CalPoly Pomona

Developing Next Generation Meat Analogues for International Cuisines Applications

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Meat Alternatives

Meat alternatives, meat substitutes, meat analogues, fake meat, plant-based meat, vegetarian meat, and vegan meat are used in different sources to describe one thing, meats-like products that are made from plant materials.

These products are eaten to replace meat products especially the need for the daily intake for proteins.

Historically consumed for several reasons including availability, religion (ex, Hinduism, Buddhism, and during Lent for Orthodox Christian), certain diseases and allergies to meat products.

Tofu and Seitan in China are among the oldest meat alternatives that are well documented around 2000 B.C. Thus, tempeh (Indonesia), Falafel “chickpeas patties” (Middle East), kachori (India), and black beans patties (UK) are a great examples.

Meat Alternatives

Tempeh

Seitan

Tofu

Falafel

Meat Alternatives

Protose

A soy-based meat like product developed by **Dr. John Harvey Kellogg** (the first American scientists to realize the great potential of soy in human diets) in 1930.

It was made of 32% soy, Malt Honey, Nut Butter, Malted Nuts (a milk substitute of ground almonds and peanuts in emulsion with malt syrup), and Maltol.

Protose, combining peanuts and wheat gluten, became Kellogg's most popular product, with several thousand tons having been consumed by 1930.

A1959 Battle Greek Vegetable Steak advertisement

Source: https://www.soyinfocenter.com/HSS/john_kellogg_and_battle_creek_foods.php

Underutilized Meat Alternatives

Sourdough bread

Idli

Pozol

Doenjang

Injira

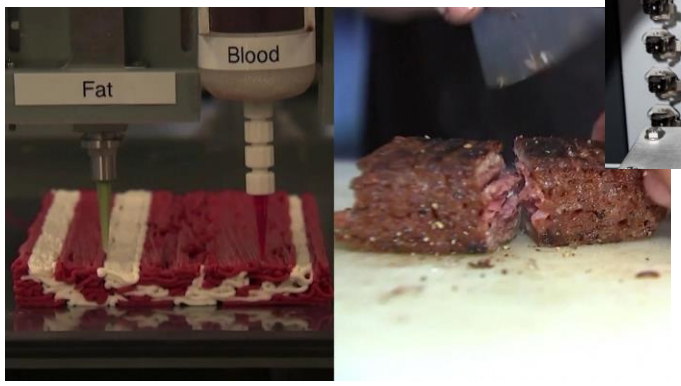
Modern Meat Analogues

What are the technologies used to make modern meat analogues?

1. Extrusion (single and twin screw).

2. Shear cell technology.

3. 3D printers.



Modern Meat Analogues

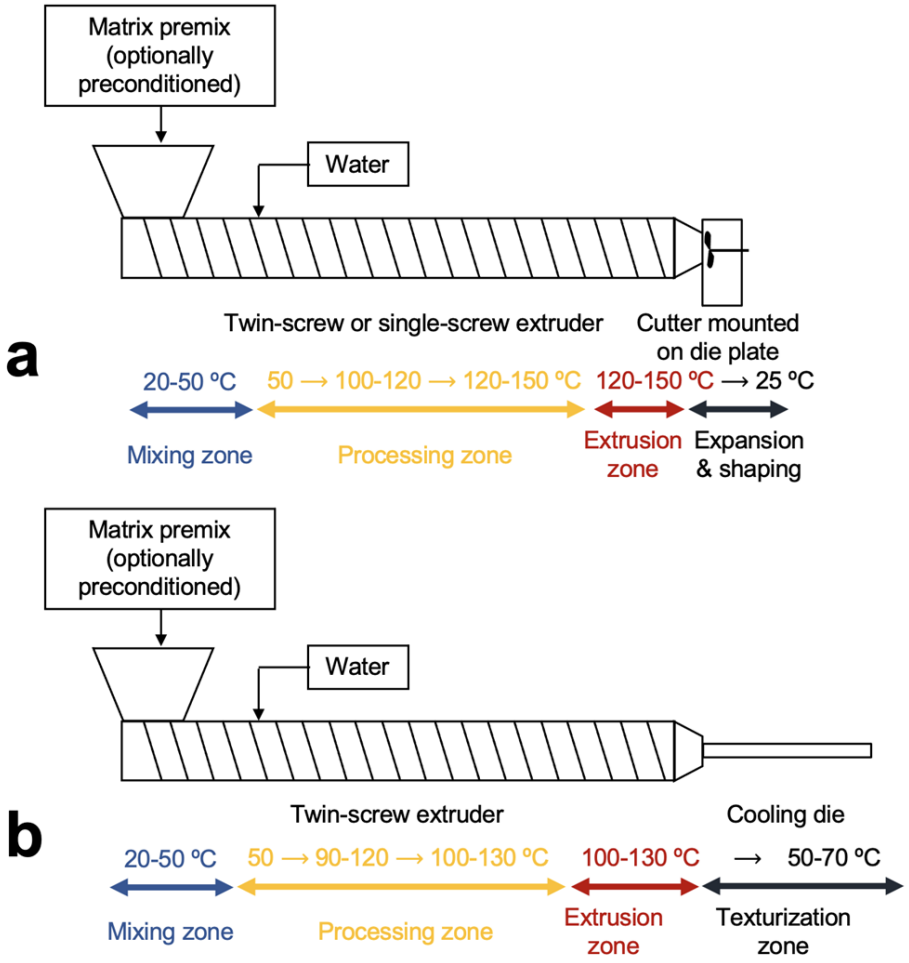
Extrusion Cooking

Extruded plant-based meats are gradually moving from niche to mainstream products.

- Large-scale commercial process to produce plant-based meats.
- Rich source for proteins (60-80% on dry basis)
- Extruders combine the compression, shear and high temperatures.
- Low moisture extrusion (LME), and high moisture extrusion (HME) started late in eighties.

Modern Meat Analogues

Extrusion

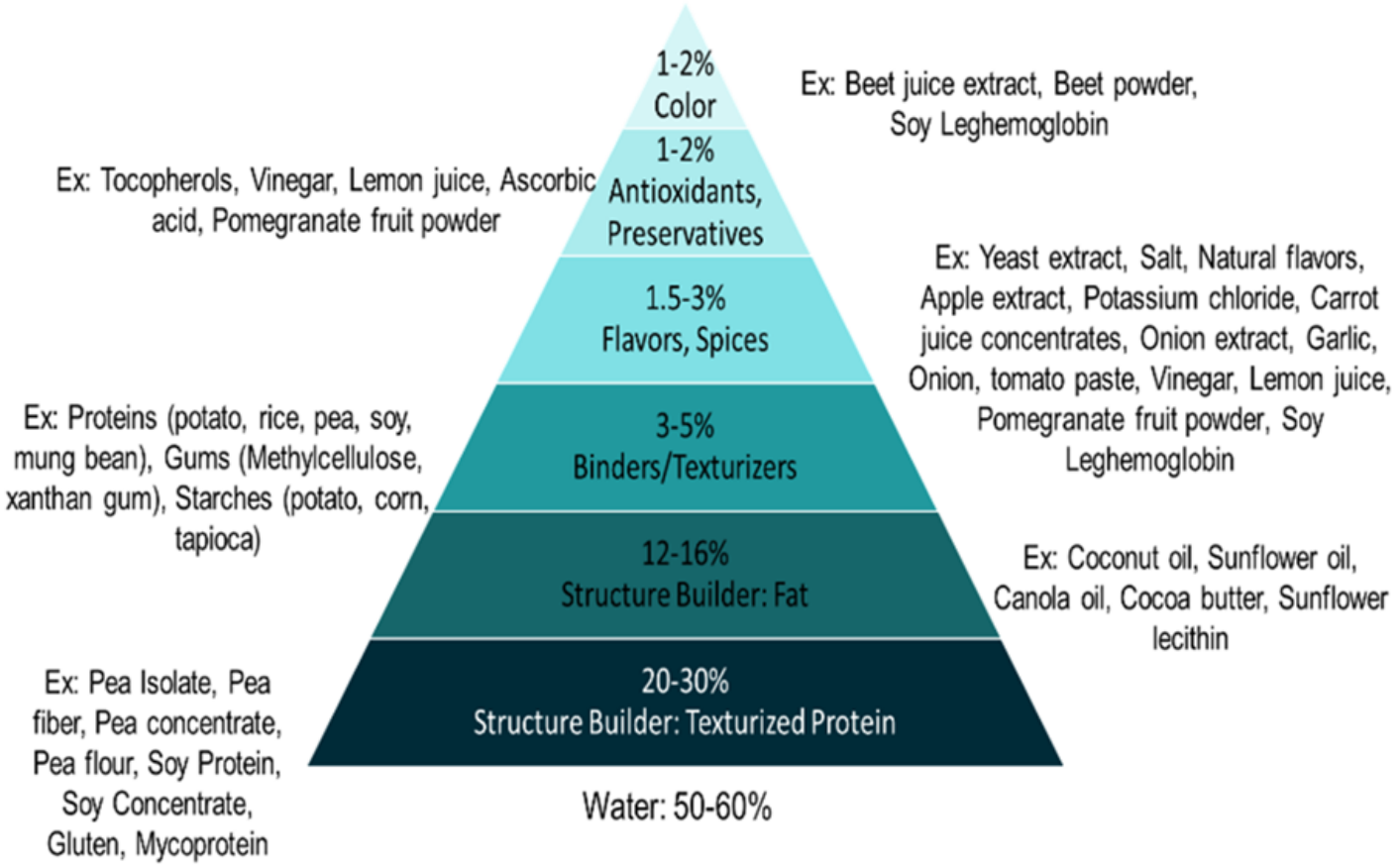


Protein powder (pea, soy, chickpea) + water 10-30% = TVP

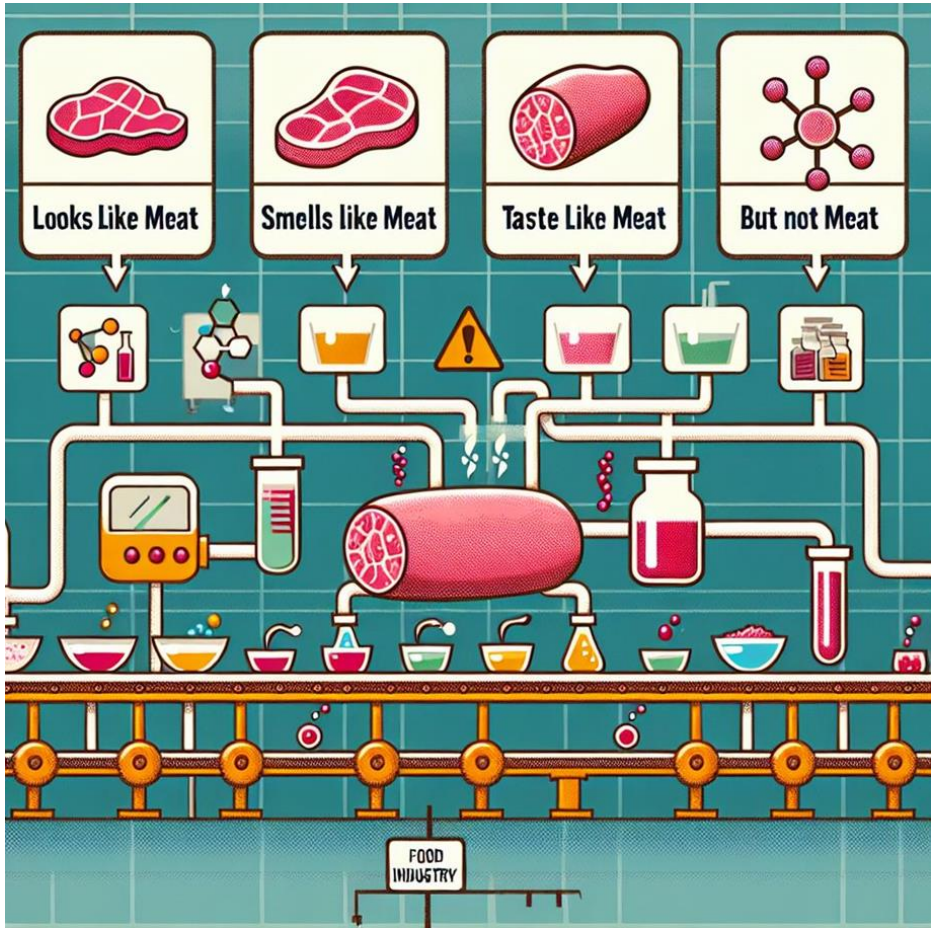
<u>80% of commercial products use TVP?</u>

Protein powder (pea, soy, chickpea) + water 40-70% = HME

Modern Meat Analogues



Ingredients (natural, artificial) added to improve the quality of plant-based patties



Food industry current goals

Muhialdin, B. J., Uzunalioglu, D. & Ubbink J. (2024). Meat alternatives: From traditional high-protein food products to modern technologies and formulation approaches

Modern Meat Analogues

Wholesale price to the consumers based on bulk purchase and most affordable brands

Angus beef patties

$39.98/10 pounds

Plant-based patties

$63.92/10 pounds

Tofu

$29.80/10 pounds

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The One Million $ Question
What is The Quality of Life?

Do we want to engineer the technology to fit the consumers demands and needs?

Do we want to engineer the consumers to adapt and fit to the technology?

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Modern Meat Analogues

The world is not only burgers and patties

The modern meat analogues industry is driven by western diet or fast-food diet.

The manufacturers uses dozens of ingredients to make it looks exactly as meat products.

Did we reach the ceiling? Will we have a sustainable and inclusive solutions?

Tailoring commercial products to meet the consumers' needs and comfort especially by providing broad range of products suitable for different cooking styles.

Our Next Generation Plant Based Meats

What are our novel findings?

Systematically studied different processing conditions such as the extrusion temperature, screw speed, feeding rate, and residence time.

Introduced the rheological properties for plant-based dough mixtures and its power to design and predict the quality.

Developed methods for different scales including technologies that has never been applied in food (for example, Micro-compounder).

Systematically studied the effects of pH on the textural properties of meat analogues.

Established that the water is the driver for the texture.

Ion strength, studied the effects of salt type and concentration on the texture.

Understanding the effects of ingredients such as condiments on the texture.

Established a method to quantify the fibrous structure formation based on swelling behavior. Affordable and simple method and adapted by food industry.

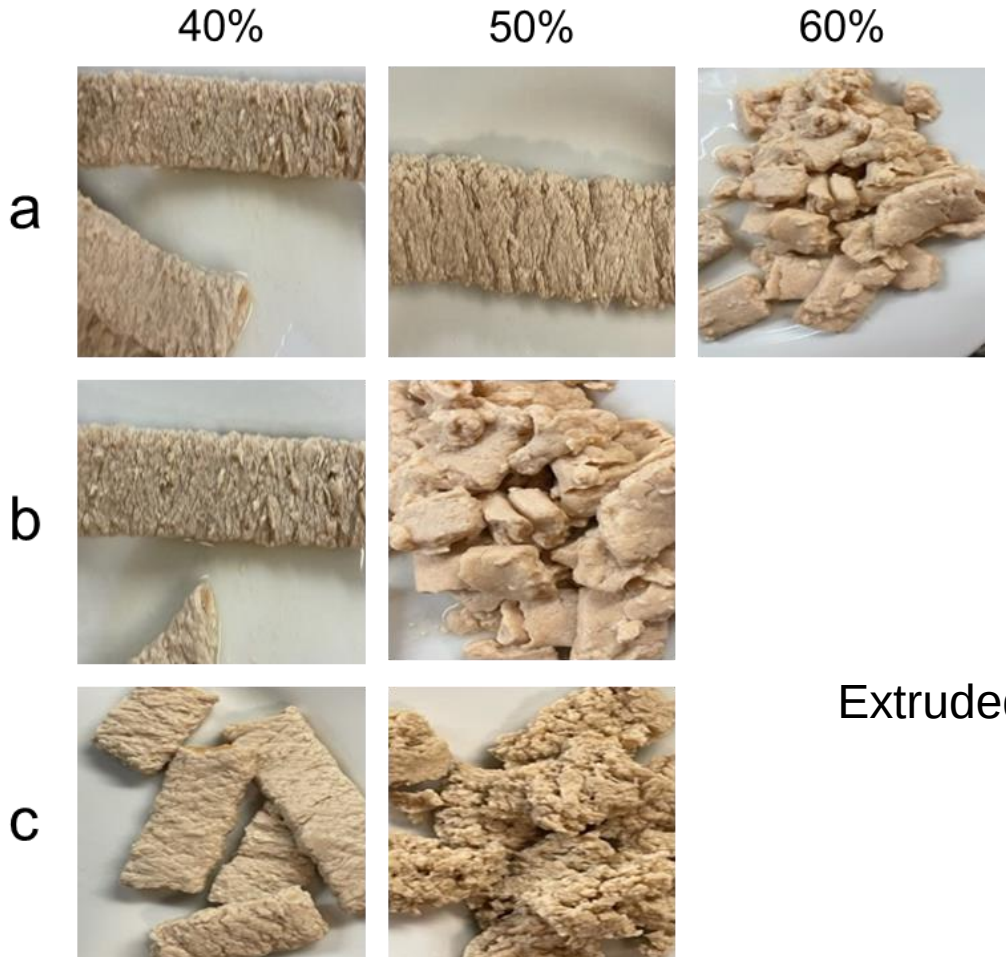
Studied the protein aging and its effects on the quality of chilled and frozen products.

Phase mapping! (Technical Expertise).

Our Next Generation Plant Based Meats

What are our novel findings?

Meat analogues can be designed to stand extended cooking time for braising and stewing.



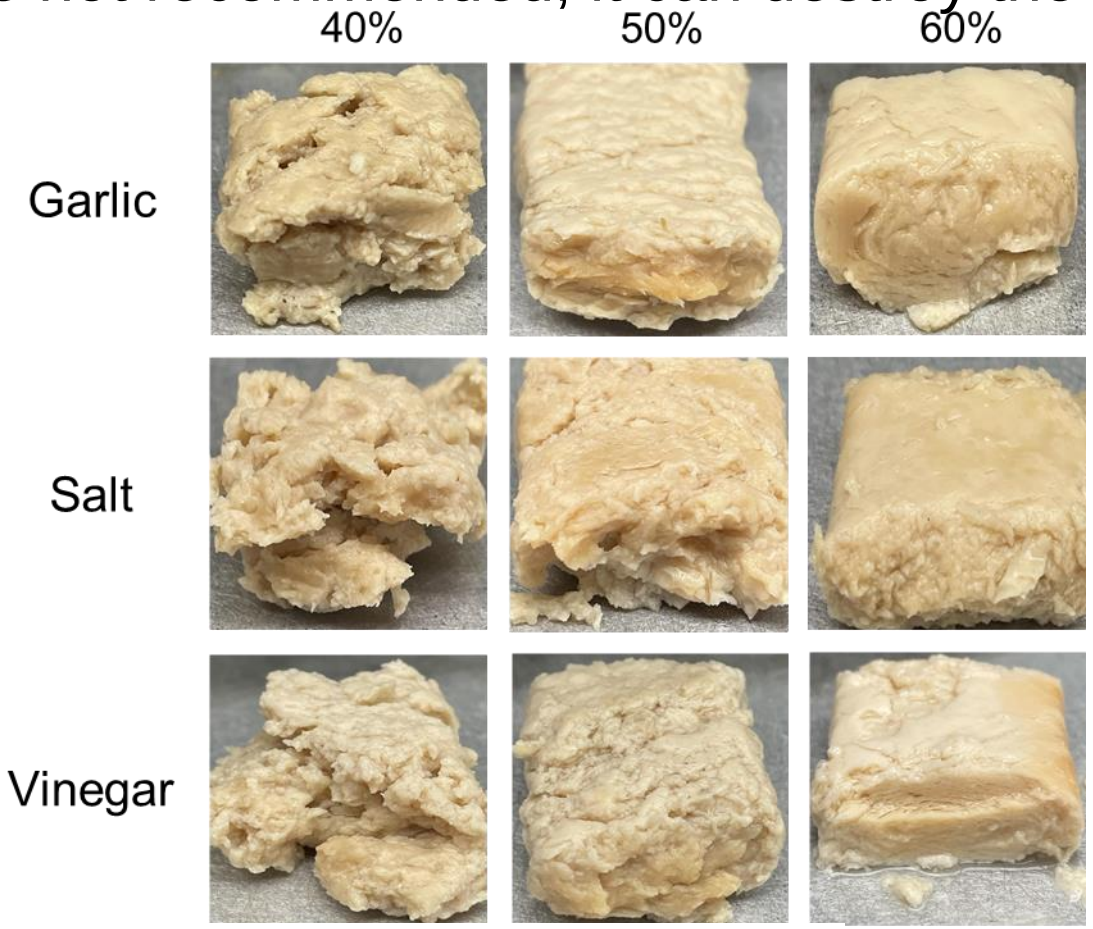
Extruded PPI boiled at 95 C. a. 1 hour, b. 2 hours, c. 3 hours

Muhialdin, B. J., & Ubbink, J. (2024). *International Journal of Gastronomy and Food Science*, *35*, 100861.

Our Next Generation Plant Based Meats

What are our novel findings?

Meat analogues have a different cooking behavior compared to meats. Salt should be added to the end of the cooking, vinegar make the texture harder, garlic make texture soft, fats and oils are not recommended, it can destroy the texture.



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Our Next Generation Plant Based Meats

What are our novel findings?

Meat analogues can be used in traditional stews to replace meat products!

Inspired by feijoada

Inspired by bœuf bourguinon

Inspired by maafe

Inspired by rendang

Inspired by qlia

Muhialdin, B. J., & Ubbink, J. (2024). *International Journal of Gastronomy and Food Science*, *35*, 100861.

Our Next Generation Plant Based Meats

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Beyond Steak Tips

Pea Protein Isolate

Mutton Ishtu **Carne Guisada** **All-American** **Mechado**

Our Next Generation Plant Based Meats

What are our novel findings?

Meat analogues can be designed to be simple and can be utilized in traditional cooking to replace meat products!

Possible consumer price

$39.80/10 pounds

Interdisciplinary Solution

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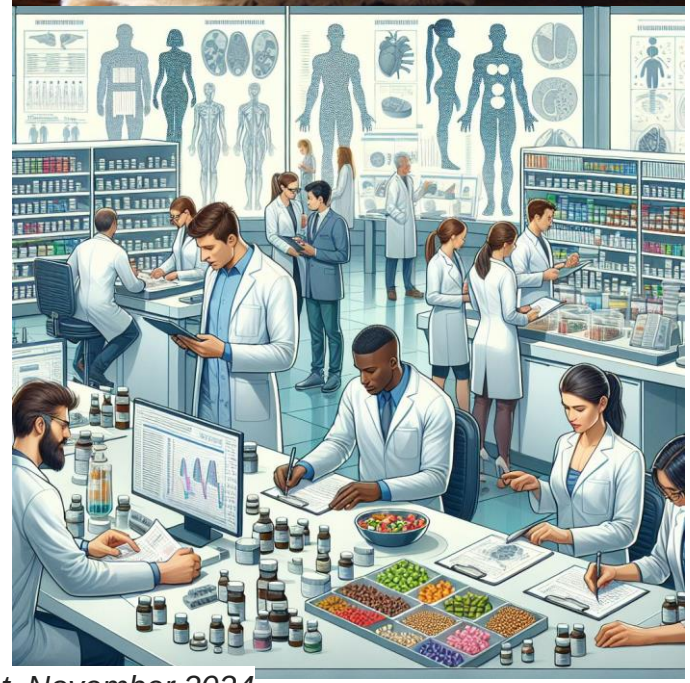
Community engagement (survey, focus groups)

1. Increase awareness among underrepresented communities
2. Consumers feedback (health, affordability, cookability)
3. Feedback for the food industry

Project funded by Strategic Interdisciplinary Research Grant Program (SIRG), Cal Poly Pomona

Future Work



1. Designing Healing Wholesome Meals

2. Clinical Studies

3. Schools and Early Age Adaptation

4. Training Chefs

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Selected Videos

Conclusion

Sustainability of food supply chain is a responsibility for different stakeholders not food scientists alone.

Interdisciplinary solutions lead to holistic solutions, we need everyone.

Diverse commercial products suitable for cultural cooking styles are needed.

Understanding consumers (underrepresented) needs to consider plant-based meat is a key to an inclusive solution.

Communications, feedback, untraditional ideas, food culture, and simplified knowledge are the keywords for a sustainable system.

Thank You

Q&A

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