Environmental and socio-economic aspects of new plant breeding technologies applied in root chicory for inulin and terpene production

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KeyGene

ID consortium

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IPB Leibniz Institute of Plant Biochemistry

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VTT

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Root chicory

Chicory varieties, such as the Belgian endive and the Italian radicchio, have been used as food in salads for a long time. They are appreciated for their characteristic bitter taste. The crop named root chicory (Figure 1) is cultivated for food fibre inulin.

Inulin is a prebiotic; it boosts the growth of beneficial gut bacteria and stimulates our immune system. Inulin is included in food such as yoghurts and cereal bars as low-calorie sweetener, fat replacer and to enhance gut health. In Europe, root chicory is mainly cultivated in the Netherlands, Belgium and the Northern part of France.

In addition to inulin, chicory roots store different terpenes. Terpenes are organic compounds naturally occurring in many plants. They give chicory varieties their typical bitter taste. Some terpenes can also inhibit the growth of fungi or bacteria, as antibiotics, or according to scientific evidence prevent cancer cells from growing. Therefore, terpenes from chicory could be processed to generate new medicinal drugs.

Figure 1: *Root chicory*

Plant breeding

CHIC, a H2020 project, aims to improve the quality of chicory by the development of new chicory plants producing on the one hand more as well as putative healthier inulin and on the other hand sufficient amounts of medicinal terpenes. Whereas it can take easily between one and two decades to develop a new plant variety by conventional plant breeding, the use of new plant breeding techniques (NPBTs) in CHIC allows to develop new chicory varieties in a much shorter time. Some of the traits CHIC wants to improve are almost impossible to achieve by conventional plant breeding only. Therefore, the ambition of CHIC is to develop and implement different NPBTs to convert chicory into a robust multipurpose crop.

The CHIC consortium evaluates the efficiency of new plant breeding techniques, as well as the safety, environmental, regulatory, socio-economic and broader societal issues.

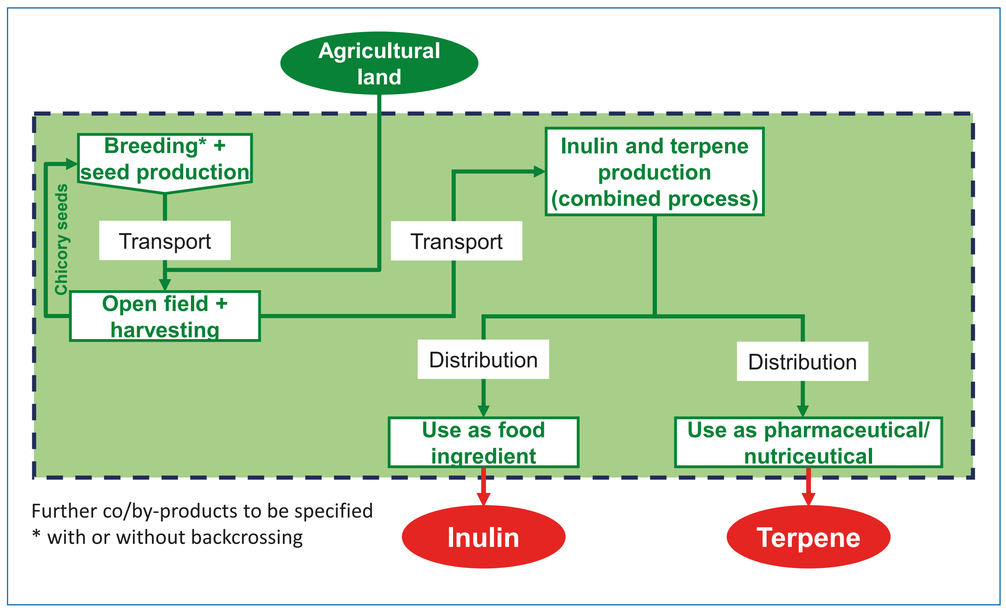

Figure 2: *New CHIC value chain*

Environmental and socio-economic aspects

To identify environmental and socio-economic impacts of the CHIC project an environmental assessment using the methodology of Life Cycle Assessment (LCA) and a socio-economic assessment employing a multi-regional input output model (MRIO) is applied. The whole value chain (e.g. breeding, cultivation, processing) will be included in the assessment (Figure 2). The assessment will give information on different indicators (Figure 3), e.g. global warming potential, primary energy demand, water consumption, land use, effect on value added, competitiveness, and employment as well as the distribution of wealth and income between different sectors and regions within the EU and the global economy. In particular, focus will be laid on how NPBTs, the large scale cultivation and processed products impact the global value chain of agriculture, food and food processing and pharmaceutical chemical industry and hence how these effects unfold in the global economy. The results will be used to lead the development within the project in a sustainable direction.

Category	Indicators	Unit
Environmental	Global warming potential/Climate change	[CO_2-equivalent]
	Primary energy demand	[MJ]
	Water consumption	[m^3]
	Land use	[ha]
	Acidification	[SO_2-equivalent]
	Eutrophication	[PO_4-equivalent]
Socio-economic	Value added	[US-dollar]
	Jobs	[Persons, full-time equivalents]
	Changes on existing value chains and creation of new value chains	[US-dollar]
	Distribution	[US-dollar]
	Competitiveness	[Efficiency indicators]

Figure 3: *Examples for environmental and socio-economic indicators*

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