OUTLINE

• Cover tasting techniques
• Hop oil chemistry
• Tasting: Myrcene, Linalool, Geraniol, 4MMP
THANK YOUS: BASE BEER

- Base Beer:
  - Ninkasi Helles Belles
  - BIG THANKS to the fine folks at Ninkasi!!

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THANK YOUS: FLAVOR STANDARDS

• Flavor Standards from Aroxa
  • Flavor standards are best way to do flavor training
  • CANNOT currently buy these hop standards
TASTING TECHNIQUES
AROMA SAMPLING TECHNIQUES

- Swirl glass
- Sample aroma
  - Distant sniff
  - Short sniff
  - Long sniff
  - Covered sniff
TASTING TECHNIQUES

• Taste Beer
  • Take “a taste”
  • Make sure it travels
• Fully engage retronasal perception
• When judging: pay attention to traits that cannot be smelled!!
HOP OIL CHEMISTRY

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KEY COMPONENTS OF HOPS

- Small yellow glands = lupulin
- Found in Lupulin:
  - Alpha acids
  - Beta acids
  - Essential oils

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4 “MAJOR” ESSENTIAL OILS

- Myrcene
- Farnesene
- Humulene
- Caryophyllene

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HOP ESSENTIAL OILS

• Over 300 compounds identified
• Many important compounds present in tiny amounts
• Interactions and synergies not fully understood
TERPENES DEFINED

• **WARNING: SUPER NERD TANGENT**
  • Hydrocarbons—a molecule made entirely of carbon and hydrogen
  • Terpene—a hydrocarbon made up of some number of isoprene units
  • Terpenoid—a terpene-based molecule which may include other functional groups (e.g., alcohols, esters, etc.)

Isoprene (C\(_5\)H\(_8\))
TERPENES DEFINED

• Naming based on number of isoprene units
  • 1 Isoprene unit –
  • 2 Isoprene units – Monoterpene
  • 3 Isoprene units – Sesquiterpene
  • 4 Isoprene units –
  • …and so on
TASTING HOP OILS

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MYRCENE

• Monoterpene found in cannabis, cardamom, hops
• Main essential oil in hops by weight (10-60%)
  • Lower in Noble hops, EKGs, etc.
  • High in a number of American varieties: Cascade, Citra, Simcoe, Amarillo

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MYRCENE

- Monoterpenes = Hydrocarbons
- Hydrocarbons = low solubility and high volatility
  - Huge component of raw hop aroma
  - Often does not translate to finished beer
  - Only present in dry-hopped beers
MYRCENE

- Flavor descriptors:
  - Raw hop
  - Resin/pine
  - Herbaceous
  - “Green”

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LINALOOL

- Monoterpenic alcohol prominent in coriander oil and lavender oil
- Commonly used in perfumes, soaps, laundry detergents, etc.
LINALOOL

• Some differences from one hop varietal to the next
• Presence in finished beer dictated by use:
  • Late hopping produces most pronounced effect
  • Dry hopping also yields a fair amount

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LINALOOL

- Flavor descriptors:
  - Floral
  - Citrus
  - Coriander
  - Lavender
  - Fruit Loops®
GERANIOL

- Monoterpenic alcohol prominent in rose oil and citronella oil
- Also commonly used in perfumes, soaps, etc.
Geraniol

• More varietal dependent than Linalool
  • High levels in Cascade, Centennial, Chinook, Citra, Mosaic, Motueka
• Late hopping and dry hopping leads to highest levels
• Some amount of bio-transformation to citronellol

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GERANIOL

- Flavor descriptors:
  - Floral
  - Citrus
  - Rose-like
4MMP

- Full name: 4-mercapto-4-methylpentan-2-one
- Cat pheromone
- Also found in black currants and Sauvignon Blanc grapes
4MMP

- Found in hops alongside several other volatile thiols:
  - 3MH: 3-mercaptohexan-1-ol
  - 3MHA: 3-mercaptohexylacetate
  - Both have notes of grapefruit, passionfruit, black currant, and Sauvignon Blanc

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4MMP

- Varietal dependent:
  - Found in Cascade, Citra, Mosaic, Nelson Sauvin, Simcoe, Summit
- Impacted by growing conditions
- Copper-containing mildew-control agents
4MMP

- Flavor descriptors:
  - Catty!
  - Black currant
  - Gooseberry
  - Sauvignon Blanc (especially NZ)
- Flavor threshold: 0.8 ppt!!!
HOP ESSENTIAL OILS

• Remember – 100s of different hop oils exist, this is a tiny sampling
• Still, you may now pick out these flavors as you sample beers
• Stay curious, and keep exploring!

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THANKS FOR COMING!!

Pat Fahey – Cicerone® Certification Program