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Involving consumers in food product development: Perspectives on the application of circular food design

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Consumers and the food they choose, along with the actors providing the food, play a crucial role in the transformation toward a more sustainable food system. The circular food design model is a tool that supports consumer orientation in food product development and shows that it is not a static one-way direction but includes feedback loops and co-creative processes. In this study, circular food design was applied in two cases. Specifically, the following was explored: (1) How the application of circular food design can be carried out in different phases of product development? (2) How creativity and interaction can be stimulated? and (3) How different business disciplines can be involved? Learnings from a series of workshops were described from the perspectives of company and consumer research. The results showed that to make consumer research valuable in this development process, there was a need for interaction in different ways, including focused consumer research and understanding by food production actors in an interactive and iterative process supported by a creative approach and visualizations, and with cooperation between different departments within companies. Using this interaction for combining consumer- and market-driven thinking delivers more tailored and technically feasible innovations with engagement among all actors.

KEYWORDS

food innovation, design thinking, consumption, consumer, circular food design, sustainable, circular economy, case studies

Introduction

Dietary change in areas with an affluent diet could play an important role in reaching environmental goals, with up to 50% potential to reduce GHG emissions and land use demand (Hallström et al., 2015). To reach environmental goals, a transformation toward a circular economy (CE) is needed, which requires a rethinking of both the supply and the demand sides of the “linear” and fossil-based economy (Repo et al., 2018). Such a food system transformation of production and consumption requires the involvement and commitment of consumers, policymakers, and actors in the food supply chain (Willett et al., 2019). On the demand side, consumers have a crucial role in the transition toward a more sustainable food system in their role as buyers and consumers. In addition, the circularity in CE requires them to be involved throughout the consumption system as users, re-users, sharers and reducers, and perhaps even participators in the production process (Camacho-Otero et al., 2018; Sijtsema et al., 2019; Gomes et al., 2022). At the same time, consumer food choices are shaped by the food environment, including access to healthy foods (Turner et al., 2021). Therefore, on the supply side, the production and processing of food also need to be more sustainable

when innovating. Ingredient selection and sourcing should be more diverse, have a lower environmental impact, and should make use of upcycling food, as well as more regeneratively produced food, in addition to packaging elimination, reuse, and material circulation (Ellen MacArthur Foundation, 2022).

The relevance of including the consumer in innovation started in the 1990s, with the publications of a consumer-oriented approach by Jongen and Meulenberg (1998). It received an even higher priority in current studies about CE, proposing a new way to think and design products in which consumers should be integrated into the design process, including innovations and insights from consumer studies which should be available to actors in the food system (Heidbreder et al., 2019; Gomes et al., 2022). However, only a few studies have explored the integration of user and consumer perspectives in the design process in terms of factors to be included in design and infrastructure to facilitate an understanding of complex relationships and methods to integrate the consumer (Camacho-Otero et al., 2018). Thus, there is a lack of literature studies about the application of frameworks and tools in practice. This issue was also already stated by Costa and Jongen (2006) when recognizing that there is a lack of concrete guidelines for the effective implementation of consumer-led food product development in everyday industry practices. Recently, a model was developed as a tool to structure innovations toward a more circular food system (Sijtsema et al., 2020).

The circular food design model (Sijtsema et al., 2020) supports the idea of involving consumers in innovation and structures according to the phase of product development and elements of the food system. Consumer orientation is central in the model: When developing new food products, insights from consumer studies have to become available to actors in the food chain who work on innovations in product production, processing, and development. In addition, the framework shows the need for the involvement and interaction of actors from different disciplines in each phase of product development. The process follows the deductive and inductive way of thinking by means of design thinking with the support of creativity, visualizations, and rapid prototyping.

The circular food design model is based on experiences within several consumer studies as part of innovative projects, but although its relevance has been mentioned in reviews about models and tools to support the transition toward CE, it has not been applied thus far in the everyday innovation practices of companies. In this study, the aim was to provide an example of the process of consumer-oriented innovation by putting circular food design (CFD) into practice and providing learning opportunities. The application of this model was explored from the current perspective: is the circular food design model a helpful approach to ensure consumer involvement in product innovation? More specifically, this study presents specific approaches related to three central elements of the food system and experiences with applying these approaches: first, tailoring to the stage of product development; second, co-creation and interaction in each stage of development; and third, interaction between different disciplines. For this, we describe and reflect on the application of the model to use consumer insights in two food innovation cases: tomato packaging and bell pepper shelf life.

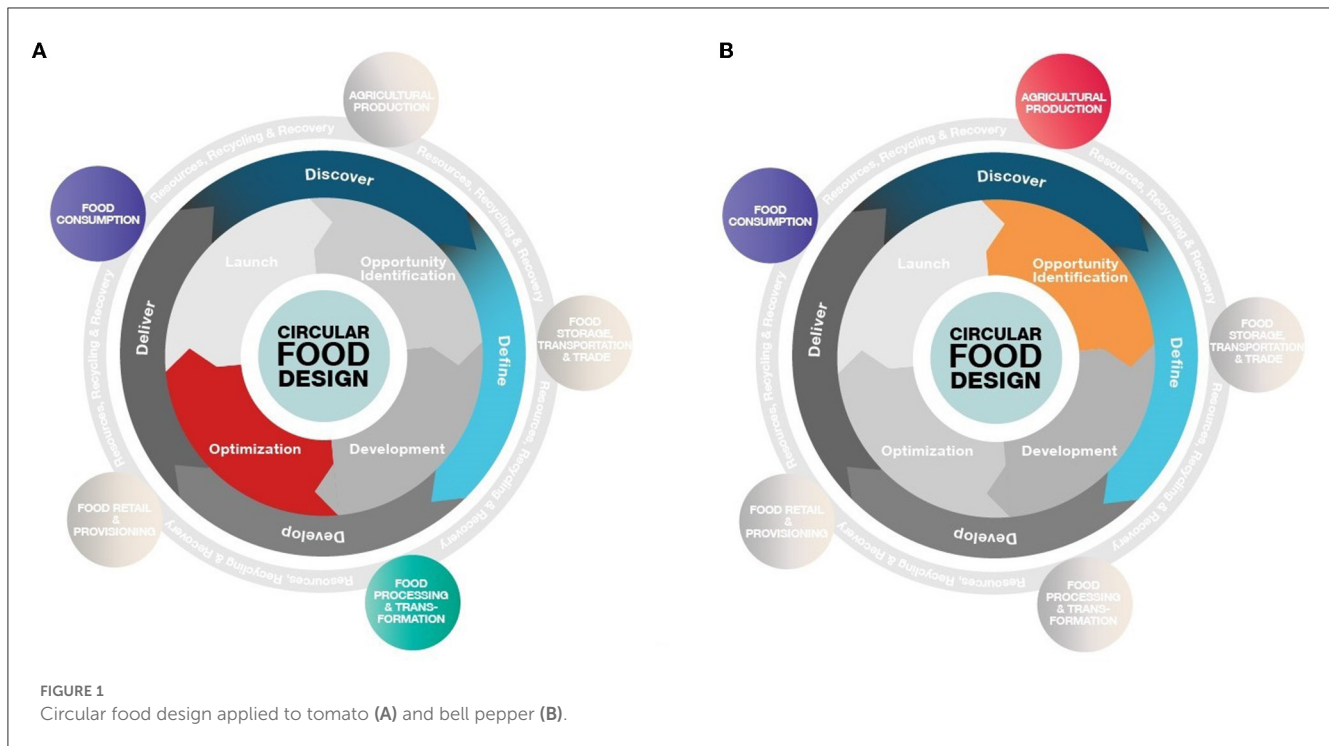
Application of circular food design

Case description

In two different companies, CFD was applied; for each company, one case was selected: a tomato case and a bell pepper case. For the tomato case, the general question to be answered was how to position and package the concept. This concept was placed in the optimization phase of product development because the product itself was already there but developing the packaging and positioning for the launch needed to be performed. This case focused on the positioning and therefore considered packaging in the following food system elements consumption, processing, and transformation (Figure 1A). During the workshops, participants from both marketing and quality control were included. In the bell pepper case, the possibilities of a more sustainable and/or healthy fresh product concept were explored. In this company, different departments had several ideas about specific intrinsic product characteristics, but the exploration of these opportunities was still needed, along with defining which ones to focus on. The company aimed to define the most interesting options from innovations in agricultural production from the perspective of consumer preferences for consumption. Thus, this concept was in the phase of opportunity identification and focused on food consumption (Figure 1B). The involved disciplines and departments within the company were research and development, marketing, and sales. The workshops were jointly prepared between the research institute and the company and were organized with the participation of various departments; together, ~30 colleagues from the company participated, representing the following disciplines: R&D, breeding, and marketing.

Workshop approach

The overall approach consisted of two workshops for each case. The first dealt with the introduction of participants and the CFD model. It also included an inventory and selection of questions to demarcate the innovation case and provided input about which food system element to focus on first. The second workshop included sharing results and discussing insights to further focus on the concept and define questions to be answered in the next step of innovation. In between, data gathering and analyses were performed and presented in such a way that colleagues outside the field of consumer science were also able to interpret and discuss the data. From this perspective, for reasons of confidentiality, only general consumers' insights were included, although production, technical, and technological issues were also addressed during the sessions and taken into consideration during the discussions and demarcation. Below, a more detailed description of the approach applied in the workshops is provided, which is structured along the three central elements for exploring and demarcating innovations in CFD. The approach and methodology used are described, as well as how this was experienced and what the outcomes of the different elements were in the following three perspectives.



Perspective: Tailor to the phase of new product development and food system elements

After an introduction to the CFD model, the participants of the workshop were challenged to share their ideas about their innovations. The questions related to these innovations or concepts were discussed to obtain a more detailed description of the information needed, and then, the main questions that had to be answered and further discussed in the second workshop were selected. Based on the description of the questions, the phase of new product development (opportunity identification, development, optimization, and launch) in which the innovation ideas were positioned could be defined. This is relevant since the phase of development defines the type of consumer involvement or input that is needed. In addition, the same table was used to map the questions according to the relevant elements of the food system (production, distribution, processing, retail, and consumption), which require specific disciplines to answer the questions.

For each case in the first workshop, the main questions were selected. When discussing the insights during the second workshop, new questions were raised during the discussion and were also categorized into phases of product development and food system elements (Table 1). The bell pepper case started in the opportunity identification phase, considering the food consumption and agricultural production food system elements. The tomato case starts in the optimization phase and shows a need for insights into consumption and food processing and transformation. Each phase has its own specific questions provided in the publication of the CFD model (Sijtsema et al., 2020; Table 1).

Perspective: Design thinking process, discover, and define

Other topics in the workshops provided approaches that support the actors' interactive and continuous involvement through the different phases of product development by facilitating the *processes* of discover, define, develop, and deliver (the 4Ds). Discover is the process of inventory and exploration; define is the process of selection, choice, and focus; develop is the process of the design of technology or concept; and deliver includes the final concept. The design thinking processes are followed in each phase of product development, although the way of discovering, defining, developing, and delivering addresses different questions in each phase. Similarly, the methods for gathering consumer insights also depend on the phase and the process.

Discover: In the first workshop, the actors from different departments in the bell pepper case jointly discussed which research questions were relevant to their case. The methods and use of consumer insights were chosen to stimulate consumer-oriented thinking and creativity as well as inspire. The methods included brainstorms, a supermarket safari task, and the presentation of outputs of earlier consumer studies. To create a common mindset toward consumer-oriented thinking, we also presented several consumer research models. In the tomato case, the first workshop was also focused on the discover process, but this case was further along in the phase of product development, namely, optimization, and the exploration was focused on packaging rather than concept development.

From Discover to Define: In the bell pepper case in the first workshop, after the discover process, there was a need to define what concepts of product development were needed to focus on during the opportunity identification phase. We used a

TABLE 1 Questions raised in product innovation cases by the product development phase and food system element.

	Opportunity identification	Development	Optimization	Launch
	Bell pepper case		Tomato case	
Agricultural production	What are possible product varieties?	<i>What are appropriate product varieties?</i>		
Food processing and transformation			Which product and packaging is most appropriate?	
Food retail and provisioning	What might be target groups?	<i>Which target group, consumption moment, distribution channels are relevant?</i>	Which target group, consumption moment is most appropriate?	<i>How do consumers perceive the packaged product? How to position?</i>
Food Consumption	What is known about actual consumption regarding the product group and/or consumption moment? Which consumer's needs (expressed or hidden) and values does my product answer? Which target groups are of interest?	<i>Which values do consumers attach to potential solutions? Which consumer target group and product group seem to be most promising How do consumers perceive the product and/or process and/or production?</i>	What perceptions do consumers have about concept, ingredient or claims? How do they consume it?	
Resources, recycling recovery				<i>If and how to communicate about coproducts and recycling?</i>

Bold is selected in the first workshop and italic in the second workshop. Since no questions were raised on food storage, transport, and trade, these are not included in the table.

combination of methods to facilitate discussion and interaction within the group and between the disciplines and backgrounds: group discussion, pitching of ideas, and voting. In the tomato case, a similar approach led to a joint decision to focus on the motivations when buying tomatoes and on the perception of the packaging.

Define: For both cases in the second workshop, the companies were provided with consumer insights that help to make the questions more concrete and define target groups and packaging options. Specifically, for the bell pepper case, secondary data analysis was presented related to the research questions on consumption patterns, consumption moments, target groups, and lifestyles. For the tomato case, since it was already at the phase of optimization, insights more focused on the innovation of packaging were presented, including insights into packaging perception of convenience, less packaging, what type of materials were preferred, hygiene issues, and product quality.

After Define: When discussing the consumer insights in the tomato case during the second workshop, the questions raised were on the develop and deliver processes. The insight into consumers' needs showed that in further development of the packaging insights in the target group, their interest in specific product characteristics, how to position it in the supermarket, and how to communicate about it were needed to optimize the concept.

Perspective: Involvement of and interaction between different disciplines

To ensure interaction between different disciplines during the workshops, attention was given to bringing a diversity of people

to the discussion and facilitating interaction. First, there were one or two contact persons of the company involved in developing the process who decided which colleagues should attend the workshops to ensure the involvement of different departments: research and development, marketing, and management. In addition, during the process, colleagues from all relevant disciplinary backgrounds were included: agricultural production (e.g., breeding), processing, quality control, food technology, marketing, and consumer research. Attendance was flexible for both workshops, and individuals could be replaced by colleagues as long as the different disciplines and departments were involved during the process. High involvement from these contact persons, as well as their enthusiasm when recruiting colleagues, resulted in a variety of participants from different departments and countries.

Facilitating interaction and understanding between actors of different disciplines and departments needed attention, for example, the use of the same terminology in discussions and when selecting the most relevant questions and topics. Participants also became aware during discussions whether questions from a certain disciplinary perspective needed more attention from other disciplines. The discussion moderators challenged the workshop participants to formulate their questions as specifically as possible and think about what is needed in terms of expertise to answer questions, i.e., whom to address the questions to. For example, during the second workshop on the tomato case, the discussion on research questions was further specified to best position the concept on the shelves of the retailer and which concept was preferred. This meant that in the next phase, other food system elements had to be involved, namely, food retail and provision.

Finally, an interactive and creative approach was used to support the right mood. Therefore, at the beginning of the

workshop, an assignment was used in the form of a supermarket safari. Before the workshop, participants were asked to select innovative food products on their own and another food category to have an open-minded approach from different perspectives. The possibilities to exchange experiences, as well as other creative approaches, resulted in high involvement and many ideas.

Discussion

There is a need for the implementation of more sustainable production and processing models and the consequent increase of actors' responsibilities and awareness for both producers and consumers, as well as the need for tools to support this (Hamam et al., 2021). The applications in our study provide an example of such a tool and show that consumer orientation and interaction between actors while structuring food innovation by means of the phase of food innovation and food system elements, support taking the next steps in product development. The integration of consumer insights was experienced as being of value since it provided a better understanding in terms of eye-openers and inspiration, support to define which topic to focus on, and being able to be more market-oriented and targeted. An important learning was that this was not a one-way direction but an interaction and iterative process. Once the discussion was started about consumer insights, learning from those insights raised further questions that could be related to different food system elements or that became relevant when moving into the next phase of innovation. This shows the continuous process of innovation supportive of the involvement and commitment of actors in a creative, flexible, interactive, and iterative process of product development.

Consumer food choice is a complex system of interrelated variables. Consumer research models were introduced in the workshops and were shown to be helpful in facilitating consumer-oriented thinking for actors from other disciplines. Examples of models that could be of help in this were the food quality model (Grunert, 2005), the DONE model, which represents all levels and subcategories of variables influencing food choice (Stok et al., 2017), and the circular food consumption practices (CFCP) framework, which is helpful in analyzing circular food consumption in everyday life practices related to CE strategies (Borrello and Cembalo, 2022). During the workshops for these two cases, consumer insights were gathered from available studies or secondary data. In product development, including new consumer studies is also needed, for example, regarding testing circular concepts or more concrete concepts in the optimization and launch phases, as well as co-creation sessions, in the opportunity identification phase. For example, for the tomato case, research insights related to choosing consumers in supermarkets and questions relevant to other disciplines were raised, such as automizing the packaging process that could be tested in consumer studies. In addition to insights from consumer studies, there is also a need for including circular consumer behavior when moving to circularity (do Canto et al., 2021), and this was not considered in the case studies presented in this study but could be the next step in future application of the CFD model.

Overall, the experiences with the involvement and interaction of different disciplines showed the need for the integration of insights from different departments and disciplines in each phase of product development. It was experienced as fruitful to the engagement of various actors of different departments since it resulted in a better understanding of other departments and joint innovation. This approach is an example of more alignment with the comprehensive and multidisciplinary agenda which El Bilali et al. (2021) present in their review of how to support more sustainable agri-food systems. The interactive and creative approach was supported by everyone. This experience underlines the need for a creative approach during innovation processes which has been recommended in an editorial for future research in agricultural systems (Berthet et al., 2018). The two cases presented in the current study differed in their phases of development. In the case positioned in an earlier phase of new product development, there was an apparent need for more departments to be involved compared to the later phases, in which work is more focused. This needs further exploration.

The most important limitation of the cases was that they did not cover the whole process of product innovation. The cases were limited to the phases of development processes, food system elements, and disciplines included. First, we only reflected on one phase of innovation per case, while it would be interesting to also describe the product development and launch phases. Second, in the two cases, the processes of discover and define, in particular, were used, and there were fewer activities focused on develop and deliver. Thus, in the future, it is necessary to apply CFD to all the phases of new product development using the processes of discovering, defining, developing, and delivering. In addition, the combination of different food system elements, from production and processing to resources and recycling, should be considered. Efficient use of resources and recycling needs also cooperation between different chain actors, according to Ciccullo et al. (2021) and, in addition, insights into consumers' perception of novel products made from waste (McCarthy et al., 2019). The case study applications were in a phase in which we focused mainly on consumer-related food system elements, such as food retail and provisioning and food consumption. When developing a more sustainable food system, there are additional steps representing the circular process in which all elements from the food system, from production, processing, retail resources, co-products, and recycling, will be considered from both consumer and technological perspectives.

In conclusion, the application of circular food design in two case studies supported the use of the CFD model in practice for food companies. It provides a structured approach to food innovation in which interaction and involvement are especially key in a consumer-oriented approach. The experiences confirmed the idea that innovation toward a more sustainable food system is an iterative continuous process moving through different phases of innovation and addressing different food system elements making use of creativity. This stimulated the involvement of actors and the interaction between different disciplines in consumer-oriented innovation.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

SS and HS: conceptualization, methodology, and writing of the original draft. SS: project administration and investigation for both case studies. HS: investigation of the bell pepper case.

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