

# FST 7630 - FOOD COLORS AND PIGMENTS

Fall 2017

Session I (August 22<sup>th</sup> to October 11)

Instructor: Dr. M. Monica Giusti, [giusti.6@osu.edu](mailto:giusti.6@osu.edu).  
TA: Jacob Farr (.39)  
Lectures: Tue 9:10-11:15am - Thu 9:10-10:30am, Parker 114.  
Lab sections: Friday 9:10-11am and 11am-12:50pm, Parker 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 equivalent 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. 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.

## VI. GRADING

Quizzes and Participation in class	35 %
Term project	35 %
Final Exam	30 %

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.
- Sigurdson, GT; Tang, P; Giusti, MM. 2017. "Natural Colorants: Food Colorants from Natural Sources." Ann. Rev. Food Sci. Technol. 8, 261-280 (6.95)

*In Food Chemistry / Food Analysis books*

- DeMann, J.M. 1999. Color. Ch 6 In *Principles of Food Chemistry*, 3<sup>rd</sup> 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 code of federal regulations (CFR) online (<http://www.access.gpo.gov/nara/cfr/>).

**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://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**

Any student who feels s/he may need an accommodation based on the impact of a disability should contact me privately to discuss your specific needs. Please contact the Office for Disability Services at 614-292-3307 in room 150 Pomerene Hall to coordinate reasonable accommodations for students with documented disabilities.

## 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.
- Authors: include name and affiliation of all authors.
- 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. Again, always in past tense and based on the results you obtained in the lab.
- References: list all cited literature, according to the format recommended for J. Food Science or other peer reviewed Journal.