

FST 7630 - FOOD COLORS AND PIGMENTS
Fall 2019 - Session I

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Lectures: Tue 9:10-11:15 - Thu 9:10-10:30am, Parker 114.
Lab sections: Friday 9:10-11am and 11am-12:50pm – meet in 311.
Office: 335 Parker Hall, phone: 247-8016
Office Hours: open door policy! Feel free to stop by or set up an appointment.

I. COURSE DESCRIPTION

FST 7630 course, 3 credits.

Pre-requisite: FST 5600 OR 5610 OR graduate standing

II. GENERAL PURPOSE

To provide students with knowledge of the role of color on consumers choices and the added value of natural pigments due to their potential health benefits. Students will gain a general understanding of the use food colorants and the laws and regulations governing their use.

III. LEARNING OBJECTIVES

- To become familiar with the theory of color
- To become familiar with the basic tools for evaluating color and pigments in foods
- To learn about the important role played by color and appearance in perception
- To become familiar with color systems and color communication
- To become familiar with the pigments responsible for colors in nature
- To become familiar with natural and synthetic colorants used in foods
- To learn the laws and regulations that apply to the use of colorants in foods.
- **To encourage student critical thinking**

IV. COURSE CONTENTS

1. Introduction: What is color and how it affects our perception of food quality
2. The theory of color
 - a. Color as a physical property
 - b. The three dimensional character of color
 - c. Different systems to measure and communicate color
 - d. Instrumentation for color measurements
 - e. How to measure color of solids: reflectance and the specular component
 - f. How to measure color of liquid samples: total and relative transmission
3. Pigments in Animal and Plant Tissue
 - a. Heme Compounds
 - b. Chlorophylls
 - c. Carotenoids
 - d. Anthocyanins and Other Phenols
 - e. Betalaines
 - f. Chemical analyses of pigments in foods: extraction, concentration, semi-purification and measurement

4. Laws and regulations
 - a. Definitions: Natural vs Artificial vs Synthetic Food Colorants.
 - b. US regulations on the use of colorants and regulations around the world
 - c. Certified Dyes and lakes vs Colors Exempt from Certification
 - d. How to get new colorants approved and how to list it in your label

V. LABORATORY TERM PROJECT

- Every student will have hands on experience on the extraction, and the qualitative and quantitative analysis of a natural pigment (anthocyanins) and color evaluation, and prepare a term project based on their results.
- **Term Project:** Each student (or teams of 2) will present a final Term Project report, summarizing the results obtained on their hands on experience with pigment extraction, isolation, quantitation and characterization, and color analysis. The report should use a scientific format (based on the Journal of Food Science format) be typewritten, no more than 10 pages long, and should include citations and references. See additional guidelines provided below for the laboratory term project.

VI. GRADING

Examinations (final exam)	20 %
Term project	35 %
Quizzes	30 %
Exercises and participation	15 %

Final grades will be as follow: A = 100-93; A- = 92-90 B+ = 89-87; B = 86-83; B- = 82-80
C+ = 79-77; C = 76-73; C- = 72-70; D+ = 69-67; D = 66-63; E < 63

VII. READING MATERIALS

Important / recommended reading materials:

General information on food colorants / Theory of color

- Konica Minolta. 2007. Precise Color Communication. Color control from perception to instrumentation. Konica Minolta Sensing Inc.
- Socaciu, C. 2008. Food Colorants: Chemical and Functional Properties. CRC Press.
- Wrolstad, RE and Culbert, C. 2008. Color quality of fresh and processed fruits and vegetables. Eds. ACS publications.
- MacDougall, D.B. 2002. Colour in food, improving quality. CRC press. FL.
- Francis, F.J. 1999. Colorants, practical guide for the food industry. Eagan Press Handbook series.
- Hutchings, J.B. 1999. Food Color and Appearance. 2nd Ed. Aspen Publishers Inc.

In Food Chemistry / Food Analysis books

DeMann, J.M. 1999. Color. Ch 6 In *Principles of Food Chemistry*, 3rd ed. Aspen Pub. Inc.
Schwartz, S.J., Von-Elbe, J.H. and Giusti, M.M. 2007. Colorants. Ch 9 In Fennema's Food Chemistry. Damodaran, S, Parkin, KL, Fennema, OR (Ed.s). 4th Edition. CRC Press

- Wrolstad, RE, Schwartz, SJ. 2005. Handbook of Food Analytical Chemistry. Unit F. Pigments and Colorants. John Wiley & Sons, Inc. New York, NY.
- Giusti, MM; Wrolstad, RE; Smith, DE. 2010. Calculation of CIE Color Specifications from Reflectance or Transmittance Spectra. In Food Analysis Laboratory Manual. Second ed. Edited by Suzanne Nielsen. New York, New York, USA: Springer Science+Business media. 171-177.
- Giusti MM and Wallace TC. 2009. Flavonoids as natural pigments. In Handbook of Natural Colorants. Wiley Series in Renewable Sources. Edited by T Bechtold and RAM Mussak. West Sussex, UK: John Wiley and Sons. 257-275.

Scientific Journals and Electronic resources:

Students are expected to review articles of relevant literature. Specific reading assignments will be given in class, and will be related to their class projects. A vast array of information can be obtained through the internet. Many official organizations have web sites with information about colors and pigments. However, make sure that the page has been posted by a reliable source. Excellent sources include FDA (<http://www.fda.gov/>), USDA (<http://www.usda.gov/usda.htm>), IFT home page (<http://www.ift.org>), and the electronic code of federal regulations (CFR) (<https://www.ecfr.gov>)

VIII. Course Policies:

- Attendance: This course is elective, and students in the class are expected to show interest and commitment through class participation. Laboratory attendance is mandatory. Acceptable reasons for missing class are sickness, family emergencies, or job interviews. If it is necessary for you to miss a laboratory session, or if you will miss more than 2 lectures, contact the instructor in advance. You will be responsible for learning the materials missed.
- Participation in class discussions: Students are expected to play an active role in the learning process. An important part of this process is discussion during class and laboratory sessions. Students are encouraged to ask questions and provide input, feedback or opinions on topics discussed in class. Read the class notes and laboratory handouts ahead of time and come prepared to learn and participate in class. Class participation will be monitored and graded.
- Exercises: There will be two homework assignments in which students will provide a written report for an assigned task. Instructions will be provided in class and posted in Carmen. All assignments should be uploaded through the Carmen dropbox by the due date.
- Due dates: All assignments and term report must be uploaded into Carmen's dropbox by 11:55pm on the due date. Any assignments received on the following day will have a 20% deduction on the grade. Each additional day late will be an additional 20% deduction, with reports receiving no credit at all if submitted 5 days late.

VIII. ACADEMIC MISCONDUCT

Academic misconduct is defined in the Code of the Student Conduct and the Rules of the University Faculty (http://studentaffairs.osu.edu/info_for_students/csc.asp & <http://www.acs.ohio->

state.edu/offices/oa/procedures/1.0.html). Suspected academic misconduct will be referred automatically to the Committee on Academic Misconduct as required by Faculty Rules.

IX. DISABILITY

Students with disabilities that have been certified by the Office for Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office for Disability Services is located in 150 Pomerene Hall, 1760 Neil Avenue; telephone 292---3307, TDD 292---0901; <http://www.ods.ohio-state.edu/>.

PLEASE TAKE CARE OF YOURSELF:

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing.

If you are or someone you know is suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling 614--292--5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on-call counselor when CCS is closed at 614-292-5766.

If you are thinking of harming yourself or need a safe, non-judgmental place to talk, or if you are worried about someone else and need advice about what to do, 24 hour emergency help is also available through the Suicide Prevention Hotline (Columbus: 614-221-5445 / National: 800-273-8255); or text (4hope to 741741); or at suicidepreventionlifeline.org

LABORATORY TERM PROJECT

Each student (in teams of 2-3 students) will have hands on experience on the extraction, and the qualitative and quantitative analysis of a natural pigment (anthocyanins unless otherwise agreed between the instructor and the student) and color evaluation, and prepare a term project based on their results.

The work should include:

- a. Color measurements on a solid and a liquid sample, using at least 2 different methods or instruments, and a comparison of the results. In addition, students will express their results in 3 different color scales.
- b. Extraction procedure. Each student will extract pigments from a food sample or plant material. Protocols for extraction can be found in the Handbook of Analytical Food Chemistry, 2005.
- c. Determination of monomeric anthocyanin pigments in a sample. The protocols can be found in the Handbook of Analytical Food Chemistry, 2005.
- d. Chromatographic separation. Each student will have the experience of semi-purifying the pigments through a C-18 cartridge and running anthocyanins through the HPLC system in an attempt to identify the anthocyanins in their samples.

The report should use a scientific format (suggested format: based on the Journal of Food Science format or the main journal of your discipline) be typewritten, no more than 10 pages long, and should include the following sections:

- Title: Should be descriptive of the work presented.
- Abstract: no more than 200 words
- Introduction: include relevant literature citations
- Materials and methods: always in past tense, describe what you did, and how it was done. Include also a description of materials and equipment used.
- Results and Discussion: present results and explain how these results compare to previously published literature, class discussions and your personal expectations.
- Conclusions. The must be based on the results you obtained in the lab. Should be written in past tense.
- References: list all cited literature, according to the format recommended for J. Food Science or other peer reviewed Journal.