Plant-based meat analogues: The Taste challenges and prospects.

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Outline

1. Types of protein sources of Meat analogues
2. Taste is paramount in plant-based protein products
3. Anatomy of plant-based meat analogues
4. Multi-dimensional taste and aroma challenges
5. Multidisciplinary Taste and aroma innovation white spaces
Plant proteins meat analogue categories

Cultured meat analogues

Plant proteins meat analogues

Fungi/ Myco-protein based meat analogues

Insect fortified meat analogues
Taste is paramount in plant-based protein products

US consumers rank taste as the most important attribute in plant-based proteins, followed by no artificial ingredients, and protein content. To leverage these consumer preferences, brands can deliver taste and texture as close as possible to the real thing, along with a clean label and high protein content.

Source: LightSpeed/Harris

Base: 1,016 internet users aged 10+ who eat plant-based proteins

Source: YouGov

Very few academic works are public showcasing the role of flavorings in the meat analogues product liking/acceptability

Addition of **seasoning and spices** to a PPC meat analogue and compared to a commercial soy meat analogue

The highest level of spices and crashed red peppers had the most acceptable meaty flavors and the least amount of off flavor and the most adequate spiciness

Addition of **Maillard preparation** at different levels to a soy meat analogue and compared to 0% MRP

20% MRP resulted in the highest sensory scores for meaty aroma and meaty taste

Addition of vegetable based “**chicken**” or “**shrimp**” flavors at different levels to 4 shapes of meat analogues prepared with 2 cooking methods (Fried and baked) and compared to unflavored sample

Highest flavor concentration with frying method received higher scores in terms of flavor intensity and saltiness


Only up to 5% of flavoring solution are used to impart the meaty Taste and aroma experience.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Purpose</th>
<th>Usage levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Hydration, distribution of ingredients emulsification, juiciness, cost</td>
<td>55-70%</td>
</tr>
<tr>
<td>Textured and Non textured proteins (Soy, Pea, fava beans, rice, myco-proteins...)</td>
<td>Water binding, texture/mouthfeel, protein fortification, emulsification</td>
<td>1-30%</td>
</tr>
<tr>
<td>Fat &amp; Oil (Coconut, canola, sunflower...)</td>
<td>Texture/mouthfeel, sizzling</td>
<td>0-15%</td>
</tr>
<tr>
<td>Binding agents (Wheat gluten, methyl cellulose, Gums, hydrocolloids, starches)</td>
<td>Texture, bite, water binding, fiber content</td>
<td>1-5%</td>
</tr>
<tr>
<td>Salts, natural and non-natural Flavors, flavor enhancers and spices</td>
<td>Meaty, beef, chicken, pork, bacon, fish, fatty, serum, grit, charred, peppery, spic, herby...</td>
<td>Upto 10%</td>
</tr>
<tr>
<td>Coloring agents (malt extracts, vegetables and fruit extracts, annatto...)</td>
<td>Appearance</td>
<td>1-5%</td>
</tr>
<tr>
<td>Preservatives (vinegar, acetic acid, fermented ingredients, spice extracts...)</td>
<td>Product conservation</td>
<td>0-2%</td>
</tr>
<tr>
<td>Vitamins and minerals</td>
<td>Nutrients, flavor (metallic), flavor precursor</td>
<td>0-1%</td>
</tr>
</tbody>
</table>

• Nutrition & Health
• Aroma & Taste
• Health & Wellness
• Labels
• Nutrition & Health
• Aroma & Taste
• Taste
• Look
• Feel

Multi-dimensional taste and aroma challenges

**Inherent plant proteins off flavor**
- Typical soy/beany/grassy/cereal off note: mainly from lipid oxidation of plant proteins
  - Canola proteins > Pea proteins > Soy proteins
- No efficient masking solutions for high level protein-based meat analogues

**High flavor-protein interaction**
- Low flavor performance
- High dosage level, high cost
- High odor in raw and during consumption

**Vegan meaty flavor shortcomings**
- Good spices and herbs
- Good cooking cues flavors: grilled and smoked notes
- Lack of genuine meaty flavors: Cooked beef, Beef tallow, cooked chicken, cooked pork.....
- Chemical, solvent flavor perception

**Low in-mouth flavor perception**
- Lack of understanding tenderness and juiciness and their impacts on the flavor perception
- Lack of understanding of in mouth aroma release and sensory perception

*Eckert M, Ricker P. Overcoming challenges in functional beverages. Food technology 20-26. 2007*
*S. J. Keast, P. A. Breslin, Pharm. Res. 19, 1019 (2002)*
Flavoring systems for modern plant protein meat analogues

VOLATILE FLAVORS
- Smokey, Grilled, Boiled beef, Beef tallow
- Crispy chicken, dark meat chicken, fried chicken notes...

NON-VOLATILE FLAVORS
- Meaty Character, Brown notes...

TECHNOLOGY
- Salts (NaCl & KCl), Umami rich ingredients,
- Off note masking flavors

BASE RECIPE
- Unflavored Vegetarian Burger

Consumer preferred flavor
- Must be pleasant
- Must mask or complement any inherent base flavor
- Evenly distributed
- Not adversely affect the mouthfeel
- Not adversely affect the texture
- Cost effective
- Consumer friendly label

References:
Multi-disciplinary taste and aroma innovation white spaces

**Protein science**
- Off flavor-cleaner textured proteins
- Improve protein juiciness and tenderness

**Accelerate Sensory Science**
- Defining sensory attributes and Drivers of liking
- Understand the impact of plant proteins ingredients and processing technologies on the taste, flavor and texture profiles.
- Effect of cooking methods and Shelf-life studies.

**Invest in Taste and Aroma science**
- Better understanding flavor/matrix interactions
- New Off flavor masking solutions
- Create new genuine natural meaty flavors: Chicken, beefy...
- Fat impact on flavor release in Mouth

Research and Development
Any Questions?