# Post-harvest handling of cut Kniphofia (*Kniphofia uvaria* 'Flamenco')

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## Abstract

*Cold storage and floral preservative treatments were evaluated on postharvest quality of Kniphofia uvaria 'Flamenco' flowers. Stems wrapped with wet newspapers stored at 4 °C showed better postharvest performances than 'dry' stored stems. Cut stems were placed in floral solutions (Standard Vase solution ('SVS'), Chrysal clear®, Flora 2000®, Flower fresh™), A biocide (8-HQS), a biological extract (Biovin®) and control (tap water) vases. Fresh weight, vase life, flower colour, water uptake and transpiration were noted for the vase period. Stems treated with Flora 2000® or Flower fresh™ produced the longest vase life (6.90 or 6.51 d respectively). The CIE colour value, a* (red) increased in all floral solutions whereas the b* (yellow) value increased in flower stems kept in SVS and Flora 2000® vases. Flower lightness (L*) was increased in flowers placed in 'SVS', 'Flower fresh' and 'Flora 2000' vases. Lowest vase osmotic potential was observed in 'Flower fresh' (-2,00 mmol/kg) and it was positively correlated with flower dry weight ($r^2 = 0.78$). Positive correlations between stem osmotic potential ($r^2 = 0.47$) or initial a* ($r^2 = 0.53$) and negative correlation between flower soluble solid concentration ($r^2 = -0.55$) and vase life were observed. For cold storage, flower stems wrapped with wet newspapers is considered the best option, reducing geotropic bending in storage period and maintaining flower quality in vase period.*

**Keywords:** *Kniphofia uvaria*, Vase life, post-harvest, floral solutions

## Introduction

Optimum flower quality can be varied according to environmental conditions and post-harvest handling methods. *Kniphofia* is one of the specialty cut flowers, which has been gaining popularity in the floriculture industry and consumers for the last several years. *Kniphofia uvaria* (Family *Liliaceae*) is called as 'Poker plant' or 'Torch lily' among florists. Flowers are usually reddish-orange, but hybrids can be yellow or even pink.

Manipulation of vase water is one of the effective methods to maintain post-harvest quality of fresh-cut-produce, throughout the post-harvest chain. Experiments were conducted to investigate the cold storage to reduce geotropic bending and vase life evaluation with introducing floral preservative solutions under normal environmental conditions.

## Materials and Methods

The research was carried out in the experimental station field, cold storage unit and a research laboratory of the University of Natural Resources and Applied life Sciences, Vienna, Austria. Flowers were harvested and transported to the institute laboratory. Stems were immediately placed in buckets with cold water and recut under water to maintain 30 cm in length.

### Experiment 1 - Cold storage

Cut flower stems were stored in 'dry' (stems enclosed in polythene bags), stems wrapped in wet newspapers and enclosed in polythene bags and 'wet' (tap water containers) storage for 5 days at 4 and 13 °C. In wet storage method, the flowers were not packed in polythene bags. After cold storage, racemes were unwrapped, weighed, recut under water and placed in vases filled with tap water.

### Experiment 2 - Vase water additives

Vase solutions of 'Standard Vase Solution' ('SVS'-$NaHCO_3$ 125 mg/l, $CaCl_2.2H_2O$ 99 mg/l, $CuSO_4.5H_2O$ 1.2 mg/l), 'Chrysal' (10 g/l) 'Flora 2000' (1 ml/l), 'Flower fresh' (9 g/l), 'Biovin' (1 ml/l) and '8-HQS' (200 mg/l) were prepared using deionised water under room temperature. Laboratory tap water was used as a control treatment. A plastic vase (1000 ml capacity) used to place cut flower stems, was filled with 500 ml of the desired vase water solution. Three freshly harvested flower racemes were taken as the experimental unit for a vase and three replicates were used for each treatment. Vases were transferred to benches in a room at 20 ± 2 °C, with a light level approximately 20 - 50 µmol □$^{-2}$ □$^{-}$□ provided by cool white fluorescent tubes, and a 12 h photoperiod.

For experiment 1, % weight change and % bent stems during storage period and vase life were measured. The end of vase life was defined as the time when flowers wilted, browned, or had abscised, or severely bent stems. Fresh weight, water uptake, transpiration, osmotic potential, soluble solid concentration and flower colour were assessed for treatments of experiment 2. The CIE $L^*$ $a^*$ $b^*$ colour system was used to assess the colour of flowers with a Chroma meter (Minolta Model CR-200b, GmbH). In all experiments, treatments were arranged according to a randomised complete block design. The data were analysed by GLM (SPSS, 11,0 version). Data were presented as means ± SE. Significant differences were assessed with the Tukey's HSD and correlation was determined by Pearson method at $P = 0.05$.

## Results and Discussion

### Experiment 1 - Cold storage

Cut stems wrapped in wet newspapers and kept at 4 °C showed significantly higher vase life (6.52 d) than other treatments (Table 1). Minimum percentage of stem bent was observed at 4 °C. During the storage, weight loss was greater in flowers stored 'dry' when compared to those stored 'wet'. Floral abscission was higher in flowers stored 'dry' (polythene bags) than others. Cut *Kniphofia* flowers have a relatively short vase life. Dry stored flowers were covered by perforated polythene bags to minimise water loss during vase period. During wet storage at higher temperatures (13 °C), nutrition breakdown occured at higher rates than for flowers stored dry (Halevy and Mayak, 1981). Mor (1989) similarly recommended 'dry' over 'wet' storage for roses since flowers with lower water content performed better than flowers with higher water content. Dry storage is the more commonly used method for long term storage of cut flowers (Nowak and Rudnicki, 1990).

**Table 1: Effect of storage temperature on vase life after cold storage, geotropic bending and fresh weight changes during cold storage of *K. uvaria*. Values are means of 12 stems ± SE**

| Storage treatment | % weight change in storage | Geotropic bended stems % | Vase life (d) |
|---|---|---|---|
| 4 °C Wrapped with wet news papers & in a polythene bag | $-12^{ab}$ | $19.56^{a}$ | $6.52^{c}$ |
| 4 °C 'Dry' storage | $-5.70^{a}$ | $35.82^{b}$ | $4.67^{b}$ |
| 4 °C 'Wet' storage | $46.78^{c}$ | $52.20^{c}$ | $3.56^{a}$ |
| 13 °C Wrapped with wet news papers & in a polythene bag | $6.37^{b}$ | $36.95^{bc}$ | $4.51^{ab}$ |
| 13 °C 'Dry' storage | $-8.32^{a}$ | $40.71^{bc}$ | $3.45^{a}$ |
| 13 °C 'Wet' storage | 7.50 | 69.38d | $3.81^{a}$ |

Means separation across columns; means followed by the same letter are not significantlydifferent by Tukey HSD test at P = 0.05.

**Experiment 2 - Vase water additives**

The fresh weight of cut kniphofia racemes increased substantially up to day 3 and then it declined up to senescence. Of all vase water additives, freshly cut kniphofia racemes placed in vase solutions of Flora and Flower fresh showed higher vase life (6.9 and 6.5 d respectively) than other treatments (Table 2). In contrast, flower °brix correlated negatively ($r^2 = -0.63, -0.77, -0.82$ on day 2, 3, end of vase life respectively at $P < 0.01$) with the fresh weight. Osmotic potential of stems and flowers increased in Flora and Flower fresh vases (Table 3). Vase life was positively correlated ($r^2 = 0.47$ at $P < 0.05$) with stem osmotic potential (Table 4).

**Table 2: Effects of vase solutions on vase life (d), osmotic potential (mmol/kg) and total soluble solids (°Brix) at the end of vase life of *K. uvaria* 'Flamenco' cut stems. Each column shows means of three replicate stems ± SE**

| Vase solution | Osmotic potential (mmol/kg) | | TSS (°Brix) | | Vase life (d) |
|---|---|---|---|---|---|
| | Stem | Flower | Stem | Flower | |
| SVS | -5.95 ± 0.24 | -9.94 ± 0.30 | 2.93 ± 0.20 | 6.60 ± 0.26 | 5.41 ± 0.63 |
| Chrysal | -5.66 ± 0.20 | -6.89 ± 0.51 | 2.97 ± 0.09 | 5.33 ± 0.12 | 5.49 ± 0.49 |
| Flora | -4.79 ± 0.47 | -6.81 ± 0.41 | 2.00 ± 0.26 | 4.53 ± 0.15 | 6.90 ± 0.90 |
| Flower fresh | -5.40 ± 0.56 | -6.90 ± 0.36 | 2.30 ± 0.15 | 4.60 ± 0.26 | 6.51 ± 0.59 |
| Biovin | -5.88 ± 0.22 | -7.71 ± 0.93 | 2.61 ± 0.06 | 6.23 ± 0.15 | 5.45 ± 0.05 |
| Tap water | -4.91 ± 0.26 | -10.58 ± 0.38 | 2.75 ± 0.17 | 7.43 ± 0.20 | 5.25 ± 0.31 |
| 8-HQS | -9.41 ± 0.34 | -9.41 ± 0.34 | 3.10 ± 0.21 | 6.20 ± 0.06 | 4.88 ± 0.26 |
| Fresh flowers | -7.93 ± 0.07 | -6.44 ± 0.05 | 2.27 ± 0.12 | 5.97 ± 0.09 | 2.05 ± 0.78 |

**Table 3. Effect of vase solutions on transpiration and water uptake rates of kniphofia. Each column shows means of three replicate stems. Means within column with different letters are significantly different at P<0.05**

| Vase solution | Transpiration (g/d.stem) | | | Uptake (g/d.stem) | | |
|---|---|---|---|---|---|---|
| | Day 1 | Day 3 | End of vase | Day 1 | Day 3 | End of vase |
| SVS | $11.45^{a}$ | $7.47^{a}$ | $7.45^{a}$ | $12.31^{abc}$ | $4.77^{a}$ | $3.93^{a}$ |
| Chrysal | $12.62^{a}$ | $12.50^{b}$ | $14.36^{d}$ | $15.05^{cd}$ | $13.36^{b}$ | $12.97^{c}$ |
| Flora | $12.65^{a}$ | $12.61^{b}$ | $13.45^{cd}$ | $14.84^{bcd}$ | $12.87^{b}$ | $12.05^{c}$ |
| Flower fresh | $14.96^{b}$ | $13.30^{b}$ | $15.42^{d}$ | $15.20^{d}$ | $14.08^{b}$ | $14.36^{c}$ |
| Biovin | $12.01^{a}$ | $9.05^{a}$ | $9.11^{ab}$ | $12.07^{ab}$ | $5.92^{a}$ | $5.71^{ab}$ |
| Tap water | $10.78^{a}$ | $7.20^{a}$ | $7.27^{a}$ | $11.02^{a}$ | $4.64^{a}$ | $4.02^{a}$ |
| 8-HQS | $11.97^{a}$ | $12.28^{b}$ | $11.26^{bc}$ | $13.49^{abcd}$ | $11.79^{b}$ | $7.62^{b}$ |

**Table 4. Peason correlation coefficient between vase life of *Kniphofia* and other quality traits during vase period**

| Quality trait | Uptake | Transpiration | Colour components | | | °Brix flower | Stem osmo. | Flower osmo. |
|---|---|---|---|---|---|---|---|---|
| | | | L* | a* | b* | | | |
| Vase lef | 0.47* | 0.46* | -0.43 | 0.53* | -0.33 | -0.55** | 0.47* | 0.40 |

*P<0.05, **P<0.01.

Initial transpiration rate did not show significant differences except Flower fresh. Transpiration rates and uptake rates of stems placed in Chrysal, Flora and Flower fresh were better able to maintain initial values until senescence than other treatments (Table 3). $L^*$ value of stems in Flora markedly increased at the end of vase life, indicating a bright flower colour until termination. Water absorption from the preservative solution maintains water balance and flower freshness. Therefore, it will delay wilting of flowers, thereby maintaining vase life. The SVS showed lower transpiration and uptake rates, suggesting that it is not suitable for kniphofia cut flowers. Development of petal colour during vase period has been observed, thereby increasing $L^*$, $a^*$ and $b^*$ values of flower stems placed in floral preservatives.

## Conclusion

The data presented here suggest that keeping cut kniphofia racemes under 'dry' (wrapped with wet newspapers and polythene) storage at 4 °C reduces stem bending and maintains keeping quality of flowers. Colour components ($L^*$, $a^*$, $b^*$) are positively affected by vase solutions with commercial floral preservatives, thereby suggesting the use of appropriate floral preservatives to maintain flower colour during the vase period.

## References


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