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Studies on extending storage life of gaillardia loose flowers using different chemical sprays and packaging material

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Abstract
The experiment entitled Studies on extending storage life of Gaillardia loose flowers using different chemical sprays and packaging material was conducted at Floricultural Research station, Rajendranagar during *Rabi* of 2020-21. The treatments comprised of T_1 Ascorbic acid @ 200 ppm + Cloth bag, T_2 $CaCl_2$ @ 0.5% + Cloth bag, T_3 Ascorbic acid @ 200 ppm + Gunny bag, T_4 $CaCl_2$ @ 0.5% + Gunny bag, T_5 Ascorbic acid @ 200 ppm + Bamboo basket, T_6 $CaCl_2$ @ 0.5% + Bamboo basket, T_7 Ascorbic acid @ 200 ppm + Plastic net bag, T_8 $CaCl_2$ @ 0.5% + Plastic net bag, T_9 Ascorbic acid @ 200 ppm + Plastic woven bag and T_{10} $CaCl_2$ @ 0.5% + Plastic woven bag. The treatment containing Ascorbic acid @ 200 ppm + Plastic woven bag recorded maximum shelf life (55.67 hrs), freshness index (55.14), minimum physiological loss in weight (5.79%), percentage spoilage (60.00%) and flower shrinkage (22.67%) when compared to other treatments. The results suggest that Ascorbic acid @ 200 ppm + Plastic woven bag can be used to enhance the storage life of Gaillardia loose flowers.

Keywords: gaillardia loose flowers, chemical sprays, packaging material

Introduction
Gaillardia (*Gaillardia pulchella* Foug.) is one of the important flower crop that belongs to the "Asteraceae" family and native of Central and Western United States. It is commonly known as "Blanket flower" and "Fire wheel". The genus name Gaillardia was proposed in honour of Mr. M. Gaillard, a French patron of botany.

In India, Gaillardia is grown all-round the year. It is one of the hardy annual that can be grown in a wide range of tropical and temperate climatic conditions. It is the substitute flower crop for chrysanthemum and China aster, whenever there is shortage of supply of these flowers (Bose *et al*., 2003) [3] and during summer months.

Ascorbic acid is an antioxidant that increases the vase life of flowers by reducing the respiration rate and ethylene production. It is an important chemical for plant growth and development, cell division, cell wall metabolism, root development, photosynthesis, regulation of florescence, regulation of leaf senescence and enzyme activity (Zhang, 2013) [15]. There is huge scope for using these chemicals to study their effect on increasing the postharvest life of Gaillardia flowers.

Chemicals like calcium chloride helps in improving postharvest quality of cut flowers by increasing the floral longevity. The application of calcium in holding solutions is used to extend the postharvest preservation. It also includes benefits like stronger cell walls and increased disease resistance (Robichaux, 2005) [10].

Packaging is a tool for controlling flower quality in the distribution chain. Apart from preventing mechanical damage, the package serves as a barrier between the conditions inside and outside the package. It protects the flowers from unfavourable outside conditions and enables a micro climate to develop inside the package (Nowak and Rudnicki, 1991) [7]. It also makes the flowers to look fresh and of good quality. The main principle of packing is towards long storage life and keeping quality of flowers by lowering the rate of transpiration, respiration and cell division during transportation and storage. Since flowers are delicate and highly perishable, they need great attention through advanced technologies in packaging to keep them fresh to consumer's satisfaction. By improving the packaging techniques farmers can get more income by extending the storage life and keeping them fresh for longer time (Bhattacharjee, 1997) [2].

Materials and Methods

The present investigation was carried out at Post harvest Laboratory, Floricultural Research Station, ARI, Rajendranagar, Hyderabad during *Rabi* season of the year 2020-21. The experimental location is situated at an altitude of 542.3 m above mean sea level on 78 0 29' East longitude and 17 0 19' North latitude. The experiment was laid out in Completely Randomized Design with 10 treatments and three replications *Viz.*, T_1 Ascorbic acid @ 200 ppm + Cloth bag, T_2 $CaCl_2$ @ 0.5% + Cloth bag, T_3 Ascorbic acid @ 200 ppm + Gunny bag, T_4 $CaCl_2$ @ 0.5% + Gunny bag, T_5 Ascorbic acid @ 200 ppm + Bamboo basket, T_6 $CaCl_2$ @ 0.5% + Bamboo basket, T_7 Ascorbic acid @ 200 ppm + Plastic net bag, T_8 $CaCl_2$ @ 0.5% + Plastic net bag, T_9 Ascorbic acid @ 200 ppm + Plastic woven bag and T_{10} $CaCl_2$ @ 0.5% + Plastic woven bag. Shelf life, freshness index, physiological loss in weight, percentage spoilage and flower shrinkage parameters were recorded. For the estimation of shelf life, 100 flowers of each treatment were taken in packaging material (packaging bags) and kept under room conditions. Spraying of water at three hours interval was done to enhance the shelf life. The end of shelf life was recorded when 50 per cent of flowers got wilted. It was recorded in hours from the time of harvesting to the end of shelf life.

Freshness index

Table 1: Sensory evaluation for freshness scoring of Gaillardia loose flowers in packaging materials

Condition of flowers	Score	Number of flowers under this score
Turgid	3	X_1
Slightly turgid	2	X_2
Wilt	1	X_3

$$\text{Freshness index (FI)} = \frac{(X_1 \times 3) + (X_2 \times 2) + (X_3 \times 1)}{(X_1+X_2+X_3) \times 3} \times 100$$

Physiological loss in weight (%)

$$\text{Physiological loss in weight (\%)} = \frac{\text{Initial weight-Final weight}}{\text{Initial weight}} \times 100$$

Percentage spoilage (%)

$$\text{Percentage spoilage} = \frac{\text{Number of flowers spoiled in the bag}}{\text{Total number of flowers in the bag}} \times 100$$

Flower shrinkage (%)

$$\text{Flower shrinkage (\%)} = \frac{\text{Initial diameter-Final diameter}}{\text{Initial diameter}} \times 100$$

3. Results and Discussion

Shelf life (Hours)

With respect to the shelf life parameters the treatment, T_9-Ascorbic acid at 200 ppm + plastic woven bag recorded maximum shelf life (55.67 Hours) and the minimum shelf life was recorded by T_8-$CaCl_2$ at 0.5% + plastic net bag (25.55 Hours). The maximum shelf life was exhibited by packing in plastic woven bags. This effect is primarily due to initially continued metabolic activities specially respiration and transpiration of flowers, might have led to the evolution of beneficial equilibrium of modified atmosphere (EMA) with high CO_2 and low O_2 and high relative humidity within the package. This further might have caused closure of stomata and minimized the respirational loss of carbohydrates as well as transpirational loss of water from flowers (Zeltzer *et al.*, 2001) [14]. Thereby, this increases the shelf life as reported by (Jagan Mohan Reddy *et al.*, 2016) [4] in tuberose flowers. Similar findings were reported by Thamaraiselvi *et al.* (2010) [12] in jasmine and Majumder *et al.* (2014) in tuberose.

Freshness index

Among the treatments, T_9-Ascorbic acid at 200 ppm + plastic woven bag recorded maximum freshness index (55.14) and T_8 -$CaCl_2$ at 0.5% + plastic net bag recorded significantly minimum freshness index (40.06). The maximum freshness index of the flowers depends on the number of turgid flowers without any damage. The Gaillardia flowers treated with ascorbic acid and kept in plastic woven bags recorded maximum freshness index due to the shelf life enhancing properties of ascorbic acid like delayed senescence, increased respiratory sugar substrates paired up with the high relative humidity maintained in the plastic woven bag. Thereby increased freshness index of Gaillardia loose flowers. Similar findings were reported by Thamaraiselvi *et al.* (2010) [12] in jasmine and Jagan Mohan Reddy *et al.* (2016) [4] in tuberose.

Physiological loss in weight (%)

The data recorded on the physiological loss in weight shows that treatment, T_9-Ascorbic acid at 200 ppm + plastic woven bag recorded significantly minimum physiological loss in weight (5.79%) and T_8-$CaCl_2$ at 0.5% + plastic net bag recorded significantly maximum physiological loss in weight (22.74%). The physiological loss in weight is mainly due to transpiration and respiration (Tadesse, 1991) [13]. Packing in plastic woven bag might have helped in maintaining high relative humidity, low respiration rate and low concentration of temperature and oxygen thereby reducing the physiological loss in weight. The flowers packed in polypropylene bags maintain lower levels of phenols which might have also been the reason for delay in senescence and fresh weight of flowers as reported by (Lavanya *et al.*, 2016) [5] in jasmine flowers. Similar findings were reported by Preema Devi *et al.* (2017) [9] in marigold, Thamaraiselvi *et al.* (2010) [12] in jasmine.

Percentage spoilage (%)

Significant difference among the treatments was observed on percentage spoilage of loose flowers. Among the treatments, T_9-Ascorbic acid at 200 ppm + plastic woven bag recorded minimum percentage spoilage (60.00%) and T_8-$CaCl_2$ at 0.5% + plastic net bag recorded significantly maximum percentage spoilage (78.00%). The minimum percentage spoilage of flowers indicates less number of damaged, wilted and rotten flowers. This positive effect may be attributed to the high relative humidity and reduces transpirational loss of water in the flowers packed in plastic woven bags and ascorbic acid and $CaCl_2$ due to its antioxidant properties reduced the spoilage of flowers. Similar findings were reported by Lavanya *et al.* 2016 [5] in jasmine, Ashenafi Haile (2018) [1] in tomato.

Flower shrinkage (%)

Flower shrinkage percentage was significantly influenced by different packaging methods. Among the treatments, the minimum flower shrinkage was recorded by T_9-Ascorbic acid at 200 ppm + plastic woven bag (22.67%) and T_8-$CaCl_2$ at 0.5% + plastic net bag recorded significantly maximum flower shrinkage (39.51%). Flower shrinkage is attributed to heavy loss of water from the petals. The minimum flower shrinkage was due to equilibrium of modified atmosphere (EMA) and high relative humidity within the package. This further led to the closure of stomata and minimized the respirational loss of carbohydrates (Zeltzer *et al*., 2001) [14]. Similar findings were reported by Lavanya *et al.* 2016 [5] in jasmine, Jagan Mohan Reddy *et al.* (2016) [4] in tuberose.

Table 1: Effect of pre and post-harvest chemicals with different packing material on shelf life, freshness index, physiological loss in weight of Gaillardia loose flowers

	Treatments (T)	Shelf life (Hours)	Freshness index	Physiological loss in weight (%)
T_1	Ascorbic acid @ 200 ppm + Cloth bag	48.52	46.52	13.86
T_2	$CaCl_2$ @ 0.5% + Cloth bag	47.44	44.30	15.29
T_3	Ascorbic acid @ 200 ppm + Gunny bag	51.26	50.48	9.48
T_4	$CaCl_2$ @ 0.5% + Gunny bag	49.33	48.83	11.81
T_5	Ascorbic acid @ 200 ppm + Bamboo basket	37.04	43.37	16.54
T_6	$CaCl_2$ @ 0.5% + Bamboo basket	35.52	41.40	18.54
T_7	Ascorbic acid @ 200 ppm + Plastic net bag	27.75	41.02	20.92
T_8	$CaCl_2$ @ 0.5% + Plastic net bag	25.55	40.06	22.74
T_9	Ascorbic acid @ 200 ppm + Plastic woven bag	55.67	55.14	5.79
T_{10}	$CaCl_2$ @ 0.5% + Plastic woven bag	54.45	53.57	7.38
	S.E. m±	0.85	0.83	0.45
	CD@ 5%	2.52	2.47	1.33

Table 2: Effect of pre and post-harvest chemicals with different packing material on percentage spoilage and flower shrinkage of Gaillardia loose flowers

	Treatments (T)	Percentage spoilage (%)	Flower shrinkage (%)
T_1	Ascorbic acid @ 200 ppm + Cloth bag	67.66	31.42
T_2	$CaCl_2$ @ 0.5% + Cloth bag	69.25	33.85
T_3	Ascorbic acid @ 200 ppm + Gunny bag	63.33	26.86
T_4	$CaCl_2$ @ 0.5% + Gunny bag	67.45	29.43
T_5	Ascorbic acid @ 200 ppm + Bamboo basket	72.66	34.65
T_6	$CaCl_2$ @ 0.5% + Bamboo basket	73.00	35.86
T_7	Ascorbic acid @ 200 ppm + Plastic net bag	73.86	37.71
T_8	$CaCl_2$ @ 0.5% + Plastic net bag	78.00	39.51
T_9	Ascorbic acid @ 200 ppm + Plastic woven bag	60.00	22.67
T_{10}	$CaCl_2$ @ 0.5% + Plastic woven bag	62.43	24.84
	S.E. m±	1.02	0.86
	CD@ 5%	3.04	2.56

Conclusion

It is concluded that ascorbic acid is a cheap, safe and biodegradable compound can be suitable alternative chemical treatments in order to prolong the shelf life by pre and postharvest application with packaging materials. The experiment shows that the flowers treated with ascorbic acid @200ppm and packed with plastic woven bag recorded maximum shelf life, freshness index, minimum physiological loss in weight, percentage spoilage and flower shrinkage.

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