Kansas State University
Brewing and Fermentation Science Short Course

January 8-10, 2024

Agenda – DRAFT subject to change

Day 1 – January 8, 2023

Manhattan Brewing Company Instruction & Context Setting

8:00-8:45 Introduction/Overview

1) Introductions
2) Purpose of class/Goals for the class
    a) Class Description
    b) Overview of Day 1

8:45-9:45 Process Overview

3) Raw ingredient overview
    a) Basic brewing ingredients
        i) Hops, Malt, Water, & Yeast
    b) Adjuncts
        i) Oats, corn, rice, etc.
4) Hot side process
    a) Mashing
    b) Lautering
    c) Boiling
    d) Whirlpool
    e) Knockout
5) Cold side process
    a) Fermentation
    b) Cellaring
    c) Packaging

9:45-10:45 Malt & Adjuncts

6) Morphology
7) Variations
8) Contribution to finished product

10:45-11:00 Break & Transition to Faculty/Industry Experts

- Q&A time with participants

Faculty or Industry Experts

11:00-12:00 Hops (*Industry expert*)

9) Morphology
10) Variations
11) Contribution to finished product

12:00-12:50ish Lunch with industry expert

- Industry engagement/Q&A time
- Information about Master Brewing Association of the Americas

Faculty or Industry Experts

1:00-2:00 Yeast (*K-State Faculty*)

12) Morphology
13) Lager vs. Ale
    a) Ale [Saccharomyces cerevisiae]
        i) "Top fermenting" yeast
        ii) Warmer, quicker fermentation
        iii) Typical fermentation by-products and beer profile
    b) Lager [Saccharomyces pastorianus]
        i) "Bottom-fermenting" yeast
        ii) Cooler, longer fermentation
        iii) Typical fermentation by-products and beer profile
14) Wild "bugs"

2:00-3:00 Water (*K-State Faculty*)

15) Purpose
    a) Base source for solubilization
16) Makeup/Water chemistry
    a) pH
    b) Basic Ions; what they do & why they are important
        i) Ca,Mg,Na,Cl,SO_4, CO_3
    c) SO_4^{-2}:Cl^{-1}
    d) Water profiles from around the world

3:00-4:00 History of Brewing (*K-State Faculty*)

17) Brief discussion on the origins of beer/brewing

Tasting and Off-Flavor Training

4:00-5:00 Introduction to Sensory Analysis (*K-State Faculty*)

18) Introduction to sensory analysis
    a) Provide an introduction to sensory analysis

5:00-5:30 Styles and Tasting *(MBC)*

b) Malty Beers
c) Hoppy Beers
d) English, Scottish, and Irish Ales
e) American beer styles

Day 2 – January 9, 2023

Manhattan Brewing Company Instruction & Context Setting

8:00-8:30 Recap of first day/Overview of day 2

- Questions & re-explain any concepts
- Overview of Day 2

8:30-9:15 Safety

1) Proper PPE
2) Chemical Safety
3) CO_2 and Confined Space

9:15-11:00 Mashing

4) Process
   a) Milling
      i) Dry Milling vs Wet Milling
      ii) Roller Mill vs Hammer Mill
   b) Mashing
      i) Single Infusion Rest
         (1) Beta vs Alpha Amylase
      ii) Multiple Rests
         (1) Acid Rest and Modification Rest (86-126) *How to Brew*
            (a) Used in Pilsen to acidify mash
            (b) No longer used
      iii) Decoction Mashing
      iv) Mash Out & Vorlauf
   c) Typical water/grist ratio
      i) Thin vs Thick Mash
5) Technology
   a) Mash Tun vs Mash Press

11:00-11:45 Lautering

6) Purpose
   a) Maximum sugar extraction
   b) Minimize Tannin Extraction
7) Technology
   a) Lauter Tun Design
   b) Lauter Tun vs Mash Press

11:45-12:45 Lunch & Transition to Faculty/Industry Experts

Faculty or Industry Experts

1:00-2:00 Boiling (*MBC*)

8) Purpose
    a) Sterilizing
    b) Hot break
    c) Deoxygenation
    d) Evaporation
    e) DMS Conversion and Volatilization
    f) Maillard Reactions
    g) Add Hops
        i) Boil time additions and their effects
9) Technology
    a) Fire vs Steam vs Electric

2:00-2:30 Whirlpool and Knockout (*MBC*)

10) Whirlpool
    a) Collect trub/proteins/hop material in center
    b) Clear wort extraction
11) Knockout
    a) Use of heat exchanger to drop temperature
    b) Oxygenation of wort for yeast replication
    c) Cooled wort sent to sanitized vessel for yeast pitching and fermentation
12) Technology

2:30-3:30 Fermentation (*K-State Faculty*)

13) What is fermentation?
14) Fermentation phases
    a) Lag phase
    b) Exponential growth phase
    c) Stationary phase
    d) Conditioning
15) Products of fermentation
    a) CO_2
    b) Ethanol
    c) Other typical by-products
        i) Esters vs phenols
        ii) Off-flavor chemicals

3:30-4:00 Content Connections *(MBC)*

Tasting & Off-Flavor Training

4:00-5:00 Off-flavor Training *(MBC/K-State Faculty)*

1) Contamination
2) H_2S
3) DMS
4) Isovaleric Acid
5) Papery
6) Diacetyl (butter/butterscotch) and Acetaldehyde (green apple)

5:00-5:30 Styles and Tasting (*MBC*)

7) Belgian
8) Lager and Ales
9) German Beers
    a) Ales of Germany
        i) Wheat Beers (Weissbier, Berliner Weiss)
        ii) Altbier & Kolsch
    b) German Lagers
        i) Bocks
        ii) Marzen & Festbier
        iii) German Pils
10) Czech Beers
    a) Czech Premium Pale Lager (Bohemian Pils)

Day 3 – January 10, 2023

Manhattan Brewing Company Instruction & Context Setting

8:00-8:30 Recap of days 1-2/Overview of day 3

- Questions & re-explain and concepts
- Overview of Day 3

8:30-10:30 Cellaring and Cleaning

1) Cleaning
    a) Chemical Safety
    b) Basic chemicals
    c) Vessel Cleaning
2) Dry Hopping/Adjuncting
3) Conditioning
4) Barrel Aging
5) Transferring
6) Filtration/Centrifuging
7) Carbonation

10:30-10:45 Context setting

- Overview of filtration, packaging, and draft technology as relates to brewing processes & importance at end of brewing process

10:45-11:00 Break & Transition to Faculty/Industry Experts

- Q&A time with participants

Faculty or Industry Experts

11:00-12:00 Filtration (*K-State Faculty*)

8) Purpose
   a) To produce clear beer
9) Technology
   a) Lenticular Filter
   b) Plate and Frame Filter
   c) Centrifuge
   d) Clarifying Chemicals
   e) Diatomaceous Earth

12:00-12:50ish Lunch

1:00-2:00 Packaging (*MBC*)

10) Types of packages
   a) Cans
   b) Bottles
   c) Kegs
   d) Growlers/Crowlers

2:00-3:00 Draft Technology *(Industry expert)*

11) Types of Draft systems
   a) Direct Draw
   b) Long Draw
      i) Beer Pumps
      ii) FOB Systems

Feedback Session

3:00-4:00 Recap & Discussion *(MBC)*

- Recap major points from three days
- Answer any remaining questions
- Gather feedback from participants

Tasting & Off-Flavor Training

4:00-5:00 Styles and Tasting (*MBC*)

12) Belgian Beers