FNH 405 Microbiology of Food and Beverage Fermentation Syllabus

Acknowledgement

UBC's Point Grey Campus is located on the traditional, ancestral, and unceded territory of the xwməθkwəy̓əm (Musqueam) people. The land it is situated on has always been a place of learning for the Musqueam people, who for millennia have passed on their culture, history, and traditions from one generation to the next on this site.

Course Details

Course	FNH 405
Prerequisites	One of MICB 201, MICB 202, BIOL 201, BIOL 203, BIOC 203; 3rd-year standing
Term/year	2022W1 (September – December 2022)
Class day/time	M/W/F, 10-11 am
Class location	MCML 258 (MacMillan Building)
Instructor	Jay Martiniuk
Email	jay.martiniuk@ubc.ca (please email through Canvas instead)
Office	Room 133, MacMillian Building
Office hours	No official office hours. Please email Jay Martiniuk to arrange if needed
TAs	Shelyn Wongso
Syllabus version	Sept 6, 2022

Course Objectives

FNH 405 will focus on the bacteria, yeast and fungi that ferment food sources into final products. Both non-alcoholic (vegetables, legume, cereal, milk, fish, meat) and alcoholic (beer, sake) fermentations will be discussed along with the cultural history and rationale. The mechanism by which the microorganism carries out the fermentation and the biochemical fermentation pathway will be presented as well as pertinent information about the physiology of the microorganisms. This course will also cover detection and identification of microorganisms involved in food and beverage fermentation and scientific information analysis.

Learning Outcomes

Upon completion of this course, students will be able to:

1. Distinguish between sensory and preservation purposes of fermentation
2. Describe food and beverage fermentation methods
3. Explain the mechanism and biochemical pathways for different fermentation types
4. Differentiate between aerobic/anaerobic and bacterial/yeast/fungal fermentations
5. Detail specific microorganisms active in each fermentation type
6. Critique culture-dependent and culture-independent molecular techniques to identify fermentation microbes
7. Evaluate scientific information about fermentation and microbial detection

Course Format

There will be three 50-minute lectures per week. Resource materials will be posted on Canvas. Five or six classes of the term will consist of student presentations and student-led discussions on a fermented food or beverage that is not covered in the course. Student participation will be marked during the student-led discussions.

Course Readings

Required readings will include the course instructor's lecture notes and a couple selected scientific papers for assignments (both will be posted on Canvas).

Currently there is no single required textbook for the course. However, there are textbooks available in Woodward library that will be used as resource material for the lectures. These have all been linked on the course Canvas page.

Reference Textbooks - Online at UBC Library

- Hutkins, R. (2006) *Microbiology and Technology of Fermented Foods.* IFT Press, Blackwell Publishing
- Cocolin, L., & Ercolini, D. (2008). *Molecular Techniques in the Microbial Ecology of Fermented Foods*. Springer Science & Business Media.
- Tamang, J. P., & Kailasapathy, K. (2010). *Fermented Foods and Beverages of the World.* CRC Press, Taylor and Francis Group.
- Sheikha, A.F.E., Levin, R. and Xu, J. (2018) *Molecular Techniques in Food Biology.* John Wiley & Sons Ltd.
- Bamforth, C. W. and Cook, D. J. (2019). *Food Fermentation and Micro-organisms*. Blackwell Science Ltd., Blackwell Publishing Ltd.

Peer-reviewed Journals

Journals are available online at the UBC library; *e.g.*, Applied and Environmental Microbiology, Antonie van Leeuwenhoek, FEMS Microbiology Letters, Food Microbiology, International Journal of Applied Microbiology, Journal of Food Microbiology, Journal of Food Science.

Students will be notified of assigned readings of selected papers in support of the instructor's lecture notes.

Learning Resources

UBC Library has a series of undergraduate user guides to support your learning. For the upcoming terms, their Online Learning video tutorial and UBC's Keep Learning website are helpful resources.

Schedule of Topics

In FNH 405, we will first cover the fundamentals of fermentations, and then move on to discuss application of fermentations in the context of food products. Depending on time, more topics may be added. Overall the topics and order of presentation are subject to change at the instructor's discretion.

Topics:

- Course overview
- Fermentation fundamentals: Acid, alkaline, alcoholic fermentations
- Microbes used in fermentations: Yeast, bacteria, other fungi
- Fermented vegetable products
    - These are done early to give you all an idea of what is expected for the student presentations
- Detection of bacteria in foods
- Detection of fungi/yeast in foods
- Fermented legume (including soy sauce) products
- Fermented cereal products
- Fermented milk/dairy products
- Fermented fish and meat products
- Alcoholic fermentations: sake and beer

Extra topics, time permitting:

- Cellular agriculture (using yeasts/fungi to produce proteins for food via fermentation)
- Use of fermentation to improve food parameters
- Other fermented foods
- Uncommon fermented foods

Course Assessment

Item	Contribution to Final Grade
Participation	5%
Assignments (x2 - due Oct 7 and Dec 2)	10% (5% each)
Quizzes (x2 - Oct 3 + Nov 21)	10% (5% each)
Group Presentation + Discussion (x1)	20%
Midterm Exam (Oct 26)	20%
Final Exam	35%

Class participation

Class participation will be assessed primarily during the online discussion portion of the group presentations. Students will need to participate by making a substantial comment and question (2-3 sentences that are more than just a few words) on the discussion for a minimum number of presentations. Student involvement during lecture or otherwise on the discussion board will also be taken into account.

Class Assignments

Two class assignments, each worth 5% will be given – one prior to the midterm and one after the midterm. The students will be assigned a scientific article on a fermentation topic and asked to answer specific questions on that article. Dates will be announced at a later date.

Midterm exam

The midterm exam will include a combination of multiple choice and short-answer questions related to the topics explored in the class.

Student Presentations

The students will be placed into groups with 3 students per group. Depending on the size of the class, there may also do two groups of 2 so that there aren't any solo presenters or a large group of 4.

Each group will be asked to present on a fermented food or beverage (not one covered in the lecture material) and asked to give a ~20 minute presentation to the class. A presentation rubric will be provided to ensure that several key elements are included in the presentation. Each student in the group will be expected to participate in preparing and giving the presentation. After groups have finished the presentations, their slides will be posted on a Canvas discussion board so that the discussion may take place there due to time limitations in class.

Final exam

The final exam will include a combination of multiple choice, short-answer and long-answer problem solving questions. The exam will be comprehensive, covering material presented throughout the term. However, topics explored after the midterm exam will be emphasized.

***Note for on-line assessments*:** All on-line assessments for FNH 405 are open book which means you are permitted to use the lecture material. However, all answers must be written by each student individually and you are not permitted to copy and paste material from the internet. You are not allowed to work with other students during a quiz or exam. If a student is discovered to have copied and pasted answers from the internet for a question, the question will receive zero marks and the student will be given a warning. More than one incident of copying and pasting answers from the internet may result in course expulsion.

Academic integrity

The academic enterprise is founded on honesty, civility, and integrity. All UBC students are expected to behave as honest and responsible members of an academic community. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work.

It is the student's obligation to learn, understand and follow the standards for academic honesty. Students must be aware that standards at the University of British Columbia may be different from those in secondary schools or at other institutions.

Violations of academic integrity lead to the breakdown of the academic enterprise, and therefore serious actions are taken. Plagiarism or cheating may result in a mark of zero on an assignment, exam, or course. More serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Academic misconduct may result in a one-year suspension from the University and a notation of academic discipline on the student's record.

The UBC library has a useful Academic Integrity website that explains what plagiarism is and how to avoid it. If a student is in any doubt as to the standard of academic honesty in a particular course or assignment, then the student must consult with the instructor as soon as possible. A more detailed description of academic integrity, including the University's policies and procedures, may be found in the Academic Calendar. All course work is required to be submitted to Turnitin.com for review.

University Policies

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions.

Details of the policies and how to access support are available on the UBC Senate website.

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Institute of Food Technologists (IFT)

UBC's Food Science Program is one of few in Canada that are approved by the Institute of Food Technologists (IFT), an internationally recognized leader in undergraduate education standards for degrees in Food Science. Programs with this approval badge are recognized as delivering a comprehensive Food Science education that covers 55 essential learning outcomes (ELOs) established by the IFT organization. For further information on IFT ELOs, click here. The highlighted ELOs below are covered in this course.

Institute of Food Technologists Essential Learning Objectives (IFT ELOs)

Food chemistry (FC)
FC.1. Discuss the major chemical reactions that limit shelf life of foods.
FC.2. Explain the chemistry underlying the properties and reactions of various food components.
FC.3. Apply food chemistry principles used to control reactions in foods.
FC.4. Demonstrate laboratory techniques common to basic and applied food chemistry.
FC.5. Demonstrate practical proficiency in a food analysis laboratory.
FC.6. Explain the principles behind analytical techniques associated with food.
FC.7. Evaluate the appropriate analytical technique when presented with a practical problem.
FC.8. Design an appropriate analytical approach to solve a practical problem.

Food microbiology (FM)
FM.1. Identify relevant beneficial, pathogenic, and spoilage microorganisms in foods and the conditions under which they grow.
FM.2. Describe the conditions under which relevant pathogens are destroyed or controlled in foods.
FM.3. Apply laboratory techniques to identify microorganisms in foods.
FM.4. Explain the principles involved in food preservation via fermentation processes.
FM.5. Discuss the role and significance of adaptation and environmental factors (e.g., water activity, pH, temperature) on growth response and inactivation of microorganisms in various environments.
FM.6. Choose relevant laboratory techniques to identify microorganisms in foods.

Food safety (FS)
FS.1. Identify potential hazards and food safety issues in specific foods.
FS.2. Describe routes of physical, chemical, and biological contamination of foods.
FS.3. Discuss methods for controlling physical, chemical and biological hazards.
FS.4. Evaluate the conditions, including sanitation practices, under which relevant pathogenic microorganisms are commonly controlled in foods.
FS.5. Select appropriate environmental sampling techniques.
FS.6. Design a food safety plan for the manufacture of a specific food.

Food engineering and processing (FE)
FE.1. Define principles of food engineering (mass and heat transfer, fluid flow, thermodynamics).
FE.2. Formulate mass and energy balances for a given food manufacturing process.
FE.3. Explain the source and variability of raw food materials and their impact on food processing operations.
FE.4. Design processing methods that make safe, high-quality foods.

FE.5. Use unit operations to produce a given food product in a laboratory or pilot plant.
FE.6. Explain the effects of preservation and processing methods on product quality.
FE.7. List properties and uses of various packaging materials and methods.
FE.8. Describe principles and practices of cleaning and sanitation in food processing facilities.
FE.9. Define principles and methods of water and waste management.

Sensory science (SS)
SS.1. Discuss the physiological and psychological basis for sensory evaluation.
SS.2. Apply experimental designs and statistical methods to sensory studies.
SS.3. Select sensory methodologies to solve specific problems in food.

Quality assurance (QA)
QA.1. Define food quality and food safety terms.
QA.2. Apply principles of quality assurance and control.
QA.3. Develop standards and specifications for a given food product.
QA.4. Evaluate food quality assessment systems (e.g. statistical process control).

Food laws and regulations (FL)
FL.1. Recall government regulatory frameworks required for the manufacture and sale of food products.
FL.2. Describe the processes involved in formulating food policy.
FL.3. Locate sources of food laws and regulations.
FL.4. Examine issues related to food laws and regulations.

Data and statistical analysis (DS)
DS.1. Use statistical principles in food science applications.
DS.2. Employ appropriate data collection and analysis technologies.
DS.3. Construct visual representation of data.

Critical thinking and problem solving (CT)
CT.1. Locate evidence-based scientific information resources.
CT.2. Apply critical thinking skills to solve problems.
CT.3. Apply principles of food science in practical, real-world situations and problems.
CT.4. Select appropriate analytical techniques when presented with a practical problem.
CT.5. Evaluate scientific information.

Food science communication (CM)
CM.1. Write relevant technical documents.
CM.2. Create oral presentations.
CM.3. Assemble food science information for a variety of audiences.

Professionalism and leadership (PL)
PL.1. Demonstrate the ability to work independently and in teams.
PL.2. Discriminate tasks to achieve a given outcome.
PL.3. Describe social and cultural competence relative to diversity and inclusion.
PL.4. Discuss examples of ethical issues in food science