

Deep impact of plant metabolism

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Plants produce a large number of specialized, or secondary, metabolites such as terpenoids, alkaloids, and phenylpropanoids. Elaborate metabolic networks deliver a diverse array of these compounds, with functions ranging from attractants for pollinators to defense compounds against herbivores and bacterial pathogens, usually conferring adaptive advantages to the plants. Plant-derived compounds have been widely exploited in our daily lives as medicines, health-promoting supplements, dyes, and perfumes, as well as in a wide range of other applications, and their use is increasingly important for a healthy and sustainable life.

Chemical diversity is one of the key terms in the field of plant metabolism. Individual scientists often focus on particular metabolites or metabolic pathways found in a limited group of plant species. Nevertheless, we also acknowledge that we have considerable common ground. The molecular factors, i.e. enzymes, transporters, or regulators, that we are studying, the methodologies that we are adapting to elucidate the functions of those factors, and the concepts or notions that we are trying to figure out are closely related and largely in common. It is therefore important to share recent updates and exchange opinions and perspectives between the researchers. Recent development of -omics approaches, i.e. genomics, proteomics, and metabolomics, has profoundly benefited research on plant metabolism. In particular, advancement of sequencing technology is the paving way for molecular genetic studies in a diverse range of plants producing specialized metabolites.

Reflecting the critically important and specific roles of metabolites that had been underestimated in the past, the term “specialized metabolism” has been widely adopted in the literature, replacing the conventionally used “secondary metabolism”, or “Niji-taisha” in Japanese, which is considered to convey the long-standing notion that secondary metabolites, in contrast to primary metabolites, had little physiological significance and were produced as metabolic by-products or waste at worst. The diverse roles of these compounds in plant adaptation,

survival, physiology, and interaction with other organisms prompt us to agree with such replacement of terms. A next question is how we translate “specialized metabolism” in Japanese. Scientific terms invented in English have translational equivalents in Japanese and appropriate equivalents bearing the nuances of the originals are essential for their wide acceptance. We have exchanged opinions within a group of Japanese peers about the issue and several candidates (e.g. Kohji-, Tekiou-, Tokka-, Tokui-, and Tokushu-taisha, ordered alphabetically) have come up through the conversation. The debate has heated up, but no conclusion has been reached. We have become aware, however, of how differently individuals perceive the meaning of “specialized metabolism”, probably reflecting the various disciplinary backgrounds of the members. We plan to continue the conversation to find consensus on this issue.

To deepen mutual understanding through face-to-face discussion and share cutting-edge information in the field, a Frontier Study Group of Plant Specialized Metabolism with members who mostly belong to the Japanese Society for Plant Cell and Molecular Biology was founded in 2012. The 2nd annual meeting of the Study Group was held along with the international symposium entitled “Deep Impact of Plant Metabolism: Going Beyond Diversity”, sponsored by the Nara Institute of Science and Technology (NAIST) in Nara, Japan on November 22 and 23, 2013. A dozen presentations were given by speakers in their 30s and 40s, leading researchers of a next generation, including two invited speakers from China and Australia, Dr. Guodong Wang (Chinese Academy of Science) and Dr. Carsten Kulheim (Australian National University). There were continuous and active discussions full of critical questions and constructive comments after all talks. Attendees included many graduate students interested in the field. We believe that relationships cultivated among the researchers through the two-day gathering will lead to lasting collaborations in various forms and multidisciplinary development of the resulting studies.

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