Empowering Trust. Unleashing Biotech.

REPORT CONSUMER CO-CREATION SESSIONS

DELIVERABLE 2.2 (V3)

WP2 – Co-creating for impact

Funded by the European Union

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Alice down the rabbit hole

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PU	Public (fully open)	X
SEN	Sensitive, limited under the conditions of the Grant Agreement	

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LIST OF ABBREVIATIONS AND ACRONYMS

B-Trust - Co-creation methodology for biotechnology trust-building measures for improved innovation uptake in the bio-based innovation system.

D - Deliverable

EC - European Commission

HEU - Horizon Europe: the 9th EU Framework Programme for Research, Technological Development and Innovation Activities

5H – Quintuple Helix

WP - Work package

RBA – Risk-Benefit Assessment

TRL – Technology Readiness Levels

DoA – Description of Action

ToC – Theory of Change

MEL Framework – Monitoring, Evaluation and Learning Framework

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1 INTRODUCTION

1.1 Framing of the co-creation trajectories and the objectives

The effective application of biotechnology plays a crucial role in building a sustainable future for a thriving European industry, contributing to not only the growth of the European economy, but also to sustainable development, and the safeguarding of public health and environmental protection. Its range of applications comprises various industrial domains including pharmaceuticals, animal health, chemicals, plastics, paper, fuel, and food and feed production.

Although benefits have been widely demonstrated, achieving broad public acceptance and implementation is proving difficult due to consumer perceptions and concerns. Despite the overwhelming scientific evidence supporting the application of biotechnology, especially when talking about the controversial areas such as vaccinations, genetically engineered food or embryonic stem cell research, consumers are reluctant to its adoption due to its perceived potentially adverse effects on environment, health and ethics (Sax, 2017).

The B-Trust project will provide a systemic governance model as a key enabler for boosting the innovation uptake of biotechnology in the bio-based & agri-food sectors based on a three-tiered approach:

1. encouraging collaboration of key stakeholders from the quintuple helix (5H);
2. fostering consumer trust, promoting transparency and ethical practices to reduce public concerns about safety and effectiveness of biotech applications and products, and
3. providing a comprehensive framework of trust-building measures and principles to reduce uncertainties and associated (perceived) risks facilitating the adoption of biotechnology.

This approach is translated into practice via co-creation trajectories, which are at the core of the methodological approach of the B-Trust project and generate several crucial outputs ().

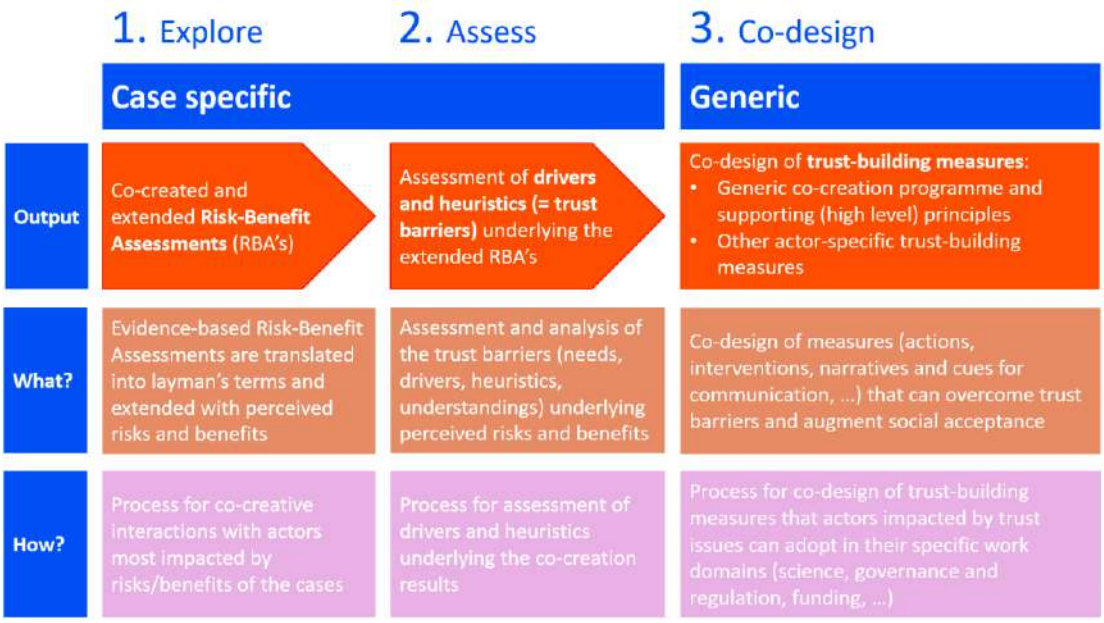

Figure 1. Objectives of the co-creation trajectories

Note: The figure was slightly adapted compared to the figure shown in D2.1. We renamed the first phase to 'Explore' instead of 'Co-create', as it seemed unclear what the distinction is between the first and the third phase, and thus led to too much confusion.

1.2 Link with previous D1.3, D1.4 and D2.1

In the framework of D1.3 an overarching methodology is described to set up and deploy these co-creation trajectories.

The co-creation trajectories and programme from WP2 start from a selection of six Biotech Co-Creation Cases that have clear application potential for the bio-based and agri-food sectors. They serve as testbeds for the development of the co-creation activities related to the B-Trust governance model (WP2). The Biotech Co-Creation Cases were selected as described in D1.4 from a longlist, considering their impact, key beneficiaries of final outcomes, application types, sectors and purposes. The cases were chosen for their potential impacts, but also include a wide range of critical parameters and aspects to ensure having a broad variety of cases.

For each case, evidence-based Risk-Benefit Assessments (RBAs) of the Cases were developed along scientific, technical and sustainability axes, as methodologically described under D1.4. As (perceived) benefits and risks of a new technology lie at the basis of trust in this technology (Oloo, 2020), these RBAs will be further explored and extended with potential real and perceived risks and benefits for different stakeholders. This is done throughout an inclusive process, forming the starting point of the co-creation methodology. The trajectories, and the resulting extended RBAs of the Biotech Co-Creation Cases serve as tools to assess the trust barriers of the actors most affected by the implementation of the technology (affect) and/or having the most impact on the market uptake and acceptance of these specific cases (influence).

D2.1 described in detail the case- and context-based trajectories from phase 1 (Explore) in Figure 1 (which will be analysed in phase 2 (Assess)) and the general planning for phase 3 (Co-design).

1.3 Scope of the current deliverable 2.2

The case-specific first phase of the co-creation trajectories (Explore) will gather data from the stakeholders that are highly impacted by the implementation of the technology, whilst also having a significant influence on the uptake of the technologies applied in each case. For the B-Trust project, it was decided that consumers should be involved in the trajectories of all the cases. This because this is a test environment, where we want to explore whether they react differently to cases with different beneficiaries, technologies, results, TRLs and application areas.

This deliverable contains the conclusions, and the information gathered throughout all consumer co-creation sessions, based on the reports of the different consumer sessions, as set out in D2.1.

1.4 Link with following D2.3 and D3.1

Parallel with the exploratory consumer co-creation sessions, sessions are organised with other actors of the 5H in T2.3. The first series of sessions with other actors are designed to gather information on trust issues and expand the RBA's, i.e. information similar to the sessions held

with consumers. These sessions are held with stakeholders that are also highly impacted by the specific case, and are thus part of phase 1 & 2 (Explore and Assess, see Figure 1) in the co-creation trajectories.

In the second series of sessions held under T2.3, we move to phase 3 of the co-creation trajectories (Co-design, see Figure 1). In these sessions, we will co-design a draft co-creation programme with underpinning principles and actor-specific trust-building measures. These sessions will be held with the stakeholders that are actively responsible for the implementation of biotechnological solutions and therefore impacted by said trust issues, such as biotech companies, bio-based and agri-food companies, researchers, but also investors, funding agencies and legislators.

Based on the reports from D2.2 and D2.3, deliverable 3.1 will contain the result of the co-creation trajectories (all three phases) described in WP2, in the form of a draft co-creation programme with underpinning principles and actor-specific trust-building measures. This co-creation programme will follow a similar approach as the one followed in the project, but with a few distinct differences:

- The co-creation programme is meant for evaluation of a single case, while the B-Trust project uses six cases with different types of beneficiaries, technologies, results, TRLs and applications;
- This implies that the first phase of the co-creation trajectory was 'run' six times in order to get enough data to develop a generic programme that covers different situations for a new case or even a new technology;
- The co-design phase of the project will result in a draft co-creation programme with underpinning principles and actor-specific trust-building measures, codesigned with the stakeholders responsible for implementation and regulation of the technology. For the actual programme, this co-design phase will obviously not result in a co-creation programme, but will lead to a set of guiding principles and measures for regulation, communication and inclusive implementation of the case.

The difference between the co-creation trajectories deployed for the project versus the co-creation programme that will be described under D3.1 is visualised in Figure 2 below.

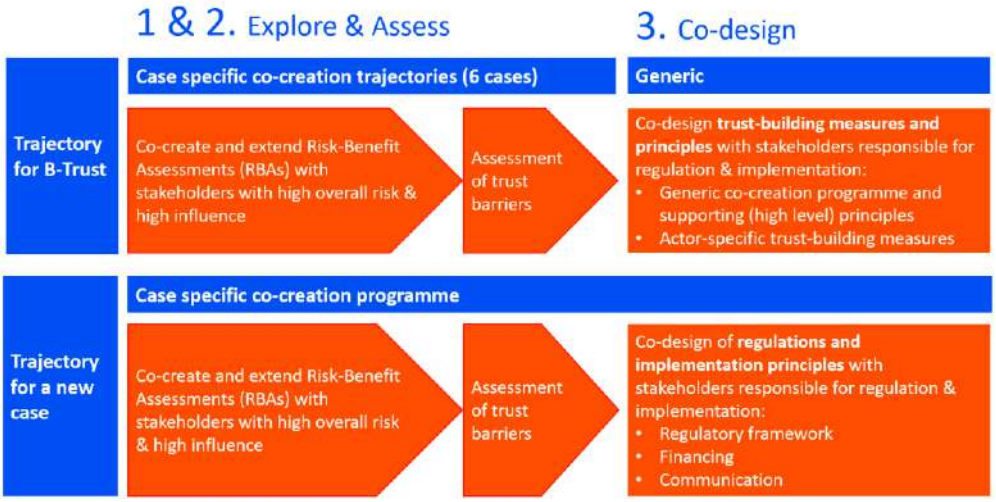

Figure 2. The comparison between the trajectory followed within the framework of B-Trust versus the trajectory for a new case/technology, as included in the co-creation programme

2 REPORTS ON THE CONSUMER CO-CREATION SESSIONS

2.1 Overview of the consumer co-creation sessions linked to the different cases

As described in D2.1, 6 exploratory co-creation sessions with consumers were executed, linked to 6 Biotech Co-Creation Cases. The co-creation sessions were not conducted as one-on-one sessions for each case. The case of 'Cell factories' was duplicated across two regions (Belgium and Denmark), while two cases, 'Biostimulants & Biofertilizers' and 'Bacteriophages' were combined into a single session. This was because both topics were more agriculture-focused and less directly connected to the daily lives of consumers. Table 1 gives an overview of the co-creation sessions (the titles as communicated to the consumers), the cases addressed, and the linked sessions held, their location and the number of consumers involved.

Table 1. Overview of the sessions

Co-creation session	Cases addressed	Date, Location and partner	Number of consumers involved
"A new way to produce food"	**'Cell factories'** Food ingredients/additives obtained through precision fermentation	Belgium (Ghent), 9/7/2024 Alice down the rabbit hole Denmark (Aarhus), 29/10/2024 Food & Bio Cluster Denmark	16 + 15 = 31
"Which weapons do we use in the battle against climate change?"	**'Climate resilient crops'** Obtained through New Genomic Techniques (NGTs)	Belgium (Ghent), 11/12/2024 Alice down the rabbit hole	12
"Meat the future"	**'Eating the cells'** Cultured cells as meat alternatives	Spain (Logroño), 23/1/2025 Food + I	9
"Agriculture and livestock farming: How can we do better?"	**'Biostimulants & biofertilizers'** **'Bacteriophages'** As antimicrobial agents in animal husbandry	Belgium (Ghent), 4/2/2025 Alice down the rabbit hole	13
"Natural materials reinvented, solution for the future?"	**'Bio-based materials'** Biotechnologically produced plastics, textiles, cleaning products, etc.	Denmark (Aarhus), 18/2/2025 Food & Bio Cluster Denmark	16

2.2 Sessions "A new way to produce food"

These sessions addressed the case of 'Cell Factories', which is in essence about having a sustainable alternative to ingredients that are currently difficult to source (demand largely exceeding production capacity) or come from sources with a high impact on climate and environment. This means the case will primarily benefit the climate and environment, which is also beneficial for the people ('consumers'). As it can also result in cheaper and more sustainable ingredients, it is also very interesting for industry, as well as consumers.

2.2.1 Consumer session in Belgium

Practical data

Location	Ghent, Belgium
Date	9/7/2024
Organisation	Alice down the rabbit hole
Participants	16, of which: • 11 women, 5 men • 13 GenX (age 44-59), 2 GenY (age 28-43), 1 GenZ (12-27) • 3 living in a city centre, 9 from city outskirts, 2 living in village centres and 2 living in rural areas • 7 (daily) meat eaters, 8 flexitarians, 1 vegetarian • 8 adventurous eaters, 8 being open to new experiences but not actively seeking it, no traditional eaters • 4 indicated sustainability as a priority in shopping, 10 health, 7 local food • 5 indicated having cooking as a hobby • 1 participant with a background in biology, 1 participant with a background in food production and 1 participant with a background in nutrition

Participants and flow of the workshop

Recruitment and participants

The main participant requirements were diversity in age and gender, but most importantly a balance of progressive and conservative voices. Additionally, the majority of participants were required to have a non-scientific background. In total 16 persons fitting the requirements described above participated in the co-creation session. We had both men and women, one teenager and mostly people in their forties and fifties. It is nearly impossible (and maybe not even relevant) to get people who care very little about the (nutritional) quality of their food and simply choose based on price, regardless of how it is produced or what it contains - despite this being a large group. As a result, the people present had at least some interest in food production, nutrition or quality.

The types of people present ranged from the quite regular, not too indifferent consumer who makes both emotional and rational choices when choosing food, over the progressive eater who likes to try new things and the very conscious citizen who tries to live as sustainable as practically possible, to the 'die hard' activist who has very strong beliefs about the way food (and the world in general) should be. One participant was extremist to a degree that it seriously interfered with the flow of the workshop. He clearly presented himself as expert (having a background in biology) and dragged other participants along with his (often false) beliefs and theories.

Flow of the session and reflections

The first part of the workshop was about the problems with the current production methods. Only after this part we moved to (and mentioned) biotechnology. Also, our own enthusiasm about the technology may have been too visible during the explanations. Both of these factors gave some people the feeling they were 'tricked' into a workshop to promote biotechnology, which may have triggered a defensive attitude.

As soon as the words 'biotechnology' and especially 'GMO' was mentioned, the discussions started to heat up. Most participants did not seem to make the link between the previous part (about the current problems) and biotechnology as a solution. The association exercise went quite smoothly.

Next up was a scenario exercise around the statement 'Imagine a world where this is the main production method for food ingredients.' Based on their answers to the question 'Would you want to live in this world', the participants were divided into three groups (yes - utopia, in doubt, no - dystopia), and were asked to think about the consequences, risks and benefits in this imaginary world. Only a minority of people were in favour of biotechnology. This was probably also due to the extreme case outline (the *main* production method). The 'dystopia' group was thus the largest (some people even mentioned they would have chosen differently if the case wasn't so extreme). The discussions went well and were constructive in the 'utopia' and the more neutral group, but extremist voices dominated the discussion in the 'dystopia' group, leaving very little room for nuance and context, and dragging other people along into a very negative narrative.

The heated discussions led to problems with the timing, and very little time to go over the techno-scientific benefits, risks and mitigation measures. The last part, about the communication, was skipped and afterwards mailed to the participants as a form. The questions were:

- How did you understand this technology? Explain in your own words;
- Can this technology help built a sustainable future? How?
- Or why don't you find the idea appealing? Are there circumstances or preconditions to be met that would make it an acceptable option?

This also gave us some feedback and reflections afterwards. 9 out of 16 participants completed this form (from now on referred to as 'post-session survey'). The results are for each session included in the conclusions.

Responses on MEL survey

The session was ended with a short Mentimeter survey, as part of the MEL framework to asses any changes in their knowledge, viewpoints and ideas linked to biotechnology and more specifically the 'Cell factories'.

13 of the 16 participants completed the survey.

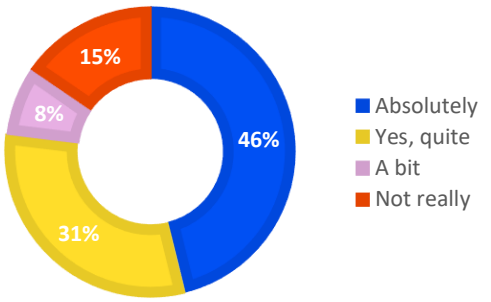

Figure 3. Improved understanding of the impact of our current way of producing food

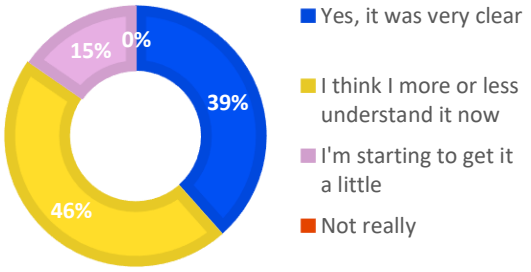

Figure 4. Improved understanding of biotechnology and 'Cell factories'

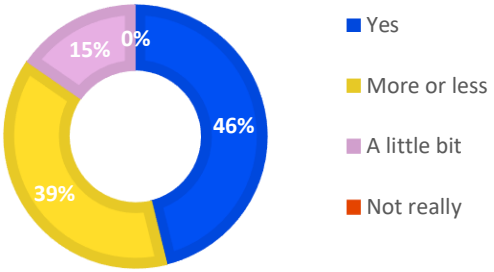

Figure 5. Improved understanding of the risks and benefits of 'Cell factories'

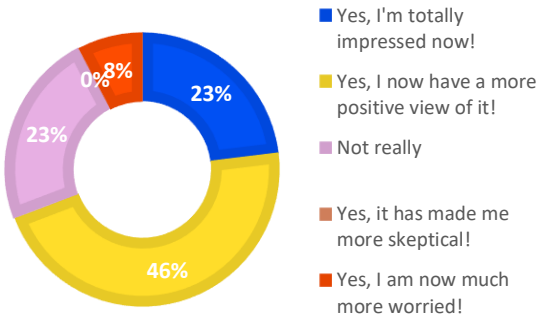

Figure 6. Change in perception of biotechnology

Learnings and additional risks/benefits

Is biotechnology a solution or an even bigger problem?

Even though many people have some or even good awareness related to (some of) the issues with our current food production system, they do not necessarily see the need to do it drastically different. In this perspective, quite a few of the participants feel nostalgic about how things used to be, and they clearly indicated they would prefer to return to this way of eating and producing our food.

Many people are very critical towards biotechnology as a solution (or in general). It feels very unnatural and overprocessed, moving us further away from how it used to be with a local supply chain, using fresh from the tree/crop/farmer products, etc. They don't see its relevance, and some of the participants even don't want to listen to rational arguments as to why, how and in which cases and context this technology could make a difference.

The topic is highly emotional, people don't like the idea of scientists 'fiddling' with their food. Associations ranged from:

- mostly negative for GMO;
- negative, neutral and positive associations and quite a lot of questions for biotechnology;
- rather positive associations for precision fermentation, with some questions regarding the 'precision'.

Some people still see it as a chemical process rather than a natural one, others however do prefer it over current 'chemical' processes for production of additives and flavours.

People are very scared of abuse of power through control of the food production system

Another emotionally laden side of the story is the fear of being controlled through the supply of food. This is often linked to things that occurred and/or went wrong in the past e.g. related to the Monsanto case, with the dependency of farmers and misuse of pesticides.

They want regulations to avoid companies monopolising the technology and food system as a whole, and to ensure government oversight of its use, to avoid 'big biotech' or 'big food' having all the power. Another proposed solution is to make the technology, once approved, openly accessible to everyone without patents. Here again it became clear that the majority of the participants do trust the government and authorities, and the linked regulations they install to avoid monopolisation, fraud and to protect the citizens.

They don't want things imposed on them and they truly want to understand the benefits and risks (and their mitigation measures) linked to the technology. People want to be educated and even involved in the implementation of these solutions. The majority of people will trust information coming from experts (like scientists) and government, as long as they don't have ulterior motives like commercial interests or gaining power.

The technology must serve a higher purpose

Luckily not all participants only (want to) see the negative side. Most of the participants were, although sceptical, open to this technology. However, this is only when it is used to serve 'a greater good', like securing access to healthy food for everyone (food security, providing missing nutrients and affordable prices) or solving sustainability (CO_2 reduction, or reduction of water use, land use, disease risk, …) and social (animal welfare, slavery and oppression of farmers) issues in the current food production system. The 'why' will always be crucial when considering applying this technology, and regulations should be set up accordingly.

Financial opportunities are not a very good argument when the financial gain is not for them, but for food companies. Or even worse, when only biotech companies make a profit. This also refers to what happened in the past, when only biotech companies seemed to get better from the technology, but putting extra pressure on farmers and the environment.

Every single application of biotechnology in a specific context needs a systems analysis

Scientists and biotech companies tend to see the technology as an answer to many problems. But just because it can be done, doesn't mean we should. Even when the intentions are good,

we need to be very critical of the relevance in each case, and beware of overuse of the technology. Overuse could for example lead to an even bigger decrease of biodiversity through dependency on the same feedstock. A parallel can be drawn with what happened with plastics: they were introduced as a solution for basically anything and now we are struggling with the plastic soup, microplastics, etc.

There are usually many ways to get the same result, and it is better to have different methods complementing each other, than being dependent on just one process. Even if that one process is the fastest or the most efficient process in terms of yield. Because the highest yield could mean bigger pressure on the environment and biodiversity.

We need to think about where this technology fits best in the whole system. When and where will it have the biggest, positive impact? How can it complement other production methods? It won't be a silver bullet, a single technological (or other) solution that will solve all of our problems and issues we are facing. In addition, it is also important that people feel they have a choice and can buy products and food that serve their inherent needs and demands.

It is a lot of information, but understanding brings acceptance

Several participants indicated it was a lot of information to absorb in such a short time. On the other hand, when looking at the results of the short survey performed at the end of the session (see also under 'Responses on MEL survey'), a majority indicated that:

- they now have a better view on the impact of our current food production system;
- they better understand what biotechnology is, and how the 'Cell factories' work;
- they now have a better idea of the potential of this technology, and the possible risks.

With the last question, probing for if the session altered their views on biotechnology, only 1 of the 13 participants who completed the survey indicated they were more worried after the session and 3 indicated their views haven't changed. Meaning most were more positive after the session.

Also the survey we forwarded afterwards, due to the fact we ran out of time to do the last exercise, indicated the participants learned a lot during the session and (more or less) understood what biotechnology is and how it can support in making our food production system more sustainable. The more activist participants proved to be undeterred and seemed impossible to convince with rational arguments.

The arguments why they find it (somewhat) creepy remained the same in this survey, referring to the (ultra)processed nature of the ingredients / molecules produced via biotech and the risk of monopolisation, power imbalances and dependency on large (biotech) companies.

We are not sure how we can make the information load more digestible and comprehensible. It is and remains a complex and broad topic. Maybe 'hacking nature' as a way of explaining things would work better? Which wording and communication works best might be something for the quantitative validation.

2.2.2 Consumer session in Denmark

Practical data

Location	Aarhus, Denmark
Date	29/10/2024
Organisation	Food & Bio Cluster Denmark
Participants	15, of which: • 8 women, 7 men • 6 aged 18-30, 1 aged 41-50 and 8 aged 51-65 • 14 living in a city centre and its outskirts and 1 living in rural areas • 8 (daily) meat eaters and 7 flexitarians • 8 adventurous eaters, 3 being open to new experiences but not actively seeking it, 4 traditional eaters • Different levels of education: ranging from a primary school degree over a masters' degree • No participants with a background in science or food technology

Participants and flow of the workshop

Recruitment and participants

Fifteen individuals participated in the session, selected to ensure diversity across gender, age, and non-specialist backgrounds, as agreed for both sessions in BE and DK. As the organizing cluster (FBCD) does not normally work with consumers and thus does not have access to a range of consumers with different profiles, they were recruited with the help of an external agency to ensure they fit the right profile. Participants, ranging from their twenties to above retirement age, had an active interest in food, nutrition, and quality, and generally approached the workshop with open minds. The group represented a mix of:

- Progressive eaters who are open to trying new things;
- Conscious citizens focused on sustainability, climate, and socio-political issues;
- A small number with strong beliefs about food production, who nevertheless engaged constructively.

The balance in backgrounds and views fostered a dynamic and respectful discussion environment.

However, the responses from the post-session survey indicate that here also, there was one person present interfering with the dynamics of the discussion, rejecting all input from other participants and making a constructive discussion with that person difficult.

Flow of the session and reflections

This information is included in the next part, 'Learnings and additional risks/benefits'.

Responses on the MEL survey

Like the other session in Belgium, the session was ended with a short Mentimeter survey, as part of the MEL framework to asses any changes in their knowledge, viewpoints and ideas linked to biotechnology and more specifically the 'cell factories'.

All 15 participants completed the survey.

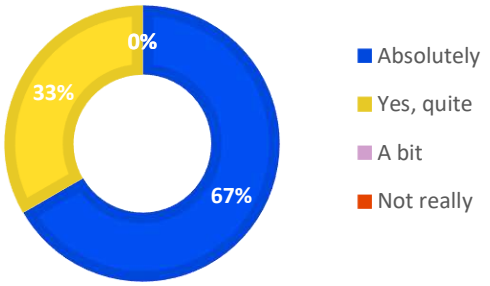

Figure 7. Improved understanding of the impact of our current way of producing food

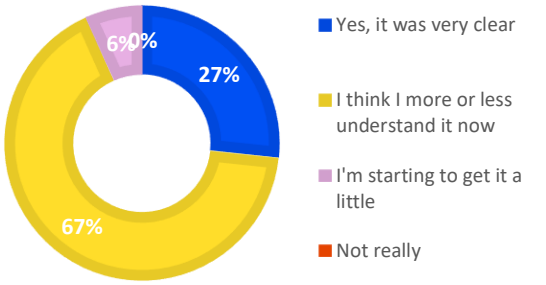

Figure 8. Improved understanding of biotechnology and 'Cell factories'

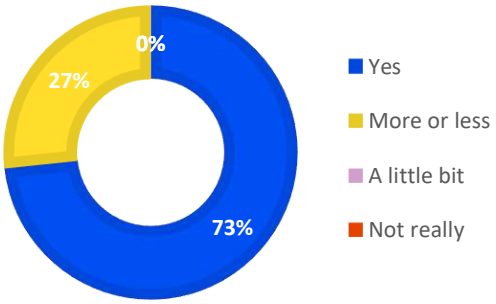

Figure 9. Improved understanding of the risks and benefits of 'Cell factories'

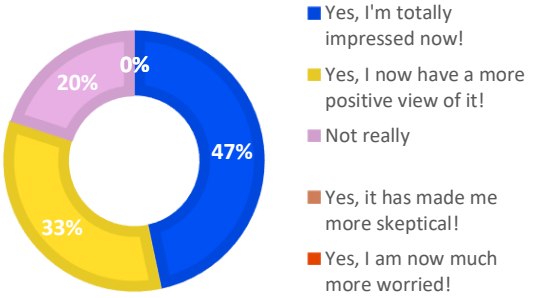

Figure 10. Change in perception of biotechnology

Learnings and additional risks/benefits

Initial questions on technology and food production

Participants were asked if they believed technology could address current food sustainability challenges. A majority of the participants responded affirmatively, indicating a general openness to technological interventions.

Association exercise on technology awareness

In the initial stages, an association exercise was conducted to gauge awareness of various food-related technologies. While most participants had some exposure to concepts like fermentation, lab-grown meat, algae, and circular production, knowledge was varied, and general definitions were limited. The exercise highlighted the need for accessible information on food tech, especially for newer solutions such as cell factories.

Presentation and discussion on biotechnological solutions

The moderator presented an overview of the EU's interest in biotechnological solutions for sustainable food production. Participants were then asked to brainstorm potential technologies that could address climate challenges in food production, which included:

- Plant-based foods
- Lab-grown meat
- Insect-based food
- Vertical farming
- Artificial production methods
- Production of algae and seaweed (micro- and macroalgae) in labs

This discussion underscored that while participants recognized a range of sustainable food technologies, knowledge levels varied, more information on specific methods was desirable.

Cell Factories: Focus discussion

Awareness and initial reactions

Participants were unfamiliar with the concept of cell factories, necessitating a simplified, step-by-step presentation of cell factory processes. This section of the workshop aimed to introduce participants to the fundamentals and real-world applications of cell factories in food production.

Scenario-Based Group Discussions

Two scenarios involving cell factories were presented, with participants choosing tables corresponding to their preferences. Discussions were notably nuanced, with views spanning from strong scepticism to cautious optimism.

Concerns included:

- Fears that large corporations might monopolize the cell factory technology, widening economic divides and creating social and environmental impacts in developing countries.
- Concerns about food 'artificiality' and potential impacts on human health and immunity if food production moves away from natural environments.
- Concerns that people working in the current food production and agriculture will lose their jobs.
- Concerns about taste: are we losing taste differences and nuances in our food? E.g. sun ripe food etc.
- Concerns about this new technology being very energy consuming.

Positive viewpoints highlighted:

- Potential for creating jobs, new business opportunities, and healthier food products.
- Environmental benefits, such as reduced CO_2 emissions through more efficient use of space in food production.
- Once full scale production is established, it has the potential to provide nutritious food to starving populations, particularly in regions like Africa.
- The new product can be designed to offer specific functional benefits, including extended shelf life, the convenience of not requiring refrigeration, and no antinutrient compounds.

- New production methods can ensure tasty food products globally without obstacles such as drought, lack of sun, or heavy rain.

Participants generally agreed that while technology kept the promise, significant information and trust-building would be essential for broader acceptance.

Consumer trust and acceptance

When asked about building consumer trust in cell factories, participants suggested:

- Increased transparency from industry regarding production processes and product ingredients.
- Strong regulatory frameworks to assure safety and fairness, with scepticism about the fairness of EU regulatory processes. A few thought the EU system was corrupt.
- Engagement methods such as test panels and product demonstrations, and a rebranding of 'cell factory' to a term with wider consumer appeal.
- Emphasize affordability: ensure that the new products are accessible to everyone.
- Food products often evoke strong emotions, which can make it challenging to effectively market the new products.
- Invest in more scientific research to support the transition.

Despite some concerns, participants recognized the potential climate benefits of cell factories and expressed conditional openness to trying cell-factory-produced foods, provided safety and health assurances were met.

Post-session survey

After the first co-creation session in Belgium on 'Cell factories' it was decided to distribute, a few days after each consumer co-creation session, a survey to the participants on how they would explain the technology in their own words and their overall perception about the biotechnological case. This enabled the participants to let the information sink in and reflect on the past session. 7 out of 15 participants completed the survey. The answers provided indicate that those who took the time to complete the survey retained the information quite well and understood the principle, the risk and the benefits presented. The answers largely confirmed the conclusions from the session, and were further processed in the combined conclusions from both the Danish and Belgian session on 'Cell factories'.

Conclusion

The co-creation workshop effectively fostered a balanced and insightful discussion on the role of cell factories in sustainable food production. Participants engaged constructively, and the workshop provided valuable consumer insights for Food & Bio Cluster Denmark and the B-Trust project as a whole. The discussions underscored the importance of public information and trust-building for the adoption of emerging food technologies. Future workshops might continue to benefit from a diversified participant base, structured team support, and an accessible approach to complex technical topics.

2.2.3 Differences between the session in Belgium and Denmark

The set-up was adapted after the first session in Belgium, to correct for unclarities and reduce the chances for (too) polarized and unconstructive discussions. Differences in outcomes may therefore be due to the differences in approach.

Adaptations that were made:

- Better framing of the workshop in general and within the B-Trust project, and moving the subject of biotechnology to the beginning of the session.
- Instead of making them think about the problems and then explaining cell factories as a solution, we explained the problems with our current food production system and made them think about the range of solutions that could be used to counter these problems before proposing the cell factories as a solution. This avoided giving them the impression that cell factories were seen as a silver bullet.
- We 'softened' the statement for the scenario exercise from "Imagine a world where this is the main production method for food ingredients" to "Imagine a world where this is a common production method for food ingredients" to avoid too much polarization.
- In addition, as described above, the last exercise on communication and overall perception of the technology at the end of the session, was altered to a survey that was sent a few days after the session ('post-session survey'). In the end it was decided to do this for all the remaining consumer co-creation sessions, as this gives the possibility to the participants to let the information sink in and give additional, individual reflections on the case. Hereafter, the questions of this survey are outlined:
    - How did you understand the technology works? Can you explain it in your own words?
    - Can this technology help make our future more sustainable? What are the most important arguments for you?
    - Or do you still think it's a scary idea? What exactly do you find so creepy about it? Are there circumstances or conditions where you might consider this an option as a production method?
    - Is there anything else you would like to say?

However, some differences were noted that are unlikely to be related to the difference in set-up. Differences such as:

- During the association exercise (which was the same in both sessions), the answers for 'biotechnology' were almost exclusively positive in Denmark, whereas the answers in Belgium were more divided and sceptical. The answers for 'GMO' were in both sessions rather divided (both positive and negative answers), whilst for 'precision fermentation' they were in both sessions largely positive.
- Job opportunities did not come up as a topic in Belgium, while it came up repeatedly in Denmark. However, equity and opportunities (or potential disadvantages) for third-world countries came up in both sessions.
- Based on the answers given by both groups, the Danish group seemed better informed and appeared to have a more realistic view on agricultural practices and new technologies used, despite the fact that none of the Danish participants had a background in science and

technology. They also seemed to better link the opportunities of the technology with the challenges we face. In other words, they tend to agree with the fact that this technology is one potential solution to some of these challenges.

These differences could still be coincidental, and related to the participant group (which is too small to be in any way representative for the population), and thus needs to be verified through quantitative research. This will be done upon finalization of the different consumer co-creation sessions.

Also, despite the changes in set-up, and framing cell factories more as 'one of many potential solutions', one participant in Denmark indicated that it still came across as a 'sales pitch' for biotechnology.

2.2.4 Mutual learnings from both sessions and additional risks/benefits

Learnings and additional risks/benefits

Is biotechnology a solution or an even bigger problem?

Even though many people have some or even good awareness related to (some of the) the issues with our current food production system, they do not necessarily see the need to do it drastically different. In this perspective quite a few of the participants are nostalgic about how things used to be and they clearly indicated they would prefer to return to this way of eating and producing our food.

People can be very critical towards biotechnology as a solution (or in general), especially when it involves GMO technology. It feels very unnatural and overprocessed, moving us further away from how it used to be with a local supply chain, using fresh from the tree/crop/farmer products, etc. They don't see its relevance, and some of the participants even don't want to listen to rational arguments as to why, how and in which cases and context this technology could make a difference.

The topic is highly emotional, people don't like the idea of scientists 'fiddling' with their food. In both sessions, associations were mostly negative for GMO. For 'biotechnology' there were negative, as well as neutral and positive associations, and quite a lot of questions. 'Precision fermentation' elicited mainly positive associations but also many questions, especially regarding the 'precision'.

Overprocessed foods and their impact on human health

People are concerned about the impact of the above-mentioned artificial nature of the process and its impact on health and immunity. Some see it more as a chemical process than using natural processes. Others however do prefer it over current 'chemical' processes for production of additives and flavours.

But the issue remains that this process moves food production further away from natural environments. While there are warnings going around about the negative impact of ultra-processed foods on human health and people are trying to move away from them, this seems like a step in the wrong direction. Taking away food production from a natural environment and

moving it to a controlled and apparently sterile environment also raises concerns on the impact on our immune systems.

People are very scared of abuse of power through control of the food production system.

Another emotionally laden side of the story is the fear of being controlled through the supply of food. This is often linked to things that occurred and/or went wrong in the past e.g. related to the Monsanto case, with the dependency of farmers and misuse of pesticides.

They want regulations to avoid companies monopolising the technology and the food system, and even control of the government over the use of the technology to avoid 'big biotech' or 'big food' having all the power. Or by making the technology (once approved) open for everyone, without patents. Here again it became clear that the majority of the participants do trust the government and authorities, and the linked regulations they install to avoid monopolisation, fraud and to protect the citizens.

They don't want things imposed on them and they truly want to understand the benefits and risks (and how these risks can be mitigated) linked to the technology. People want to be informed, educated and even involved in the implementation of these solutions. The majority of people will trust information coming from experts (like scientists) and government, as long as they don't have ulterior motives like commercial interests or gaining power.

The technology must serve a higher purpose

Luckily not all participants only (want to) see the negative side. Most are, although sometimes sceptical, open to this technology, but only when it is used to serve 'a greater good'. Examples are securing access to healthy food for everyone (food security, providing missing nutrients and affordable prices) or solving sustainability (CO_2 reduction, or reduction of water use, land use, disease risk, etc.) and social (animal welfare, slavery and oppression of farmers) issues in the current food production system. The 'why' will always be crucial when considering applying this technology, and regulations should be set up accordingly.

Financial opportunities are not a very good argument when the financial gain is not for them, but for food companies. Or even worse, when only biotech companies make a profit. This also refers to what happened in the past, when only biotech companies seemed to get better from the technology, but putting extra pressure on farmers and the environment. But, when the technology could mean a financial gain for them, such as job opportunities or reduced food prices, they are more open to it.

Transparency and a good regulatory framework are crucial

It is also important that people feel they have a choice and can buy products and food that serve their inherent needs and demands. Those who do not want modified or biotechnologically produced foods should be able to choose those. And that implies transparent communication about the nature of the ingredients and the processes used.

It also implies a solid regulatory framework on transparency, required information to the consumer and guarantees for food safety. That being said, there seems to be very little awareness about the (very strict) European regulatory framework that is already in place on food safety, additives, novel food, claims and the use of GMO (this especially in comparison with

other regions in the world like the US and Asia). Many consumers do not realise that many of their concerns are already addressed in these strict EU regulations and should therefore be no concern at all. Better communication on the regulatory framework should therefore be an important part of a communication strategy around these technologies.

Every single application of biotechnology in a specific context needs a systems analysis

Scientists and biotech companies tend to see the technology as an answer to many problems. But just because it can be done, doesn't mean we should. Even when the intentions are good, we need to be very critical of the relevance in each case, and beware of overuse of the technology. Overuse could for example lead to an even bigger decrease of biodiversity through dependency on the same feedstock. A parallel can be drawn with what happened with plastics: they were introduced as a solution for basically anything and now we are struggling with the plastic soup, microplastics, etc.

There are usually many ways to come to the same result, and it is better to have different methods complementing each other or being implemented alongside each other, than being dependent on just one process or solution. Even if that one process is the fastest or the most efficient one in terms of yield. Because the highest yield could mean bigger pressure on the environment or biodiversity.

We need to think about where this technology fits best in the whole system and this from various perspectives (economically, environmental, social, etc.). When and where will it have the biggest, positive impact? How can it complement other production methods? It won't be a silver bullet, a single technological (or other) solution that will solve all of our problems and issues we are facing.

It is a very complex topic, but clear and transparent information can improve perception.

For most participants, it was a very complex topic and not easy to understand, both the technical aspects as well as the consequences on a socio-economical, safety and environmental level. Providing them with objective information - grounded in scientific findings but explained in an accessible way - allows them to reconsider their initial perceptions. Despite being open about the potential risks, participants were generally more positive after the session (some were already positive before the session). The arguments for fearing this technology remain the same, but they seem to realise that there are clear benefits to the technology that may outweigh these risks.

2.3 Session "Which weapons do we use in the battle against climate change?"

This session addressed the case of 'Climate resilient crops', where the main goal is to secure food production under the pressures of a changing climate. The main beneficiaries are therefore the consumers/citizens, and by extension the entire food chain. It is a very controversial topic, occasionally popping up in the news and having been the subject of 'anti-biotech campaigns', for example in Belgium, where experimental fields with modified crops have been repeatedly destroyed. This was however before the NGTs were introduced, so the session was also aimed at finding out whether NGT crops are seen differently from the classic GMO crops.

Practical data

Location	Ghent, Belgium
Date	11/12/2024
Organisation	Alice down the rabbit hole
Participants	12, of which: • 5 women, 7 men • 1 Babyboomer (age 60-78), 6 GenX (age 44-59), 3 GenY (age 28-43) and 2 GenZ (12-27) • 3 living in a city centre, 7 from city outskirts and 2 living in rural areas • 6 (daily) meat eaters, 4 flexitarians and 2 vegetarians • 6 adventurous eaters, 4 being open to new experiences but not actively seeking it and 2 traditional eaters • 4 indicated sustainability as a priority in shopping, 6 for health and 5 for local food • 7 indicated having cooking as a hobby • 2 participants with a background in bio-engineering, and1 participant with a background in chemistry (pharmacist) • 4 participants who also participated in the 'cell factories' session in Belgium

Participants and flow of the workshop

Recruitment and participants

As for the other sessions, the requirements for the participants were to have people from different ages and both men and women, but most importantly to have both progressive and conservative voices, and to have a majority of people without a scientific background.

There were 16 people registered for the session, however 4 cancelled last minute due to sickness or work related issues. The age range among the remaining 12 participants remained well spread, and so was the balance between men and women. We invited a few participants from

the 'Cell factories' workshop to participate in this session as well, to see whether they view this type of biotechnology differently. We noticed that the educational level was generally rather high among the remaining participants, and so was the consciousness on food, nutrition and food (production). However, as mentioned in 2.2.1, it is not relevant to involve people with little interest in food quality.

There was a good range of opinions among the participants, from rather sceptical towards new technologies to very eager to see them become reality. Despite these differences, the dialogue was respectful and constructive throughout the session.

Flow of the session and reflections

Before the session and in the invitation, the topic was intentionally kept vague, and biotechnology was not mentioned. So except for those who also participated in the 'Cell factories' session, the participants were not aware the session was about biotechnology and genetic modification. This was done to be able to capture first thoughts and impressions during the association exercise, which was held immediately after the framework and topic of the session was explained.

The session continued with a deep dive on the challenges that we face, including an exercise on the expected impact on daily life and how our society can adapt to meet these challenges. A range of possible solutions were explained, ranging from diet shifts and adaptations in agricultural practices to technological solutions, to avoid positioning genetic modification as a silver bullet solution. A technical explanation on the difference between different types of modification was given. Despite stressing that it was only a possible solution (and not 'the' solution), and keeping information on a factual and nuanced level, it still gave some participants the impression of 'promoting' the technology. It is likely that when doing a workshop about this technology, it will always in some way come across as promotion, unless you're being utterly negative. However, this fact did not lead to any defensive reaction or a feeling of being pushed to change their beliefs.

The last part of the session, where the risks and benefits were discussed and weighed, also led to many interesting, constructive and eye-opening discussions.

The post-session survey, to assess how well they captured and retained the information and certain aspects thereof, and what 'stuck' with them was sent out a few days later. 7 out of 12 participants completed the survey.

Responses on MEL survey

The session was ended with a short Mentimeter survey, as part of the MEL framework to asses any changes in their knowledge, viewpoints and ideas linked to biotechnology and more specifically the 'climate resilient crops'. After evaluation of the MEL from the first two sessions, we slightly adapted the survey:

- We left out the question about the increased knowledge of the food system as it seemed less relevant for assessing the sessions;

- We added a question to gauge whether they felt they had enough opportunities to express their ideas and opinions, in order to better evaluate the process and interaction/feedback opportunities of the participants.

From this consumer co-creation session onwards this question was each time added.

11 of the 12 participants completed this Mentimeter survey.

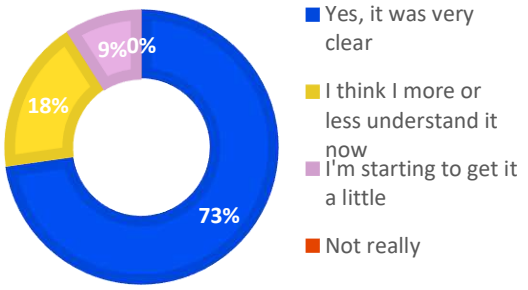

Figure 11. Do you now better understand what biotechnology is and how 'Climate resilient crops' work?

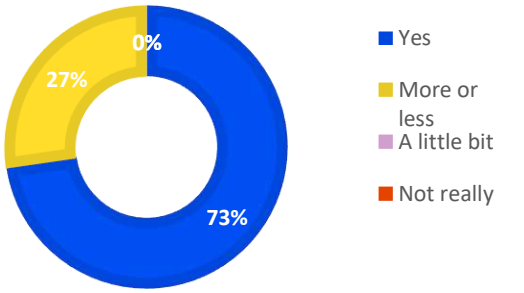

Figure 12. Do you now have a better understanding of the potential of this technology and the possible risks?

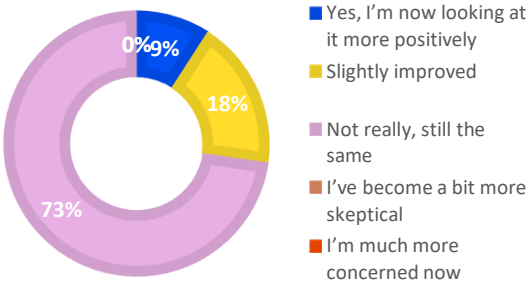

Figure 13. Has this session changed your perception of biotechnology?

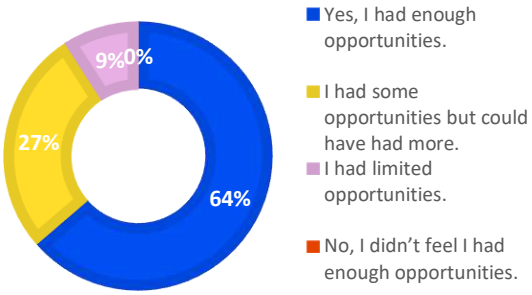

Figure 14. Do you feel that you had enough opportunities to clearly express your ideas and opinions during the session?

Remark (linked to Figure 13): Several of the participants already were quite positive about biotech, so this can either mean their positive perception hasn't changed or their negative perception. We will alter this possible answer in future surveys to be able to distinguish between their initial viewpoints.

Learnings and additional risks/benefits

Climate adaptation versus climate mitigation?

A notable comment on this technology is the question whether this is not just a good excuse to 'loosen the belt' on climate change mitigation. There is a danger that the narrative would become "Why solve climate change if we can adapt to it?". It gives a way out of the urgency of the climate problem, and a reason to postpone climate mitigation interventions even more. Obviously, both climate mitigation and adaptation are necessary at this point, but the

participants agreed that we need to make sure we don't lose sight of the mitigation part by focussing on adaptation.

People still do not want to believe the scale of the problem

During the session it became clear that the participants have a very romantic view on how things were in the past and hope that we can still save everything with organic farming, agroecological principles, vertical farming, and other adaptations. Although most indicated they know the problems we are facing are huge and cannot be solved overnight, they were quite surprised that if we implement all the above and more, there still is a gap to be filled related to the amount of food to be produced in the future.

And yes, conscious consumers do want to adapt and change their eating patterns (less meat, more seasonal, etc.), but for sure they want to keep having the freedom of choice. We are used to having a broad range of food products to choose from, scaling down in this perspective is always very difficult and for the majority of people a 'no go'. On the other hand they do agree that, especially when comparing to the situation in the past where people used to eat for example cabbage throughout the winter, the situation today is a bit decadent. "Do we really need to eat tomatoes and lettuce in the winter? And what about all these exotic fruits? We can for sure do without?"

Maybe they aren't confronted with the consequences enough yet? Indeed prices have gone up considerably for food products, but in the end the product range in the supermarket remains very broad, not considering the seasons and with plenty of exotic fruits. People in Western Europe have not been confronted with major shortages for decades and forgot about how things used to be in the past. When they see the abundancy in the supermarkets, etc., they think it's not all that bad and they like to bury their heads in the sand ('Don't look up').

People have a very romantic idea about how agriculture works

People do not like the idea of scientists 'fiddling' with our foods, but they do not seem to realise that this has been happening for centuries, and that our agricultural products are only the way they are because of our interference with them. One person remarked that "you tell it like our crops are 'handicapped' and need to be fixed". They do not realise that our crops are indeed weak and not adapted to survival in the wild, and can only grow well due to the care of the farmer and/or interventions for pest management, weed control and fertilisation. Comparing the situation with pedigree animals, and the health issues they face due to inbreeding (a much better known issue), did enlighten them with a more accurate view on the situation.

The finger points too much to farmers and consumers, while the system itself should change

Consumers and farmers often get the blame for their unsustainable behaviour. Even though it is true that when many people would make more sustainable choices, the combined effects could make a big difference, the problem is that the system makes it very hard for consumers to make these sustainable choices. Sustainable behaviour is not rewarded financially, with more sustainable products and services often being more expensive, and the abundance of choices make it very difficult for consumers with little background knowledge to know which choices are

more sustainable. On top of that, the sustainable choice is also often the one that requires the most time, energy and effort.

The same holds for farmers, who are stuck in a system where they struggle to get a fair price for their hard work and on the other hand make huge investments. To alleviate the financial pressure a bit they can only turn to classic interventions (like e.g. use of pesticides and chemical fertilizers) to increase their yield.

The biggest difference can be made by the players who have the biggest margins and profits, being the industry and the retailers. They decide on the product range that reaches the consumers and how the food products are presented and marketed. They have the power and possibilities to make the sustainable choice the easiest and evident one for the consumer. Industry and retailers are reluctant to make these changes and make bold choices in this perspective, as they fear and foresee profit losses and reductions of their market share. Regulatory and other interventions of the authorities and cooperative actions could create a more level playing field and decrease individual risks.

The fact that the modified crops cannot be distinguished from 'naturally' created ones is quite convincing to prove it is harmless

Several participants repeatedly asked: "So genetically they are completely the same? They cannot be distinguished (from natural crosses), and only genetic material from within the same species is being used?" Some still think it is messing with our food and playing God, but concluded that "If you cannot detect the difference, it can't be that bad".

People see the advantages, but are scared that it will be used by the wrong parties (companies) and for the wrong reasons

One of the larger issues that consumers have with genetic modification is the fear that it will be used for pure financial gain (for (biotech) companies) at the cost of the environment and the independency of farmers and in extension the consumer. The idea that (biotech) companies hold the power and control over our food chain is a very scary one, and a real one, as this is what happened in the past.

The voices were unanimous when it came to restricting patenting in the new legislation. Even though not all the participants had the same confidence in the European authorities, they nevertheless clearly expressed their hope that strict measures and legislation will be installed to prevent patents from being taken, monopolies from being installed, etc. Like in the 'Cell factories' session, several of the older participants are very much aware of what went wrong in the past with monopolies of companies like Monsanto and other big agro-tech businesses, and hope that the EU now has the guts to prevent that history is being repeated.

Participants are not aware of the strict regulations installed by the EU

Although people, especially since COVID-19, have increasing confidence in the authorities and expect them to intervene, they are not aware of how strict the EU already is when it comes to food products and food legislation in general. They are being protected on multiple levels through legislation on food safety, additives, novel foods, claims, and many more, but are hardly aware of these regulations. They generally trust food safety, but think producers are free to use

whatever ingredient and additive they like, and make wild claims towards health benefits and nutritional properties.

Many consumers do not realise that many of their concerns are already addressed via these strict EU regulations and should therefore be no concern at all. Better communication on the regulatory framework should therefore be an important part of a communication strategy around these technologies.

Next to the authorities they also look at the scientific community

When discussing the risks and benefits one participant asked "Why are you asking us and discussing this topic with us? Is the scientific community not aligned on it?" Indicating that she/he didn't find it a very reassuring thought that there would be 2 groups in the scientific community when it comes to the implementation of NGTs, etc. She/he was reassured when we pointed out that the vast majority of scientists and experts agree with what we outlined as benefits and risks, but that there is always a part that has different opinions or other ideas on this topic. We drew a parallel with climate change, where more than 95% of the scientists agree that this is caused by human activities and emissions, etc.

Scientists are always very nuanced in what they claim. Rarely will they speak in absolute terminologies or indicate that something is 100% safe (since 'having no effect' is more difficult to prove than 'having an effect'). This can come across as very confusing for the consumers and for sure adds on to their doubts and even mistrust linked to biotech and new technologies in general. Being transparent and communicating about the development process, indicating which tests have been done on the technology/product prior to approval and implementation, for sure is an important aspect to focus on and consider.

Is it not already here?

Not everyone has the romantic idea of our agricultural system being 'natural' and 'authentic'. Some people know that the crops we have today are nothing like what they used to be. But some of them seem to think they are made with GMO technologies, and that the technology is already being used on a large scale in Europe … Which is not the case.

On the other hand, those who realise Europe is not on 'the GMO track', do know that the rest of the world is. Given that many of our foods are imported from outside Europe, and the fact that NGTs cannot be detected through analysis, how can we be sure that our food is GMO-free? As GMO fields are abundant in many countries where we import food from, and those fields can easily 'contaminate' nearby non-GMO crops. Furthermore, food fraud is not uncommon, and traceability issues are abundant for long food chains, so there is quite a chance that some of our foods are already made with NGT-adapted crops.

On a sidenote: the fact that GMOs are being produced and consumed in the US for several decades already, is not really a very reassuring argument as the USA is not seen as a great example both from a health perspective (obesity) and mentality/intelligence (Trump elected for president).

2.4 Session "Meat the future"

This session is based on the case 'Eating the cells'. This case is about cellular agriculture in the context of meat replacement, comprising both the culturing of animal cells ('cultured meat'), as well as protein-rich microbial cells for direct consumption. The main goal is replacing meat, thus reducing its impact on climate and environment, making 'our planet' the prime beneficiary, which is obviously important for the future of its inhabitants. It also has a large impact on animal welfare, making the consumer also an important beneficiary in terms of ability to make moral food choices.

Practical data

Location	Logroño, Spain
Date	23/01/2025
Organisation	Food + I
Participants	9, of which: • 7 women, 2 men • 3 Babyboomers (age 60-78), 1 GenX (age 44-59), and 5n GenY (age 28-43), • 4 living in a city centre, 1 from city outskirts and, 4 living in village centres • 6 (daily) meat eaters and 3 vegetarians • 4 adventurous eaters, 3 being open to new experiences but not actively seeking it and 2 traditional eaters • 1 participant was a professional chef (very conscious about local and sustainable production), 3 participants with a scientific (analytical) background, but none on the biotech/food industries. The group also included two teachers, one designer and a civil servant,

Participants and flow of the workshop

Recruitment and participants

The session was conducted with 9 participants. Of the initial 12 registrants, 3 were unable to attend due to illness, as various viruses were circulating in Logroño at the time. Despite efforts to achieve a balanced gender representation, the group consisted of 2 men and 7 women. However, the session successfully achieved an excellent age balance, with participants ranging from 31 to 79 years old. Additionally, a diverse mix of scientific and non-scientific profiles was represented.

Attracting non-conventional eaters proved challenging in this region, where meat consumption is predominant. Nevertheless, the session included 3 vegetarians, enriching the diversity of perspectives. A balanced mix of progressive and conservative viewpoints was also achieved, fostering a well-rounded discussion.

Participants were highly engaged throughout the session, leading to thought-provoking and meaningful discussions. We were particularly pleased to observe that all opinions were shared and received with respect. This open and welcoming environment ensured participants felt comfortable expressing themselves freely, with no tense or uncomfortable moments arising.

Set-up

Minor adaptations were made to the planned activities to accommodate the available space. For example, in exercises requiring participants to write on paper, large murals were hung on the walls, and participants used post-it notes, which were later attached to the murals for easy organisation and visibility.

To create a welcoming atmosphere, food and drinks were provided throughout the session. As a token of appreciation, each participant received a B-Trust mug, a small gesture to thank them for their time and contributions.

Session flow and input

Welcome, introduction & warm-up

The session started by welcoming all the participants, getting them comfortable and used to the space. We added context by explaining the project, avoiding terms like 'trust' to avoid generating negative feelings towards the session and making sure they understood we gathered them to really listen to them.

Once the context was set, we briefly went over the rules and moved on to a round of ice breakers to get them in the mood.

Part 1 - Meat production and its alternatives

After framing this part, and the session, as an exploratory session on how biotechnology can help (or not) in the transition towards meat replacement and a more sustainable meat production, we started with an association exercise.

A large majority of participants stated from the very beginning their awareness of issues such as sustainability, animal cruelty, pollution, over production, … and other similar issues in the industry. However, for traditional eaters, their concern was more about improving these setbacks rather than having alternative options.

When talking about animal feed, concerns arose as to the quality of feed and feeding techniques, as well as for antibiotics, hormones and other undesired chemicals that then move on to humans, but they were quite surprised to learn about the quantity of feed needed for these animals.

Part 2 – Comparing alternatives

We moved on to alternative sources of proteins with this exercise, providing little to no explanation beforehand, to capture as much unbiased and raw information as possible. While vegetarians had a wide knowledge of options, some traditional meat eaters struggled to come up with these alternatives, stating on some occasions that they didn't understand the need for 'alternative meat' when meat was in the market, even though they had previously stated they understood the issues discussed in the first exercise.

For the second part of the exercise, they discussed in small groups (pairs and one group of 3) about the pros and cons of these alternatives (each group was assigned one alternative). The most repeated con for several of the alternatives were 'expensive', 'less appealing', 'unclear origin/source'.

Part 3 – The case of cellular agriculture explained

We started this part with an explanation of the technologies involved in cellular agriculture, specifically on micro-organisms and cultivated meat. After the explanation, and based on the questions that arose after it, we could say participants were curious about this technology, but didn't quite trust that it was as nutritious or tasty as conventional meat.

We asked the participants the following question: "Cultured meat or eating micro-organisms, which of these do you see happening in our future?" They then had to position themselves on the answer they most agreed with:

- None, it's downright creepy (4)
- I can see cultured meat happening, but do not like the idea of eating microbes (0)
- I don't mind eating microbes, but I find it hard to believe meat can be grown in a tank (4)
- I think both of them have great potential for the future (1)

None of them expressed any negative feelings or serious concerns about these technologies, but the results show they lean more towards the traditional way of eating. Vegetarians are not very convinced about cultivated meat but are happy with other alternative cultivated cells.

For the last exercise of the evening, we asked them to discuss what risks and benefits they could think of for cultivated cells. The most shared risk, and the most mentioned one, was 'cost' as all participants were convinced the cost would be much higher than the traditional options. 'Lack of control' and 'fear of the unknown' was another common commentary, even after the explanation they still couldn't quite trust that it was done in a controlled environment and with heavy regulations, so maybe more communication to the general public about this is needed. One of the risks that was widely discussed was that the current system would exploit the final products if they were successful, and eventually they would become as harmful to the environment as the traditional ways, with over exploitation and lower quality to improve margins. One of the participants mentioned that "cells that reproduce are cancer cells", luckily, we had information on the materials provided by Alice to explain the reality of this.

When discussing benefits, the most repeated one was "cruelty free" or at least less cruel so far, and "more sustainable".

The general conclusion was that these technologies are something in the far future, and that we'll still need to see about taste, texture and price.

Once everyone got a chance to share their perceived risks and benefits, we moved on to explain the risks ' (including mitigation measures) and benefits developed by the project from scientific literature. It eased some of their concerns, but their trust concerns with cost, taste and viability weren't tackled 100%.

On a sidenote: They were very impressed and excited about the possibility of trying mammoth meat, though.

Outro and post-session survey

Once we shared the real risk and benefits and commented on them, we moved on to the last part of the session, by thanking them for their time and their valuable contributions and providing with the link for the MEL questionnaire.

The post-session survey was sent out a few days later and completed by 4 out of 9 participants. The answers provided indicate that those who took the time to complete the survey retained the information quite well and understood the principle, the risk and the benefits presented. The answers largely confirmed the conclusions from the session.

Responses on MEL survey

The session was ended with a short Mentimeter survey, as part of the MEL framework, to asses any changes in their knowledge, viewpoints and ideas linked to biotechnology and more specifically the 'climate resilient crops'.

All 9 participants responded.

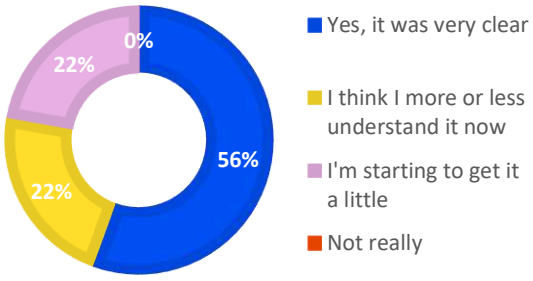

Figure 15. Do you now better understand what biotechnology is and how cellular consumption works?

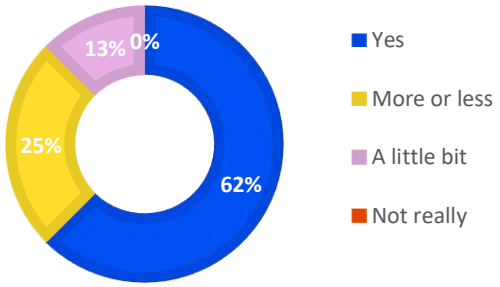

Figure 16. Do you now have a better understanding of the potential of this technology and the possible risks?

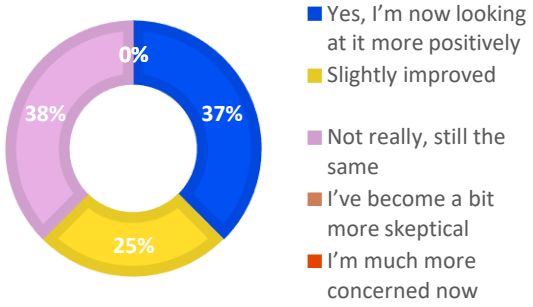

Figure 17. Has this session changed your perception of biotechnology?

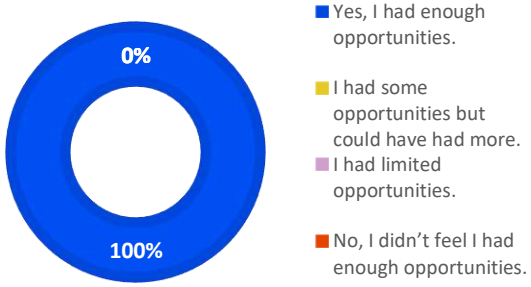

Figure 18. Do you feel that you had enough opportunities to clearly express your ideas and opinions during the session?

Learnings and additional risks/benefits

People are aware of the issue, until it starts affecting them

Participants demonstrated a strong awareness of the challenges within the current food system, yet they underestimate the scale of the problem and downplay their own contribution to it. It was clear from the reactions in the association exercise that they did not realise the amount of feed going to the animals, and how little food (meat) we get in return. When thinking about soy, they only seem to think about soy for human consumption, and apparently did not realise most soy is produced for feed. Adding to that, when the solution for this problem means they will have to change their eating habits or give up on certain luxuries, some of the participants suddenly seem to revert to blissful ignorance. The system must change, as long as they can keep doing what they like (and eat what they like).

This observation is in line with what was seen in consumer co-creation sessions for the cases 'Cell factories' and 'Bacteriophages'. Everyone seems aware that intensive animal production is a problem, but finds it far easier to think that we just need to (for example) waste less than admitting that we actually need to eat less meat.

Can cultured alternatives really replace meat?

Despite acknowledging that cultivated alternatives are emerging as potential solutions, they remain cautious about their true replacement potential.

Key concerns included uncertainties around sustainability, particularly whether cultivated products will genuinely reduce environmental impact. Stating that overproduction will always be polluting, regardless of the production method. Additionally, participants questioned their ability to prevent animal cruelty, replicate the taste and texture of conventional foods, and be affordable enough for widespread adoption.

While not opposed to cultivated alternatives, many consumers expressed doubt about their feasibility in the near future, citing technological, economic, and regulatory barriers that must still be overcome.

The price issue

As mentioned above, one of their main concerns is one affecting them personally, namely the price. The fact that cultured meat is thus far portrayed like 'a hamburger that cost € 300.000,-' might contribute to this concern, as will the fact that current meat replacers are often still more expensive than real meat (except products like tofu or seitan). It is very hard to see beyond the fact that this technology is in its baby shoes, and will evolve to become more efficient and thus cheaper, while the price of meat is likely to continue to rise. They tend to only see the situation as it is now. Meat replacers in general have the reputation of being expensive, but especially cultured meat is currently known as something very expensive and exclusive, therefore projections of price evolution may help make the idea more accessible.

Cultured meat or cultured micro-organisms?

Within the group, there seemed to be little support and many reservations (technical, legal, price, etc.) for cultured meat, while cultured micro-organisms did seem to be more acceptable,

especially for the vegetarians. This observation however needs to be challenged in a quantitative manner, as the group was far too small to draw any conclusions, but it is in line with previous observations (and the experience with Quorn) that the microbial source for meat replacers does not seem to encounter too much opposition (on a note: the vast majority of consumers doesn't look at the ingredient lists of the products they buy, so they wouldn't be aware of the source anyway). When it is framed correctly, referring to everyday food items that are made using micro-organisms as a natural part of the production process (like cheese, bread or yoghurt), does not seem so strange or threatening at all. This while cultured meat is publicly often criticized for not being sustainable, expensive and unnatural, and even being compared with cancer cells (as it did in the session). Maybe the idea of making meat without animals feels too much like science fiction, rather than a scientific fact?

Communicate regulations in place

As with the other sessions, it seems that many of the concerns from the public surrounding these new technologies are already tackled in the extensive European regulatory system. Unfortunately, the public remains very unaware of the strict regulations for food, especially when it comes to (new) ingredients and processes and their potential effect on health and even the environment. This leads to caution and scepticism on their behalf (in contrast to microbial safety, which they seem to know and trust better as previous sessions pointed out). Fear of the unknown will always play a part in trust and acceptance of new technologies, but knowing that their health and the environment is being safeguarded through regulation could help ease their mind, and should therefore always play a part in the communication.

Don't overdo it

Like with the other cases, there is a justified concern from people that this technology will go in overdrive and in the long run become just as harmful as the practice it replaced. To the environment, but also on a social level, with exploitation and waning quality as consequences. It is not the solution that will solve everything, and it should only be implemented when and where the benefits clearly outweigh the negative consequences. This means it should be complemented with other approaches and solutions to avoid being too reliant on a single technology, and to create a more balanced system.

2.5 Session "Agriculture and livestock farming: How can we do better?"

This is the session where two cases were addressed: 'Biostimulants & biofertilizers' and 'Bacteriophages'. The case of 'Biostimulants & biofertilizers' strives to find alternatives to chemically produced fertilizers and reduce the use of pesticides. Bacteriophages have the potential to replace or at least reduce the use of antibiotics in keeping animal diseases and contaminations at bay, thereby securing food safety without the potential threat of antibiotic overuse on human health.

These cases were taken together as they both provide alternative solutions for agricultural practices that have a rather dubious reputation, but remain in practice as they are needed to provide the necessary yields for (conventional) farmers to keep up with low food prices. Both cases thus mainly benefit the farmers, but have spill-over effects to the environment and food safety and therefore benefit the consumer indirectly.

Practical data

Location	Ghent, Belgium
Date	04/02/2025
Organisation	Alice down the rabbit hole
Participants	13, of which: • 5 women and 8 men • 10 GenX (age 44-59), 2 GenY (age 28-43) and 1 GenZ (12-27) • 5 living in a city centre, 3 from city outskirts, 2 living in village centres and 3 living in rural areas • 6 (daily) meat eaters, 5 flexitarians and 2 vegetarians • 7 adventurous eaters, 5 being open to new experiences but not actively seeking it and 1 traditional eater • 6 indicated sustainability as a priority in shopping, 8 for health and 6 for local food • 6 indicated having cooking as a hobby • 1 participant with a background in biology, 1 participant with a background in food & nutrition and 1 participant with a background in greenery • 4 participants that were present in at least one of the other B-trust sessions ('Cell factories' and/or 'Climate resilient crops')

Participants and flow of the workshop

Recruitment and participants

Similar to the other sessions, the requirements for the participants were to have people from different ages and both men and women, but most importantly to involve both progressive and

conservative voices in the session, and to have a majority of people without a scientific background. We invited a few participants from the 'Cell factories' and 'Climate resilient crops' workshops to participate in this session as well, to see whether they view this type of biotechnology differently.

In the preliminary communication and invitations, the topic for this session was not as vague as for the other sessions, as we expected that the general population has little awareness about the existence of these concepts. It was thus presented as 'alternatives to pesticides, synthetic fertilisers and antibiotics', but biotechnology was not mentioned.

Of the 16 people registered for the session, 3 cancelled last minute due to sickness. The remaining group of 13 people consisted of 5 women and 8 men, primarily aged between 40 and 60 (GenX and older Millennials) and one person in his/her 20's (older GenZ).

As for the other sessions, the educational level was rather high among the remaining participants, and so was the consciousness related to eating and food (production). This can be explained by the nature of the topic, that requires a certain interest in food production methods and awareness on sustainability to respond to such an invitation. However, as mentioned in 2.2.1, it is not relevant to involve people with little interest in food quality.

Flow of the session and reflections

Like for the other sessions, we started with an association exercise to get an insight in the background level of knowledge on the topic among the participants. The results indicated that there was a rather high level of knowledge on the topics. Also, the majority of participants were fairly open to biotechnology, despite there being a good balance between meat eaters, flexitarians and vegetarians. On the other hand a majority described themselves as 'adventurous eaters', which we used (together with being a flexitarian) as an indicator for progressiveness.

There is a number of factors that might explain this increased openness compared to previous sessions in Belgium:

- The fact that four of the participants were present on at least one of the other B-trust sessions ('cell factories' and/or 'climate resilient crops'). However, note that three of them showed to be more on the critical side of the spectrum in the previous sessions.
- The nature of the topic, which did not include genetic modification and therefore was less likely to trigger a polarized discussion.
- The topic, that is more 'agriculture-oriented' than 'food-oriented' and therefore not as close to home for most of the population, is more likely to attract people with an interest in 'the future of agriculture'.
- The nature of the cases, who provide an alternative to unpopular (among the general public) agricultural practices such as the use of pesticides, synthetic fertilisers and antibiotics.

The session continued with a deep dive into the challenges we face in food production, and the current solutions that have many downsides. The exercise worked well to draw attention to these problems and explore them before comparing them to the proposed alternatives: biostimulants & biofertilizers (for pesticides and synthetic fertilisers) and bacteriophages (as alternative to antibiotics). As expected, there were many questions and discussions on the presented topics, that are not well-known and have not been extensively explored in research.

The last part of the session, where the risks and benefits were discussed and weighed, also led to many interesting, constructive and eye-opening discussions.

The post-session survey, to assess how well they captured and retained the information and certain aspects thereof was sent out a few days later. 8 out of 13 participants completed the survey. The results are included in the conclusions.

Responses on MEL survey

The session was ended with a short Mentimeter survey (as part of the MEL framework) to assess any changes in their knowledge, viewpoints and ideas linked to these technologies, and biotechnology in general.

As mentioned in 2.3, we noticed that with the question 'How did the session change your view on biotechnology', for those who answered 'not really', we could not distinguish between those who were positive before (and still are) and those who were negative before (and still are). Thus for the last two sessions, we altered the answer options in order to make this distinction.

12 out of 13 participants completed the survey.

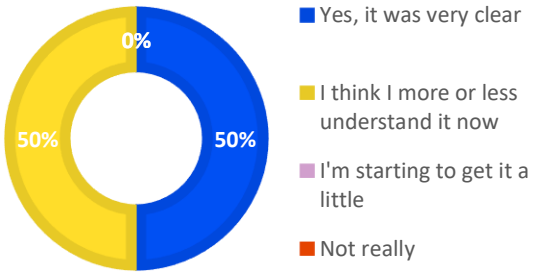

Figure 19. Improved understanding of the technology and how and how biostimulants and bacteriophages come about

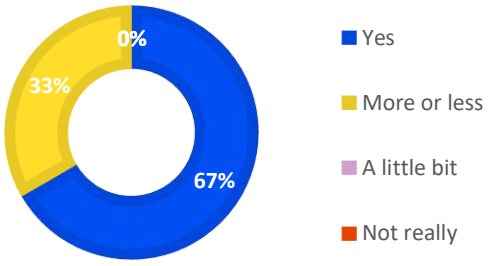

Figure 20. Do you now have a better view of the potential of this technology and the possible risks?

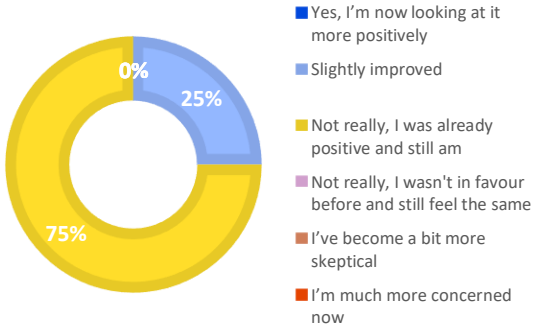

Figure 21. Did this session change your view on biotechnology?

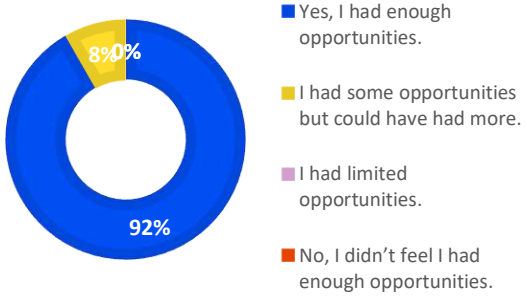

Figure 22. Do you feel that you had sufficient opportunity to express your ideas, opinions and concerns during the session?

Learnings and additional risks/benefits

Biotechnology not so bad after all?

In contrast with previous co-creation sessions we have done in the framework of the B-Trust project, this group of participants was a lot more positive about biotechnology and technological solutions in general after all. In the association exercise and during the session only a few negative remarks were made when it came to biotechnology, while the food-related sessions generated a lot more negative associations. Possible reasons why this was the case are described above, under 'Flow of the session and reflections'.

These technologies are perceived as more natural than the current practices and other types of biotechnology

It was clear that these technologies did not face the same stigma as the technologies that were linked with an industrial or laboratory environment (like genetic modification, cultured meat and cell factories), and were generally perceived as rather natural. It could be that the more 'agricultural' use sets their mind onto a more 'natural' environment, or it could be influenced by the way it was explained and framed – biostimulants were compared with probiotics, and bacteriophages were represented as 'natural enemies' of bacteria.

These representations did resonate well, and stuck with them after the session, as the answers from the post-session survey indicated. They are perceived as solutions that fit quite well with an 'organic' approach, and are despite the lack of information on the consequences of their use, promising tools for better agricultural practices.

Patents remain a 'no go'!

An emotionally laden issue that comes up in basically every case is the risk of monopolization and control of the food chain and supply via patenting. As for this session, again the 'Monsanto monster' was mentioned a few times, where farmers became dependent on the supply by these large corporates and which resulted for example in the misuse of pesticides.

People want regulations to avoid companies from monopolising the technology and food system, and to ensure government oversight of its use, to avoid 'big biotech' or 'big food' having all the power. This session confirmed what we saw in previous sessions, that the majority of participants do trust the (European) government and authorities, and the linked regulations they install to avoid monopolisation, fraud and to protect the citizens.

Another way to fight off monopolisation is public investments in research, to ensure a high level of knowledge in the public domain. Especially for these types of applications where the biggest financial hurdle is the research and scaling of the research and this technology.

More research is needed

As mentioned above, public investments in research for these technologies are necessary to increase public knowledge in this domain. Participants did question why these technologies have not been broadly implemented by now, and the discussion concluded that part of the reason is financial. As living organisms that are found in nature cannot be patented, and the research investment is substantial, it is hard for these technologies to compete with the current solutions.

Once enough theoretical knowledge is available on the desired effects on plants and animals, companies, even small ones, can pick up the opportunity to turn them into commercial products as this step is financially more feasible.

Also, additional research (investments) is needed to increase the knowledge on and reduce the risks associated with the application of these concepts on a very large scale. This is especially important in these cases, as 'living' micro-organisms are actively being added to ecosystems and "we cannot control what happens in nature".

The better we know what we are dealing with, and what the possible (longterm) (side)effects of these interventions will be, the easier it becomes to trust the technology.

No silver bullet … once again

A few of the participants were overly enthusiastic about the proposed solutions and stated that they would go for a direct and complete switch ("What are we waiting for!"). Though most participants were more prudent and stated that they had their reservations related to the broad and massive application of these biostimulants, biofertilizers and bacteriophages. "What if they mutate? Do we know what the consequences are if they are so broadly implemented? What is the impact on the microbiome of the soil, our own microbiome?"

In the end there was in some way a consensus that we should go for a gradual and partial shift. We must at all costs avoid replacing one flawed solution with another one, especially since we have little knowledge on the long-term consequences. Because you risk ending up with the same types of problems we face with the current practices. More research is needed to learn more about the impact of these biostimulants, biofertilizers and bacteriophages, and we should cautiously and gradually implement them, and complement with other approaches.

The importance of a holistic / systemic approach

Especially when comparing antibiotics with bacteriophages, it became very clear that they prefer a scenario where none of these solutions is needed. Bacteriophages, when applied in large quantities could face similar problems as we encounter now with antibiotics. This led to the question being raised: "Are we solving the right problem?". Animal production as a whole needs to downsize and improve, to give the animals the space and the natural immunity to fight of diseases in a natural way. This downscaling should be combined with technological solutions for early detection, allowing for a far more targeted intervention strategy.

As for the biostimulants, there are also different ways to implement them, and some are better than others. Single-organism additions do not respect the complexity of the ecosystem, and risk bringing even more disbalance to the system. Using a mix of healthy organisms as a cure for unhealthy soils seems like a good approach, but is a temporary fix. Soils are better kept healthy through alternative farming practices, like organic farming, agroecological principles, agro-forestry, etc.

In short, these are quick fixes that can relieve the burden in the current agricultural system, but a more holistic approach is needed in the long run.

When it becomes personal, people tend to bury their head in the sand

Generally speaking, most people are aware of the state of our climate and environment, and know that we quite urgently need to do something about it. But, when it becomes personal and they are asked to change their (eating) habits, they tend to downscale the problem and/or the impact they have.

For example, when discussing about the bacteriophages and their possible application as substitute for antibiotics, somebody (a vegetarian) stated that we could as well stop eating meat or at least reduce our meat consumption and move away from the intensive livestock farming systems we have today. This met with quite a lot of resistance among some of the other participants who would rather not give up on their daily piece of meat.

People are creatures of habit and need time to adapt and change their habits. Informing them on the impact they have, creating awareness and nudging, but still giving them the possibility to choose, all remain very important.

Open and clear communication empowers people to better assess potential and risks

Despite it being rather difficult topics, participants were very keen to learn more about these topics and take part in the discussion. The results from the MEL survey, as well as the answers for the post-session survey, indicated an increase in understanding, also a better view on the benefits and risks, and a more positive view on these technologies. These results are in line with those from the other sessions. For those interested in new technologies and/or the future of our food system, neutral information provided by a reliable and/or independent source gives them the opportunity to decide for themselves whether the benefits outweigh the risks. Even if they still reject it, at least they made an informed decision, instead of blindly rejecting a technology out of fear. It just means they have certain priorities or principles where this technology does not fit in or offers a solution.

2.6 Session "Natural materials reinvented, solution for the future?"

The main outcome of the 'Biomaterials' case is having sustainable alternatives to the current fossil-based, non-biodegradable materials. The non-toxic and (often) biodegradable nature of these materials primarily benefits the environment, but is obviously also a great opportunity for the bio-based industry.

Practical data

Location	Aarhus, Denmark
Date	18/02/2025
Organisation	Food & Bio Cluster Denmark
Participants	16, of which: • 8 women and 8 men • 7 GenX (age 44-59), 6 GenY (age 28-43) and 3 GenZ (12-27) • 4 living in a city centre and 12 from city outskirts • The education background varied from elementary school to a bachelor degree level

Participants and flow of the workshop

Recruitment and participants

A professional agency was involved for recruiting participants. Sixteen individuals participated in the session, selected to ensure diversity across gender, age, and non-specialist backgrounds with an educational level ranging from comprehensive school to bachelor's degree. Participants, ranging from their twenties to their sixties, had an active interest in new technology, and generally approached the workshop with open minds. The participants were tagged with a certain consumer profile and represented a mix of:

- The Convenient: Prioritises ease and comfort over sustainability;
- The Carefree: Doesn't think much about consumption or the environment, shops impulsively without guilt;
- The Pro-Green: Prefers sustainable products but isn't necessarily deeply engaged in climate activism;
- The Economical: Focuses on saving money and consuming minimally, often for financial reasons;
- The Sceptic: Distrusts green initiatives, often sees sustainability as exaggerated or marketing-driven;
- The Climate Warrior: Passionate about climate issues, actively chooses sustainable options and supports green initiatives.

The balance in backgrounds and views fostered a positive, dynamic and respectful discussion environment.

Flow of the session and reflections

The workshop was facilitated by a moderator and three colleagues from FBCD, each responsible for tasks such as presentations, table group facilitation, and practical coordination. This team structure was noted to be effective for managing and engaging the 16 participants. As the 'Cell factories' workshop (organised in the fall of 2024) had taken place in a relaxing and cozy location, it was decided to use the same venue.

Prior to the session, and in the invitation, the topic was deliberately kept vague, with no mention of the topic of the workshop. Participants were unaware that the session would focus on biotechnology, bio-based materials and chemicals, or fossil-based materials and fossil-based chemicals. This approach aimed to capture their initial thoughts and impressions during the association exercise, which took place immediately after the session's framework and topic were introduced.

The workshop agenda included:

- Introduction to Food & Bio Cluster Denmark, the workshop goals, and a brief icebreaker
- Part 1: focusing on the present and captivating perceptions on biotechnology, bio-based materials, bio-based chemicals, and of fossil-based material and chemicals.
- Part 2: focusing on the future, in which the moderator showed new sustainable solutions which biotechnology could provide. The presentation was comprehensive, and it was notable that the topic was complex and could have been in more layman's terms, if possible. However, the cases seemed to make it more understandable.
- The last part focused on how we can benefit from this new technology and what the consequences could be. The moderator presented the risks and benefits, followed by two scenario exercises to initiate the discussion.

The post-session survey was sent out a few days after the session. 11 persons out of the 16 participants responded to this survey. The comments and results thereof are integrated in the overall conclusions of the session.

Input from the exercises

Association exercises

The activities in the workshop were initiated with conducting an association exercise to gauge awareness of various material-related technologies. After a brief introduction to bio-based materials and bio-based chemicals the groups were asked to define fossil-based materials and chemicals. It can be noted that after this exercise and introduction to fossil-based material and chemicals, the moderator asked if any, BEFORE the question was raised, knew what fossil-based materials and chemicals were. NONE knew it, and it gives food for thought about the word 'fossil-based'. In addition, the fact that 95% of all products contain petrochemical raw materials came as a surprise to many of the participants.

Keyword	Perspectives	Conclusion
Biotechnology	• Optimistic and visionary perspective: an exciting and	These perspectives highlight that biotechnology is a

	sustainable innovation with future potential. • Industrial and large-scale viewpoint: views it from an industrial and economic standpoint, with a mix of opportunity and scepticism. • Technological, climate-focused, and ethical considerations focuses on the scientific, environmental, and ethical implications, recognizing both benefits and challenges.	multifaceted field with immense potential but also significant ethical, economic, and environmental considerations. The main challenge is to balance progress with responsibility.
Bio-based materials	• Optimistic and innovative perspective: optimistic and innovation-driven, highlighting affordability, sustainability, and future applications. • Practical and industrial viewpoint: takes a practical and industrial approach, recognizing both the benefits and the environmental trade-offs of bio-based materials. • Natural and environmental focus: focuses on natural sources and biodegradability but also points out that bio-based materials remain relatively underrepresented.	Biobased materials are seen as a promising alternative to fossil-based materials, offering solutions for sustainability, packaging, and construction. However, challenges remain in scaling production, managing resources responsibly, and increasing awareness. The key takeaway is that bio-based materials hold great potential, but require innovation, efficiency, and public awareness to become mainstream solutions.
Bio-based chemicals	• Innovation and industry-oriented view: sees bio-based chemicals as an innovative, future-oriented solution, but raises concerns about regulations and consequences. • Safety, natural origins, and scepticism focuses on safety and natural origins but questions the transparency of how these chemicals are marketed. • Environmental impact and transparency concerns:	Bio-based chemicals are generally perceived as a promising alternative to conventional chemicals, particularly for reducing toxicity and environmental harm. However, transparency, regulation, and public awareness are key challenges. Many people feel uninformed or sceptical, highlighting the need for better communication, clear safety standards, and

	acknowledges potential benefits but expresses distrust, particularly regarding toxicity and greenwashing.	scientific validation to build trust.
Fossil-based chemicals and materials	• Practical understanding with some uncertainty • Clear but limited knowledge, focus on non-renewability • Critical perspective with a focus on systemic issues	The groups collectively understand that fossil-based materials and chemicals are non-renewable, widely used, and environmentally problematic. However, knowledge gaps exist, particularly regarding specific applications and production processes. There is a strong desire for alternatives, better waste management, and clearer public communication to bridge the gap between scientific discussions and everyday understanding.

Scenario exercise: Imagine a world without plastics, synthetic rubber, nylon, chemical cleaning products etc.

- The responses reflect a mix of optimism, scepticism, and practicalities regarding the elimination of plastics, synthetic rubber, and fossil-based materials. The key concerns revolve around functionality, sustainability, supply chains, and societal impact:
    - Optimistic but practical concerns: sees innovation and sustainability as the way forward but acknowledges challenges in land use and motivation.
    - Sceptical and concerned about practicalities: sceptical about feasibility, emphasizing supply chain vulnerabilities and quality concerns.
    - Realistic and focused on transitioning rather than eliminating: focuses on recycling and gradual transition, arguing that new materials must be economically viable before a large-scale shift can happen.

Conclusion

- While eliminating plastics is unlikely, reducing single-use plastics, improving recycling, and investing in sustainable alternatives can significantly reduce environmental harm while maintaining functionality in daily life.
- Total elimination of plastics and synthetic materials is widely seen as impractical. However, reducing reliance on fossil-based materials and finding sustainable alternatives is feasible. A world without plastics would be a massive transformation requiring:
    - New materials and production methods (bamboo, seaweed, biodegradable plastics, etc.);
    - A smooth transition period with hybrid solutions;

- Stronger recycling and waste management efforts;
- Legislation and incentives to reduce unnecessary plastic use.

Scenario exercise What if we lived in a world where this production method was normal?

"It sounds scary, why should we do this?" (1 person)

- There will be a growing gap between the global south and global north (developed countries and developing countries) both concerning the consequences socially and environmentally;
- Big business: there will be companies 100 times the size of Novo Nordisk and they will be too powerful;
- No significant improvements to humans, but we may maintain our living standards;
- Concerns exist that when applying this technology on a large scale would make us very vulnerable, especially in times of crisis. What if the Russians bomb the large factories?
- Or what in case of nature catastrophes.
- Important concerns also include the application/implementation of GMOs: what if these leak in the environment, etc. But maybe a new, modified GMO would be ok.
- On the other hand this technology will also give new jobs and opportunities;
- Some building materials would be acceptable.

"I am not sure, yes, there will be advantages, but I am concerned that …" (13 persons)

- Concerns about more production will be moved to the sea;
- More pollution;
- How can we cultivate sufficient fungus? Huge greenhouses?
- It is important that we dare – we need to try it;
- How durable are the new materials;
- Social consequences: where would this leave the existing producing countries, e.g. in textiles;
- Would there be challenges using the new materials?
- Improvement to the living standard should be a must, but also the resource situation should be taken into consideration;
- Improvement: more equal distribution of jobs in different countries;
- Considerable decrease in chemical influence on human genes;
- Improvement: less exploitation of children and poor people in other countries (as the production will be cheaper);
- Production in Denmark or in the EU: Make EU strong again!

"It sounds great, what are we waiting for?" (2 persons)

- We would get closer to each other;
- Climate changes influence our possibilities for cultivating certain crops;
- Would there be enough room and resources to produce new material, e.g. fungus for building materials;
- Huge positive environmental consequences;
- It is essential there is control over the changes;
- We will experience restrictions, and we will have to learn how to waive some of our convenient lives;

- It would create new societal structures and create value;
- We would live less costly – we will have to save on resources;
- Uncertainties about the new materials. Can you get sick of these?
- We need to produce locally thus more local products;
- Concerns about the consequences;
- Can we control nature?;
- More awareness raising so people can make their choices in an informed way;
- A need for legislation and it must be top-down;
- Insulation material, wood and insects would be acceptable;
- The health aspect.

Responses on MEL survey

The session was, as with every session, ended with a short Mentimeter survey (as part of the MEL framework) to asses any changes in their knowledge, viewpoints and ideas linked to these technologies, and biotechnology in general. All 16 participants completed the survey.

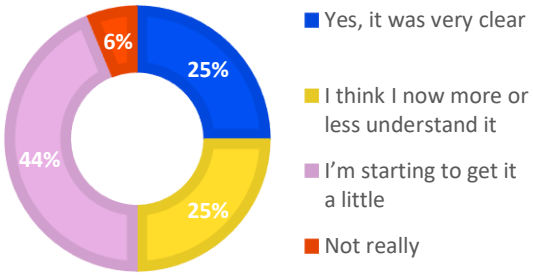

Figure 23.Did you get an improved understanding of the technology

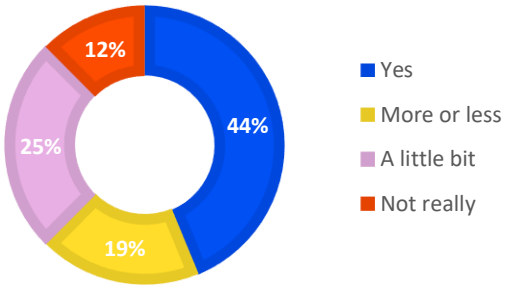

Figure 24. Do you now have a better view of the potential of this technology and the possible risks?

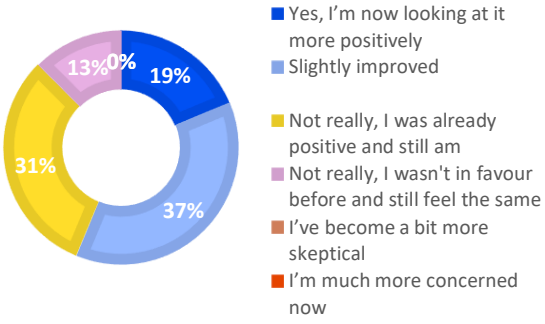

Figure 25. Did this session change your view on biotechnology?

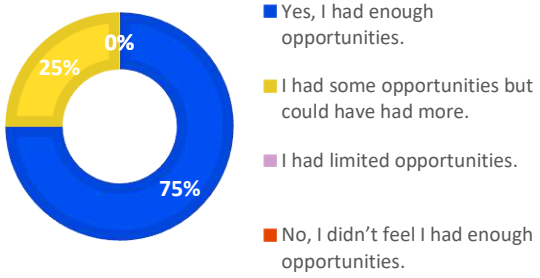

Figure 26. Do you feel that you had sufficient opportunity to express your ideas, opinions and concerns during the session?

Learnings and additional risks/benefits

A different side of biotechnology

Biotechnology in the context of biomaterials seems to get considerably more positive (and thus less negative) associations than in the context of food. When thinking about materials, biotechnology gets a more positive aura and is much more seen as something green, sustainable and innovative. This opposed to a food context where it was often seen as 'chemical' and unnatural.

The positive halo also spreads to the social consequences. Although there are a few concerns about monopolization and dependency on large companies, the outlook on equality, job creation and opportunities seems mainly positive. As does the perception that it may give us cleaner products for better prices.

A gradual shift away from fossil-based

The concept of fossil-based materials and chemicals is not very well-known and needs more explanation. The issue of non-renewable resources is known, but there is little awareness on the role played and impact of these fossil-based materials and chemicals. We also do not know to what extent that these non-renewable resources are used in materials and chemicals, and the products that are made from them. But when explained, people do recognize the link with the waste problem.

It is clear for people that we need to move away from these fossil-based materials and chemicals, but even though a world without plastics seems an attractively safe and clean world, it is not a very practical one. People fear it will reduce their living standards. Therefore, we need a long enough transition period to make sure we have plenty of worthy replacements on a functional level, but are better in terms of sustainability and toxicity (biodegradability).

Can we produce enough biomass?

The increased need for biomass and thus increased land use for agriculture/forestry is a major concern, especially when considering the competition with food production and wildlife/nature. Together with soaring prices due to the limitations linked to production and land use.

On the other hand, biomaterials and biochemicals (in general) are often associated with circularity, sustainability, nature and good resource management.

Link these two together, and it seems like a no-brainer that biomaterials and -chemicals are the perfect opportunity for more circular production systems.

Less toxic for us and for the environment

Despite some concerns about health consequences and allergic reactions for skincare products, generally the (new) biomaterials are seen as less toxic for us and for our environment. Biodegradability is often mentioned, as it is assumed that natural materials will be biodegradable without polluting the environment. This also implies some concerns about the durability of the products.

It may be noted that biochemicals get a little more scepticism than biomaterials, with concerns about greenwashing and (hidden) toxicity.

Research and a good regulatory framework to ensure safety and transparency

Especially when using new technologies, people demand transparency and a good regulatory framework to ensure they are informed about how the products are made and of which ingredients/raw materials they consist. Also, clear communication on potential side effects, allergy risks and sustainability benefits are important.

This requires enough independent research on potential consequences, safety, and benefits compared to existing alternatives. It also implies directions for testing and certification by trusted organizations to ensure safety, especially for sensitive products where they come into direct contact with like personal care products/ingredients, food ingredients/additives, etc.

3 GENERAL INSIGHTS AND CONCLUSIONS

3.1 Conclusions on set-up and dynamics of the workshops

3.1.1 Context, participant recruitment and communication strategy

In order to get honest and relevant input from the participants in a consumer session, it is important to create a welcoming environment and to take into account several aspects of human behaviour to create a desirable group dynamic. A good group dynamic for these sessions is reached in groups of 8-16 people. This group size is large enough to cover different profiles and opinions, but not too big to become too intimidating for (most) people to speak in front of the whole group. However, the bigger the group, the more relevant and necessary it becomes to make smaller groups for the exercises, because when the group gets bigger, less people will dare to take part in the plenary discussions. In the B-Trust sessions, participant groups ranged between 9 and 16 people, thus securing the group dynamic.

The requirements for the participants were to have people from different ages and both men and women, but most importantly to have both progressive and conservative voices, and to have a majority of people without a scientific background. Good communication and a sound recruitment strategy is an integral part of attracting the right people for your session:

- While Alice has its own consumer panel, the other partners organising consumer sessions either involved a recruitment agency or used the 'friends of friends' strategy. Avoid having participants that have somehow a stake in the case (something to gain from it) or where a personal relationship might keep them from stating their honest opinions.
- The people who will be willing to participate in these events are bound to care about sustainability and the future of food (production, quality and health) and/or our society. Many people pay little attention to what their food is made of, where it comes from or what its impact is on health and society. These people are nearly impossible to recruit for such a session, but are also not that relevant in the discussion as they will not be influenced by these matters in their buying behaviour.
- We wanted both the more conservative and progressive profiles in our session, but assessing these parameters is not evident. Long questionnaires for an accurate typology are not practically feasible and asking them directly is too political and personal. Since most sessions were food-related, we used their eating habits as a proxy for assessing these parameters, focussing on two aspects thereof: the level of openness towards new and unknown food products (traditional eater, open eater or adventurous eater) and their meat eating habits (daily meat eater, flexitarian or vegetarian/vegan).
- Conservative voices are harder to recruit than more progressive profiles, especially for discussions about the future and new technologies. Therefore, we made sure to recruit sufficient conservative profiles before targeting the 'easy to recruit' profiles and/or limiting the subscriptions from the more progressive persons.
- For a sensitive subject that is prone to polarisation, you need to recruit people who are interested in the subject, but able to engage in a constructive discussion and open to new information as a basis for their opinions. Activist personalities are better involved via

interviews, as they tend to interfere too much with the dynamics of the session (as we experienced in the first session).

- In order to avoid attracting people with the most extreme viewpoints (on either side of the spectrum), we did not mention the subject of biotechnology in our communications. Instead we framed them as discussions about 'the future of our food (production) in the face of challenges like climate change, environmental pollution, and global food security'. Additional screening of the participants via social media profiles may be necessary.

This way we succeeded in recruiting people with a certain interest in food production and/or nutrition and quality, with a balanced mix of profiles, both men and women, of different ages. Concerning ages, the most represented age group is generally 35-60. The hardest age group to reach is 25-35, as these are most often people with young children and little time on their hands.

Another important aspect is the welcoming environment, where people feel comfortable enough to drop their guard. Therefore, we chose for venues with a 'homey' and inspiring vibe, and held all sessions in the evening, while serving them a nice dinner and drinks. This 'brainstorming dinner' formula works wonders to create a relaxed, fun and positive atmosphere, where people are not afraid to be honest and say how they really feel, instead of answering to expectations.

For sensitive subjects like biotechnology (especially GMO technology), it is best to keep representatives of the biotech industry and even biotechnology researchers out of the discussion, as it might hinder open and constructive dialogue due to negative feelings towards industry or the fear of appearing stupid in front of experts. It is also important that the moderators are objective, independent and neutral, and do not have a stake in the research or the biotech industry. Ideally moderators have a decent level of knowledge on the subject and the framework, so that they can present the information correctly, answer questions and if necessary, correct false statements.

3.1.2 General set-up and adaptations

Even though the general set-up was similar for all sessions, there were some adaptations made throughout the trajectory, and variations depending on the case.

The general outline that works quite well can be summarised as:

- Framing of the context: Why are we doing this session? What is expected from them in this perspective?;
- Capturing intuitive responses on certain words, topics and aspects via an association exercise (without much explanation), followed by a short explanation of the words presented;
- Explaining the reasons for developing and implementing this technology: which problem can it (help) solve. For generally known problems it helps to incorporate an exercise where they think about the problem statement themselves, how it could be solved and how it affects their own lives;
- Explaining and/or an exercise about possible solutions for this problem, making clear that addressing 'the big challenges' will always be a combined effort and there is no single solution;

- Explaining how the technology works on a technical level, in layman's terms and presented in a neutral manner;
- A scenario exercise on the possible consequences of implementing this technology, on its own or compared with 'doing nothing' or with other solutions;
- Presenting the risks (and mitigation measures) and benefits identified by the scientific community (in layman's terms) and comparing them with their own identified risks and benefits via a in depth discussion.

This general outline is the result after we made some adaptations along the way to improve the framing, flow and input.

More concretely such adaptations were:

- Better framing of the workshop in general and within the B-Trust project. At the beginning of the workshop, it is necessary to explain to the participants why they are there, what the topic is, what is expected from them, and what will happen with their input and who will receive the results. In the first workshop, it was not clarified from the beginning that the workshop was done in the framework of an EU project, which left the door open for speculation. In addition, this might have given some participants the idea we were promoting biotechnology for a company and/or in general.
- The subject of biotechnology is pretty controversial to some, and since we wanted to capture their first thoughts on the subject during the session, we did not mention this in the invitations. This aspect was kept throughout all sessions, but in the first session, we waited to 'drop the bomb' until we had framed the problem statement. This gave a bit of a 'silver bullet' idea, which is why, after the first session, we moved the subject of biotechnology to the beginning of the session, already mentioning it during the framing.
- In line with this, in the first session we made them think about the problems themselves and then explained biotechnology as a solution. We felt this contributed to the 'silver bullet' effect, so we decided to turn this around: Explaining the problem(s) and making them think of possible solutions that could be used to counter these problems prior to proposing biotechnology as a solution. In addition, we also elaborated on the other solutions, and highlighting the actions that are already being taken. This worked quite well to avoid the 'silver bullet trap'.
- A downside of the top-down presentation of the problem statement is that the scale of the problem is often underestimated. It seems that because the participants have already heard so much about these problems, a kind of numbness for these issues arises. In the "Agriculture and livestock farming: how can we do it better?" session (cases 'Biostimulants & Biofertilizers' and 'Bacteriophages') and the "Which weapons do we use in the battle against climate change?" session (case 'Climate Resilient Crops') we made them work on the problem statement and let them formulate solutions themselves, which did make it easier to link problem and solution. For this last case specifically, we made them think about the expected effects of climate change on their everyday lives, which brought the problem closer to home and increase the sense of urgency in the need for solutions.
- A scenario exercise on letting them imagine what would happen if this technology was implemented, is a good way of letting them think about the possible risks and benefits. However, making this scenario too extreme, like we did in the first session "Imagine a world

where this is the most common production method for food ingredients.", might lead to an exaggeration of the risks. Therefore, we switched to a more realistic scenario, stated as "Imagine a world where this is a common production method for food ingredients" to avoid too much polarization.

- As the participants get flooded with information during the session, it turned out to be good to give them some time to let everything sink in for a few days before asking them what their individual reflections and key takeaways were.
- In most sessions we presented the potential risks and benefits identified from the scientific literature orally, while discussing them plenary. However, in the "Agriculture and livestock farming: how can we do it better?" session (cases 'Biostimulants & biofertilizers' and 'Bacteriophages'), we printed them out and let them browse the information while giving them time to comment individually before discussing them plenary. We feel this gave better input and was less overwhelming for the participants as they could focus on the ones that they felt were most important to them individually.

3.2 Conclusions on the trust barriers for biotechnology, and how to address them

3.2.1 For consumers, biotechnology equals genetic modifications and laboratory interference

Biotechnology, as defined by scientists and experts (in biological sciences), is a very broad scientific field that includes classical concepts like fermentation and selective breeding. However, this is not how consumers interpret this term, nor do environmental protection groups. For them, biotechnology stands for genetic modification, and other ways of interfering with nature in an unnatural setting like a laboratory.

Biotechnology is also linked to the major biotech companies like Monsanto and Bayer (which are now one company), that do not have a good reputation and are seen as greedy and power-hungry corporations.

3.2.2 The process is important, but so is the end result

The process is often seen as very unnatural. It is best accepted in cases where the current practice (the current standard) is chemical and/or unsavoury (e.g. flavour and vitamin production), or cruel and unsustainable (intense meat production).

The technology is more acceptable when the end result is no different than what we currently have or find in nature (NGT1 plants, products made by cell factories, eating micro-organisms).

3.2.3 People see the advantages, but are scared that it will be used by the wrong parties (companies) and for the wrong reasons

One of the main issues that consumers have with genetic modification is the fear that it will be used for pure financial gain (by biotech companies and/or the industry as a whole) at the cost of the environment, farmers and in extension the consumer.

The idea of having biotech companies and/or large corporations holding the power and control over our food chain is a very scary one, and a real one, as this is what happened in the past (Monsanto).

People link patents with monopolies, and they would rather get rid of them. People hope that strict measures and legislation will be installed to prevent patents from being taken, monopolies from being installed, etc.

Building enough public knowledge (open-source research investments) is another way to make sure not only the most powerful players can commercialise biotech solutions.

3.2.4 People need to know the risks (and mitigation measures), but also that authorities are aware of these risks and are addressing them

Transparent communication is highly appreciated. People will see several risks anyway when presenting a new technology, so it is better they are informed that researchers, authorities and companies are also aware of these risks.

Communicate on the way these risks are being addressed in regulations, guidelines and safety procedures and measures, etc.

Overall people tend to have good confidence in EU authorities, but are often not aware of how strict the EU is when it comes to food products and legislation in general, and the precautionary principle the EU follows as guiding principle.

They generally trust food safety, but think producers are free to use whatever ingredient and additive they like and make wild claims towards health benefits and nutritional properties. Many do not realise that most of their concerns are already addressed via these strict EU regulations and should therefore be no concern at all. Better communication on the regulatory framework should be an important part of a communication strategy around these technologies.

In addition, the trust issues are in part caused by the fact that GMOs are not allowed in the EU: "The EU government must have good reasons to not allow it, right?"

3.2.5 Benefits for society need more attention

Many people are, although sceptical, open to this technology, but only when it is used to serve ‘a greater good’, like:

- securing access to healthy food and specific/missing nutrients for everyone (at affordable prices);
- tackling sustainability (CO_2 reduction, or reduction of water use, land use, disease risk, etc.) and social (animal welfare, slavery and oppression of farmers, etc.) issues in the current (food) production system.

The ‘why’ will always be crucial when considering applying this technology. Regulations should be set up accordingly, and the people need to know and understand the reason for resorting to these technologies.

Financial opportunities are not a very good argument when the financial gain is not for them, but for food companies. Or even worse, when only biotech companies make a profit. But when

the technology could mean a financial gain for them, such as reduced food prices or job opportunities, they are more open to it. So, it is best to translate benefits for producers into benefits for consumers (such as: higher yield = cheaper prices, more space for nature/forests, etc.).

And walk the talk: if you claim a benefit for society or in general serving 'a greater good', truly do so and stick to this promise and approach. If not this will backfire for sure and you'll be back at square one in no time.

3.2.6 Beware of misinformation and misinterpretation of information

Pay attention to how technologies are portrayed in the media!

Misinformation obviously needs to be countered with reliable, scientifically correct information, from a reliable and trusted source and without dismissing concerns.

But even correct information can create a certain impression, like these technologies being very expensive, or very far from natural processes. The narrative could be changed and focused on the 'bio' in biotechnology. Opposers see biotechnology as 'using living organisms and playing god with them' while it could be more like 'making use of the natural world to improve our lives, our planet'.

Most people trust the opinion of the scientific community, especially when scientists from different fields largely agree. On the other hand scientists are always very nuanced in what they claim. Rarely will they indicate that something is 100% safe (as this is impossible to prove) or speak in absolute terminologies. This can come across as very confusing for the consumers and for sure adds on to their doubts and even mistrust. Communicating about these technologies and their applications is a specific field of expertise and should be done by experts in communication (but with a scientific background), starting from scientifically sound data and information.

3.2.7 Is it not already here?

Many people realise we live in a globalized world and society, and imported products from other continents are likely to contain GMO already.

They also realise that pizzas do not grow on trees: the food we buy is pretty processed already and GMO technology is just one of the ways our food is being processed and adapted. By some people it is seen on the same level as the chemicals and harsh physical processes that are being used already.

3.2.8 People should always be able to opt out

Many consumers do not really care about where their food comes from, how it is produced, and how long the ingredient list is: they just want cheap and tasty food products.

But others do care, and want to find the right information and have the options available to make the choices that align with their values, beliefs and priorities. Transparency and correct information is key to ensure they have the freedom of choice, as well as making sure the different options are available to choose from.

3.2.9 Don't overdo it, it is not a silver bullet!

There is a justified concern from people that these technologies and the implementation and application thereof, will go in overdrive and will be too broadly implemented, and in the long run become just as harmful as the practice(s) it replaced. Harmful to the environment and for biodiversity, but also on a social level, with exploitation and waning quality as consequences.

It is not the solution that will solve everything, and it should only be implemented when and where the benefits clearly outweigh the negative consequences. This means it should be complemented with other approaches and solutions to avoid being too reliant on a single technology, and to create a more balanced system. In line with this, concerns about reduced biodiversity are in many cases justified. Like the prospect of having even more monocultures that can provide the feed in cellular agriculture, precision fermentation or the production of biomaterials. Or the dependency on just a few, climate adapted crops. Circularity needs to be an essential part in the implementation of these technologies, as is ensuring enough agricultural biodiversity.

Also, it should be avoided at all cost that this new technology, these biotech solutions, diverts our attention away from climate mitigation, as it gives governments or even the reigning system as a whole a way out of the urgency of the climate problem, and a reason to postpone climate mitigation interventions even more.

3.2.10 The finger points too much to farmers and consumers, while the system itself should change

Consumers often get the blame for their unsustainable behaviour. Indeed their behaviour is important, yet the problem is that the system makes it very hard for consumers to make sustainable and informed choices. Because the sustainable choice is often the least evident one, requiring the most money, time and/or being the most burdensome.

The same holds for farmers, who are stuck in a system where they struggle to get a fair price for their hard work and on the other hand made huge investments.

The biggest difference can be made by the players who have the biggest margins and profits, being the industry and the retailers. They decide on the product range that reaches the consumers and how the food products are presented and marketed. They have the power and possibilities to make the sustainable choice the easiest and evident one for the consumer. Industry and retailers are reluctant to make these changes and make bold choices in this perspective, as they fear and foresee profit losses and reductions of their market share. Regulatory and other interventions of the authorities and collective actions could create a more level playing field and decrease individual risks.

3.2.11 People do not want to believe the scale of the problem and have a very romantic idea about how agriculture works

People have a very romantic view on how things were in the past and hope that we can still save everything with organic farming, agroecological principles, vertical farming, and other adaptations. Although most indicated they know the problems we are facing are huge and cannot be solved overnight, they still underestimate the scale of the problem.

They do not realise that our crops and farm animals are weak, not adapted to survival in the wild, and only able to thrive thanks to the interventions of the farmers.

Consumers do want to adapt (a little) and change their eating patterns (less meat, more seasonal, etc.), but want to keep having the freedom of choice. They admit the current situation is a bit decadent, but scaling down is easier said than done.

Maybe they aren't confronted with the consequences enough yet? Indeed, prices have gone up considerably for food products, but in the end the product range in the supermarket remains very broad, not considering the seasons and with plenty of exotic fruits. When they see the abundancy in the supermarkets, etc., they think it's not all that bad and they like to bury their heads in the sand. This shows again the possible impact and also responsibility of the retail.

Also, as pointed out above, it helps to make the challenges more concrete for the consumers by making them think about the possible consequences and impact of the problems we are facing today, and a further escalation thereof, on their everyday lives. This brings the problem closer to home, and increases the sense of urgency in the need for solutions.

3.2.12 A different side of biotechnology: the application field matters

The application field for sure has an impact on how biotechnology is perceived by the consumers. When the products produced are more at arm's length of the consumer (so not for consumption, applied to the skin, etc.), the overall perception on biotechnology is more positive and people are more open to it.

When thinking about materials for example, biotechnology gets a more positive aura and is much more seen as something green, sustainable and innovative. This opposed to a food context where it was often seen as 'chemical' and unnatural. The positive halo also spreads to the social consequences.

4 DEVIATIONS

Due to encountered challenges and difficulties of Food & Bio Cluster Denmark related to the recruitment of the consumers with the right profile, it was decided to outsource this to a bureau with specific expertise in this task. This bureau had access to a broad pool of consumers.

The deadline of this deliverable was originally set at M15 (as described in the DoA), so by the end of February '25. Due to the fact that Food & Bio Cluster Denmark encountered a setback with the company responsible for the recruitment of the consumers and lastminute had to consult another recruiter, the consumer co-creation session on the 'Biomaterials' case had to be postponed to the 18th of February. Given that discussions on the results and findings among the moderator and notetakers are essential and often require time to fully process, and since the results need to be integrated into the overall findings for this deliverable by Alice, it was decided to postpone the submission by one month, extending the deadline to the end of March 2025.

As described in D2.1, from the stakeholders assessments, it became clear that besides consumers other actors like farmers and environmental lobby groups are highly affected and could have a lot of influence on the implementation of the technology. Therefore, the B-Trust partners decided to expand the exploration phase to farmers and industry actors (related to the 'Biomaterials' case). The sessions foreseen in T2.3 were thus divided into 4 exploratory co-creation sessions (phase 1) with farmers and the chemical industry, and 6 co-design sessions (phase 3) with industry, governments, investors and academia. However, due to the timing and practical feasibility the results from these sessions could not be included in this deliverable, they will – as originally planned – be included in deliverable 2.3. The same goes for the in-depth interviews with civil society organisations, such as organisations representing the environment and social equity (also described in D2.1).

In the project proposal, we set the KPI for consumers in the co-creation sessions to 100. This would mean that each co-creation session would need at least 16 participants. However, upon evaluation of co-creation sessions, and as explained in 3.1.1, 16 participants is more like the maximum of participants that should be included in a session, as more participants would interfere with the group dynamic. Larger groups risk diminishing the effectiveness of the sessions. Also, on several occasions, participants called off last minute due to sickness or personal issues, and since the participant profile needs to fit certain requirements, it is usually not possible to find replacements on such short notice. Therefore, the total amount of consumers in co-creation sessions (81) is a bit lower than foreseen in the KPI but aligned with best practices for effective co-creation.

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