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Components of Flower Pigments in Petals of Lily

Fan Jin-ping, Zhang Hai-xiao, Miao Mei-mei, and Che Dai-di*

College of Horticulture, Northeast Agricultural University, Harbin 150030, China

Abstract: This paper carried on a preliminary study on pigment composition of lilies of different colors by means of specific color reactions and UV-visible spectra. The results showed that the colors of lilies were usually caused by the combined action of several pigments; yellow and orange lilies mainly contained the flavonoids and carotenoids; pink lilies mainly contained flavonoids and anthocyanins, and white lilies contained small amount of flavonoids.

Key words: lily, flower pigment, category

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Introduction

Lily (*Lilium* spp.) belongs to liliaceous (*Liliaceae*), lily (*Lilium*) (Chen and Cheng, 1989; Zhao, 2000). Because of its excellence, colorful flowers, various varieties and meaning of good wishes, lily is very popular among the world flower market and enjoys the reputation of "the king of flower bulbs" (Zhang, 2014). Lily breeding has also been one of the most concerns in the global flower industry, while the color is an important index to measure the value of ornamental lily in the process of lily breeding. Lily flower color is the color of all the petals in the floral organs (An, 1989; Zhang, 1989). Researching the relationship between the pigment composition and color of lily flower and investigating the color, mechanism of different color lily could provide theoretical basis for lily flower color breeding in China and accelerate the development of Chinese lily industry.

Related studies of lily colors have been widely reported in foreign countries. During the investigation of the Japanese lily pigment researces, Banba (Banba, 1967; Banba, 1968) and others found yellow and orange lilies of Asian lily mainly contained carotenoids, pink lilies mainly contained anthocyanins, and the spots of lily petals lilies were usually caused by anthocyanins. Studies have reported that the lily petals only contained derivatives of beta carotene (Nielsen *et al*., 2003; Liu *et al*., 2004), while other carotenoids have not been found. Norbeak and Kondo (1999) analyzed the anthocyanin composition of hybrid varieties of Asiatic lily and Oriental lily, the result showed that lily petals contained proanthocyanidins excepting the white ones, red petals mainly contained procyanidins, cyanidin 3-O-beta rutinoside and a small amount of vector cornflower pigment 3-O-beta rutinoside 7-O-beta glucoside.

This study conducted a flower color measurement, the specific color reactions and UV-visible spectra of flower pigments among different colors of lilies. It aimed to lay a theoretical foundation for lily flower pigment of further separation and identification and promote the breeding process of different colors of

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Fan Jin-ping, female, engaged in the research of garden genetics and breeding. E-mail:fan_xuer2000@aliyun.com
* Corresponding author. E-mail: daidiche@aliyun.com

lily.

Materials and Methods

Plant materials

In this study, experimental materials were the main cultivated varieties of lily A1"Pollyanna", A3"Prato", A4"Cedeazzle", A5"Dark beauty", A6"Elite", A7"Navona", L1"Longiflorum", W1"Devil lily", W2"Lilium pumilum", W3"L. concolor Salisb" and 125 hybrid F1 generations cultivated from cross breeding with the three ones as parents from conservation laboratory of genetics and breeding of ornamental plants of Northeast Agricultural University. The four hybrid combinations were A: A3×A5; B: A5×A3; C: A3×A7; D: A7×A3, and F_1 generation plants of these hybrid combinations were A: R1-R30, B: P1-P34, C: M1-M29, and D: N1-N32. The collected materials were stored at –20℃ after overnight and dried in oven at 40℃, a dark dry preservation.

Determination of lily flower color

When the flowers in full bloom, a visual color measurement was conducted to each variety, and then compared the main color parts of petals with the Royal Horticultural Society Color Card (RHSCC) in natural light indoors.

Qualitative analysis of pigment

Qualitative analysis of lily pigment type 0.1 g of the petal powder was placed in a tube with plug, put in petroleum, 10% hydrochloric acid and 30% ammonia 5 mL, respectively, the change of the color was observed and recorded.

The color reaction of flavonoids 0.1 g of the petals powder was placed in a tube with plug, extracted it for 15 h using hydrochloride methanol solution (HCl : MeOH=1 : 99, v/v), then filtered and metered volume to 25 mL. 2 mL extract was collected for the following chromogenic reactions (Chen, 1990). Then, the color change was observed and recorded.

(1) Concentrated hydrochloric acid-zinc reaction: added a small amount of zinc powder, then added 10 drops of concentrated hydrochloric acid, set aside for 1 h after shaking up.

(2) Ferric chloride reaction: added 2 mL 5% $FeCl_3 \cdot 6H_2O$ solution.

(3) Alchlor reaction: added 2 mL 1% methanol solution of $AlCl_3 \cdot 6H_2O$.

(4) Lead acetate reaction: added 2 mL 1% Pb $(CH_3COO) \cdot 3H_2O$ solution set aside for 2 h after shaking up.

(5) Ammonia strontium chloride reaction: collected 10 mL methanol solution; added ammonia volume to 25 mL to make a methanol solution of ammonia water saturation. Adding 10 drops of 0.01 $mol \cdot L^{-1}$ $SrCl_2 \cdot 6H_2O$ methanol solution and the methanol solution saturated by ammonia respectively into the extract, shook and let it still for 1 h.

(6) Boric acid reaction: added 10 drops of 1% $H_2O_2C_4 \cdot 2H_2O$ solution and 3 mL 2% H_3BO_3 solution.

(7) Sulfuric acid reaction: added 1.5 mL concentrated H_2SO_4, shook it up, and then put it to the boiling water for 5 min.

(8) Alkaline reagent reaction: added 3 mL 5% Na_2CO_3 solution, shook it up and set aside for 30 min hermetically, then ventilated it for 10 min.

(9) The reaction of sodium borohydride: added 8 mg $NaBH_4$ powder and 2 mL 1% hydrochloric acid, shook it up and set aside for 2 h.

UV-visible spectrum analysis

Detection of chloro-phyll in petals. 0.1 g of the petals powder was placed in a tube with plug, extracted it with 90% acetone : ethanol (4 : 1, v/v), then filtered and metered volume to 5 mL. Scanned it in the wavelength ranging from 400 to 700 nm using T6 UV-visible spectrophotometer, with the cuvette of 1 cm light size (Markham, 1982).

Detection of carotenoids in petals. 0.1 g of the petals powder was placed in a tube with plug, extracted it with petroleum ether: acetone (1 : 1, v/v), then filtered and metered volume to 10 mL. Scanned it in the wavelength ranging from 200 to 700 nm using T6 UV-