



Influence of dehydration techniques on colour retention and related traits of gerbera (*Gerbera hybrida*) flowers

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ABSTRACT

Gerbera (*Gerbera hybrida*) is the most popular florist flower due to various colours, shapes and sizes. It belongs to the family Asteraceae. The present study was conducted to determine the effect of different drying techniques on retention of flower colour and its related traits of *Gerbera hybrida* var. Doni. Maximum flower colour acceptability score (3.67), high acceptability of texture of dry flowers (3.67), minimum brittleness of dried flowers (2.33), minimum damage of florets (1.33) and maximum score (2.67) for the shape of embedded dry flowers were observed with vacuum air oven drying upto 60 days. Maximum colour retention up to 60 days was observed on the adaxial surface of the floret in vacuum drying (Y-O14A); however, on the abaxial surface of the floret, colour retention was seen maximum up to 60 days at room temperature drying, i.e. control (Y-12B) technique. Minimum reduction in flower size (5.22 %) was observed in vacuum drying; however, minimum reduction in flower weight (82.21%) was found in microwave drying technique. Vacuum air oven drying method was observed to be the best technique for retention of flower colour and related traits.

Key words: Dehydration, *Gerbera hybrida*, Flower colour, Traits

Dried floral arrangements preserve the graceful lines, textures and colours of flowers and foliage with a subtle and gently aged appearance. Preserving plant materials in a dried form is not only a new research area; however, it has been considered an art for hundreds of years. Fresh flowers are very attractive, but very expensive and short lived as well as available only during a particular season. On the other hand, dry flower products are long lasting and retained their aesthetic value irrespective of the season (Singh and Laishram 2010). The demand for dry flowers and attractive plant parts, dried floral arrangements and floral crafts has increased manifolds during the last decade. The range of dried flowers and other attractive plant parts is quite extensive, namely stems, leaves, roots, shoots, cones, seeds, foliage, bracts, thorns, barks, lichens, fleshy fungi, mosses, sellaginellas, etc. (Desh Raj 2001).

Gerbera (*Gerbera hybrida*) is very popular and widely used as a decorative garden plant or as cut flowers. It is known for its flowers with attractive colours including white, yellow, orange, red and pink. Gerbera is the 5th most used cut flower in the world after rose, carnation, *chrysanthemum* and tulip. The flowers of gerbera are suitable for drying and further use in preparation of value added products. There are several ways to dry the flowers such as by hanging

them upside down, laying them flat (for flower heads), or pressing them under room temperature, air drying technique, microwave or vacuum flower drying techniques etc. Finding out an appropriate drying technique for better quality and colour is important to support the entrepreneurs in the competitive global flower market. Therefore, the present investigation was carried out to determine the effects of different drying techniques on colour retention and related traits in gerbera flowers.

MATERIALS AND METHODS

The present study was carried out in the laboratory of Division of Floriculture and Landscaping, ICAR-IARI, New Delhi. The planting material utilized was the flowers of yellow coloured variety Doni of *Gerbera hybrida*. In this study, five drying techniques having three replications, viz. microwave drying for 40 sec (T₁), hot air oven drying at 50°C for 4 hr (T₂), vacuum air oven drying at 40°C with pressure of 0.08 K pascal (T₃), room temperature drying at 25 ± 1°C (T₄) and control (T₀) (blotting paper drying) were used to dry gerbera flowers. Silica gel was used as base/embedding material in the present study. Data on different observations were recorded at intervals of 20 days after drying of flowers.

Data regarding different observations like dry flower colour, flower diameter, flower weight, flower colour acceptability, texture, brittleness, intactness and shape were recorded. Quality parameters like colour, texture, brittleness,

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intactness, shape and overall acceptability were assessed by means of sensory evaluation scored on a five point scale, i.e. 1-5 (Hemant *et al.* 2016). The data were analysed in completely randomized design by using OPSTAT statistical software.

RESULTS AND DISCUSSION

Data presented in the Table 1 showed that fresh flower colour of the adaxial and abaxial surfaces of florets were Y-O-14A and Y-12B (Royal Horticultural Society colour chart). However, colour of dried flowers varied with different drying techniques. Maximum colour retention up to 60 days was observed on the adaxial surface of the floret in vacuum air oven drying (Y-O14A) and room temperature drying (Y-O14C) followed by control and microwave drying. Whereas, minimum retention on the adaxial surface of the floret was in hot air oven drying (Y-O15B, Y-O16B, Y-O16C) at 20, 40 and 60 days, respectively from the day of drying of flowers. Similarly, on the abaxial surface of the floret, colour retention was seen maximum upto 60 days at room temperature drying (Y-12C) technique followed by vacuum air oven drying. However, minimum retention on the abaxial surface of the floret was observed in hot air oven drying (Y-O16B, Y-O18B, Y-O18B) and in control (Y-O-14B, Y-O13B, Y-O 12B) at 20, 40 and 60 days, respectively from the day of drying of flowers.

Dry flower size and per cent reduction in flower size

Data presented in the Table 2 showed the significant results with respect to dry flower size of gerbera flowers embedded in silica gel under different drying techniques including control. The maximum size of dry flowers (93.69 mm) was observed in microwave drying technique which is significantly at par with hot air oven drying (91.76 mm), vacuum air oven drying (90.74 mm). Whereas, minimum dry flower size (64.31 mm) was observed in control (T_0). Significant results were observed with respect to per cent reduction in size of gerbera flowers. Minimum per cent reduction in size of flowers (5.22%) was observed in vacuum air oven drying followed by microwave drying (11.71%), hot air oven drying (14.80%) and room temperature drying (19.97%). However, maximum reduction in size was observed in control (36.42%). The variation in reduction of size may also due to higher temperature, rate of moisture loss or liberation of moisture from flower tissues was more

due to higher transfer of heat by conduction and convection. The results are in confirmation with the findings of Bhalla *et al.* (2006).

Dry flower weight and per cent reduction in flower weight

Data presented in the Table 2 showed the significant results with respect to per cent reduction in dry flower weight of gerbera flowers embedded in silica gel under different drying techniques including control. However, data was found non-significant with respect to dry flower weight. The dry weight (2.30 g) of gerbera flowers was maximum in microwave drying followed by hot air oven drying (2.24 g), control (2.20 g) and room temperature drying (2.03 g). However, minimum dry flower weight (1.85 g) was observed in vacuum drying technique.

Significant results were observed with respect to per cent reduction in weight of gerbera flowers (Table 2). Minimum per cent reduction in flower weight (82.21%) was observed in microwave drying technique. However, maximum reduction in weight of flowers (84.97%) was observed in control which is significantly at par with

Table 2 Influence of dehydration techniques on flower size, flower weight and per cent reduction in flowers of Gerbera var. Doni

Treatment	Dry flower size (mm)	Reduction in flower size (%)	Dry flower weight (g)	Reduction in flower weight (%)
Control (Bloating paper) (T_0)	64.31	36.42 (37.09)	2.2	84.97 (67.17)
Microwave (T_1)	93.69	11.71 (19.90)	2.3	82.21 (65.03)
Hot air oven (T_2)	91.76	14.80 (22.56)	2.24	83.88 (66.31)
Vacuum air oven (T_3)	90.74	5.22 (13.12)	1.85	83.58 (66.08)
Room temperature (T_4)	81.20	19.97 (26.53)	2.03	83.96 (66.36)
CD (P=0.05)	3.513	4.54 (3.66)	N/A	1.43 (1.11)
SE(m)	1.101	1.42 (1.15)	0.166	0.45 (0.35)

Values in parenthesis are transformed values

Table 1 Effect of dehydration techniques on flower colour (RHS Chart) of Gerbera var. Doni

Treatment	Dry flower colour					
	Adaxial ray floret			Abaxial ray floret		
	20 Days	40 Day	60 Day	20 Days	40 Day	60 Day
Control (Bloating paper) (T_0)	Y-O14A	Y-O14B	Y-O14C	Y-O-14B	Y-O13B	Y-O12B
Microwave (T_1)	Y-O14A	Y-O14C	Y-O16B	Y-O16B	Y-O16C	Y-16D
Hot air oven (T_2)	Y-O15B	Y-O16B	Y-O16C	Y-O16B	Y-O18B	Y-O18B
Vacuum air oven (T_3)	Y-O14A	Y-O14A	Y-O14A	Y-12B	Y-13C	Y-13C
Room temperature (T_4)	Y-O14A	Y-O14C	Y-O14C	Y-12B	Y-12B	Y-12C

room temperature drying (83.96%), hot air oven drying (83.88%) and vacuum air oven drying (83.58%). It was reported that different drying methods and temperature influences the qualitative and quantitative parameters where drying at higher temperatures results into rapid drying and low moisture content (Singh *et al.* 2003).

Data presented in the Table 3 and 4 reveals that significant changes were observed with respect to colour acceptability, texture acceptability, brittleness, intactness and shape of gerbera flowers embedded in silica gel under different drying techniques.

Flower colour and texture acceptability

Maximum colour acceptability score (3.67) was observed with vacuum air oven drying upto 60 days which was at par with room temperature drying (3.33) whereas minimum acceptability of dry flower colour (1.00) was observed with microwave drying from the first day of drying up to 60 days. This might be due to the increased temperature and duration in a hot air microwave oven, which leads to more loss of the pigment. Similar to our findings, Dahiya *et al.* (2003) also reported that carotenoid content of chrysanthemum flowers was decreased with the increase in temperature and duration in an oven after embedding in sand and silica gel.

The high acceptability of texture of dry flowers (3.67) was observed with vacuum drying upto 60 days followed by room temperature drying (2.00) and hot air oven drying (2.00). However, minimum texture acceptability was found

in rest of the treatments i.e. control (1.00) and microwave drying (1.00) upto 40 days. The efficacy in retention of flowers petal colour and texture in silica gel was also confirmed in flowers like gomphrena, ixora, mussaenda, sunflower, plumeria, meyeria and bauhinia by Pamela (1992) and later on in different flower crops by Singh and Dhaduk (2005).

Flower brittleness

Minimum brittleness of dried flowers (2.33) was observed with vacuum air oven drying upto 60 days while maximum brittleness was found in hot air oven drying (3.67) followed by control (3.00) (Table 3). This might be attributed to the rapid removal of agitated water molecules from the petal surface by the microwave and to the subsequent rapid removal of moisture by silica gel. This could probably operate through physical adsorption and capillary condensation of the liberated water molecules in its large network of interconnecting microscopic pores (Acharyya *et al.* 2013).

Flower intactness

Data presented in Table 4 shows that the minimum damage of florets (1.33) was observed with vacuum air oven drying followed by microwave drying (2.00) and room temperature drying (2.67) upto 60 days. However, maximum damage of florets (3.00) was observed with control followed by hot air oven drying (2.00) on 20th day of the experiment. Singh *et al.* (2003) also reported that

Table 3 Effect of dehydration on colour, texture and brittleness of gerbera flowers var. Doni

Treatment	Flower colour acceptability (1-5)				Flower texture acceptability (1-5)				Flower brittleness (1-5)			
	1 Day	20 Days	40 Days	60 Days	1 Day	20 Days	40 Days	60 Days	1 Day	20 Days	40 Days	60 Days
	Control (Bloating paper) (T ₀)	3.67	2.67	1.33	1.33	2.00	1.00	1.00	1.00	3.00	3.67	4.00
Microwave (T ₁)	1.33	1.00	1.00	1.00	1.33	1.33	1.00	1.00	3.67	3.67	3.67	4.00
Hot air oven (T ₂)	2.33	2.00	2.00	1.67	3.00	2.67	2.33	2.00	3.67	3.67	4.00	4.00
Vacuum air oven (T ₃)	4.00	4.00	3.67	3.67	4.00	4.00	3.67	3.67	2.00	2.00	2.00	2.33
Room temperature (T ₄)	4.00	4.00	3.33	3.33	4.00	3.67	2.67	2.00	2.33	3.00	3.67	4.00
CD (P=0.05)	1.427	0.952	1.165	1.259	0.952	0.824	0.824	1.259	NS	NS	1.064	1.259
SE(m)	0.447	0.298	0.365	0.394	0.298	0.258	0.258	0.394	0.447	0.447	0.333	0.394

Table 4 Influence of drying techniques on intactness and shape of the Gerbera flowers var. Doni on visual basis (1-5)

Treatment	Flower intactness				Flower shape			
	1 Day	20 Day	40 Day	60 Day	1 Day	20 Day	40 Day	60 Day
Control (Bloating paper) (T ₀)	2.67	3.00	3.00	3.00	1.00	1.00	1.00	1.00
Microwave (T ₁)	1.33	2.00	2.00	2.00	2.00	1.67	1.33	1.33
Hot air oven (T ₂)	2.67	2.00	3.00	3.00	1.33	1.33	1.33	1.00
Vacuum air oven (T ₃)	1.00	1.00	1.00	1.33	2.67	2.67	2.67	2.67
Room temperature (T ₄)	1.33	1.67	2.67	2.67	2.33	2.00	1.33	1.33
CD (P=0.05)	0.952	0.952	0.952	1.064	1.165	NS	0.952	0.824
SE(m)	0.298	0.298	0.298	0.333	0.365	0.365	0.298	0.258

moisture content in dried flowers influence flower quality and longevity. According to them, excessive drying results into petal shedding during handling and moisture content below 8% also results in petal shedding. Bhalla *et al.* (2006) reported that the dried flowers remained in a more presentable state under covered conditions than those kept under open conditions.

Flower shape

Maximum score for the shape of embedded dry flowers was well maintained (2.67) in vacuum drying method followed by room temperature drying (1.33) and microwave drying (1.33) up to 60 days. However, minimum retention of shape was observed in control (1.00) followed by hot air oven drying (1.33) upto 40 days (Table 4). Shape retention obviously was due to embedding of flowers in the silica gel, as also suggested by Singh and Dhaduk (2005) in different flower crops. Microwave dried flowers in this method retained their colour and drying time was also less. Hot air oven drying technique shows that almost all the flowers retained colour but the petals become shriveled and lost their shape. Singh *et al.* (2003) found that drying of zinnia flowers was much faster and better with silica gel and borax. Aravinda and Jayanthi (2004) also standardized the drying techniques like microwave drying, oven drying and sun drying for *chrysanthemum* (Button type local) flowers. Microwave drying with silica gel gave the best results for shape while oven drying with white sand was found best for colour and overall acceptability.

Conclusion

In present study, vacuum air oven drying proved to be the best with respect to the drying, and retention of flower colour and related traits as compared to other drying techniques. Flowers embedded in silica gel resulted in maximum moisture loss and early drying, regardless of the different drying conditions. However, room temperature

drying was also the effective method to retain the true colour of the Gerbera flowers. Silica gel embedding coupled with vacuum oven drying technique, was the most suitable dehydration method for the Gerbera variety 'Doni'. Additionally, our findings demonstrated that silica gel embedding resulted in better colour and shape retention as compared to other treatments. Moreover, the colour, texture and shape were least degraded.

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