Secondary metabolism in plant biotechnology

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Secondary metabolites, which represent more than 30,000 natural products, have been used as medicines, perfumes, dyes and food supplements in human life. They have been attractive research targets for many phytochemists because of their importance in our life, as well as the complexity in their chemical structures. In the last several decades discoveries have been made to show that they are involved in many biological events to support plant life, which has drawn much attention of plant biochemists and physiologists. For instance, many secondary products play important roles in biotic and abiotic stress responses such as disease resistance and salinity stress tolerance, or act directly as herbivore repellents and UV protectants, functioning to protect plant body from environmental stress. Some of these low molecular substances are also responsible for communication between plants and other organisms like bacteria and insects, e.g. leguminosaeous nodulation is regulated by flavonoids, and pollinators are attracted by volatile terpenoids. Despite the fact that secondary metabolism has the potential of becoming great resources for biochemical research, plant biochemists faced many technical difficulties on studying their biosyntheses due to their structural complexities, low abundance, and strong inhibitory effects on many enzymes, including their own biosynthetic enzymes.

In the 1980s, production of these natural compounds by use of plant tissue and cell cultures became very popular, which provided useful materials to study their biosynthetic pathways. Recently, molecular genetic techniques have been intensively applied to analyses of plant secondary metabolism, to study not only their biosyntheses but also their transport mechanisms in plant body.

One of the most successful examples of production of secondary metabolites is shikonin production by cell cultures of Lithospermum erythrorhizon, which was established by late Professor Emeritus Mamoru Tabata of Kyoto University. He was one of the original members who founded the Japanese Society for Plant Cell and Molecular Biology, and largely contributed to the development of this society in many research fields of plant tissues and cell cultures, particularly in secondary metabolism. In memory of Professor Emeritus Mamoru Tabata, this special issue of Plant Biotechnology on Secondary Metabolism is cordially dedicated by the editors, former collaborators, colleagues, students, and friends from around the world.