

University of Florida
Even years, Summer B semester 2018
Horticultural Sciences Department

HOS 5711 Section 5243 Phytochemicals in Food & Health

Format: Lecture 3 credits
Schedule: MTWRF, Period 6 (3:30 pm to 4:45 pm).
Location: Fifield Hall Room 2316.
Pre-requisite: BCH 4024 or equivalent or instructor consent.

Course Description:

This applied biotechnology course will examine the nature and properties of phytochemicals in fruits and vegetables including their taxonomic distribution, potential roles in human disease prevention/health promotion, biosynthesis and degradation, enzymes, genes and case studies of select plant breeding or metabolic engineering efforts.

Course Objectives:

At the completion of this course, the students are expected to be able to (a) describe major groups of phytochemicals and their chemical, physical and biological properties, (b) to design plant breeding and genetic engineering strategies to overproduce specific phytochemicals in plants and other organisms, and (c) to interpret and evaluate research on health promoting phytochemicals.

Instructor: Dr. Bala Rathinasabapathi (Dr. Saba)
Room 2247 Building Fifield Hall
Phone 352-273-4847
E-mail brath@ufl.edu
Office Hours: By appointment

Resources:

There is no required textbook for this course. The following are suggested as general guides:

Harborne JB 1998. *Phytochemical methods*. Chapman and Hall.
Lea PJ, Leegood RC 1993. *Plant Biochemistry and molecular biology*. Wiley.

Biochemistry & Molecular Biology of Plants, Second edition, print or electronic version, 2015, Wiley Blackwell (Available on Google Play
https://play.google.com/store/books/details/Bob_B_Buchanan_Biochemistry_and_Molecular_Biology?id=9YAZCgAAQBAJ for \$93.59)

Heldt, HW. 2005. Plant Biochemistry and Molecular Biology. Oxford University Press, 3rd Ed.

Campbell, TC and Campbell II, TM.. 2006. The China Study: The most comprehensive study of nutrition ever conducted and the startling implications for diet, weight loss and long-term health. Benbella Books, Dallas, TX.

Reading List This tentative reading list of review articles and will be updated during the course:

Overview Articles

Espin JC, Garcia-Conesa MT, Tomas-Barberan FA (2007) Nutraceuticals: Facts and fiction. *Phytochemistry* 68: 2986 – 3008.

Benninghoff AD, Lefevre ML, Hitze KJ, Ward RE, Broadbent JR (2015) Fighting cancer with functional foods: New approaches to investigate the interactions of dietary bioactive chemicals and gut microbiome. *J Dev Sust Agric* 10: 34-54.

Giampieri F, Forbes-Hernandez TY, Gasparini M, Alvarez-Suarez JM, Afrin S, Bompadre S, Quiles JL, Mezzetti B, Battino M (2015) Strawberry as a health promoter: An evidence based review. *Food and Function* 6: 1386.

Ascorbic acid:

Smirnoff N, Wheeler GL (2000) Ascorbic acid in plants: biosynthesis and function. *Crit Rev Biochem Mol Biol* 35: 291-314.

Debolt S, Melino V, Ford CM (2007) Ascorbate as a biosynthetic precursor in plants. *Annals of Botany* 99: 3-8.

Glucosinates:

Juge N, Mithen RF, Traka M (2007) Molecular basis for chemoprevention by sulforaphane: a comprehensive review. *Cell Mol. Life Sci.* 64:1105-1127.

Fahey JW, Zalemann AT, Talalay P (2001) The chemical diversity and distribution of glucosinolates and isothiocyanates among plants. *Phytochemistry* 56: 5-51.

Carotenoids:

Faulks RM, Southon S (2005) Challenges to understanding and measuring carotenoid bioavailability. *Biochim Biophys Acta* 1740: 95-100.

Kim Y, Oh D (2010) Biotransformation of carotenoids to retinal by carotenoid 15, 15'-oxygenase. *Appl Microbiol Biotechnol* 88: 807-816.

Kotake-Nara E, Nagao A (2011) Absorption and metabolism of xanthophylls. *Mar. Drugs* 9: 1024-1037.

Namitha KK, Negi PS (2010) Chemistry and biotechnology of carotenoids. *Critical Rev Food Sci and Nutrition* 50: 728-760.

Das A, Yoon SH, Lee SH, Kim JY, Oh DK, Kim SW (2007) An update on microbial carotenoid production: application of recent metabolic engineering tools. *Appl Microbiol Biotechnol* 77:505-512.

Klein-Marcuschamer D, Ajikumar PK, Stephanopoulos G (2007) Engineering microbial cell factories for biosynthesis of isoprenoid molecules: beyond lycopene. *Trends in Biotechnol.* 25: 417-424.

Kopec RE, Schick J, Tober KL, Riedl KM, Francis DM, Young GS, Schwartz SJ, Oberyszyn TM (2016) Sex differences in skin carotenoid deposition and acute UVB-induced skin damage in SKH-1 hairless mice after consumption of tangerine tomatoes. *Mol Nutrition and Food Research* (in press).

Gang DR (2005) Evolution of flavors and scents. *Annu. Rev. Plant Biol.* 56:301-325.

Zhang C, Zhang W, Ren G, Li D, Cahoon RE, Chen M, Zhou Y, Yu B, Cahoon EB (2015). Chlorophyll synthase under epigenetic surveillance is critical for vitamin E synthesis, and altered expression affects tocopherol levels in Arabidopsis. *Plant Physiol* 168: 1503-1511.

Flavonoids and phenolics:

Ross JA, Kasum CM (2002) Dietary flavonoids: Bioavailability, metabolic effects and safety. *Annu. Rev. Nutrition* 22:19-34.

Hoek-van den Hil EF, Schothorst EM, Stelt I, Swarts HJM, Vilet M, Amolo T, Vervoort, JJM, Venema D, Hollman, PCH, Rietjens IMCM, Keijer J (2015) Direct comparison of metabolic effects of the flavonoids quercetin, hesperetin, epicatechin, apigenin and anthocyanins in high-fat-fed mice. *Genes Nutr* 10: 23.

Cassidy A, Mukamal KJ, Liu L, Franz M, Eliassen H, Rimm (2013) High anthocyanin intake is associated with a reduced risk of myocardial infarction in young and middle-aged women. *Circulation* 127: 188-196.

Xie D, Dixon RA (2005) Proanthocyanidin biosynthesis – still more questions than answers. *Phytochemistry* 66:2127-2144. [Review]

Lambert JD, Sang S, Yang CS (2007) Biotransformation of green tea polyphenols and the biological activities of those metabolites. *Mol. Pharm.* 4:819-825.

Villasante A, Powell MS, Moutou K, Murdoch GK, Overturf K, Wacyk J, Hardy RW (2016) Effects of anthocyanidins on myogenic differentiation and antioxidant defense in primary myogenic cells isolated from rainbow trout (*Oncorhynchus mykiss*). *Aquaculture* 454: 81-89.

Alkaloids:

Facchini PJ, St-Pierre B (2005) Synthesis and trafficking of alkaloid biosynthesis enzymes. *Current Opinion in Plant Biology* 8: 657-666.

Sato F, Hashimoto T, Hachiya A, Tamura K, Choi K, Morishige T, Fujimoto H, Yamada Y (1999) Metabolic engineering of plant alkaloid biosynthesis. *Proc. Natl. Acad. Sci U.S.A.* 98:367-372.

Amino acids and proteins:

Galili G, Amir R, Hoefgen R, Hesse H (2005) Improving the levels of essential amino acids and sulfur metabolites in plants. *Biol. Chem.* 386: 817-831.

Shewry PR, Halford NG (2002) Cereal seed storage proteins: structures, properties and role in grain utilization. *J Exp. Bot.* 53: 947-958.

Internet Homepage for the Course Linked from <http://www.hos.ufl.edu/sabaweb/>

Course Outline:

Nature and properties, distribution, biosynthesis and genetics of pathways for the selected phytochemicals will be discussed. The course will be during a 6-week period each week centering on a theme. The last week is for student presentations.

Week 1: Methods used to study connections between phytochemicals and health.

07-02-18	Mon	Introduction
07-03-18	Tue	Methodologies of phytochemistry, genetics & biochemistry.
07-04-18	Wed	Independence Day – No class
07-05-18	Thu	Total antioxidant activity assays
07-06-18	Fri	Animal models

Week 2: Sugars and organic acids.

07-09-18	Mon	No class
07-10-18	Tue	Sugars & Soluble fibers
07-11-18	Wed	Ascorbic acid
07-12-18	Thu	Other organic acids
07-13-18	Fri	Amino acids

Week 3: Flavonoids and phenolics.

07-16-18	Mon	Flavonoids and Isoflavonoids
07-17-18	Tue	Anthocyanins
07-18-18	Wed	Condensed tannins
07-19-18	Thu	Green Tea polyphenolics
07-20-18	Fri	Exam 1

Week 4: Carotenoids, Terpenoids and Glucosinolate.

07-23-18	Mon	Fatty acids and oils
07-24-18	Tue	Carotenoids
07-25-18	Wed	Diterpenes & gibberellins
07-26-18	Thu	Triterpenoids and steroids
07-27-18	Fri	Glucosinates

Week 5: Proteins and Alkaloids

07-30-18	Mon	Seed storage proteins
07-31-18	Tue	Seed storage proteins
08-01-18	Wed	Alkaloid biosynthesis I
08-02-18	Thu	Alkaloid biosynthesis II
08-03-18	Fri	Plant-animal interactions

Week 6: Student presentations

08-06-18	Mon	Student presentation
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08-07-18	Tue	Student presentation
08-08-18	Wed	Student presentation
08-09-18	Thu	Student presentation
08-10-18	Fri	Student presentation

Student Presentation: Students are required to make a 30 minute presentation on their chosen research topic relevant to their written research proposal. Grading will be based on (a) communication of the main idea (b) explanation of the methods used, (c) critical analysis of the research plan and (d) clarity of delivery.

Written Assignment: Students should write a research proposal within 5 pages (double or single-spaced, including references) on any health promoting food phytochemical. The research could be on based on one or many of the following: (a) phytochemical surveys, (b) analytical methods, (c) evidence for health benefits, (d) elucidation of biosynthesis or catabolism, (e) plant breeding to improve nutraceuticals and (f) metabolic engineering. Grading will be based on (a) a building a testable hypothesis from the literature, (b) choosing and describing the appropriate methods that could be used for testing the hypothesis, (c) a discussion on the expected results and their significance and (d) clarity in writing.

Course Evaluation

Attendance & participation	50 points
Written assignment	50 points
Classroom presentation	50 points
Tests	50 points
TOTAL	200 points

Letter grades for the course will be assigned according to the chart below:
 90-100 = A; 87-89 = A-; 84-86 = B+; 80-83 = B; 77-79 = B-; 74-76 = C+;
 70-73 = C; 67-69 = C-; 64-66 = D+; 60-63 = D; 57-59 = D-; 56-below = E.

Course Policies and Procedures

1. Attendance: Attendance at the lectures and active participation in classroom discussions are required (50 points out of 200 total). Two absences will be tolerated, if prior written notification is given to the instructor.
2. Homework Policy: The assignment should be returned to the instructor by 5 p.m. on the specific date announced and late submissions will receive zero points. Classroom presentations should be completed by the specific date announced.
3. Honor Code: By registering for classes, all students agree to abide by and follow the University of Florida Student Honor Code (Rule 6C1-4.017). Visit: <http://regulations.ufl.edu/chapter4/4017.pdf> to read the Student Honor Code.

Honor code violations in this course will not be tolerated, and may result in the assignment of a failing grade.

4. UF Counseling Services:
Counseling & Wellness Center, 301 Peabody Hall, 392-1575, personal and career counseling. <http://www.counseling.ufl.edu>
Student Health Care Center, 392-1161, personal counseling. <http://shcc.ufl.edu/>
Career Resource Center, Reitz Union, 392-1601, career development assistance and counseling. <http://www.crc.ufl.edu/>
5. Software Use: Everyone is required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages/criminal penalties for the violator.
6. Electronic Device Policy: The use by students of cellular phones, messaging devices and other electronic devices during lectures is prohibited. In class, the students are asked to put the phones and messaging devices on silent mode and turn off other devices.
7. Students with Disabilities Act. The Dean of Students Office coordinates the needed accommodations of students with disabilities. To register contact: Dean of Students Office, 202 Peabody Hall, 392-7066, www.dso.ufl.edu