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Editorial: Modern Methods in Plant Natural Products themed issue

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Over the last decade, stunning advances in analytical techniques have revolutionised how we detect, and consequently study, study natural products. In parallel, the advent of next generation sequencing technology has given us fast and cheap access to genome and transcriptome sequence data, which can be used to deconvolute the genetic basis that underpins the biosynthesis of these compounds. Collectively, these advances are ushering in a new, modern era for natural products. In this themed issue, we highlight a selection of these methods and discuss the impact that they have had on the field of natural products, particularly plant-derived products.

NMR is one of the gold standards for the structural characterisation of natural products. Breton and Reynolds (DOI: 10.1039/C2NP20104F) discuss improvements in NMR methodology that enable the detailed structural characterisation of minute quantities of material. These advancements have proven to be crucial for the study of rare natural products, which can only be isolated in low quantities because of poor production levels, the rarity of the producing organism, or an inability to cultivate the producing organism in the laboratory.

We also touch on the advances that have been made in isolating and characterising the bioactive natural products that are present in extracts. Bucar, Wube and Schmid (DOI: 10.1039/C3NP20106F) describe new advances in separating the complex mixtures of compounds that comprise extracts. A host of new chromatographic techniques that streamline natural product purification has been introduced in the last 5 years. Notably, Hamburger and Potterat (DOI: 10.1039/C3NP20094A) discuss approaches to identify the valuable bioactive components present in a crude natural product *before* purification procedures are applied. This approach allows one to identify a hit from a crude extract, and then perform the hard work of isolation, purification and scale up after a promising biological activity has been established.

Developing production platforms that can yield sustainable levels of complex natural products could enable rare natural products to be put into wider use. Reconstituting natural product pathways in heterologous hosts is one approach to enable improved production levels of these compounds. To do this, however, the genes that encode the natural product pathways must be elucidated. This themed issue also explores the role that modern DNA sequencing methods can play in elucidating this information. Góngora-Castillo and Buell (DOI: 10.1039/C3NP20099J) describe how transcriptomic data can be used to understand the metabolism of medicinal plants. Notably, while transcriptome data for medicinal plants can be obtained very easily, most medicinal plants currently lack a reference genome, which confounds assembly and accurate annotation. However, metabolomic studies can complement these medicinal plant transcriptomic datasets and help overcome these challenges. Hur and coworkers (DOI: 10.1039/C3NP20111B) describe how large metabolic datasets can be organised and used to elucidate metabolic networks. Specifically, tracking time-resolved and spatially defined metabolite abundance data can help us generate hypotheses about biosynthetic pathways.

Finally, Ngo, Okogun and Folk (DOI: 10.1039/C3NP20120A) discuss some of the challenges in locating new natural products. Plants that are used as traditional medicines are outstanding sources of natural products. However, it is essential to respect the origin of these plants and ensure that the countries and peoples that discovered these plants are not exploited and benefit equitably from any natural product studies. In their article, Ngo and coworkers suggest that development of Regional Centres of 'omics Technologies', functionally linked with Regional Centres of Genetic Resources, can help link the study and use of traditional medicines with cutting edge biology approaches.

We focus on natural products from plants. Notably, advances in technologies involved in the discovery and

implementation of plant-derived natural products have lagged when compared to advances for microbe-derived compounds. A number of reviews in NPR outside of this themed issue have described the technological advances that have driven forward work in the field of microbial natural products. For example, advances in DNA sequencing have led to the rapid sequencing of bacterial genomes, which, in turn, has enhanced our ability to mine genomes for new natural products (New natural product biosynthetic chemistry discovered by genome mining, Corre and Challis, *Nat. Prod. Rep.*, 2009, **26**(8), 977–986). Advances in mass spectrometry have allowed us to visualise the profile of natural products produced by microorganisms (Esquenazi, Yang, Watrous, Gerwick and Dorrestein, *Nat. Prod. Rep.*, 2009, **26**(12), 1521–1534).

In total, by allowing us to more easily characterise natural product structures, identify active components in complex mixtures, and elucidate underlying genetic biosyntheses, technical advances in analytical methodologies have driven forward the extent to which we can harness these chemicals for a range of pharmaceutical, agricultural and other industrial uses.

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