FNH 301 FOOD CHEMISTRY I

Principles of Food Chemistry

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Evaluation: Distribution of marks for final grade in Food Chemistry:
Midterm exam[1] = 25% On-line Quizes[2] = 5%; Tutorial Exam[3]
Group Projects[4] = 10% and Final Exam[5] = 40%

Food Science [301] – Food Chemistry Course Objectives:

- To teach students the principles of food chemistry as they related to the chemical composition and properties of major constituents of food
- To provide the student with the fundamental knowledge of chemical reactions that occurs in food, which explain the biochemical transformations common to post-harvest storage, biodegradation and processing of foods
- To provide the student with the knowledge on the chemical changes that occurs in food systems, which ultimately influence the functional, nutritional and sensory properties of food.

Learning Outcomes from Food Chemistry:

The class lectures, supplemented with tutorial and lecture section handouts, specified supplementary reading and independent student group projects, will provide the student with the knowledge and ability to evaluate the role of molecular, structural and physical properties of food systems in providing functional, organoleptic and nutritional safety of food. The student will learn the interfacial dynamics between different food systems and the environment. Special emphasis will be placed on learning the processes involved in the manufacture and preservation of foods. Critical concept learning will be developed in class discussions and midterm examination towards reinforcing an understanding of the basis for food constituent alternation with such examples as: increasing temperature of foods during processing, or decreasing temperature with formation of ice; reasons for reducing water content by dehydration; effects of introducing or removing oxygen from food systems; effects of introducing ionizing radiation or non-ionizing radiant energy; the addition of food additives for functional and safety purposes.

Required Text Book: FNH 301 Lecture and Tutorial Manuals available $35.00

Textbook: FOOD CHEMISTRY, 4th Edition. O.R. Fennema. (available in UBC book store). This is a required textbook for the course. Older editions can be found in library and are good to use.

Reference Journals: Not required for the course, but helpful for group projects.

- Food Technology (available in Woodward library)
- Journal of Agricultural Food Chemistry (available in McMl library)
- Journals of Food Science and Food Research International (McMl and Woodward libraries)
- Journal of Food Chemistry (available in McMl library)
- Food Nutrition Reviews (available in McMl library)

Course Lecture Outline: (Lectures, 3 hours/week; Tues. 0800-1000; Thurs. 0900)
(Tutorial, 1 hour/week; Thurs. 0800). McMl Bldg. Rm 160

1. Introduction to Food Chemistry: 1 lecture

A lecture on the role of food and food technologies in contemporary life style. Some examples of advances in Food Chemistry and the impact of today's food supply.
Gases in Food systems.

2. Chemistry of water in food. Reader Notes: "Water in Food"

Topics Include: Reference Reading in Food Chemistry, Chapter 2.

• Physical-Chemical properties of water	p. 18-27
• Physical properties of ice	p. 28-29
• Water-solute interactions	p. 31-40
• Water activity concepts	p. 41-53
• Moisture Sorption Concepts	p. 65-77

These lectures will provide information on the physical properties of water and ice; water-solute interactions; water activity and binding; roles of water in chemical reaction rates and microbiological growth. Water and the basis of some food technologies (e.g. freezing, freeze drying)

- **Tutorial #1: Water in Food Systems. 1 hour.**

3. Chemistry of carbohydrates in food. Reader Notes: "Carbohydrate Chemistry"

Topics Include: Reference Reading in Food Chemistry, Chapter 3.

• Monosaccharide chemistry	p. 84-90
• Oxidation, reduction reactions	p. 92-93
• Non-enzymatic browning	p. 96-101
• Sweetness chemistry/sweeteners	p. 643-645
• Caramelization (see reader)	p. 100
• Oligosaccharide chemistry	p. 103-105
• Polysaccharide chemistry	p. 108-113
• Starch, cellulose chemistry	p. 120-135
• Starch granule morphology	p. 123
• Gelatinization and pasting	p. 126
• Retrogradation and Staling	p. 127

- Hydrolysis reactions p. 128
- Modified starches p. 130-135
- Pectins p. 146

Lectures will emphasize the identification and function of carbohydrate (e.g. mono, oligo - & polysaccharides); Chemical reactions (Maillard reaction, caramalization). Chemistry of sweetness (structure/activity relationships) of nutritive and non-nutritive sweeteners in foods. Lectures on chemistry and structure of polysaccharides to include starch, celluloses, pectins. Starch chemistry to include component sugars, granule structure, gelatinization, retrogradation and staling. Functional properties of starch hydrolysis products, modified starches.

- **Tutorial #2: Carbohydrates 1. 1 hour**
- **Tutorial #3: Carbohydrates 2. 1 hour**

4. Chemistry of fats and oils in foods. Reader Notes: "Chemistry of Fats and Oils in Food Systems"

Topics Include: Reference Reading in Food Chemistry. Chapter 4

- Classification/Metabolic pathways p. 157-164;210-211
- Polymorphism p. 176-77
- Fatty acid oxidation (auto-oxidation) p. 186-198
- Sterols & sterol oxidation p. 198-
- Lipid oxidation measurements p. 207-209
- Thermal degradation of fat p. NA
- Chemistry of fat/oil processing p.179
- Hydrogenation p. 180,210
- Interesterification p. 182,211

Lectures will emphasize the chemical classification of fats and oils in animal and plant food systems. Chemical reactions of fats and oils (e.g. positional distribution of fatty acids, lipid oxidation reactions, interesterification, hydrogenation, polymorphic behaviour of commercial fats.

- **Tutorial #4: Chemical Reactions of Lipids. 1 hour**

5. Chemistry of amino acids and proteins in foods. Reader Notes: "Amino Acids, Peptides and Proteins"

Topics Include: Reference Reading in Food Chemistry, Chapter 5.

- Amino acid structure/classification p. 219-224
- Structure and bonding p. 231-245
- Nutritional/safety factors p. 296-299
- Carbonyl-amine reactions p. 412-413
- Protein-protein interactions p. 312
- Denaturation p. 249-257
- Functional properties p. 269-289

- Milk protein structure-function p. 889, 899, 909,917

Lectures will emphasize the structure and classification of amino acids in food proteins. Physico-chemical properties of amino acids, e.g. solubility). Chemical reaction of amino acids (e.g. esterification & acylation). Reaction of amino acids in non-enzymatic browning. Amino acid sources and reaction in vasoactive amine production. Classification of food proteins; protein functionality (structure/function relationships with emulsification, foaming, gelation & binding. Chemical changes in proteins with denaturation. Chemistry of Casein proteins will be used as an overall example of all principles.

- **Tutorial #5: Chemical Reactions of Amino Acids and Proteins. 1 hour**
- **Tutorial #6: Chemical Reactions of Browning. 1 hour**

6. Enzymes in foods. Reader Notes: "Enzymes"

Topics Include: Reference Reading in Food Chemistry, Chapter 6.

- Proteases p. 277,377
- Enzymatic browning p. 407
- Lipooxygenase activity p. 388,415
- Ascorbic acid oxidase p. 469

Lectures will emphasize some of the roles of key food enzymes relative to functionality and quality of food systems.

7. Food Additives. Reader Notes: "Acid, bases and salts"

Topics include: Reference Reader in Food Chemistry, Chapter 11

- Acid-base buffering p. 698,707,711
- Sequestering agents/phosphates p. 204,527-529,411
- Antioxidants p. 198-206,463,702-4
- Emulsifiers p. 270-275,823-5

Lectures will emphasize many of the commonly used food additives and their roles in stabilizing food systems.

Food Chemistry Tutorial/ Group Projects:

Tutorials	**(Dates of Activity)**
1. Water in food systems	(Sept 16)
2. Carbohydrate 1	(Sept 23)
3. Carbohydrate 2	(Sept 30)
4. Lipids	(Oct 14)
5. Maillard Reactions	(Oct 21)
6. Amino acids and proteins	(Oct 28)
7. Food additives	(Nov 18)

Note to Students: You are strongly encouraged to participate in the group discussions that cover and review the tutorial exercises which will be lead by the teaching assistant. Prior preparation of the material using your Fenama Food Chemistry text book and your FNH 301 manual will assist you in full understanding and appreciation of the tutorial exercise and related concepts which are closely tied to the class lectures. Your attendance and attention to the tutorials therefore is expected, but will not be monitored. A good understanding of the tutorial materials will ensure that you will do well on the tutorial exam which is given in late November. Please note: You will not be able to sit for the FINAL exam in December for FNH 301, if you do not write the tutorial exam.