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Genetic engineering of orange-colored Petunia

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Flower color, an important horticultural trait in the market, is mainly determined by anthocyanin and carotenoid. Though classical breeding programs have been very successful to develop cultivars having various flower colors, some flower species are inherently unable to produce sets of flower colors due to the lack of an essential gene or to the substrate specificity of a biosynthetic enzyme. Genetic engineering can complement the classical breeding method to develop various flower colors. My laboratory is interested in developing sets of technology that will enable us to modulate the flower color by genetic engineering. One of technologies we have developed was the method of producing orange-colored flower by genetic engineering.

Production of orange-colored Petunia using an engineered DFR gene

Many plant species exhibit a reduced range of flower colors due to the lack of an essential gene or to the substrate specificity of a biosynthetic enzyme. *Petunia Cymbidium* do not produce orange flowers because dihydroflavonol 4-reductase (DFR) from these species, an enzyme involved in anthocyanin biosynthesis, inefficiently reduces dihydrokaempferol, the precursor to orange pelargonidin-type anthocyanins. Molecular mechanism how substrate specificity is determined in DFR, however, is not known. By analyzing chimeric *DFRs* of *Petunia* and *Gerbera*, we identified a region that determines the substrate specificity of DFR. Furthermore, by changing a single amino acid in this presumed substrate binding region, we developed a DFR enzyme that preferentially reduces dihydrokaempferol. With this orange-color specific DFR gene, we have generated *Petunia* bearing orange-colored flower. We are currently collaborating with an American horticultural company to commercialize the orange-colored Petunia.