The Science of Beer and Food Pairing

August 13, 2016
Presented by the Beer & Food Working Group

Our Group

Lindsay Barr, MA
Ray Daniels @CIcerone_Org
Chef Adam Dulye @AdamDulye
Pat Fahey @PatFah24
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Julia Herz @HerzMuses
Randy Mosher

Beer Pairing
State of the Art

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Our Mission

- Inherited a process for pairing from wine
- This working group could have taken up the process of consensus-making
- Instead we’ve chosen a disruptive path with science at its core
- For now: necessarily incomplete; potentially frustrating.
- This is what progress looks like...

Warm Up/Wake Up Exercise

From the big picture to the nitty gritty of human anatomy and physiology

Sensory 101: What is Flavor?
We use all of our senses to detect individual notes.

Flavor is in the Brain! Data integration leads to perception.

Then we take action.

When it comes to flavor, there are only two choices of action...

What you bring to the table...

Detection and Identification: Combination of Genetics and Practice

Detection, due to genetics

Identification, due to practice

Genetics (inherited biology)

Adaptations (learned biology)

Cultural Experiences (emotions, nostalgia, familiarity)
Preference: Combination of Genetics, Cultural, & Biological Experiences

Aroma is Synthetic: “Firing” Pattern Leads to Detection and Identification

Aroma is a “learned sense”
- Identification
- Preferences
Possible 10k-100k identifiable aromas

If you only learn one thing about taste, remember this...

Quick Detour on Genetics

Your DNA is like a cookbook just for your body
We have 25,000 genes, and each gene is like a recipe that makes something our body needs to survive.

**Focus on bitter:**
Is this bitter to you or does it just taste like paper?

**Small changes in your DNA change your taste detection ability**

**IMPORTANT:** There are 25 confirmed bitter taste genes, each for different groups of bitter taste molecules, this is not the same as the genes for alpha acids.
Theory of Supertasters

Theory that flavor sensitivity is increased to "super" if you have high density of fungiform papillae (bumps on your tongue that house your taste buds).

Data from the Genetics of Taste Lab Challenges “Supertaster” Theory

If taste helps us survive, why only 5?

Genetics✓ Papillae ≠

Garneau et al. 2014

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Taste Anatomy
What about the fats in our diet?

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Tucker et al. 2015; Garneau et al., submitted

Running et al. 2015

YES!

Oleogustus

Mouthfeel
(Touch in the Mouth)

If you only learn one more thing about taste, remember this...

Spicy is NOT a taste, it is a mouthfeel!
The senses that originate from the mouth and contribute to flavor.

Three types of interactions that can occur with flavors originating from the mouth.
**Sensory Tests**

- **Discrimination** – Analytic test that asks *if* products are different.
- **Descriptive Analysis** – Analytic test that inform *how* products differ.
- **Affective** – Hedonic test that answers *how well* the products are liked.

*The test method must match the objective*

**Descriptive Analysis**

- **Who** – Highly trained expert panelists
- **Answers a whole mess of questions!**
  - “Where does my product fall in comparison to others?”
  - “Why are the products different?”
- **When paired with hedonics, DA can even answer:** “What are the sensory drivers of liking?”
- **When using highly trained validated panelists you can get away with using only about 10 individuals.**
- **Free form descriptions v. scaling of attributes**

**Affective Testing**

- **Who** – *Untrained* product users
- **When the question is:** how much *is* the product liked and how does that compare to other products.
- **Preferences vary widely amongst users so these tests require very large numbers to achieve a normal distribution of responses.**

**Training**

- **Language Development** – Develop and standardize terms
- **Scale Development** – Frame of reference for intensities
- **Achieve panel consensus on the scale and definitions of terms**
- **Continue training at a regular intervals**
Vocabulary Generation

- Term generation
  - Select samples that span the range of concern
- Brain dump
- Terms should be:
  - Orthogonal – Non-redundant, independent, unrelated
  - Singular – Specific, having only one meaning... but what about complexes?
  - Clearly defined – Anchored on references

Scale Alignment

- Perception varies from person to person so it is imperative to clearly define each attribute and anchor on intensities.
- Outlier determination, realignment in the case of scale misuse

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Definition</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generated</td>
<td>Aromas reminiscent of the sweet, heavy smell of floral, cherries, or citrus芳</td>
<td>General</td>
</tr>
<tr>
<td>Green Tea</td>
<td>Green green aromas like: white grape, rose, white tea, herbal, light fruit. Minty green tea leaves.</td>
<td>General</td>
</tr>
<tr>
<td>Grass</td>
<td>Fresh, juicy, melon-like, fresh green grass, herbal, licorice. Minty green tea leaves.</td>
<td>General</td>
</tr>
<tr>
<td>Grapefruit Peel</td>
<td>Zesty citrus with a pith, bitter peel. Grapefruit peel.</td>
<td>General</td>
</tr>
<tr>
<td>Limonade</td>
<td>Light floral, like lemonade, and a few more florals. Like France Liqueur, citrusy.</td>
<td>General</td>
</tr>
<tr>
<td>Moxinana</td>
<td>Fresh, floral, with herbal, citrus, woody, spicy and smoky. Moxinana.</td>
<td>General</td>
</tr>
</tbody>
</table>
Running a Descriptive Analysis Panel

• Scale Development and Validation Using Sweet
  – Evaluate the three sweet standards in front of you to align the concept of sweet intensity.
    • Sample #1: Low = 2
    • Sample #2: Medium = 4
    • Sample #3: High = 8
  – After grounding on the three standards, evaluate the two sweet tests using this Survey Gizmo link: http://goo.gl/B3Z2pv
    • Sample A: ?
    • Sample B: ?

Rinse your mouth with plenty of water between samples.

Stay tuned, we will see how you did after the break but for now you’re in good hands with...

Free Form Pairing Exercise

Science ✓
Methods ✓
Now let’s do one for yourself: two beers, two cheese selections = 4 pairings
Pairing Lexicon

a.k.a. the language of pairing

Lexicon

1. a wordbook or dictionary, especially of Greek, Latin, or Hebrew.
2. the vocabulary of a particular language, field, social class, person, etc.

Pairing

[pair-ing]
1. a coupling.

Language

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Complement, Resonate, Harmony, Accentuate, Cancel, Contrast, Cut, Soften, Clash, Soothe, Create, Diminish (Intensity), Impact, Weight

Cicerone Syllabus

Resonate, Balance, Cut, Harmony, Emphasize, Enhance, Match, Contrast, Complement, Tame, Blend, Overwhelm, Cleanse (Intensity)

Tasting Beer

Match, Refresh (the palate), Highlight, Cut, Harmony, Complement, Fend Off, Balance, Overwhelm, Play Off (one another), Clear (the palate), Lift (from the palate), Scratch (from the palate), Link, Marry With, Counteract, Soothe, Melk Into, Latches Onto, Wake Up, Cancel, Pair, Blend, Match On, Lift Up, Clash, Brighten (Impact)

Brewmaster’s Table

Balance, Settle, Match, Intensify, Calm, Transfer, Enhance, Cleanse, Counter, Increase, Cut, Complement, Decrease, Resonate, Clash, Contrast, Lift, Overwhelm, Cleanse (Intensity)

BA Beer & Food Guide

Contrast, Cut, Lift (from the palate), Tame, Mirrored, Complement, Match, Balance, Stand Up (to something), Highlight, Overpower, Works Well, Pairs Well, Pick Up On, Tie In To, Counter, Latch On, Temper, Pull Out, Counteract, Bring Out, Blend, Support, Envelop, Punch Through, Amply, Boost, Scour Away, Catch

General Publications

Contrast, Cut, Lift (from the palate), Tame, Mirrored, Complement, Match, Balance, Stand Up (to something), Highlight, Overpower, Works Well, Pairs Well, Pick Up On, Tie In To, Counter, Latch On, Temper, Pull Out, Counteract, Bring Out, Blend, Support, Envelop, Punch Through, Amply, Boost, Scour Away, Catch

CBC Group Lexicon

Julia: Complement, Harmony, Bridge, Echo, Bridge, Create/Contrast, Cut
Randy: Recreation, Synthesis, Potentiation, Amplification, Calming, Soothing, Masking, Cancel

Magnitude Scale

Groups: New, Emphasis, Neutral, Lessened, Negated

Who’s Who of Pairing Language

What About Wine Pairing Terms?

• “Buy on an apple and sell on cheese”
  • Malic acid in apple intensifies acidity and tannin in wine
  • Lactic acid in cheese softens, rounds off wine

• “White wine with fish; red wine with meat.”

Getting Everyone On the Same Page

• What kinds of interactions happen during pairing
  • How we perceive them
  • How we describe them
When Beer Meets Food

Pairing leads to discussion that may include the following:

- Balance/Intensity
  - How much flavor in each
  - Ability of the two to play nicely together
- Interaction: How the presence of one affects perception of the other
  - Basic level: flavors (tongue tastes)
  - Advanced: aromas (olfactory stimulus)
- Synergy: New flavors unseen in either alone

Two Measures of Intensity

- Overall: holistically describes level of flavor in a given beer or dish
- Scientifically: two dimensions
  - Detection Intensity
  - Hedonic Intensity
    - Taster’s degree of like/dislike
    - Experience-dependent factors
- Overall Intensity = Detection Intensity as modified by Hedonic Intensity

Two Measures of Intensity

<table>
<thead>
<tr>
<th>Detection Intensity</th>
<th>Hedonic Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely Weak</td>
<td>Dislike Extremely</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Extremely Strong</td>
<td>Like Extremely</td>
</tr>
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<td></td>
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</tbody>
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How intensely you detect a flavor characteristic at a given strength.
Balance or Intensity

- Everyone talks about this in some way
- Idea: flavor quantity or intensity from each part of pair
  - Intensity, balance, compatibility
  - Overwhelms, gets lost, etc.
- Can identify intensity factors in both food and beer
- Goal:
  - Generally look for similar levels between the partners
  - This alone doesn’t make a good pairing or avoid bad ones
  - More a necessary pre-condition

Balance or Intensity

<table>
<thead>
<tr>
<th>Beer Intensity</th>
<th>Food Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Maltiness/Alcohol</td>
<td>• Ingredient</td>
</tr>
<tr>
<td>• Hop Flavor/Aroma</td>
<td>• Cooking method</td>
</tr>
<tr>
<td>• Bitterness</td>
<td>• Spices, sauces, garnish</td>
</tr>
<tr>
<td>• Roast and smoke character</td>
<td>• Acidity</td>
</tr>
<tr>
<td>• Fermentation traits:</td>
<td>• Bitterness</td>
</tr>
<tr>
<td>• Fruity, spicy, tart</td>
<td>• Mouthfeel</td>
</tr>
<tr>
<td>• Mouthfeel</td>
<td>•</td>
</tr>
</tbody>
</table>

Interactions

- How the juxtaposition affects perception of each partner
  - Basic level: taste (tongue tastes)
    - Most limited set of interactions
    - Focus of our initial work should yield specific and tangible recommendations
  - Advanced: aromas (olfactory stimulus)
    - A vast matrix of possibilities
    - Conclusions will have to be generalized
  - Whole package/all senses (even more complicated)
- In all cases, various outcomes
Compare & Contrast:
Sweet vs. Salty with Double IPA

Pairing Steps in A Nutshell
1. Consider your beer and food elements separately.
2. Find flavor harmonies
3. Think about potential interactions
4. Carefully match overall intensities
5. Perform a test tasting (and describe what stands out)
6. Tweak and modify the pairing

Umami
a. combining the Japanese characters for delicious and taste.
b. the name for the fifth basic taste
c. originally defined (1908) as coming from the salt of glutamic acid, later other umami taste substances identified from inosinate (animal protein) and guanylate (plant-based; mushrooms)
simply defined: umami harmonizes tastes and aromas, the two main components of flavors and in doing so heightens the sensation of both

*it takes cooking, curing or fermentation to bring out the glutamates and unleash the savory on your palate
Maillard Reaction

The important thing about the Maillard reaction is that once you have achieved the color it's no longer about the color, it's the flavors and aromas. In cooking it is "the flavor reaction," not the "browning reaction." The molecules provide the intense aromas responsible for the familiar smells of roasting, baking, and frying.

The Pairing

rye bread with hummus w/

Combining the Maillard Reaction “aroma” of the rye bread with the umami from the hummus (garbanzo beans contain glutamic acid)

Future of Pairing

Science: Conducting Research to Support Knowledge

Lindsay and Nicole

Everyday people using their spare time to "create content, solve problems, even do corporate R&D." ~Jeff Howe

Wired Mag 2006
Crowdsourcing’s Family Tree

Crowdsourcing & the Scientific Process

Our Crowdsourced Sensory Research

Experimental Design

- Objective: Generate hypotheses surrounding what drives the liking of food and beer pairs.
- Consumers scaling for overall liking:
  - Three foods chosen to highlight umami, sweet and spicy.
  - Four very different beer styles: Brown, Hefe, Stout and IPA
  - Each combination of food and beer
- Expert Descriptive Analysis Panelist scaled tastes and mouthfeels (sweet, sour, salty, bitter, umami, fatty, astringency, irritation, body) for the three foods and four beers individually and as a pair.
Did the Pairings Achieve What we Expected?

- High Preference for Umami- Brown Pairing
  - the Brown Ale was significantly more preferred than the Hefe, Stout and IPA when paired with umami
  - The Stout was significantly less preferred than the other beers.

Taste and Liking Correlations

Mouthfeel and Liking Correlations
Umami Example

- Taste beer with nose plugged, scale sweet, umami and body
- Taste food with nose plugged, scale sweet, umami and body
- Taste both with nose plugged, scale sweet, umami and body

- Taste beer with nose unplugged and scale liking
- Taste food with nose unplugged and scale liking
- Taste both with nose unplugged and scale liking

Best Practices and Caveats

1. Randomization is logistically difficult but important
2. Have lots of water available
3. Inform participants about the basic food ingredients (being careful to avoid bias) as to not expose anyone to allergies or aversions
4. Pairings should be in order of the foods, not beers
5. Less is more. Fatigue comes into play so it is best to ask more questions with fewer pairings.
6. Pre-taste beers and foods to make sure they don’t overpower one another
7. Do a dry run

Bringing It All Together

Cheers to your own beer pairing journey!