



COURSE SYLLABUS

General information

Course title:	RAW MATERIALS AND BY-PRODUCTS IN THE BREWING INDUSTRY
ISVU course code:	266811
Course instructor:	
Course assistant:	
Study programme and specialization in which the course is taught:	Food processing technology
ECTS credits:	5.0
Semester of the course execution:	IV
Exam prerequisites:	-
Course objectives:	The aim of the course is to acquaint students with raw materials used in the brewing industry, their characteristics, methods of obtaining, cultivation, processing and production. Students will learn about the by-products that arise during the production of beer and malt and the places in the technological process where they appear. In addition, they will learn all the ways in which the resulting by-products can be processed and used.

Course structure

Teaching mode	Number of contact hours per semester:	Student's requirements per teaching mode
Lectures:	30	80%
Exercises (auditory, linguistics):		
Exercises (laboratory, practical):	26	100%
Field work:	4	100%
Other:		
TOTAL:	60	

Monitoring of students' work and knowledge evaluation during the course

OUTCOMES		Colloquium 1	Colloquium 2	Seminar work	Total	Pass	Time frame for the recognition of the outcome
Outcome 1	Explain the importance of water quality in beer production	12%			12%	6%	By the end of the academic year
Outcome 2	Define the physical, chemical and biochemical characteristics of barley	12%			12%	6%	By the end of the academic year
Outcome 3	Describe the role, importance and varieties of hops and their physical and chemical characteristics	12%			12%	6%	By the end of the academic year
Outcome 4	Name the varieties of brewer's yeast, describe their		12%		12%	6%	By the end of the academic year



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	characteristics and application						
Outcome 5	Explain the formation and processing of by-products in malt production.		12%		12%	6%	By the end of the academic year
Outcome 6	Describe the by-products that arise during the production of wort, finishing and bottling of beer.		12%		12%	6%	By the end of the academic year
Outcome 7	Choose an efficient way of using the by-products of beer and malt production			28%	28%	14%	By the end of the academic year
Total % grade points		36	36	28	100	50	
Share in ECTS		1,8	1,8	1,4	5,0		

Knowledge evaluation on exams

Exam prerequisites					
OUTCOMES		Written exam	Oral exam	Total	Pass
Outcome 1	Explain the importance of water quality in beer production	12%		12%	6%
Outcome 2	Define the physical, chemical and biochemical characteristics of barley	12%		12%	6%
Outcome 3	Describe the role, importance and varieties of hops and their physical and chemical characteristics	12%		12%	6%
Outcome 4	Name the varieties of brewer's yeast, describe their characteristics and application	12%		12%	6%
Outcome 5	Explain the formation and processing of by-products in malt production.	12%		12%	6%
Outcome 6	Describe the by-products that arise during the production of wort, finishing and bottling of beer.	12%		12%	6%
Outcome 7	Choose an efficient way of using the by-products of beer and malt production		28%	28%	14%
Total % of grade points		72	28	100	50
Share in ECTS		3,6	1,4	5,0	

Review of units per week with associated learning outcomes

Week	Lecture course content and learning outcomes:	Outcome	Exercises course content and learning outcomes:	Outcome
1.	The importance of water as a raw material in the production of malt and beer, water consumption in the brewery, water supply, drinking water requirements	I1	Physico-chemical analysis of water. - laboratory exercises	I1
2.	Water quality parameters, water hardness, ions present in water	I1	Determination of permanent and transient water hardness, determination of the most frequently	I1



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			present ions in water - laboratory exercises	
3.	Water treatment methods	I1	Preparation of water for beer production - laboratory exercises	I1
4.	Basics of the production process of processing barley into malt.	I2	Manual, mechanical and physicochemical assessment of the quality of malt and wort - laboratory exercises	I2
5.	Unmalted raw materials, high-fructose syrup, barley malt extract	I2	Physico-chemical characteristics of unmalted raw materials - laboratory exercises	I2
6.	Hops, the discovery of the wort hop process, the law on the purity of beer, a brief overview of the development of hops	I3	Getting to know the hop plant - laboratory exercises	I3
7.	The goal of growing hops - the role and importance of hops in the production of beer, storage of hops in the brewery	I3	Getting to know the conditions of storage and preservation of hops in the brewery - laboratory exercises	I3
8.	Chemical compounds in hops	I3	Demonstration and determination of hop oils and alpha-acids - laboratory exercises	I3
9.	Basics about yeasts used in the brewing industry	I4	Selection, isolation and microscopy of yeasts - laboratory exercises	I4
10.	Grain waste, raft - floating grains, malt sprouts, silo waste	I5, I7	Identification and determination of the proportion of waste in the production of malt - laboratory exercises	I5, I7
11.	Average chemical composition of brewer's spent grains, processing of brewer's spent grains	I6, I7	Determining the chemical composition of beer trop - laboratory exercises	I6, I7
12.	Average chemical composition of brewer's yeast, reception and processing of yeast from fermenters	I6, I7	Brewer's spent yeast processing from maturation tanks - laboratory exercises	I6, I7
13.	Amount of CO ₂ produced, physical and chemical properties of CO ₂ , flow rate, emptying of tanks using CO ₂	I6, I7	Monitoring the formation of CO ₂ during beer fermentation. - laboratory exercises	I6, I7
14.	Wastewater load, wastewater for sewage and treatment	I6, I7	Field lesson - visit to a craft brewery	I1-7
15.	Bottles, caps, labels, glue, detergents, used hops	I6, I7	Field lesson - visit to an industrial brewery	I1-7

References (compulsory / additional)

Compulsory:

1. Kunze, W., Technology Brewing and Malting, VLB Berlin, 6. izd., Njemačka, 2019.
2. Briggs, D. E., Malts and Malting, Blackie Academic & Professional, Velika Britanija, 1998.
3. Palmer, J.J., Water: A Comprehensive Guide for Brewers, Brewers Publications, SAD, 2013.
4. Hieronymus, S., For The Love of Hops: The Practical Guide to Aroma, Bitterness and the Culture of Hops, Brewers Publications, SAD, 2012.
5. White, C., Yeast: The Practical Guide to Beer Fermentation, Brewers Publications, SAD, 2010.
6. Šubarić, D., Jozinović, A., Panjičko, M. (urednici): Neke mogućnosti iskorištenja nusproizvoda prehrambene industrije, Knjiga 4., Prehrambeno-tehnološki fakultet Osijek, Hrvatska, 2022. (Poglavljja 8 i 10)