The type III polyketide synthase involved in plant polyphenol biosynthesis

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Type III polyketide synthases (PKSs) are structurally simple, homodimeric proteins that use a single active-site to produce pharmaceutically and biologically important, structurally divergent natural polyketide scaffolds. For example, chalcone synthase (CHS) and stilebene synthase (STS) catalyze the sequential condensation of *p*-coumaroyl-CoA as a starter substrate with three C2 units from malonyl-CoA, to produce the C6-C3-C6 scaffold of naringenin chalcone, the key intermediate in flavonoid biosynthesis, and the C6-C2-C6 scaffold of resveratrol, respectively. On the other hand, it was recently reported that the C6-C7-C6 diarylheptanoid scaffold of curcumin is also produced by novel type III PKSs. Curcumin, the principal component of the turmeric *Curcuma longa*, is widely used as a food additive and in traditional Asian medicine, and has been shown to possess anti-inflammatory, anti-carcinogenic, and anti-tumor activities.

Curcuminoid scaffold is synthesized *via* a three-step reaction from phenylpropanoids. First, malonyl-CoA condenses with feruloyl-CoA to produce a diketide-CoA that is converted into β-keto acid by hydrolysis, which is then finally condenses with another molecule of feruloyl-CoA to produce curcumin. Isolation of a novel enzyme termed as curcuminoid synthase (CUS) from *Oryza sativa* confirmed the above hypothesis. The CUS catalyzes condensation of two molecules of *p*-coumaroyl-CoA with one malonyl-CoA to produce bisdemethoxycurcumin.

Curcuminoids are characteristic compounds in Haemodorales as well as Zingiberales which include turmeric, ginger and banana are closely related to Haemodorales, however. The CUS is derived from rice *O. sativa*, which is phylogenetically distinct from Haemodorales and Zingiberales. Curcuminoids and phenylphenalenones have not been reported in *O. sativa*. Both *p*-coumaroyl-CoA and malonyl-CoA are common in plants and the typical substrates for plant type III PKSs as well as the CUS. The rice CUS might produce curcuminoids in undetectable amounts in mathematical possibility.

The genes for two type III PKSs of Common morning glory, which generate chromone derivatives, as well as one for benzalacetone synthase from Rhubarb, have been introduced to *Arabidopsis* to investigate whether these transgenic plants could be a promising resource for plant polyphenols with agrobacterium system. Now we are going to transfer the modified rice CUS gene fusing with its endogenous promoter into the rice plant itself, if possible, to transfer into the corresponding genomic sequences of rice recombinants by targeting method. We would like to investigate whether the expression of the CUS results in producing curcuminoids in rice plant in future.