Relationships Between Descriptive Beef Flavor Attributes and Consumer Liking

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Outline
- Introduction
- Whole Muscle Beef Flavor Lexicon
- Use of the Beef Flavor Lexicon
  - Heavy beef eaters
  - Light beef eaters
- Consumer perceptions of beef flavor
- Relationships between flavor attributes and consumer liking
- Millennial and Non-Millennial consumers
- Conclusions

Why is Beef Flavor Important
- Consumers have indicated that flavor is an important aspect of beef demand (NCBA)
- Beef flavor is complicated as it is impacted by:
  - Lean component
  - Lipid component
  - Heat effects
  - Maillard reactions between reducing sugars and amino acids
  - Fatty acid and phospholipid composition
  - Lipid oxidation and heat denaturation
  - Level of heat applied and degree of doneness

Data will be presented from 4 Beef Check-off Funded projects from 2009 to 2014
- Whole muscle beef flavor lexicon (Adhikari et al. 2011)
- Relationships of beef flavor descriptors and volatile flavor aromatics (Miller and Kerth, 2012; Aquirre et al., 2014; Laird et al., 2014)
- Relationship between beef flavor descriptors and heavy beef eaters (Miller et al., 2013; Glascock, 2014)
- Relationship between beef flavor descriptors and light beef eaters (Miller et al., 2014; Luckemeyer et al. 2015)
- Compare Light and Heavy beef eaters that are millennial and non-millennials

The Lexicon — Adhikari et al. (2011)

<table>
<thead>
<tr>
<th>Major notes</th>
<th>Sour</th>
<th>Spoiled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef Identity</td>
<td>Salty</td>
<td>Warmed-Over</td>
</tr>
<tr>
<td>Brown/ Roasted</td>
<td>Bitter</td>
<td>Animal Hair</td>
</tr>
<tr>
<td>Bloody/Serumy</td>
<td>Umami</td>
<td>Dairy’</td>
</tr>
<tr>
<td>Metallic</td>
<td>Liver-like</td>
<td>Coca’</td>
</tr>
<tr>
<td>Fat-like</td>
<td>Green-hay</td>
<td>Green</td>
</tr>
<tr>
<td>Overall Sweet</td>
<td>Chemical</td>
<td>Leather’</td>
</tr>
<tr>
<td>Sweet</td>
<td>Burnt</td>
<td>Sour Daisy’</td>
</tr>
<tr>
<td>Sour Aromatics’</td>
<td>Rancid</td>
<td>Cooked Milk’</td>
</tr>
</tbody>
</table>

Other notes
- Smoky – charcoal, Smoky – wood, Buttery, Refrigerator-stale, Soapy, Barnyard, Heated oil, Asparagus, Cumin, Floral, Beet, and Petroleum-like
- *Aroma only
Select Top Choice and Select top loin steaks
-0.5
Top Choice and Select bottom round roasts
TLoin

Select top sirloin steaks
TLoin

Select strip steak = 5.5
Top Choice and Select bottom round roasts
TLoin

Top Choice and Select top loin steaks
-0.5
Top Choice and Select flat iron steaks
Top Choice and Select bottom round roasts

Internal cooked temperature endpoints: 58, 70, or 82°C (137, 158 or 176°F)

Cook methods
- Steaks: George Foreman Precision Grill set at 375°F or Serrano gas grill at 450°F
- Roasts: standard gas oven at 325°F crock-pot with liquid and cooked on low.

Relationships of beef flavor descriptors and volatile flavor aromatics (Miller and Kerth, 2012; Aquirre et al., 2014; Laird et al., 2014)

Cuts
- Top Choice and Select top loin steaks
- High pH top loin steaks (pH > 6.0)
- Select top sirloin steaks
- Top Choice and Select flat iron steaks
- Top Choice and Select bottom round roasts

References
- Aquirre et al., 2014; Laird et al., 2014

Principal component analysis of trained descriptive flavor attributes, cooking treatments and consumer liking for heavy beef eaters

Measured
- Expert, trained beef flavor descriptive attribute panel using the Beef Lexicon
- Consumer overall, flavor, beef, grill liking
- Volatile aromatic compounds
- Chemical attributes on raw: fatty acids, pH, myoglobin, non-heme iron, lipid/moisture %

What Flavors do Moderate to Heavy Beef Eaters Like?
- Select top sirloin steaks George Foreman 176
- Select top sirloin steaks George Foreman 176
- Select bottom round roast crockpot 137
- Select bottom round roast George Foreman 176

Partial least squares regression bi-plot using beef flavor attributes and volatile aromatic compounds.
Heavy and Light beef eaters
Millenial versus Non-Millenial

✓ Combined two previous research studies
✓ Removed Tenderloins from Light beef eaters study
✓ Used aromatic compounds common to both studies (n=49)
✓ Examined Light Millenial, Light Non-millenial, Heavy Millenial, and Heavy Non-millenial consumers
Correlations with $t$ on axes $t_1$ and $t_2$ for light and heavy beef eaters

Correlations on axes $t_1$ and $t_2$ for non-millennial heavy beef eaters

Correlations on axes $t_1$ and $t_2$ for millennial light beef eaters

Correlations on axes $t_1$ and $t_2$ for non-millennial heavy beef eaters

Correlations on axes $t_1$ and $t_2$ for millennial light beef eaters

Word cloud from Wordle.net of consumer positive comments from (a) heavy beef eaters and (b) light beef eaters.

Word cloud from Wordle.net of consumer negative comments from (a) heavy beef eaters and (b) light beef eaters.
Conclusions and what is next!

- Flavor is a predominant driver of consumer overall liking
- **What do consumers NOT like?**
  - Liver-like, cardboardy, ketones, aldehydes, benzaldehydes
- **What do consumers like?**
  - Fat-like, pyrazines, grill flavor, Maillard reaction products, brown/roasted, beef identity, sweet, salt & umami
  - Metallic & serumy/bloody related
- Millennials versus Non-Millennials do not differ in response to flavor of beef; other factors drive consumption other than palatability factors
- **Current**: Light, heavy, millennial, & non-millennial response to beef, pork and chicken
  - Central location
  - In-home placement
- **Future**: Ground beef and flavor drivers

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