Plant Cell Culture and Specialized Metabolism

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Plant cell cultures are widely used in the production of useful specialized metabolites. On the other hand, the industrial application of plant cell cultures is rather limited due to the difficulties associated with functional differentiation in cell cultures[1)]. In this talk, we overview our experiences with functionally differentiation of specialized metabolism in cultured plant cells. We emphasize the high potentials of genome information, as well as power of synthetic biology, to dissect the molecular regulation of specialized metabolism in plant cell culture[2)].

Plants can grow without the addition of any organic carbon sources under the sunlight. However, once plant tissues or cells are isolated from intact plants, they lose this photosynthetic ability, partially due to the effect of sugars and plant growth hormones in the culture medium. For the establishment of photoautotrophic (PA) cells, cellular selections of chlorophyll producing tissues are critical. On the other hand, our comparative characterization of proteome and transcriptome in cultured PA cells clearly showed that they were considerably different from those in leaf mesophyll cells; PA cells accumulated large quantities of pathogenesis-related proteins, suggesting that they were under physiologically stressed conditions. On the other hand, high secondary metabolite (a benzylisoquinoline, BIA, berberine)-producing *Coptis japonica* cells have been established by cellular selection as for PA cells. Further metabolic engineering enabled the establishment of high root-type BIA (sanguinarine) producing California poppy cells, but these cells did not produce leaf-type pavine alkaloids in cells. These data indicated that the establishment of functionally differentiated plant cell cultures are limited. However, recent progresses in genome sequencing and extensive transcriptome studies enabled the molecular dissection of cellular differentiation and specialized metabolism. Our current studies to dissect the molecular regulation systems of specialized metabolism using draft genome of California poppy[2,3)] are discussed in this talk.

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References

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