



Sensory Analysis, Beer, and Hops

9th Annual Hop Conference

February 16, 2018

Roy D. Desrochers

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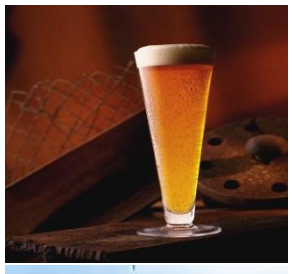
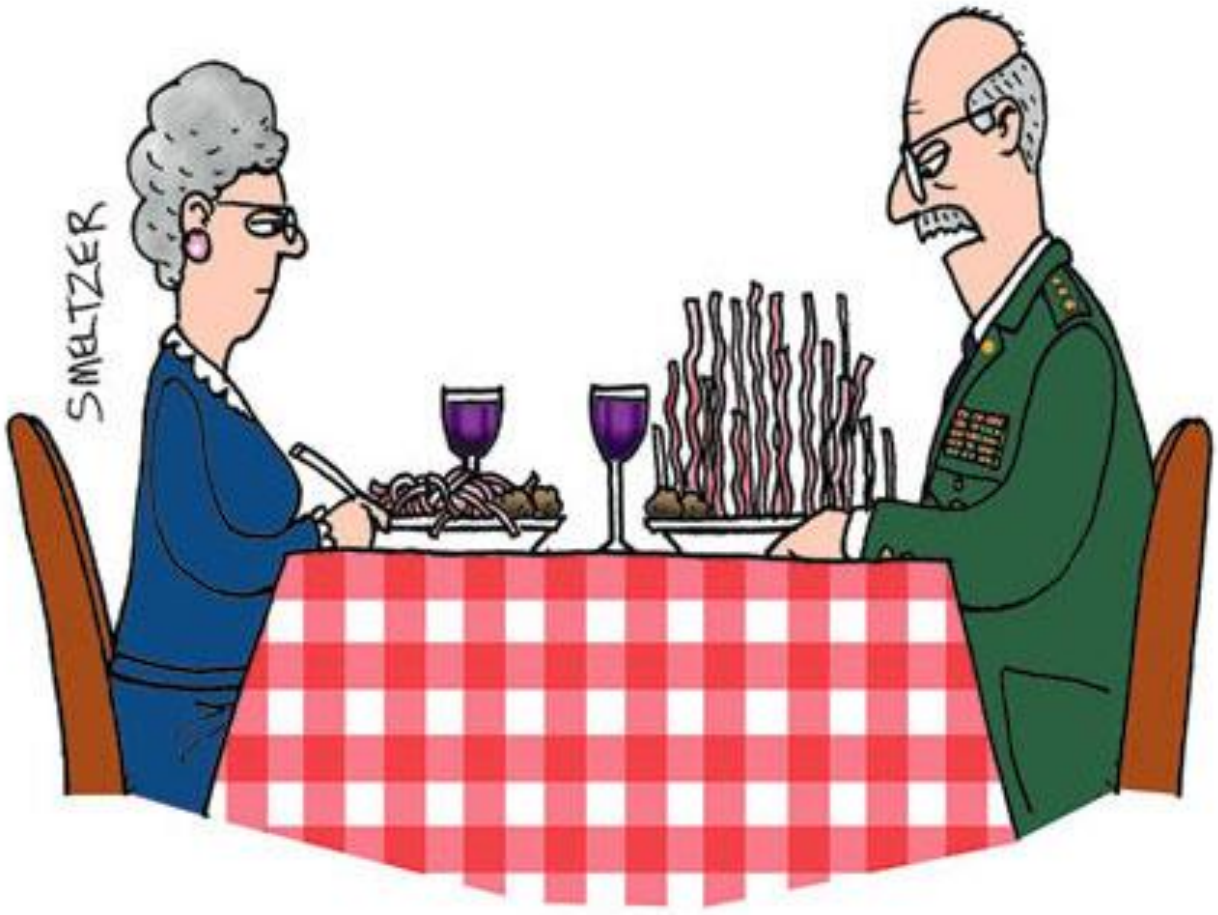




Today's Agenda

- Introduction and Overview
- The Basics of Sensory
  - Basic Tastes
  - Aromatics
  - Mouthfeels
- Sensory Characteristics of Hops
- Hops Sensory and Chemistry Research Initiative



"At ease!"

Information Needs and Gaps

Climate

Terroir

Other

Hops

- What factors out of my control affect hop quality and how?
- How can I manage these factors?

Brewing

- What hops will deliver to my customer's/ brewer needs?
- How can I adjust my farming practices to maximize hop quality?
- How do we measure hop quality?

Customer

- What hops will give me the aroma and flavor I need?
- How do I measure hop quality before brewing?
- Brewing parameters?

- What hop aroma and flavor drives drinker overall liking?
- Beer Specifications?
- How do we monitor changing needs?

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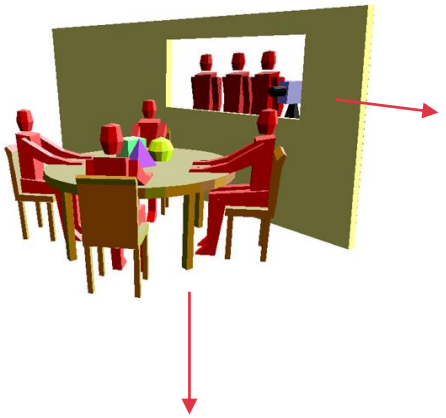
Innovative Consumer Research

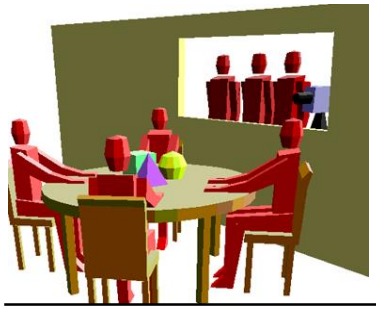
Customer

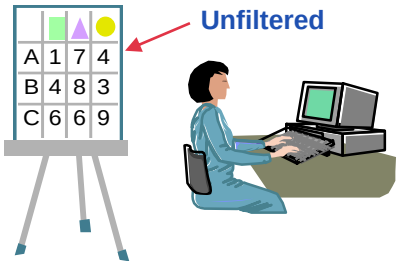
Traditional Focus Groups



Reactions, comments, responses

Innovative Focus Groups





Reactions + Scoring = Data

Data + Statistics = Flavor Requirements

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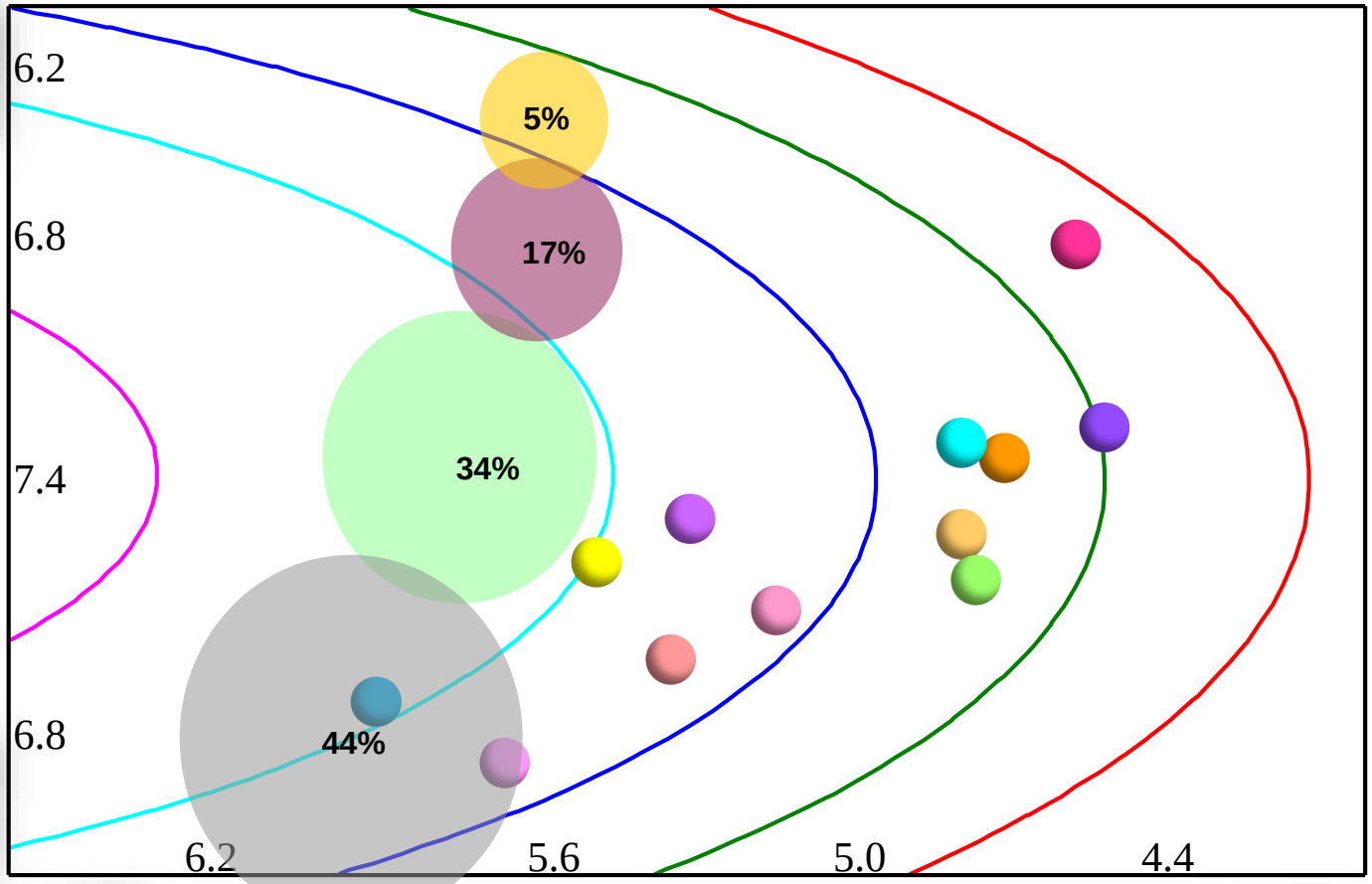
Descriptive Sensory Analysis

Brewing



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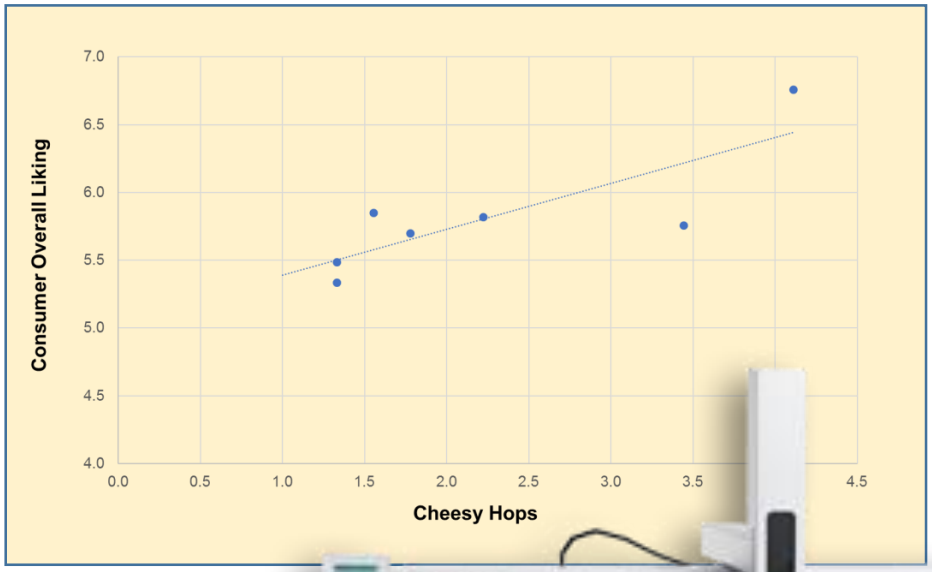
Consumer, Sensory and Chemistry

Ingredients

Hops



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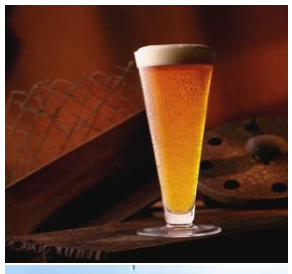



Basics of Sensory

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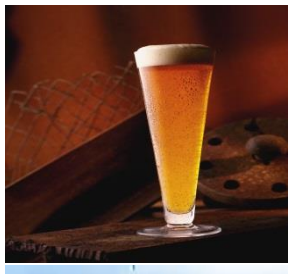
Basics of Sensory





Sensory analysis is defined as:

The use of people as instruments to measure sensory response to stimuli

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Basics of Sensory

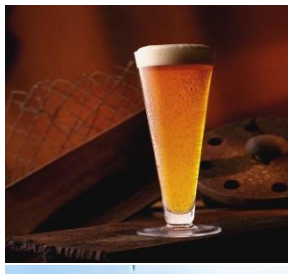
Everything is Safe to Smell and Taste

Basics of Sensory

Flavor is comprised of three components:

1. Basic tastes
2. Aromatics
3. Mouthfeels

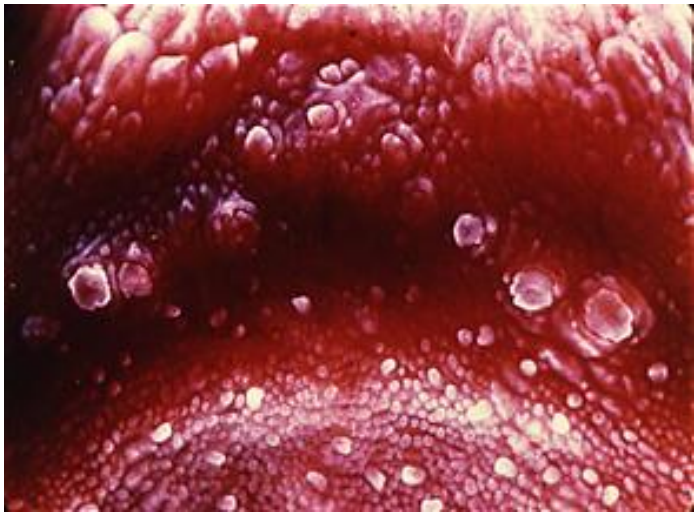
Basics of Sensory



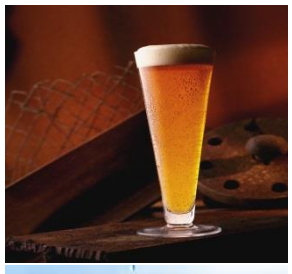


1 Basic tastes

Taste refers to those sensations perceived through the stimulation of the receptor cells enclosed within the taste buds on the tongue.



Basics of Sensory



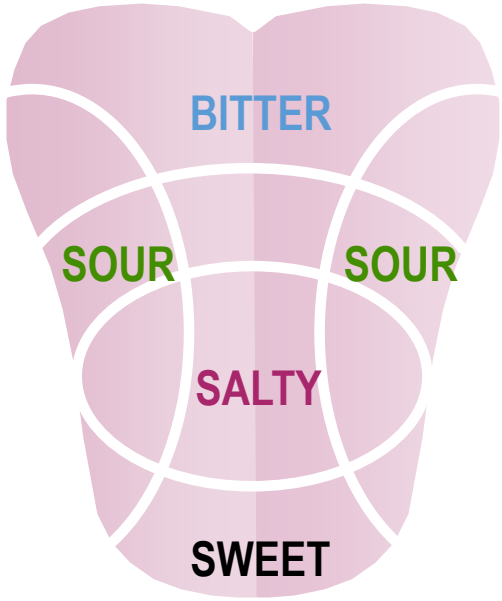


1 Basic tastes

Basic Taste	Sensed more on…
Sweet	…tip of tongue
Salty	…all over tongue
Sour	…back sides of tongue
Bitter	…back of tongue

Umami	…middle of tongue

We have all the taste buds all over the tongue…

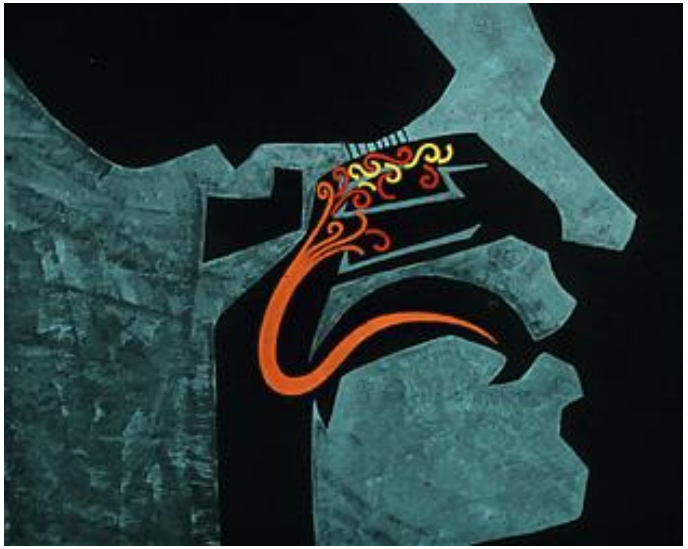


however, we sense the different basic tastes more in some regions than others.

Basics of Sensory

2 Aromatics

Aroma Aromatics are perceived through stimulation of the olfactory receptor cells and the free nerve endings of the trigeminal nerve.



Flavor aromatics are compounds volatized in the mouth, travel up the back passage, and are detected in the olfactory region of the nose.

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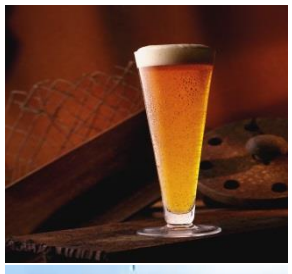
Basics of Sensory





3 Mouthfeels

Mouthfeels are chemical or physical sensations which are detected in the mouth, nose, or throat.



- **Astringent**
- **Dry**
- **Tannin**
- **Harsh**
- **Bite and burn**
- **Yeasty**

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Beer Flavor





BASIC TASTES	AROMATICS	MOUTHFEELS
Sweet	**Hops**	**Astringent**
Sour	**Yeast**	**Dry**
Bitter	**Grain**	**Yeasty**
Salt (rare)	**Fruity**	

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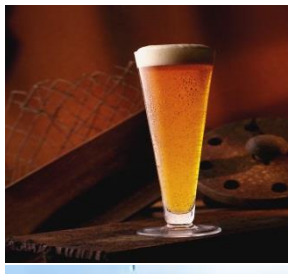
Beer Flavor





To Be Successful Everyone Must Be Customer Focused

Communicate a promise/image of an appealing product

Consistently deliver the beer flavor the consumer wants

Have the "right" package

Produce and distribute the product economically

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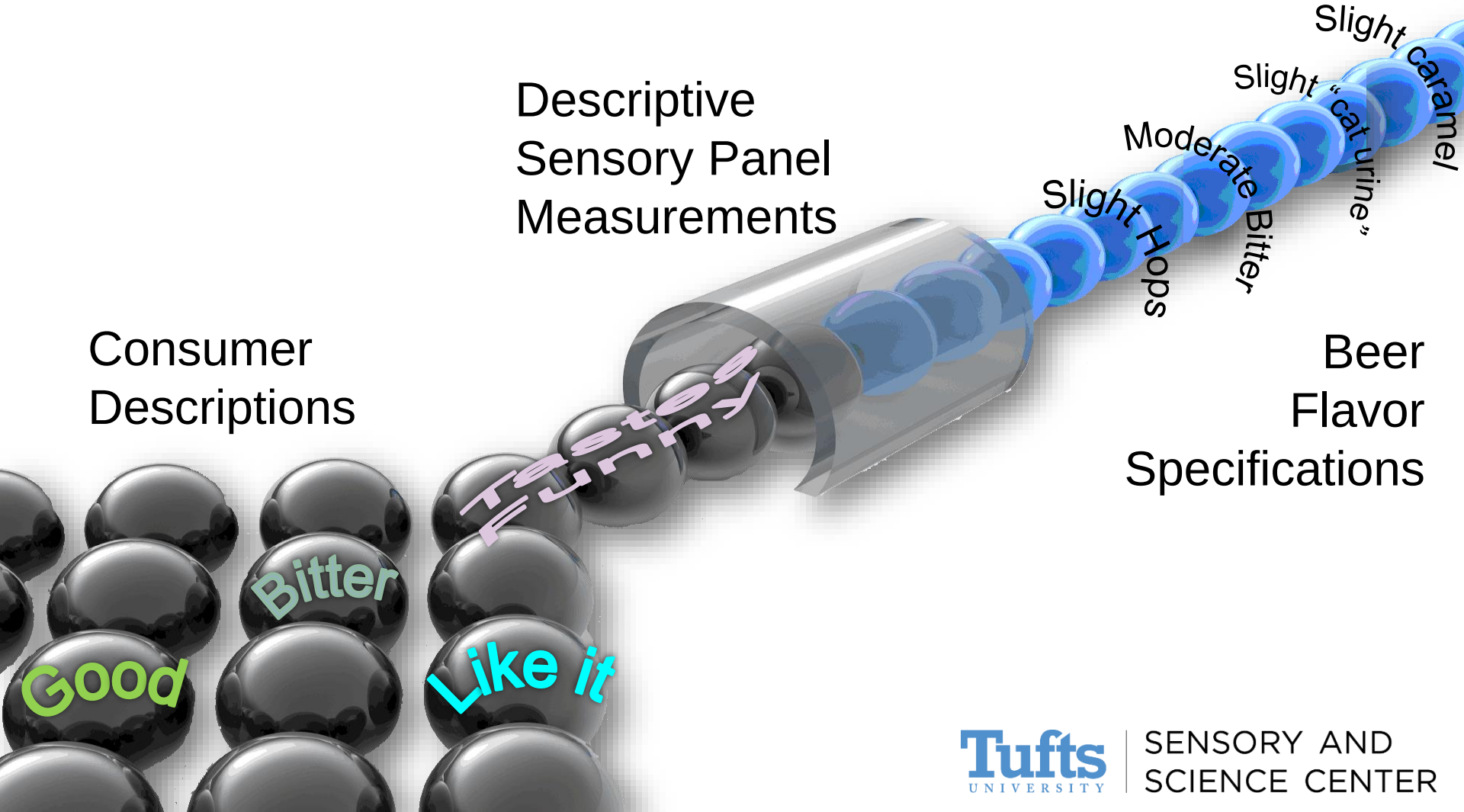
Beer Flavor

“The Sensory Translator”



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Beer Flavor

“The Answer”

	Flavor Leadership Criteria	
1	**Aromatic Identity**	◆ Immediate impact of identifying flavor
2	**Amplitude**	◆ Rapid development of balanced, full flavor
3	**Mouthfeel**	◆ Compatible mouthfeel factors
4	**Off-notes**	◆ No “off” flavors.
5	**Aftertaste**	◆ Short clean aftertaste

Hops

Aroma Characteristics of Hops

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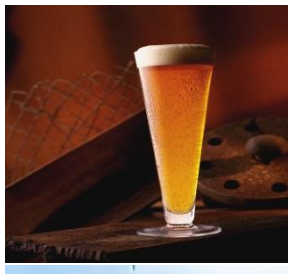
Hop Aroma

Jean De Clerck* wrote in reference to evaluating fine aroma hops:

"Aroma is tested by smelling a crushed handful of whole cones. The hops should have a pronounced aromatic smell free from extraneous taints and odors, [list of unpleasant odors]. Smell may also be tested by rubbing the cones between the fingers which splits the lupulin grains. The aroma of the sample should not be sharp, but fine and mellow."

*De Clerk, J. A Textbook of Brewing. Vol. 1, p. 65, Chapman and Hill Ltd, London, 1958.

Hop Aroma





Odor Recognition Bottles

1. Fenchyl alcohol: Musty/Camphor
2. Methyl butyric acid: Cheesy/sweaty
3. Citral: Lemon/citrus
4. Beta pinene: Piney/mentholic
5. Hexanoic acid: Sweaty/BO/cheesy

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Hop Aroma





Common Hop Descriptors

Fruity
Citrus
Lemon
Grapefruit
Orange
Tropical

Herbal
Sage
Basil
Oregano
Thyme
Minty

Vegetable
Cabbage
Broccoli

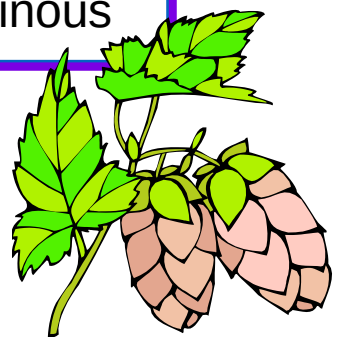
Other
Skunky
Brothy
Urine
Skunky
Briny
Musty
Earthy
Dirt
Resinous

Cheesy
Stinky
Rancid
Sweaty
Body odor

Floral
Perfumy
Rose
Geraniol
Lavender
Tobacco

Green
Grassy
Stemmy
Leafy
Tea

Spicy
Peppery
Ginger
Onion



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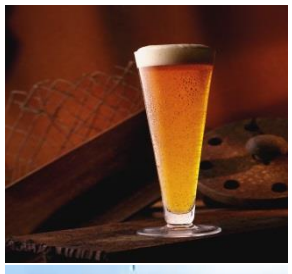



Sensory-Directed Chemical Analysis

Hop Study

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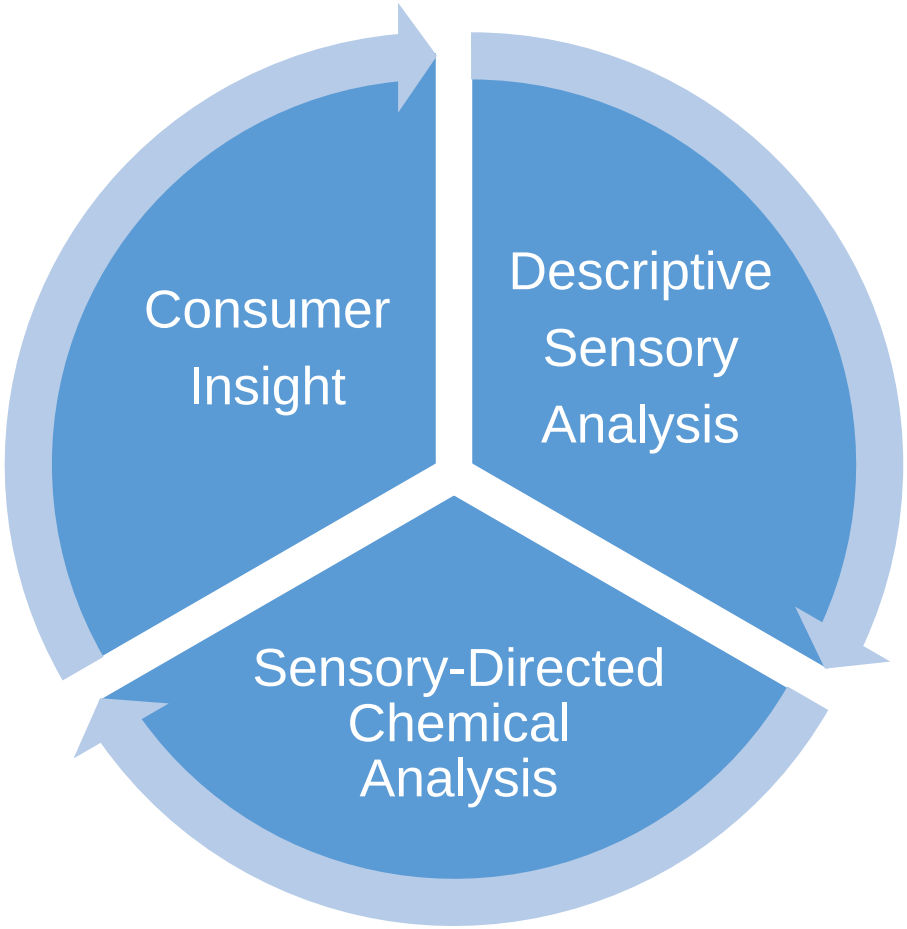
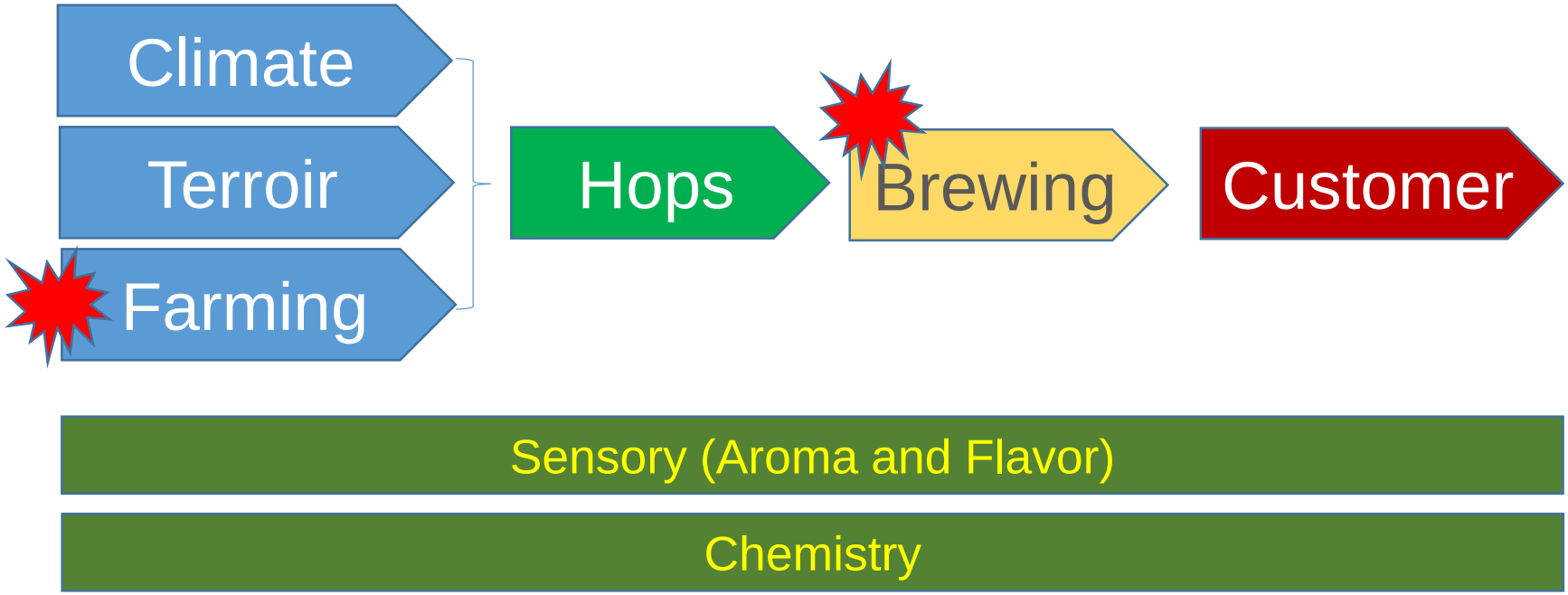
Sensory-Directed Chemical Analysis



Hop Research Using Sensory



Typically, consumers react to five types of beer…

Neutral
- Pilsners, Lagers

Grain-led
- Porters, Stouts, Brown Ales

Hop-led
- IPAs

Other/Fruit/spice-led
- Lambics, Sours, Jalapeno

Yeast-led
- Hefes, Belgian Whites

This example study focused on Hop-led beers.

Beers used in study:

IPA (65 IBU)

IPA (60 IBU)

IPA (45 IBU)

IPA (42 IBU)

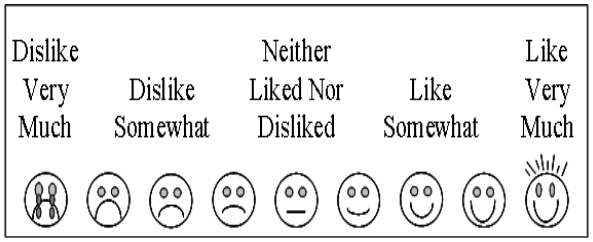
American Pale Ale (42 IBU)

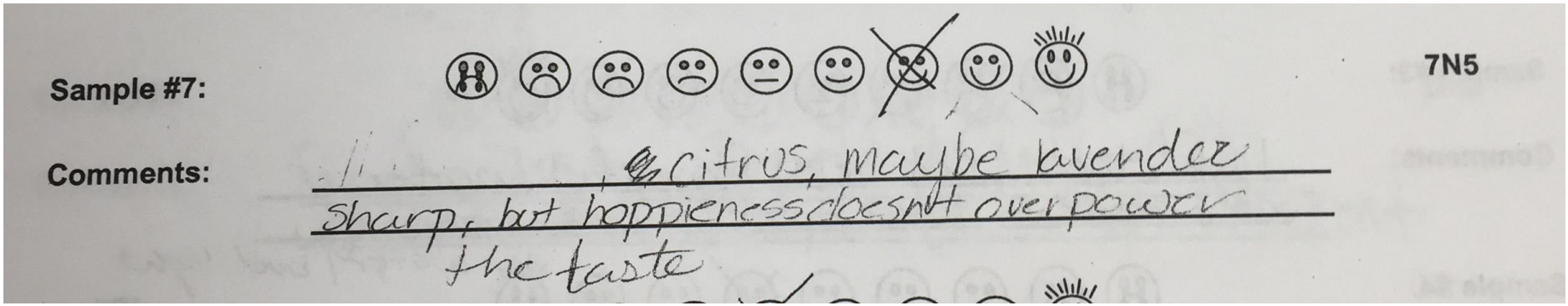
American IPA (> 40 IBU)

Pale Ale (38 IBU)

Neutral (17 IBU)

Innovative Consumer Testing





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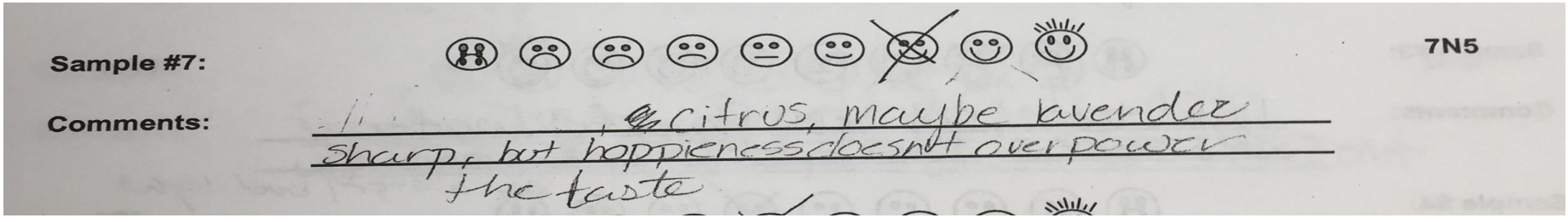
Innovative Consumer Testing



Weird Flavor No Weird to Strong Weird	**Hops** Not Hoppy to Very Hoppy
Roast Not Roasted to Very Roasted	**Fruity** No Fruity to Strong Fruity
Strength of Flavor Bland to Strong	**Bitter** No Bitter to High Bitter
Mouthfeel No MF to Strong MF	**Aftertaste** No AT to Strong AT
Sweet Not Sweet to Very Sweet	

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Innovative Consumer Testing

Category	Scale Low → High	Descriptive Words
Weird Flavor	No WF → Strong WF	Soapy, Armpits, Old lettuce, Funky, Skunky, Yeasty, Urine, Sp. Milk
Roast	Not Roasted → Very Roasted	Malty, Spice, Caramel, Sl. Coffee, Coffee, Nutty, Stout-like, Dry wood, Nutty, Mild Malty, Toasty, Sl. smoky
Strength of Flavor	Bland → Strong	Strong, Light, Watery, Rich, Bold, Weak, Mild, Plain, Bland, Flavorful, Neutral, Heavy
Mouthfeel	No MF → Strong MF	Dry, Complex, Full Bodied, Stinging, Clean, Sticky, Smooth, Milky, Grainy, Thin, Chalky, Thick, Rich, Sharp, Flat
Sweet	Not Sweet → Very Sweet	Sweet
Hops	Not Hoppy → Very Hoppy	Strong Hops, Med. Level Hoppy, Hoppy, A Little Hoppy, More Hoppy, V. Hoppy, Not Too Hoppy, Piney, Floral
Fruity	No Fruity → Strong Fruity	Citrus Flavor, Lemon, Pineapple, Juicy, Grapefruit, Mango, Slight Fruity, Apricot, Cherry
Bitter	No Bitter → High Bitter	Strong Bitter, Bitter, No Bitter, Not Very Bitter, Sl. Bitter
Aftertaste	No AT → Strong AT	Lingering AT, Bitter AT, Weird AT, No AT, Smooth AT, Hoppy AT

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Descriptive Sensory Analysis

- Highly trained, experienced tasters
  - Completed formal training
  - Passed standard exam for proficiency
- Profile Attribute Analysis (PAA)
  - Score sheet approach based on the Flavor Profile Method (ASTM)
- Panel design:
  - Random order
  - Samples served blind to panel
  - Three replicates for each sample
  - Served between 6-8°C
  - Served one at a time

PAA Panel Sheet

Attribute:	Sample:
Balance	1 2 3 4 5 6 7
Fullness	1 2 3 4 5 6 7
Overall Hop Int.	1 2 3 4 5 6 7
Hop Complexity sl/1-2, md/3-4, st/>4	1 2 3 4 5 6 7
Citrus Hop Int.	1 2 3 4 5 6 7
Floral Hop Int. ie-floral, frsh grass	1 2 3 4 5 6 7
Veg/Sulf Hop Int. ie-broc, beany	1 2 3 4 5 6 7
Herb/spicy Hop Int. ie-herbs, piny, tea	1 2 3 4 5 6 7
Cheesy Hop Int. ie- cheesy, sweaty	1 2 3 4 5 6 7
Other Hop Int. ie-cat urine	1 2 3 4 5 6 7

Grain Intensity Type:	1 2 3 4 5 6 7
Alc/fruity Type:	1 2 3 4 5 6 7
Sour	1 2 3 4 5 6 7
Bitter	1 2 3 4 5 6 7
Mouthfeel Type:	1 2 3 4 5 6 7
Others Type:	1 2 3 4 5 6 7
Aftertaste	1 2 3 4 5 6 7

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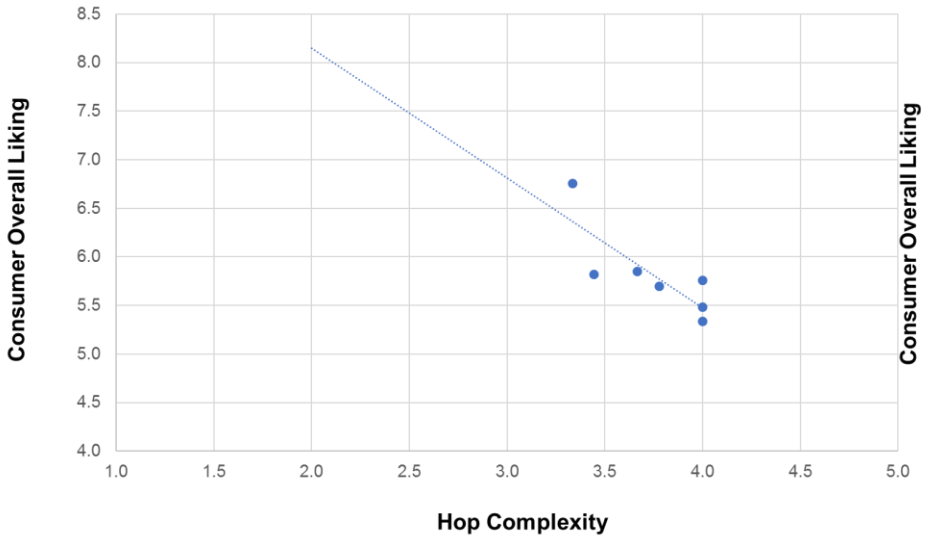
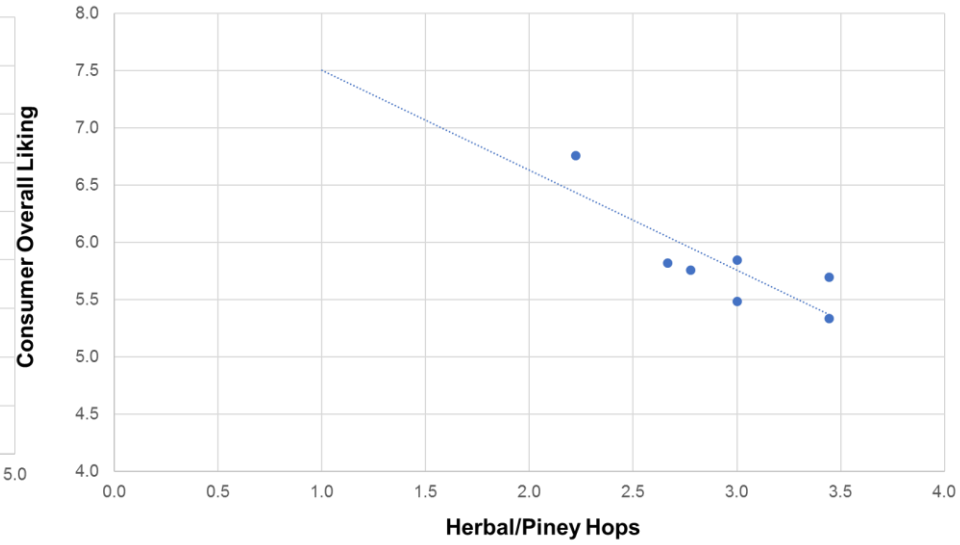
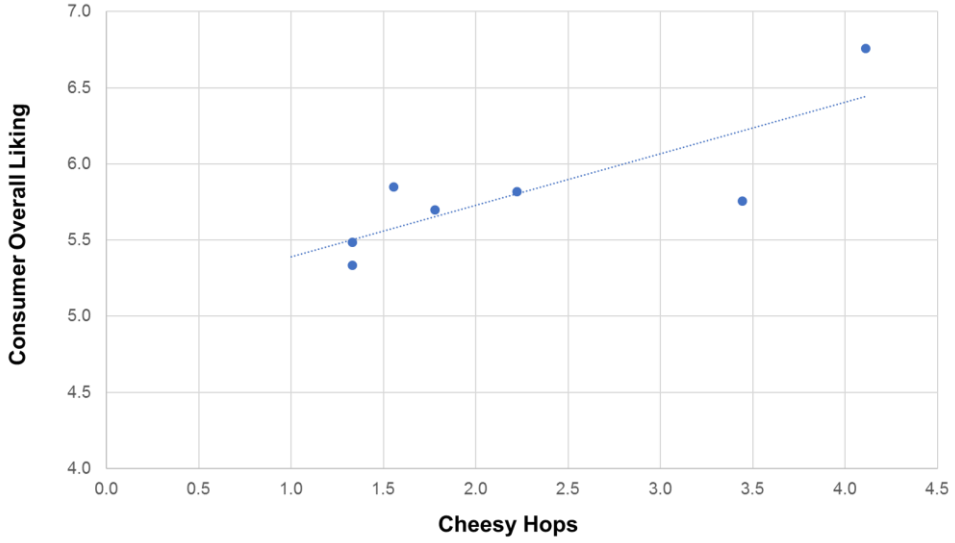
Overall Liking vs. Descriptive Panel







Attribute	Correlation
Hop Complexity	-0.7835
Herbal/Piney	-0.8662
Cheesy	0.8536

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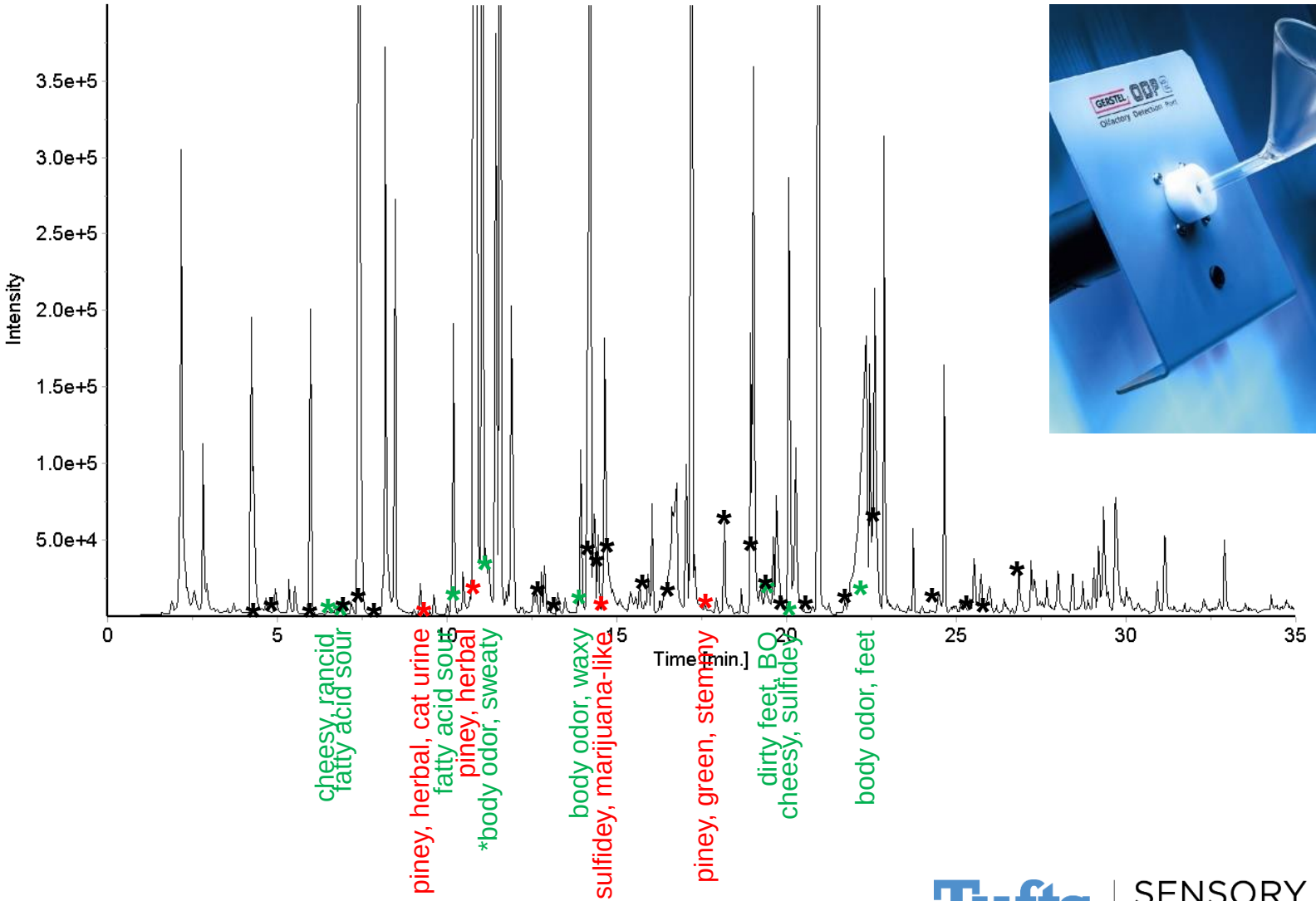
Sensory Directed Chemical Analysis

Sensory Directed Chemical Analysis



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Preliminary Findings

- Craft beer drinkers prefer hop-led beers with cheesy, fatty acid sour characteristics more than beers with piney, herbal characteristics

- The most liked hop-led beer in this study had cheesy, fatty acid sour characteristics, including:
  - Isovaleric acid, Butyric acid, Isobutyric acid
  - Hexanoic acid, 2-methyl-2-pentenoic acid
  - Unknown(s)

“Big Picture”

- Conduct experiments with a range of hops to:
  - Analyze chemical profiles of hop starting materials
  - Understand hop chemistry that ends up in beer
  - Identify chemical changes to hop-related chemistry that may occur during brewing process
  - Correlate hop-related chemistry in final product to overall liking by craft beer drinkers
  - Link hop-related chemistry that drives craft beer drinker overall liking back to hop varietal
    - Work with brewers to optimize hops in their recipes
    - Work with hop farmers to understand how climate and growing conditions affect desirable chemistry in the hops

We are Filling the Information Gaps

Climate

Terroir

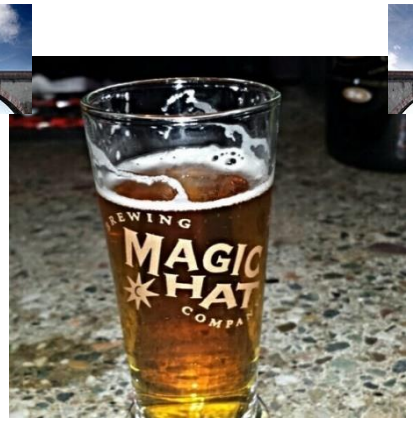
Other

Hops

- What factors out of my control affect hop quality and how?
- How can I manage these factors?

- What hops will deliver to my customer's/ brewer needs?
- How can I adjust my farming practices to maximize hop quality?
- How do we measure hop quality?

Brewing



- What hops will give me the aroma and flavor I need?
- How do I measure hop quality before brewing?
- Brewing parameters?

Customer

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- Beer Specifications?
- How do we monitor changing needs?

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