

Food Packaging and Shelf Life

Food 3003A, Fall 2023

Course Instructor: Dr. Yaxi Hu (yaxihu@cunet.carleton.ca), Assistant Professor, Food Science

Lecture Sections: Monday & Wednesday, 11:35 am – 12:55 pm (Mackenzie Building 3356)

Office Hours: Monday, 3:30-4:30 pm, Steacie Building Room 229

Notes: 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.

Course Description

Food packaging is an indispensable portion of food products and can take up 8-10% of the overall product costs. Being an interdisciplinary subject, food packaging involves material science, food chemistry, food microbiology, food processing and engineering. Instead of focusing on the engineering perspective of packaging manufacturing, this course focuses on introducing the fundamental information needed to select packaging materials for specific food products, design packaging with particular functions and assess the performance of packaging. The nexus between packaging and shelf life of food products will also be discussed since one of the major functions of food packaging is to protect foods and extend shelf life.

This course contains 5 modules. Module 1 is the background and introduction of food packaging, including its history, functional properties and regulation. Module 2 is about the properties and functions of packaging materials that have been commonly used for packaging food products. Module 3 focuses on some innovative techniques in food packaging. Module 4 explains the methods commonly used to evaluate the performance and sustainability of food packaging. Lastly, module 5 introduces the concepts of shelf life and the evaluating methods, as well as uses a few types of common food commodities to demonstrate the nexus between food packaging and shelf life.

Course Learning Outcomes (LOs)

| Learning Outcomes | This includes the ability to: |
|---|---|
| LO1. Explain the functions, properties and regulations of food packaging | <ul style="list-style-type: none"> • Outline the history of food packaging • Explain major functions of food packaging • Define critical physical and chemical properties considered for food packaging materials • Describe basic regulatory framework for food packaging materials |
| LO2. Describe and compare conventional packaging materials | <ul style="list-style-type: none"> • Describe the sources of major conventional food packaging materials • Compare physical and chemical properties of different packaging materials • Explain basic manufacturing processes of packaging materials • Identify applications for each major packaging materials in different food sectors |
| LO3. Explain advancements and trends in food packaging materials and technologies | <ul style="list-style-type: none"> • Recognize innovations and trends in food packaging materials and techniques through searching credible sources • Describe and explain advanced food packaging materials and techniques • Describe physical and chemical properties of advanced packaging materials (<i>e.g.</i>, edible and biodegradable) • Describe and explain principles of advanced packaging techniques (<i>e.g.</i>, active and intelligent packaging) • Compare the functional and economical performance of advanced materials and technologies with conventional materials. |
| LO4. Evaluate the performance and sustainability of food packaging | <ul style="list-style-type: none"> • Identify and explain tools used to evaluate the physical, chemical, mechanical, and optical properties of packaging materials • Recognize the importance of life cycle analysis for food packaging • Explain and apply the principle of life cycle analysis for food packaging |
| LO5. Propose packaging solutions to minimize deteriorative reactions in specific foods | <ul style="list-style-type: none"> • Describe mechanisms by which intrinsic and extrinsic factors influence deteriorative reactions in food • Identify appropriate indices of failure in specific food commodities • Design shelf life testing experiments and calculate shelf life of food based on known limiting quality index • Presume how such reactions are occurring in standard food packaging • Propose packaging solutions to overcome these deteriorative reactions |
| LO6. Effectively interpret and communicate findings in food packaging | <ul style="list-style-type: none"> • Interpret and present food packaging advancements to a scientific audience of peers • Interpret primary literature which assesses the effectiveness of food packaging |

Resources

Textbook (required):

1. "Food Packaging: Principles and Practice", 2012, 3rd edition. Gordon L. Robertson. Taylor & Francis Group, Boca Raton (ISBN 9781439862414). Available as eBook from Carleton Library (https://ocul-crl.primo.exlibrisgroup.com/permalink/01OCUL_CRL/1ortgfo/cdi_elibro_books_ELB141151)
2. "Food Packaging and Shelf Life: A Practical Guide", 2010. Gordon L. Robertson. Taylor & Francis Group, Boca Raton (ISBN 9781439862414). Available as eBook from Carleton Library (https://ocul-crl.primo.exlibrisgroup.com/permalink/01OCUL_CRL/hgdufh/alma991022680501905153)
3. "Food Packaging: Materials, Techniques and Environmental Issues", 2022. N.C. Saha *et al.* Springer, Singapore, (ISBN 978-981-16-4235-7). Available as eBook from Carleton Library (https://ocul-crl.primo.exlibrisgroup.com/permalink/01OCUL_CRL/hgdufh/alma991022988390505153)

Useful websites on food packaging and shelf life news and innovations:

<https://www.packagingdigest.com/>
<https://www.food-safety.com/>
<https://www.newfoodmagazine.com/?s=shelf+life>
<https://www.ift.org/news-and-publications>

Assessment Activities

- In-class activities: 10%
- News Report Presentations 6% (2 x 3%)
- Mid-term exam 1: 20%
- Mid-term exam 2: 25%
- Field Trip Observation: 14% (4 x 3.5%)
- Paper Review or Case Study: 25% (5 x 5%)

This grading distribution is non-negotiable

Details of Assessment Activities

In-class activities (10%):

In-class activities will be included in every lecture to practice concepts that are taught and to obtain feedback. Participation for in-class tasks will also serve as attendance. Each lecture, in-class tasks will be graded as SAT/UNSAT. 18 out of 22 in-class tasks must be completed for full grades.

News Report Presentations (6%, for LO3 and 6)

Each student will be responsible for reading, summarizing and explaining **two brief news reports (2 x 3%)** in the field of food packaging and shelf life through out the term. Students are encouraged to sign up to the *Packaging Digest* (<https://www.packagingdigest.com/>), *FoodSafety Magazine* (<https://www.food-safety.com/>), or other credible online sources for inspiration. The presentation focus is on content. Presentation delivery will be informal and should last 5-6 minutes.

Presentation will be arranged at the beginning of lecture hours and timeslot are reserved on a first-come-first-serve basis. The topics are chosen by students with the approval of the instructor **at least two days before the presentation date**.

Field Trip Observation (14%, LO2 and 3)

Each student is expected to visit one or a few grocery stores to observe different food packaging materials and identify the types of food packaged in different materials. Four lists **(4 x 3.5%)** of **at least 10 different food products** for each major type of packaging materials (*i.e.*, paper-based, glass-based, metal-based and polymer-based) should be submitted one day before the corresponding lecture time (see details of the deadline in the table for Tentative schedule below). This activity is to help students build the connections between the knowledge learned in class and the real-world applications.

Midterm exam 1 & 2 (20% & 25%, LO1-4):

The two midterm exams will be closed-book exams with a **letter size (8.5"x11") hand-written "cheat sheet"**. **The "cheat sheet" for Midterm Exam 1 is single-sided, while for Midterm Exam 2 can be 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/design a food packaging for a specific food product or with a specific function, 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 1 will focus on content during Sep 6th to Sep 27th, and Midterm exam 2 will focus on content during Sep 6th to Oct 18th.

Paper Reviews or Case Study (25%, LO5 and 6)

There will be 3 paper reviews and 2 case studies during the last module about shelf life. Students will work in pairs to interpret food packaging primary literature selected or a case formulated by the instructor. To demonstrate accurate interpretation of the literature or case, students will read the selected literature or case 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).

***Late submission Policy:**

- News Report Presentations: no late penalties, but failure to present two news reports before the end of term will result in a **grade of zero** for this activity.
- Late submission of each list of 10 products (for the Field Trip Observation assignment) will result in a **grade of zero** for each assignment.

- Late submission of each the paper review or case study will result in **losing 1.5% a day out of the 5% total marks** for each paper-review assignment.

Tentative Schedule of Lectures

| Date | Lecture Content | Related Textbook Chapters | Important Dates |
|--|---|---|--|
| Module 1. Background and Introduction | | | |
| Sep 6 | Introduction and History of Food Packaging | Textbook 3: Food Packaging: Concepts and Its Significance Textbook 1: Chapter 1 | |
| Sep 11 | Functional Properties | https://www.hindawi.com/journals/ijps/2012/302029/ | |
| Sep 13 | Food Packaging Regulation | Textbook 1: Chapter 22; https://laws-lois.justice.gc.ca/eng/regulations/c.r.c.,_c._870/index.html | |
| Module 2. Conventional Packaging Materials | | | |
| Sep 18 | Paper-based Packaging Materials | Textbook 1: Chapter 6 | List of 10 products due at 12 pm, Sep 17 |
| Sep 20 | Glass-based Packaging Materials | Textbook 1: Chapter 8 | List of 10 products due at 12 pm, Sep 19 |
| Sep 25 | Metal-based Packaging Materials | Textbook 1: Chapter 7 | List of 10 products due at 12 pm, Sep 24 |
| Sep 27 | Plastic-based Packaging Materials | Textbook 1: Chapter 2, 4 & 5 | List of 10 products due at 12 pm, Sep 26 |
| Oct 2 | Midterm Exam 1 | | |
| Module 3. Advanced Packaging Materials and Technologies | | | |
| Oct 4 | Edible, Bio-based and Biodegradable Packaging Materials | Textbook 1: Chapter 3 | |
| Oct 11 | Active and Intelligent Packaging | Textbook 1: Chapter 15 & 16 | |
| Module 4. Evaluation of Packaging | | | |
| Oct 16 | Testing and Quality Evaluation of Packaging Materials | Textbook 3: Testing and Quality Evaluation of Packaging Materials and Packages | |

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|-----------------------------|---|---|------------------------|
| Oct 18 | Life Cycle Analysis of Packaging Materials | Textbook 3: Life Cycle Analysis of Packaging Material | |
| Oct 23 | Fall Break | | |
| Oct 25 | Fall Break | | |
| Oct 30 | Midterm Exam 2 | | |
| Module 5. Shelf Life | | | |
| Nov 1 | Deteriorative Reactions in Foods | Textbook 1: Chapter 11; Textbook 2: Chapter 2 | |
| Nov 6 | Shelf Life and Shelf Life Testing | Textbook 1: Chapter 12; Textbook 2: Chapter 3 | |
| Nov 8 | Packaging and Shelf Life of Dairy Products | Textbook 2: Chapter 5-8 | |
| Nov 13 | Case Study - Dairy | | Due at 10 pm, Nov 17th |
| Nov 15 | Packaging and Shelf Life of Fish and Seafoods | Textbook 2: Chapter 15 | |
| Nov 20 | Paper Review - Fish | | Due at 10 pm, Nov 24th |
| Nov 22 | Packaging and Shelf Life of Cereals and Snack Foods | Textbook 2: Chapter 18 | |
| Nov 27 | Case Study - Cereals | | Due at 10 pm, Dec 1st |
| Nov 29 | Packaging and Shelf Life of Vegetable Oil | Textbook 2: Chapter 17 | |
| Dec 4 | Paper Review - Vegetable Oil | | Due at 10 pm, Dec 8th |
| Dec 6 | Packaging and Shelf Life of Fresh Produce | Textbook 2: Chapter 9 & 10 | |
| Dec 8 | Paper Review – Fresh Produce | | Due at 10 pm, Dec 13th |

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

FND = (Failed, no Deferred) = student could not pass even with 100% on final exam

Equal, Diverse and Inclusive Class Environment

Inclusive teaching statement

All students in the class, the instructor, and any guests should be treated with respect during all interactions. I will continually strive to create inclusive learning environments and would therefore appreciate your support and feedback.

Land Acknowledgement

Here at Carleton University, it is important that we acknowledge that the land on which we gather is the traditional and unceded territory of the Algonquin nation.

Community Guidelines

The following values are fundamental to academic integrity and are adapted from the International Center for Academic Integrity*. In our course, we will seek to behave with these values in mind:

| | As students, we will... | As a teaching team, we will... |
|-----------------------|--|---|
| Honesty | <ul style="list-style-type: none">• Honestly demonstrate our knowledge and abilities on assignments and exams• Communicate openly without using deception, including citing appropriate sources | <ul style="list-style-type: none">• Give you honest feedback on your demonstration of knowledge and abilities on assignments and exams• Communicate openly and honestly about the expectations and standards of the course through the syllabus, and with respect to assignments and exams |
| Responsibility | <ul style="list-style-type: none">• Complete assignments on time and in full preparation for class• Show up to class on time, and be mentally/physically present• Participate fully and contribute to team learning and activities | <ul style="list-style-type: none">• Give you timely feedback on your assignments and exams• Show up to class on time, and be mentally & physically present• Create relevant assessments and class activities |
| Respect | <ul style="list-style-type: none">• Speak openly with one another, while respecting diverse viewpoints and perspectives• Provide sufficient space for others to voice their ideas | <ul style="list-style-type: none">• Respect your perspectives even while we challenge you to think more deeply and critically• Help facilitate respectful exchange of ideas |
| Fairness | <ul style="list-style-type: none">• Contribute fully and equally to collaborative work, so that we are not freeloading off of others• Not seek unfair advantage over fellow students in the course | <ul style="list-style-type: none">• Create fair assignments and exams, and grade them in a fair, and timely manner• Treat all students equitably |

| | | |
|----------------|---|---|
| Trust | <ul style="list-style-type: none"> • Not engage in personal affairs while on class time • Be open and transparent about what we are doing in class • Not distribute course materials to others without authorization | <ul style="list-style-type: none"> • Be available to all students when we say we will be • Follow through on our promises • Not modify the expectations or standards without communicating with everyone in the course |
| Courage | <ul style="list-style-type: none"> • Say or do something when we see actions that undermine any of the above values • Accept a lower or failing grade or other consequences of upholding and protecting the above values | <ul style="list-style-type: none"> • Say or do something when we see actions that undermine any of the above values • Accept the consequences (e.g., lower teaching evaluations) of upholding and protecting the above values |

* This class statement of values is adapted from Tricia Bertram Gallant, Ph.D.

Special Information Regarding COVID-19

It is important to remember that COVID is still present in Ottawa. The situation can change at any time and the risks of new variants and outbreaks are very real. There are a number of actions you can take to lower your risk and the risk you pose to those around you including being vaccinated, wearing a mask, staying home when you're sick, washing your hands and maintaining proper respiratory and cough etiquette.

Please review the latest covid-19 guidance here: <https://newsroom.carleton.ca/coronavirus-covid-19/messages/>

Note About COVID-19 & Mental Health

The global pandemic has led to extra stress and uncertainty for everyone, and while we may all be experiencing the same storm, this does not mean that we are all in the same boat! If you are struggling, please do not hesitate to reach out. I am happy to listen, and/or direct you to resources that might help. In terms of class, if you need extra help or missed a lesson, don't stress! Email me and we will set a time to meet. I'll work with you, I promise. Remember that Carleton also offers an array of mental health and well-being resources, which can be found [here](#).

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).

Academic Accommodations, Regulations, Plagiarism, Etc.

Carleton University is committed to providing access to the educational experience in order to promote academic accessibility for all individuals.

Academic accommodation refers to educational practices, systems and support mechanisms designed to accommodate diversity and difference. The purpose of accommodation is to enable students to perform the essential requirements of their academic programs. At no time does academic accommodation undermine or compromise the learning objectives that are established by the academic authorities of the University. More information can be found at: <https://students.carleton.ca/course-outline/>

University rules regarding registration, withdrawal, appealing marks, and most anything else you might need to know can be found on the university's website, here:

<https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/>

Academic Accommodations for Students with Disabilities

If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or pmc@carleton.ca for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with your instructor as soon as possible to ensure accommodation arrangements are made. For more details, visit the [Paul Menton Centre website](#).

Addressing Human Rights Concerns

The University and all members of the University community share responsibility for ensuring that the University's educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the [Department of Equity and Inclusive Communities](#) at equity@carleton.ca.

Religious Obligations

Please contact me with requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the [Student Guide to Academic Accommodation \(PDF, 2.1 MB\)](#).

Survivors of Sexual Violence

As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: <https://carleton.ca/sexual-violence-support/>

Accommodations for Missed Work

Carleton recognizes that students may be experiencing greater stress and other life factors that are not in their control. As a result, Carleton has put into place a protocol for students to apply for accommodations using a self-declaration form in the event of missed work. The form can be found at: <https://carleton.ca/registrar/wp-content/uploads/self-declaration.pdf>

**Note that these forms should be used for short-term concerns related to missed work; if you are experiencing chronic, ongoing challenges which necessitate a broader solution, I recommend reaching out to the Paul Menton Centre and/or the Care Support team.*

For Pregnancy

Please contact me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the [Student Guide to Academic Accommodation \(PDF, 2.1 MB\)](#).

Accommodation for Student Activities

Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see the [Senate Policy on Accommodation for Student Activities \(PDF, 25KB\)](#).

Academic Integrity

Academic Integrity is upholding the values of honesty, trust, respect, fairness, responsibility, and courage that are fundamental to the educational experience. Carleton University provides supports such as academic integrity workshops to ensure, as far as possible, that all students understand the norms and standards of academic integrity that we expect you to uphold. Your teaching team has a responsibility to ensure that their application of the Academic Integrity Policy upholds the university's collective commitments to fairness, equity, and integrity.

(Adapted from [Carleton University's Academic Integrity Policy](#), 2021).

Examples of actions that do not adhere to Carleton's Academic Integrity Policy include:

- Plagiarism
- Accessing unauthorized sites for assignments or tests
- Unauthorized collaboration on assignment and exams

Please review the checklist [linked here](#) to ensure you understand your responsibilities as a student with respect to academic integrity and this course.

Sanctions for Not Abiding by Carleton's Academic Integrity Policy

A student who has not upheld their responsibilities under Carleton's Academic Integrity Policy may be subject to one of several sanctions. A list of standard sanctions in 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 follow the Carleton University [Student Academic Integrity Policy](#). The Policy is strictly enforced and is binding on all students.

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 office 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/>