

Cicerone[®] Certification Program

Master Cicerone[®] Syllabus

Updated July 1st, 2015

This syllabus outlines the knowledge required of those preparing for the Master Cicerone[®] exam. While this list is comprehensive in its scope of content, further study beyond the syllabus is necessary to fully understand each topic. The content tested on the Advanced Cicerone[™] exam, the Certified Cicerone[®] exam, and the Certified Beer Server exam is a subset of the information presented here, and individual syllabi for those tests may be found on the cicerone.org website.

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Full Syllabus

I. Keeping and Serving Beer

A. Purchasing and accepting beer

1. The three-tier system in the United States and the reasons for its existence
 - a. By law, alcoholic beverages sold in the United States must move through the three-tier system. The three tiers are Brewers/Importers, Wholesalers (also known as Distributors), and Retailers
 - i. Brewers and importers sell to wholesalers
 - ii. Wholesalers sell to both on- and off-premises retailers
 - iii. On- and off-premises retailers sell to consumers
 - b. Some states have granted exceptions to the three-tier system. Common exceptions include:
 - i. Brewpubs that both brew and retail to consumers
 - ii. Breweries that brew and sell directly to retailers or consumers
2. Taxes levied on beer
 - a. Specific taxes
 - i. Federal Excise Tax – paid by brewers
 - ii. State Excise Tax – generally processed and paid by wholesalers
 - iii. Sales taxes and other locally required fees – paid by retailers
 - iv. Income taxes levied on brewers, distributors, and retailers
3. Assessing beer shipment: physical condition and age
 - a. Date code if available
 - i. Meaning
 - Bottling/packaging date
 - Best by date
 - ii. Type: Order and number of digits may vary
 - Traditional consumer date codes (e.g., 060912 = June 9, 2012)
 - Julian/ordinal date codes (364-12 = December 30, 2012)
 - Brewery-specific date codes
 - b. Physical condition of container
 - i. Not dented or broken
 - ii. No signs of leakage or box weakness
 - c. Temperature
 - i. Ideally beer will still be cool when it reaches the retailer—the flavor of beer that is warm or hot to the touch may have changed substantially during shipment

B. Serving alcohol

1. Alcohol's effects
 - a. Absorption and elimination
 - b. Physical and behavioral indicators
2. Responsible serving practices
 - a. Provide accurate ABV information to consumers
 - b. Adjust serving size based on ABV

C. Beer storage

1. Beer is best consumed fresh

- a. When beer is released from the brewery, it is ready to drink
 - b. A very few strong or intensely flavored beers may age in ways that make them interesting to drink months or years later if properly cellared
2. Freshness can be preserved and enhanced by wholesaler and retailer actions
- a. Rotate inventory
 - i. Ensure that beer is consumed in the order of dating
 - ii. Remove out of date products from service inventory
 - iii. When beers lack an expiration date:
 - Non-pasteurized draft beer about 45-60 days (refrigerated)
 - Pasteurized draft beer about 90-120 days (refrigerated)
 - Bottled beer:
 - If kept refrigerated, can be good for up to six months
 - When not refrigerated or if subjected to other stresses, may be noticeably off after three months
 - Taste aged product against fresh product to determine deterioration
 - iv. Train staff to encourage/sell/promote all beers offered
 - b. Store beer properly
 - i. Refrigerated storage is best for all beers at all times. Required for draft beer and many craft beers
 - ii. Non-refrigerated storage accelerates aging and development of off flavors
 - With time, all beers will develop signs of oxidation (papery, wet cardboard flavors)
 - Possible autolysis of yeast when present (meaty)
 - Possible development of microbial off flavors (sour, buttery, phenolic, other)
 - iii. Bottled beers are subject to skunking
 - Caused by sunlight and fluorescent light
 - Most noticeable in the aroma of the beer
 - Brown glass blocks 98% of the wavelengths of light that cause skunking, and therefore offers superior protection to clear and green glass
 - Green glass blocks 20% of the wavelengths that cause skunking
 - Clear glass offers no protection against skunking
 - Skunking may be evident after a few minutes of light exposure
 - Cans, ceramic bottles, and bottles in closed case boxes that completely shield beer from light give maximum protection from skunking
 - iv. Bottled beers may pick up moldy flavors
 - Beer stored in damp environments may take on corky (trichloroanisole) and other musty/moldy flavors
 - c. Serve beer properly
 - i. Draft beer must be served using CO₂ or a CO₂-nitrogen mix at the proper pressure setting

- ii. Compressed air should never be used instead of CO₂ or a CO₂-nitrogen mix in a draft dispense system
 - iii. A party pump limits the flavor stability of the beer to **less than one day** because oxygen and airborne contaminants are put in contact with the beer
- D. On-premises draft systems and their maintenance
 - 1. Anatomy of a standard keg
 - a. Common commercial volumes
 - b. Awareness of variety in keg valve systems/coupler types
 - c. Internal structure of the keg
 - 2. Pressure side components, anatomy and function
 - a. Gas sources
 - b. Cylinder/bulk tank
 - c. Nitrogen generator
 - d. Air compressor
 - i. **Never** use with traditional keg
 - ii. May be used with “bag-in-ball” type kegs (e.g., KeyKeg)
 - e. Gas blender
 - f. Beer pump
 - g. Primary and secondary regulators
 - h. Gas line
 - i. Couplers
 - 3. Beer side components, anatomy and function
 - a. Couplers
 - b. Jumper line
 - c. FOB detectors
 - d. Wall brackets
 - e. Beer pumps
 - f. Trunk line (an insulated bundle of beer line and glycol line)
 - g. Power packs (glycol chillers)
 - h. Beer line (vinyl, barrier, stainless, etc.)
 - i. Choker line and other restriction devices
 - j. Draft tower
 - k. Beer faucets
 - i. Standard (rear shutoff) faucet
 - ii. Nitro faucet
 - iii. Ventless, European, Roto-Faucet, and Flow-Control
 - 4. Types of US draft systems
 - a. Direct draw
 - b. Air-cooled
 - c. Glycol-cooled
 - 5. Draft system design
 - a. Principles and goals, appropriate application of each system type
 - b. Effect of variations in gas blends and pressures
 - c. Effect of variations in draw distance
 - d. Effect of variations in altitude

- e. Influences of product mix and volume
- f. System balance
 - i. Dynamic resistance
 - ii. Static resistance
- 6. Draft system operation
 - a. Standard temperature of 38 °F
 - b. Troubleshooting (for each system type)
 - i. No beer at faucet
 - ii. Beer foaming
 - iii. Flat beer
 - iv. Cloudy beer
 - v. False head
- 7. Draft system maintenance
 - a. Cleaning of lines, faucets, couplers and FOBs
 - b. Goals of cleaning
 - c. Criteria for proper cleaning
 - i. Frequency
 - ii. Cleaner type
 - iii. Concentration
 - iv. Temperature
 - v. Method and contact time
 - vi. Flow rate (for dynamic cleaning)
 - d. Manual cleaning of components
 - e. Cleaning system components
 - f. Operation of line cleaning process
 - g. Safety issues: operator, consumer
- E. Beer glassware
 - 1. Select appropriate glassware
 - a. Size
 - i. Based on style and alcohol content (stronger beers, smaller glass)
 - ii. Provide room for an appropriately sized head
 - b. Shape
 - i. Cultural and historical traditions
 - ii. Aesthetics of presentation
 - iii. Flavor and aroma effects
 - c. Brand
 - i. Branded glasses matched to beer
 - 2. Use beer clean glassware
 - a. Glass cleaning procedure
 - i. Empty glass into open drain
 - ii. Wash with non-petroleum based (sudsless) cleaner and brush
 - iii. Rinse in cold water, heel in, heel out
 - iv. Rinse in sanitizer, heel in, heel out
 - v. Dry inverted on rack so air circulates inside
 - vi. Rinse with cold water immediately before dispense

- b. Checking glass for “beer clean”
 - i. Without beer
 - Sheeting (wet glass, empty, water should sheet off of glass evenly; formation of droplets or webbing indicates not beer clean)
 - Salt test (wet glass, sprinkle salt throughout; places where salt does not adhere are not beer clean)
 - ii. With beer
 - Head size, shape, retention
 - Bubbles clinging to sides of glass (in liquid beer) indicate **not** beer clean
 - During consumption, lace will cling to the side of a beer clean glass following each sip
 - c. Preparation to serve
 - i. Glass temperature
 - Room temperature and chilled glasses are acceptable
 - Frozen/frosted glasses are not recommended: causes foaming, makes beer too cold, frozen water or sanitizer may be present
 - ii. Cold water rinse of glass before filling
 - Removes residual sanitizer
 - Cools glasses that may be warm from washing
 - Aids ideal head formation and retention
- F. Serving bottled beer
1. Prepare for service
 - a. Bottle-conditioned beer should be stored upright prior to service
 - b. If possible, store beer at ideal serving temperature as dictated by style, otherwise store all beer under refrigeration (43 °F or less)
 2. Examine bottle
 - a. Look for white flakes (snow-like) which can indicate old, unstable beer. Do not serve beer in this condition
 - b. Look for a thin ring of gunk at liquid level in neck—generally indicative of a bad bottle if present. Do not serve beer in this condition
 - c. Check for yeast on bottom of bottle
 - i. Retain yeast in bottle unless:
 - Consumer requests yeast to be poured
 - Style (e.g., Weissbier) is traditionally poured with yeast
 - ii. To pour yeast, rouse by swirling, rolling, or inverting
 3. Opening bottle: twist-off, pry-off, cork, combo
 - a. Twist-off caps
 - i. Twist off by hand
 - ii. Napkin may be used to aid grip and protect hand.
 - b. Pry-off caps
 - i. Prefer openers with a bar or other lift area at least ¼ inch wide to prevent possibility of breaking the bottle during opening
 - ii. Lift in one motion

- c. Mushroom cork
 - i. Remove wire cage by untwisting the tab
 - ii. Remove cork by hand—napkin may aid grip
 - iii. Be gentle so as not to disturb sediment and make beer volatile
 - iv. Practice cork safety—keep bottle pointed away from consumer at all times
 - d. Cap plus cork: corkscrew will be required after removing cap
 - e. Present the cork (always) or the cap of a rare, unusual, or new beer, to the consumer
 - f. Check bottle lip: do not serve beer from bottles with broken/damaged lips
 - g. Also examine bottle lip for rust, dried beer, or yeast that could affect flavor or appearance of beer
4. Pouring bottled beer
- a. Hold glass at 45-degree angle, pour down the side until glass is half full
 - b. Gently tilt glass upright and pour down the middle to create approximately one inch of foam head on the beer as the pour finishes. Weizens and Belgian ales traditionally have two to four inches of head
 - c. Some brands contain a small amount of yeast at the bottom of the bottle. In most cases, yeast should be retained in the bottle so be prepared to stop pouring when the yeast moves toward the top of the bottle
 - d. When in doubt about pouring yeast, ask the consumer their preference
- G. Serving draft beer
1. Pouring a beer
- a. Hold glass at 45-degree angle, one inch below the tap faucet
 - b. Grip faucet handle near the base, pull forward to the fully open position to start the flow of beer—when a faucet is only open partially, beer will pour foamy
 - c. Pour down the side until glass is half full
 - d. While continuing to pour gently tilt glass upright and pour down the middle to create appropriate amount of head on the beer as the pour finishes
 - e. Close faucet as foam cap reaches the top of the glass to prevent beer waste
 - f. **Never** put faucet in contact with the glass or allow any part of the faucet to become immersed in beer in the glass
2. Changing a keg (same product)
- a. Kegs must be chilled to draft system operating temperature (generally 38 °F) before tapping and serving—general guideline is 24 hours in cooler before serving
 - b. On common American and import Sankey kegs: grip keg coupler handle, pull out and raise to the “up” or “off” position to disengage. Turn the coupler a quarter turn (90 degrees) counterclockwise to unseat. Lift off of the keg
 - c. Seat the coupler on a new keg. Turn clockwise a quarter turn (90 degrees) to engage then lower the coupler handle to the “down” or “on” position
 - d. In long-draw systems that use them, the foam-on-beer (FOB) detector for the keg needs to be reset after a keg change. This is usually done by venting the FOB mechanism to release foam and gas from the chamber
3. Changing products on a line
- a. Ensure that the proper coupler for the new product is correctly installed

- b. If necessitated based on contrast between products:
 - i. Rinse or clean lines
 - ii. Replace jumper hose (in extreme cases)
 - c. Ensure that gas blend and pressure are properly set for the new product
- H. Special situations
- 1. Growlers and draft beer to go
 - a. Filling techniques and shelf life
 - b. Closures (open container laws)
 - c. Cleaning and reusing growlers
 - d. Safety considerations
 - 2. Temporary draft systems
 - a. Picnic pump/party tap
 - i. Hand pumped
 - ii. Single-use CO₂ cartridge
 - b. Jockey box
 - i. Coil style
 - Setup
 - Gas and pressure settings
 - ii. Cold plate
 - Setup
 - Gas and pressure settings
 - iii. Cleaning and maintenance
 - 3. Real ale from cask
 - a. Definition of real ale (CAMRA)
 - b. Ingredients required to achieve carbonation
 - c. Real ale serving systems and their use
 - i. Gravity dispense
 - ii. Beer engine
 - Short spout
 - Swan neck
 - d. Anatomy of a cask, anatomy of beer engine
 - e. Real ale process from brewer to customer
 - f. Cellaring real ale: soft and hard spiles, tapping, assessing readiness for service
 - g. Serving life of cask ale: assessing product quality, cask breathers
 - h. Use of sparklers
 - 4. KeyKeg/one-way keg/“bag-in-ball” keg
 - 5. Party pigs, mini-kegs and other containers
 - a. Filling techniques, product quality and shelf life
 - b. Serving setups: CO₂ or hand pump and implications for product quality and serving life
 - c. Cleaning and refilling
- I. Economics of beer
- 1. Margins and markups
 - 2. Raw material cost and supply volatility

II. Beer Styles

- A. Understanding beer styles
 - 1. The historical development of beer styles
 - a. First driven by available ingredients, equipment, and water
 - b. Shaped by technology, taxes and regulations, culture, consumer appeal, etc.
 - 2. Cataloged today in the US, principally by
 - a. Beer Judge Certification Program¹
 - b. Brewers Association²
- B. Style parameters
 - 1. Knowledge requirements
 - a. Upper and lower quantitative limits for all quantitative values for all styles
 - b. Nuanced understanding of qualitative properties for all styles
 - c. Five commercial examples covering classic producers, American producers, and other notable producers of the style globally
 - d. Familiarity with BA style guidelines
 - 2. Quantitative parameters of beer character
 - a. Alcohol content
 - b. International Bitterness Units
 - c. Color
 - i. SRM
 - ii. EBC
 - d. Carbonation
 - e. Original Gravity
 - f. Final Gravity
 - g. Apparent attenuation
 - 3. Qualitative parameters of beer character
 - a. Aroma
 - b. Flavor
 - c. Aftertaste
 - d. Mouthfeel
 - e. Perceived bitterness
 - f. Appearance
- C. History, characteristics, and flavor attributes of styles by region
 - 1. Belgium and France
 - a. Lambic beers
 - i. Lambic
 - ii. Gueuze
 - iii. Fruit Lambic (Kriek, Framboise, etc.)
 - b. Flanders ales
 - i. Flanders Red Ale
 - ii. Oud Bruin

¹ The Cicerone® Certification Program uses the 2015 BJCP Style Guidelines as the reference source for all matters related to style in its exams. You can access the guidelines online at www.bjcp.org and through their mobile device apps.

² Certified Cicerone® and Advanced Cicerone™ candidates should be aware of the Brewers Association guidelines. Master Cicerone® candidates should have familiarity with the general differences between the BA and BJCP guidelines, and should have knowledge of BA categories that do not exist in the BJCP guidelines.

- c. Trappist and abbey ales
 - i. Trappist Single
 - ii. Belgian Dubbel
 - iii. Belgian Tripel
 - iv. Belgian Dark Strong Ale
- d. Pale Belgian beers
 - i. Blond Ale
 - ii. Belgian Pale Ale
 - iii. Belgian Golden Strong Ale
- e. Unique beers
 - i. Saison
 - ii. Bière de Garde
 - iii. Witbier
- 2. Britain and Ireland
 - a. England
 - i. Pale ales
 - Ordinary Bitter
 - Best Bitter
 - Strong Bitter
 - British Golden Ale
 - English IPA
 - ii. Dark ales
 - Dark Mild
 - British Brown Ale
 - London Brown Ale
 - English Porter
 - Sweet Stout
 - Oatmeal Stout
 - Tropical Stout
 - Foreign Extra Stout
 - iii. Strong ales
 - British Strong Ale
 - Old Ale
 - English Barleywine
 - b. Scotland
 - i. Scottish Light
 - ii. Scottish Heavy
 - iii. Scottish Export
 - iv. Wee Heavy
 - c. Ireland
 - i. Irish Red Ale
 - ii. Irish Stout
 - iii. Irish Extra Stout

3. Germany, Czech Republic, and Austria
 - a. Lagers
 - i. Pale
 - German Leichtbier
 - German Pils
 - Munich Helles
 - German Helles Exportbier
 - Czech Pale Lager
 - Czech Premium Pale Lager
 - ii. Amber or dark
 - Vienna Lager
 - Czech Amber Lager
 - Czech Dark Lager
 - Festbier
 - Märzen
 - Munich Dunkel
 - Schwarzbier
 - Rauchbier
 - iii. Bocks
 - Helles Bock
 - Dunkles Bock
 - Doppelbock
 - Eisbock
 - iv. Specialty
 - Kellerbier
 - b. Ales
 - i. Wheat/rye beers
 - Weissbier
 - Dunkles Weissbier
 - Weizenbock
 - Berliner Weisse
 - Gose
 - Lichtenhainer
 - Roggenbier
 - ii. Rhine Valley ales
 - Altbier
 - Kölsch
4. United States
 - a. Pale lagers
 - i. American Light Lager
 - ii. American Lager
 - b. Pale ales
 - i. American Wheat Beer
 - ii. American Blonde Ale
 - iii. American Pale Ale
 - iv. American Amber Ale

- c. IPAs
 - i. American IPA
 - ii. Double IPA
 - iii. Specialty IPA
 - Belgian IPA
 - Black IPA
 - Brown IPA
 - Red IPA
 - Rye IPA
 - White IPA
- d. Dark ales
 - i. American Brown Ale
 - ii. American Porter
 - iii. American Stout
 - iv. Imperial Stout
- e. Strong ales
 - i. American Strong Ale
 - ii. American Barleywine
 - iii. Wheatwine
- f. Historic styles
 - i. Cream Ale
 - ii. California Common
 - iii. Kentucky Common
 - iv. Pre-Prohibition Lager
 - v. Pre-Prohibition Porter
- g. Beers made with special ingredients or processes
 - i. Alternate grains and malts (e.g., rye)
 - ii. Smoked malts
 - iii. Sugars and other non-malt fermentables (e.g., honey)
 - iv. Fruits and vegetables
 - v. Herbs, spices, and natural flavorings (e.g., coffee, chocolate)
 - vi. Fermentation with non-Saccharomyces organisms (e.g., *Brettanomyces* species)
 - vii. Fermentation or aging with barrels/wood of various types
- 5. Other regions
 - a. Australia
 - i. Australian Sparkling Ale
 - b. International
 - i. International Pale Lager
 - ii. International Amber Lager
 - iii. International Dark Lager
 - c. Poland
 - i. Piwo Grodziskie
 - d. Scandinavia
 - i. Baltic Porter
 - ii. Sahti

III. Beer Flavor and Evaluation

A. Taste and flavor

1. How we perceive flavor
 - a. Aroma
 - i. Orthonasal
 - ii. Retronasal
 - b. Taste
 - i. Established
 - Sweet
 - Salty
 - Sour
 - Bitter
 - Umami
 - ii. Emerging
 - Fat
 - c. Mouthfeel
 - i. Body
 - ii. Carbonation
 - iii. Astringency
 - iv. Creaminess
 - v. Alcoholic warming
2. Variations in taste perception
 - a. Genetic and biological differences
 - b. Physiological factors
 - c. Personal/behavioral factors
 - i. Smoking, coffee, food preferences
 - ii. Consumption habits
 - d. Mental and psychological factors
3. Beer evaluation
 - a. Setting and tools
 - i. Environment for tasting
 - ii. Drinking vessels and other accessories
 - iii. Beer temperature
 - b. Components of evaluation
 - i. Appearance
 - ii. Flavor profile
 - Aroma
 - Taste
 - Mouthfeel
 - Aftertaste
 - c. Key evaluation techniques
 - i. Aroma techniques
 - Distant Sniff: Swirl beer while holding glass six to eight inches away from nose and take one to two short sniffs

 - Short Sniff: Swirl beer; bring glass to nose and take one to two short

- sniffs
 - Long Sniff: Swirl beer; bring glass to nose and take one long sniff
 - Covered Sniff: Cover glass with hand; swirl beer for three to five seconds; bring glass to nose, remove hand, and sniff
 - ii. Use consistent background to assess color and clarity
 - iii. Beer should reach all parts of tongue during tasting
 - iv. Flavor perception continues after swallowing
- B. Identify normal flavors of beer and their source
1. Malt and grain flavors
 - a. Pale beer: Uncooked flour, bread dough
 - b. Golden beer: White bread, wheat bread, water cracker
 - c. Light amber beer: Bread crust, biscuit, graham cracker
 - d. Amber beer: Toast, caramel, pie crust
 - e. Brown beer: Nutty, toffee, chocolate, dark/dried fruit
 - f. Black beer: Roast, burnt, coffee
 2. Hops
 - a. Bitterness, flavor and aroma effects
 - b. Traditional regional hop traits
 - i. American: Piney, citrus, resinous, tropical fruit, catty
 - ii. English: Earthy, herbal, woody
 - iii. German/Czech: Floral, perfumy, peppery, minty
 - c. Familiarity with flavors of specific hop varieties from each region
 3. Fermentation flavors
 - a. Ale versus lager flavors
 - b. Weizen yeast flavor
 - c. Acidic fermentation (lactic, acetic)
 - d. Brettanomyces
- C. Identify common beer flavors by name and source
1. From *Saccharomyces cerevisiae*
 - a. Diacetyl
 - b. Sulfur flavors
 - i. H₂S (hydrogen sulfide)
 - ii. Sulfidic
 - c. Acetaldehyde
 - d. Phenols
 - i. Know range of flavors associated with phenols
 - ii. 4-vinylguaiacol
 - iii. 4-ethylphenol
 - iv. Other phenols
 - e. Esters
 - i. Know range of flavors associated with esters
 - ii. Isoamyl acetate
 - iii. Ethyl acetate
 - iv. Ethyl butyrate
 - v. Ethyl hexanoate
 2. From other organisms

- a. Diacetyl
 - b. Phenols (see 1d above)
 - c. Acetic acid
 - d. Lactic acid
 - e. Butyric acid
 - f. Indole
 - g. Caprylic acid
 - h. Mercaptan
 - i. H₂S
 - j. DMS
 - k. Acetaldehyde
3. Packaging and storage
 - a. Oxidation/aging flavors
 - i. Honey
 - ii. Papery/wet cardboard (trans-2-nonenal)
 - iii. Waxy/lipstick
 - iv. Sherrylike
 - v. Damascenone
 - vi. Increased toffee/caramel
 - vii. Decreased bitterness
 - b. Lightstruck/skunky
 - c. Autolysis
 - d. Trichloroanisole (TCA)/cork taint
 4. Process and ingredients
 - a. Isovaleric acid
 - b. Metallic
 - c. Chlorophenol
 - d. DMS
 - e. Astringent/tannic
 - f. Grainy
 - g. Malty-biscuity
 - h. Catty/ribes
 - i. Leathery (Isobutylquinoline)
 - j. Geosmin/earthy
 - k. Vanillin
- D. Perform the following under test conditions:
1. By taste, detect and identify full range of off flavors by comparing spiked samples to a control beer
 2. By taste, identify beer styles of unknown samples
 3. Based on your sensory analysis of an unknown sample, write a consumer oriented profile of the beer suitable for a menu or shelf-talker, providing detailed and specific flavor descriptors
 4. Based on your sensory analysis of an unknown sample, write a complete description of all flavors and characteristics present

IV. Beer Ingredients and Brewing Processes

A. Ingredients

1. Grains

- a. Malted barley
 - i. Why barley used for brewing
 - ii. Species of barley, cultivation areas, varieties of barley
 - iii. Malting: process stages and steps, floor malting
 - iv. Process variations that lead to different malt types
 - Kilned: Pils, Pale Ale, Vienna, Munich, Victory
 - Stewed: Crystal/caramel malts
 - Roasted: Chocolate, Black Patent
- b. Wheat, oats, rye and other specialty grains
 - i. Forms used: raw, malted, flaked, torrified, roasted
 - ii. Impact on brewing process
 - iii. Sensory contributions to finished product
- c. The use of corn and rice in beer
 - i. Contributions to wort and beer
 - ii. Requirements for processing
 - iii. Styles where used

2. Hops

- a. Anatomy of hop plant and cone
- b. Cultivation
 - i. Structure and layout of hop field
 - ii. Life cycle of hop plants
 - iii. Attending to the hop plant: pruning, training
 - iv. Factors affecting yield
 - Pests and diseases
 - Climate, agronomic considerations
 - Pollination
 - v. Harvesting, drying and baling
 - vi. Storage and delivery to breweries
 - vii. Agricultural economics of hops
- c. Major growing regions
 - i. Continental Europe
 - Germany
 - Czech Republic
 - Belgium
 - Slovenia
 - Poland
 - France
 - Spain
 - ii. Britain
 - iii. United States
 - Yakima Valley, Washington
 - Oregon
 - Idaho
 - Other US growing areas

- iv. Australia and New Zealand
 - v. Other areas: China, Japan
 - d. Categories of hops
 - i. Bittering hops (high alpha acid)
 - ii. Aroma hops (desirable flavor and aroma properties)
 - Noble hops (Hallertau Mittelfruh, Spalt, Tettnang, Saaz)
 - iii. Dual use hops (possessing properties of both bittering and aroma hops)
 - iv. US cultivars of classic European hops
 - e. Chemistry
 - i. Alpha acids, isomerization, and IBUs
 - ii. Hop oils determine flavor and aroma
 - Four major oils
 - Many additional compounds
 - Role of oxidation in hop flavor
 - f. Hop forms and products used in brewing
 - i. Whole hops
 - ii. Pellet hops (90/45)
 - iii. Extracts
 - Alpha acid
 - Hydro-isomerized alpha acid (skunk resistant)
 - Isomerized alpha acid
 - Essential oils
 - g. Uses and effects during brewing
 - i. Bittering contribution of hops added at different times during the boil
 - ii. Flavor and aroma hop additions and effects
 - Boil
 - Hot wort steep/whirlpool
 - Dry hopping
 - iii. Novel uses: mash hopping, first wort hopping, wet hopping, hop back
- 3. Yeast
 - a. Taxonomy
 - i. Ale yeast
 - *Saccharomyces cerevisiae*
 - Generally produce esters in levels which give fruity flavors to finished beers
 - Some possess a phenolic off-flavor gene (POF+) which results in production of phenolic flavors such as clove, nutmeg, white pepper
 - ii. Lager yeast
 - *Saccharomyces pastorianus* also known as *Saccharomyces carlsbergensis*
 - Generally do not produce esters or phenols in appreciable quantities, resulting in a focus on malt and hop character
 - iii. Wild yeast
 - Non-brewing strains of *Saccharomyces* can cause off flavors or excessive attenuation
 - b. Factors required for healthy fermentation: aeration, pitching rate, yeast health

- c. Non-*Saccharomyces* organisms
 - i. Important organisms
 - *Brettanomyces* species:
 - *B. bruxellensis*
 - *B. anomalus*
 - Some strains of these species are commercially available under the following names:
 - *B. lambicus* (a strain of *B. bruxellensis*)
 - *B. claussenii* (a strain of *B. anomalus*)
 - *Acetobacter* species
 - *Lactobacillus* species
 - *Pediococcus* species
 - Other organisms
 - ii. Intentional use
 - iii. Unintentional appearance
4. Water
 - a. The importance of water in brewing
 - b. Chemistry of water
 - i. Chlorine
 - Off flavors associated with chlorine
 - Common techniques for removal
 - ii. Water cycle and sources of salts
 - iii. Water traits of classic brewing cities: Munich, Pilsen, Burton-on-Trent, London, Dublin, Dortmund
 - iv. Permanent and temporary hardness
 - v. Alkalinity
 - c. Common water minerals and their flavor impact in beer
 - d. Possible adjustment of brewing water for the production of specific beer styles and their flavor effects
5. Other ingredients
 - a. Specialty ingredients
 - i. Sugars
 - Fermentable
 - Common household sugars
 - Corn sugar/dextrose/glucose
 - Candi sugar/invert sugar syrup
 - Non-caramelized
 - Caramelized to various degrees
 - Specialty sugars (Demerara, jaggery, piloncillo, etc.)
 - Honey, molasses
 - Non-fermentable
 - Lactose
 - ii. Fruits and vegetables
 - iii. Herbs and spices
 - Common cooking herbs/spices
 - Chili peppers

- Coffee, cocoa, chocolate, teas
 - Gruit/traditional herbs
 - iv. Other flavorings
 - b. Considerations in their addition to beer: when and how added, likely effects on process
 - c. Historical precedent for addition of non-traditional ingredients
- B. Processes
 1. Milling
 - a. Possible flavor impact of milling on finished beer
 - b. Purpose and objectives of milling
 - c. Variations in mills and milling techniques
 - d. Qualitative traits of a proper grind
 2. Mashing
 - a. General description and goals
 - b. Major enzymes active during mashing and their impact on beer attributes
 - c. Types of mash regimens and when they might be used, impact on flavor and beer character (infusion, step-infusion, decoction, cereal, historical methods)
 3. Lautering
 - a. Objectives of lautering
 - b. General process of lautering
 - i. Initiate wort run-off
 - ii. Vorlauf (recirculation)
 - iii. Begin collection of wort for boiling
 - iv. Sparge
 - c. Potential impacts of lautering on beer character
 4. Boiling
 - a. Process and objectives of boiling
 - i. Inputs and outputs
 - ii. Significant physical and chemical changes
 - b. Flavor impacts of boil
 - c. Heating methods, equipment variations, and potential flavor impacts
 5. Whirlpool
 - a. Objectives of whirlpool
 - b. General operation of whirlpool including wort removal
 - c. Alternatives to whirlpooling: wort strainer, cold flotation, hop back, coolship
 6. Chilling
 - a. Modern methods of wort chilling
 - i. Heat exchanger
 - ii. Coolship
 - b. Historical methods of wort chilling
 - c. Flavor issues associated with wort chilling
 7. Aeration and pitching
 - a. When wort is aerated in the brewing process
 - b. Reasons for wort aeration
 - c. Potential flavor impact of aeration
 8. Fermentation (*Saccharomyces cerevisiae* or *Saccharomyces pastorianus*)

- a. General description of fermentation
 - i. Ale fermentation
 - ii. Lager fermentation
 - Diacetyl rest
 - b. Major biochemical inputs and outputs
 - i. Input: Sugars
 - ii. Outputs: Alcohol and carbon dioxide
 - c. Resulting flavor compounds (see flavor section, III.C.1)
 - d. Equipment used for fermentation
 - e. Variations in fermentation temperature and their flavor impact
 - f. Potential flavor impacts of fermentation vessels
 - g. Hybrid fermentations and other variations and their possible effects on beer character
 - h. Maturation
9. Lagering
- a. Objectives of lagering
 - b. Lagering temperature and duration
 - c. Impact on finished beer characteristics
 - d. Use of wood strips or chips
10. Aging
- a. Flavor impacts of aging
 - i. In stainless steel
 - ii. In new wood
 - iii. In previously used wood
 - b. Factors influencing flavors produced
 - i. Prior use of vessel
 - Residual flavors from other liquids
 - Microflora
 - ii. Porosity and micro-aeration (surface to volume ratio)
 - iii. Char or toast of wood
 - iv. Time and temperature
11. Clarification
- a. Common methods used for beer clarification
 - i. Filtration
 - ii. Finings
 - iii. Settling/aging
 - iv. Centrifugation
 - b. Consumer issues (dietary restrictions)
12. Carbonation
- a. Carbonation levels found in beer (by style or type) in volumes of CO₂
 - b. Methods of achieving carbonation in beer, when and how used
 - i. Capture during fermentation
 - ii. Forced carbonation
 - iii. Secondary fermentation in serving vessel
 - c. Sensory impact of carbonation on finished beer
13. Packaging and pasteurization

- a. Package types
 - i. Draft
 - ii. Bottles
 - iii. Cans
- b. Force-carbonated vs. package conditioned (e.g., bottle conditioned)
- c. Quality control
 - i. Cleaning/sanitizing of containers
 - ii. Importance of air exclusion during packaging
 - iii. Cap-on-foam
- d. Pasteurization and its impact on beer
 - i. Types: flash versus package
 - ii. Pasteurization conditions
 - iii. Impact on stability and flavor

V. Pairing Beer with Food

No single model perfectly explains all the dynamics of beer and food pairing. This syllabus draws from various sources to present common concepts and widely accepted principles. Master candidates will be expected to demonstrate a broad knowledge of foods and cuisines and to confidently create pairings based on their own experience and learned knowledge of what works well.

- A. Possible outcomes of successful beer and food pairings
 1. Desirable flavors are highlighted in both the beer and the dish
 2. Combination of the two invokes memory, emotion, and/or deeper thought
 3. Pairing creates new flavors not originally present in either the beer or the dish
- B. Beer and food vocabulary
 1. Beer vocabulary
 - a. For common beer flavor descriptors, see section III.B
 2. Food vocabulary
 - a. Describe specific food tastes beyond basic identification of key ingredients and preparation (e.g., instead of “seared scallop”, use “scallop has a caramelized, crispy sear with rich toasted and toffee flavors, while the dense interior has a buttery sweetness”)
 - b. Understand basic cooking techniques and their effects on flavor (e.g., poaching, roasting, frying, etc.)
 - c. Familiarity with a range of commonly encountered foods and ingredients (e.g., vegetables, fruits, herbs, spices, etc.)
 - d. Familiarity with a wide range of cuisines and common dishes
- C. Pairing concepts
 1. Intensity (referred to as “impact” by Garrett Oliver, called “weight” in wine)
 - a. A beer’s intensity is determined by the levels of several characteristics
 - i. Malt flavor
 - ii. Hop bitterness
 - iii. Sweetness/body (note that these are related)
 - iv. Alcohol content
 - v. Carbonation
 - vi. Tartness/sourness

- vii. Fermentation derived flavors (esters, phenols, etc.)
- viii. Hop flavor/aroma
- ix. Special ingredients/processes (e.g., fruit, coffee, barrel-aging, etc.)
- b. A dish's intensity is determined by the interplay of several characteristics
 - i. Flavor impact of individual ingredients
 - ii. Preparation/cooking method
 - iii. Spices used
 - iv. Sauces served alongside
 - v. Levels of fat, umami, sweetness, bitterness, saltiness, sourness, etc.
- 2. Flavor interactions
 - a. Interactions between similar flavors
 - i. Complement/resonance—Similar or compatible flavors present in both the beer and the food complement one another (e.g., an Indian curry with cloves resonates with the clove flavors found in a Dunkels Weissbier)
 - ii. Accentuating—A flavor from one side of the pairing highlights a flavor from the other side. (e.g., light diacetyl in a beer coaxes out a faint caramel note in cooked meat)
 - iii. Canceling—Similar flavors in both sides of the pairing can seem to eliminate perception of that flavor in one side of the pairing. (e.g., smoky flavors seem diminished when a smoky beer is paired with smoked foods; fruit flavors seem bland when a fruit beer is paired with a fruit dessert)
 - b. Interactions between dissimilar flavors
 - i. Contrast—By offering an opposing flavor, the beer highlights a flavor in the dish or vice versa. (e.g., mussels served with Gueuze seem richer and sweeter due to the acidity of the beer)
 - ii. Cut—Some beer traits help refresh the palate by lifting, cleansing or removing rich or fatty flavors from the palate. Common “cutting” beer traits include carbonation, sourness, and bitterness, and to a lesser extent, alcohol and roastiness
 - iii. Accentuating—A dissimilar flavor in the beer heightens the perception of a flavor in the dish or vice versa (e.g., bitterness in a beer accentuates capsaicin heat from chili peppers)
 - iv. Softening—A flavor in the beer diminishes the intensity of a flavor in the dish, or vice versa (e.g., malt sweetness soothes spicy capsaicin “heat”)
 - v. Clashing—A flavor present in the beer creates an unpleasant juxtaposition with a flavor in the dish (e.g., high bitterness and briny fish create clashing, metallic flavors)
- D. Common beer and food interactions
 - 1. Malt flavors
 - a. Complement toasted and caramelized flavors in a variety of foods
 - b. Soothe/soften capsaicin “heat”
 - 2. Hop flavors
 - a. Depending on hop variety, can complement fruit, citrus, herb, and spice flavors
 - 3. Fermentation-derived flavors

- a. Esters
 - i. Harmonize with fruit flavors
 - ii. Harmonize with dairy
- b. Phenols (clove and peppercorn flavors)
 - i. Resonate with spices
 - ii. Contrast fat and umami
 - iii. Can become harsh in some pairings
4. Carbonation
 - a. Cuts fat, umami, and sweetness
 - b. Accentuates capsaicin “heat”
5. Bitterness
 - a. Cuts fat, umami, and sweetness
 - b. Accentuates capsaicin “heat”
 - c. Can create harsh or metallic effects with certain foods (e.g., oily fish)
 - d. Can harmonize with, soften, or cancel bitter foods (e.g., bitter salad greens)
6. Roastiness
 - a. Complements chocolate, caramelized, and burnt flavors
 - b. Cuts fat
 - c. Contrasts sweetness
 - d. Accentuates umami
7. Alcohol
 - a. Can cut fat
 - b. Generally resonates with sweetness
 - c. Can accentuate capsaicin “heat”
8. Tartness/sourness
 - a. Can brighten some food flavors
 - b. Can complement or accentuate sour flavors
 - c. May favorably contrast fat, umami, or salt
9. Sweetness
 - a. Soothes capsaicin “heat” and other spices
 - b. Accentuated by saltiness
- E. Creating a pairing
 1. Match intensities of both beer and dish so that neither overpowers the other
 2. Consider the flavor interactions listed in sections V.C.2 and V.D to hone the pairing
- F. Designing a meal
 1. Intensity of dishes and pairings generally increases as the meal progresses
 2. Plan meal around a unifying theme
- G. Classic beer and food pairings
 1. European traditions
 - a. Belgium
 - b. Germany
 - c. England
 2. Recommended literature
 - a. *Brewmaster’s Table*, Garrett Oliver
 - b. *Tasting Beer*, Randy Mosher

H. Cooking with beer

1. Common uses

- a. Used in place of water or other liquid as an ingredient or cooking medium
 - i. Batters and baked goods
 - ii. Marinades, brines, and dressings
 - iii. Braising, roasting, deglazing, and sauces
 - iv. Soups or stews
 - v. Desserts

2. Flavor effects

- a. Concentrating beer through cooking intensifies non-volatile flavors
 - i. Bitterness can intensify exponentially and may become unpleasant
 - ii. Malt flavors and sweetness increase, sugars caramelize
 - iii. Volatile hop and ester flavors decrease and may disappear entirely
 - iv. Astringent/burnt flavors of roasted malt can increase and may become unpleasant
- b. Delicate hop and fermentation flavors in beer can be brought to a dish by not cooking the beer (e.g., using an IPA in a salad dressing)