

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

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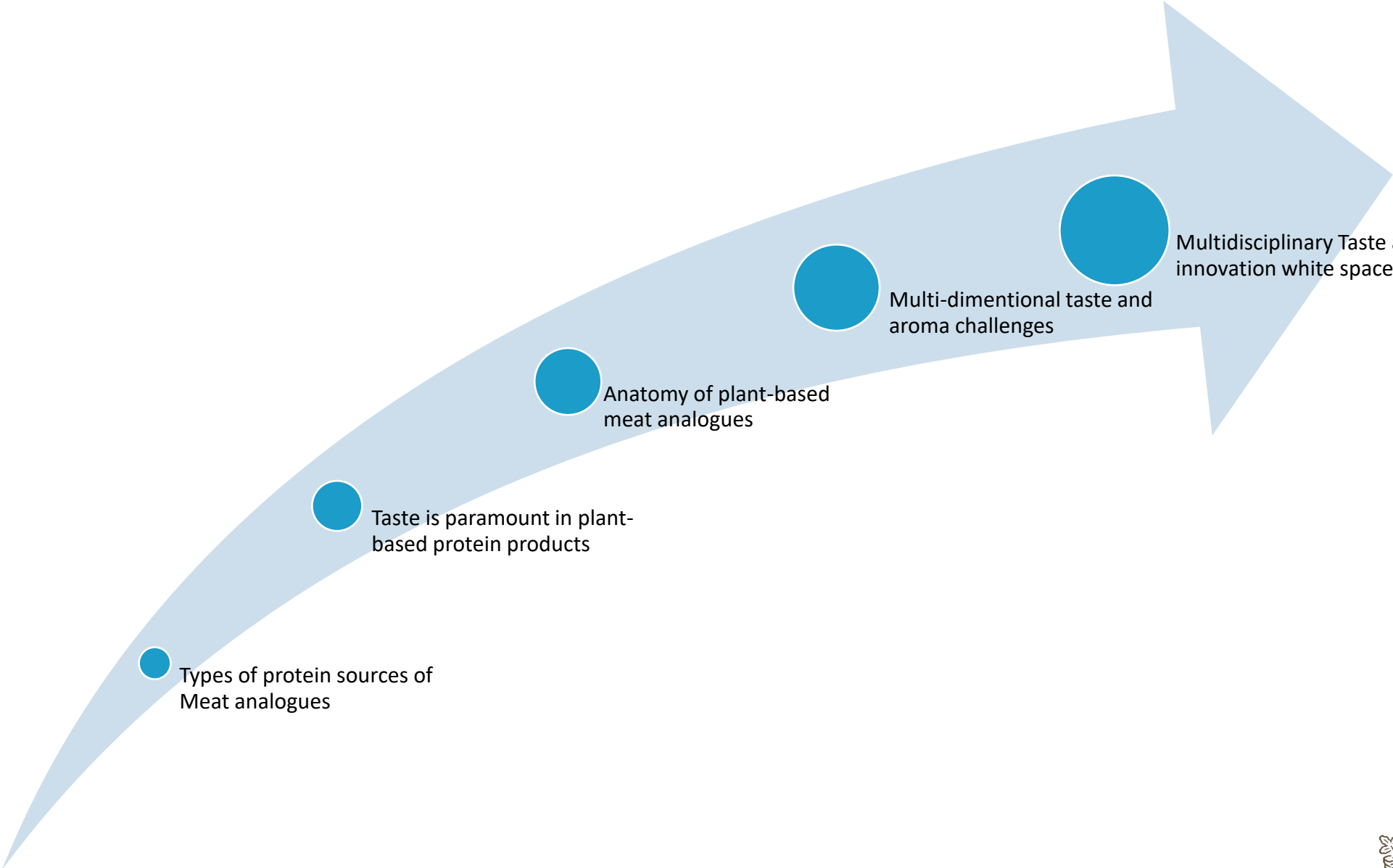
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Outline



Types of protein sources of Meat analogues

Taste is paramount in plant-based protein products

Anatomy of plant-based meat analogues

Multi-dimensional taste and aroma challenges

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



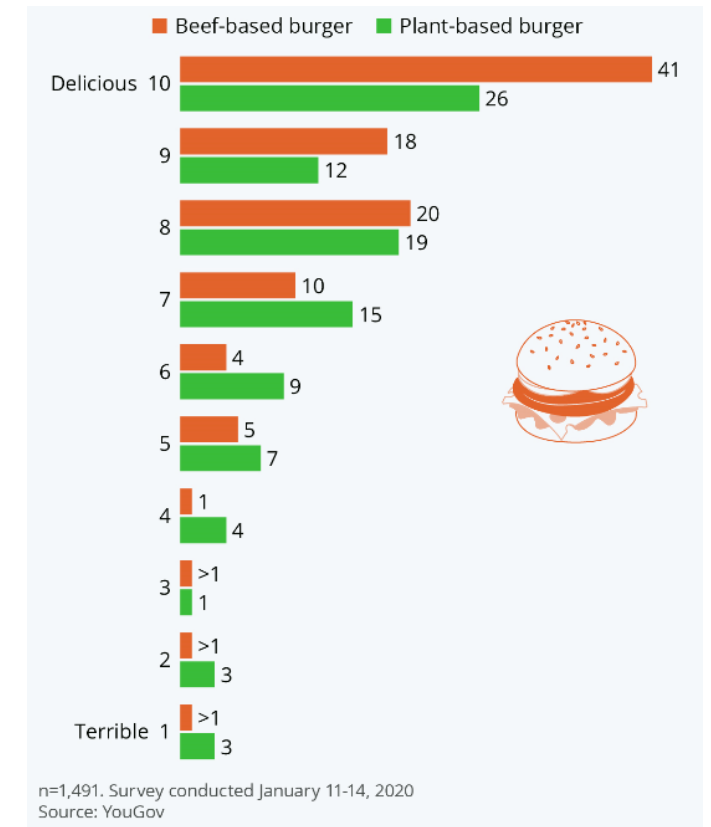
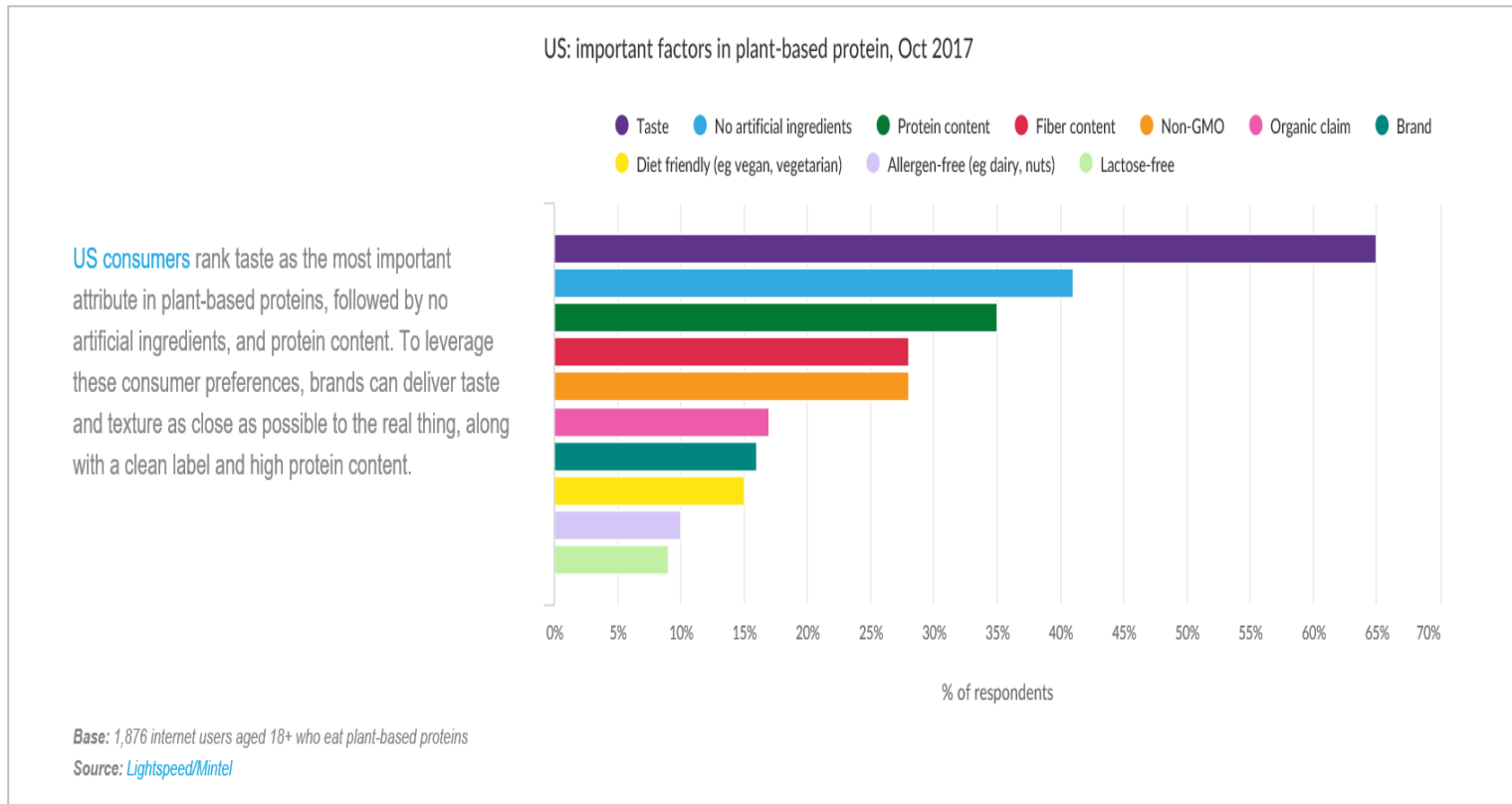
Insect fortified meat analogues



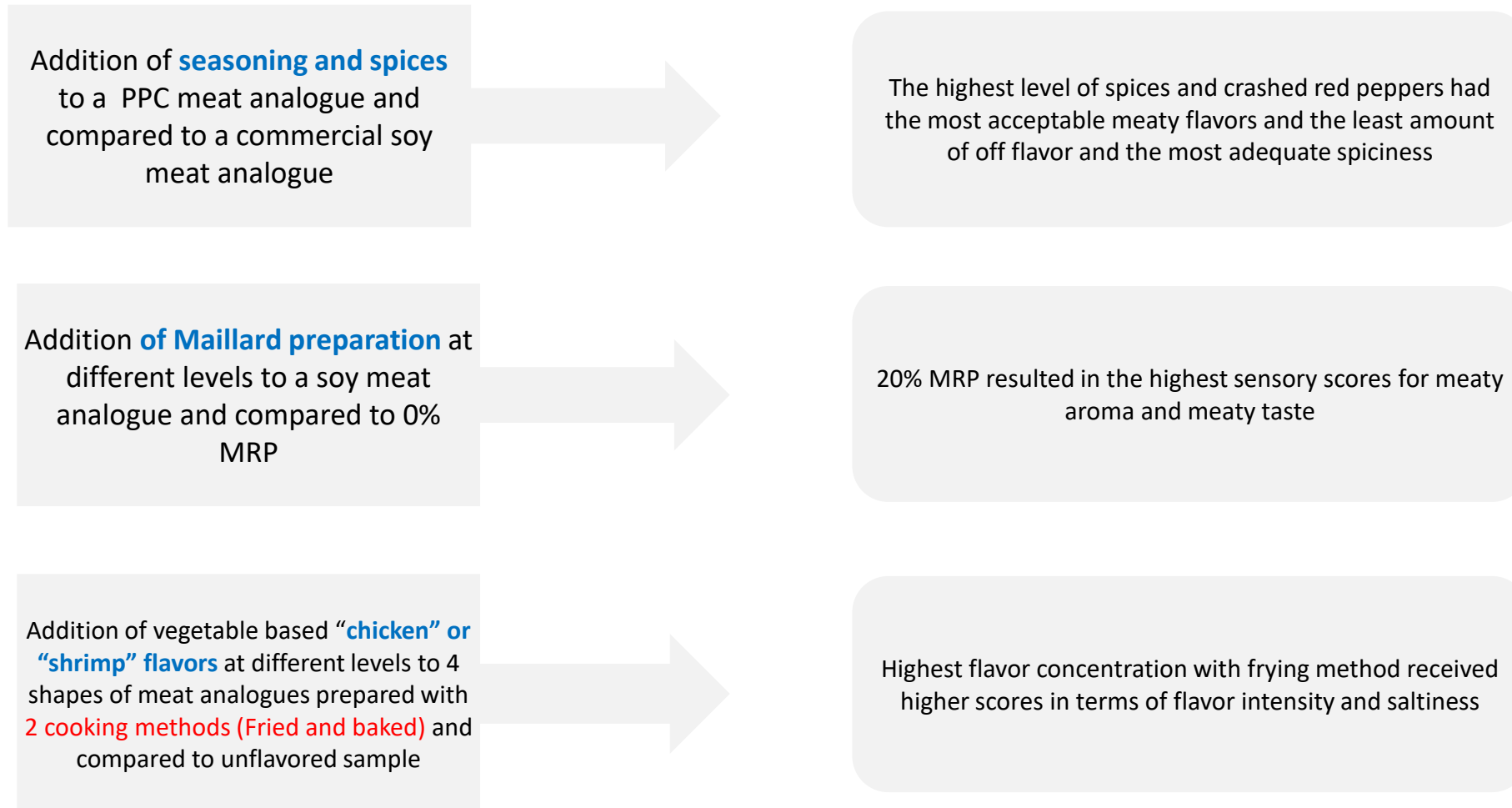
e - Estimated; p - Projected*Other sources include quinoa, oats, beans, nuts, and seeds. **Other products include slices, fillets, outlets, slides, fingers, and crumbles. Source: Secondary Sources, Publications, Articles, and MarketsandMarkets Analysis

- Gómez-Luciano et al. (2019). Consumers' willingness to purchase three alternatives to meat proteins in T the United Kingdom, Spain, Brazil and the Dominican Republic. Food Qual. Prefer. 2019, 78, 103732
- Grasso, et al (2019). Older consumers' readiness to accept alternative, more sustainable protein sources in the European Union. Nutrients 2019, 11, 1904.
- Fiorentini, et al (2020). Role of Sensory Evaluation in Consumer Acceptance of Plant-Based Meat Analogs and Meat Extenders: A Scoping Review. Foods 2020, 9, 1334;
- Curtin and Grafenauer (2019). Plant-Based Meat Substitutes in the Flexitarian Age: An Audit of Products on Supermarket Shelves. Nutrients 2019, 11, 2603;
- Malav et al. Meat Analog: A Review. Critical Reviews in Food Science and Nutrition, 55:1241–1245 (2015).









Taste is paramount in plant-based protein products

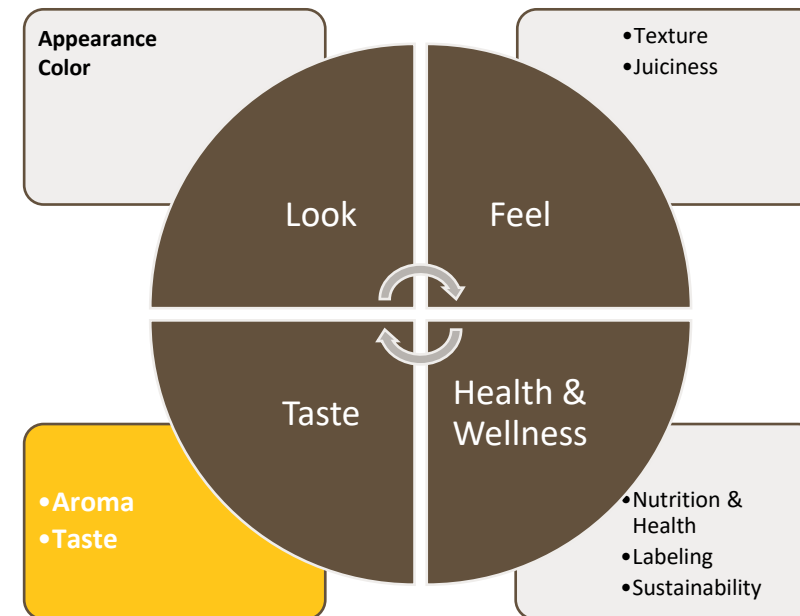


Very few academic works are public showcasing the role of flavorings in the meat analogues product liking/acceptability



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

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



Multi-dimensional taste and aroma challenges

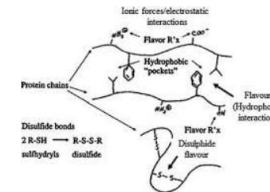
Inherent plant proteins off flavor

- Typical soy/beansy/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



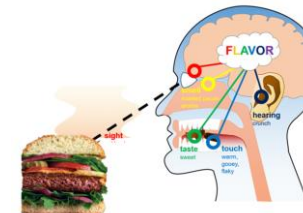
Vegan meaty flavor shortcomings

- 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

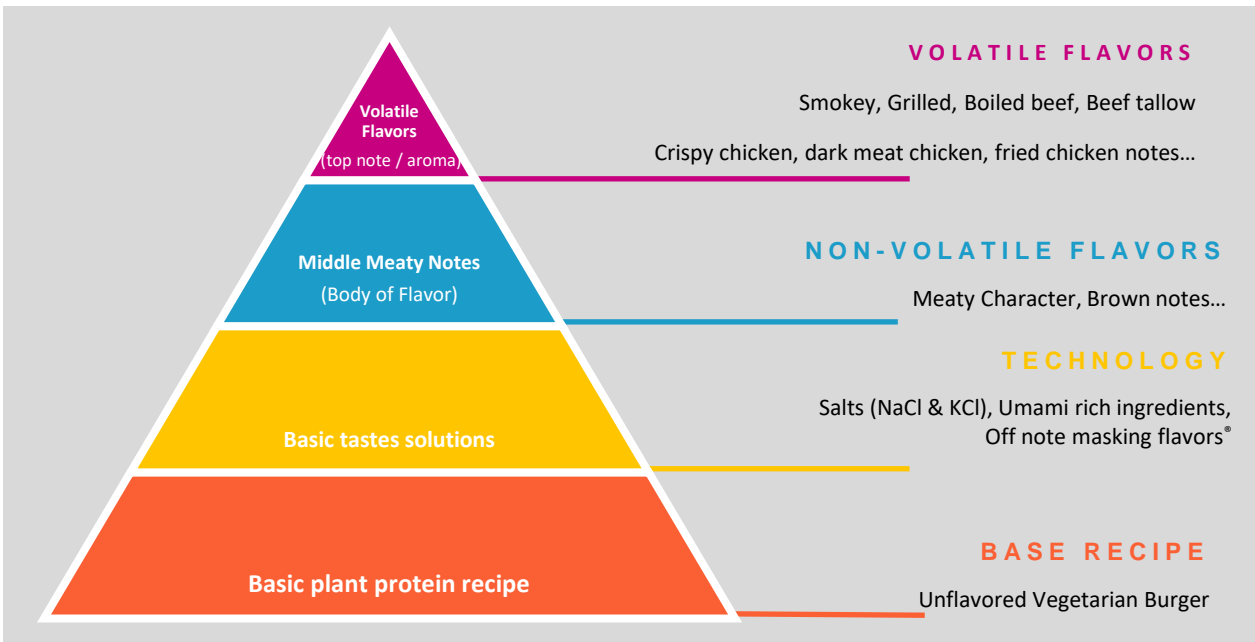
Beef flavor type
Chicken flavor type

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



Flavoring systems for modern plant protein meat analogues

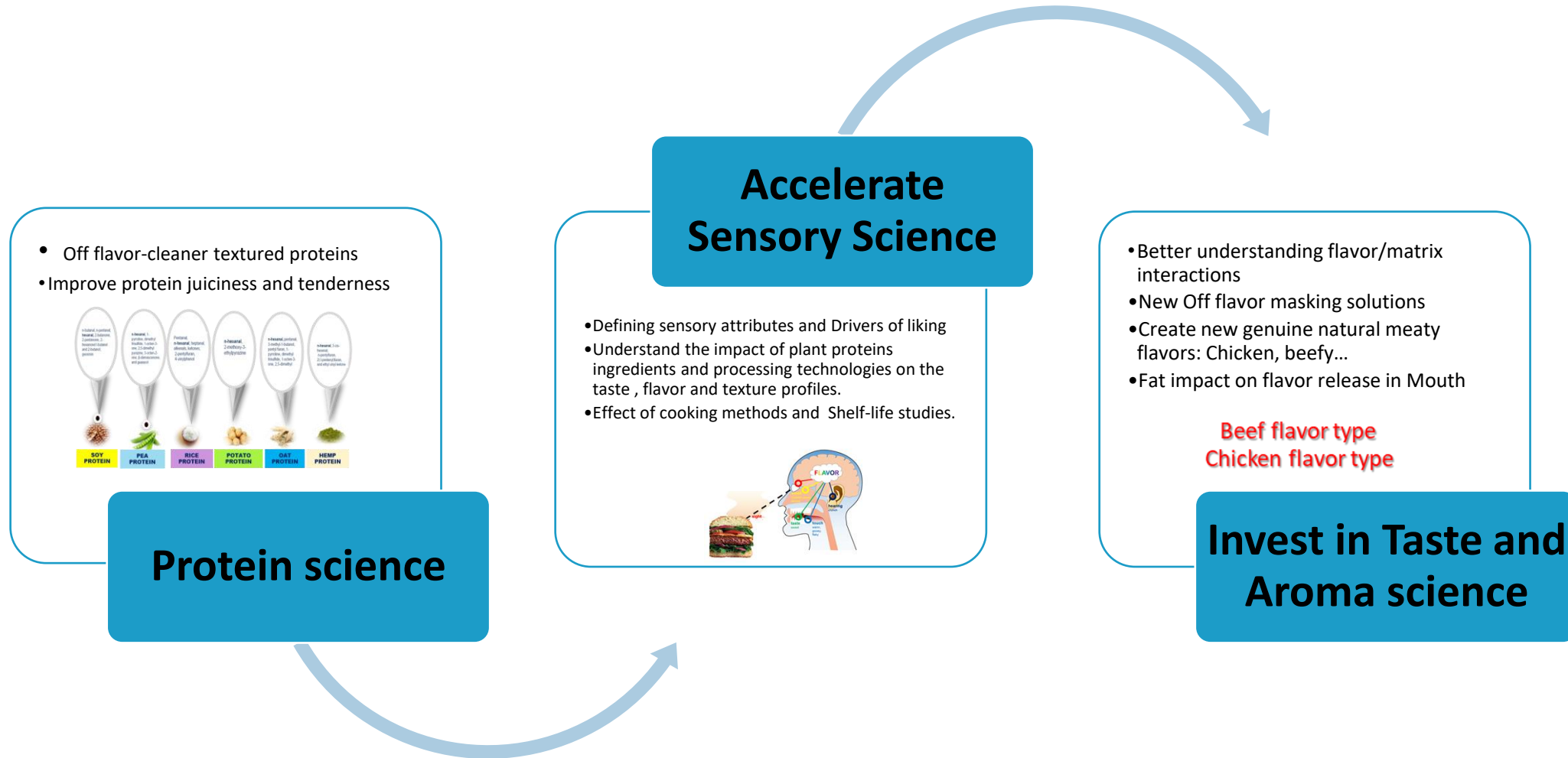


Consumer preferred flavor

- ❖ 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



Multi-disciplinary taste and aroma innovation white spaces



Any Questions?