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| **Department**  | **Food Technology** |
| **College**  | **Agriculture** |
| **University** | **Salahaddin– Erbil** |
| **Subject** | **Industrial Fermentation****(Theory Part)** |
| **Course Book** | **3rd Class Students** |
| **Lecturer's name** | **Dr. Khalid E. Aziz**  |
| **Academic Year** | **2022 – 2023** |

**Course Book**

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| 1. Course name | Industrial Fermentation |
| 2. Lecturer in charge | **Assist. Lecturer Khalid E. Aziz**  |
| 3. Department/ College | **Food Technology, Agriculture** |
| 4. Contact | **e-mail: Khalid\_esmahel@yahoo.com****Tel: (07504720153)** |
| 5. Time (in hours) per week  | **Theory: 2 hours****Practical: 6 hours**  |
| 6. Office hours | **10 hours per week** |
| 7. Course code |  |
| 8. Teacher's academic profilePersonal InformationName: Aziz, Khalid |E.Title(Positions): Ph.D. degree in Food MicrobiologyPrimary Department: Food TechnologyCurrent Academic Rank: LecturerPeriod in Current Academic Rank: 4 yearsGender: MalePrevious Academic Position: Department of Food Technology, College of Agriculture, Salahaddin University – Erbil, Demonstrator, 18 years.Primary Academic/Practice Discipline: Department of Food Technology, College of Agriculture, Salahaddin University – Erbil, Lecturer, 5 years.Degrees and Other CredentialsDegrees Awarded

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| **No** | **Degree** | **Institution** | **Year** |
| **1** | B.Sc in Biology Science | Department of Biology, College of Science, Salahaddin University, in Erbil, Iraq | 1998 |
| **2** | Master in Food Microbiology | Department of Biology, College of Science, University of Al-Mustansryaih, in Baghdad, Iraq | 2006 |
| **3** | Doctorate in Food Microbiology | Department of Biology, College of Science, University of Al-Mustansryaih, in Baghdad, Iraq | 2015 |
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Employment History

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| **No.** | **Employments** | **Year – Year** |
| **1** | Date of first employment: Demonstrator. Animal Resources Dept., Agriculture College, Salahaddin University – Erbil, Iraq. | 1998 |
| **2** | Became a Lecturer | 2012 |
| **3** | Member in the Examination Committee of the College of Agriculture. | 2010-2015 |
| **4** | Member in Quality insurance committee of Biology Dept. | 2015-2016 |
| **5** | In charge of higher education and scientific research programme  | 2015-2016 |
| **6** | Member of law at the college of Agriculture  | 2015-2016 |

Prior Academic Experience

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| **No** | **Institution** | **City, Country** | **Position/Title** | **Year – Year** |
| **1** | College of Agriculture/ Salahaddin University | Erbil, Iraq | Lecturer | 2005-2016 |

Research, Scholarly, Professional and Scientific Activity1. Khalid Ismael,Zeerak F.Ahmed,Hero M.Ismael. Hamad. (2008).Assessment of Antifungal Bioactivity of calendula officinalis plant extract.Zanco, journal of pure and applied sciences/Salahaddin university-Hawler…..Vol.20 No.4
2. Khalid Ismael. (2012).Study the effect of local honey on the growth of pathogenic bacteria. *International Journal of Enhanced Research in Science Technology and Engineering, 3 (7):392-399, Impact Factor: 1.252*
3. Khalid E.Aziz, Zirak F.A. Abdulraman and Rajwa Hassen Essa. (2015).Microbiological and Molecular study of Lactococcus lactis subsp,Lactis Isolated from Cow milk. *Zanko Journal of Pure and Applied Science,* 3 (2): 89-99.
4. Khalid E.Aziz, Zirak F.A.AbdulramanandRajwa Hassen Essa. (2015).Antibiotic resistance pattern and effect of some growth condition on Lactococcus Lactis subsp,Lactis Isolated from cow milk.International journal of current microbiology and applied sciences Issn:2319-7706 volume 4number 6 (2015)pp.388-405.
 |
| 9. Keywords |  |
| 10. Course overview is the conversion of [carbohydrates](https://en.wikipedia.org/wiki/Carbohydrate) to [alcohols](https://en.wikipedia.org/wiki/Alcohol) and [carbon dioxide](https://en.wikipedia.org/wiki/Carbon_dioxide) or organic acids using [yeasts](https://en.wikipedia.org/wiki/Yeast), [bacteria](https://en.wikipedia.org/wiki/Bacteria), or a combination thereof, under [anaerobic](https://en.wiktionary.org/wiki/anaerobic) conditions. Fermentation usually implies that thThe term "fermentation" is sometimes used to specifically refer to the chemical conversion of sugars into ethanol, a process which is used to produce alcoholic beverages such as wine, beer, and cider. Fermentation is also employed in the leavening of bread (CO2 produced by yeast activity); in preservation techniques to produce lactic acid in sour foods such as sauerkraut, dry sausages, kimchi, and yogurt; and in pickling of foods with vinegar (acetic acid). Natural fermentation precedes human history. Since ancient times, however, humans have been controlling the fermentation process. The earliest evidence of an alcoholic beverage, made from fruit, rice, and honey, dates from 7000–6600 BC, in the Neolithic Chinese village of Jiahu. and winemaking dates from 6000 BC, in Georgia, in the Caucasus area. Seven-thousand-year-old jars containing the remains of wine, now on display at the University of Pennsylvania, were excavated in the Zagros Mountains in Iran. |
| 11. Course objectiveThe primary benefit of fermentation is the conversion of sugars and other carbohydrates into preservative organic acids, e.g. converting juice into wine, grains into beer, carbohydrates into carbon dioxide to leaven bread, and sugars in vegetables. Food fermentation has been said to serve five main purposes. Enrichment of the diet through development of a diversity of flavors, aromas, and textures in food substrates. Preservation of substantial amounts of food through lactic acid, alcohol, acetic acid, and alkaline fermentations. Biological enrichment of food substrates with protein, essential amino acids, and vitamins.  |
| 12. Student's obligationAt the end of the course, the student should be able to conduct two exams.  |
| 13. Forms of teachingTeaching method used in lectures1. Data show and power point
2. White board
3. Black Board
4. Paper of lectures
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| 14. Assessment schemeExamination and Marking1. Average of the course: 20% marks Theory.
2. Final exam marks: 40%
3. Total: 60%‌
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| 15. Student learning outcomeThe objective of this course is to provide an understanding for the graduate business student on idusterial fermentation concepts Shown here are the general learning goals of the program broken down into specific student learning outcomes (SLOs). These SLOs represent what a student should be able to do as a result of successfully completing this program. Student performances on these outcomes are routinely assessed by program faculty as a way of informing programmatic improvement efforts.

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| Goal | Outcome |
|  Students will synthesize knowledge of key scientific principles of fermentation across various applications. Students will show adaptability and skill in effective communication to both a scientific/academic audience as well as within a professional/production environment. Advanced practical skills on molecular techniques to study microbial genetics. Advanced practical skills on immunological and serological techniques. Advances in the understanding of microbiology and of the composition of foods and their raw materials (e.g. cereals, milk), as well as the development of tools such as artificial refrigeration and the steam engine, allowed more consistent processing, while simultaneously vastly expanding the hinterland for each production facility. The advances in microbiology spawned starter cultures,such that the fermentation was able to pursue a predictable course and no longer one at the whim or fancy of indigenous and adventitious microflora. | * 1.1 Students identify main biological and chemical inputs and endproducts of various fermentation processes.
* 1.2 Students can describe and differentiate between critical process points in various applications of fermentation
* 1.3 Students will apply knowledge of fermentation biochemistry to analyze new situations.
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| * 2.1 Students will demonstrate effective critical thinking.
* 2.2 Students will apply scientific principles to a research or production project.
* 2.3 Students will analyze experimental results and draw reasonable conclusions from them.
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|  | * 3.1 Students clearly describe and differentiate between various views on topics relevant to Fermentation Sciences.
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| 16. Course Reading List and References‌1- Principle of fermentation technology. Second edition. Fermentation microbiology and biotechnology.2- Modern industrial microbiology and biotechnology.3- Fermentation Microbiology and Biotechnology 4- [www.pinkmonkey.com/study quuides/ subjects/biology edited/chap.asp](http://www.pinkmonkey.com/study%20quuides/%20subjects/biology%20edited/chap.asp). |
| Number of weeks  | **Topics** |
| Week 1 | What is fermentation |
| Week 2 | Modes of fermentation operation |
| Week 3 | Why we eat fermented food  |
| Week 4 | Types of fermentation |
| Week 5 | Feed-batch culture |
| Week 6 | Continues culture  |
| Week 7 | Microbiological and structure of microorganisms in food  |
| Week 8 | Metabolic pathways from the biosynthesis of industrial microbiology products  |
| Week 9 | Downstream processing  |
|  Week 10 | Extraction of fermentation products  |
| Week 11 | Exam  |
| 18. Practical Topics (If there is any) |  |
| 19. ExaminationsQ1 definitionQ2 multiple choice Q3 Sign true or falseQ4 Match below terms to the following statementsQ5 Give the reason to the followingQ6 Explain the following statementsQ7 complete the meaning of sentencesQ8 Write the differences between the followingQ9 Count only |
| 21. Peer review پێداچوونه‌وه‌ی هاوه‌ڵ  |