post-harvest processing, storage, and primary processing of various types of cereal, groat, and legume crops for different purposes, as well as fruits, vegetables, potatoes, berries, and technical crops (such as sugar beets, flax, hops, and essential oils). The course curriculum covers the study of crop storability and its ability to produce certain processed products under favorable growing conditions and under deviations, as well as how protective factors and agrochemicals affect the quality of fresh or processed products. The basics of drying, cooling, chemical preservation, and storage of grain and other types of products are also covered. The course also examines the impact of growing and post-harvest processing factors on the storability of potatoes and vegetables, the theoretical foundations of long-term storage, and the basics of primary processing of agricultural products.

Area of knowledge, specialty, academic programme, academic degree		
Academic degree	<i>Bachelor's</i>	
Specialty	<i>201 Agronomy</i>	
Academic programme	<i>Agronomy</i>	
Characteristics of the discipline		
Type	Compulsory	
Total number of hours	150	
Number of ECTS credits	5	
Number of modules	4	
Course project (work) (if any)	–	
Form of assessment	<i>Exam</i>	
Indicators of the discipline for full-time and part-time forms of university study		
	University study	
	Full-time	Part-time
Year of study	4	
Term	7	
Lectures	60 hr.	hr.
Practical classes and seminars	– hr.	hr.
Laboratory classes	60 hr.	hr.
Self-study	30 hr.	hr.
Number of hours per week for full-time students	8 hr.	

1. Aim, competences and expected learning outcomes of the discipline

Aim: formation of specialists with knowledge of the complete process of crop production, which does not end with harvesting but requires continuation - post-harvest processing, storage, and processing technologies. In the case of seasonal production, only high-quality preservation and processing of the products ensure year-round food for humans, feed for livestock, and raw materials for the processing industry.

Competences acquired:

Integral competence (IC): The ability to solve complex specialized tasks and practical problems in agronomy, which involves the application of theories and methods of the relevant science and is characterized by complexity and compliance with zonal conditions.

General competencies (GC): GC 6. Knowledge and understanding of the subject area and professional activity; GC 7. Ability to apply knowledge in practical situations; GC 8. Skills for performing safe activities.

Special (professional) competences (SC): SC 2. The ability to cultivate, propagate, and manage agricultural crops, and carry out technological operations for primary processing and storage of products; SC 4. the ability to apply knowledge and understanding of physiological processes of agricultural plants to solve production and technological tasks; SC 9. the ability to manage complex actions or projects, with responsibility for making decisions in specific production conditions.

Expected learning outcomes (ELO): ELO 4. Compare and evaluate modern scientific and technical achievements in the field of agronomy; ELO 11. Initiate timely and appropriate solutions to production problems in accordance with zonal conditions; ELO 15. Plan economically viable production of agricultural products.

2. Programme and structure of the discipline

Modules and topics	Number of hours													
	full-time							part-time						
	weeks	total	including					total	including					
			1	p	lab	ind	s.st.		1	p	lab	ind	s.st.	
2	3	4	5	6	7	8	9	10	11	12	13	14		
Module 1. The tasks of the crop production preservation and processing industry														
Topic 1. The significance of the storage and processing of agricultural products.	1	10	4	–	4	–	2							
Topic 2. Grain mass as an object of post-harvest processing and storage.	2	10	4	–	4	–	2							
Topic 3. Physical and physiological properties of grain masses. Self-heating of grain masses.	3	12	4	–	4	–	4							
Total for module 1		32	12	–	12	–	8							
Module 2. Post-harvest treatment, storage, and processing of grain (seeds)														
Topic 1. Post-harvest	4	10	4	–	4	–	2							

processing of grain crops.														
Topic 2. Active ventilation of grain crops. Grain drying, regimes and methods of drying.	5	10	4	–	4	–	2							
Topic 3. General principles of preserving plant raw materials.	6	10	4	–	4	–	2							
Topic 4. Basics of grain processing for flour and bread baking.	7	10	4	–	4	–	2							
Topic 5. Basics of processing of cereal and oilseed crops.	8	10	4	–	4	–	2							
Total for module 2	50		20	–	20		10							
Module 3. <i>Post-harvest processing, storage and processing of fruit and vegetable products</i>														
Topic 1. Post-harvest treatment and storage of vegetable crops.	9	10	4	–	4	–	2							
Topic 2. Post-harvest treatment and storage of potato tubers.	10	10	4	–	4	–	2							
Topic 3. Specifics of post-harvest treatment and storage of fruit and berry products.	11	10	4	–	4	–	2							
Topic 4. Basics of processing fruit and vegetable products.	12	10	4	–	4	–	2							
Total for module 3	40		16	–	16		8							
Module 4. <i>Post-harvest processing, storage and processing of technical crops raw materials and feed production</i>														
Topic 1. Basics of post-harvest processing, storage, and processing of technical raw materials.	13	9	4	–	4	–	1							
Topic 2. Basics of technology for the production and storage of mixed feeds and plant-based feed.	14	9	4	–	4	–	1							
Topic 3. Basics of post-harvest processing, storage, and processing of sugar beet	15	10	4	–	4	–	2							
Total for module 4	28		12	–	12	–	4							
Total hours	150		60	–	60	–	30							
Course project (work) on _____ (if included in the curriculum)	–		–	–	–	–	–							
Total hours	150		60	–	60	–	30							

3. Topics of lectures

No	Topic	Hours
1	The significance of the storage and processing of agricultural products.	4
2	Grain mass as an object of post-harvest processing and	4

	storage.	
3	Physical and physiological properties of grain masses. Self-heating of grain masses.	4
4	Post-harvest processing of grain crops.	4
5	Active ventilation of grain crops. Grain drying, regimes and methods of drying.	4
6	General principles of preserving plant raw materials.	4
7	Basics of grain processing for flour and bread baking.	4
8	Basics of processing of cereal and oilseed crops.	4
9	Post-harvest treatment and storage of vegetable crops.	4
10	Post-harvest treatment and storage of potato tubers.	4
11	Specifics of post-harvest treatment and storage of fruit and berry products.	4
12	Basics of processing fruit and vegetable products.	4
13	Basics of post-harvest processing, storage, and processing of technical raw materials.	4
14	Basics of technology for the production and storage of mixed feeds and plant-based feed.	4
15	Basics of post-harvest processing, storage, and processing of sugar beet	4
	Total	60

4. Topic of laboratory (practical, seminars) classes

№	Topic	Hours
1	Selection of spot samples, preparation of composite and daily samples	2
2	Organoleptic (sensory) evaluation of grain	2
3	Determination of grain infestation by granary pests and damage by the corn bug	4
4	Determination of grain test weight	2
5	Determination of grain moisture content	2
6	Determination of impurities in grain (seeds)	2
7	Identification of types and subtypes of cereal crops	2
8	Determination of quantity and quality of crude gluten in wheat grain	2
9	Determination of autolytic activity of grain and flour by Hagberg Falling Number	4
10	Active ventilation of grain masses.	2
11	Technological calculations for grain and seed cleaning	2
12	Technological calculations for grain and seed drying	2
13	Sale of grain.	2
14	Quantitative and qualitative accounting of grain	2
15	Dislocation grains in the granary at the storage	2

16	Estimation quality of the groats grain	4
17	Determination output and quality of the wheat flour	2
18	Evaluation of flour quality by laboratory test baking	4
19	Determination of potato quality	2
20	Storage of potatoes and vegetables in temporary (field) storage facilities	2
21	Organization of fruit and vegetable storage	4
22	Production of the pickle cabbage	4
23	Evaluation of the quality of sugar beets for technical purposes	4
	Total	60

5. Topics of self-study

No	Topic	Hours
1	Working with standards, studying quality indicators normalization.	2
2	Microorganisms and pests of grain reserves. Their role in grain and seed storage. Preparation for laboratory classes in the workshop.	2
3	Respiration of grain masses. Preparation for laboratory classes in the workshop.	2
4	Familiarization with normalization of grain impurities. Preparation for laboratory classes in the workshop.	2
5	Technological properties of special post-harvest processing lines. Preparation for laboratory classes in the workshop.	2
6	Characteristics of storage facilities for storage of grain of different crops.	2
7	Features of drying legume and technical crops. Preparation for laboratory classes in the workshop.	2
8	Dependence of flour quality on the influence of entomo- and phytopathological factors on grain. Preparation for laboratory classes in the workshop.	2
9	Main quality indicators of oil and oilseed crops. Preparation for laboratory classes in the workshop.	2
10	Impact of cultivation factors on the quality and storability of tubers. Features of storage of carrot, beet, and other root crops. Preparation for laboratory classes in the workshop.	2
11	New and environmentally friendly schemes for processing fruit and vegetable products. Preparation for laboratory classes in the workshop.	2
12	Features of storage of different types of fruit and berry products. Preparation for laboratory classes in the workshop.	2
13	Fundamentals of post-harvest processing, storage, and	2

	processing of raw materials of the technical crops. Preparation for laboratory classes in the workshop.	
14	Fundamentals of post-harvest processing and storage of feed.	2
15	Fundamentals of post-harvest processing, storage, and processing of sugar beets	2
	Total	30

**6. Methods of assessing expected learning outcomes:
(select necessary or add)**

- oral or written survey;
- interview;
- test;
- defending laboratory/practical, design/graphical works, projects;
- peer-to-peer assessment, self-assessment.

7. Teaching methods (select necessary or add):

- problem-based method;
- practice oriented studying method;
- case method;
- project education method;
- flipped classroom, mixed education method;
- research based method;
- learning discussions and debates method;
- team work, brainstorm method.

8. Results assessment.

The student's knowledge is assessed by means of a 100-point scale converted into the national grades according to the "Exam and Credit Regulations at NULES of Ukraine" in force

8.1 Distribution of points by types of educational activities

Educational activity	Results	Assessment
Module 1. The tasks of the crop production preservation and processing industry		
Lab. 1. Selection of spot samples, preparation of composite and daily samples	To master the techniques and acquire practical skills in taking spot samples and forming average and daily average samples from different batches of grain.	8
Lab. 2. Organoleptic (sensory) evaluation of grain	Acquisition of practical skills in determining organoleptic indicators of grain quality.	8
Lab. 3. Determination of grain infestation by granary pests and damage by the corn bug	Acquisition of practical skills in determining grain infestation by barn pests and damage by the corn bug.	8
Lab. 4. Determination grain-unit of grain.	Mastering the methodology and acquiring practical skills in determining the grain-unit of grain.	8

Lab. 5. Determination of grain moisture content	Mastering the methodology and acquiring practical skills for determining grain (seed) moisture content	8
Lab. 6. Determination of impurities in grain (seeds)	Mastering the methodology and acquiring practical skills for determining the content of impurities in grain (seeds).	8
S. st. 1. Microorganisms and pests of grain reserves. Their role in grain and seed storage.	Familiarization with the main pests that damage grain during storage, their development cycle, conditions that affect their vital activity and methods of control.	22
Module control work 1	Know and understand the importance of the field of storage and processing of plant products for modern economic conditions. Compare and evaluate modern scientific and technical achievements in the field of storage and processing of plant products.	30
Total for module 1		100
Module 2. Post-harvest handling, storage and processing of grain (seeds)		
Lab. 7. Identification of types and subtypes of cereal crops	Know and apply methods for determining types and subtypes of grain crops.	8
Lab. 8. Determination of quantity and quality of crude gluten in wheat grain	Know and apply methods for determining the quantity and quality of raw gluten in wheat grain.	8
Lab. 9. Determination of autolytic activity of grain and flour by Hagberg Falling Number	Know and apply methods for determining the autolytic activity of grain and flour by the falling number on the Hagberg-Perten device.	8
Lab. 10. Active ventilation of grain masses.	Know the methods of performing calculations for ventilation of grain and seeds.	10
Lab. 11. Technological calculations for grain and seed cleaning	Know the methods of performing calculations for cleaning grain and seeds.	10
Lab. 12. Technological calculations for grain and seed drying	Know the methods of performing calculations for drying grain and seeds.	10
S. st. 2. Characteristics of storage facilities for storage of grain of different crops.	Know the types of granaries that exist in Ukraine and the requirements for their arrangement. Features of grain storage in granaries of different types.	16
Module control work 2	Plan economically advantageous technologies for post-harvest processing, storage and processing of grain (seeds). Know and recommend technologies for post-	30

	harvest processing, storage and processing of grain (seeds). Initiate prompt and appropriate solutions to production problems regarding post-harvest processing, storage and processing of grain (seeds) in accordance with zonal conditions.	
Total for module 2		100
Module 3. Post-harvest handling, storage and processing of fruit and vegetable products		
Lab. 13. Sale of grain.	Be able to make calculations for grain depending on its quality.	15
Lab. 14. Quantitative and qualitative accounting of grain	Be able to conduct quantitative and qualitative accounting of grain during post-harvest processing and storage of grain (seeds).	15
Lab. 15. Dislocation grains in the granary at the storage	Be able to calculate the capacity and number of storages when storing grain (seeds).	8
Lab. 16. Estimation quality of the groats grain	Mastering the methodology and acquiring practical skills in assessing the quality of cereal grain.	8
Lab. 17. Determination output and quality of the wheat flour	Mastering the methodology and acquiring practical skills in assessing the quality of flour.	8
S. st. 3. Impact of cultivation factors on the quality and storability of potatoe tubers. Features of storage of carrot, beet, and other root crops	Impact of cultivation factors on the quality and storability of potatoe tubers. Features of storage of carrot, beet, and other root crops Know how cultivation factors affect the quality of vegetables. Get acquainted with the features of storing carrots, beets and other root crops	16
Module control work 3	Plan economically advantageous technologies for post-harvest handling, storage and processing of fruit and vegetable products. Know and recommend technologies for post-harvest handling, storage and processing of fruit and vegetable products. Initiate prompt and appropriate solutions to production problems regarding post-harvest handling, storage and processing of fruit and vegetable products in accordance with zonal conditions.	30
Total for module 3		100
Module 4. Post-harvest handling, storage and processing of technical crops raw materials and feed production		
Lab. 18. Evaluation of flour quality by laboratory test baking	Mastering the methodology and acquiring practical skills in assessing the quality of flour using the laboratory test baking method.	8

Lab. 19. Determination of potato quality	Mastering the methodology and acquiring practical skills for determining the quality of potato tubers.	8
Lab. 20. Storage of potatoes and vegetables in temporary (field) storage facilities	Be able to calculate the number and capacity of storage facilities for storing potato tubers and vegetables in temporary (field) storage facilities.	8
Lab. 21. Organization of fruit and vegetable storage	Be able to calculate the storage of fruits and vegetables in stationary storage facilities.	8
Lab. 22. Production of the pickle cabbage	Mastering the methodology and acquiring practical skills for making pickle cabbage.	8
Lab. 23. Evaluation of the quality of sugar beets for technical purposes	Mastering the methodology and acquiring practical skills for assessing the quality of sugar beets for technical purposes.	8
S. st. 4. Bases of post-harvest handling, storage and processing of sugar beets	To get acquainted with the main raw materials for sugar production. To know the technology of sugar production from sugar beets	30
Module control work 4	Plan economically advantageous technologies for post-harvest processing, storage and processing of raw materials of industrial crops and the production of compound feed. Know and recommend technologies for post-harvest processing, storage and processing of raw materials of industrial crops and the production of compound feed. Initiate prompt and appropriate solutions to production problems on issues of post-harvest processing, storage and processing of raw materials of industrial crops and the production of compound feed in accordance with zonal conditions.	30
Total for module 4		100
Class work		$(M1 + M2)/2 * 0,7 \leq 70$
Exam/credit		30
Total for year		Coursework + exam ≤ 100
Course project/work (if any)		100

8.2. Scale for assessing student's knowledge

Student's rating, points	National grading
90-100	excellent
74-89	good
60-73	satisfactory
0-59	unsatisfactory

8.3. Assessment Policy

Deadlines and exam retaking rules	<i>EXAMPLE:</i> works that are submitted late without valid reasons will be assessed with a lower grade. Module tests may be retaken with the permission of the lecturer if there are valid reasons (e.g. a sick leave).
Academic integrity rules	<i>EXAMPLE:</i> cheating during tests and exams is prohibited (including using mobile devices). Term papers and essays must have correct references to the literature used
Attendance rules	<i>EXAMPLE:</i> Attendance is compulsory. For good reasons (e.g. illness, international internship), training can take place individually (online by the faculty dean's consent)

9. Teaching and learning aids:

- e-learning course of the discipline (<https://elearn.nubip.edu.ua/course/view.php?id=2742>);
- Gunko S.M. Workbook to the subject: "Technology of storage and processing of crop production" for the students' Training direction "Agronomy". «Centre of information technologies». 2024. 72 p.
- Gunko S.M. Handbook to the subject: "Technology of storage and processing of crop production" for the students' Training direction "Agronomy". «Centre of information technologies». 2024. 81 p.
- Gunko S.M., Podpriatov G.I. Handbook "Technology of grain storage". K.: «Centre of information technologies». 2009. 221 p.
- references to digital educational resources;
- textbooks, manuals, tutorials;
- guidelines for studying a discipline by full-time and part-time students.

10. Recommended sources of information

1. Подпратов Г.І., Бобер А.В. Переробка продукції рослинництва: Навчальний посібник. К.: ЦП «Компринт», 2017. 524 с.
2. Подпратов Г.І., Бобер А.В. Післязбиральна доробка та зберігання продукції рослинництва. Навчальний посібник. К.: Редакційно-видавничий відділ НУБіП України, 2019. 492 с.
3. Подпратов Г.І., Бобер А.В., Ящук Н.О. Технохімічний контроль продукції рослинництва. Підручник. К.: ЦП «Компринт», 2022. 790 с.

5. Подпратов Г.І., Бобер А. В., Гунько С.М. Переробка продукції рослинництва: Навчальний посібник. К. : НУБіП України, 2023. 580 с.

6. Jian F., Jayas D. S. Grains: Engineering fundamentals of drying and storage. CRC Press, 2021. 502 p.

7. Smith D. S. (Ed.). Processing vegetables: science and technology. Taylor & Francis, 2023. 417 p.

Information resources

<https://agrovektor.com/ua/art/1116-aktivne-ventilyuvannya-zerna-zaporuka-zberezhennya-vrozhayu.html>

<https://agroexpert.ua/vidpovidnist-obladnannia-dlia-zberihannia-zerna-vymoham-standartiv/>

<https://agroelita.info/scho-take-suchasnyj-zernovyj-elevator/>

<http://agronomy.com.ua/statti/515-suchasni-tekhnologii-sushinnia-zerna.html>

<https://agrosep mash.ua/uk/yak-vidbuvayetsya-ochishhennya-zernovix-etapi-ta-obladnannya/>

<http://agro-business.com.ua/agro/mekhanizatsiia-apk/item/8931-suchasni-zernoochysni-mashyny.html>

<https://ravaro.com.ua/products-ua/zernosusharki-potochni>

<http://www.eridon-tech.com.ua/sukup-mixed-flow-dryers/>

<http://agro-business.com.ua/agro/zberihannia/item/8235-umovy-zberihannia-fruktiv-ta-ovochiv-u-skhovyshchakh.html>

https://elib.lntu.edu.ua/sites/default/files/elib_upload/%D0%95%D0%9F%D0%94%D1%96%D0%B4%D1%83%D1%85/part15.html

<http://www.agromage.com/vegetable.php>

<http://agro-business.com.ua/agro/mekhanizatsiia-apk/item/8932-pisliazbyralna-obrobka-nasinnia.html>