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Short communication

Studies on microwave oven drying of *Gomphrena globosa* L. 'Magenta' and 'White'

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ABSTRACT

Present investigation was carried out to standardize the medium and temperature for drying of *Gomphrena globosa* L. Two cultivars 'Magenta' (GGM) and 'White' (GGW) were dried in silica gel and mixture of sand and silica gel for 3, 4 and 5 min. in microwave oven with 24, 48 and 72 h setting durations. It was observed that maximum moisture loss was recorded in flowers embedded in silica gel and dried for 5 min. with 72 h setting time in cvs Magenta and White, respectively. The maximum decrease in size was recorded in flowers embedded in silica gel and kept for 5 min. with 72 h setting time in cvs Magenta and White, respectively. However, the maximum scores for quality parameters (out of a total of 20) based on colour, texture, brittleness and shape retention were obtained when flowers were embedded in silica gel and kept for 3 min. with 72 h setting time in cv. Magenta and for 3 min. and kept for 24 h. setting in cv. White.

Key words: Drying, alpha gomphrena, microwave oven, drying silica gel.

Dry flowers and plant materials have established a tremendous potentiality as a substitute for fresh flowers and cut foliage for vase decoration, along with other artistic and commercial purposes in exteriors and interiors. The dry flower industry is gaining popularity among the consumers as they are inexpensive, long-lasting and eco-friendly products that are available throughout the year. The demand for dry flowers has increased manifold in the last decades and increasing at an impressive rate of 8-10% annually, thus offering immense opportunities for the Indian entrepreneurs to enter the global floriculture trade. The contribution of dry flower industry is 77.1% followed by cut flowers, bulbs and rhizomes, cut foliage and others. *Gomphrena globosa* L. is a popular commercial flower grown in the southern districts of Tamil Nadu, used for garland making and also as a cut flower. Due to its dry papery bracts of flowers, it is highly suitable for making dry flower products. A number of value-added products like garlands, potpourri, button holes and flower arrangements *etc*. can be prepared from the dry flowers. However, there is limited literature available on drying methodology of *Gomphrena globosa* L. and therefore, the present studies were undertaken to find out the suitable technique of drying of gomphrena flowers in two cultivars Magenta and White.

The experiment was conducted in the Floral Craft Laboratory, Department of Floriculture and Landscape Architecture, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, HP. Nursery of *G. globosa* 'Magenta' (GGM) and *G. globosa* 'White' (GGW) plants was raised and then transplanted in the experimental plots. The department and flowers were harvested for drying in July-August. The experiment was conducted in a Completely Randomized Design (factorial). The experimental material consisted of two cultivars of *G. globosa* 'Magenta' (GGM) and *G. globosa* 'White' (GGW), with treatments of two desiccants (silica gel and mixture of sand and silica gel), three microwave oven drying time (3, 4 and 5 min.) and three setting durations (24, 48 and 72 h) with three replications. The freshly harvested flowers were carried to the laboratory and observations on flowers size and weight of fresh flowers were recorded. Heat resistant plastic containers were filled evenly with the desiccants up to 10 cm of height and flowers were placed evenly on the respective media. The media was evenly distributed so as to equalize the pressure on all sides of the flower. After this, the plastic containers were put in the microwave oven for specified microwave time (3, 4 and 5 min.) and setting duration for drying (24, 48 and 72 h). Both the quantitative as well as qualitative observations like flower weight, size, colour, texture, brittleness and shape retention were recorded. The quality of dried flowers was judged on the basis of their colour, texture, brittleness and shape retention. The scores were given on the basis of 9-point hedonic scale suggested by Peryam (9) and a modified score card was developed.

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There was a significant effect of media, microwave time and duration on drying and quality parameters of both the cultivars. Out of the two desiccants used for drying of 'Magenta' and 'White', maximum moisture loss was recorded when flowers were dried in silica gel as compared to flowers dried in a mixture of sand and silica gel (Table 1). Amongst the different microwave treatments, the maximum moisture loss was recorded when flowers were dried for 5 min. and minimum moisture loss was recorded in case of 3 min. drying. Among the setting durations, the maximum moisture loss was recorded in the flowers of 'Magenta' and 'White' kept at a setting duration of 72 h, whereas minimum moisture loss was observed in 24 h setting duration. Flower drying using microwave oven after embedding in silica gel had been reported as the quickest method of drying earlier also (Paparozzi and McCallister, 8). Drying of both the cultivars 'Magenta' and 'White' in silica gel increased the moisture loss from the flowers as compared to the mixture of sand and silica gel. This might be due to the strong hygroscopic nature of silica gel which leads to the rapid removal of moisture from the flowers. These results are in accordance with dehydration of *Zinnia* flowers reported by Singh *et al.* (10) that the maximum moisture loss was observed when flowers were embedded in silica gel as compared to sand or borax.

In case of decrease in size of both 'Magenta' and 'White', the maximum decrease in size was obtained when flowers were dried in silica gel as compared to the mixture of sand and silica gel. Earlier, Bhalla *et al*. (1) also reported the maximum size reduction in chrysanthemum flowers following the silica gel-microwave treatment over sand media and reduction in flower size was ascribed to the properties of the media. In case of drying time, the maximum decrease in size was recorded for 5 min. drying and minimum was recorded in 3 min. drying of cvs Magenta and White. The maximum reduction of flower size at higher temperature and for prolonged durations has also been reported by earlier workers (Moona, 6). Among the different setting duration, it was found that those flowers, which were given a setting duration of 72 h resulted in the maximum decrease in size in both the types of gomphrena flowers.

On comparing the effect of different drying media under study on quality parameters of dried flowers of 'Magenta and 'White' (Table 1) more scores were attained by those flowers, which were embedded in silica gel as compared to the mixture of sand and silica gel. Hemant *et al.* (4) also reported that drying of cut roses in microwave oven after embedding in silica gel retains good dry flower quality in terms of flower colour, shape, pigment retention and longevity. Amongst microwave time under study, the maximum scores were allotted to those flowers which were dried for 3 min. (in case of 'Magenta') and 4 min. (in case of 'White'). In case of setting duration, the maximum score was obtained by the those flowers of 'Magenta' which were kept for 72 h and in case of 'White' it was 48 h.

Table 1. Effect of drying media, microwave time, setting duration on moisture loss (%), decrease in size (%) and quality parameters of *Gomphrena globosa* 'Magenta' and 'White'.

Treatment		Moisture loss (%)		Decrease in size (%)		Quality parameters (score out of 20)	
		GGM	GGW	GGM	GGW	GGM	GGW
Silica gel	M_1	69.41	70.04	14.66	13.33	18.06	17.76
Sand: silica gel (50:50 v/v)	M_2	63.88	63.80	11.89	7.90	16.87	16.39
3 min.	T_1	59.45	63.54	9.86	9.06	17.94	17.14
4 min.	T_2	68.01	66.22	12.72	10.11	17.76	17.42
5 min.	T_3	72.47	71.00	15.70	12.67	16.70	16.64
24 h	D_1	57.90	64.24	9.28	7.58	17.28	17.00
48 h	D_2	67.44	66.13	12.80	10.53	17.50	17.18
72 h	D_3	74.58	70.39	16.20	13.73	17.62	17.03
CD at 5%	M	0.92	0.55	0.56	0.50	0.11	0.10
	T	1.13	0.67	0.69	0.61	0.14	0.12
	D	1.13	0.67	0.69	0.61	0.14	0.12

Score card for evaluating the quality of dried flowers (modified after Peryam, 1957) (Score out of a total of 20), Flower colour and Shape retention: 5 = Excellent; 4 = Very good; 3 = Good; 2 = Poor; 1 = Very poor; Texture: 5 = Smooth; 3 = Medium; 1 = Rough; Brittleness: 5 = Intact; 3 = Slightly brittle; 1 = Brittle

In case of interaction of drying media × microwave time × setting duration (Table 2) the maximum moisture loss in 'Magenta' & 'White' was recorded in flowers, which were embedded in silica gel and kept for 5 min. in microwave oven with 72 h setting, whereas, the minimum moisture loss in 'Magenta' flowers was recorded, which were embedded in a mixture of sand and silica gel and kept in microwave oven for 3 min. with the setting period of 24 h, whereas, in case of 'White' moisture loss was minimum when flowers were embedded in a mixture of sand and silica gel and kept in microwave oven for 3 min. with 48 h setting duration.

The decrease in size in both the strains of gomphrena flowers was found maximum in flowers which were embedded in silica gel and kept for 5 min. in microwave oven with 72 h setting duration, whereas, the minimum was recorded in the flowers which were embedded in a mixture of sand and silica gel and kept in microwave oven for 3 min. with 24 h setting duration. Kher and Bhutani (5), while describing the properties of sand with respect to drying of flowers reported that fine sand does not react with the water vapour released during the process of drying as in the case of silica gel and borax. It allowed the water vapour to escape freely, thereby, causing minimum moisture loss and, therefore, size reduction was minimum in case of mixture of sand and silica gel.

In case of quality parameters (Table 2), the maximum score was attained by the flowers of 'Magenta', which were embedded in silica gel and dried for 3 min. in microwave oven kept for 72 h setting duration, while in case of 'White' maximum score was given to those which were embedded in silica gel and dried for 3 min. in microwave oven kept for 24 h setting duration, whereas, the minimum score was attained by the 'Magenta', which were embedded in a mixture of sand and silica gel and dried in microwave oven for 5 min. and kept for 48 h setting durations.

Table 2. Interaction effect of drying media, microwave time, setting duration on moisture loss (%), decrease in size (%) and quality parameters of *Gomphrena globosa* 'Magenta' and 'White'.

Treatment		Moisture loss (%)		Decrease in size (%)		Quality parameters (score out of 20)	
		GGM	GGW	GGM	GGW	GGM	GGW
Silica gel + 3 min. + 24 h	$M_1T_1D_1$	52.52	64.86	9.67	9.10	18.53	18.60
Silica gel + 3 min. + 48 h	$M_1T_1D_2$	55.49	67.59	12.80	12.58	18.80	18.13
Silica gel + 3 min. + 72 h	$M_1T_1D_3$	65.55	70.36	16.73	14.90	19.20	18.20
Silica gel + 4 min. + 24 h	$M_1T_2D_1$	60.56	64.77	11.10	11.00	18.13	17.80
Silica gel + 4 min. + 48 h	$M_1T_2D_2$	74.84	65.81	12.84	12.88	18.40	18.00
Silica gel + 4 min. + 72 h	$M_1T_2D_3$	80.50	71.55	18.55	15.43	18.60	18.07
Silica gel + 5 min. + 24 h	$M_1T_3D_1$	66.27	69.63	14.63	12.10	16.27	16.80
Silica gel + 5 min. + 48 h	$M_1T_3D_2$	80.50	75.07	17.48	14.51	17.00	17.00
Silica gel + 5 min. + 72 h	$M_1T_3D_3$	88.43	80.69	20.10	17.49	17.60	17.20
Sand: silica gel (50:50 v/v) + 3 min. + 24 h	$M_2T_1D_1$	50.82	61.20	3.84	3.42	16.80	16.00
Sand: silica gel (50:50 v/v) + 3 min. + 48 h	$M_2T_1D_2$	64.21	55.59	6.46	5.93	17.40	16.00
Sand: silica gel (50:50 v/v) + 3 min. + 72 h	$M_2T_1D_3$	68.10	61.63	9.63	8.43	16.93	15.93
Sand: silica gel (50:50 v/v) + 4 min. + 24 h	$M_2T_2D_1$	55.68	64.51	7.77	3.74	17.20	16.40
Sand: silica gel (50:50 v/v) + 4 min. + 48 h	$M_2T_2D_2$	63.43	69.20	11.52	6.22	17.20	17.67
Sand: silica gel (50:50 v/v) + 4 min. + 72 h	$M_2T_2D_3$	73.05	61.46	14.55	11.45	17.00	16.60
Sand: silica gel (50:50 v/v) + 5 min. + 24 h	$M_2T_3D_1$	61.58	60.48	8.65	6.11	16.73	16.40
Sand: silica gel (50:50 v/v) + 5 min. + 48 h	$M_2T_3D_2$	66.17	63.53	15.68	11.14	16.20	16.27
Sand: silica gel (50:50 v/v) + 5 min. + 72 h	$M_2T_3D_3$	71.86	76.61	17.67	14.66	16.40	16.20
CD at 5%	MxTxD	2.76	1.64	1.68	1.49	0.34	0.30

M_1 : Silica gel
M_2 : Sand: silica gel (50:50v/v)
T_1 : 3 min. T_2 : 4 min. T_3 : 5 min.
D_1 : 24 h D_2 : 48 h D_3 : 72 h

In case of 'White' flowers, the minimum score was attained by those which were embedded in a mixture of sand and silica gel and dried in microwave oven for 3 min. and kept for 72 h setting. In the present studies, the maximum score on quality parameters was given to those flowers, which were dried for 3 min. in microwave oven, however with the increase in microwave time, quality was also deteriorated for different parameters, also reported by Biswas and Dhua (2) in microwave drying of cut carnation where the lowest duration of 2 min. showed the best results in both the 'Cano' and 'Kristina' when assessed in respect of colour, texture and appearance of dried flowers as compared to drying durations of 3 and 4 minutes.

The shedding of bracts was found to be more in silica gel embedded flowers might be due to the strong hygroscopic nature of silica granules, which makes the flower more brittle with maximum moisture removal and because of prolonged microwave drying time, bracts drop off even with slight pressure. This is also in accordance to the findings of Chandrasekhar *et al.* (3) on standardization of drying techniques of carnation 'Master' where maximum petal loss was noticed with silica gel and borax in comparison to quartz sand. The efficacy in retention of colour and texture in sand and silica gel was also confirmed by Pamela (9).

Our experimental findings clearly demonstrate that silica gel embedding coupled with microwave drying was the most suitable dehydration method for the two examined strains of gomphrena flowers and silica gel embedding resulted in better colour, texture and brittleness when dried at 3 min. microwave oven drying time as compared to other treatments. Thus it can be concluded that embedding of *G. globosa* 'Magenta' in silica gel in microwave oven for 3 min. and for 72 h as setting duration was found to be the best method which scored the maximum for quality parameters, whereas, in case of *G. globosa* 'White' the highest score was obtained by the flowers which were embedded in silica gel and dried for 3 min. with 24 h setting duration.

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