Tropical Agricultural Research Vol. 19: 202 - 209 (2007)

Effect of Coconut Water in Extending the Vase Life of Anthurium Cut Flower Variety Wild Pink

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ABSTRACT. *Effects of coconut water on vase life of Anthurium cut flowers was investigated. Freshly cut Anthurium (wild pink variety) flowers were used in the experiments. The flowers were treated with 40, 50 and 60% fresh coconut water solutions. Distilled water and 5% sucrose was used as control and standard, respectively. All treatments inclusive of standard and control contained 0.23% NaOCl as a biocide. Each treatment contained six samples and experimental setup was arranged in Completely Randomized Block Design (CRBD). All treatments were applied as direct dip method (DD), oasis block method (OB) and cotton plug method (CP). The flowers were assessed daily for any impaired conditions such as browning, wilting and rotten stem bases. The vase life was recorded in days. Flowers treated with 50% coconut water with 0.23% NaOCl recorded the the longest vase life (21 days) compared with control and other treatments. Therefore, 50% coconut water with 0.23% NaOCl has the potential to be used as a preservative medium for Anthurium cut flowers.*

INTRODUCTION

Anthurium belongs to the family *Araceae*. It is native to Central and South American countries such as Ecuador, Colombia, Peru, Brazil and Venezuela (Othman, 2004). Anthurium flowers are being used as one of the major sources for the cut flower trade in Sri Lanka. Popular Anthurium varieties grown for cut flower production in Sri Lanka are Wild pink, Choco, Gothamala and Tropical. Some other varieties such as Fantasia, Midori, Sunglow and Terra are also common in the trade. The elegant blooms of this tropical aroid are produced and sold throughout the world (Othman, 2004). The true flowers are found on the "spadix" the upright organ in the center of the "spathe" which is the decorative petal-like organ surrounding the spadix. Although Anthuriums are sensitive to low temperatures, they have a long vase life when properly handled (Othman, 2004). The end of their vase life is usually the result of inability to draw water from the vase solution and is associated with loss of glossiness and then blueing of spathe. Most of the water lost by the flower evaporates from the spadix (Othman, 2004). Application of wax to prevent this water loss or pulsing with silver nitrate to improve water relations of the flower can extend their vase life considerably (Othman, 2004). The government of Sri Lanka has identified Anthurium as one of the priority crops for development and export promotion (Kelegama, 2001). Imported Anthurium varieties are also available in Sri Lanka.

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Factors such as the mode of transportation, conditions during transport, storage at the distributors and time lag from shipment to ultimate sale ("Chain-of-Life") are very important factors in the maintaining the quality and extending the shelf-life (Kelegama, 2001). Industry believes that most of the abuses suffered by flowers occurs after flowers leave the packing shed and before they arrive in the markets. Furthermore, the quality of the water in which flowers are dip after harvest, is known to affect the keeping or vase life quality of the flowers (Kelegama, 2001).

Reduced post-harvest life is apparently associated with clogging of the vascular tissue in the stem by flower-produced material. Silver nitrate (together with distilled water) treatment of the stem reduces this blockage and helps maintain water conductivity tissues, thereby increasing post-harvest life by up to 50% (Dhanasekera, 1998). However, Silver nitrate is a harmful chemical to be employed in large quantities. Reduced water loss from the flower by wax coating also increases the post harvest life up to 30%. The best wax of those tested was the carnauba base wax (FMC-819). Both of these treatments (silver nitrate and wax) have commercial possibilities with the wax treatment being the easiest to use (Dhanasekera, 1998). Experiments with hypoboric acid and controlled atmosphere storage are not encouraging (Dhanasekera, 1998). The very small increase in the total post-harvest life could more easily be obtained with less costly alternatives. In experiments on refrigerated storage, it was found that there is no significant difference in the vase-life of flowers when stored at 15^{o}C and at room temperature for 7 days (Dhanasekera, 1998).

Coconut is a versatile crop and its many uses encompass food, energy, industrial and even in construction applications. In Sri Lanka, about one billion coconuts are produced annually. Coconuts are used for extraction of coconut oil and production of desiccated coconut (Kamemoto, 1995). Mature coconut water is considered as a rich source of sugars, electrolytes, (Jayalekshmy *et al.*, 1986) and growth regulators such as auxins, gibberellins and cytokines (Mamaril *et al.*, 1986). In Sri Lanka about, 250,000 t of coconut water is generated annually by the desiccated coconut and coconut oil industries. Very little attempts have been made to utilize coconut water as a source in other potential industries. Therefore it has created an enormous environmental problem due to aggregation of large organic matter content (Kamemoto, 1995).

There is an interest to develop low cost and effective methods to increase the vase life of Anthurium flowers. Coconut water has been effectively used to extend the storage life of Gerbera cut flowers (Nair *et al.*, 2000). However, in Sri Lanka few studies have been conducted on the use of coconut water as a preservative solution for cut flowers. Therefore present investigation was conducted to develop a low cost method to increase the vase life of Anthurium flowers using coconut water.

MATERIALS AND METHODS

Coconut water

Fresh coconut water from 7 - 9 month old nuts (3 L batches) collected hygienically was used in this study. Coconut water was filtered through a clean and sterilized cotton cloth to remove any suspended particles before use. The pH, Brix %, conductivity, total reducing sugars (TRS) and free amino acid content (FAA) were measured to ensure the chemical consistency of the coconut water used in the study.

Anthurium flowers

Fresh and defects free Anthurium (wild pink variety) flowers with same degree of maturity were purchased from florists in the early hours of the day and brought to the lab within an hour. Maturity of Anthurium flowers was determined by the proportion of open flowers on the spadix. In immature Anthuriums, the spadix is smooth. Flower opening starts at the base of the spadix and proceeds upwards. Spadices with open flowers are noticeably rough (Reid, 2004). Flowers were placed in water buckets during transport to minimize the transport stress on flowers. In the laboratory, flowers were immediately dipped in a water bath and the distal ends were recut to have stem length of 30 cm (Zencirkiran, 2005).

The treatment response was monitored through non-parametric observations, as it was a subjective method based on visual characteristics of the flowers (Premawardena *et al.*, 2000). Each and every flower was inspected individually on every day and the vase life was measured as the time till flowers were discarded (Paull and Chantrachit, 2001). Anthurium spadix senescence (necrosis) was ranked with the scale: 1 (no senescence) to 5 (50% of spadix showing senescence), Spathe blueing scale: 1 (no blueing) to 4 (100% blueing), spathe gloss scale: 1 (full gloss) to 4 (full gloss loss) (Paull and Chantrachit, 2001) and additionally spathe browning scale: 1 (no browning) to 4 (20% browning). Flowers were discarded if they were rated 4 for spadix senescence, 3 for spathe blueing, 4 for spathe gloss (Paull and Chantrachit, 2001) and 3 for spathe browning. Flowers were observed daily until the quality of all flowers deteriorated.

Treatments

A series of solutions containing 40% coconut water (40% CW), 50% coconut water (50% CW) and 60% coconut water (60% CW) were prepared. The 100% coconut water used had the specifications given in Table 1. Distilled water (DW) control and 5% sucrose (5% sucrose) standard were used for comparison. All treatments contained 0.23% NaOCl as a biocide (Emongor, 2004). Following treatment methods were tested with the above solutions; in the Direct Dip method (DD), flowers were placed in vases each containing 300 mL of solution (Pompodix *et al.*, 2004), in the Oasis Blocks method (OB) the flowers were stabbed in the Oasis blocks soaked with preservative solution and sprayed with appropriate solution on every other day and in the Cotton Plug method (CP) the distal ends of Anthurium stems were wrapped with absorbent cotton wool moistened with preservative solution and covered with polythene before arranging them in racks. Each treatment method consisted of all 5 treatments and each treatment was comprised with six replicate samples and arranged in completely randomized block design. The data was analyzed in ANOVA statistical method and Tukey's multiple comparison tests.

RESULTS AND DISCUSSION

The parameters of the coconut water measured showed some consistency in the properties pH, Brix %, conductivity, total reducing sugar content and free amino acid content (Table 1.). But it was reported that these parameters could differ depending on the maturity of the coconuts and their cultivar (Jayalekshmy *et al.*, 1986). The result suggests that the physicochemical properties are consistent when the coconut water was collected from the nuts with a maturity of 7 - 9 month.

Table 1. Physical and Chemical properties of Coconut water.

Physicochemical Property	Mean ± SD
pH	5.2 ± 0.4
Brix %	5.1 ± 0.4
Conductivity (mS/cm)	7.9 ± 0.4
Total Reducing Sugars (g/L)	6.0 ± 0.3
Free Amino Acid (mg/L)	20.2 ± 0.8

Note: Fresh coconut water was collected from 7 - 9 months old nuts in 3L batches. Each data point represents the mean of five replicates ±SD.

In each treatment method flowers treated with 40%, 50% and 60% coconut water solutions showed extended vase life over distilled water control and 5% sucrose standard. Furthermore, 50% coconut water conserved the flowers for longer period of time (Figure 1). It was significantly different from the distilled water control and 5% sucrose standard in DD and OB methods except in CP method at the $P<0.05$ level and pair vise comparison with Tukey's test. In the present study 50% coconut water extend the vase life of cut Anthurium flowers up to 21 days. Out of the 03 treatment methods, DD and OB methods showed far more effectiveness in extending vase life of Anthurium cut flowers compared to the CP treatment method. In each of the three treatment methods vase life of the flowers treated with 40% and 60% coconut water was not significantly different from each other ($p<0.05$, ANOVA and Tukey's multiple comparison test).

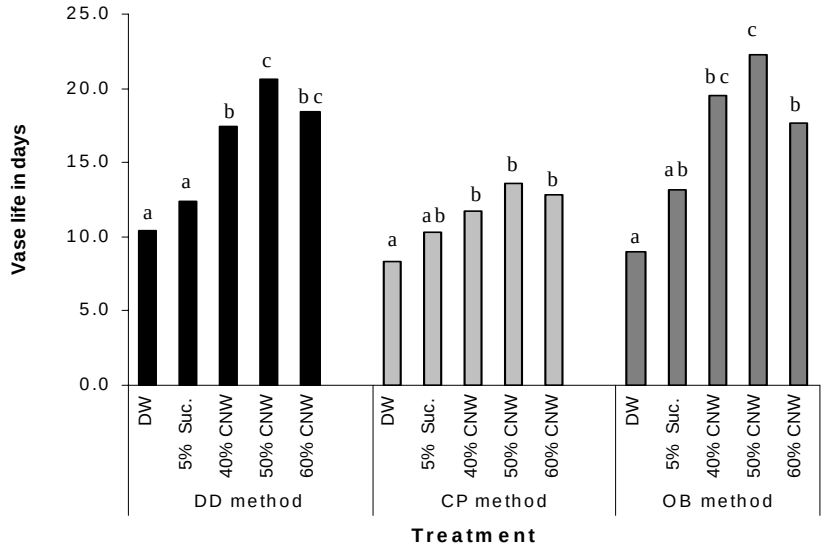

Figure 1. Vase life of Anthurium cut flowers in different treatment methods.

Note: DD: Direct dip, CP: Cotton plug and OB: Oasis block. Each bar represents the mean of six samples. Different letters (a, b, c) in each method separately denote significant difference between treatments ($p<0.05$) by ANOVA one way method and pair vise comparison with Tukey's test.

According to the results, 50% coconut water solution is the best preservative medium in DD and OB methods from the tested treatments for extending the vase life of Anthurium cut flowers (Figure 1). Nair *et al.* (2000) have showed that 50% CW significantly extended the vase life of Gerbera cut flowers than 60% CW and 40% CW. Furthermore, it was stated that 4% Sucrose with 20 ppm $AgNO_3$ has been almost effective (13.9 days) as 50% CW (14.3 days) in extending the vase life of Gerbera cut flowers (Nair *et al.*, 2000). Anthurium cut flowers can be stored up to one week if packed in moist shredded newsprint and held at 15^{o}C (Reid, 2004). However, in the present study in DD method, 50% CW added with 0.23% NaOCl (21 days) was far more effective than the 5% sucrose standard with 0.23% NaOCl (12 days) in extending the vase life.

In the present study spathe blueing of the flowers was observed in large patches about 30 - 50% of the total spathe area. The common cause of vase life termination was the spathe blueing. Browning was the second major condition that has been observed in the flowers to terminate their vase life. In the present study, spathe blueing was observed prior to senescence of the spadix. Therefore, senescence was not among the major factors to terminate the vase life of flowers. Furthermore, loss of spathe gloss and loss of rigidness in the flower stems was observed in some flowers. Any of the flowers did not show any observable change during the first week in vases.

A clear visual change in spathe color was observed in control flowers after 7 days. At the initial stage, the red orange color of the spathe slowly turned into purple color and later progressed to blue color. At about 10 days of vase life, flowers in the standard solution showed evidence of senescence. The vase life of control flowers was terminated after 12 days. Flowers in the standard did not last over 14 days. Flowers in the 40% CW and 60% CW started to fadeout after 16 days. After 21 days most of the flowers except those treated with 50% CW were discarded. Generally, the post harvest life is expressed in days and there are no well-defined criteria and conditions on evaluating the lasting qualities of cut flowers (Premawardena *et al.*, 2000).

Table 2. Increase in the vase life of Anthurium cut flowers compared to the control and standard in direct dip method.

Treatment	Mean vase life	Increase in vase life % Compared to the	
		Control	Standard
Control (DW)	10.4^{a}		
Standard (5% Sucrose)	12.4^{a}	19	
40% Coconut water	17.4^{b}	67	40
50% Coconut water	20.7^{c}	99	67
60% Coconut water	18.5^{bc}	78	49

Note: All treatments contained 0.23% NaOCl as a biocide. Each treatment comprised six samples. a, b, c, letters denote the significant difference between the treatment means ($p<0.05$).

In the present study, the vase life of flowers was considered from the day they were placed in vases. However, in other studies, the time of harvest is considered as the starting point of

the vase life (Paull and Chantrachit, 2001). The total length of vase life depends on the point that is considered as initiation of the vase life. The maturity at harvest is also variable and not exactly defined. Maturity of Anthurium flower is determined by the proportion of open flowers on the spadix. In immature Anthuriums, the spadix is smooth. Flower opening starts at the base of the spadix and proceeds upwards; spadices with open flowers are rough. For maximum life flowers should be purchased when the spadix is 50 to 75% rough (Gross *et al.,* 2004). In this study, Anthurium flowers have been harvested at a maturity when the spathes were completely open. But it has been reported that in some researches the maturity at harvest was considered when the flowers at least three quarters open on the spadix (Paull and Chantrachit, 2001). Because of these differences, the vase life of Anthurium cut flowers could be having differences despite of the treatment methodology.

Anthurium flowers treated with different coconut water concentrations showed increase in vase life compared to flowers treated with the control and the standard (Table 2). The longest vase life for an individual flower was recorded in the study was 24 days in those flowers treated with 50% CW and recording 99% and 67% increase in vase life compared to control flowers and standard flowers, respectively (Table 2).

It has been reported variable effects on the vase life in different Anthurium cultivars with Bezyladenine (BA) treatment and the maximum vase life up to 51 days was recorded with New Pahoa red variety with the BA treatment (Paull and Chantrachit, 2001). It was well defined that the vase life of Anthurium cut flowers depend on the variety and the treatment given to them (Paull and Chantrachit, 2001).

In the DD method, average solution uptake was measured and solution uptake of flowers showed no significant difference ($p<0.05$, ANOVA and Tukey's multiple comparison test) among the coconut water treatments (Table 3). But the 50% CW treatment was significantly different ($p<0.05$, ANOVA and Tukey's multiple comparison test) from the control and the standard in solution uptake.

Table 3. Average solution uptake of Anthurium flowers in direct dip method.

Treatment	Average solution uptake (mL/day/stem)
Control (DW)	1.34^{a}
Standard (5% Sucrose)	1.36^{a}
40% Coconut water	1.43^{ab}
50% Coconut water	1.56^{b}
60% Coconut water	1.46^{ab}

Note: Each treatment comprised six samples. a, b letters denote the significant difference between the treatment means ($p<0.05$).

It was well documented that coconut water contains auxins, gibberellins and cytokinins (Mamaril *et al.,* 1986). The result of the study suggests that the flowers treated with coconut water showed extended vase life over the standard and the control due to the presence of kinetin

In addition, coconut water contains lot of reducing sugars (Jayalekshmy *et al*., 1986). With increase of coconut water percentage in the preservative medium, reducing sugar concentration also increases. It provides a favorable environment for the growth of bacteria on cut surface of the flower stalk and thereby block water conducting tissues. Therefore, flowers lose their ability to draw water from the vase solution a resulting vase life termination. For Anthuriums, stalk clogging and the subsequent decline in water uptake has been related to the reduced vase life (Paull and Chantrachit, 2001). Hence, higher the coconut water percentage in the medium, higher the clogging in the vessels would occur, consequently reduction in flower quality could be expected. In combination of the above suggestions, it is obvious that the 50% CW performs better than the other coconut water treatments (40%<50%> 60%). By evaluating the impact of preservative treatments by carrying out further investigations, some of the above treatments may be used extensively in increasing the vase life of Anthurium cut flowers.

CONCLUSIONS

In this study, coconut water from 7 - 9 months old nuts had been effectively used to extend the vase life of Anthurium “wild pink” variety flowers, up to 21 days. 50% coconut water solution has the potential to be developed in to a preservative medium that would extend vase life of Anthurium cut flowers.

ACKNOWLEDGMENT

Financial support by NSF under the grant number RG/2006/AG/03 is acknowledged.

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