Indian Journal of Agricultural Sciences **92** (3): 402–4, March 2022/Short Communication
https://doi.org/10.56093/ijas.v92i3.122725

Vacuum drying: a new technique for drying ornamental flowers and bracts

RAGHUPATHI B[1] and SUBHENDU S GANTAIT[1]*

Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal 741 252, India

Received: 07 July 2020; Accepted: 08 September 2021

Keywords: Dry flowers, Drying technique, Vacuum drying, Value addition

Vacuum oven drying is a novel technology for drying of ornamental flowers and leaves, retaining its natural colour and form with less energy usage, lower process temperatures with greater efficiency and improved drying rates (Alibas 2009). In this method, plant materials are dried under sub-atmospheric pressures as lower pressures allow drying temperature to be reduced, which maintains cell integrity resulting in fine structure and shape of plant materials without the loss of ornamental value. Therefore, the present study was undertaken with an objective to standardize vacuum oven drying technology for drying of some ornamental flowers and bracts.

The experiment was conducted at Department of Floriculture and Landscape Architecture, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal during 2018–19. Experiment was laid out in CRD (Factorial) with eight treatment combinations by embedding in sand and silica and drying

Table 1 Effect of drying media (M), duration (D) and their interaction on vacuum oven dried *Wedelia trilobata* and *Ixora chinensis* flowers

Treatment	*Wedelia trilobata*						*Ixora chinensis*					
	FW (g)	DW (g)	ML (%)	Texture	Brittleness	Appearance	FW (g)	DW (g)	ML (%)	Texture	Brittleness	Appearance
M_1	0.34	0.09	73.86	5.15	7.20	4.70	0.15	0.05	67.40	5.55	7.90	5.60
M_2	0.34	0.06	81.98	7.30	7.40	7.65	0.16	0.03	81.87	7.10	7.10	7.85
S.Em (±)	0.00	0.00	0.39	0.03	0.03	0.03	0.00	0.00	0.93	0.03	0.03	0.04
CD at 5%	N/A	0.01	1.13	0.08	0.09	0.08	0.00	0.00	2.69	0.10	0.10	0.10
D_1	0.34	0.09	74.07	6.60	8.40	6.70	0.16	0.06	64.09	4.80	8.40	5.40
D_2	0.36	0.08	76.77	6.90	8.30	7.20	0.16	0.04	75.52	6.30	8.00	6.70
D_3	0.34	0.07	79.95	5.90	6.60	5.50	0.15	0.03	77.81	7.10	7.40	7.50
D_4	0.33	0.06	80.89	5.50	5.90	5.30	0.15	0.03	81.12	7.10	6.20	7.30
S.Em (±)	0.00	0.00	0.55	0.04	0.05	0.04	0.00	0.00	1.32	0.05	0.05	0.05
CD at 5%	0.01	0.01	1.60	0.12	0.13	0.12	0.00	0.01	3.81	0.14	0.14	0.14
M_1D_1	0.34	0.10	69.32	5.40	8.20	5.00	0.16	0.08	49.99	4.00	8.40	4.20
M_1D_2	0.36	0.10	73.10	5.60	8.40	5.80	0.15	0.05	69.33	4.80	8.20	4.80
M_1D_3	0.34	0.08	75.99	5.00	6.60	4.20	0.14	0.04	73.56	6.60	7.60	6.60
M_1D_4	0.33	0.08	77.02	4.60	5.60	3.80	0.14	0.03	76.71	6.80	7.40	6.80
M_2D_1	0.34	0.07	78.81	7.80	8.60	8.40	0.16	0.03	78.20	5.60	8.40	6.60
M_2D_2	0.35	0.07	80.43	8.20	8.20	8.60	0.17	0.03	81.70	7.80	7.80	8.60
M_2D_3	0.34	0.06	83.90	6.80	6.60	6.80	0.16	0.03	82.05	7.60	7.20	8.40
M_2D_4	0.32	0.05	84.76	6.40	6.20	6.80	0.16	0.02	85.54	7.40	5.00	7.80
S.Em (±)	0.00	0.01	0.78	0.06	0.06	0.06	0.00	0.00	1.86	0.07	0.07	0.07
CD at 5%	0.01	N/A	N/A	0.17	0.19	0.17	0.01	0.01	5.39	0.19	0.20	0.20
	M_1- Sand, M_2- Silica gel, D_1- 1.5 h, D_2- 2.5 h, D_3- 3.5 h, D_4- 4.5 h						M_1- Sand, M_2- Silica gel, D_1- 2 h, D_2- 3 h, D_3- 4 h, D_4- 5 h					

[1]Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal *Corresponding author email: ssgflori@gmail.com

Table 2 Effect of drying media (M), duration (D) and their interaction on vacuum oven dried *Ageratum conyzoides* flowers and *Mussaenda erythrophylla* bracts

Treatment	*Ageratum conyzoides*						*Mussaenda erythrophylla*					
	FW (g)	DW (g)	ML (%)	Texture	Brittleness	Appearance	FW (g)	DW (g)	ML (%)	Texture	Brittleness	Appearance
M_1	0.95	0.65	31.40	4.45	7.95	4.00	0.54	0.24	55.39	6.10	6.95	5.90
M_2	1.06	0.33	68.87	7.25	7.85	7.40	0.49	0.15	68.65	7.10	6.00	7.05
S.Em (±)	0.01	0.00	0.28	0.03	0.04	0.03	0.00	0.00	0.00	0.03	0.03	0.03
CD at 5%	0.01	0.01	0.82	0.09	N/A	0.08	0.01	0.00	0.01	0.09	0.08	0.09
D_1	1.09	0.63	42.54	4.60	8.20	5.50	0.51	0.23	54.99	7.70	7.90	7.60
D_2	0.92	0.45	47.39	5.80	8.10	6.00	0.51	0.20	60.25	7.30	7.40	6.90
D_3	1.06	0.48	53.67	6.40	7.80	5.70	0.50	0.18	64.62	6.30	5.80	6.30
D_4	0.97	0.42	56.92	6.60	7.50	5.60	0.54	0.17	68.23	5.10	4.80	5.10
S.Em (±)	0.01	0.00	0.40	0.05	0.05	0.04	0.00	0.00	0.00	0.04	0.04	0.04
CD at 5%	0.02	0.01	1.16	0.13	0.15	0.12	0.01	0.01	0.01	0.12	0.11	0.12
M_1D_1	1.10	0.86	22.28	3.60	8.00	3.20	0.55	0.29	47.29	7.40	8.20	7.40
M_1D_2	0.74	0.54	27.03	4.20	8.20	4.40	0.48	0.22	54.36	7.00	7.80	6.60
M_1D_3	1.01	0.64	36.56	4.60	7.80	4.00	0.56	0.24	57.50	5.80	6.40	5.80
M_1D_4	0.96	0.58	39.71	5.40	7.80	4.40	0.55	0.21	62.41	4.20	5.40	3.80
M_2D_1	1.07	0.40	62.80	5.60	8.40	7.80	0.47	0.17	62.69	8.00	7.60	7.80
M_2D_2	1.09	0.35	67.76	7.40	8.00	7.60	0.53	0.18	66.13	7.60	7.00	7.20
M_2D_3	1.11	0.33	70.79	8.20	7.80	7.40	0.45	0.13	71.74	6.80	5.20	6.80
M_2D_4	0.97	0.25	74.13	7.80	7.20	6.80	0.52	0.12	74.04	6.00	4.20	6.40
S.Em (±)	0.01	0.01	0.56	0.06	0.08	0.06	0.01	0.00	0.00	0.06	0.06	0.06
CD at 5%	0.03	0.01	1.64	0.19	0.22	0.17	0.02	0.01	0.01	0.17	0.16	0.17
	M_1- Sand, M_2- Silica gel, D_1- 3 h, D_2- 4 h, D_3- 5 h, D_4- 6 h						M_1- S and, M_2- Silica gel, D_1- 1 h, D_2- 2 h, D_3- 3 h, D_4- 4 h					

under different durations in the vacuum oven drier at 45°C temperature and 100 mmHg pressure (Table 1, 2). Three different flowers, viz. *Wedelia trilobata*, *Ixora chinensis*, *Ageratum conyzoides* and bracts of *Mussaenda erythrophylla* were used for the experiments as model ornamental crops. The dried samples were analysed for colour, texture, brittleness and appearance or shape retention.

Table 1 and 2 shows the effect of different drying media, duration and their interaction on vacuum oven dried *Wedelia trilobata, Ixora chinensis, Ageratum conyzoides* flowers and *Mussaenda erythrophylla* bracts. Silica gel (M_2) recorded highest moisture loss percent in *Wedelia* (81.98%), *Ixora* (81.87%), *Ageratum* (68.87%) and *Mussaenda* (68.65%), which is statistically at par with sand. This might be due to strong hygroscopic nature of silica gel. The texture and appearance score were also noted significantly higher in silica gel regardless of all the tested plant species. Similar results were also reported by Raol *et al.* (2012) and Namita *et al.* (2018). The plant parts embedded in silica gel and vacuum oven dried for 2.5 h in *Wedelia*, 5 h in *Ageratum* and 3 h both in *Ixora* and *Mussaenda* were found most superior, this technique for drying was thus best for the overall moisture loss and quality parameter scores i.e. texture, brittleness and appearance. These results are in agreement with Patel *et al.* (2017).

In the present study the moisture content at the surface gradually decreased as the drying time increased. At higher drying duration rate of moisture loss, dry weight loss was more due to more conduction and convection of heat but after certain percent of moisture loss, increased brittleness and decreased appearance, texture scores were recorded. This might be due to longer periods of exposure that may have accelerated degradation of all pigments i.e. chlorophylls, carotenes, xanthophylls, anthocyanins. Similar results were also reported by Mathapati *et al.* (2015), Sharma *et al.* (2015) and Safeena and Patil (2014). At lower drying durations and moisture loss percentage, the texture of flowers was poor and noted low sensory scores irrespective of the embedding media. As drying proceeded both embedding media and drying duration influenced the plant material surface. Upto a certain duration of drying, percentage of moisture loss, the texture score increased which later decreased and surface texture turned rough importantly at higher duration of drying. This finding was in conformity with Nair and Singh (2011), and Kumari *et al.* (2017).

SUMMARY

The vacuum drying technology was standardized as a new way for drying of ornamental flowers and bracts for preparing value added dry flower products. The results

of experiment concluded that embedding in silica gel and vacuum oven drying (temp. 55°C with 100 mmHg pressure) for 2.5 h was best suitable for drying of *Wedelia trilobata* flowers, 3 h was appropriate for *Ixora chinensis* flowers and *Mussaenda erythrophylla* bracts, and 5 h was found ideal for *Ageratum conyzoides* flowers.

ACKNOWLEDGEMENT

The authors duly acknowledge the grant support of Department Science and Technology, Government of India for conducting the experiments.

REFERENCES

Alibas I. 2009. Microwave, vacuum and air drying characteristics of collard leaves. *Drying Technology* **27**(11): 1266–73.

Kumari S, Kashyap B and Gupta Y C. 2017. Studies on microwave oven drying of *Gomphrena globosa* L. 'Magenta' and 'White'. *Indian Journal of Horticulture* **4**(1): 146–49.

Nair B and Singh K P. 2011. Aesthetic quality of chrysanthemum (*Dendranthema grandiflora* T.) flowers as affected by the desiccants. *Journal of Agro Crop Science* **2**(2): 11–14.

Namita, Jain R, Janakiram T, Singh P L, Sindhu S S, Panwar S and Pinder R. 2018. Optimization of dehydration techniques for colour retention and other qualitative attributes of gerbera (*Gerbera hybrida*) cv. 'Ruby Red'. *Chemical Science Review and Letters* **7**(27): 796–800.

Raol J B, Kumpavat M T and Vyas D M. 2012. Effect of different drying methods on quality of rose and gerbera flowers. *Agricultural Engineering Today* **36**(1): 18–23.

Safeena S A and Patil V S. 2014. Studies on the effect of microwave oven drying on flower quality of dried Dutch rose flowers. *National Academy Science Letters* **37**(1): 19–24.

Mathapati S, Naik B H, Chougala S, Pujeri U S and Kumar S. 2015. Standardization of drying temperature and time in hot air oven of gerbera var. Impireal. *International Journal of Scientific Research* **4**(12): 22–24.

Patel K M, Patel R B, Chawla S L, Parmar S and Patel U R. 2017. Standardization of drying method for winter annual flowers. *International Journal of Chemical Studies* **5**(5): 557–59.

Sharma M K, Joshi K I and Joshi D C. 2015. Study on different methods of dehydration of pot marigold flowers (*Callendula officinalis* L.) var. 'Dwarf Orange'. *Journal of Agricultural Science and Research* **2**(1): 31–38.