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Effect of embedding media, microwave power and duration on drying quality of gerbera cv. Dana Ellen in microwave oven drying

Jagadeeswari VV, Suseela T, Sudha Vani V, Salomi Suneetha DR and Sujatha RV

Abstract
An experiment was laid out to study the "Effect of different levels of embedding media, microwave power and duration on drying quality of gerbera cv. Dana Ellen in microwave oven drying**"** was carried out in the Department of Floriculture and Landscape Architecture, College of Horticulture, Venkataramannagudem, West Godavari district, Andhra Pradesh during the year 2020-21. Significant difference was noticed with respect to per cent weight loss and per cent moisture loss of gerbera var. Dana Ellen. The maximum per cent weight loss, per cent moisture loss (74.75%, 80.02) respectively was recorded in the flowers embedded in silica gel at high microwave power level for 4.0 minutes and the minimum per cent weight loss, per cent moisture loss (53.75%, 37.41%) respectively was observed by the flowers embedded in sand at low microwave power level for 2.0 minutes. Minimum change in diameter (0.564 cm) was observed in sand embedded flowers at low microwave power level for 2 min and maximum change in diameter (1.114 cm) was observed in silica gel embedded flowers at high microwave power level for 4 min. The maximum xanthophyll retention (51.26%) has recorded in gerbera flowers embedded in silica gel at low microwave power level for 2 min. Minimum xanthophyll retention (26.33%) has recorded in gerbera flowers embedded in sand at high microwave power level for 4 min. Silica gel embedded flowers at high microwave power level for 2 to 4 min duration, has took less time for drying. From the above findings it could be concluded that flowers embedded in silica gel dried at medium level of micro power level for 3.0 minutes duration under 36 hours of setting time showed good results with respect to per cent weight loss, per cent moisture loss, change in diameter, time taken for drying and xanthophyll retention compare to flowers dried at higher level of micro power density and higher duration.

Keywords: Gerbera, microwave oven, silica gel, dry flower

Introduction
Dry flowers have good demand both in domestic and international markets (Vishnu priya and Jawaharlal, 2014) [5]. The dried flowers industry in India is about years old and its products have got high export value. Export of dried flowers and plants from India is worth of about Rs.100 crores per year, which contributes to nearly 60 per cent of floriculture export to Europe and it is below 1.5 per cent of the world requirement. The USA has the largest demand for dried flowers, which is estimated around US $2.4 million annually, followed by Germany and UK (Datta, 2004) [2]. Other exporting countries for dry flowers are west European countries, Japan, Hong Kong and Singapore. The Netherlands ranks first in export of dried flowers to the American market followed by Columbia, Mexico, India and Israel. In the recent years, Australia is emerging as a leader in dry flower export with Japan, Germany and the United States of America as their prime markets (Mathapathi *et al.* 2015) [4]. Survey report reveals that, nearly about 40% of total flower production is unsold and wasted every day (Masure and Patil, 2014) [3]. Sometimes due to glut in market, the farmer cannot realize profits and forced to dispose off the produce in the market. In the view of above issues the present study was under taken to standardize media, drying level and time in microwave oven of gerbera.

Materials and Methods
The present investigation was carried out on "Effect of embedding media, microwave power and duration on drying quality of gerbera cv. Dana Ellen in microwave oven drying" during 2020-21 at Department of Floriculture and Landscape Architecture, College of Horticulture, Venkataramannagudem, West Godavari district, Andhra Pradesh.

Gerbera flowers collected during glut period from kadiyapulanka flower market, situated in Coastal Andhra Pradesh. Gerbera flowers immediately after brought to the laboratory embedded in different media (sand, silica gel, sand: silica gel (50:50 v/v), dried in microwave oven at different microwave power levels (Low level-180 W, Medium level-540 W, High level – 900 W) for different durations (2 min, 3 min, 4 min). Flowers kept in face up position and dried in microwave oven and after drying in microwave oven flowers kept for setting. The experiment was laid out in a Factorial Completely Randomized Design.

Treatments combinations are T_1- $M_1P_1D_1$: Sand + Low level + 2:00 min, T_2- $M_1P_1D_2$: Sand + Low level + 3:00 min, T_3- $M_1P_1D_3$: Sand + Low level + 4:00 min, T_4- $M_1P_2D_1$: Sand + Medium level + 2:00 min, T_5- $M_1P_2D_2$: Sand + Medium level + 3:00 min, T_6- $M_1P_2D_3$: Sand + Medium level + 4:00 min, T_7- $M_1P_3D_1$: Sand + High level + 2:00 min, T_8- $M_1P_3D_2$: Sand + High level + 3:00 min, T_9- $M_1P_3D_3$: Sand + High level + 4:00 min, T_{10}- $M_2P_1D_1$: Silica gel + Low level + 2:00 min, T_{11}- $M_2P_1D_2$: Silica gel + Low level + 3:00 min, T_{12}- $M_2P_1D_3$: Silica gel + Low level + 4:00 min, T_{13}- $M_2P_2D_1$: Silica gel + Medium level + 2:00 min, T_{14}- $M_2P_2D_2$: Silica gel + Medium level + 3:00 min, T_{15}- $M_2P_2D_3$: Silica gel + Medium level + 4:00 min, T_{16}- $M_2P_3D_1$: Silica gel + High level + 2:00 min, T_{17}- $M_2P_3D_2$: Silica gel + High level + 3:00 min, T_{18}- $M_2P_3D_3$: Silica gel + High level + 4:00 min, T_{19}- $M_3P_1D_1$: Sand:silica gel (50:50 v/v)+ Low level + 2:00 min, T_{20}- $M_3P_1D_2$: Sand:silica gel (50:50 v/v)+ Low level + 3:00 min, T_{21}- $M_3P_1D_3$: Sand:silica gel (50:50 v/v)+ Low level + 4:00 min, T_{22}- $M_3P_2D_1$: Sand:silica gel (50:50 v/v)+ Medium level + 2:00 min, T_{23}- $M_3P_2D_2$: Sand:silica gel (50:50 v/v)+ Medium level + 3:00 min, T_{24}- $M_3P_2D_3$: Sand:silica gel (50:50 v/v)+ Medium level + 4:00 min, T_{25}- $M_3P_3D_1$: Sand:silica gel (50:50 v/v)+ High level + 2:00 min, T_{26}- $M_3P_3D_2$: Sand:silica gel (50:50 v/v)+ High level + 3:00 min, T_{27}- $M_3P_3D_3$: Sand:silica gel (50:50 v/v)+ High level + 4:00 min.

Results and Discussion

The data was recorded on following quantitative parameters.

Percent weight loss and moisture loss (%): Significant difference was noticed with respect to per cent weight loss and per cent moisture loss. The gerbera cv. Dana Ellen embedded in silica gel recorded highest per cent weight loss and moisture loss (69.87%, 65.89%) and it was minimum (60.71%, 48.07%) in sand. Regarding the effect of microwave power levels maximum per cent weight loss and per cent moisture loss (69.71%, 67.21%) was observed in high microwave power level and minimum (60.47%, 49.88%) in low microwave power level. The duration of gerbera flowers for 4 min resulted in maximum per cent weight and moisture loss (66.65%, 60.15%) whereas minimum (64.02%, 53.96%) was recorded in flowers dried for 2 min.

The interaction effect of embedding media and microwave power levels indicated that maximum per cent weight loss and moisture loss (66.27%, 76.87%) were recorded when gerbera flowers were embedded in silica gel and dried at high microwave power level and minimum (55.09%, 39.51%) in sand when kept at low microwave power level. Similarly, the interaction between microwave power and duration resulted in maximum per cent weight loss and moisture loss (70.76%, 70.39%) when flowers were dried at high microwave power for 4 min and minimum (58.82%, 44.15%) in flowers dried at low microwave power for 2 min. The interaction between embedding media and duration on per cent weight loss and moisture loss (70.07%, 69.30%) was recorded significantly maximum when flowers were embedded in silica gel dried for 4 min. However, minimum Per cent weight loss and moisture loss (59.21%, 45.56%) were recorded in flowers embedded in sand dried for 2 min. A results illustrate that the maximum per cent weight loss and per cent moisture loss (74.75%, 80.02%) respectively was noticed in flowers embedded in silica gel dried at higher level of micro power density for 4 min and minimum per cent weight loss and per cent moisture loss were recorded (53.75%, 37.41%) respectively in sand embedded flowers at low microwave power for 2 min. Similar line of work has done by Biswas and Dhua (2010) [1] in carnation and revealed that there is an increase in weight loss and increased per cent moisture loss with increased time duration when cut carnation flowers are subjected for drying in microwave oven and also might be due to the additive effect of the desiccating property of silica gel.

Table 1: Effect of embedding media, microwave power level and duration on per cent weight loss (%) in gerbera cv. Dana Ellen (Actual figures)

Micro wave power level (P)	Duration (D)	Media (M))															
		Drying period															
		12 Hours				24 Hours				36 Hours				48 Hours			
		M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
P_1	D_1	53.75	63.75	58.96	58.82	55.86	66.45	60.27	60.86	57.46	67.61	62.75	62.60	58.46	69.36	65.27	64.36
	D_2	55.36	66.59	60.14	60.69	56.29	67.89	62.49	62.22	58.09	69.39	64.63	64.03	59.18	70.74	66.27	65.39
	D_3	56.18	67.55	62.02	61.91	57.79	69.42	64.22	63.81	59.15	70.94	66.17	65.42	60.86	71.84	66.32	66.34
	Mean	55.09	65.69	60.37	60.47	56.64	67.92	62.37	62.29	58.23	69.31	64.51	64.02	59.50	70.64	65.95	65.36
P_2	D_1	58.69	69.24	65.29	64.40	60.21	70.79	66.25	65.75	62.06	71.50	67.10	66.88	63.07	72.05	68.42	67.84
	D_2	61.20	70.39	66.33	65.97	62.36	71.49	67.30	67.05	64.11	72.10	69.42	68.54	65.13	-	70.28	-
	D_3	63.23	71.40	67.21	67.28	64.25	71.98	69.31	68.51	65.18	-	69.91	-	65.45	-	70.78	-
	Mean	61.04	70.34	73.31	65.88	62.27	71.42	67.62	67.10	63.78	-	68.81	-	64.55	-	69.82	-
P_3	D_1	65.20	71.94	69.39	68.84	65.28	-	70.19	-	66.08	-	71.18	-	66.22	-	70.99	-
	D_2	65.64	73.24	69.68	69.52	66.44	-	70.30	-	67.22	-	71.08	-	68.16	-	-	-
	D_3	67.17	74.75	70.38	70.76	67.97	-	71.68	-	68.14	-	-	-	68.78	-	-	-
	Mean	60.37	66.27	69.81	69.71	66.56	-	70.72	-	67.14	-	-	-	67.72	-	-	-
For comparing embedding media (M) and duration (D) levels																	
	D_1	59.21	68.31	64.54	64.02	60.45	-	65.57	-	61.86	-	67.01	-	62.58	-	68.22	-
	D_2	60.73	70.07	65.38	65.39	61.97	-	66.69	-	63.14	-	68.37	-	64.15	-	-	-
	D_3	62.19	65.38	66.53	66.65	63.33	-	68.40	-	64.15	-	-	-	65.03	-	-	-
	Mean	60.71	69.87	65.48	65.35	61.82	-	66.89	-	63.05	-	-	-	63.92	-	-	-

M1 - Sand, M2 - Silica gel, M3 – Sand: Silica gel (50:50 v/v); P1 - low level (180 W), P2 - Medium level (540 W), P3 - High level 900 (W); D1 - 2 min, D2 - 3 min,D3 - 4min

Table 2: Effect of embedding media, microwave power level and duration on per cent weight loss (%) in gerbera cv. Dana Ellen (transformed figures)

Micro wave power level (P)	Duration (D)	Media (M)															
		Drying period															
		12 Hours				24 Hours				36 Hours				48 Hours			
		M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
P_1	D_1	47.13	52.96	50.14	50.07	48.34	54.58	50.91	51.27	49.27	55.29	52.37	52.30	49.85	56.37	53.87	53.36
	D_2	48.05	54.66	50.83	51.18	48.59	55.46	52.21	52.08	49.64	56.39	53.49	53.16	50.27	57.23	54.47	53.99
	D_3	48.53	55.25	51.93	51.90	49.46	56.40	53.24	53.03	50.25	57.36	54.41	54.00	51.25	57.93	54.50	54.56
	Mean	47.90	54.29	50.96	51.05	48.80	55.48	52.11	52.13	49.71	56.34	53.42	53.16	50.45	57.17	54.28	53.97
P_2	D_1	49.98	56.29	53.88	53.38	50.87	57.26	54.46	54.19	51.96	57.71	54.98	54.88	52.56	58.06	55.79	55.46
	D_2	51.45	57.01	54.50	54.32	52.13	57.70	55.10	54.97	53.17	58.09	56.41	55.89	53.79	-	56.94	-
	D_3	52.65	57.64	55.04	55.11	53.25	58.02	56.34	55.87	53.82	-	56.71	-	53.98	-	57.26	-
	Mean	51.36	56.98	54.47	54.27	52.08	57.66	55.29	55.01	52.98	-	56.03	-	53.44	-	56.66	-
P_3	D_1	53.82	57.99	56.38	56.06	53.87	-	56.89	-	54.36	-	57.51	-	54.44	-	57.39	-
	D_2	54.09	58.82	56.56	56.49	54.57	-	56.95	-	55.05	-	57.45	-	55.63	-	-	-
	D_3	55.02	59.81	57.00	57.27	55.50	-	57.83	-	55.61	-	-	-	56.01	-	-	-
	Mean	54.31	58.87	56.65	56.61	54.64	-	57.22	-	55.00	-	-	-	55.35	-	-	-
For comparing embedding media (M) and duration (D) levels																	
	D_1	50.31	55.74	53.47	53.17	51.03	-	54.08	-	51.86	-	54.95	-	52.28	-	55.68	-
	D_2	51.20	56.83	53.96	54.00	51.76	-	54.75	-	52.62	-	55.77	-	53.22	-	-	-
	D_3	52.06	57.57	54.66	54.76	52.74	-	55.80	-	53.22	-	-	-	53.74	-	-	-
	Mean	51.19	56.71	54.03	53.97	51.84	-	54.88	-	52.57	-	-	-	53.08	-	-	-

Factor	$S.E_m(\pm)$	CD @ 5%	$S.E_m(\pm)$	CD @ 5%	$S.E_m(\pm)$	CD @ 5%	$S.E_m(\pm)$	CD @ 5%
Media (M)	0.04	0.12	0.01	0.03	0.02	0.05	0.02	0.05
Microwave power (P)	0.04	0.12	0.01	0.03	0.02	0.05	0.02	0.05
Duration (D)	0.04	0.12	0.01	0.03	0.02	0.05	0.02	0.05
M x P	0.07	0.20	0.02	0.05	0.03	0.09	0.03	0.09
P x D	0.07	0.20	0.02	0.05	0.03	0.09	0.03	0.09
M x D	0.07	0.20	0.02	0.05	0.03	0.09	0.03	0.09
M x P x D	0.12	0.35	0.03	0.08	0.06	0.16	0.05	0.15

Figures indicate arc sign transformed values.

Table 3: Effect of embedding media, microwave power level and duration on per cent moisture loss (%) in gerbera cv. Dana Ellen (Actual values)

Micro wave power level (P)	Duration (D)	Media (M)															
		Drying period															
		12 Hours				24 Hours				36 Hours				48 Hours			
		M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	M_1
P_1	D_1	37.41	51.02	44.02	44.15	40.18	55.09	47.38	47.55	42.30	58.34	50.58	50.40	44.28	62.05	53.31	53.21
	D_2	39.25	55.46	47.29	47.33	41.93	59.35	50.00	50.42	43.44	62.47	53.13	53.01	45.40	66.26	56.30	55.98
	D_3	41.87	58.67	49.10	49.88	43.46	62.57	52.68	52.90	45.46	66.56	55.39	55.80	47.23	70.25	57.26	58.24
	Mean	39.51	55.05	46.80	47.12	41.85	59.00	50.02	50.29	43.73	62.45	53.03	53.07	45.63	66.18	55.62	55.81
P_2	D_1	44.72	62.38	53.76	53.62	46.51	66.25	56.31	56.35	49.07	69.27	59.21	59.18	50.77	73.65	62.34	62.25
	D_2	48.19	65.05	57.28	56.84	49.31	69.24	60.21	59.58	51.36	73.68	63.57	62.87	53.46	-	66.57	-
	D_3	51.04	69.21	60.27	60.17	52.41	73.56	63.21	63.06	54.30	-	66.24	-	56.25	-	69.59	-
	Mean	47.98	65.54	57.10	56.87	49.41	69.68	59.91	59.66	51.57	-	63.00	-	53.49	-	66.16	-
P_3	D_1	54.57	73.56	64.26	64.13	55.88	-	67.26	-	57.46	-	70.11	-	58.25	-	73.68	-
	D_2	56.30	77.03	68.02	67.11	58.54	-	71.31	-	60.34	-	73.03	-	62.54	-	-	-
	D_3	59.32	80.02	71.85	70.39	61.99	-	74.13	-	62.23	-	-	-	64.37	-	-	-
	Mean	56.73	76.87	68.04	67.21	58.80	-	70.90	-	60.01	-	-	-	61.72	-	-	-
For comparing embedding media (M) and duration (D) levels																	
	D_1	45.56	62.32	54.01	53.96	47.52	-	56.98	-	49.61	-	59.96	-	51.10	-	63.11	-
	D_2	47.91	65.84	57.53	57.09	49.92	-	60.50	-	51.71	-	63.24	-	53.80	-	-	-
	D_3	50.74	69.30	60.40	60.15	52.60	-	63.34	-	53.99	-	-	-	55.95	-	-	-
	Mean	48.07	65.82	57.31	57.06	50.02	-	60.27	-	51.77	-	-	-	53.61	-	-	-

M_1 - Sand, M_2 - Silica gel, M_3 – Sand: Silica gel (50:50 v/v); P_1 - low level (180 W), P_2 - Medium level (540 W), P_3 - High level 900 (W); D_1 -2 min, D_2 - 3 min, D_3 – 4 min

Table 4: Effect of embedding media, microwave power level and duration on per cent moisture loss (%) in gerbera cv. Dana Ellen (transformed figures)

Micro wave power level (P)	Duration (D)	Media (M)															
		Drying period															
		12 Hours				24 Hours				36 Hours				48 Hours			
		M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	M_1
P_1	D_1	37.69	45.57	41.55	41.60	39.32	47.90	43.48	43.56	40.55	49.78	45.31	45.21	41.70	51.95	46.88	46.84
	D_2	38.77	48.12	43.43	43.44	40.34	50.37	44.98	45.23	41.21	52.20	46.78	46.73	42.34	54.47	48.60	48.47

	D_3	40.30	49.97	44.47	44.91	41.23	52.26	46.52	45.66	42.38	54.65	48.08	48.36	43.40	56.92	49.16	49.82
	Mean	38.92	47.88	43.14	43.31	40.29	50.17	44.99	45.15	41.38	52.21	46.72	46.77	42.47	54.44	48.21	48.37
P_2	D_1	41.95	52.15	47.14	47.07	42.98	54.46	48.61	48.68	44.45	56.31	50.29	50.34	45.42	59.09	52.12	52.21
	D_2	43.94	53.74	49.17	48.95	44.59	56.29	50.87	50.58	45.76	59.11	52.85	52.57	46.97	-	54.66	-
	D_3	45.57	56.28	50.91	50.91	46.36	59.03	52.64	52.67	47.45	-	54.46	-	48.57	-	56.51	-
	Mean	43.82	54.05	49.07	48.98	44.64	56.59	50.70	50.64	45.88	-	52.53	-	46.98	-	54.43	-
P_3	D_1	47.60	59.03	53.26	53.3	48.36	-	55.08	-	49.27	-	56.84	-	49.73	-	59.11	-
	D_2	48.60	61.34	55.54	55.15	49.90	-	57.59	-	50.95	-	58.69	-	52.24	-	-	-
	D_3	50.35	63.42	57.93	57.23	51.92	-	59.40	-	52.06	-	-	-	53.33	-	-	-
	Mean	8.85	61.26	55.57	55.23	50.05	-	57.35	-	50.75	-	-	-	51.76	-	-	-
For comparing embedding media (M) and duration (D) levels																	
	D_1	42.41	52.24	47.31	47.32	43.55	-	49.05	-	44.75	-	50.81	-	45.61	-	52.70	-
	D_2	43.77	54.39	49.37	49.18	44.94	-	51.14	-	45.97	-	52.77	-	47.18	-	-	-
	D_3	45.41	56.55	51.10	51.02	46.50	-	52.85	-	74.29	-	-	-	48.43	-	-	-
	Mean	43.86	54.40	49.26	49.17	44.99	-	51.01	-	46.00	-	-	-	47.07	-	-	-

Factor	$S.E_m(\pm)$	CD @ 5%	$S.E_m(\pm)$	CD @ 5%	$S.E_m(\pm)$	CD @ 5%	$S.E_m(\pm)$	CD @ 5%
Media (M)	0.04	0.12	0.06	0.16	0.07	0.21	0.05	0.15
Microwave power (P)	0.04	0.12	0.06	0.16	0.07	0.21	0.05	0.15
Duration (D)	0.04	0.12	0.06	0.16	0.07	0.21	0.05	0.15
M x P	0.07	0.20	0.10	0.28	0.12	0.36	0.09	0.26
P x D	0.07	0.20	0.10	0.28	0.12	0.36	0.09	0.26
M x D	0.07	0.20	0.10	0.28	0.12	0.36	0.09	0.26
M x P x D	0.12	0.35	0.17	0.49	0.21	0.62	0.15	0.45

Figures indicate arc sign transformed values.

Change in flower diameter (cm): Significant difference was noticed with respect to change in diameter. The gerbera cv. Dana Ellen embedded in sand recorded minimum change in flower diameter (0.688 cm) and it was maximum (0.929 cm) in flowers embedded in silica gel. As regards the effect of microwave power levels minimum change in flower diameter (0.703 cm) was observed in low microwave power level and maximum (0.917 cm) in high microwave power level. The duration of gerbera flowers for 2 min resulted in minimum change in flower diameter (0.775 cm) whereas maximum (0.843 cm) was recorded in flowers dried for 4 min.

The interaction effect of embedding media and microwave power levels indicated that minimum change in flower diameter (0.593 cm) was recorded when gerbera flowers were embedded in sand and at low microwave power level and maximum (1.060 cm) in silica gel when kept at high microwave power level. Similarly, the interaction of microwave power and duration resulted in minimum change in flower diameter (0.673 cm) when flowers were dried at low microwave power for 2 min and maximum (0.955 cm) in flowers kept at high microwave power for 4 min. The interaction of embedding media and duration on gerbera flowers indicated that minimum change in flower diameter (0.659 cm) was recorded when flowers were embedded in sand for 2 min. However, maximum change in diameter (0.973 cm) was recorded in flowers embedded in silica gel for 4 min. The minimum change in diameter (0.564 cm) was noticed in flowers embedded in sand dried at low level of micro power density for 2 min and maximum change in flower diameter has recorded (1.114 cm) in silica gel embedded flowers at high microwave power for 4 min. It is observed that higher per cent weight loss and per cent moisture loss with increase in microwave power level and duration of treatment combinations caused augmented reduction in flower diameter during drying in gerbera cv. Dana Ellen.

Table 5: Effect of embedding media, microwave power level and duration on change in diameter (cm) of dried gerbera cv. Dana Ellen

Micro wave power level (P)	**Duration (D)**	**Media (M)**															
		Drying period															
		12 Hours				**24 Hours**				**36 Hours**				**48 Hours**			
		M_1	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**M_1**
P_1	D_1	0.564	0.773	0.681	0.673	0.604	0.800	0.713	0.706	0.641	0.840	0.741	0.741	0.662	0.882	0.787	0.777
	D_2	0.592	0.811	0.702	0.702	0.625	0.851	0.742	0.739	0.655	0.886	0.781	0.774	0.674	0.913	0.807	0.798
	D_3	0.623	0.841	0.743	0.736	0.655	0.882	0.771	0.769	0.674	0.915	0.792	0.794	0.703	0.961	0.816	0.827
	Mean	0.593	0.808	0.709	0.703	0.628	0.844	0.742	0.738	0.657	0.880	0.771	0.769	0.680	0.919	0.803	0.801
P_2	D_1	0.660	0.882	0.781	0.774	0.683	0.914	0.792	0.796	0.700	0.951	0.833	0.828	0.731	0.992	0.865	0.863
	D_2	0.691	0.911	0.814	0.805	0.712	0.965	0.833	0.837	0.742	0.993	0.874	0.870	0.762	-	0.892	-
	D_3	0.721	0.963	0.833	0.839	0.731	1.001	0.877	0.870	0.761	-	0.892	-	0.783	-	0.923	-
	Mean	0.691	0.919	0.809	0.806	0.709	0.960	0.834	0.834	0.734	-	0.866	-	0.759	-	0.893	-
P_3	D_1	0.752	1.003	0.875	0.877	0.776	-	0.905	-	0.793	-	0.944	-	0.804	-	0.971	-
	D_2	0.785	1.062	0.916	0.921	0.792	-	0.954	-	0.822	-	1.001	-	0.834	-	-	-
	D_3	0.808	1.114	0.942	0.955	0.821	-	1.013	-	0.831	-	-	-	0.855	-	-	-
	Mean	0.782	1.060	0.911	0.917	0.796	-	0.957	-	0.815	-	-	-	0.831	-	-	-
For comparing embedding media (M) and duration (D) levels																	
	D_1	0.659	0.886	0.779	0.775	0.688	-	0.803	-	0.711	-	0.839	-	0.732	-	0.87	-
	D_2	0.689	0.928	0.811	0.809	0.710	-	0.843	-	0.740	-	0.885	-	0.757	-	-	-
	D_3	0.717	0.973	0.839	0.843	0.736	-	0.887	-	0.755	-	-	-	0.780	-	-	-
	Mean	0.688	0.929	0.810	0.809	0.711	-	0.844	-	0.735	-	-	-	0.756	-	-	-

Factor	$S.E_m(\pm)$	CD @ 5%	$S.E_m(\pm)$	CD @ 5%	$S.E_m(\pm)$	CD @ 5%	$S.E_m(\pm)$	CD @ 5%
Media (M)	0.001	0.004	0.002	0.005	0.002	0.007	0.002	0.007
Microwave power (P)	0.001	0.004	0.002	0.005	0.002	0.007	0.002	0.007
Duration (D)	0.001	0.004	0.002	0.005	0.002	0.007	0.002	0.007
M x P	0.002	0.007	0.003	0.008	0.004	0.012	0.004	0.012
P x D	0.002	0.007	0.003	0.008	0.004	0.012	0.004	0.012
M x D	0.002	0.007	0.003	0.008	0.004	0.012	0.004	0.012
M x P x D	0.004	0.012	0.005	0.014	0.007	0.021	0.007	0.020

M_1 - Sand, M_2 - Silica gel, M_3 – Sand: Silica gel (50:50 v/v); P_1 - low level (180 W), P_2 - Medium level (540 W), P_3 - High level 900 (W); D_1 - 2 min, D_2 - 3 min, D_3 – 4min

Time taken for drying: Gerbera flowers embedded in silica gel at high microwave power level dried for 1 to 3 minutes duration of flowers took less time for complete drying. Where as, sand embedding gerbera flowers at low microwave power level dried flowers took maximum time for drying. Drying time was depends on desiccating agent, microwave power density and duration.

Table 6: Effect of embedding media, microwave power level and duration on time taken for drying of gerbera cv. Dana Ellen

Treatment combinations	Time taken for drying
$M_1P_1D_1$	48 hours of setting
$M_1P_1D_2$	48 hours of setting
$M_1P_1D_3$	48 hours of setting
$M_1P_2D_1$	48 hours of setting
$M_1P_2D_2$	48 hours of setting
$M_1P_2D_3$	48 hours of setting
$M_1P_3D_1$	48 hours of setting
$M_1P_3D_2$	48 hours of setting
$M_1P_3D_3$	48 hours of setting
$M_2P_1D_1$	48 hours of setting
$M_2P_1D_2$	48 hours of setting
$M_2P_1D_3$	48 hours of setting
$M_2P_2D_1$	48 hours of setting
$M_2P_2D_2$	36 hours of setting
$M_2P_2D_3$	24 hours of setting
$M_2P_3D_1$	12 hours of setting
$M_2P_3D_2$	12 hours of setting
$M_2P_3D_3$	12 hours of setting
$M_3P_1D_1$	48 hours of setting
$M_3P_1D_2$	48 hours of setting
$M_3P_1D_3$	48 hours of setting
$M_3P_2D_1$	48 hours of setting
$M_3P_2D_2$	48 hours of setting
$M_3P_2D_3$	48 hours of setting
$M_3P_3D_1$	48 hours of setting
$M_3P_3D_2$	36 hours of setting
$M_3P_3D_3$	24 hours of setting

M_1: Sand, M_2: Silica gel, M_3: Sand: Silica gel (50:50 v/v)**,** P_1 - low level (180 W), P_2 - Medium level (540 W), P_3 - High level 900 (W); D_1 - 1 min, D_2 - 2 min, D_3 – 3min.

Xanthophyll retention (%): Significant difference was noticed with respect to xanthophyll retention. The gerbera cv. Dana Ellen embedded in silica gel recorded highest xanthophyll retention (43.52%) and it was minimum (30.07%) in sand. Regarding microwave power levels, maximum xanthophyll retention (43.32%) was observed in low microwave power level and minimum (32.89%) in high microwave power level. The duration of gerbera flowers for 2 min resulted in maximum xanthophyll retention (39.64%) whereas minimum (36.67%) was recorded in flowers dried for 4 min.

The interaction effect of embedding media and microwave power levels indicated that maximum xanthophyll retention (49.32%) was recorded when gerbera flowers were embedded in silica gel and at low microwave power level and minimum (26.77%) in sand when kept at high microwave power level. Similarly, the interaction between microwave power and duration on xanthophyll retention (45.02%) was significantly maximum when flowers were dried at low microwave power for 2 min and minimum (31.69%) in flowers kept at high microwave power for 4 min. The interaction effect between embedding media and duration on xanthophyll retention (45.40%) was significantly maximum when flowers were embedded in silica gel for 2 min. However, minimum xanthophyll retention (28.92%) was recorded in flowers embedded in sand for 4 min. From the three way interactions it can be concluded that the maximum xanthophyll retention (51.26%) was noticed in flowers embedded in silica gel dried at low level of micro power density for 2 min and minimum xanthophyll retention has recorded (26.33%) in sand embedded flowers at high microwave power for 4 min. Maximum xanthophyll retention could be due to hydro - absorbant nature of silica gel and low microwave power density.

Table 7: Effect of embedding media, microwave power level and duration on xanthophyll retention (%) of dried gerbera cv. Dana Ellen

Micro wave power level (P)	Duration (D)	Media (M)			
		M_1	**M_2**	**M_3**	**Mean**
P_1	D_1	35.60 (36.62)	51.26 (45.70)	48.21 (43.96)	45.02 (42.09)
	D_2	34.21 (35.78)	49.35 (44.61)	46.59 (43.03)	43.38 (41.14)
	D_3	32.11 (34.50)	47.37 (43.48)	45.23 (42.25)	41.57 (40.07)
	Mean	33.97 (35.63)	49.32 (44.60)	46.67 (43.08)	43.32 (41.10)
P_2	D_1	30.15 (33.29)	45.83 (42.59)	43.00 (40.96)	39.66 (38.94)
	D_2	29.99 (33.19)	43.27 (41.12)	41.31 (39.98)	38.19 (38.09)
	D_3	28.33 (32.15)	41.21 (39.92)	38.02 (38.05)	35.85 (36.70)
	Mean	29.49 (32.88)	43.43 (41.21)	40.77 (39.66)	37.90 (37.91)
P_3	D_1	27.00 (31.29)	39.13 (38.71)	36.64 (37.24)	34.25 (35.74)
	D_2	26.98 (31.28)	37.98 (38.03)	33.26 (35.21)	32.74 (34.84)
	D_3	26.33 (30.86)	36.37 (37.08)	32.39 (34.68)	31.69 (34.20)
	Mean	26.77 (31.14)	37.82 (37.94)	34.09 (35.71)	32.89 (34.93)
For comparing embedding media (M) and duration (D) levels					
	D_1	30.91 (33.72)	45.40 (42.33)	42.61 (40.71)	39.64 (38.92)
	D_2	30.39 (33.42)	43.53 (41.25)	40.38 (39.40)	38.10 (38.02)
	D_3	28.92 (32.50)	41.65 (40.15)	38.54 (38.32)	36.37 (36.99)
	Mean	30.07 (33.21)	43.52 (41.24)	40.51 (39.47)	38.03 (37.97)
Factor		$S.E_m(\pm)$		CD @ 5%	
Media (M)		0.04		0.12	
Microwave power (P)		0.04		0.12	
Duration (D)		0.04		0.12	
M x P		0.07		0.20	
P x D		0.07		0.20	
M x D		0.07		0.20	
M x P x D		0.12		0.35	

Figures in parentheses were arc sign transformed values
M_1 - Sand, M_2 - Silica gel, M_3 – Sand: silicagel (50:50 v/v);
P_1 - low level (180 W), P_2 - Medium level (540 W), P_3 - High level 900 (W);
D_1 - 2 min, D_2 - 3 min, D_3 – 4min

Conclusion

Parameters like per cent weight loss, moisture loss, change in diameter was registered maximum in silica gel embedded flowers dried at high microwave power (900 W) level for 4 min and less time registered for drying of flowers was observed in silica gel embedded flowers dried at high microwave power (900 W) level for 2 to 4 min. Maximum xanthophyll retention was noted in flowers embedded in silica gel dried at low microwave power for 2 minutes. From the above results it could be concluded that flowers embedded in silica gel dried at medium level of micro power level for 3.0 minutes duration under 36 hours of setting time showed good.

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