Extracting value from the Biochemical Diversity of Plants

Dirk Bosch
Wageningen Plant Research, Wageningen University and Research, Wageningen, The Netherlands (dirk.bosch@wur.nl)

Plant kingdom provides us with an immense variety of metabolites that play crucial roles in the survival, growth, communication and defence mechanisms of plants. The diversity of these metabolites arises from the intricate biochemical pathways that plants have evolved over millions of years. Their secondary metabolites serve as powerful tools for plant defence, deterring herbivores, pathogens and competing plants, but also to adapt to their surroundings and environment and to interact with diverse organisms in their environment. Plants engage in intricate chemical dialogues with other organisms, including microorganisms in the soil and insects. As a result, many plant chemotypes have evolved in different ecological niches even from single plant species. This wealth of metabolites serves not only the plants themselves in terms of survival and growth but also offers invaluable resources for human applications in medicine, agriculture, and industry.

Knowledge of these pathways, combined with state of the art biotechnological approaches allow to make these compounds available at scale. In the framework of the EU-CHIC project, genome editing protocols were developed and compared and used to create new industrial chicory varieties trough precision breeding of the biosynthetic pathways leading to bitter tasting terpenes. Varieties in which the accumulation of bitter tasting terpenes was completely abolished by targeting all 8 alleles of a the terpene synthase that initiates terpene biosynthesis. This allows for more economical and more sustainable extraction of the food fibre inulin for which this field crop is grown. Rerouting biosynthesis by interfering with P450 enzymes resulted in chicory varieties that each accumulate different specific terpenes with medicinal potential. These could be positioned as secondary products from root chicory, next to inulin. Plant terpenes can also be made available at commercial scale by introducing their biosynthesis into industrial micro-organisms. This green-white biotechnological approach may offer the advantage that these terpenes are made year round available at constant prises, independent of agronomy and free from agrochemicals. Currently this approach is economically best feasible when high value compounds such as natural flavours or drugs are targeted. When this technology advances overtime and becomes more cost-effective, also lower value compounds such as natural crop protectants and colorants or even building blocks for bioplastic can be mined from the plant kingdom via green-white biotechnology.