

**Upcoming Food Innovations: A Delphi Study**

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### **Introduction**

The European Union (2015) defines novel foods as those whose “absence of use for human consumption to a significant degree within the Union before...15 May 1997” that have developed from “production processes not used for food production within the Union before 15 May 1997” (p. 2). In the United States, a definition of novel foods or food innovations is lacking. This study falls under the National Association of American Agricultural Education’s *Research Priority 2: New Technologies, Practices, and Products Adoption Decisions* since it seeks to establish a knowledge base so that the next steps in Rogers’ (2003) innovation diffusion process of food innovations can continue. Food innovations are essential for creating novel nutritious food, improve agricultural sustainability, and increase food firms market profits (Albertsen et al., 2020). This Delphi study aims to propose a consensus definition of food innovations and identify upcoming food innovations that will be available in the next five years.

### **Theoretical Framework**

Roger’s Diffusion of Innovations Theory served as the theoretical framework for this study. It builds the foundation for the adoption process. This theory has been used to understand the adoption of new technologies, products, or ideas in the context of agriculture, food, and natural resources. The five-stage model (knowledge, persuasion, decision, implementation, and confirmation) of this theory was used to illuminate the research problem and study issues in food innovations (Rogers, 2003). The first stage, knowledge, emphasizes the importance of understanding a particular innovation, how it works, and why it works (Rogers, 2003). This Delphi study was used to inform the first stage by establishing a definition and knowledge of upcoming food innovations. The attributes of both consumers and innovations are important for prompting adoption. The identified characteristics of food innovations and their specifics can be used to understand consumer opinions toward new food innovations.

### **Methodology**

This study used the Delphi technique popularized by the RAND Corporation and formulated by Delbecq et al. (1975). To build consensus among participants, three survey rounds were administered via Qualtrics. We sent three reminder emails for each round to encourage retention. To be categorized as an expert, an individual needed to consider themselves an expert in agriculture and nutrition research, the food industry, public health, or food policy and be knowledgeable about upcoming food innovations. Thirteen of 15 experts responded to the first questionnaire which established their opinion on specific upcoming food innovations and their definition. The definitions were then synthesized into three possible definitions of food innovations and the specific food innovations were inductively sorted into themes by two independent researchers. The amalgamated definitions and upcoming food innovations were then sent to the 13 experts for round two. In this round, experts rated their level of agreement on the food innovation definitions and the likelihood of the food innovations to be available to consumers in the next five years on a 5-point Likert scale (1= strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree). There was also room for comments on the definitions and the food innovations. All 13 experts responded to round two. For round three, a new definition was created based upon experts’ comments, since there was no consensus on any of the three synthesized definitions. The specific food innovations to be included on the final questionnaire received  $\geq 70\%$  agreement (Bernabeu et al, 2021; Thompson et al., 2021). Participants were asked to rate their level of agreement with the new definition and food

innovations on the same 5-point Likert scale and rank the food innovations in their order of likelihood to be available to consumers in the next five years.

### Results

This study had a 100% retention rate among the experts across each round of the Delphi study. The three themes that emerged for the definition of food innovations are *how food innovations are created, what food innovations are, and food innovations' purpose*. The food innovations definition- *food innovations aid in the development, production, or transportation of new food products, processes, or technology to promote human health, food security, or environmental sustainability*- received 76.9% agreement. The ranked specific food innovations most likely to be available in the next five years are plant-based meat alternatives, personalized nutrition, natural foods, new genetically modified organisms, regenerative agriculture, urban agriculture, packing innovations, alternative flours, improving shelf life, supply chain technologies, improved soil health, and technology for traceability. These items attained  $\geq 70\%$  agreement among the experts. The agreement rates were lower (53.8%) for three specific food innovations—making soil and gut biome connections, reprocessing food waste, and restaurant digitization. Therefore, those items were not included in the rankings.

### Conclusions, Recommendations & Implications

The Delphi study proposed a consensus definition for food innovations and identified 12 specific food innovations that will be available to consumers in the next five years. Regarding the definition, some experts expressed concern on the inherent positive bias towards innovations. This positive bias towards food innovations is noted much in Rogers' (2003) *Diffusion of Innovations*. However, if a novel food does not provide some positive effect, then it may not be classified as a food innovation under this definition.

The top two food innovations rated in our study are plant-based meat alternatives and personalized nutrition. Concerning human health and agricultural sustainability, plant-based meat alternatives have a broad range potential as a functional food (Baker et al., 2022a, 2022b; Bakhsh et al., 2021). Food science experts have supported personalized nutrition since nutrition-related chronic disease has been a challenge globally (Bush et al., 2020). Natural food was rated third in this study. Therefore, two different perspectives have emerged among the experts. One group supported technology-based methods while the other supported nature-based methods to improve the food system. This dissonance provides a window into the differing perspectives across the agri-food industry. Issues related to food innovations have been complex; however, food innovations can bring many benefits to the public. Agricultural educators and communicators should disseminate clear information to help the public better understand food innovations, especially the specific food innovations highly ranked in this study. Future research should also further identify and understand the differences among the varied philosophies among food system experts to bridge the gap between food science and society.

The identified food innovations can connect food science and society. Food industry experts, researchers, and policymakers can employ the identified food innovations to advance food innovation development research. For instance, researchers can investigate the diffusion attributes (i.e., relative advantage, trialability, observability, and compatibility, and complexity) for the top-rated food innovations, as adoption rate is significantly influenced by the diffusion attributes (Rogers, 2003). Researchers have investigated individuals' perceptions of the diffusion attributes in the context of GM food and science (Rumble et al., 2016). Additionally, future research should narrow the focus of the food innovation items and assess their likely acceptance among consumers across the nation.

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