

## Requirements for molecular farming to produce nutraceutical and pharmaceutical components

Hirokazu KOBAYASHI<sup>1</sup>, Tsutomu NAKAYAMA<sup>1</sup>, and Hiroshi NOGUCHI<sup>2</sup>

<sup>1</sup>*Graduate School of Nutritional and Environmental Sciences*, <sup>2</sup>*Graduate School of Pharmaceutical Sciences*

Most nutraceuticals and pharmaceuticals necessary for preventing humans from lifestyle-related illness and resulting in their longevity with health, are derived from plants. Although genetic manipulation of plants is a powerful tool for improvement of plants to accumulate such useful components, genetically-modified (GM) plants must be seriously evaluated in two viewpoints: (1) safety in direct oral intake and (2) influence on the ecological system through so called “genetic pollution”. We have established the technology to satisfy these requirements. Its application to plant cells in association with commercialization of the compounds extracted from them, would be much sooner achieved than the establishment of new edible plant cultivars genetically modified in consideration of consumers’ acceptance.

Selectable marker genes for genetic transformation are ideally to be plant origin or to be eliminated after establishment of transformation. We have focused on an enzyme involved in amino acid biosynthesis in plastids, acetolactate synthase (ALS) [acetohydroxyacid synthase (AHAS)]. A variety of amino acid substitutions have been introduced into this enzyme and its tolerance to herbicides has been evaluated. We have made constructs to express them in nuclei, as well as in plastids, in brassica plants and tobacco.

Plant cells are usually cultured under heterotrophic conditions in supplementation with sugar, resulting in nongreen cells propagating. To stimulate the biogenesis of chloroplasts under such conditions, genes for “greening”, if any, may be worth being cloned. We have identified several “greening genes” designated as *CES101* to *CES103* (*callus expression of RBCS*) from the model plant *Arabidopsis thaliana*. We will discuss about the mechanisms of participation of these genes in greening.

We have also tried to express exogenous genes for chalcone synthase in *Arabidopsis* plants, resulting in accumulation of kaempferol and others.

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