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Research Article

Post-Harvest Life of Tinted Single and Bicolored Rose Variety Ice Breaker as Influenced by Dye Concentration

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Abstract

Rose is one of the cut flowers of higher demand both in the domestic and international market. It comes in a variety of single colors however bicolor and multicolor roses are not common. The study aimed at evaluating the effects of different dyes and their concentrations on post-harvest life of tinted single and bicolored rose variety Ice breaker. The experiment consisted of the control, 3 dyes (blue, green and orange) each at 15g and 30g to obtain the single color, and orange and blue colors in the ratio of 1: 1 (30:30) and 2:1(30:15) to obtain the bicolor, replicated 3 times. The flowers were allowed to stand in the dye solution for a period of 24 hours. The absorption of blue dye solution at 15g was higher compared to the orange and green dye solutions and their concentrations. Flowers treated with orange and blue dyes in the ratio of 2:1 absorbed more dye than those treated with the same dyes at the ratio of 1:1. After tinting, the flowers were placed in the preservative solution containing sucrose and citric acid to determine the quality and vase life. High concentration of dye limited petal expansion and tinted flowers treated with 30g of each of the dyes used recorded lower flower diameter and petal fresh weight than those treated with 15g of the dyes. Vase life was also shortened by high dye concentration to 6 days compared to 9 days for those treated with low dye concentration. Bicolored flowers recorded shorter vase life than the control and those treated with 15g of each of the dyes. Bicolored flowers treated with orange and blue dyes in the ratio of 2:1 exhibited longer vase life and petal fresh weight than those treated with the same dyes in the ratio of 1:1. Though bicolored flowers had a shorter vase life they can be very attractive in decorations and floral arrangements.

Keywords: Dye concentration, vase life, tinting, Rose, Bicolor

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Introduction

The success of flower industry is dependent upon the efficiency of strengthening the fresh flower market through value addition. The techniques of value addition like coloring of white flowers, dehydration of flowers, flower processing and recent advances in flower arrangement can add value upto 5 to 10 times [1]. Cut roses have high economic value in the agro-based industries such as cosmetics, perfumery and also play important roles in medicine and nutrition [2]. Cut rose come in different colors ranging from white, red, pink, yellow, orange, among others. Color is one of the prime considerations for purchasing cut flowers [3] and it is very sensitive to human emotions and affects a lot of psychological phenomena. White rose varieties are very common and they symbolize purity, chastity and innocence. Orange, is a bright and energetic color that signify passion and energy. Blue roses cannot be achieved naturally and so they represent the unattainable or the mysterious that makes it a way to tell someone that they're unique and extraordinary. In order to obtain different shades of desired color either singly or in combination after harvesting, artificial coloring can be done. For instance, blue roses can be obtained by tinting white roses. Tinting is one of the important value addition techniques for imparting different shades of colors to flowers where the desired pigment is either absent or light or dull. Tinting enhances the aesthetic value of fresh flowers and makes the flower arrangement and stage decorations more attractive in fresh and dry cut flowers [4].

Food coloring dyes, organic in nature, have been used in tinting of flowers [4, 5] due to their non-toxic nature and biodegradability [6]. Tinting can be done by either dipping of flower heads in the dye solution e.g. in daisies or by stem absorption e.g. in carnations, gerberas, tuberose, roses, gladiolus [7-10]. Stem absorption is commonly used due to good color retention [11].

Naturally bicolored or multicolored roses are also not very common and can only be obtained by tinting [4]. Bicolored roses in flower arrangements can look much more attractive and novel. The study aimed at evaluating the effects of different dyes and their concentrations on post-harvest life of tinted single and bicolored rose variety Ice breaker.

Materials and Method
Experimental site

The study was carried out in the laboratory of the Department of Agricultural Biosystems, Economics and Horticulture at the University of Kabianga in Kericho. The cut rose variety Ice breaker harvested at stage 2.5-3 (when 2-3 outer petals have opened and there is an opening at the heart of the bud) was obtained from Harvest flower farm in Athi river, Kenya. The stems were recut and reconditioned by dipping them in distilled water for four hours before applying the treatments.

Experimental procedure

The stems were dipped in food dyes (orange, blue and green) dissolved in 100ml of distilled water. The treatments consisted of the control (untreated with dye), orange, blue and green dyes each at 15g and 30g to obtain single colors, orange and blue dyes in the ratio of 1:1 and 2:1 to obtain bicolor. To obtain the bicolor the basal ends were cut and divided along the length wise for up to 1.5cm then dipped in two different containers carrying the different color solutions as shown in **Figure 1**. The stems were allowed to absorb the dye solution under ambient conditions for a period of 24hours and thereafter removed and placed in a vase solution containing 4% sucrose and 0.35g citric acid dissolved in 300ml of distilled water. Each treatment consisted of 3 flower stems. The experiment was laid out in a Completely Randomized Design with three replications.

Figure 1 Flower stems dipped in orange and blue dye solutions in the ratio of 1:1 to obtain bicolor

Data collection

Quantity of dye uptake (ml/stem), water uptake (ml/stem), flower diameter (cm), vase life (day) and flower length (cm) and fresh weight (g) were recorded. The fresh weight of flowers was measured using a weighing balance. Water and dye uptake was measured using a measuring cylinder. Flower length and diameter were measured using calipers. Vase life was based on wilting/drying of the petals and bent neck. The data was collected at an interval of 2 days.

Data analysis

The data was analysed using GENSTAT Statistical package. Least significance difference (LSD) was used to separate the means at 5% probability level.

Results and Discussions
Solution uptake

The absorption of blue dye solution at 15g was higher compared to the other dye solutions and their concentrations. The uptake of blue dye solution at 30g and orange and green dye solutions at 15g were statistically similar and higher than orange and green dyes at 30g (**Figure 2a**). The uptake of orange and blue dye solutions in the ratio of 1:1 was significantly lower than that in the ratio of 2:1 **(Figure 2b)**. No significant difference was noted in the uptake of the two dyes though the uptake of orange color was more and color of the petals more intense than the blue color in flowers treated with the orange and blue dye solutions in the ratio of 2:1 **(Figure 2c)**. There was increased flower color intensity with increased dye concentration since more dye was available to the flowers for absorption **(Figure 2c)**. Similar findings were recorded in tuberose cultivars [10, 12-14]. Moreover, 24hour period of standing in the dye solution allowed more dye to be translocated to the petals.

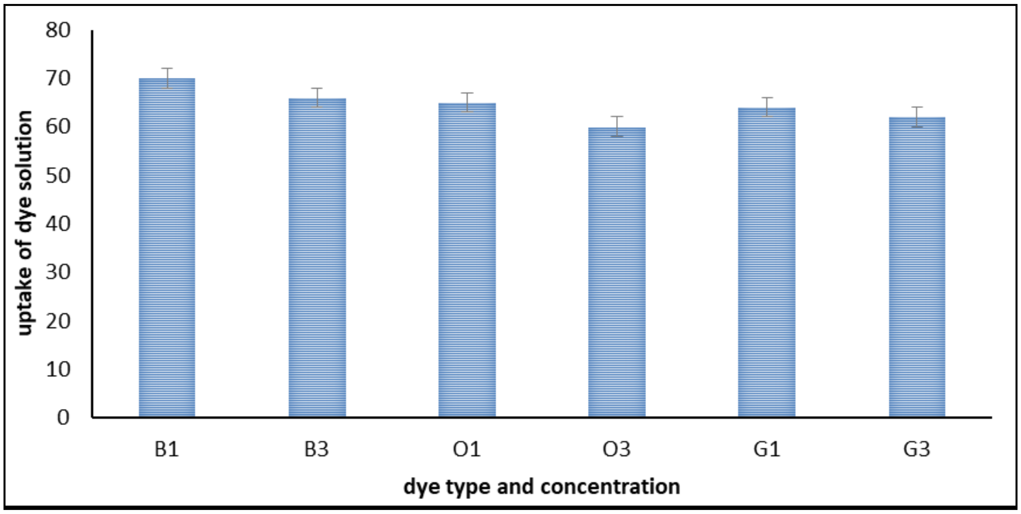

Figure 2a Uptake of blue, orange and green dye solutions by cut rose variety ice breaker. B(Blue) O(Orange), G(Green), 1(15g), 3(30g) of dye

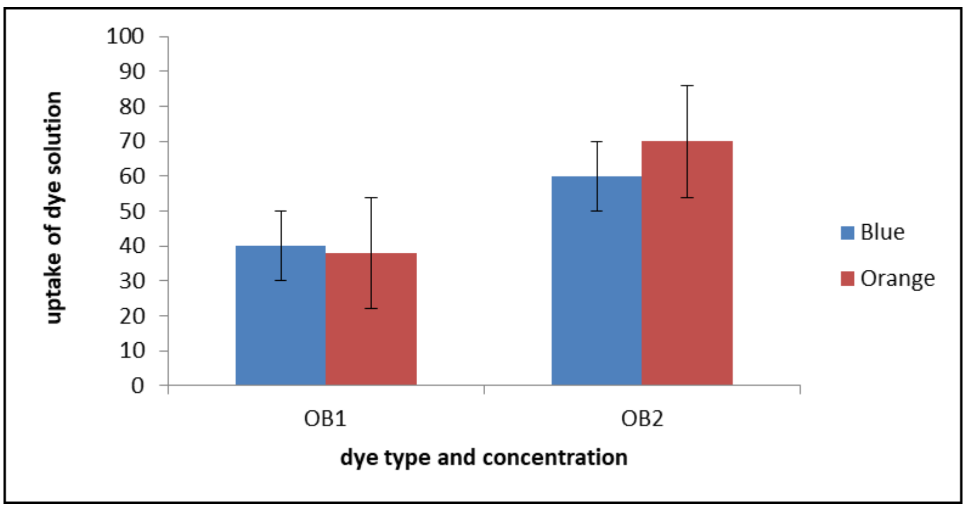

Figure 2b Uptake of orange and blue dye solution in the ratio of 1:1 and 2:1 by cut rose variety ice breaker. OB1(Orange and blue dye in the ratio of 1:1), OB2(Orange and blue dye in the ratio of 2:1)

Figure 2c Absorption of blue dye solution at 15g (left), 30g (middle). On the right flowers treated with orange and blue dyes in the ratio of 2:1 standing in preservative solution.

Water uptake

Water uptake was high in flowers treated with lower concentration of each of the dyes used and the control compared to those treated with high dye concentrations. Among the days, maximum water uptake was noted on the 4th day followed by a decrease on day 6 (**Figure 3**). Blue dye treated flowers and the control recorded higher water uptake than the other treatments on day 4. However, on day 6, the control recorded maximum water uptake than the other treatments **(Figure 3)**. Similar findings were reported by Bijay [7] and Ranchana [8]. The rate of water uptake and water loss determines the turgidity of the plant and flowers [15]. Water uptake from the vase solution maintains a better water balance and freshness of flowers and also prevents early wilting resulting in increases in vase life [16, 17]. Reduced water uptake was high in flower stems treated with high dye concentration though no significant difference was noticed (**Figure 3**). In addition, these flowers also showed early wilting of the petals and the leaves as was also observed in bicolored flowers. This could have been due to loss of membrane integrity as a result of loss of turgor pressure of cells.

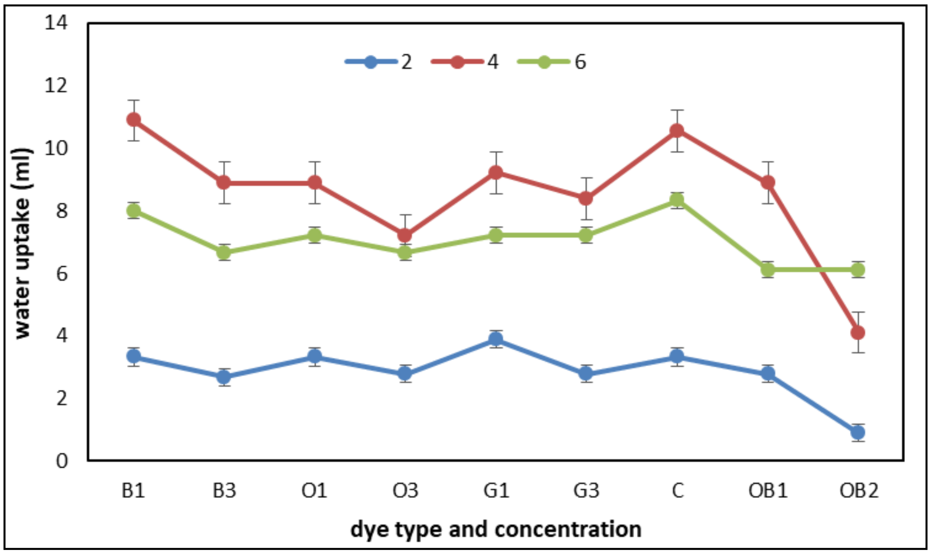

Figure 3 Water uptake as influenced by dye type and its concentration. B(Blue) O(Orange), G(Green), 1(15g), 3(30g), OB1(Orange and blue dye in the ratio of 1:1), OB2(Orange and blue dye in the ratio of 2:1) and C(Control)

Flower diameter

Flowers treated with 15g of blue and orange dyes exhibited significantly higher diameter than the other treatments irrespective of the dye color type on day 2 (**Table 1**). On days 4 and 6, flowers treated with high concentration of orange and blue dyes exhibited significantly lower diameter than those treated with lower concentration of the same dyes **(Table 1).** Flower diameter is an indicator of the extent of flower opening and flowers treated with lower concentration of the dye exhibited wider diameter than those treated with higher concentration of each of the dyes (**Figure 4**). Rapid growth and enlargement of petal cells is associated with flower opening which is sequentially regulated by carbohydrate sources and the cell water potential [18, 19]. Sucrose supplies the energy required for cell division, cell expansion and carbon skeletons for the tissue structure contributing to floret expansion [20]. It is possible that the flowers treated with lower concentration of dye allowed uptake of more sucrose from the vase solution. Reduction of flower diameter in the vase solution signifies quality reduction and treatments with higher concentration of dye solution also recorded shorter vase life (**Table 3**). High concentration of the dye presumably restricted cell division and expansion of the petals which was further intensified by reduced water uptake (Figure 3). Anjali et al. [21] and Safeena et al. [13] however, recorded no significant effect of dye and concentration on flower opening.

Table 1 Effects of dye type and concentration on flower diameter

Treatments	**Days**			
	0	**2**	**4**	**6**
Blue (15g)	5.1	5.72a	6.8a	7.55a
Blue (30g)	5.1	4.9c	5.7b	6.05b
Orange (15g)	5.2	6.0a	6.8a	7.47a
Orange (30g)	5.5	5.4a	5.7b	5.70b
Green 15g	5.4	5.8a	6.7a	7.54a

Green 30g	5.2	5.0c	5.5b	5.68b
Control	5.1	5.71a	6.41a	6.94ab
Orange: Blue (15g:30g)	4.6	5.1c	5.40b	4.82b
Orange: Blue (30g:30g)	5.0	4.9c	5.5b	5.62b
LSD	NS	0.60	0.9	1.31

LSD (Least Significant Difference), letters a, b, c, means followed by the same letters along the row are not significantly different

Figure 4 Flower diameter as influenced by green, orange and blue dyes and their concentrations on the 5th day. Left (concentration of 15g) and right (concentration of 30g)

Petal fresh weight

The petal fresh weight of flowers treated with 15g of blue, orange and green dyes decreased from day 0 to day 2 followed by a gradual increase to day 6 and this could be due to increased water uptake which increased cell turgidity. On the 2nd and 4th days flowers treated with orange and blue dyes in the ratio of 1:1exhibited significantly lower petal fresh weight than the other treatments and the control. Petal weight of flowers treated with 30g of dye however showed a decreasing trend from day 0 to day 6, and a similar trend was also observed in bicolored flowers (**Table 2**). The reduced weight might be due to high concentration of dye within the cell and presumably the sucrose concentration in the vase solution was also high, and this influenced metabolism and the osmotic pressure of the cells that alters cell turgidity [12]. The reduced water uptake caused the cells to be flaccid and plasmolysed which in turn contributed to reduced size of cells and that of petals.

Table 2 Effects of dye type and concentration on petal fresh weight

Treatments	**Days**			
	0	**2**	**4**	**6**
Blue (15g)	12.28	10.27a	10.32	11.12a
Blue (30g)	11.60	11.37a	10.56	9.39a
Orange (15g)	12.46	10.34a	10.42	10.52a
Orange (30g)	10.64	9.88a	9.08	9.10a
Green 15g	12.22	10.46a	10.66	10.99a
Green 30g	13.44	12.73a	11.83	10.12a
Control (not treated with dye)	12.42	11.17a	10.00	9.14a
Blue: Orange (15g:30g)	11.49	9.64a	9. 56	9.32a
Blue: Orange (30g:30g)	7.91	5.53b	7.10	6.08b
LSD	NS	3.10	NS	3.03

LSD (Least Significant Difference), letters a, b, means followed by the same letters along the row are not significantly different

Post-harvest life

Flowers treated with 15g of blue, orange and green dyes exhibited longer vase life of 9 days than the other treatments. Flowers treated with orange and blue dyes in the ratio of 2:1 had similar vase life to 30g dye treated flowers. Flowers treated with orange and blue dyes in the ratio of 2:1 exhibited significantly shorter vase life than the other treatments (**Table 3**). Shorter vase life with increased dye concentration has been reported in carnations, Gerbera [10], China aster flowers [8], tuberose [10, 14]. Leakage of dye was also observed in flowers treated with 30g of blue, green and orange dyes on the 4rd day and in bicolored flowers on the 3rd day indicating that the cells were saturated with the dye that affected cell metabolism and osmotic pressure resulting to loss of cell membrane integrity. Sing *et al.* [22] also associated increased ion leakage with shorter vase life of ornamental flowers. High ions in the cell restricts the movement of water and food materials which causes the cells to be dehydrated and in turn causes wilting and senescence of leaves and petals. The color intensity of flowers treated with 15g of dye, decreased with days in the vase solution as shown in **Figures 5a-c**. It was observed that flowers treated with orange and blue dyes in the ratio of 2:1, drying of petals occurred early on petals that absorbed the orange dye (30g) solution and this reduced its vase life. Shorter vase life of flowers treated with 2 types of dye solutions could be due to interactions or incompatibility of the dyes within the plant cell apart from the dye concentration.

Table 3 Effects of dye concentration on vase life

Treatments	Vase life
Blue (15g)	9.0d
Blue (30g)	6.00bc
Orange (15g)	9.0d
Orange (30g)	6.00bc
Green 15g	9.00d
Green 30g	6.00bc
Control	6.67c
Blue: Orange (15g:30g)	5.33b
Blue: Orange (30g:30g)	4.33a
LSD	0.86

LSD (Least Significant Difference), letters a, b, c, d, means followed by the same letters along the row are not significantly different

Figure 5a Quality of flowers (leaves, petals, color intensity) treated with blue, orange and green dyes at a concentration of 15g on the 6th day

Figure 5b Quality of flowers (leaves, petals, color intensity) treated with blue, orange and green dyes at a concentration of 15g on the 9th day

Figure 5c Quality of flowers (leaves, petals, color intensity) treated with orange and blue dyes in the ratio of 1:1 (left) and 2:1(right) on the 5th day

Conclusion

The concentration of the dyes used influenced the solution uptake, water uptake, flower diameter, petal fresh weight and vase life of tinted rose variety. The higher the concentration of dye the shorter the vase life of flowers which received both single and double colors. The bicolored rose flowers had shorter vase life though they can be very attractive for decorations and floral arrangements. The flowers to be treated with high concentration of dye either to obtain intense single color or bicolor can be harvested at almost full bloom stage instead of tight flower bud stage since they failed to open fully. Shorter time for the uptake of dye at higher concentration can increase the vase life and also maintain the color of tinted single and bicolored roses.

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