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STUDIES OF VARIOUS PACKAGING MATERIALS ON POST-HARVEST QUALITY AND LONGEVITY OF CHRYSANTHEMUM (*Dendranthema grandiflora* L.)

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ABSTRACT

This investigation evaluated the effect of different packaging materials on the post-harvest quality and longevity of loose chrysanthemum flowers (*Dendranthema grandiflora* L.) cv. Poornima white. The experiment was carried out during the Rabi season of 2025–26 at the Research Horticulture Laboratory of K.D. College of Horticulture and Research Station, Jagdalpur (Chhattisgarh), using a Completely Randomized Design with nine treatments and three replications. Fresh flowers were packed in different materials, including T_2 200-gauge and T_6 400 -gauge polyethylene, T_3 newspaper, T_4 cardboard boxes, T_5 gunny bag, T_7 onion mesh bag, T_8 thermocol and T_9 brown paper bag, with unpackaged flowers as T_1 control. Physiological, sensory and physical quality attributes were assessed during storage. Among the treatments, 400-gauge polyethylene (T_6) consistently performed best. It recorded the minimum physiological loss in weight (4.54, 8.02 and 12.53%), maximum relative water content (83.55, 80.47 and 73.10%), maximum moisture content (87.00, 84.13 and 81.27%), minimum spoilage (0.00, 1.05 and 3.91%) and minimum browning (0.00, 5.74 and 10.52%) on the 1st, 2nd and 3rd days, respectively. T_6 also maintained the highest freshness index (5.00, 5.00 and 4.89), fresh flower percentage (100.00, 93.33, and 85.33%) and the longest shelf life (8.92 days), with the smallest change in fresh weight (12.12 g). The control showed the greatest deterioration. Thus, 400-gauge polyethylene was the most effective packaging material for maintaining post-harvest quality and extending the storage life of loose chrysanthemum flowers under the study conditions.

Key words : Chrysanthemum, Packaging materials, Post-harvest quality, Shelf life, Loose flowers.

Introduction

Chrysanthemum (*Dendranthema grandiflora* L.) is an important commercial flower crop cultivated as loose flowers, cut flowers and pot plants. It belongs to the family Asteraceae and is widely valued for its diverse flower forms, colors and sizes and for its use in garlands, religious offerings, bouquets, floral decoration, bedding and landscaping. Its commercial value is further supported by its attractive appearance, durability and adaptability (Bose *et al*., 2007).

In Chhattisgarh, the total area under flower cultivation was estimated at 12.973 thousand hectares, with an annual production of 172.629 thousand tonnes and a productivity of 13.307 tonnes per hectare (Anonymous, 2024). India is one of the major producers of loose flowers, and chrysanthemum holds an important position because of its commercial and ornamental value. During 2024–25, Andhra Pradesh recorded the highest production of loose chrysanthemum with 451.83 thousand tonnes, followed by Karnataka (205.61 thousand tonnes), Tamil Nadu (204.46 thousand tonnes), Telangana (38.23 thousand tonnes), Madhya Pradesh (21.36 thousand tonnes), Gujarat (7.61 thousand tonnes), Maharashtra (4.50 thousand tonnes), Himachal Pradesh (1.48 thousand tonnes), Chhattisgarh (1.24 thousand tonnes), Haryana (0.15 thousand tonnes), Kerala (0.01 thousand tonnes),

Others (0.01 thousand tonnes) and Jammu & Kashmir (0.00 thousand tonnes). Total loose chrysanthemum production in India was 936.48 thousand tonnes (Anonymous, 2025).

Chrysanthemum is highly perishable after harvest, and deterioration is associated with moisture loss, wilting, loss of freshness, browning, spoilage and other physiological changes. Packaging is therefore an important post-harvest operation because it can reduce moisture loss, mechanical injury and deterioration during handling, transport and marketing and can help maintain freshness and marketability (Krishnamoorthy, 1990). Earlier studies have shown that polyethylene and other suitable wrapping materials can reduce weight loss and improve flower longevity in chrysanthemum and other loose or cut flowers (Chaudhury *et al*., 2004; Kumari *et al*., 2017; Jagadale *et al*., 2019; Khongwir *et al*., 2017). However, information on suitable packaging materials for loose chrysanthemum under the agro-climatic conditions of Chhattisgarh remains limited. This investigation therefore evaluated different packaging materials to maintain post-harvest quality and extend the shelf life of chrysanthemum flowers.

Materials and Methods

The experiment was conducted during the Rabi season of 2025–26 at the Research Horticulture Laboratory of K.D. College of Horticulture and Research Station, Jagdalpur (C.G.), India. The crop used was chrysanthemum (*Dendranthema grandiflora* L.) cv. Poornima white. The experiment followed a Completely Randomized Design (CRD) with nine treatments and three replications. The treatments comprised T_1-Control (without packaging), T_2-polyethylene 200-gauge, T_3-newspaper, T_4-cardboard boxes, T_5- gunny bag, T_6-polyethylene 400-gauge, T_7- onion mesh bag, T_8-thermocol and T_9-brown paper bag. We procured fresh, fully opened loose flowers from growers near Jagdalpur, then sorted and packed them according to the respective treatments. Each treatment consisted of one package in each of three replications and was stored at room temperature. The laboratory conditions during evaluation averaged about 24°C with 44–53% relative humidity. Observations were recorded after 1, 2 and 3 days of storage for physiological loss in weight (PLW), relative water content (RWC), moisture content, spoilage percentage, browning percentage, freshness index and fresh flower percentage. Shelf life was recorded as the number of days flowers remained acceptable until approximately 50% of the flowers showed senescence. Change in fresh weight after storage was also recorded. PLW, RWC and moisture content were calculated using the formulae described in the thesis methodology. The data were subjected to analysis of variance under CRD, and treatment differences were tested using critical difference at the 5% level of significance (Fisher and Yates, 1963).

Results and Discussion

Physiological parameters

Physiological loss in weight (%)

Among all the treatments, on the first day after packaging, the minimum physiological loss in weight (4.54%) was recorded in T_6 (polyethylene, 400-gauge), which was statistically at par with T_2 (polyethylene, 200-gauge) (4.68%), whereas the maximum physiological loss in weight (16.37%) was observed in T_1 (control). On the second day, T_6 recorded the minimum physiological weight loss (8.02%), followed by T_2 (9.08%), while T_1 recorded the maximum (36.09%). On the third day, T_6 recorded the minimum physiological weight loss (12.53%), followed by T_2 (15.44%), whereas T_1 showed the maximum (55.00%).

The minimum physiological weight loss under T_6 may be attributed to the moisture-retentive nature of polyethylene packaging, which maintains higher relative humidity inside the package and restricts moisture movement, thereby reducing transpiration and respiration losses. The thicker 400-gauge polyethylene was more effective in maintaining flower weight during storage. Similar findings were reported by Ravi *et al*. (2004), Kannappiah *et al*. (2006) and Khongwir *et al*. (2017).

Relative water content (%)

Among the treatments, T_6 recorded the highest relative water content on the first day (83.55%), statistically at par with T_2 (83.18%), whereas T_1 (control) recorded the minimum (68.75%). On the second day, T_6 recorded the maximum relative water content (80.47%), followed by T_2 (76.93%) and T_8 (75.00%), while T_1 recorded the minimum (62.96%). On the third day, T_6 recorded the maximum relative water content (73.10%), followed by T_2 (69.23%) and T_8 (67.17%), while T_1 recorded the minimum (54.03%).

The maximum relative water content under T_6 may be due to the greater thickness and moisture-barrier properties of 400-gauge polyethylene, which helped maintain favorable humidity inside the package and reduced moisture loss. Relative water content is closely associated with moisture retention, physiological loss in weight and maintenance of flower freshness. Khongwir *et al*. (2017), Verma and Jhanji (2019) reported similar findings.

Table 1 : Effect of different packaging materials on physiological parameters of chrysanthemum flower.

Treatment details		Physiological loss in weight (%)			Relative water content (%)			Moisture content (%)		
		1st Day	2nd Day	3rd Day	1st Day	2nd Day	3rd Day	1st Day	2nd Day	3rd Day
T_1	Control (without packaging)	16.37	36.09	55.00	68.75	62.96	54.03	69.33	61.08	52.11
T_2	Polyethylene (200-gauge)	4.68	9.08	15.44	83.18	76.93	69.23	86.33	83.17	79.42
T_3	Newspaper	13.82	27.63	45.01	75.22	69.11	61.15	80.67	75.30	69.28
T_4	Cardboard boxes	12.18	24.37	39.48	78.71	72.90	65.00	84.67	80.19	75.12
T_5	Gunny bag	15.90	31.36	53.07	73.11	67.20	59.15	78.00	72.12	65.83
T_6	Polyethylene (400-gauge)	4.54	8.02	12.53	83.55	80.47	73.10	87.00	84.13	81.27
T_7	Onion mesh bag	16.20	32.73	53.23	70.97	64.96	55.98	75.00	68.09	60.54
T_8	Thermocol	10.24	20.48	38.33	80.91	75.00	67.17	85.00	81.28	76.84
T_9	Brown paper bag	12.31	27.34	44.00	77.32	71.08	62.78	81.67	77.28	71.92
C.D.		0.81	1.59	2.66	1.91	1.46	1.33	5.18	4.60	4.56
SE(m)		0.27	0.53	0.89	0.64	0.49	0.44	1.73	1.54	1.52
C.V.		3.99	3.80	3.89	1.44	1.18	1.22	3.70	3.51	3.75

Moisture content (%)

The maximum moisture content on the first day was recorded in T_6 (87.00%), which was statistically at par with T_2 (86.33%), while the minimum (69.33%) was recorded in T_1. On the second day, T_6 recorded the maximum moisture content (84.13%), statistically at par with T_2 (83.17%), whereas T_1 recorded the minimum (61.08%). On the third day, T_6 recorded the maximum moisture content (81.27%), statistically at par with T_2 (79.42%), while T_1 recorded the minimum (52.11%).

The higher moisture content under T_6 may be attributed to the resistance of 400-gauge polyethylene to moisture loss and its ability to maintain favorable humidity within the package. Higher moisture retention helped maintain flower hydration and reduced wilting during storage. This finding agrees with observations reported by Khongwir *et al.* (2017) and Jawaharlal *et al.* (2017) in loose flowers.

Sensory quality parameters

Spoilage percentage (%)

Among all treatments, T_6 recorded the lowest spoilage percentage on the first day (0.00%), followed by T_2 (1.12%), whereas T_1 (control) showed the highest (6.65%). On the second day, T_6 recorded the minimum spoilage (1.05%), followed by T_2 (2.39%), while T_1 showed the maximum (13.39%). On the third day, the minimum spoilage (3.91%) was recorded in T_6, statistically at par with T_2 (4.31%), whereas the maximum spoilage (20.87%) was recorded in T_1.

The lower spoilage percentage under T_6 may be attributed to better moisture retention and maintenance of favourable conditions inside the polyethylene package, which reduced physiological deterioration and delayed flower senescence. The increase in spoilage with advancement of storage duration may be due to progressive moisture loss and deterioration of flower tissues. Similar results were reported by Verma and Jhanji (2019) in marigold flowers.

Browning percentage (%)

On the first day, the minimum browning percentage (0.00%) was recorded in T_2 (200-gauge polyethylene), T_6 (400-gauge polyethylene) and T_8 (thermocol), whereas the maximum (14.81%) was recorded in T_1 (control). On the second day, T_6 recorded the minimum browning (5.74%), followed by T_2 (6.98%), while T_1 recorded the maximum (18.40%). On the third day, T_6 recorded the minimum browning (10.52%), followed by T_2 (13.44%), whereas T_1 recorded the maximum (20.93%).

The lower browning percentage under polyethylene packaging may be attributed to reduced moisture loss and delayed senescence of flower tissues. In contrast, the higher browning under control conditions may be associated with greater moisture loss and faster tissue deterioration. Brown coloration may result from the accumulation of complexes formed through the polymerization of flavins and phenolic substances in cell vacuoles

Freshness index

The maximum freshness index was consistently recorded in T_6 (400-gauge polyethylene), with values of

Table 2 : Effect of different packaging materials on sensory quality parameters of chrysanthemum flower.

Treatment details		Spoilage percentage (%)			Browning percentage (%)			Freshness index		
		1st Day	2nd Day	3rd Day	1st Day	2nd Day	3rd Day	1st Day	2nd Day	3rd Day
T_1	Control (without packaging)	6.65	13.39	20.87	14.81	18.40	20.93	3.18	2.31	2.08
T_2	Polyethylene (200-gauge)	1.12	2.39	4.31	0.00	6.98	13.44	4.84	4.75	4.62
T_3	Newspaper	4.33	9.35	13.41	8.13	13.44	19.00	3.96	3.74	3.26
T_4	Cardboard boxes	3.15	5.40	9.49	5.41	13.30	17.11	4.47	4.24	3.88
T_5	Gunny bag	4.81	10.20	15.20	9.58	14.26	20.30	3.86	3.64	2.93
T_6	Polyethylene (400-gauge)	0.00	1.05	3.91	0.00	5.74	10.52	5.00	5.00	4.89
T_7	Onion mesh bag	5.81	11.24	17.17	12.44	14.95	20.43	3.61	3.41	2.81
T_8	Thermocol	2.15	3.54	7.59	0.00	12.79	16.97	4.76	4.46	4.31
T_9	Brown paper bag	3.35	6.11	11.44	7.82	13.35	18.26	4.20	4.19	3.74
C.D.		0.16	0.34	0.40	0.34	0.51	1.14	0.14	0.14	0.21
SE(m)		0.05	0.11	0.14	0.11	0.17	0.38	0.05	0.05	0.07
C.V.		2.63	2.83	2.04	2.99	2.34	3.78	1.91	2.01	3.41

5.00, 5.00 and 4.89 on the first, second and third days, respectively. This was followed by T_2 (200-gauge polyethylene) and T_8 (thermocol). The minimum freshness index was recorded in T_1 (control), with values of 3.18, 2.31 and 2.08 on the respective days.

The higher freshness index under T_6 may be attributed to reduced moisture loss and maintenance of a favorable microenvironment inside the polyethylene package. Better moisture retention delayed wilting and senescence, thereby maintaining the visual quality and freshness of chrysanthemum flowers Khongwir *et al*. (2017) reported similar findings for loose tuberose flowers.

Physical parameters

Shelf life (days)

T_6 (polyethylene, 400-gauge) recorded the maximum shelf life (8.92 days), followed by T_2 (polyethylene, 200-gauge) (8.23 days) and T_8 (thermocol) (6.65 days), whereas T_1 (control) showed the minimum shelf life (3.74 days).

The maximum shelf life under T_6 may be attributed to the moisture-retentive nature of polyethylene packaging, which reduced moisture loss and maintained a favorable microenvironment around the flowers. This delayed senescence and deterioration of flower quality, resulting in prolonged shelf life. Yeluguri and Girvani (2013) and Verma and Jhanji (2019) reported similar findings for marigolds under ambient storage conditions.

Fresh flower percentage (%)

The maximum fresh flower percentage was recorded in T_6 (400-gauge polyethylene) on the first (100.00%), second (93.33%) and third (85.33%) days of storage, and was statistically at par with T_2 (200-gauge polyethylene). The minimum fresh flower percentage was recorded in T_1 (control), with 76.67, 67.33 and 57.85% on the first, second and third days, respectively. Other treatments showed intermediate values.

Overall, T_6 maintained the highest percentage of fresh flowers throughout storage, followed by T_2. The better performance of polyethylene packaging may be attributed to reduced moisture loss and maintenance of favourable humidity and gaseous conditions inside the package, which helped preserve flower freshness and delayed quality deterioration. Similar results were reported by Yeluguri and Girvani (2013) in African marigold.

Change in fresh weight after storage (g)

The minimum change in fresh weight after storage was recorded in T_6 (400-gauge polyethylene) (12.12 g), which was statistically at par with T_2 (200-gauge polyethylene) (13.53 g). It was followed by T_8 (thermocol) (33.44 g), T_4 (cardboard boxes) (36.92 g), T_9 (brown paper bag) (39.79 g), T_3 (newspaper) (42.21 g), T_5 (gunny bag) (42.32 g) and T_7 (onion mesh bag) (43.05 g). The maximum change in fresh weight was observed in T_1 (control) (43.72 g).

The minimum change in fresh weight under T_6 may be attributed to better moisture retention and reduced transpiration and respiration losses under polyethylene packaging. In contrast, the greater change in fresh weight under control conditions may be due to higher moisture

Table 3 : Effect of different packaging materials on physical parameters of chrysanthemum flower.

Treatment details		Shelf life (days)	Fresh flower percentage (%)			Change in fresh weight after storage (g)
			1st Day	2nd Day	3rd Day	
T_1	Control (without packaging)	3.74	76.67	67.33	57.85	43.72
T_2	Polyethylene (200-gauge)	8.23	98.67	90.67	83.33	13.53
T_3	Newspaper	5.53	87.33	77.33	68.21	42.21
T_4	Cardboard boxes	6.16	91.33	81.33	72.67	36.92
T_5	Gunny bag	4.97	84.67	75.33	65.01	42.32
T_6	Polyethylene (400-gauge)	8.92	100.00	93.33	85.33	12.12
T_7	Onion mesh bag	4.28	79.33	74.67	62.52	43.05
T_8	Thermocol	6.65	97.33	83.33	75.33	33.44
T_9	Brown paper bag	5.76	89.33	80.67	71.33	39.79
C.D.		0.53	2.98	3.46	4.28	2.62
SE(m)		0.18	0.99	1.16	1.43	0.88
C.V.		5.09	1.93	2.49	3.47	4.44

loss from unpackaged flowers. Similar findings were reported by Ravi *et al*. (2004), Karuppaiah *et al*. (2006) and Khongwir *et al*. (2017).

Conclusion

Under the conditions of the present investigation, 400-gauge polyethylene (T_6) was the most effective packaging material for maintaining the post-harvest quality and longevity of loose chrysanthemum flowers. T_6 consistently resulted in lower physiological loss in weight, higher relative water and moisture content, lower spoilage and browning, higher freshness and fresh flower percentage, lower change in fresh weight and the longest shelf life of 8.92 days. The unpackaged control deteriorated rapidly and performed the worst. Thus, 400-gauge polyethylene is the most promising packaging material among the tested treatments for short-term storage and handling of chrysanthemum flowers under ambient laboratory conditions.

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