

Project PlantPro – Accelerating an efficient green consumer transition
Project nr 0224-00044B

PlantPro short note on research on Upcycled Food



**MAPP CENTRE – RESEARCH ON VALUE CREATION
IN THE FOOD SECTOR**
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Acknowledgement and transparency on involvement¹:

No company partner was involved in the writing of this report. This report puts together various research insights from PlantPro research on upcycled food, while also drawing on previous research from PlantPro researchers, to provide a short note on Upcycled Food research for interested stakeholders. The companies Circular Food Technology, Møllerup Brands (now Dava Foods), FairTrees and Beyond Coffee provided products or product concepts which were used in the PlantPro study called ‘Upcycled Food Journey’ mentioned in the report; In addition, the companies Glean, Marienlyst Ento, Scicular, Connecting Grounds, and Reduced were shown as cases in the ‘Upcycled Food Journey’.

¹ In line with the AU BSS Principles on responsible scientific conduct, see: https://medarbejdere.au.dk/fileadmin/user_upload/Principles_on_responsible_scientific_conduct_at_Aarhus_BSS_final_160915.pdf

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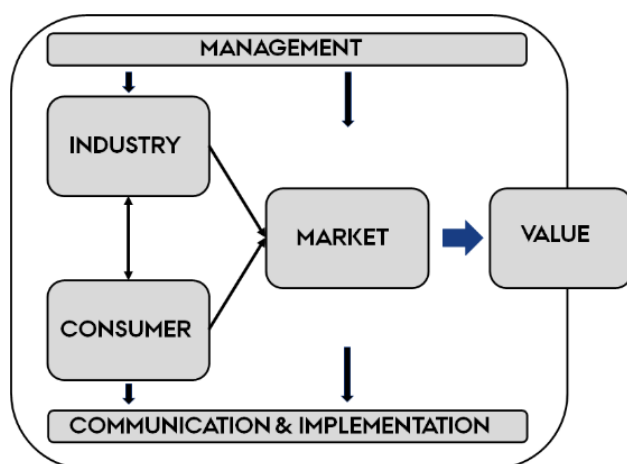
PlantPro project

The project PlantPro contributes to accelerating an efficient green consumer behaviour transition towards more plant-rich diets and reduced food waste. It aims to fill a knowledge gap on factors that drive consumer behaviour change towards more sustainable plant-rich diets and upcycled foods and greater acceptance of sustainable food technologies.

PlantPro is funded by Innovation Fund Denmark. The project runs for three years, from 1 April 2021 to 2024. The project is a collaboration between the MAPP Centre at the Department of Management at Aarhus University, Department of Food Science at University of Copenhagen, Copenhagen Business School, Plantebranchen, Dansk Vegetarisk Forening, Thinktank OneThird, Simple Feast, Beyond Coffee, Circular Food Technology, Møllerup Brands, Food Innovation House, Orkla, Naturli, Planteslagterne, Upfield, Eachthing, Rema1000, Fair Trees and Nemlig.com.

Throughout the project, PlantPro identifies key success factors in industry and societal transitions, maps consumer factors that determine acceptance and behaviour across consumer lifestyle groups, assesses environmental impact, and measures the effect of nudging, information, and motivation on behavioural change in public and private settings under real-life context. It delivers a catalogue of marketing and policy actions.

The commercial value created consists of market growth for innovative plant-based food and food upcycling businesses. The societal value created consists of the achievement of climate targets and sustainable development goals. The overall goal is to contribute to the development that a greater share of the broader population consumes more plant-rich diets in ways that at the same time reduce food waste in the system.



The work package structure focuses on the industry (WP1), the consumer (WP2), and the interplay of both in the market (WP3). WP4 consists of the management of the project, and WP5 entails communication and implementation.

WP1 aims to identify which key success factors shape sustainable industry and societal transitions in the food and other sectors, in Denmark and abroad. WP2 aims to map the consumer factors that determine the acceptance and behaviour across different consumer lifestyle groups, and the respective environmental impact of it. WP3 aims to assess the impact of actions to nudge, inform or motivate behaviour change among consumers in different public and private choice contexts.

See more at <https://mgmt.au.dk/plantpro>

What is upcycled food

Upcycled food is based on ‘upcycling’. The term upcycling goes back to the ground-breaking cradle-to-cradle (C2C) design concept ((Braungart et al. 2007). Simply said, it is “reuse of discarded materials which results in an increase in ‘value’” (Bridgens et al., 2018, p. 146), or “a process of converting materials into new materials of higher quality and increased functionality” (Ellen McArthur foundation, 2019).

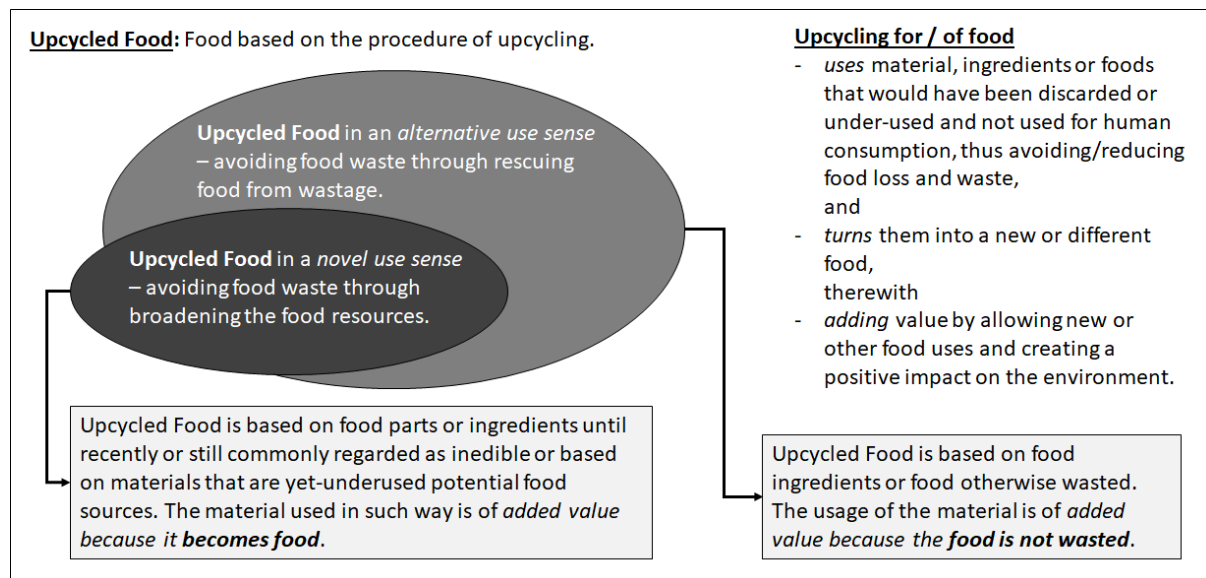
The Upcycled Food Association writes that “*Upcycled foods use ingredients that otherwise would not have gone to human consumption, are procured and produced using verifiable supply chains, and have a positive impact on the environment*” (Upcycled food definition task force, 2020).

Upcycled food needs to combine three aspects (Aschemann-Witzel et al., 2023): It is

- 1) a product consisting of or containing materials that otherwise would be **waste**, this material is
- 2) turned into a **food** product for human consumption, and this is done via
- 3) a process that involves an increase in **value**.

Aschemann-Witzel et al. (2023) argue that there are two types of upcycled food, **alternative and novel use upcycled food**, as explained in the following: “*One is avoiding that those resources which have gone into food production are wasted, thus introducing upcycled foods through alternative use, the other is diversifying and broadening the food resource base by introducing upcycled food through novel use*” and state that “*The crucial distinction is based on the consumer perception of whether the starting point is food or not, that is, whether it is currently perceived as edible or not*” (p. 134).

Figure 1. Two types of upcycled food.



Source: Aschemann-Witzel et al., 2023, p. 134.

What is known about consumers and upcycled food

A systematic literature review on empirical consumer research on waste-to-value in food and drink from the past ten years (Aschemann-Witzel & Stangherlin, 2021) concluded that – based on the state of research reflected in the 18 identified published studies at that point in time – the following **state of knowledge** emerges:

- Product acceptance is determined by individual, context- and product-related factors.
- Product type and origin, the degree and type of processing and its interaction are important factors.
- Consumers' environmental concerns and communication about environmental benefits increase favourable reaction.
- There are consumer segments willing to accept these products.
- Degree of processing and use of both positive and negative arguments to communicate about recycled water are favourable.

What is **yet missing**, though, are the following next steps in terms of approaches or topics:

- Use of more diverse methodologies (e.g. qualitative research and real field studies).
- Applying and testing consumer behaviour theories.
- Studies in emerging or developed countries.
- Exploring gender and age effects and the role of generations.
- Communication of potential health versus potential environmental benefits.
- Exploring different food categories.
- How consumers understand circular practices and how they interact (e.g. spillover).

Consumers associations to upcycled food in Denmark

In a related previous study (yet unpublished but see methodology of data collection as in Aschemann-Witzel et al., 2022), respondents in a 5-country representative survey were asked the following: 'Please write the first words that come to your mind when seeing this concept or such products!'. All associations were coded into different categories to be able to quantify them. Among the Danish respondents, the share of mention of codes was as shown in table 1 (note that each respondent's answer could be coded into several types, e.g. one person might mention something negative but also positive, and a word coded as efficient as well as interesting). While close to 1 out of 4 respondents had a negative association, there were also a range of positive types of associations.

Table 1. Share of association types as mentioned by respondents.

Share	Type of association (several per person)
12.6%	'Do not know' type of comments
23.3%	Negative associations (skepticism, dislike, concern about taste or nutrition)
10.3%	Positive but unspecified (e.g. 'good')
10.3%	Associations to 'innovation' (e.g. future, trend, idea, etc.)
8.8%	Efficient / smart / needed / saves
7.1%	Environment / environmental
7.1%	Interesting / inspiring / curious / fun
5.8%	Sustainable / sustainability
5.1%	Avoid food waste

Source: Own.

What does the PlantPro benchmark study find about upcycled food

The PlantPro project conducts repeated representative consumer surveys to take stock of the changes in the key performance indicators (KPI) of the project, during the project period. The first benchmark survey was conducted in May 2021. The research team conducted an additional benchmark survey midterm, in October 2022. The benchmark survey at the end will be conducted in spring 2024.

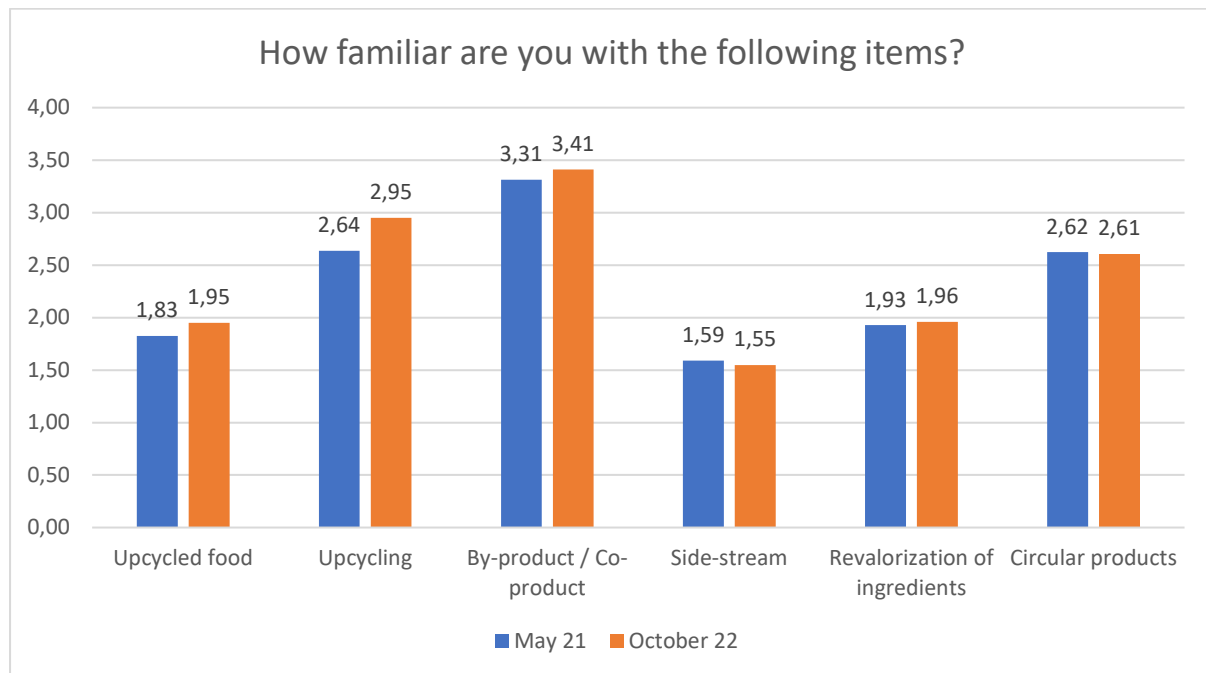
More information (including the methodology and a report on all variables at both points in time, where the two figures are taken from) can be found under

<https://mgmt.au.dk/plantpro/activities/benchmark-survey>

In the following, the findings on upcycled food term awareness and attitude to upcycled food are shown.

How familiar are Danish consumers with terms indicating upcycling?

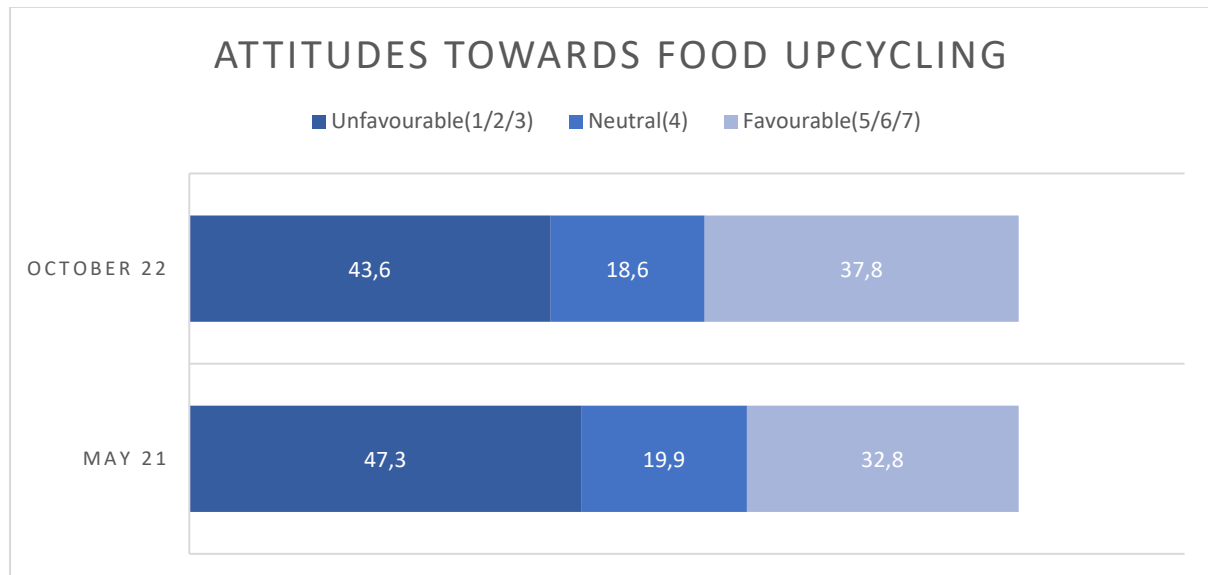
Below one can see the development of familiarity about the terms mentioned below. The numbers are the averages (from a 7-point Likert scale “How familiar are you with the following terms: Upcycled food, Upcycling, By-product/Co-product, Side-stream, Revalorization of ingredients, Circular products? (meaning; you have heard the term and have an idea about what it stands for”). Overall, knowledge of these terms that can describe upcycled food, is low, but there appear to be differences in which terms respondents have heard of so far.



Interestingly, the terms ‘upcycled food’ and ‘upcycling’ were significantly more familiar to consumers in Denmark in 2022 than in 2021 – contrary to all other terms listed above, whose familiarity did not significantly change. Upcycled food in 2022 ($M=1.95$, $SD=1.56$) was more familiar to the respondents compared to 2021 ($t(1257) = 2.825$, $p = .005$), where the average was 1.83. Upcycling in 2022 ($M=2.95$, $SD=2.22$) was more familiar to the respondents compared to 2021 ($t(1257) = 5.006$, $p < .001$), where the average was 2.64.

What is Danish consumers attitude towards upcycled food?

After a short explanation (“Upcycled foods use ingredients that otherwise would not have gone to human consumption. This reduces food waste.”), respondents were asked about their attitude towards upcycling with three statements (Eating/drinking these products is ... [1 = extremely bad / extremely good]; I am [strongly against / strongly for] eating/drinking these products; I [dislike / like] eating/drinking these products.).



The figure shows the average across the three statements, grouped for unfavourable, neutral, or favourable attitude. The measurement was done on a 7-point disagree-agree Likert scale. At least a third of respondents express a favourable attitude, but more than 40% express an unfavourable attitude.

Also here, a change between 2021 and 2022 can be observed: In 2021, the attitude towards upcycled food was at an average of 3.63 (SD=1.63) for the 1222 respondents in the sample. Compared to this mean of 3.63, the attitude towards upcycled food significantly increased in 2022, where the average was 3.78 (SD=1.59) ($t(1257) = 3.318, p < .001$).

The PlantPro Upcycled Food Journey study

As part of the PlantPro project, the AU research team, together with Social Action, conducted a study called ‘Upcycled Food Journey’. Below is the text from the 1-pager that was used to explain the study in a nutshell:

Reducing waste across the whole supply chain, uncovering the value in what is currently ‘waste’, and closing nutrient loops is an important step towards creating a resilient, sustainable and circular food system. This cannot be done by experts and professionals alone – citizens and consumers will be an active part of such a system as well.

Citizen-consumers can build an understanding for system interdependency and circularity, and change the general mindset to see humans as just one element of the circle and ecosystem, instead of the end-receiver of a one-directional ‘take, make, waste’ chain. A practical hands-on example of this are upcycled foods - foods that contain ingredients previously regarded inedible or wasted in the supply chain.

What is the ‘Upcycled food journey’?

A 4-week ‘journey’ consisting of 2-3 weekly emails with a link to material that takes circa 3-5 minutes to engage with. This material consists of information, quizzes, questions, activities and product cases, as text, images or videos. The different ‘rounds’ of emails build on one another and lead through the topics of food waste, upcycling as concept, the climate effect of food, and the food system. Each round gives examples of upcycled foods that increasingly challenge what one thinks is edible or not. The journey also addresses the nutrient cycle – and that phosphorous from our wastewater can be extracted as fertilizer for our food. The goal is to have consumers engage with the concrete example of upcycled food and what it tells them about the current and future food system. It is evaluated using a before and after survey, exploring how consumers conceptualize ‘circularity’ in food systems and understand ‘upcycled food’, and how their understanding, openness to new circular food products, and system thinking capability changes through engaging with the journey.

The findings of this study contribute to **better understanding of citizen-consumers perspectives** and learning process and help to develop **recommendations for communication strategies** for stakeholders and companies working with the issue. Findings can support companies developing concrete products that are upcycled foods who need to know more about consumer perception, behaviour and its implications for communication of products in Denmark.

The study was conducted March-June 2022, with the ‘journey’ per se during April and May, and interviews conducted before and after that period. The qualitative in-depth interviews are currently analysed with regard to consumers understanding and conceptualisation of ‘circularity’ in the food system.

The interaction with and responses from participating consumers were very positive, and we plan to use the experiences for following up with a large-scale study of similar design. A video summarizing the study and with observations and comments from participants can be found here <https://mgmt.au.dk/plantpro/activities/communication> (see fold-out ‘video on the Upcycled Food Journey study’).

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