Application of Pulse Treatment to Prolong Shelf Life of Fresh Cut Rose (*Rosa hybrida*)

Shyntia Atica Putri [1)], Dyah Ismoyowati [2)], Mohammad Affan Fajar Fallah [2)]
Department of Agroindustrial Technology, Faculty of Agricultural Technology
University of Brawijaya, Jl. Veteran Malang 65145.
Email: shyntia_atica@yahoo.com ; shyntia_atica@ub.ac.id [1]

Abstract

Fresh cut flower has characteristis such as perishable and short shelf life. Pulse treatment is a kind of method that can prolong fresh cut flower's shelf life. Pulse treatment is a postharvest handling which is done by soaking the stem of flower into a solution containing nutrients (glucose and sucrose) and germicides. The objectives of this reseacrh were to determine the best alternatives of pulse treatment and determine shelf life of fresh cut rose flower of each treatment. There were 6 alternatives, namely P_1 (5% sucrose+20 mg/l $AgNO_3$), P_2 (150 mg/l $AgNO_3$), P_3 (1,2% sucrose+0,2 mM STS), P_4 (5% sucrose+20 mg/l $AgNO_3$+320 mg/l citric acid), P_5 (1,2% sucrose+ 0,2 mM STS+ warm water (40^0C)), P_6 (5% sucrose+20 mg/l $AgNO_3$+320 mg/l citric acid+warm water (40^0C)). The parameters used for determining shelf life are color of petals (lightness and redness), moisture content, and texture of stem. As results, shelf life of P1 was 8 days, P2 was 6 days, P3 was 4 days, P4 was 6 days, P5 was 5 days, and P6 was 5 days. All of the alternatives gave longer shelf life than control (4 days). The best alternatives was P1 with 8 days shelf life. Moisture content in that day was 78,313%, texture of stem was 47,0603 N, lightness was 31,237 and redness was 46,942.

Key words: *fresh cut rose, pulse treatment, shelf life*

1. INTRODUCTION

The research is motivated by the fluctuating market condition of fresh cut roses, both supply and demand ofthe product. Their short shelf lives require sufficient knowledge of post-harvest treatment of the cut rose's market player.Indonesia has 39,265,696 stems of cut roses (BPS, 2010).From those numbers, a range of31-60 stems were requested by each florist in Kotabaru Yogyakarta everyday. Therefore, pulse treatment, as an alternative method to extend the shelf life of cut roses,is required to support their trading.

Rose had contributed in export trading which made up 37.25% from total fresh cut export with the number of values around 185,000 US$ which is low price category. It delivered to Taiwan, Japan, Malaysia, and Timor Leste (BPS, 2010). The data appear to confirm that the quality of rose needed more attention to increase bargaining power in trading.

Pulse treatment is a treatment that is performed on cut roses by immersing their stem tip into a preservative solution containing nutrients and germicides for about12 hours (Suyanti, 2005). The treatment is expected to prolong the rose's shelf life andto maintainits quality.

The objectives of this research were to determine the best alternatives of pulse treatment and determine the shelf life of fresh cut rose of each treatment. There were 6 alternatives, namely P_1 (5% sucrose+20 mg/l $AgNO_3$), P_2 (150 mg/l $AgNO_3$), P_3 (1.2% sucrose+0.2 mM STS), P_4 (5% sucrose+20 mg/l $AgNO_3$+320 mg/l citric acid), P_5 (1.2% sucrose+ 0.2 mM STS+ warm water (40^0C)), P_6 (5% sucrose+20 mg/l $AgNO_3$+320 mg/l citric acid+warm water (40^0C)).

2. MATERIAL AND METHODS

Red fresh cut roses (*Rosa hybrid*) from Batu, Malang, East Java whichare distributed to Yogyakarta through the florist center in Kotabaru were used as materials. To produce optimal results, the study was conducted based on systematic stages, which must be implemented completely step-by-step.

To achieve the objectives, variation of pulse treatment were applied to the material

and their shelf lives were measured.The analysis of data were t-test and visual shelf life. T test were conducted to check significant value from all variables such as the difference between moisture content; stem texture; and petal color in 1st day and 5th day. Visual analysis of shelf life was done by check all the variables visually and made a conclusion wheter it proper or not to be sold.

Laboratory testing was conducted to check moisture content (thermogravimetric analysis), color of petals (Hunter's colorimetric system CR-400 Minolta), and texture of stem (compression test-Universal Testing Machine, Shimadzu Japan). The experiment was conducted everyday until the end of their shelf lives. The variation of pulse treatment and estimation of shelf life are shown in Table 1.

Table 1. Variations of pulse treatment and shelf life estimation

Code	Variation	Shelf life estimation
P_1	5% Sucrose + 20mg/l $AgNO_3$	8 days[1]
P_2	$AgNO_3$ 150 mg/l	9 days[2]
P_3	1.2% sucrose + 0.2mM STS	10 days[3]
P_4	5% sucrose + $AgNO_3$ 20mg/l + citric acid 320 mg/l	10 days[4]
P_5	1.2% sucrose + 0.2mM STS + warm water (40^0C)	
P_6	5% sucrose + $AgNO_3$ 20mg/l + citric acid 320 mg/l + warm water (40^0C)	

Sources: [1)] Ketsa, 1991. [2)] Butt, 2005. [3)] Liao, 2000. [4)] Sulusi, 2007.

3. RESULT AND DISCUSSION

To be accepted in the market, fresh cut rose must have an attractive appearance and a bright color. These parameters, along with shelf life,depend on several factors such as cultivation techniques, harvest time, and environmental conditions. Plants that are planted with proper cultivation techniques will produce high quality flowers. The quality of flowers is very influential on the appearance and display of cut roses self life. Generally, rose being harvested in specific frequency, and in specific physiological phaseto get best quality (Teixeira, 2003).

The laboratory experiment were examine quality varibales such as moisture content, stem texture, and color petals in 6 alternatives of pulse treatment. All chemicals used for the pulse treatment is a technical grade, not a Pro Analysis (PA) due to the significant price difference.The Chemicals used for pulse treatment were (1) Sugar as a sourceof sucrose., (2) $AgNO_3$, (3) Silver Thio Sulfate (STS) were made from $AgNO_3$ and Sodium Thio Sulfate; and (4) citric acid. The general functions of the chemicals used are as follows:

a. Sucrose serves as a nutrient for plants that can still carry out metabolism, although it has been cut from the tree (Doi and Reid, 1995). Starch and sugars stored in the stem, leaves and petals provide most nutrients needed for opening and maintenance during storage. The levels of these carbohydrates are highest when plants are grown in a medium with high light condition and proper cultivating management. Carbohydrate levels are, in fact, generally highest in the late afternoon, after a full day of sunlight. However, flowers are preferably harvested in the early morning, not only because of it slower temperature, but also because of higher water content of the plant, and more time available for processing the cut flowers. Pulsing cut-flowers immediately after harvest with a sugar solution can improve the flower's quality and their vase-life. Pulsing was done by standing the cut flowers in the solution for a short period, usually less than 24 h, and often at low temperature (Reid, 2004).
b. Silver nitrate ($AgNO_3$) serves as germicide that inhibits the entry of microbes into flower stems, keeping their metabolism to run properly.
c. Silver Thiosulfate (STS) serves as germicide. In addition, the chemical is

alsoan ethylene inhibitor (Liao, 2000), which blocks the formation of ethylene. Ethylene itself is known as the ripening/ maturing plant hormone. Therefore, it was expected that the chemical can extend cut roses' shelf life through inhibiting the maturation of the flower.

d. Citric acid had function to lower pH, causing inhibition of microbial growth in the pulsing solution (also known as an antiseptic). Concurrent with the decrease of pH value, the water absorption also properly transfer (Amiarsi, 2002).

Table 2 showed the change in water content for the first eight days. Thermogravimetric (drying oven) analysis was used to measure moisture content. Pulse treatment is expected to maintain moisture content in the stem so the nutrients after cutting is still remain. After cut, metabolism of plants is continuing and end till no more nutrients remains. This where the role of the treatment in prolonging the shelf life of cut roses, preserving the water content in the stem (Fallah, 2010).

Compression test used Universal Testing Machine (Shimadzu, Japan) was done on rose stem to find out the effect of pulse treatment in delaying the maturation process of plant tissue.The trend change in this test is greater because the texture of the stem is senescing and lignificating so it need to be maintained by the pulse treatment.

Effect of silver nitrate ($AgNO_3$) in the biosynthesis of the plant was significant. The chemicalis ethylene inhibitor that has a strong impact on the metabolism of the plant itself. Protoplasm in the expansion cells is affected by $AgNO_3$, which will have an effect on the large size stem and petals, but the length of the plant is smaller/shorter (Butt, 2005). Silver nitrate affects the texture of the stem, where after the treatment, the rod becomes larger, causing its compressive force tends to increase. Table 3 showed the results of texture analysis of the roses' stem using Universal Testing Machine compression method.

The third and fourth parameters are lightness (brightness) and redness (red color tendency) of rose petals. Redness value has the same pattern with lightness value. Both values were similar on the first and the second days, were getting increased on the third day, and decreased dramatically on the fifth day. It can be concluded that the optimal shelf life according to the redness is three days. After the third day, rose has loss its quality. The data are shown in Table 4 and 5.

The color of the roses' petals is influenced by the sucrose concentration used for pulsing. Color loss or fading colors are common signs of maturity (senescence). Carotenoids and anthocyanins changed significantly during the maturation of the plant. Cut flowers preserved with sugar to increase the substrate respiration, delaying hydrolysis cell components, reducing ethylene production, enhance the effects of cytokines, and improve the water balance. Sucrose is transported from the media through the xylem and phloem vase. Sugar is transported and accumulated in the flower, which increases the osmotic pressure and the ability of flowers to absorb water and maintains turgor (Putri, 2009). This is the main contribution of sugar in extending the shelf life of cut flowers, especially for their color parameters.

Overall, the comparison of each pulse treatment alternative (P_1 to P_6, and roses' standard) can be seen in Figure 1. Based on visual observations, it appeared that P_1 was the alternative with the best appearance. In addition, Table 6 showed the summary shelf life cut roses at several pulse treatments.

To find out whether there was a significant difference among the daily treatment, t test was used and the test result was shown in Table 7. The null hypothesis is (Ho) no significant difference between the first and fifth days. Ho is accepted if two tailed generated significance value greater than the confidence level (α=5%) (Deny, 2008).

Based on the previous explanation, if Ho is accepted,we may conclude that there was no significant different between the first and the fifth days in the quality of cut roses was. P_2 was eligible, followed by P_1. However, P_1 was not qualified enough for the parameters of lightness. But the shelf life produced by P_1 was longer than P_2 (8 days compare with 6 days). Therefore, the best alternative based on the results was P_1(sucrose + 5% $AgNO_3$ 20 mg/l).

Table 2 Moisture Contain(%)

	Day 1	Day 3	Day 5
P1	83.03	82.69	82.81
P2	82.48	81.50	78.79
P3	81.57	80.85	73.56
P4	80.77	81.01	77.77
P5	82.37	80.91	79.98
P6	82.20	80.13	75.51
S	82.63	83.00	76.85

Table 3 Compression Test (Newton)

	Day 1	Day 3	Day 5
P1	48.26	40.38	48.46
P2	41.66	48.33	43.12
P3	39.72	42.35	53.19
P4	42.67	40.71	49.70
P5	43.99	42.96	44.63
P6	39.62	41.94	42.31
S	41.26	40.99	46.31

Table 4 Summary of Lightness (L)

	Day 1	Day 3	Day 5
P1	33.45	38.32	30.90
P2	30.98	36.77	29.50
P3	32.05	35.20	27.58
P4	32.55	37.16	29.86
P5	30.32	34.06	25.87
P6	32.47	35.60	30.35
S	32.45	33.95	27.33

Table 5 Summary of Redness

	Day 1	Day 3	Day 5
P1	46.96	50.98	45.83
P2	46.40	51,613	45.87
P3	46.83	50.41	43.78
P4	47.54	50.83	45.92
P5	44.34	49.17	41.48
P6	47.50	49.48	45.39
S	47.41	49.51	44.32

Table 6 Summary of Shelf Life

Code	Treatment	Shelf Life (days)
P1	Sucrose 5% + $AgNO_3$ 20mg/l	8
P2	$AgNO_3$ 150mg/l	6
P3	Sucrose 1.2% + 0.2 mM STS	4
P4	Sucrose 5% $AgNO_3$ + 20mg/l + citric acid 320mg/l	6

P5	Sucrose 1,2% + STS 0,2mM + warm water 40^0C	5
P6	Sucrose 5% + $AgNO_3$ 20mg/l + acid citric 320mg/l + warm water 40^0C	5
S	Standard/control	4

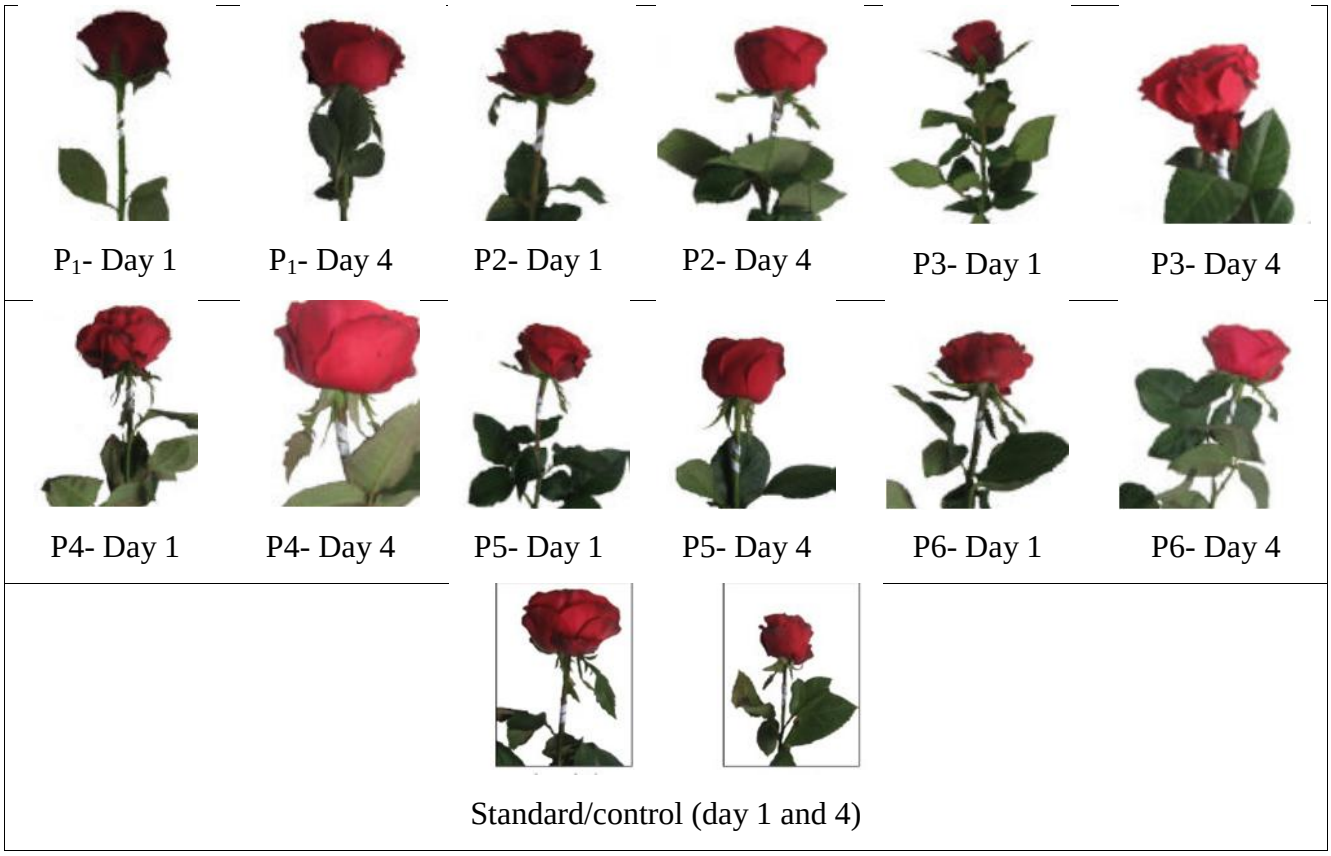

Figure 1. Matrix Comparisson of Roses

Table 7 Paired t-test between the first and fifth treatment (α = 0.05)

Moisture Content	**Sig.2 tailed**	**Conclusion**
S	0,003	Ho rejected
P1	0,846	Ho accepted
P2	0,130	Ho accepted
P3	0,080	Ho accepted
P4	0,004	Ho rejected
P5	0,199	Ho accepted
P6	0,001	Ho rejected
Texture	**Sig.2 tailed**	**Conclusion**
S	0,150	Ho accepted
P1	0,942	Ho accepted
P2	0,559	Ho accepted
P3	0,003	Ho rejected
P4	0,031	Ho rejected
P5	0,819	Ho accepted
P6	0,435	Ho accepted

Lightness	**Sig.2 tailed**	**Conclusion**
S	0,001	Ho rejected
P1	0,00	Ho rejected
P2	0,114	Ho accepted
P3	0,00	Ho rejected
P4	0,00	Ho rejected
P5	0,001	Ho rejected
P6	0,023	Ho rejected
Redness	**Sig.2 tailed**	**Conclusion**
S	0,055	Ho accepted
P1	0,051	Ho accepted
P2	0,586	Ho accepted
P3	0,001	Ho rejected
P4	0,112	Ho accepted
P5	0,07	Ho accepted
P6	0,108	Ho accepted

Ho: no significant difference between the first day and the fifth day
Ha: there is a significant difference between the first day and the fifth day

4. CONCLUSION

Based on the result, P_1 had the longest shelf life (8 days). The rest treatments had various shelf lives, as followsP_2 (6 days), P_3(4 days), P_4(6 days), P_5(5 days), and P_6(5 days). All treatment had longer shelf life than control.

REFERENCES

Amiarsi D, Yulianingsih, Murtiningsih dan Sjaifullah. 2002. *Penggunaan Larutan Perendam Pulsing untuk Mempertahankan Kesegaran Bunga Mawar Potong Idole dalam Suhu Ruangan*. *J. Hort*. 12(3):178-183.

Badan Pusat Statistik. 2010. *Hortikultura dan Fitofarmaka*.

Bourne, M. 2002. *Food Texture and Viscosity Concept and Measurement 2nd edition*. USA: Academic Press An Elsevier Science Imprint.

Butt, S.J. 2005. *Extending the Vase Life of Roses (Rosa hybrida) with Different Preservatives.* International Journal of Agriculture & Biology Vol.7, No.1 2005. Pakistan.

Deny, K. 2008. http://ineddeni.wordpress.com *Uji Berpasangan (Paired t-Test*). Accessed on March 24th 2011.

Doi, M, and Reid, M.S. 1995. Sucrose Improves the Postharvest Lifeof Cut Flowers of a Hybrid *Limonium*. Hortscience 30(5):1058–1060. California.

Falah, M. A. F. 2010. *Maintaining Freshness Quality of Fresh Cut Rose (Rosa sp) Flower Through Controlled Environment and Sucrose Pulse Treatment*. Proceeding International Seminar on Food and Agriculture Sciences. Bukittingi.

Liao, L. Lin, H. Liang, H,K. Chen, S,W. Cheng, M. 2000. *Postharvest Life of Cut Rose Flowers as Affected by Silver Thiosulfate and Sucrose.* Botanical Bulletin of Academia Sinica Vol 41, 2000. China.

Ketsa, S, T. Chitrapan, T. P. 1991. *Effect of Silver Nitrate and Silver Thiosulfate on Vase Life of Cut Roses.* Bangkok.

Putri, S. A. 2009. *Pengaruh Penggunaan Pulse Treatment Menggunakan Sukrosa Terhadap Kerusakan Produk Bunga Mawar (Rosa hybrida) Potong Segar.* Skripsi Jurusan Teknologi Industri Pertanian Universitas Gadjah Mada Yogyakarta. Tidak Diterbitkan.

Reid, M.S. 2004. *Produce Facts Rose, Spray Rose, Sweetheart Rose Recommendations for Maintaining Postharvest Quality*. California: Postharvest Technology Research & Information Center.

Sulusi, P. 2007. *Menjaga Bunga Potong agar Tetap Segar*. Warta Penelitian dan Pengembangan Pertanian Vol 29 No.6. Bogor.

Suyanti dan Murtiningsih. 2005. *Mawar Pemanfaatan untuk Bunga Potong, Bunga Kering, Aromaterapi, Kosmetik, dan Makanan.* Jakarta: Penebar Swadaya.

Teixeira da Silva, J.A. 2003.*The Cut Flower: Postharvest Considerations*. OnLineJournal of Biological Sciences 3 (4): 406-442.