FS 551 Food Fermentation Laboratory, Spring Semester, 1 credit
Laboratory: 2 Class hours/week
Prerequisites: Current enrollment in FS, 21 years of age, and consent of instructor

Instructors:
Hans Zoerb, 113B Babcock, hzoerb@wisc.edu
Jim Steele, 127B Babcock, jlsteele@wisc.edu
Andrew Lefeber
Mat Arbuckel

Course Description: Food Fermentation Lab offers students the opportunity to learn to produce fermented beverages and dairy products in laboratory and scalable production facilities. Individual labs are designed to introduce students to the chemical and physical basis for development of specific characteristics associated with individual styles of products as well as analytical methods to quantify those characteristics.

Course Objectives: Successful participation in this lab will provide students with
- an understanding of the physical, chemical and biological processes contributing to the conversion of grain and dairy raw materials, through fermentation, to beer and cheese,
- a practical knowledge of the processes and principles of beer and cheese production,
- an introduction to sensory analysis and chemical analysis of fermented products
- working examples of product sensory changes and shelf life models for each product.

Learning Outcomes:
- Describe and explain the beer brewing and cheese making processes.
- Discuss the role of malt in generating fermentable substrates and flavors in wort.
- Discuss hops chemistry in developing flavor and taste in beer.
- Explain yeast fermentation of wort, specifically how it contributes to flavor and off-flavor in beer. Discuss fermentation parameters that impact both.
- Design and produce an original beer and conduct suitable chemical and sensory analyses defining the beer.
- Describe the process differences that result in cheese styles.
- Discuss the role of bacteria, yeasts and molds in developing individual cheeses.

Required Text: None, but there will be handouts and references provided.

Course Format: Short lectures and discussions, demonstrations, hands-on brewing and cheese making, laboratory exercises.
Grading:

A  90%-100%
B  80%-90%
C  70%-80%
D  60%-70%
F  Below 60%

Assessment Format:

Individual lab reports:
- Mashing laboratory - 10%
- Wort fermentation - 10%
- Yeast metabolism and flavor development - 30%
- Beer production and analysis - 30%
- Cheese production -10%

Participation - 10%

Course Topics:

- Introduction to brewing techniques
  - Mashing, lautering, hops addition, fermentation
- Yeast fermentation
  - Strain selection, production, and fermentation strategies
  - Role of yeast in different beer styles and quality
- Analytical methods for production and product quality
- Introduction to cheese production techniques
- Sensory analysis models for fermented beverages and cheese

Laboratory Outline

1) Introduction the brewing process
   a) The brewing process
   b) Malts, creating a "grain bill", calculating IBUs
2) Mashing, enzymatic conversion of starch to fermentable carbohydrates
3) Yeast production
   a) Isolation and identification
   b) Grow out and pitching strategies
4) Fermentation of wort (2000ml),
   a) Monitoring the fermentation process; sugar, alcohol, SG and flavor changes
5) Beer production and analysis (group project brewing)
6) Yeast metabolism and flavor development in beer (Group Projects, 2-3 weeks)
   a) Fermentation at different temperatures with different yeast strains
   b) GC and HPLC analysis of wort and beer samples
7) Beer finishing
   a) Lab: Conditioning, Racking, Filtering
   b) Continuation of Group Projects
8) Sensory Analysis of beer
   a) Flavor and taste identification
   b) Modes of failure and shelf life models
9) Cheese manufacture (CDR)
   a) Small vat manufacture of selected cheese