Effect of Dampening Paper, Silica Gel and Temperature Treatment on Change of Flower Color of Dog-tooth Violet (*Erythronium japonicum* Decne) in Press Flower

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ABSTRACT

We have studied the effects of dampening papers (Dampened paper, Newspaper, Korean paper, Flower sheet), silica gel (30g, 60g) and temperature (20℃, 25℃) on color changes of *Erythronium japonicum*. In the treatment of 20℃, color changes were low in treatments with silica gel rather than in a treatment of dampening papers. In particular, newspaper and Korean paper showed much less changes in colors by the combination treatments with 30g of silica gel. Likewise, in the treatment of 25℃, color changes were low in combination treatments with silica gel rather than in a alone treatment of dampening papers. For the combination treatment with 30g of silica gel, low color changes were shown in the divisions of newspaper and Korean paper, while for the combination treatment with 60g of silica gel, low color changes were shown in the those of Korean paper and dampened paper.

Key words : Dampening paper, *Erythronium japonicum*, flower color, silica gel

INTRODUCTION

Erythronium japonicum is a perennial herb belonging to Liliaceae. It grow naturally in fertile half-shades located in the areas of southern, middle, and northern of Korea, which is forming communities. It makes deep pink flowers open in early spring (March-May), a flower comes out of the stalk, and the flower turns towards the ground. It has two leaves and a little long leafstalk. The borders of the leafstalk are plain and a little bit crumpled, while the surface of it is green with purple spots (Kim, 1996).

Leaves of *Erythronium japonicum* push out the first shoots in early April and the shoots are gathered. The collected shoots are boiled and dried to make them as wild edible greens, scale stems of the plant are fried to eat, or starch of the scale stems used to be extracted. Drying agent of scale stems also used to be utilized as Oriental medical herbs including robustness, and stomach strong.

A recent attempt is being made to pot *Erythronium japonicum*, but the outcome is immaterial yet. Therefore, a mountain hike is the only way of viewing and enjoying the flower. Nevertheless, since the flower has so beautiful shapes and colors, its value as an ornamental plant is so high that it has also enough merit to be developed.

In order to enjoy the flower for a long time, if it is

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developed as dried flower decorations rather than natural flowers, it could get more and more value added.

As scientific civilization has recently been developed, human beings have tried to beautifully change neighboring environment into comfortable living one. In particular, people have tried to develop potted flowers or flower decorations for the purpose of enjoying clean natural environment in their neighborhood (Condon, 1962; Hiller, 1994; Song, 1997). However, decorative natural flowers not only have relatively short preservation period but also can have a bad influence upon household economy due to the huge expenditure caused after the flowers are gone and degraded to environmental wastes. By this, people naturally began to be interested in decoration works of dried flowers with which have a longer preservation period (Blandford, 1991; Song, 1997).

With regard to the dryness of flowers, their shapes and colors are greatly changed depended on sorts of flowers and how to dry them. And different drying ways should be developed for each plant. The reason why is that colors and shapes of dried flowers are linked directly with improvement in quality (Song, 1997).

Most of natural flowers are generally sub-acid and many flowers are easy to discolor because moisture within their cells combines with enzyme and protein to destroy coloring matters (Song, 1997).

Therefore, hows to remove moisture, which is a reactant on color destruction, are introduced: how to treat silica gel (Hiller and Hilton 1986; Son,1994b; Park *et al.*, 1998a, 1998b; Song and Kim, 2002), how to process dampening papers (Song *et al.*, 1998a, 1998b; Song and Kim 2002), the method of heating treatment (Son, 1994a; Park *et al.*, 1998a), and the use of iron heat. Especially, reports were released about the conclusions that kinds of drying materials (Song *et al.*, 1998a, 1998b; Park *et al.*,1998b) and different mean particle sizes of silica gel affect the dryness of plants (Son, 1994a; Park *et al.*, 1998a) and pH influences the variation of flower colors (Im *et al.*, 2003).

The most important part in the process of making dried flowers is the drying and processing of plants, which is the most crucial factor for fixing the qualities of dried flower goods.

And, this study tried to examine the effects of how much dampening papers, silica gel, and temperature treatment have on the change of flower colors, which all of the three elements are influential to plant drying.

MATERIALS AND METHODS

Materials

Utilized materials are deep pink *Erythronium japonicum* naturally grown in the Mt. Jogye of Korea. For gathering bloomed flowers, moisture and dust are removed from the surfaces of their petals. We measured the same part of them as much as possible for preventing color contents from being changed and the size of the measurement we took was 1.5×1.5cm (length and breadth).

Temperature and drying agent treatment

For temperature treatment, we adopted a incubator to divide temperature for treatment into 20℃ and 25℃. Three methods of treatments were used: a alone treatment of dampening papers, combination treatment of dampening papers and 30g of silica gel, and combination treatment of dampening papers and 60g of silica gel. Each division of treatment was put into the incubator for the examination of color change.

Processing of dampening papers

Four kinds of papers were used for drying: dampened paper, newspaper, Korean paper, and flower sheet. We tried to modulate the weights of the papers in each fixed 50g and the sizes of them in 1/2 of normal newspaper.

The experimental papers were ironed out until moisture with them has been completely removed. And each 50 g of papers was used to treat on the top and in

the bottom centering around petals.

The other papers except for newspaper were paid to get in the market. Decompression and drying after sealing up were made for keeping air from being contacted (Song and Kim, 2002).

Mixture of dampening papers and drying materials

For using drying materials, white silica gel added 1/2 of blue silica gel was used and each 30 g and 60 g were used for treatment. For combination dampening papers with drying materials, the decompression and drying method adopted by Song and Kim (2002) was applied.

How to measure changes of flower colors

For the measurement of flower colors changes, we completely removed moisture and dust on the petal surfaces and then tried to measure the changes six times at intervals of two days by using the Colorimeter (Model No. Jk-777, Juki company, Japan). Repeated treatments of the total of ten times were replicated.

The value automatically calculated by the Colorimeter Analytical System was applied for the measurement figures of L*a*b* and the value of $\Delta^*(ab)[=\sqrt{(\Delta L^*)^2+(\Delta a)^2+(\Delta b)^2}]$ was compared for the final analysis.

And, for the treatments of 20℃ and 25℃, the values got from a alone treatment of dampening papers and combination treatments of the papers and silica gel (30g, 60g) were compared and analyzed.

As the result of the analysis of Δ*(ab) color figures, we could find out that the less Δ*(ab) was, the less color changes were.

RESULTS AND DISCUSSION

Effects of the treatment of dampening in the temperature of 20℃

Effects of the independent treatment of dampening papers in the condition of 20℃ are as follows (Table 1): for dampened papers, the value of Δ*(ab) was 15.80 on the second day from the treatment being taken, which the figure indicated that the flower color was close to its original color. As time went by, drying was progressed and the original color was inclined to disappear gradually. However, such a subtle change in colors was invisible to the naked eye. For newspapers, the value of Δ*(ab) was 16.98 on the second day and 16.00 on the sixth day, which the figures meant that the flower color was close to its original color. And the value of Δ*(ab) was 17.28 on the eighth day, which represented the gradual disappearance from the original color. But the difference was so small to the naked eye and as drying time went by, the color showed a tendency to return to the original one. For Korean papers, the value of Δ*(ab) was 15.93 on the second day and 15.10 on the sixth day, which indicated that the flower color after the treatment was close to the original color. Since the eighth day, obvious changes in color have appeared to the naked eye. For flower sheets, the value of Δ*(ab) was 15.93 on the second day and a slight color change was shown until the sixth day. As drying time went by, the color showed a tendency to go away from the original color. (Table 1)

Based upon the results mentioned above, for the changes of flower colors in the temperature of 20℃, the sixth day from the treatment showed the least color change in the dry state and the orders of color changes by papers were Korean paper, flower sheet, newspaper, and dampened paper.

According to the report by Song and Kim (2002), in drying of gentian flowers, the minimum change in color was made on the sixth day and changes of the flower colors were so great depended on sorts of papers. These conclusions were the same as those from this study and they were similar to the studies of rose (Song *et al.*, 1998a) and petunia (Song *et al.*, 1998b). So, we can guess that both dampening papers and temperature have

Table 1. Effect of dampening papers on the change of flower color in *Erythronium japonicum* at 20℃ condion

Days of treatment	Value of color	Dampened paper	Newspaper	Korean paper	Flower sheet
0	L*[z]	41.95	43.35	42.11	43.30
	a*[y]	24.48	22.36	22.79	22.29
	b*[x]	-18.95	-17.61	-17.56	-17.67
2	L*	32.27	30.58	31.42	34.03
	a*	11.99	11.18	10.98	9.35
	b*	-18.85	-17.39	-17.47	-16.97
	ΔL*	-9.68	-12.77	-10.69	-9.27
	Δa*	-12.49	-11.18	-11.81	-12.94
	Δb*	0.10	0.22	0.09	0.70
	ΔE*(ab)[w]	15.80	16.98	15.93	15.93
4	L*	31.77	32.05	32.31	33.15
	a*	11.56	10.75	10.92	10.21
	b*	-18.70	-17.47	-18.08	-17.43
	ΔL*	-10.18	-11.30	-9.80	-10.15
	Δa*	-12.92	-11.61	-11.87	-12.08
	Δb*	0.25	0.14	-0.52	0.24
	ΔE*(ab)	16.45	16.21	15.40	15.78
6	L*	31.26	32.24	32.86	33.93
	a*	11.54	10.88	10.99	10.02
	b*	-19.52	-18.53	-18.51	-18.01
	ΔL*	-10.69	-11.11	-9.25	-9.37
	Δa*	-12.94	-11.48	-11.89	-12.27
	Δb*	-0.57	-0.92	-0.95	-0.34
	ΔE*(ab)	16.79	16.00	15.10	15.44
8	L*	31.26	31.04	32.10	33.27
	a*	11.20	10.24	10.03	9.50
	b*	-18.40	-17.41	-17.98	-17.46
	ΔL*	-10.69	-12.31	-10.01	-10.03
	Δa*	-13.28	-12.12	-12.76	-12.79
	Δb*	0.48	0.20	-0.42	0.21
	ΔE*(ab)	17.05	17.28	16.22	16.25
12	L*	31.29	32.09	32.33	32.45
	a*	10.82	10.44	9.88	9.74
	b*	-18.91	-17.57	-17.95	-17.90
	ΔL*	-10.66	-11.26	-9.78	-10.85
	Δa*	-13.66	-11.92	-12.91	-12.55
	Δb*	0.04	0.12	-0.39	-0.23
	ΔE*(ab)	17.32	16.40	16.20	16.59

[z]L* : Lightness

[y]a*, [x]b* : Chromaticity coordinates

(a* : Red direction, -a* : Green direction, b* : Yellow direction, -b* : Blue direction)

[w]$\Delta E^*(ab)\ [=\sqrt{(\Delta L^*)^2+(\Delta a^*)^2+(\Delta b^*)^2}]$

influences on flower drying (Son, 1994b).

Effects of the combination treatments of dampening papers and silica gel in the condition of 20℃

In the case of a combination treatment of dampening papers and 30g of silica gel in the temperature of 20℃ (Table 2), for dampened papers, the value of Δ*(ab) was 13.21 on the second day and 13.78 on the fourth day, which the two figures indicated no change in the flower color. The sixth day showed the best drying state and even no difference in color change to the naked eye. For newspapers, the value of Δ*(ab) was 13.16 on the second day, 13.74 on the fourth day, and 13.82 on the sixth day, which meant so insignificant changes in colors. For Korean papers, the value of Δ*(ab) was 15.77 the second day and 14.55 on the sixth day. The two values represented a little changes in colors but similarity to the original color. And for flower sheets, the value of Δ*(ab) was 15.66 on the second day and 16.25 on the sixth, which showed color changes more than the other papers. (Table 2)

Considering the results above, we can see that in the combination treatment of dampening papers and 30g of silica gel in 20°C, the flower color showed the most changes in Korean paper and flower sheet. Above all, the greatest color change was made in flower sheet different from the result of the alone treatment of dampening papers.

In the case of a combination treatment of dampening papers and 60 g of silica gel in the temperature of 20℃ (Table 3), for dampened papers, the value of Δ*(ab) was 16.05 on the second day and 15.65 on the sixth day, which the figure of the sixth day indicated the closest to the original color. For newspapers, the value of Δ*(ab) was 16.53 on the second day, 15.50 on the sixth day, and 15.53 on the twelfth day, which indicated the fact that the more treatment days were, the more color changes were, but the changes were invisible to the naked eye. For Korean papers, the value of Δ*(ab) was 16.53 on the second day, 15.50 on the sixth day, and 16.11 on the eighth day. The sixth day showed the least color change but the differences were difficult to tell to the naked eye. And for flower sheets, the value of Δ*(ab) was 17.55 on the second day, which represented a relatively greater change than those of the other papers. This phenomenon was the same in the condition of the extended treatment periods. (Table 3)

Considering the results above, we can see that in the combination treatment of dampening papers and 60g of silica gel in 20℃, the best outcomes were shown in the divisions of Korean paper and newspaper. The greatest color change was made in the flower sheet.

In other words, we can get the conclusion that no silica gel treatment for the flower sheet is more effective for reducing color changes as much as possible.

Overall, in the temperature of 20℃, the effects of how much silica gel was added were different according to the sorts of papers. As a whole, the best outcomes were shown in the treatments of newspaper and Korean paper with low color changes.

It is estimated that for the plane drying of *Erythronium japonicum*, a combination treatment of papers and silica gel was the most effective to keep the flower color from being changed. This conclusion was similar to the reports of which the addition of silica gel for rose drying was effective to the prevention of color changes (Park *et al.*, 1998a) and of which color changes varied according to different sizes of silica gel's mean particles (Son, 1994a).

Effects of the treatment of dampening papers in the condition of 25℃

In the case of an independent treatment of dampening papers in the temperature of 25℃ (Table 4), for dampened papers, no color change was made until the sixth day from the treatment. The value of Δ*(ab) slightly rose to 17.84 on the eighth day and since then,

Table 2. Effect of dampening papers with silica gel 30g on the change of flower color in *Erythronium japonicum* at 20℃ condion

Days of treatment	Value of color	Dampened paper	Newspaper	Korean paper	Flower sheet
0	L*[z]	44.91	44.91	42.01	41.61
	a*[y]	20.05	20.05	24.25	24.52
	b*[x]	-16.42	-16.42	-18.54	-18.77
2	L*	36.73	36.73	32.75	33.16
	a*	9.75	9.75	11.43	11.35
	b*	-16.04	-16.04	-18.59	-18.34
	⊿L*	-8.18	-8.18	-9.26	-8.45
	⊿a*	-10.30	-10.30	-12.85	-13.17
	⊿b*	0.38	0.38	-0.05	0.43
	⊿E*(ab)[w]	13.16	13.16	15.77	15.66
4	L*	36.06	36.06	35.25	34.41
	a*	9.55	9.55	11.13	10.11
	b*	-16.33	-16.33	-18.52	-17.23
	⊿L*	-8.85	-8.85	-6.76	-7.20
	⊿a*	-10.50	-10.50	-13.12	-14.41
	⊿b*	0.09	0.09	0.02	1.54
	⊿E*(ab)	13.74	13.74	14.71	16.20
6	L*	35.88	35.88	34.63	33.14
	a*	9.84	9.84	11.55	10.67
	b*	-16.73	-16.73	-18.93	-18.28
	⊿L*	-9.03	-9.03	-7.38	-8.47
	⊿a*	-10.21	-10.21	-12.7	-13.85
	⊿b*	-0.03	-0.03	-0.39	0.49
	⊿E*(ab)	13.63	13.63	14.65	16.25
8	L*	36.40	36.40	34.23	32.10
	a*	9.07	9.07	11.01	10.20
	b*	-16.44	-16.44	-18.93	-18.07
	⊿L*	-8.51	-8.51	-7.78	-9.51
	⊿a*	-10.98	-10.98	-13.24	-14.32
	⊿b*	-0.02	-0.02	-0.39	0.70
	⊿E*(ab)	13.89	13.89	15.32	17.21
12	L*	32.92	37.06	35.59	33.74
	a*	11.06	9.10	11.05	10.62
	b*	-18.84	-16.30	-18.62	-18.16
	⊿L*	-11.99	-7.85	-6.42	-7.87
	⊿a*	-8.99	-10.95	-13.20	-13.90
	⊿b*	-2.42	0.04	-0.08	0.61
	⊿E*(ab)	15.19	13.47	14.63	15.99

[z]L* : Lightness

[y]a*, [x]b* : Chromaticity coordinates

(a* : Red direction, -a* : Green direction, b* : Yellow direction, -b* : Blue direction)

[w]$\Delta E^*(ab)\ [=\sqrt{(\Delta L^*)^2+(\Delta a^*)^2+(\Delta b^*)^2}]$

Table 3. Effect of dampening papers with silica gel 60g on the change of flower color in *Erythronium japonicum* at 20℃ condion.

Days of treatment	Value of color	Dampened paper	Newspaper	Korean paper	Flower sheet
0	L*[z]	44.07	47.57	44.08	41.78
	a*[y]	21.27	20.06	25.30	24.52
	b*[x]	-17.27	-15.71	-18.05	-18.96
2	L*	32.81	36.46	32.88	31.22
	a*	9.83	8.58	12.30	10.52
	b*	-17.27	-15.36	-18.21	-18.23
	⊿L*	-11.26	-11.11	-11.20	-10.56
	⊿a*	-11.44	-11.48	-13.00	-14.00
	⊿b*	0	0.35	-0.16	0.73
	⊿E*(ab)[w]	16.05	15.98	16.53	17.55
4	L*	33.04	36.13	35.22	32.58
	a*	9.72	7.91	12.25	10.38
	b*	-17.70	-17.73	-18.30	-17.94
	⊿L*	-11.03	-11.44	-8.86	-9.20
	⊿a*	-11.55	-12.15	-13.05	-14.14
	⊿b*	-0.43	-2.02	-0.25	1.02
	⊿E*(ab)	15.98	16.81	15.24	16.90
6	L*	33.71	37.31	34.41	32.07
	a*	9.55	8.88	12.35	11.03
	b*	-17.75	-16.11	-18.52	-18.47
	⊿L*	-10.36	-10.26	-9.67	-9.71
	⊿a*	-11.72	-11.18	-12.95	-13.49
	⊿b*	-0.48	-0.40	-0.47	0.49
	⊿E*(ab)	15.65	15.18	15.50	16.63
8	L*	33.00	37.55	34.38	31.56
	a*	9.08	8.75	11.74	9.82
	b*	-17.72	-16.48	-18.39	-18.06
	⊿L*	-11.07	-10.02	-9.70	-10.22
	⊿a*	-12.19	-11.31	-13.56	-14.70
	⊿b*	-0.45	-0.77	-0.34	0.90
	⊿E*(ab)	16.47	15.12	16.11	17.93
12	L*	33.85	37.10	34.76	31.44
	a*	9.34	8.61	12.24	10.65
	b*	-17.65	-16.32	-18.67	-18.33
	⊿L*	-10.22	-10.47	-9.32	-9.34
	⊿a*	-11.93	-11.45	-13.06	-13.87
	⊿b*	-0.38	-0.61	-0.62	0.63
	⊿E*(ab)	15.71	15.53	15.50	16.73

[z]L* : Lightness

[y]a*, [x]b* : Chromaticity coordinates

(a* : Red direction, -a* : Green direction, b* : Yellow direction, -b* : Blue direction)

[w]$\Delta E^*(ab)\ [=\sqrt{(\Delta L^*)^2+(\Delta a^*)^2+(\Delta b^*)^2}]$

no difference in the value was shown again. For newspapers, the value of Δ*(ab) was 16.36 on the second day, the value was reduced to 15.49 on the sixth day, and it greatly rose to 16.72 on the eighth day. Since then, so slight a difference has been made and even the differences were invisible to the naked eye. For Korean papers, the value of Δ*(ab) was 15.42 on the second day, whose color was close to the original one. Then, the values rose to 15.61 on the sixth day and 17.40 on the eighth day, which the changes were so visible that the changed colors were distant from their original one. But a return close to the original color was shown on the twelfth day again. (Table 4)

Considering the results above, in the treatment of dampening papers in 25℃, the orders of color changes were newspaper, flower sheet, dampened paper, and Korean paper. And Korean paper showed the biggest gap in color changes from the original color and as time went by, the gap was greater. Then, the value of Δ*(ab) was reduced on the last twelfth day.

Effects of the combination treatment of dampening papers and silica gel in the 25℃

In the case of the combination treatment of dampening papers and 30g of silica gel in the temperature of 25℃ (Table 5), for dampened papers, the value of Δ*(ab) was 16.81 on the second day, 16.48 on the fourth day, and 16.36 on the sixth day, which the figures were close to the original color. For newspapers, the value of Δ*(ab) a little varied to 13.32 on the second day but on the whole, there was no change visible to the naked eye. For Korean papers, the value of Δ*(ab) was 14.00 on the second day and it fell to 13.30 on the fourth day, whose color was close to the original one. Then, the value rose to 14.87 on the eighth day (distant from the original color). Since then, a return close to the original color was shown. For flower sheets, the value of Δ*(ab) was 16.66 on the second day, 16.33 on the fourth day, and 16.29 on the sixth, which there were relatively insignificant changes. The change was greater on the tenth day and then reduced again on the twelfth day. (Table 5)

Based upon the results above, we can find out that in the combination treatment of dampening papers and 30 g of silica gel in 25℃, the orders of color changes were newspaper, Korean paper, flower sheet, and dampened paper and there were huge differences in the changes. Above all, newspaper and Korean paper showed the smallest gap in color changes from the original color.

In the case of the combination treatment of dampening papers and 60g of silica gel in the temperature of 25℃ (Table 6), for dampened papers, the value of Δ*(ab) was 14.46 on the second day, slightly rose on the fourth day, and reduced to 13.96 on the sixth day, which the figures were close to the original color and color changes were distinguished to the naked eye. However, the value rose to 15.28 on the eighth day, whose difference was great. Since then, the value fell close to the original color.

For newspapers, the value of Δ*(ab) was 16.14 on the second day and was almost the same until the eight day. But the value rose to 17.62 on the tenth day, which there was a difference visible to the naked eye. Since then, a return close to the original color was shown. For Korean papers, the value of Δ*(ab) was 15.33 on the second day and it slowly fell to 14.47 on the sixth day, whose colors were close to the original one. Since the eighth day, a gradual return close to the original color was shown. And for flower sheets, the value of Δ*(ab) was 16.77 on the second day, whose color was the most different from the original one. But the value reduced to 14.38 on the fourth day and the changed color had a tendency to return close to the original one. (Table 6)

Considering these results, we can see that in the combination treatment of moisture absorption papers and 60g of silica gel in 25℃, there were less changes in colors for dampened, Korean, and flower sheets while greater change for newspapers.

Table 4. Effect of dampening papers on the change of flower color in *Erythronium japonicum* at 25℃ condion.

Days of treatment	Value of color	Dampened paper	Newspaper	Korean paper	Flower sheet
0	L*[z]	41.82	45.20	41.62	40.55
	a*[y]	24.22	20.38	24.18	23.97
	b*[x]	-19.00	-16.67	-18.53	-18.75
2	L*	31.42	33.66	30.99	32.38
	a*	10.45	8.78	9.63	10.90
	b*	-18.49	-16.33	-17.91	-18.30
	⊿L*	-10.40	-11.54	-10.64	-8.17
	⊿a*	-13.77	-11.60	-14.55	-13.07
	⊿b*	0.51	0.34	0.62	0.45
	⊿E*(ab)[w]	17.26	16.36	18.03	15.42
4	L*	32.87	34.60	30.95	31.21
	a*	10.05	8.36	9.49	10.76
	b*	-18.55	-16.48	-18.10	-18.43
	⊿L*	-8.75	-10.60	-10.67	-9.34
	⊿a*	-14.17	-12.02	-14.69	-13.21
	⊿b*	0.45	0.19	0.43	0.32
	⊿E*(ab)	16.76	16.02	18.16	16.18
6	L*	33.22	35.52	30.31	31.89
	a*	9.84	8.40	9.43	10.98
	b*	-18.38	-16.28	-18.71	-18.80
	⊿L*	-8.87	-9.68	-11.31	-8.66
	⊿a*	-14.33	-11.98	-14.75	-12.99
	⊿b*	0.17	0.39	-0.18	0.32
	⊿E*(ab)	16.85	15.49	18.59	15.61
8	L*	32.43	34.49	29.93	29.64
	a*	9.05	7.54	8.72	10.42
	b*	-18.61	-16.37	-18.25	-18.82
	⊿L*	-9.39	-10.71	-11.69	-10.91
	⊿a*	-15.17	-12.84	-15.46	-13.55
	⊿b*	0.39	-0.04	0.28	-0.07
	⊿E*(ab)	17.84	16.72	19.38	17.40
12	L*	32.28	35.26	31.00	30.51
	a*	9.39	8.24	8.92	10.86
	b*	-18.72	-16.66	-18.69	-18.75
	⊿L*	-9.54	-9.94	-10.62	-10.04
	⊿a*	-14.83	-12.14	-15.26	-13.11
	⊿b*	0.28	0.01	-0.16	0
	⊿E*(ab)	17.63	15.69	18.59	16.51

[z]L* : Lightness

[y]a*, [x]b* : Chromaticity coordinates

(a* : Red direction, -a* : Green direction, b* : Yellow direction, -b* : Blue direction)

[w]$\Delta E^*(ab)\ [=\sqrt{(\Delta L^*)^2+(\Delta a^*)^2+(\Delta b^*)^2}]$

Table 5. Effect of dampening papers with silica gel 30g on the change of flower color in *Erythronium japonicum* at 25℃ condion

Days of treatment	Value of color	Dampened paper	Newspaper	Korean paper	Flower sheet
0	L*[z]	40.50	45.99	45.02	39.13
	a*[y]	25.77	19.21	19.92	26.32
	b*[x]	-19.43	-16.05	-16.11	-18.45
2	L*	32.07	37.74	37.76	30.73
	a*	11.25	8.76	7.96	11.94
	b*	-18.42	-16.35	-15.59	-18.01
	⊿L*	-8.43	-8.25	-7.26	-8.40
	⊿a*	-14.52	-10.45	-11.96	-14.38
	⊿b*	1.01	-0.30	0.52	0.44
	⊿E*(ab)[w]	16.81	13.32	14.00	16.66
4	L*	32.82	36.87	38.34	31.15
	a*	11.22	8.85	8.42	12.09
	b*	-18.34	-16.68	-16.02	-17.81
	⊿L*	-7.68	-9.12	-6.68	-7.98
	⊿a*	-14.55	-10.36	-11.50	-14.23
	⊿b*	1.09	-0.63	0.09	0.64
	⊿E*(ab)	16.48	13.81	13.30	16.33
6	L*	33.22	37.49	37.89	31.04
	a*	9.84	8.99	8.27	12.19
	b*	-18.38	-16.60	-16.04	-18.11
	⊿L*	-7.28	-8.50	-7.13	-8.09
	⊿a*	-14.62	-9.22	-11.65	-14.13
	⊿b*	1.05	-0.55	0.07	0.34
	⊿E*(ab)	16.36	13.30	13.66	16.29
8	L*	31.25	38.20	36.21	30.03
	a*	10.32	8.58	7.95	11.17
	b*	-18.68	-16.72	-16.73	-17.95
	⊿L*	-9.25	-8.62	-8.81	-9.10
	⊿a*	-15.45	-10.63	-11.97	-15.15
	⊿b*	0.75	-0.67	-0.62	0.50
	⊿E*(ab)	18.02	13.20	14.87	17.68
12	L*	32.83	37.81	37.94	31.06
	a*	10.59	8.39	7.92	11.97
	b*	-18.50	-16.53	-16.25	18.06
	⊿L*	-7.67	-8.18	-7.08	-8.07
	⊿a*	-15.18	-10.82	-12.00	-14.35
	⊿b*	0.93	-0.48	-0.14	0.39
	⊿E*(ab)	17.03	13.57	13.93	16.47

[z]L* : Lightness

[y]a*, [x]b* : Chromaticity coordinates

(a* : Red direction, -a* : Green direction, b* : Yellow direction, -b* : Blue direction)

[w]$\Delta E^*(ab)\ [=\sqrt{(\Delta L^*)^2+(\Delta a^*)^2+(\Delta b^*)^2}]$

Table 6. Effect of dampening papers with silica gel 60g on the change of flower color in *Erythronium japonicum* at 25℃ condion.

Days of treatment	Value of color	Dampened paper	Newspaper	Korean paper	Flower sheet
0	L*[z]	45.52	42.18	45.24	43.87
	a*[y]	21.21	23.42	23.02	22.48
	b*[x]	-17.23	-18.42	-17.62	-17.16
2	L*	36.46	33.45	36.49	32.44
	a*	9.96	9.86	10.44	10.24
	b*	-17.81	-17.84	-17.13	-18.06
	⊿L*	-9.06	-8.73	-8.75	-11.43
	⊿a*	-11.25	-13.56	-12.58	-12.24
	⊿b*	-0.58	0.59	0.49	-0.90
	⊿E*(ab)[w]	14.46	16.14	15.33	16.77
4	L*	35.30	32.01	36.58	35.57
	a*	10.22	9.81	10.62	10.79
	b*	-18.43	-18.23	-17.55	-18.40
	⊿L*	-10.22	-10.17	-8.66	-8.30
	⊿a*	-10.99	-13.61	-12.40	-11.69
	⊿b*	-1.21	0.19	0.07	-1.24
	⊿E*(ab)	15.06	16.99	15.12	14.38
6	L*	36.81	32.99	37.10	34.74
	a*	10.39	9.98	10.73	10.80
	b*	-18.57	-18.41	-17.66	-18.46
	⊿L*	-8.71	-9.19	-8.14	-8.30
	⊿a*	-10.82	-13.44	-12.29	-11.68
	⊿b*	-1.34	0.01	-0.04	-1.24
	⊿E*(ab)	13.96	16.28	14.74	14.88
8	L*	35.44	32.71	37.12	35.44
	a*	9.84	9.37	10.01	10.28
	b*	-18.79	-18.31	-17.69	-18.59
	⊿L*	-10.08	-10.75	-8.12	-8.43
	⊿a*	-11.37	-14.05	-13.01	-12.20
	⊿b*	1.56	0.11	-0.07	-1.43
	⊿E*(ab)	15.28	16.95	15.33	14.89
12	L*	36.54	33.08	36.86	35.27
	a*	9.93	9.76	10.40	10.82
	b*	-18.61	-18.37	-17.69	-18.55
	⊿L*	-8.98	-9.10	-8.38	-8.60
	⊿a*	-11.28	-13.66	-12.62	-11.66
	⊿b*	-1.38	0.05	-0.07	-0.49
	⊿E*(ab)	14.48	16.42	15.15	14.553

[z]L* : Lightness

[y]a*, [x]b* : Chromaticity coordinates

(a* : Red direction, -a* : Green direction, b* : Yellow direction, -b* : Blue direction)

[w]$\Delta E^*(ab)\ [=\sqrt{(\Delta L^*)^2+(\Delta a^*)^2+(\Delta b^*)^2}]$

On the whole, the divisions of the combination treatments of silica gel showed less changes in flower colors and the relations between the addition amount of silica gel and dampening papers were different according to temperature conditions.

Son (1994b) reported the conclusions that the addition of silica gel was effective to keep the flower color from being changed in the flower drying and temperature was also influential to the changes. These conclusions were similar to the report of the drying experiment of Hibiscus syriacus conducted by Park *et al.* (1998b). Many reports including this paper have the same conclusions.

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