CHIC "Chicory as a multipurpose crop for dietary fibre and medicinal terpenes"

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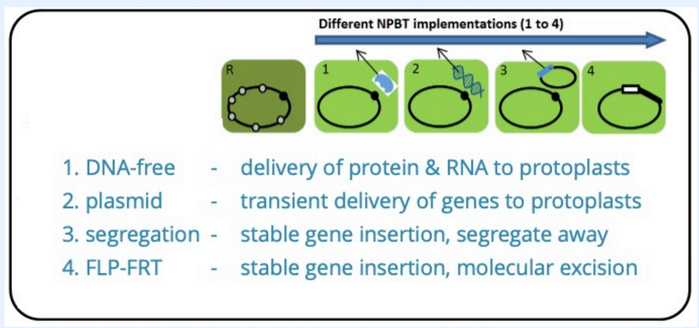
What is CHIC?

- CHICORY is a minor industrial crop used for production of the food fiber inulin which is used in e.g. muesli bars and yogurts. Breeding improved chicory is challenging because it is self-incompatible. Therefore, genome editing can make a great difference.
- CHIC aims to implement genome editing in order to establish chicory as a multipurpose crop for sustainable molecular farming of products with consumer benefits; dietary fibres and medicinal terpenes.
- CHIC also aims to facilitate a transparent discussion and create awareness about genome editing techniques such as CRISPR/Cas.

Genome editing in chicory

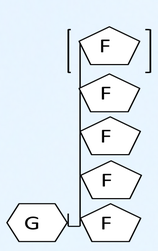
Development of genome editing approaches for chicory

We developed four different CRISPR approaches for gene editing in chicory that differ in how the CRISPR/Cas complex is delivered into plant cells.



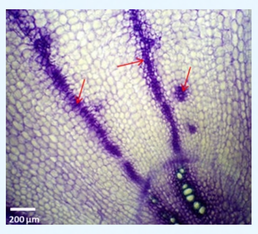
Implementing genome editing in chicory

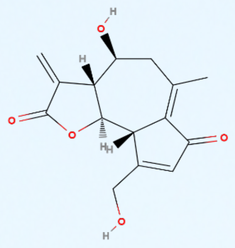
1: Improved inulin



We generated chicory plants in which the genes encoding the inulin break-down enzymes are blocked to improve inulin quality.

2: Terpenes as bioactives





We blocked the biosynthesis of the bitter terpenes that naturally accumulate in the roots to facilitate inulin extraction and make it more sustainable. We identified endogenous terpenes with anti-inflammatory and antimicrobial health properties.

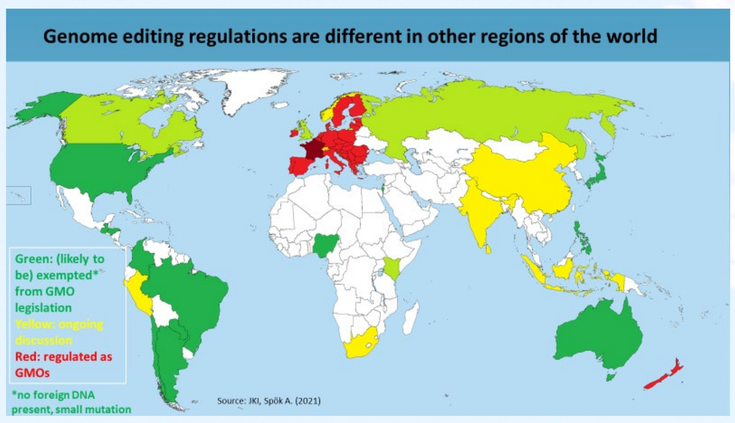
3: Break self-incompatibility

The genes for self-incompatibility in chicory have been found, and solutions to bypass their action are being tested now.

Societal and environmental impact

Technical, regulatory and safety assesment

The safety of the genome edited chicory lines is evaluated by off-target analysis and by testing for potential toxicity of products (terpenes).
Due to the ECJ ruling the risk assessment of products derived by genome editing is currently the same as for GMOs in Europe but discussions are ongoing. Regulatory regimes and legislations all around the world are being monitored.



Socio-economic and environmental impacts of the whole value chain

A socio-economic and environmental impact assessment of genome edited chicory and the whole value chain will be applied. This will give information on e.g. job creation, trade, greenhouse gas emissions, primary energy demand, water consumption and land use of the new value chain developed by CHIC.
We defined scenarios were defined that differ in aspects such as whether CRISPR edited chicory is regulated as GMO or not, whether it is grown in the open field or greenhouses and what type of products are isolated from them. These scenarios will be evaluated for their socio-economic and environmental impacts.

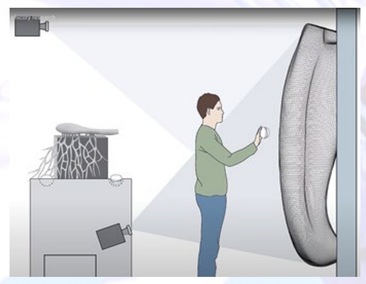
Scenario	1	2a	2b	3
Plant defined as GMO due to ruling	No	Yes	Yes	No
Cultivation	Open field	Greenhouse	Open field	Open field
Process optimized for	Combined process	Terpene production	Terpene production	Inulin production
Products	Inulin (food) + Terpene (nutriceutical)	Terpene (pharmaceutical)	Terpene (pharmaceutical)	Inulin (food)
Further characteristics ...		Inulin will be produced according to current commercial process	Inulin will be produced according to current commercial process	Produced with an adapted current commercial process

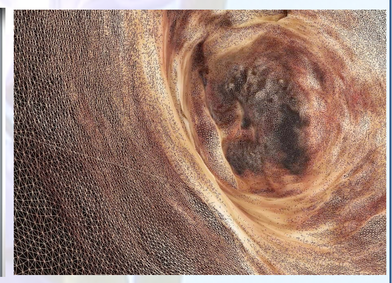
Communication and stakeholder engagement

Stakeholder engagement

Stakeholder engagement aims to identify factors that possibly facilitate or hinder the acceptability of commercial development of genome-edited chicory and derived products (inulin and/or terpenes). Stakeholder consultations mainly with actors along the chicory value chain and policy makers were held.

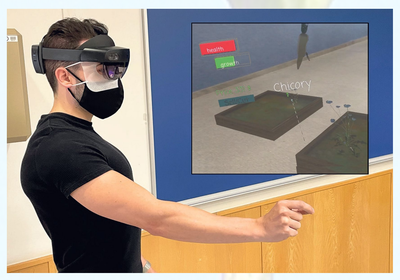
CHIC artists in residence





Perception and understanding of science and scientific facts through the eyes of Art & Culture can greatly contribute to bring knowledge to our evolving society. CHIC artists are linking scientific research and art, fostering interdisciplinary work towards an exchange of cultures and milieus. Their projects – "Aftertaste" and "Biotechnology from the Blue Flower" – are planned as interactive, multimedia experiences, incorporating best practices among science-based art. Meet the artists at:
https://europlantbiology2020.org/art-and-science-synergy/

Communication to young adults



We presented CHIC in open events across Europe, such as Researchers Night and Fascination of Plants Day. Additionally, an interactive MyCHIC Farm game has been developed allowing people to play and learn about gene editing and its impact using augmented reality.

1. WR, NL
2. ULille, FR
3. IPB, DE
4. PFR, NZ
5. WU, NL
6. FEM, IT
7. VTT, FI
8. IBISS, RS
9. JKI, DE
10. TUGraz, AT
11. ASSF, PL
12. EPSO, BE
13. Sensus, NL
14. iBET, PT
15. JR, AT
16. KG, NL
17. IDC, ES

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