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RESEARCH ARTICLE

POST HARVEST SHELF LIFE INFLUENCED BY WRAPPING AND PACKAGING TECHNIQUES IN CARNATION

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ABSTRACT

Carnation is the most important cut flower in the international trade market and is highly perishable in nature and need to be treated and packed properly to improve their post harvest quality and vase life. Cut carnations are very sensitive to ethylene injury. In the existence of ethylene, cut carnation flowers have restriction for their fruitful marketing due to petal enrolling and discoloration. It leads to flower senescence and reduction in vase life. As carnations have ability to rehydrate after transportation, its flower quality during long distance transportation should be maintained. The experiment was conducted by wrapping the flowers with cellophane sheets, polyethylene, polypropylene, butter paper and corrugated thin sheets and packed in corrugated fibre board boxes during transport of flowers to long distant market. Among the wrapping materials compared, polyethylene sleeve of 100 gauge thickness was superior and it was associated with highest water uptake (15.38 g), water balance (8.78 g), fresh weight change (176.29 per cent), anthocyanin (1.352 mg/g) and carotenoid content (0.056 mg/g) and the lowest transpirational loss of water (10.26 g). This wrapping technique ensured minimum physical damage, physiological loss in weight (39.62 per cent), membrane integrity (80.64 per cent), peroxidase activity (0.023 units/g fresh weight) and extended the vase life to 15.67 days when compared to control the flowers remained fresh for 7.0 days only.

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INTRODUCTION

Carnation is the most important cut flower because of highest economic importance in the floricultural industry. Carnation flowers are sold year around but specifically during the Valentine's day, Christmas and New Year are in great demand and fetches high price in the world flower market. In the International cut flower trade, carnation stands among the top ten cut flowers because of carnation's excellent keeping quality, it holds an esteemed position. Carnation is a climacteric flower that is highly sensitive to ethylene (Pun *et al.*,1999). Due to high perishability, cut flowers are vulnerable to large post-harvest losses upto 50 per cent of the farm value. It has the ability to withstand long distance transportation, remarkable ability to rehydrate along with its lighter weight and excellent keeping quality has made carnation flowers a unique item in cut flower trade. Packaging is an important aspect in the flower trade and much depends on the proper method of packing to ensure quality flowers to the consumer.

Packaging must ensure protection of flowers against flower damage, water loss and external conditions, which are detrimental to flowers in transit (Sivaswamy *et al.*,1999). The main principles of packaging was to prevent mechanical injury and make them retain their freshness, attractiveness and quality (Maini *et al.,* 1993) to lower the rate of transpiration, respiration and cell division during transportation. Boxes made of corrugated fibre board are suitable for packing of carnation (Bhattacharjee, 1999). Post-harvest life of cut flowers also depends upon efficient packaging and storage. It protects the flowers from unfavorable outside conditions and enables a micro-climate to develop inside the package (Lavanya *et al*., 2016). The flowers are packed after bunching in sleeves and finally in card board boxes having dimensions of 122 x 50 x 30 cm. Bunch of 25 flowers is placed in the box with one half of the total bunches oriented on each end of the container. When the box is filled with flowers, insulating layer of paper is placed across box to cover the flowers completely.

Flowers are stored at 1° C (34° F) in a box lined with polyethylene and newspaper. Open flowers can be stored 2 to 4 weeks, while bud-cut flowers, can be safely stored up to 4 or 5 weeks. Hauge *et al.* (1977) reported that roses sealed in cellophane sleeves could be kept for five days at 4.5 to 7.2°C without any loss in storage quality. The advantage of using tight packs for dry stored flowers is the modification of the atmosphere inside the package, which is a result of the slow but constant respiration of the carnation flowers (Goszczynska and Rudnicki, 1983). Ahn (1999) reported that packing roses cv. Mary de Vor in corrugated cardboard boxes (CCB) gave an extended vase life. Rajni *et al.* (2000) revealed that the decrease in mechanical strength of the stems caused by simulated transit for 24 hours was lower in rose cv. Queen Elizabeth wrapped with polyethylene sleeves (7.51 per cent) than in corrugated paper (13.75 per cent). Beura and Singh (2003) reported that both cellophane and butter paper packed gladiolus spikes stored at 4°C for 2, 4 and 6 days recorded significantly highest vase life. Mariam *et al.* (2003) reported that flowers of rose cv. Golden Gate packed in butter paper had vase life for six months. Suhrita *et al.* (2005) observed that packing in polythene sleeve was better than newspaper packing for gladiolus.

MATERIALS AND METHODS

The study was undertaken in the Department of Floriculture and Landscaping, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. The experiment was laid out in completely randomized block design consisting of six treatments and replicated thrice. In the present investigation, different wrapping materials *viz*., W_1- Corrugated thin sheet, W_2- Polyethylene (PE; 100 gauge thickness) sleeves, W_3 - Polypropylene (PP; 100 gauge thickness) sleeve, W_4- Cellophane sleeve, W_5- Butter paper and W_5- Control (without wrapping) were used for packing the flowers. Immediately after harvest, the flower stalks were placed in a bucket containing water. The leaves from the lower one-third portion of the flower stalks are removed.

Table 1. Effect of wrapping materials on the physical parameters in carnation cv. Malaga

Treatments	Water uptake (g)	Transpirational loss of water (g)	Water balance (g)	Fresh weight change (% of initial weight)	Flower freshness (days)	Vase life (days)
W_1 - Corrugated thin sheet	8.03	12.43	6.38	84.22	13.00	11.33
W_2 - Polyethylene (PE; 100 gauge thickness) sleeve	15.38	10.26	8.78	176.29	15.50	15.67
W_3 - Polypropylene (PP; 100 gauge thickness) sleeve	9.30	12.37	7.93	116.19	14.17	13.33
W_4 - Cellophane sleeve	11.20	13.73	8.47	150.54	14.67	13.33
W_5 - Butter paper	8.72	12.23	7.48	113.73	13.33	12.00
W_6 - Control (without wrapping)	8.20	11.30	6.60	73.64	9.17	7.33
SE(d)	0.173	0.219	0.491	3.071	0.451	0.544
CD (5%)	0.377	0.478	1.069	6.691	0.983	1.186

Table 2. Effect of wrapping materials on the physiological and biochemical parameters in carnation cv. Malaga

	Physiological and biochemical parameters						
Treatments	Physiological loss in weight (%)	Loss of membrane integrity (%)	Total sugar content (mg/g)	Reducing sugar content (mg/g)	Peroxidase activity (units/g fresh weight)	Anthocyanin content (mg/g)	Carotenoid content (mg/g)
W_1 - Corrugated thin sheet	54.10	92.55	0.228	0.111	0.036	0.755	0.036
W_2 - Polyethylene (PE;100 gauge thickness) sleeve	39.62	80.64	0.252	0.131	0.023	1.352	0.056
W_3 - Polypropylene (PP;100 gauge thickness) sleeve	58.26	91.45	0.234	0.115	0.030	1.117	0.041
W_4 - Cellophane sleeve	45.83	91.28	0.238	0.126	0.026	1.148	0.048
W_5 - Butter paper	61.42	92.44	0.231	0.115	0.032	1.016	0.038
W_6 - Control (without wrapping)	63.52	96.45	0.106	0.052	0.040	0.341	0.028
SE(d)	1.938	0.945	0.0015	0.0016	0.0005	0.0020	0.0007
CD (5%)	4.222	1.732	0.0032	0.0036	0.0010	0.0043	0.0020

A bunch of 25 flowers were inserted in the unsealed wrapping sleeves and packed in 5 ply cardboard fibre board boxes with dimension of 100x40x30 cm. The boxes were placed in the cool chamber for 24 hours to simulate transit. After the simulated transit, the flower stalks were taken out. The basal portions were recut and the flower stalks were rehydrated by dipping in water for 30 minutes. The vase life parameters were evaluated in distilled water at ambient temperature. The physical parameters viz., Transpirational loss of water (TLW), Water Uptake, Water balance, Fresh weight change (FWC) were taken at alternate days interval. The vase life of cut lower was evaluated daily by counting the number of days taken for the symptom of shrivelling and wilting. Physiological parameters *viz.*, Physiological loss in weight (%), Membrane integrity (%) and Biochemical parameters *viz.*, total sugars (mg/g), reducing sugars (mg/g), peroxidase activity (change in OD/g/min) (POD), anthocyanin content and carotenoid content (mg/g) were observed during 1, 6 and 12th day of treatment for the studies. The statistical analysis was done by adopting the standard procedures of Panse and Sukhatme (1985). The information available on the packaging of carnation is very meager. Hence, the present study was undertaken to determine the effect of different packaging materials on post harvest quality and vase life.

RESULTS AND DISCUSSION

Vase life of cut flowers is one of the main characteristics determining the commercial value of the ornamental flowers (Nukui *et al.* 2004). Usually the vase life of carnation flower has been determined by observing senescence profiles *i.e*., in-rolling of petal margin and wilting of whole petals as well as ethylene production. Wrapping provides modified atmosphere for flowers and slows down the respiration, transpiration and cell division process, but these conditions remains only up to a specific period of time (Bhattacharjee, 1997) and the wrapping materials may tend to retain the moisture, reduce the transpirational loss of water, aid in retaining the freshness of lower and protect the lower from mechanical damage.

Physical parameters: The highest water uptake (15.38 g/stalk) was recorded in the flowers wrapped in Polyethylene sleeves than Control (8.20 g/stalk) on day 12.

The water uptake increased at each successive intervals of observation from day 2 to day 8 but decrease in water uptake from day 10 towards the end of vase life. This increased water uptake might be due to reduced damage in the conducting vessels ensuring continuous water uptake as reported by Jeeva and Balakrishnamoorthy (1999) in rose.

The decreased water uptake was mainly due to plugging of xylem vessels caused by bacteria as reported by Doorn *et al*. (1986). The highest water balance (8.78 g/stalk) was recorded in the Polyethylene sleeves wrapped flowers. Thus, the polyethylene sleeves exhibited better mechanical strength. It might however be cautioned that prolonged wrapping in polyethylene sleeves could increase the microbial growth on the buds due to high moisture retention as supported by Rajni *et al*.(2000). The transpirational loss of water (10.26 g/stalk) was found to be lowest in the Polyethylene sleeves wrapped flowers. The increased transpirational loss may be due to the increased water uptake exhibited and thus maintained the water balance. This was in line with the findings of Beura and Singh (2003) in gladiolus. The fresh weight change (176.29 percent) was highest in Polyethylene sleeves wrapped flowers. Higher fresh weight was due to the higher turgor and lower moisture loss during storage. Increased water uptake might also be the reason for maintenance of fresh weight. This was in line with the work of Divya (2003) in rose. Similarly, the flowers remained fresh for 15.50 days with the treatment with Polyethylene sleeves. Thus, the retainment of flower freshness which might be due the polyethylene sleeves that protects the flowers from water loss and permits gas exchange, maintains fresh weight and turgidity of flowers (Dutt, 1998).

The longest vase life of 15.67 days was recorded with Polyethylene sleeves wrapped flowers and in control the flowers remained fresh for 7 days only. This might be due to the creation of modified atmosphere in moisture proof containers, which increased the concentration of carbondioxide, limits the action of ethylene and binding sites for ethylene. Increased vase life was also due to increased water uptake and fresh weight maintenance. These results are strengthened by Nichols (1973).

Physiological parameters: The physiological loss in weight (39.62 per cent) recorded was lowest in the Polyethylene sleeves wrapped flowers. The reduced physiological loss in weight might be due to creation of modified atmosphere with low temperate and high humidity, which reduced the concentration of oxygen thereby reducing respiration. The concentration of carbon dioxide would be increased as the substrate for respiration was limited which reflected the low physiological loss in weight as postulated by Suhrita *et al*. (2005). However, the loss in membrane integrity (80.64 per cent) was also lowest in Polythene sleeves wrapped flowers than the control (96.45 per cent). The total sugars (0.252 mg/g) and reducing sugars (0.131 mg/g) were found to be high in the Polythene sleeves wrapped flowers.

Biochemical parameters: The peroxidase activity increased towards the senescence. The peroxidase activity (0.023 units/g fresh weight) was observed to be low in Polythene sleeves wrapped flowers. The anthocyanin (1.352 mg/g) and carotenoid content (0.056 mg/g) were found to be high in Polythene sleeves wrapped flowers. The beneficial effect of wrapping in polyethylene sleeves might be due to the reason that it provides the modified atmosphere for the flowers and slows down respiration, transpiration and cell division processes but these condition remains only up to a specific period of time. This was in accordance with the findings of Prem *et al*. (2004).

CONCLUSION

To conclude, the study has revealed many facts that to standardize wrapping techniques in carnation, polyethylene sleeve of 100 gauge thickness packed flowers exhibited the best performance also enhanced the shelf life of carnation flowers after harvest and improves the quality of flowers in the packing for long distance transport to fetch higher prices for the flowers. It enhanced the water uptake, water balance, fresh weight, bud opening, freshness, colour, vase life, total and reducing sugars, anthocyanin and carotenoid pigments and reduces the physiological loss in weight, loss in membrane integrity and peroxidase activity.

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