FOOD 3002A for **Winter 2026**

Food Analysis

Course Instructor: Yaxi Hu **How to address me:** Dr. Hu or Yaxi **Gender Pronouns:** (she/her/hers) **Email:** yaxihu@cunet.carleton.ca Note: Feel free to send me an email for anything you want to tell and/or ask me and I will try my best to respond within 48 h. If you would like to talk to me in person outside the office hours, please email to make an appointment. **Student Hours**: Wednesday, 10:30-11:30 am **Office Location**: Room 229, Steacie Building	**Lecture Location:** Please check Carleton Central for the room location. **Lecture Times:** Wed, 11:35 am – 12:55 pm Fri, 11:35 am – 12:55 pm **Lab Location:** Steacie Building 409 **Lab Times**: A1: Wed: 1:35 pm – 4:25 pm **Prerequisites:** FOOD 3001 **Preclusions:** N/A **Department/Unit:** Chemistry

Topics Covered and Learning Outcomes

Course Description

The chemical composition of a food is of critical importance for the evaluation of the nutrition and health, the toxicology and safety, the quality and authenticity, as well as the stability to microbiological, chemical or physical changes. Analysis of food components and characteristics is necessary for managing the quality of food products, for providing consumers with health and nutrition information, and for ensuring the compliance with government regulations and policies regarding the nutrition labeling and food safety, quality and authenticity requirements. Selecting appropriate analytical techniques is the foundation to acquire reliable results, which depends on a good knowledge of the various techniques and the nature of products being analyzed.

The focus of this course is on introducing the principles and procedures of a variety of analytical techniques for the measurement of the composition and characteristics of food products. Topics to be covered include sample handling and preparation, reporting of data, analysis of major (i.e., proximate analysis: moisture, ash, protein, lipid, and carbohydrate) and minor (e.g., mineral, acids, vitamins and antioxidants) food components. The applications and principles of advanced analytical techniques including spectroscopy, titration, potentiometry, electrophoresis, chromatography, mass spectrometry and molecular techniques will be explored using examples of selected food chemical components (e.g., vitamins, minerals, carbohydrates, proteins, lipids) and food integrity (i.e., safety, quality and authenticity) cases.

Technical Checklist:

- Laptop computer & Pens for some in-class activities
- Calculator for exam

Course Level Learning Outcomes (CLOs):

Upon successful completion of this course (lecture and lab), you will be able to

Learning Outcomes	This includes the ability to:
LO1. Explain the importance of food integrity and food analysis	• Define food integrity, explain the relationship and differences of food integrity issues (i.e., safety, quality and authenticity), and describe their impact to all stakeholders (i.e., food industry, consumers and government) • Define food analysis and identify their application scenarios (e.g., labeling, rapid screening)
LO2. Select appropriate analytical methods based on the purpose of analysis and properties of foods	• Describe the principles and procedures of analytical methods, including sample handling and preparation • Recognize and explain technical terminology and scientific units related to food analysis and labeling • Evaluate analytical methods for sensitivity, accuracy, reproducibility, time, complexity, and cost • Identify the purpose of food analysis (e.g., proximate analysis vs characterization of a specific food component; and quality control vs rapid screening) and the impact of food matrix on the performance of food analytical methods • Rank and select the appropriate analytical method(s) for a specific application based on the advantages and disadvantages of different analytical methods
LO3. Design and perform experiments for specific applications of food analysis	• Identify reliable sources and key information related to design / perform a food analytical experiment • Critique experimental design in scientific publication for food analysis • Perform mathematical calculations involved in the preparation of samples and reagents for food analysis • Perform experiments of food analysis following established protocols • Analyze and interpret the results acquired using different methods
LO4. Apply principles of green analytical chemistry to food analysis	• Explain the 12 principles of green analytical chemistry, their importance and their impact on the performance of analytical methods • Assess the greenness of food analytical methods using appropriate metrics and propose modification for a given protocol of food analysis • Describe challenges and propose solutions to the application of green analytical chemistry principles in food analysis
LO5. Effectively interpret, critique and communicate research in food	• Interpret, critique and present primary food analysis research literature to a scientific audience of peers • Concisely justify the use of a specific method for given analyses • Clearly describe and defend the design of experiments

	• Apply appropriate data visualization tools to display results (e.g., table vs graphs and different types of graphs) • Compare your results to those of relevant published literature

Topics to be Covered (tentative schedule)

Date	Lecture Content	Related Textbook Chapters	Important dates for presentation assignment
Jan 7 & 9	Introduction of Food Analysis; Evaluation of Analytical Data; Sampling and Sample Preparation	1, 4, 5	
Jan 14 & 16	Overview of Proximate Analysis; Moisture and Total Solid Analysis; Ash Analysis	15, 16	A list of topics to be provided
Jan 21 & 23 & 28	Fat Analysis and Characterization	17, 23	
Feb 4	Carbohydrate Analysis and Characterization	19	
Feb 6 & 11	pH and Titratable Analysis; Mineral Analysis	21, 22	
Feb 13	Review for mid-term	25	
Feb 25	Mid-Term		
Feb 27	Green Analytical Chemistry in Food Analysis	https://doi.org/10.1016/j.cogsc.2021.100522	Deadline to confirm the topic of selection
Mar 4	Overview of Spectroscopy, UV-Vis and Fluorescence Spectroscopy	6, 7	
Mar 6	Chemometric Analysis & Infrared spectroscopy	8	
Mar 11	Raman Spectroscopy	8	
Mar 13	Paper Review for spectroscopic technique		Deadline on Mar 13th, 10 pm
Mar 18	Mid-term debrief		
Mar 20	Chromatographic basics, LC, GC and MS	11-14	
Mar 25	Paper review for chromatography & MS		Deadline on Mar 25th, 10 pm

Mar 27	Vitamin Analysis, Phenolics Analysis and Antioxidant Capacity in Food and Ingredients	20, 25	
Apr 1	Program-level cuPortfolio		Deadline for abstract submission
Apr 3	Statutory holiday		
Apr 8	Presentation		Deadline for finishing cuPortfolio

Assessments

Grade Breakdown

Component	Grade Value	Date
Mid-term exam	30%	
Paper review assignments	2*5%	*Details in the table for Topics to Cover above and session for Assessment Details below.*
Presentation	15%	
Program-level cuPortfolio	10%	
Lab	35%	Details refer to the Syllabus for Lab provided by your lab coordinator

Assessment details

Midterm exam (30%, LOs 1-3):

This will be a closed-book exam with **a letter size (8.5"x11") hand-written "cheat sheet", double-sided**. This closed-book exam is to ensure that you have a comprehensive understanding of the content covered during the lectures. You do not need to memorize everything but are expected to identify important information when you are asked to select and develop an analytical method for a specific food analysis problem, which is why a "cheat sheet" is allowed. The preparation of the "cheat sheet" is also a great way to help you review and summarize the content of lectures.

Remember to bring your **calculator**. Midterm exam will focus on content during Jan 7th – Feb 13th which is about proximate analysis and characterization of major food components.

Paper Reviews (10%, LO5)

There will be 2 paper reviews during the second part of the course for the advanced analytical techniques. Students will work in pairs to interpret food analysis primary literatures selected by the instructor. To demonstrate accurate interpretation of the literature, students will read the selected literature prior to class and work together in-class to answer a series of questions. Students will

submit their work by 10 pm on the designated due date (details found in the table below for Tentative Schedule).

Presentation (15%, LOs 4, 5):

In this assignment, you are asked to propose analytical methods that can tackle a persistent or emerging food integrity issue faced by the food industry. A list of ten food integrity issues will be provided for you to choose from, but you may work on issues off the list upon the discussion with and approval of the instructor. You will work in pairs and are expected to search the literature for a thorough understanding of the issue, list available/potential analytical methods for this issue, compare and analyze the performance of at least 3 different analytical methods and identify the most appropriate method or a group of methods. You are also expected to evaluate the greenness of the method. Based upon the literature search and analysis, you will develop a detailed experimental plan for sample collection and preparation/pretreatment, analytical procedures and results analysis for analyzing the particular issue. You will present the work to the class through **a written abstract** and a **15 min oral presentation** to introduce the food integrity issue and the importance of tackling it, as well as to explain and justify your experimental plan. *Each student will talk for 7-8 mins, but the instructor will assign who is talking the first part one day before the presentation. So, both students in a pair should be familiar with the whole presentation during the preparation instead of only focusing on half of it.*

The presentation will be scheduled during the last lecture and the abstract should be submitted a week before the presentation (tentatively due on Apr 1st). Each presentation will be followed by a ~5 min question session. Each presentation will be evaluated by the instructor and fellow students. The presentation is worth 10%, abstract worth 3%, and peer evaluation on the participation during this assignment is worth 2%. The detailed breakdown of the marks and rubric for the evaluation of the written abstract and oral presentation can be found on Brightspace in the document "Presentation_Rubric.docx".

This assignment is to prepare you for real-world scenarios in which you are asked to design analytical methods to solve specific food integrity issues. You will practice and apply literacy skills to find relevant scientific literature, knowledge you learned in the class to evaluate the performance and greenness of the methods described in the literature, critical thinking and integration skills to identify the most appropriate methods, as well as the scientific writing and presentation skills to effectively communicate your research findings with others. These skills and knowledge are not only important for food related research, but can be generally applied to many other fields such as chemistry, biology, biochemistry and pharmaceutical analysis.

Program-level cuPortfolio (10%):

In this assignment, you will be asked to reflect on your learning experiences in food science courses, including this one, and begin to consider your academic, professional, and intellectual development throughout the Food Science program. We will dedicate one lecture session close to the end of the term for you to work on this assignment.

What is the purpose of this assignment? It is to challenge you to become more aware of your own learning and development as a Food Science student. As such, the reflection prompts are directly connected to the Food Science program-level learning outcomes. These outcomes describe what every student should be able to do as a result of completing the program and speak

to the specific knowledge, skills, and abilities that students will develop.

Why reflect? Reflection requires you to think critically about your learning. It is not enough to simply achieve the learning outcomes for the program – the true value of your education lies in your ability to recognize, articulate, and synthesize what you have learned so that you can apply your learning post-graduation.

What is an artifact? You will also be asked to select pieces of evidence (artifacts) that demonstrate your developing competency in specific program learning outcomes and describe why these pieces best represent your knowledge, skills, abilities, and/or learning, such as assignments, presentations, lab reports, posters, review articles etc.

Lab (35%):

There are 5 labs in total to provide hands-on experiences for some of the techniques we learn during the lecture. Each lab is worth of 7% in the final grade. Details can be found in the lab section on Brightspace and will be discussed during the lab.

Late and Missed Work Policies

- Late submission of each the paper review will result in **losing 1.5% a day out of the 5%** total marks for each paper-review assignment.
- Late submission of the abstract for presentation will result in **losing 1% a day out of the 3%** total marks for abstract.

Learning Material(s) and Other Course/Lab-Related Resources

*All resources used for this course are freely accessible

Textbook (required):

- "FOOD ANALYSIS", 2017, 5th edition. S. Suzanne Nielsen, Editor. Springer, New York (ISBN 978-3-319-45774-1). Available as eBook from the Carleton Library (https://ocul-crl.primo.exlibrisgroup.com/permalink/01OCUL_CRL/hgdufh/alma991023035122105153).

  Very Important Notes: There are two copies of ebook available in our library, meaning that only two users can access the ebook at the same time. A portion of the book can be downloaded for offline reading. Detailed policy regarding copy/print and download limits can be found here https://support.proquest.com/s/article/Ebook-Central-Per-User-Per-Day-Copy-print-and-download-limits?language=en_US

- Lecture videos created by the editor of the textbook: https://www.youtube.com/@baraemismail6563/videos

Useful Reference (optional):

- "FOOD ANALYSIS LABORATORY MANUAL", 2017, 3rd edition. S. Suzanne Nielsen, Editor. Springer, New York (ISBN 978-3-319-44125-2). Available as eBook from the Carleton Library

(https://ocul-crl.primo.exlibrisgroup.com/permalink/01OCUL_CRL/hgdufh/alma9910226273089051 53).

- "SENSING TECHNIQUES FOR FOOD SAFETY AND QUALITY CONTROL", 2017. Xiaonan Lu, editor. The Royal Society of Chemistry, Croydon (ISBN: 978-1-78262-664-0). Available as eBook from the Carleton Library (https://ocul-crl.primo.exlibrisgroup.com/permalink/01OCUL_CRL/hgdufh/alma991022743324405153).
- "MODERN TECHNIQUES FOR FOOD AUTHENTICATION", 2018, 2nd edition. Dawen Sun, editor. Academic Press of Elsevier, Oxford (ISBN: 978-0-12-814264-6). Available as eBook from the Carleton Library (https://ocul-crl.primo.exlibrisgroup.com/permalink/01OCUL_CRL/hgdufh/alma991022668245805153).
- "DNA TECHNIQUES TO VERIFY FOOD AUTHENTICITY: APPLICATIONS IN FOOD FRAUD", 2020. Malcolm Burns, Lucy Foster, Michael Walker, editors. The Royal Society of Chemistry, Croydon (ISBN: 978-1-78801-178-5). Available as eBook from the Carleton Library (https://ocul-crl.primo.exlibrisgroup.com/permalink/01OCUL_CRL/hgdufh/alma991022950400505153).

Useful websites on food composition and analysis of food composition:

- AOAC International: http://www.aoac.org/
- Methods and Application of Food Composition Laboratory: Beltsville, MD https://www.ars.usda.gov/northeast-area/beltsville-md-bhnrc/beltsville-human-nutrition-research-center/methods-and-application-of-food-composition-laboratory/
- Nutrition Labelling, Nutrient Content Claims and Health Claims:
  CFIA Compliance Test to Assess the Accuracy of Nutrient Values
  https://inspection.canada.ca/en/food-labels/labelling/industry/nutrition-labelling/additional-information/compliance-test
  Health Canada. Guide to Developing Accurate Nutrient Values
  http://www.hc-sc.gc.ca/fn-an/label-etiquet/nutrition/reg/guide-nutri_val_tc-tm-eng.php

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Academic Accommodations and Regulations

Carleton is committed to providing academic accessibility for all individuals. You may need special arrangements to meet your academic obligations during the term. The accommodation request processes are outlined on the Academic Accommodations website (https://students.carleton.ca/course-outline/).

AI Use in this course: Minimal Use - Basic Assistance Only (unless specified*)

Students may use AI tools for basic word processing and formatting functions, including:

- Grammar and spell checking (e.g., Grammarly, Microsoft Word Editor)
- Basic formatting and design suggestions (e.g., Microsoft Word's formatting tools, PowerPoint Design editor)

Documenting AI Use: It is not necessary to document the use of AI for the permitted purposes listed above. If you have questions about a specific use of AI that isn't listed above, please consult your

instructor.

Why have I adopted this policy? This policy ensures that student voices and ideas are prioritized and authentically represented, maintaining the integrity of the work produced by students while allowing basic support to enhance clarity, correctness, layout, and flow of ideas. The goal of adopting a limited use of AI is to help students develop foundational skills in writing and critical thinking by practicing substantive content creation without the support of AI.

*AI might be used in more advanced mode for certain activities during the course. Special instructions will be provided.

Statement on Academic Integrity

Students are expected to uphold the values of academic integrity, which include fairness, honesty, trust, and responsibility. Examples of actions that that compromise these values include but are not limited to plagiarism, accessing unauthorized sites for assignments or tests, unauthorized collaboration on assignments or exams, and using artificial intelligence tools such as ChatGPT when your assessment instructions say it is not permitted.

Misconduct in scholarly activity will not be tolerated and will result in consequences as outlined in Carleton University's Academic Integrity Policy. A list of standard sanctions in the Faculty of Science can be found here.

Additional details about this process can be found on the Faculty of Science Academic Integrity website.

Students are expected to familiarize themselves with and abide by Carleton University's Academic Integrity Policy.

COURSE SHARING WEBSITES

Classroom teaching and learning activities, including lectures, discussions, presentations, etc., by both instructors and students, are copy protected and remain the intellectual property of their respective author(s). All course materials, including PowerPoint presentations, outlines, and other materials, are also protected by copyright and remain the intellectual property of their respective author(s).

Students registered in the course may take notes and make copies of course materials for their own educational use only. Students are not permitted to reproduce or distribute lecture notes and course materials publicly for commercial or non-commercial purposes without express written consent from the copyright holder(s).

University Policies

In accordance with the Carleton University Undergraduate Calendar Regulations, the letter

grades assigned in this course will have the following percentage equivalents:

A+ = 90-100	B+ = 77-79	C+ = 67-69	D+ = 57-59
A = 85-89	B = 73-76	C = 63-66	D = 53-56
A- = 80-84	B- = 70-72	C- = 60-62	D- = 50-52

F = <50
WDN = Withdrawn from the course
ABS = Student absent from final exam
DEF = Deferred

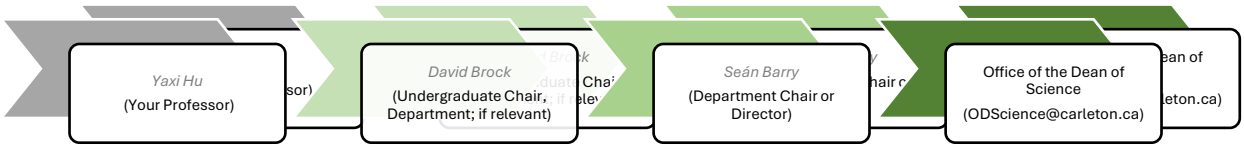
Student Rights & Responsibilities

Students are expected to act responsibly and engage respectfully with other students and members of the Carleton and the broader community. See the 7 Rights and Responsibilities Policy for details regarding the expectations of non-academic behaviour of students. Those who participate with another student in the commission of an infraction of this Policy will also be held liable for their actions.

Student Concerns

If a concern arises regarding this course, **your first point of contact is me**: Email or drop in during student hours and I will do my best to address your concern. If I am unable to address your concern, the next points of contact are (in this order):

Note: You can also bring your concerns to Ombuds services.



Assistance for Students

Academic and Career Development Services: http://carleton.ca/sacds/
Writing Services: http://www.carleton.ca/csas/writing-services/
Peer Assisted Study Sessions (PASS): https://carleton.ca/csas/group-support/pass/
Math Tutorial Centre: https://carleton.ca/math/math-tutorial-centre/
Science Student Success Centre: https://sssc.carleton.ca/