Harnessing plant metabolic diversity

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Plants produce a wealth of natural products that are valuable as industrial or pharmaceutical products. For example, plant-derived drugs represent >5% of the total pharmaceutical industry with sales revenues of £18 billion. The growing reliance on chemicals from plants is driving demand for green, environmentally friendly and sustainable feedstocks across industrial sectors in order to enable us to reduce our dependence on products derived from chemical refineries. Importantly, many of the natural products that are produced by plants are structurally complex and beyond the reach of chemical synthesis. These compounds are commonly extracted from plant material either growing in the wild or in cultivation. Availability is limited by difficulties in accessing and cultivating source species, low yield and problems of purification. The scale of the economic opportunity for improving the supply of high value products from plants is therefore enormous.

The vast majority of the natural product diversity encoded by plant genomes remains as yet untapped. The explosion in available plant genome sequence data coupled with affordable DNA synthesis and new DNA assembly technologies now offer unprecedented opportunities to harness the full breadth of plant natural product diversity and generate novel molecules in foreign hosts using synthetic biology approaches. The recent discovery that genes for the synthesis of different kinds of natural products are organised in biosynthetic gene clusters in plant genomes is now opening up opportunities for systematic mining for new pathways and chemistries. The production of plant and plant-inspired molecules in heterologous plant and microbial expression systems will enable the development of rational strategies to produce known and new-to-nature chemicals that are tailored for particular applications. This presentation will focus on our work on triterpene engineering using synthetic biology approaches.