FOOD 522: Advances in Food Chemistry

Course Details

Course	FOOD 522 [3-0-0] (hours/week of [lecture-lab-tutorial])
Term/year	Winter Term 2 (January – April 2023)
Class day/time	Mon/Wed 9:00-10:30 am
Location	BIOL-1001
Instructor	Dr. Derek Dee
Email	derek.dee@ubc.ca
Office hours	Please email me to schedule a meeting

Instructor's Biographical Statement

I completed my BSc (Hons) in Food Science, and a minor in Chemistry, from the University of Saskatchewan. I did undergraduate research projects on flax oil, biodiesel, and plant phenolics. My main interest was enzymes, so I then did a MSc in Food Science and a PhD in Biophysics at the University of Guelph, studying the biophysics of protein structure and stability. I went further into biophysics as a postdoctoral fellow at the University of Alberta, using optical tweezers to trap and study single molecules of protein (prion protein specifically, related to Mad Cow disease). I started a Food Chemistry lab at the University of Georgia, studying food protein nanofibrils, and then moved my lab to UBC. We study plant and animal proteins at the nanoscale to understand their properties for food and health applications.

Course Objectives

Throughout this course, we will examine the structure and functionality of food proteins, including enzymes, allergens, prions, the major animal and plant-derived food proteins, and potential future protein sources. This course will begin with an introduction to protein structure, stability, folding and aggregation. Methods commonly used to study protein structure will also be reviewed, along with some basic structural analysis and bioinformatics tools. Structure-function relationships of specific food proteins (*e.g.*, from dairy, eggs, plants, meat) will be covered. Students will learn about the latest developments in food protein chemistry by presenting and critically assessing recently published journal articles (*i.e.*, journal club). The emphasis will be to relate fundamental principles of protein science to applications in food, with opportunities for the students to tailor the course content to their specific interests **(*e.g.*, see "Interesting Topics - Food Proteins" below for ideas)**.

Learning Outcomes

Upon completion of this course students will be able to:

- Discuss the structure-function relationships of food proteins, in various food systems, using several examples
- Describe several methods used to examine protein structure, stability, and function
- Access and utilize primary sources of scientific information
- Critically assess scientific literature
- Present and discuss complex ideas clearly
- Write a logical and compelling review paper

Suggested Reading

Fundamentals of Protein Structure and Function, by Engelbert Buxbaum. Springer, Boston (2007). UBC library: QH345 (**online**).

Proteins in Food Processing, 2nd edition, by Rickey Y. Yada (ed). Woodhead Publishing (2018). UBC library: TX553.P7 (**online**).

Handbook of Food Enzymology, by John R. Whitaker, A.G.J. Voragen, & Dominic W.S. Wong (eds). Marcel Dekker, New York (2003). UBC library: TX553.E6 H36 2003 (**online**).

Applied Food Protein Chemistry, by Zeynep Ustunol (ed). John Wiley & Sons (2014). UBC library: TX553.P7 (**online**).

Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding, by Alan Fersht. W.H. Freeman & Company, New York (1999). UBC library: QD431.25.S85 F47 1999.

Useful links:

The Good Food Institute is a good place to find out about advances in alternative proteins:

https://www.gfi.org/

PDB101 has lots of nice summaries of different proteins (“molecule of the month”)

http://pdb101.rcsb.org/

The Institute for Protein Design is leading the development of tools that could end up in designer foods, medicines, and biosensors.

https://www.ipd.uw.edu/audacious/

Course Schedule

Dates	Topic
Jan 9–Jan 30	introduction; protein structure; protein folding, stability & aggregation; bioinformatics; methods for structure, stability, & functionality analysis
Question set posted ~Jan 30th	
Feb 1–Feb 8	Food proteins (*e.g.*, meat, milk, egg, legumes, gluten)
Feb 13	Guest lecture (Sunil Sukumaran, Perfect Day)
Feb 15	Critical assessment of literature – group
Question set due Feb 15th	
Feb 20	*No classes – Family Day*
Feb 22	*No classes – Midterm break*
Feb 27	Guest lecture (Sunil Sukumaran, Perfect Day)
March 1	Journal club – groups 1-3
March 6	Guest lecture (Sunil Sukumaran, Perfect Day)
March 8	Journal club – groups 4-6
March 13	Journal club – groups 7-9
March 15	Journal club 1, 2, 3
March 20	Journal club 4, 5, 6
March 22	Journal club 7, 8, 9
March 27	Journal club 10, 11, 12
March 29	Journal club 13, 14, 15
April 3	Journal club 16, 17, 18
April 5	Journal club 19, 20, 21, 22
April 10	*No classes – Easter Monday*
April 12	Journal club 23, 24, 25
Review paper due April 19th	

Course Assessment

1. Question set: a question set, based on the lecture material, will be given early in the course.

2. Group Journal club: in groups of two, students will present a peer-reviewed, published research paper to the class, providing context and critical discussion of the papers' findings.

3. Individual Journal club: each student will present a peer-reviewed, published research paper to the class.

4. Writing assignment: students will write a review paper on a topic of current interest/advancement related to proteins and food chemistry.

Further details on each assignment will be given separately

Weightings of assignments:

Question set	25%
Journal club - group	25%
Journal club - individual	25%
Review paper	25%

Grade scale (master's level):

A+	A	A–	B+	B	B–	C+	C	F
90-100	85-89	80-84	76-79	72-75	68-71	64-67	60-63	0-59

Academic integrity

Refer to UBC's policy on academic misconduct (http://www.calendar.ubc.ca/Vancouver/index.cfm?tree=3,54,111,959), particularly relating to plagiarism. Consult the UBC Learning Commons for Resource Guides, including for Citing Sources (https://learningcommons.ubc.ca/resource-guides/). Please avoid all forms of plagiarism, including direct copy-and-paste of someone else's writing.

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.

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.

Note: the above is a tentative Course Schedule, and the actual lecture content may change in response to student learning needs as the semester progresses. Course content and weighting of assignments/tests may change at the discretion of the instructor.

Interesting Topics – Food Proteins

You may be wondering, what topic should I choose for my Journal Club and Review Paper?

Here is a list of key words describing various topics related to proteins and food (safety, quality, processing, analysis), nutrition, and health. These topics are broad or more narrowly defined.

To Do:

1. You can add to this list – anything you think is interesting & relevant.
2. You can use this list for inspiration in choosing a topic for your assignments.

Topics (at some level, these all involve protein structure-function relationships at the heart of their mechanism):

Allergens / Immune response / Processing conditions / Treatments
Amyloid proteins / disease-causing / functional / engineered
Analogues of meat/dairy/eggs/fish → plant proteins /
Anti-freeze proteins / ice-structuring proteins /
Bioinformatics / proteomics / food quality / food safety
Biosensors / food quality / food safety
Biotechnology / Genetic engineering / Protein engineering / Enzyme design
Cellular meat (clean meat) / muscle proteins / growth media
Enzymes / food quality / polyphenol oxidase / gene editing
Enzymes / extremophiles (high/low temp, salt, pressure) / engineering / food processing
Fermentation / recombinant proteins / novel food ingredients
Flavour / sensory reception
Food microstructure / gels / foams / emulsions / cryoEM / fluorescence microscopy /
Food safety / biosensors
Food safety / viruses / phage / bacteria / biofilm / drug targets / antimicrobials
Food safety / prion disease / Mad Cow / Chronic Wasting Disease
Functional foods / enzyme inhibitors / aggregation inhibitors (*e.g.*, treat Alzheimer's)
Functional foods / enzymes / hormones / antioxidants / controlled-release
Maillard reaction / advanced glycation end products (AGEs) / toxicology
Microbiome / diet-gut-microbiome-health nexus/
Nanotechnology / Nanomaterials / Nanomachines
Processing effects on protein / High-pressure / Microwave /
Sensory / taste, aroma, light, pressure receptors /
Sweet-tasting proteins / umami flavour /

…others?