

A Challenge to Make a Blue Rose[®]

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It is rare for a single plant species to have a broad range of flower colors. Roses, carnations, and chrysanthemums lack blue/violet color. Morning glories and pelargoniums lack yellow. In particular, blue roses are regarded as the “Holy Grail” by rose fanciers and have been sought after. Blue flowers achieve their color by a combination of various factors including:

- 1) Production of delphinidin, a pigment that most blue flowers contain
- 2) Modification of pigments by aromatic acyl groups
- 3) Accumulation of flavones or flavonols that cause bluing of pigments
- 4) Elevation of vacuolar pH where pigments localize
- 5) Accumulation of ferrous or aluminum ion

Non-blue flowers rarely have these abilities. Among these factors, molecular mechanism of delphinidin production is most well studied. Flavonoid 3',5'-hydroxylase (F3'5'H) is the critical enzyme for delphinidin biosynthesis (Fig. 1).

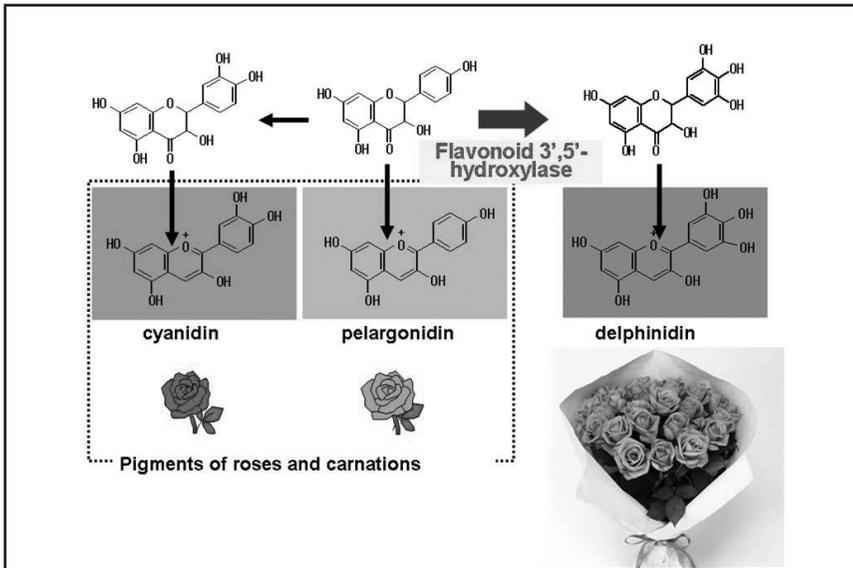


Figure 1. Biosynthetic pathway of floral pigments.

In order to obtain blue roses, it is necessary to introduce F3'5'H gene into roses with genetic engineering. Development of genetically modified blue flowers requires:

- 1) Isolation of a F3'5'H gene
- 2) Development of a rose transformation protocol
- 3) Regulation of transgenes in transgenic plants

For commercialization, it is necessary to obtain permission by the government on the basis of "Law Concerning the Conservation and Sustainable Use of Biological Diversity through Regulations on the Use of Living Modified Organisms" (Cartagena Protocol domestic law).

One plant species contains tens of thousands of genes. We isolated the F3'5'H gene from petunia. Transgenic carnations harboring the F3'5'H gene had novel bluish flower by producing delphinidin. The carnations, 'Moondust', are produced in Colombia and Ecuador and sold in U.S.A., Europe, and Japan.

A pansy F3'5'H gene was introduced to about 40 rose cultivars selected from several hundred cultivars. Transgenic rose lines accumulating delphinidin at high content percentage and having a novel blue hue were obtained. General release permission was granted to the selected line after showing the release of the transgenic rose would not affect biodiversity in Japan. The rose, 'Suntory Blue Rose Applause', was launched in Japan on 3 Nov. 2009. Efforts to yield bluer roses are on-going by incorporating the various factors affecting flower color in addition to delphinidin production.