Research Article

Standardization of post harvest management techniques for *Jasminum nitidum* flowers

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Abstract

A study was conducted to standardize post harvest management techniques for flowers of a clonal selection (Acc.Jn-1) of the underutilized jasmine, *Jasminum nitidum* evolved at TNAU. The experiment was laid out in CRD with four treatments and four replications. Polyethylene bags of 200 micron thickness with 15 cm x 9 cm dimension without ventilation were used for packaging the flowers. Observations were recorded on the visual quality in terms of freshness index, flowers opening index, colour retention index, fragrance index and shelf life of flowers and the physiological parameters associated with the post harvest quality of flowers, namely, moisture content, relative water content, physiological loss in weight, membrane integrity (measured in terms of solute leakage) and total carbohydrate content. It was found that treating the flowers with 4% boric acid followed by cold storage (5°C) could significantly extend the shelf life to 174.6 hours (compared to 71.32 hours in Control). This treatment recorded the maximum freshness index (98.76, 92.94 and 81.74 %), minimum flower opening index (1.91, 4.71 and 10.61 %), maximum colour retention index (97.23, 91.68 and 82.81 %) and fragrance index (2, 3 and 3) respectively during the second, fourth and sixth days after treatment of flower buds, which were significantly superior when compared to other treatments and control. This treatment also proved superior with respect to the physiological parameters, since it recorded the maximum moisture content (78.57 and 61.46 %), maximum relative water content (74.93 and 64.07 %), minimum physiological loss in weight (1.59 and 2.92 %), maximum membrane integrity (i.e., lowest solute leakage) (54.82 and 66.52 %) and maximum total carbohydrate content (92.00 and 75.00 mg g^{1}) observed during the second and fourth days after treatment of flower buds, when compared to the other treatments and control.

Keywords: *Jasminum nitidum*, post harvest, visual observations, physiological parameters, boric acid, polyethylene bags, packaging

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Introduction

Jasmine (*Jasminum* sp.) belongs to the family "Oleaceae", which is one of the oldest fragrant flowers cultivated by man. The term jasmine is derived from an Arabic word "Jessamine" and in Persian language it is called as "Yasmin" or "Yasmyn" which means fragrance Bailey, 1951 [1].There are more than 200 species of *Jasminum* of which 40 species have been identified in India, and 20 species are cultivated in South India Bhattacharjee, 1980 [2]. Among the commercial flowers, jasmine is considered the most important one possessing high exportable value and earning lucrative income for the flower growers.

Among the large number of *Jasminum* species existing, only three species (*J. sambac*, *J. grandiflorum*, *J. auriculatum*) have attained importance in commercial cultivation Rimando, 2003 [3]; Green and Miller, 2009 [4]. However, these three species do not produce flowers during the off-season from December to March. Preliminary research taken up at TNAU has indicated that besides the above species, few more species namely, *J. calophyllum, J. nitidum*, *J. rigidum, J. flexile* and *J. multiflorum (*Syn: *J. pubesecens)* possess economic importance since they produce flowers which are suitable for use as loose flower and the plants of these species are suitable for use as fragrant flowering garden plants. The above species have the added merit of flowering throughout the year Ganga *et al*., 2015 [5], unlike the three popular commercial species namely, *J. sambac, J. grandiflorum and J. auriculatum*, besides being relatively free from major pests and diseases.

Flowers are known for their aesthetic sense and people prefer them to remain fresh for a longer period of time. The floral physiology is quite complex and often researchers focus mainly on changes occurring during the senescence of petals and not necessarily the shelf life of flowers Desai *et al.,* 2012 [6]. In a previous research, Bose and Raghava 1975 [7] investigated the storage life of *J. sambac* and concluded that the flower buds can be stored in fresh condition for 6 days at 7.2 °C. Karuppaiah *et al.,* 2006 [8] has found that packing *J. sambac* flowers in 200 gauge polythene bags without ventilation proved effective in extending the post harvest life up to 81 hours. The present study was undertaken with the objective of optimizing post harvest techniques flowers of a clonal selection (Acc.Jn-1) of the underutilized jasmine, *Jasminum nitidum* evolved at TNAU (**Figure 1**).

Figure 1 (Acc.Jn-1) clone of underutilized jasmine, *Jasminum nitidum*

Materials and Methods

The experiment was conducted in the Department of Floriculture and Landscaping, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. Unopened fresh flower buds of uniform size were used for the study. Experiments were laid out in CRD with 4 treatments with 4 replications. Polyethylene bags of 200 gauge micron thickness and 15 cm x 9 cm dimension without ventilation were used for packing of flowers. The treatments included T_1 - Storage at room temperature (Control), T_2 - Storage under refrigeration 5^0 C, T_3 - Boric acid 4 % + Room temperature and T_4 - Boric acid 4% + Refrigeration 5^0 C. For boric acid treatment, 50 numbers of fresh flower buds of uniform size were treated, surface dried, packed in polyethylene bags and heat sealed. These bags were stored under room temperature or cold storage conditions. The temperature and relative humidity of the cold room were 5 °C and 80-85 % respectively, as per the recommendation of Bose and Raghava 1975 [7].

The quality parameters namely, freshness index, flower opening index, colour retention index, fragrance index (Least and undesirable-1, Mild-2, Strong-3, Very strong-4) and shelf life were recorded based on hedonic scale scoring as per Madhu 1999 [9]. Physiological paramaters namely moisture content (MC), relative water content (RWC), physiological loss in weight (PLW), membrane integrity (MI) and total carbohydrate content were determined as per Barrs and Weatherley 1962 [10]. All the observations were recorded on the second, fourth and sixth days after treatment. Standard procedure of Sukhatme and Amble 1985 [11] was adopted for statistical scrutiny of data.

Results and Discussion

Visual flower quality parameters

Data pertinent to the flower quality parameters recorded in the present study are presented in **Table 1**, **Figures 2-4**. Among the different treatments imposed, treating flowers with Boric acid 4% + Storage under refrigeration at 5^0 C (T_4) recorded the highest freshness index (98.76, 92.94 and 81.74 %) on the second, fourth and sixth days after treatment respectively (Figure 1). This was followed by flowers stored under refrigeration at 5^0C (T_2) with freshness index of 93.21, 81.46 and 67.46 % respectively. The lowest freshness index (78.89, 58.62 and 37.72 % respectively) was observed in the untreated Control. The lowest flower opening index of flowers (1.91, 4.71 and 10.61 % respectively) was observed in the treatment T_4 (Boric acid 4 % + Refrigeration 5^0C) and this was followed by flowers stored under refrigeration at 5^0C (T_2) with flower opening index of (5.43, 11.61 and 23.76 % respectively). Maximum flower opening index (26.30, 49.48 and 73.47 % respectively) was observed in Control (T_1). The maximum colour retention index of flowers was observed in the flowers subjected to Boric acid 4 % + Refrigeration at 5^0C (T_4) with the values being (97.23, 91.68 and 82.81 %). This was followed by the flowers stored under refrigeration at 5^0C (T_2) with colour retention index of 91.93, 82.71 and 71.73 % respectively. The lowest colour retention index of 67.80, 52.29 and 34.29 % respectively was observed in (T_1 – control). Among the different treatments, (T_4 – Boric acid 4 % + Refrigeration at 5^0C) recorded the highest fragrance index (2.00, 3.00 and 3.00 % respectively) and this was on par with (T_2 – flowers stored under refrigeration at 5^0C). The least fragrance index was observed in (T_1 – control) with the values of (2.00, 1.00 and 1.00 % respectively). The longest shelf life of flowers (174.60 hours) was also recorded in the treatment (T_4 – Boric acid 4 % + Refrigeration at 5^0C). This was followed by (T_2 – flowers stored under refrigeration at 5^0C) with shelf life of 143.79 hours. The shortest shelf life (71.32 hours) was observed in (T_1 – Control) (Figure 2).

Table 1 Effect of post harvest treatments on flower quality parameters of *Jasminum nitidum*

Treatments	**Freshness index (%)**			**Flower opening index (%)**			**Colour retention index (%)**			**Fragrance index**			**Shelf life (Hours)**
	Days after packing			**Days after packing**			**Days after packing**			**Days after packing**			
	2	**4**	**6**	**2**	**4**	**6**	**2**	**4**	**6**	**2**	**4**	**6**	
T_1 Storage at room temperature	78.89	58.62	37.72	26.30	49.48	73.47	67.80	52.29	34.29	2.00	1.00	1.00	71.32
T_2 – Storage under refrigeration 5^0C	93.21	81.46	67.46	5.43	11.61	23.76	91.93	82.71	71.73	2.00	3.00	3.00	143.79
T_3 - Boric acid 4 % + Room temperature	87.47	73.26	54.46	12.73	23.49	51.34	80.17	69.21	56.74	2.00	3.00	1.00	94.52
T_4 - Boric acid 4 % + Refrigeration 5^0C	98.76	92.94	81.74	1.91	4.71	10.61	97.23	91.68	82.81	2.00	3.00	3.00	174.60
Mean	89.58	76.57	60.34	11.59	22.32	39.79	84.28	73.97	61.39	2.00	2.50	2.00	121.05
SEd	1.94	1.64	1.35	0.35	0.24	0.98	1.14	1.51	1.76	0.03	0.02	0.05	4.00
CD(0.05)	4.49	3.78	3.11	0.81	0.56	2.26	2.63	3.50	4.06	0.07	0.05	0.13	9.23

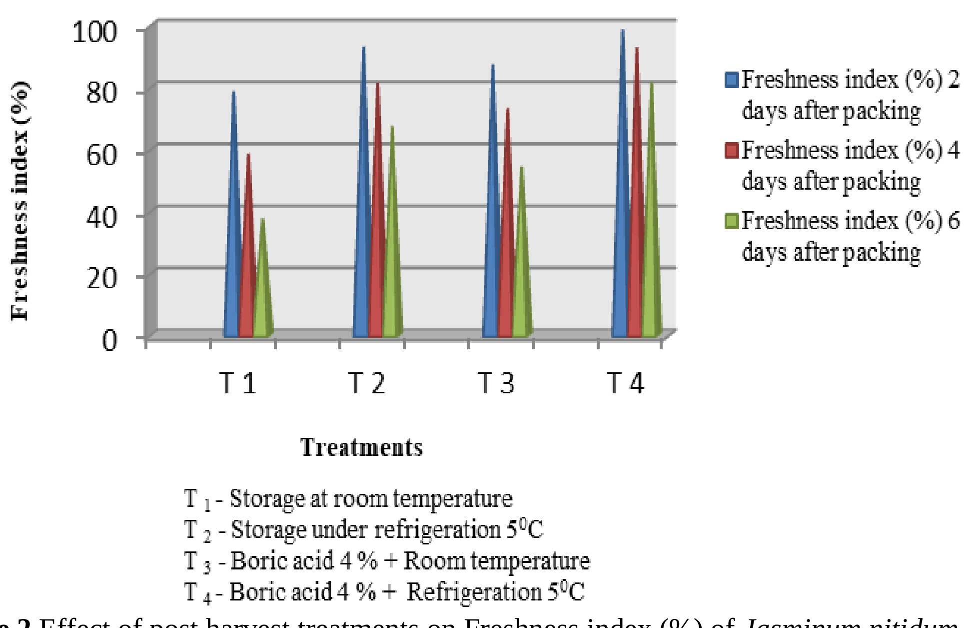
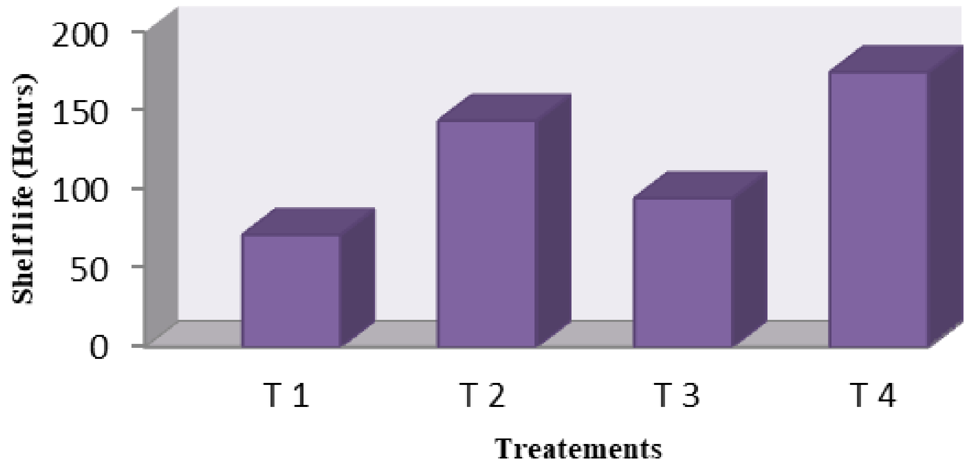


Figure 2 Effect of post harvest treatments on Freshness index (%) of *Jasminum nitidum* flowers

The results revealed that the Boric acid treated flower buds had higher freshness index and colour retention index than the untreated flower buds. Boron that has been implicated in cellular differentiation and development, hormone, fat and P metabolism, water relations and photosynthesis Nason and Mc Elroy, 1963 [12]. Boric acid has been used as a mineral salt that could increase the osmotic concentration and pressure potential of the petal cells, thus improving their water balance and longevity in cut flowers Halevy, 1976 [13], Vanmeeteren, 1989 [14]. In agreement with the present finding, the potential of boric acid in prolonging the post harvest life of flowers has been reported earlier in *Lupinus* Aarts, 1958 [15], jasmine Mukhopadhyay, 1980 [16], crossandra Bhattacharjee, 2002 [17], carnation Serrano *et al.*, 2006 [18], jasmine Thamaraiselvi, 2009 [19] and Bini sundar, 2011 [20] and tuberose Thamaraiselvi, 2009 [19].

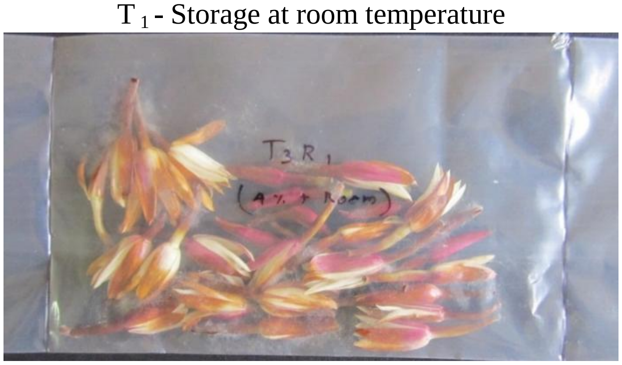


T_1 - Storage at room temperature
T_2 - Storage under refrigeration 5^0C
T_3 - Boric acid 4 % + Room temperature
T_4 - Boric acid 4 % + Refrigeration 5^0C

Figure 3 Effect of post harvest treatments on Shelf life (hours) of *Jasminum nitidum* flowers

T_1 - Storage at room temperature

T_2 - Storage under refrigeration 5^0C



T_3 - Boric acid 4 % + Room temperature

T_4 - Boric acid 4 % + Refrigeration 5^0C

Figure 4 Effect of post harvest treatments on shelf life and qualityof *Jasminum nitidum* flowers (7 days after treatment)

Flower physiological parameters

Data pertinent to the flower physiological parameters are presented in **Table 2** and Figure 4. Among the different post harvest treatments, Boric acid 4% + Refrigeration 5^0 C (T_4) recorded the highest moisture content (78.57, 61.46 and 43.37 % respectively) and this was followed by (T_2 - storage under refrigeration at 5^0 C) (71.34, 49.27 and 27.14 %) on second, fourth and sixth day after treatment. The lowest moisture content (51.93, 26.09 and 7.04 % respectively) was observed in (T_1- Control). The highest relative water content was observed in (T_4 - Boric acid 4% + Refrigeration 5^0 C) with values of (74.93, 64.07 and 52.60 %) on second, fourth and sixth day after treatment this was followed by (T_2 - storage under refrigeration at 5^0 C) with relative water content of (69.75, 57.29 and 44.02 %) and minimum relative water content (53.11, 37.55 and 21.68 %) was observed in (T_1 - Control) on second, fourth and sixth day after treatment.

Table 2 Effect of post harvest treatments on physiological parameters of *Jasminum nitidum* flowers

Treatments	Moisture content (%)			Relative water content (%)			Physiological loss in weight (%)			Membrane integrity (%)			Total carbohydrates (mg g^{1})		
	Days after packing			Days after packing			Days after packing			Days after packing			Days after packing		
	2	4	6	2	4	6	2	4	6	2	4	6	2	4	6
T_1 Storage at room temperature	51.93	26.09	7.04	53.11	37.55	21.68	4.72	7.29	11.43	69.95	89.08	97.04	58.00	34.00	16.24
T_2 Storage under refrigeration 5^0C	71.34	49.27	27.14	69.75	57.29	44.02	2.37	3.57	5.29	59.92	72.97	86.14	78.00	61.00	42.30
T_3 Boric acid 4 % + Room temperature	62.99	37.81	11.07	61.93	48.74	34.53	3.91	5.09	7.11	67.18	80.18	93.88	66.00	48.00	30.07
T_4 Boric acid 4 % + Refrigeration 5^0C	78.57	61.46	43.37	74.93	64.07	52.60	1.59	2.92	4.89	54.82	66.52	78.82	92.00	75.00	56.60
Mean	66.20	43.65	22.16	64.93	51.91	38.21	3.14	4.71	7.18	62.96	77.18	88.97	73.50	54.50	36.30
SEd	1.30	0.48	0.49	1.08	0.99	0.43	0.03	0.14	0.17	1.19	1.32	2.39	1.78	1.43	0.67
CD (0.05)	3.00	1.12	1.12	2.49	2.28	0.99	0.09	0.32	0.39	2.74	3.04	5.51	4.10	3.30	1.55

Similar reduction in moisture content due to rapid water loss in petals has also been reported in *Rosa hybrida* Carpentar and Rasmussen, 1973[21] and anthurium cv. Ozaki Red Paull and Goo, 1985 [22]. Similar evidence has also been reported in gladiolus, wherein a decrease in RWC of tepals caused the dehydration of tissues and in turn wilting Zahed Hossain *et al.*, 2006 [23]. The relative water content of the flowers manifests the water status of the flower petals. It is obvious that when moisture content is more and weight loss is less, relative water content stays at higher levels. Flowers subjected to treatment with Boric acid 4% + Storage under refrigeration at 5^0 C (T_4) recorded the lowest physiological loss in weight (1.59, 2.92 and 4.89 % respectively) and this was followed by flowers stored under refrigeration 5^0 C (T_2) (2.37, 3.57 and 5.29 % respectively). The highest physiological loss in weight (4.72, 7.29 and 11.43 % respectively) was observed in Control (T_1). The lowest solute leakage and hence the highest membrane integrity (54.82, 66.52 and 78.82 %) was observed in (T_4 - Boric acid 4% + Storage under refrigeration at 5^0 C). This was followed by (T_2 - flowers stored under refrigeration 5^0 C) with membrane integrity of (59.92, 72.97 and 86.14 %). The highest solute leakage (and hence the lowest membrane integrity (69.95, 89.08 and 97.04 %) was observed in (T_1 - Control) on second, fourth and sixth day after treatment.

Increased PLW leads to decline in fresh weight of flowers, which is expressed visually as senescing symptoms such as wilting of flowers as reported in carnation Nichols, 1966 [24] and in *Rosa damascena* Sharma, 1981[25]. A similar declining trend in fresh weight with an abrupt weight loss during senescence was also reported earlier in gerbera Burzo *et al.*, 1992 [26], tulip Jones *et al.*, 1995 [27] and *Rosa hybrida* cv. Samantha Xue and Lin, 1999 [28]. Contrary to the above, an increase in fresh weight was noticed during flower opening which reached a broad plateau and then fell again as the flower senesced was reported in daylily by Lukaszewski and Reid 1989 [29]. The changes in membrane permeability and an associated water loss as symptoms of petal wilting in flowers have been established in *Ipomoea* Hanson and Kende, 1976 [30] and jasmine Thamaraiselvi, 2009 [20]. Burger *et al.*, 1986 [31] reported that in senescing carnation cv. White Sim, the change in membrane permeability could be attributed to the alteration of lipid fraction of the lipoprotein membrane structure by lipid degrading enzymes. Solute leakage reflecting membrane deterioration has also been reported in carnation flowers Paulin *et al.*, 1986 [32].

A high degree of membrane deterioration expressed as decrease in membrane stability index percentage (MSI %) has also been reported in the tepals of wilted gladiolus flowers Zahed Hossain *et al.*, 2006 [23].

Among the different post harvest treatments, (T_4 - Boric acid 4% + Storage under refrigeration at 5^0 C) recorded maximum total carbohydrate level of (92.00, 75.00 and 56.60 mg g^{-1} respectively) and it was followed by (T_2 - flowers stored under refrigeration 5^0 C) (78.00, 61.00 and 42.30 mg g^{-1} respectively). Minimum total carbohydrates level of (58.00, 34.00 and 16.24 mg g^{-1} respectively) was observed in (T_1 - Control) on second, fourth and sixth day after treatment. Kazemi *et al.*, 2011 [33] reported that vase life of cut flowers seriously depends on carbohydrate status, and sugars degradation is a factor that is associated with senescence. Extension of vase life and prevention of fresh weight loss could be due to the prevention of ethylene synthesis, as a result of decrease in the amount of ACC synthase and ACC oxidase activity. These results are in accordance with those of Hoseinzadeh Liavali and Zarchini 2012 [34], Ezhilmathi *et al.,* 2007 [35] in cut roses. Senescence process of flowers is generally related to decrease in water content, depletion of carbohydrates and other nutrient reserves, modification of the enzyme activities and increase of ethylene production and action. Water loss is the major limiting factor that controls the post harvest physiology of flowers by enhancing their senescence and browning. Water stress limits the shelf life and a reduction in the rate of water loss relies mainly on maintaining a high relative humidity (90-98%) either through the use of packaging or by storage at low temperature Wills *et al*., 1998 [36].

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