Packaging Technology for Extending Shelf Life of Jasmine (Jasminum sambac CV. Gundumalli) Flowers

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A B S T R A C T

A research on standardization of method of packaging to extend shelf life of Jasminum sambac CV. Gundumalli was conducted in College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar during 2015-16. The experiment was laid out in FCRD with two factors in three replications, with 16 treatment combinations. Observations were recorded on the visual quality in terms of freshness index, flowers opening index, colour retention index, and shelf life of flowers and the physiological parameters associated with the postharvest quality of flowers, namely, moisture content, relative water content, physiological loss in weight. The flowers treated with 4% boric acid, packed in 60 micron polyethylene bags without ventilation and stored under 7°C significantly extend the shelf life to 168.33 hours with highest freshness index (87.74%), maximum colour retention index of (93.75%), and lowest flower opening index (11.25%), highest moisture content of (76.20%) and lowest physiological weight loss percent (0.48%) 48 hours after packing.

Keywords: Jasmine, Sucrose, Boric acid, NAA, Packaging method, Polythene bags, Micron thickness

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Introduction

Jasmine (Jasminum sambac Ait.) is one of the important and oldest fragrant flowers cultivated by man from very ancient days in India. It is highly esteemed for its attractive, white colour and a fragrant flower and has a pride of place in the heart of every Indian woman. In Fragrance industry, jasmine has unique importance and popularity due to its unique sweet fragrance like that of rose, vetiver and represents a type that cannot be exactly imitated at present by a mixture of any known synthetic aroma chemicals or natural isolates. The extracts of jasmine are used for flavouring or preparation of 'Jasmine scented Tea' in China and 'Jasmine rice' in Bangkok, Thailand. The antioxidant properties has the potential to induce weight loss and to reduce serum and hepatic lipid levels through the
increase of leptin level which address the burning problems of fattiness and obesity (Li Zhen et al., 2011) In addition to use as fresh flowers for making garlands and bouquets, for religious offerings, etc., now a days jasmine is emerging as an important industrial flower crop and also used for production of essential oils in the form of ‘concrete’ and ‘absolute’ used in cosmetic and perfumery industries and as a source of aroma chemicals and food flavouring industries. These flowers have good demand for export due to its attractive fragrance. But one of the major problem faced by farmers are lack of suitable packaging material, less shelf of flowers and browning of petals on the second day of harvest with abrupt loss in fragrance. In India, if we avoid wastage of horticultural produce up to 2% from field to market, there will be saving of 100 to 200 crores per year (Ramana et al., 1988) Keeping this in mind, a study was undertaken to enhance the shelf life of Gundumalli flower along with developing a packaging material for export.

Materials and Methods

The present experiment was conducted in the laboratory of Department of floriculture and landscaping, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar. Fully developed fresh flower buds of uniform size, shape and milky white colour, were used for the study. Fifty numbers of fresh flower buds of uniform size were treated with the chemicals and surface dried. Then the treated flowers packed in polythene bags of 40, 60 micron thickness and 20cm*12cm dimension without vents and heat sealed. These bags were stored under room temperature or cold storage conditions. The temperature and relative humidity of the cold room were 7 °C and 80-85 % respectively. This experiment was laid out in FCRD with 16 treatment combinations and 3 replications and the treatments comprised of two factors

**Chemical treatments**
- C1: Sucrose 4%
- C2: Boric acid 4%
- C3: NAA 100ppm
- C4: Water

**Packaging method**
- P1: Packed in 40micron polythene bags and Stored under7°C
- P2: Packed in 60micron polythene bags and Stored under7°C
- P3: Packed in 40micron polythene bags and Stored under room temperature
- P4: Packed in 60micron polythene bags and Stored under room temperature

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 Madhu1999. Physiological parameters namely moisture content (MC), relative water content (RWC), physiological loss in weight (PLW). All the observations were recorded on the 24th,48th hours after packing. Standard procedure of Sukhatme and Amble 1985 was adopted for statistical scrutiny of data.

Results and Discussion

Visual flower quality parameters

**Freshness index**

The data presented in table 1 revealed that among the different treatments imposed, treating flowers with Boric acid 4%, packed in 60micron polythene and stored under7°C (C2P2) recorded the highest freshness index (98.75, 87.74%) on the, 24th,48th hours after treatment respectively. The lowest freshness index 88.14, 55.82% respectively) was
observed in (C4P3) i.e. flowers treated with water and packed in 40 micron polythene and stored under room temperature.

**Colour retention index**

The data presented in table 2 revealed that the maximum colour retention index of flowers was observed when the flowers subjected to Boric acid 4% and packed in 60 micron polythene and stored under $7^\circ$C (C2P2) with the values being (100, 93.75 %), on the 24$^{th}$, 48$^{th}$ hours after treatment respectively. The lowest colour retention index of 77.77, 50.28 % respectively was observed in (C4P3) i.e. flowers treated with water and packed in 40 micron polythene and stored under room temperature.

**Flower opening index**

The lowest flower opening index (3.16, 11.25% respectively) was observed in the treatment C2P2 i.e. Boric acid 4% and packed in 60 micron polythene and stored under $7^\circ$C. Maximum flower opening index (10.92, 34.93 % respectively) was observed in (C4P3) i.e. flowers treated with water and packed in 40 micron polythene and stored under room temperature.

**Shelf life**

The data presented in table 4 and figure 4 revealed that the longest shelf life of flowers (168.33 hours) was recorded in the treatment C2P2 i.e. Boric acid 4% and packed in 60 micron polythene and stored under $7^\circ$C. The shortest shelf life (60.75 hours) was observed in (C4P3) i.e. in flowers treated with water and packed in 40 micron polythene and stored under room temperature.

The results revealed jasmine flowers treated with Boric acid 4 %. Packed in 60 micron polythene and stored under $7^\circ$C had highest freshness index and colour retention index with a longest shelf life (168.33 hours) while flowers treated with water and packed in 40 micron polythene and stored under room temperature lost their colour, fragrance and with a shortest shelf life (60.75 hrs.).

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 as reported by Vanmeeteren, (1989). This might be due to treatment of boric acid is an antisense agent. Burzo et al., (1998) reported that the brown colouration and loss of fragrance might be due to the accumulation of flavins and other phenolic substances in flower cell vacuoles. The phenol accumulation was also found to be minimum with normal colour retention and fragrance in the packed flowers than the control. In agreement with the present finding, the potential of boric acid in prolonging the postharvest life of flowers has been reported earlier in jasmine by (Mukhopadhyay et al., 1980, Binisundar, 2011, Jawaharlalet al., 2012, Manimaranet al., 2018) in crossandra by Bhattacharjee, 2002, in carnation by Serrano et al., 2006.

**Flower physiological parameters**

**Moisture content**

The data presented in table 5 and figure 2 revealed that the highest moisture content of flowers (168.33 hours) was observed when the flowers subjected to Boric acid 4% and packed in 60 micron polythene and stored under $7^\circ$C (C2P2) with the values being (82.36, 76.20 %), on the 24$^{th}$, 48$^{th}$ hours after treatment respectively. The lowest moisture content (54.88, 35.09 % respectively) was observed in (C4P3) i.e. flowers treated with water and packed in 40 micron polythene and stored under room temperature.
### Table 1 Effect of chemical treatment and packaging on freshness index of *Jasminum sambac*

|                | 24 hours after packing | 48 hours after packing |                | 24 hours after packing | 48 hours after packing |
|----------------|------------------------|------------------------|----------------|------------------------|------------------------|
|                | P1         | P2         | P3         | P4         | Mean    | P1         | P2         | P3         | P4         | Mean    |
| C1             | 93.82     | 95.74     | 90.71     | 91.24     | 92.88   | 83.57     | 85.99     | 70.09     | 72.80     | 78.11   |
| C2             | 97.99     | 98.75     | 93.42     | 94.36     | 96.13   | 86.25     | 87.74     | 77.02     | 79.28     | 82.57   |
| C3             | 96.02     | 97.23     | 92.17     | 93.16     | 94.65   | 84.28     | 85.00     | 73.14     | 75.08     | 79.38   |
| C4             | 95.20     | 92.13     | 88.14     | 89.42     | 91.22   | 75.14     | 77.77     | 55.82     | 56.56     | 66.32   |
| MEAN           | 95.76     | 95.96     | 91.11     | 92.05     | 93.72   | 82.31     | 84.13     | 69.02     | 70.93     | 76.60   |

|                | SEm(±)   | CD(0.05) |
|----------------|----------|----------|
| Packing(p)     | 1.01     | 2.90     |
| Chemical©      | 1.01     | 2.90     |
| PXC            | 2.01     | NS       |

### Table 2 Effect of chemical treatment and packaging on colour retention index of *Jasminum sambac*

|                | 24 hours after packing | 48 hours after packing |                | 24 hours after packing | 48 hours after packing |
|----------------|------------------------|------------------------|----------------|------------------------|------------------------|
|                | P1         | P2         | P3         | P4         | Mean    | P1         | P2         | P3         | P4         | Mean    |
| C1             | 100.00    | 100.00    | 100.00    | 100.00    | 100.00 | 82.71     | 83.89     | 74.72     | 75.93     | 79.31   |
| C2             | 100.00    | 100.00    | 100.00    | 100.00    | 100.00 | 92.41     | 93.75     | 80.29     | 84.88     | 87.83   |
| C3             | 100.00    | 100.00    | 88.89     | 77.77     | 91.67   | 80.35     | 81.66     | 50.28     | 51.71     | 66.00   |
| C4             | 100.00    | 100.00    | 97.22     | 94.44     | 97.92   | 86.50     | 88.00     | 70.55     | 72.69     | 79.43   |
| MEAN           | 100.00    | 100.00    | 97.22     | 94.44     | 97.92   | 86.50     | 88.00     | 70.55     | 72.69     | 79.43   |

|                | SEm(±)   | CD(0.05) |
|----------------|----------|----------|
| Packing(p)     | 0.12     | 0.35     |
| Chemical©      | 0.12     | 0.35     |
| PXC            | 0.24     | 0.71     |

### Table 3 Effect of chemical treatment and packaging on flower opening index of *Jasminum sambac*

|                | 24 hours after packing | 48 hours after packing |                | 24 hours after packing | 48 hours after packing |
|----------------|------------------------|------------------------|----------------|------------------------|------------------------|
|                | P1         | P2         | P3         | P4         | Mean    | P1         | P2         | P3         | P4         | Mean    |
| C1             | 6.19      | 5.83      | 10.25     | 9.31      | 7.89    | 18.75     | 16.25     | 27.12     | 26.10     | 22.05   |
| C2             | 4.16      | 3.16      | 9.42      | 8.12      | 6.21    | 13.75     | 11.25     | 21.23     | 20.75     | 16.74   |
| C3             | 5.82      | 5.00      | 9.12      | 9.05      | 7.24    | 15.00     | 12.50     | 25.25     | 23.75     | 19.12   |
| C4             | 9.15      | 8.75      | 10.92     | 10.15     | 9.74    | 22.50     | 19.24     | 34.93     | 30.94     | 26.90   |
| MEAN           | 6.33      | 5.68      | 9.92      | 9.15      | 7.77    | 17.50     | 14.81     | 27.13     | 25.38     | 21.20   |

|                | SEm(±)   | CD(0.05) |
|----------------|----------|----------|
| Packing(p)     | 0.17     | 0.48     |
| Chemical©      | 0.17     | 0.48     |
| PXC            | 0.17     | 0.48     |
Table 4: Effect of chemical treatment and packaging on shelf life of Jasminum sambac

|          | P1     | P2     | P3     | P4     | Mean   |
|----------|--------|--------|--------|--------|--------|
| **C1**   | 140.5  | 148.66 | 68.5   | 73     | 107.67 |
| **C2**   | 158.08 | 168.33 | 74.16  | 78.75  | 119.83 |
| **C3**   | 144.16 | 150.33 | 72.75  | 75.5   | 110.69 |
| **C4**   | 120.75 | 127.83 | 60.75  | 65.66  | 93.75  |
| **Mean** | 140.87 | 148.78 | 69.04  | 73.22  | 107.98 |

SEm(±) CD(0.05)

|          | 1.10   | 3.20   |

Packing (p)

| Chemical © | 1.10   | 3.20   |

PXC

|        | 2.21   | 6.40   |

Table 5: Effect of chemical treatment and packaging on moisture content of Jasminum sambac

|          | 24 hours after packing | 48 hours after packing |
|----------|------------------------|------------------------|
| **C1**   | 75.75                  | 78.68                  |
|          | 58.17                  | 60.62                  |
|          | 68.31                  | 72.85                  |
|          | 54.79                  | 68.31                  |
| **C2**   | 80.15                  | 82.36                  |
|          | 63.07                  | 67.56                  |
|          | 70.95                  | 74.38                  |
|          | 55.17                  | 68.31                  |
| **C3**   | 78.02                  | 80.14                  |
|          | 62.15                  | 63.47                  |
|          | 70.95                  | 74.38                  |
|          | 55.17                  | 68.31                  |
| **C4**   | 74.02                  | 75.05                  |
|          | 54.88                  | 55.96                  |
|          | 64.98                  | 70.95                  |
|          | 55.17                  | 68.31                  |
| **Mean** | 76.99                  | 79.06                  |
|          | 59.57                  | 61.90                  |
|          | 69.38                  | 69.86                  |
|          | 50.89                  | 71.19                  |
|          | 52.08                  | 61.01                  |

SEm(±) CD(0.05)

|          | 0.31     | 0.90     |
|          | 0.31     | 0.90     |
|          | 0.62     | 1.80     |

Table 6: Effect of chemical treatment and packaging on Relative water content, Jasminum sambac

|          | 24 hours after packing | 48 hours after packing |
|----------|------------------------|------------------------|
| **C1**   | 89.03                  | 90.86                  |
|          | 83.19                  | 85.08                  |
|          | 87.04                  | 85.08                  |
|          | 86.37                  | 61.17                  |
| **C2**   | 91.82                  | 93.40                  |
|          | 89.52                  | 90.73                  |
|          | 91.37                  | 87.27                  |
|          | 89.35                  | 77.74                  |
| **C3**   | 90.81                  | 91.26                  |
|          | 87.74                  | 88.26                  |
|          | 89.52                  | 86.23                  |
|          | 88.47                  | 64.44                  |
| **C4**   | 85.06                  | 87.27                  |
|          | 81.15                  | 84.64                  |
|          | 84.53                  | 78.94                  |
|          | 80.05                  | 49.82                  |
| **Mean** | 89.18                  | 90.70                  |
|          | 85.40                  | 87.18                  |
|          | 88.11                  | 84.38                  |
|          | 86.06                  | 63.29                  |
|          | 64.74                  | 74.62                  |

SEm(±) CD(0.05)

|          | 0.83     | 2.4      |
|          | 0.83     | 2.4      |
|          | 1.66     | NS       |
|          | 0.83     | 2.4      |
|          | 0.83     | 2.4      |
|          | 1.66     | NS       |

1728
Table 7 Effect of chemical treatment and packaging on physiological weight loss percent of *Jasminum sambac*

|               | PLW (%)     |               |               |       |       |       |       |       |       |       |       |       |
|---------------|-------------|---------------|---------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|               | 24 HOURS    | 48 HOURS      |               |       |       |       |       |       |       |       |       |       |
|               | P1          | P2            | P3            | P4    | MEAN  | P1    | P2    | P3    | P4    | MEAN  | P1    | P2    |
| C1            | 1.22        | 0.21          | 2.47          | 2.23  | 1.53  | 1.65  | 0.77  | 6.01  | 5.00  | 3.36  | 1.03  | 1.57  |
| C2            | 0.18        | 0.12          | 0.85          | 0.65  | 0.45  | 1.24  | 0.48  | 3.33  | 2.26  | 1.83  | 0.67  | 1.37  |
| C3            | 0.23        | 0.14          | 2.41          | 1.71  | 1.12  | 1.43  | 0.52  | 3.75  | 2.70  | 2.10  | 0.87  | 1.70  |
| C4            | 1.29        | 0.27          | 2.78          | 2.62  | 1.74  | 2.09  | 0.88  | 7.08  | 6.00  | 4.01  | 1.26  | 2.03  |
| MEAN          | 0.73        | 0.19          | 2.09          | 1.84  | 1.21  | 1.60  | 0.66  | 5.04  | 3.99  | 2.82  | 0.73  | 1.57  |
| SEm(±)        | 0.03        | 0.08          | 0.04          | 0.12  |
| CD 0.05       | 0.03        | 0.08          | 0.04          | 0.12  |
| packing(p)    | 0.061       | 0.17          | 0.08          | 0.246 |
| chemical©     | 0.061       | 0.17          | 0.08          | 0.246 |
| PXC           | 0.061       | 0.17          | 0.08          | 0.246 |

Fig.1 Effect of chemical treatment and packaging on shelf life of *Jasminum sambac*

N.B C1: Sucrose 4%, C2: Boric acid 4% C3: NAA 100ppm C4: Water
P1: Packed in 40micron polythene bags and Stored under 7°C
P2: Packed in 60micron polythene bags and Stored under 7°C
P3: Packed in 40micron polythene bags and Stored under room temperature
P4: Packed in 60 micron polythene bags and Stored under room temperature
Fig. 2 Effect of chemical treatment and packaging on moisture content (%) of *Jasminum sambac*

![Bar chart showing the effect of different treatments on moisture content](image)

N.B C1: Sucrose 4%, C2: Boric acid 4% C3: NAA 100ppm C4: Water
P1: Packed in 40 micron polythene bags and stored under 7°C
P2: Packed in 60 micron polythene bags and stored under 7°C
P3: Packed in 40 micron polythene bags and stored under room temperature
P4: Packed in 60 micron polythene bags and stored under room temperature

**Relative water content**

From Table 6, it is clear that the relative water content was highest when the flowers subjected to Boric acid 4% and packed in 60 micron polythene and stored under 7°C (C2P2) with the values being (93.40%, 89.35%), on the 24th and 48th hours after treatment respectively. The lowest relative water content (81.15, 49.82% respectively) was observed in (C4P3) i.e. flowers treated with water and packed in 40 micron polythene and stored under room temperature.

**Physiological loss in weight**

The lowest physiological weight loss percent (0.12%, 0.48% respectively) was observed in the treatment C2P2 i.e. Boric acid 4% and packed in 60 micron polythene and stored under 7°C on the 24th and 48th hours after treatment respectively.

The highest physiological weight loss percent (2.78%, 7.08% respectively) was observed in (C4P3) i.e. flowers treated with water and packed in 40 micron polythene and stored under room temperature.

Physiological loss in weight (PLW), moisture content, relative water content (RWC) of flowers are traits inter-related to each other. Increased PLW leads to decline in fresh weight of flowers, which expresses visually as symptoms of wilting of flowers, as reported in carnation (Nichols, 1966) and Rosa damascena (Sharma, 1981). Relative water content of flowers manifests water status of petals. It is obvious that when moisture content is higher and weight loss is lower, relative water content stays high. Similar
Evidence has been reported in gladiolus, wherein a decrease in RWC of petals caused the dehydration of tissues and in turn wilting, as reported by ZahedHossain et al., 2006. This might be due to maintenance of optimum humidity temperature and proper balance of CO\textsubscript{2} and O\textsubscript{2} concentration under refrigerated condition which in turns slows down the process of respiration and evapo transpiration and ultimately reduced the PLW. The results are in close agreement with the findings of Nirmala and Venkatesh Reddy (1993) and Yathindra et al. (2018).

From the present investigation, it may be concluded that for long term storage of J. sambac flowers, a packaging technology of treatment with 4% boric acid + packing 60 micron polythene bags with no ventilation and stored under 7\textdegree C proved effective with a high freshness index, colour retention index, high moisture content and low physiological loss in weight. Flowers in this package can be kept fresh for a longer period with a shelf life of 168.33 hours.

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