Archives of Current Research International

Volume 25, Issue 5, Page 180-186, 2025; Article no.ACRI.135368
ISSN: 2454-7077

Drying Carnation Flowers by Using Desiccantas

Shivkumar Mahadeo Wararkar [a++*], SR Dalal [b#], Shiva Nand Mohan Mishra [c†] and Vikas Singh Senger [d‡]

[a] Lokmangal College of Agriculture, Wadala, Solapur, Maharashtra, India.
[b] College of Agriculture, Dr. PDKV, Akola, Maharashtra, India.
[c] Department of Horticulture, Chaudhari Shivanath Singh Shandilya PG College, Machhara, Meerut, Uttar Pradesh, India.
[d] Department of Agriculture, SIPS, Dehradun, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/acri/2025/v25i51197

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://pr.sdiarticle5.com/review-history/135368

Original Research Article

Received: 25/02/2025
Accepted: 30/04/2025
Published: 01/05/2025

ABSTRACT

The objective of the experiment was to evaluate the dehydration techniques, suitable desiccant and suitable drying temperature for carnation flower. The experiment was conducted in the Laboratory, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the years 2015-16 and 2016-17. The objective was to determine the most suitable desicants for drying carnation flower. The study followed a Randomized Block Design with a four replication. Six

[++] Assistant Professor (Horticulture);
[#] Professor of Horticulture;
[†] Research Scholar;
[‡] Assistant Professor;
**Corresponding author: Email: shivwararkar@gmail.com;*

Cite as: *Wararkar, Shivkumar Mahadeo, SR Dalal, Shiva Nand Mohan Mishra, and Vikas Singh Senger. 2025. "Drying Carnation Flowers by Using Desiccantas". Archives of Current Research International 25 (5):180-86. https://doi.org/10.9734/acri/2025/v25i51197.*

different drying methods were tested as treatments: Air drying in the shade (control), drying after embedding in borax, clean fine sand, silica gel, a 1:1 glycerol-water mixture, and a 1:3 glycerol-water mixture. Maximum weight of dry flower 4.23, 4.13 and 4.18 g was found in 1:1 glycerol: water solution embedding. Maximum diameter of dry flower 5.13, 5.23 and 5.18 cm was recorded in sand embedding drying. Maximum moisture loss 75.14, 74.44 and 74.79 % was observed when flowers embedded in silica gel. Minimum moisture content 56.98, 53.14 and 55.06% was observed in 1:1 glycerol: water solution embeddingless time 3.68, 3.53 and 3.60 days was required for drying of carnation flowers in silica gel, when compared with flowers dried in air drying 13.55, 13.13, and 13.34 days. Maximum reduction in diameter of flower 0.77, 0.97 and 0.87 cm was recorded when flowers embedded in treatment silica gel.

Keywords: Carnation flowers; dehydration; embedding; silica gel; borax; glycerol.

1. INTRODUCTION

“Floriculture is an old age farming activity in India having animmense potential for generating gainful self-employment among small and marginal farmers. This business is expanding rapidly throughout the world.In the fiscal year 2018, the floricultural produce in India amounted to approximately 2.78 million metric tons. Tamil Nadu was the leading producer of flowers, aromatics and medicinal plants with over 428 thousand metric tons. Flowers have been dried, for various reasons from thousands of years. The ancient Egyptians made immensely detailed preparations for their dead to enjoy all that they had during this life in the next one. Many centuries later medieval monks harvested and dried the flowers and an herb by hanging bunches upside down in shade for medicinal use” (Susan, 1990).

“India, with its vast resources, varied products and experience in the field of dried flowers and plant parts enjoy a distinct advantage in the world export market. The country also enjoys the benefit of cheap labour and favourable climate as against other countries” (Gurumurti, 1997).

“Dry flower industry is growing very fast with more than 70 per cent share to the floriculture industry in India, a turnover of more than Rs. 385 crores during the year 2013-2014. Our share in the export of these items is below 1.5 per cent in Europe and it is below one per cent of the world requirements. Netherlands ranks first in the export of dried flowers followed by Columbia, Mexico, India and Israel. The USA is the largest consumer of dried and artificial flowers followed by Germany, UK and Netherlands. Other importing countries are West European countries, Canada, Japan, Hong Kong, Italy, Ethiopia and Australia” (Anon., 2014).

“The beauty and value of the dried flowers are that they can be kept and cherished for years, which survive the cold of winter and heat of summer. With growing eco-consciousness, the use of more and more nature-friendly things like this come as a natural choice for decoration. The life of dried flowers varies according to the species, texture of their petals and total consistency of flowers. Dried flowers can be effectively used for making decorative floral craft items for interior decoration and commercial exploitation” (Ranjan & Misra, 2002).

“In the global market, USA, Germany and United Kingdom are the largest consumers of dried flowers. India, Netherlands, Mexico, Israel and more recently, Australia are the major exporters in the trade. Indian dried flower export market is classified into three main product segments, namely, a) Dried plant parts in bulk, popularly called ‘botanicals’ b) Potpourri and c) Decor products. Globally, India has emerged as a leader in export of dried-flower products, trading dried flowers worth Rs 150 crores annually. This constitutes 25% of the global dried-flower market. The industry exports 500 different varieties of dried plant parts to 20 countries. The Indian industry risks losing its competitiveness to suppliers of other origin for lack of reliable processing technologies. To strengthen the dry flower industry, more research is required so as to promote and uplift the industry. Drying, bleaching and dyeing are the essential processing techniques in dried flower making, and these greatly influenced quality of the final product, before usage finally” (Patil, 2007).

“Therefore, a study was undertaken to standardize processes for dried-flower production. Flowers have always remained an integral part of man’s life and love for natural flowers is an inherent instinct. Fresh flowers though quite attractive, are very expensive and short lived as well as available only during a

particular season. Dried flower products on the other hand are long lasting and retain their aesthetic value irrespective of the season" (Malcolm, 1994). "Art of flower drying is a very age-old practice. Earlier dried flowers were in practice in the form of herbarium made by botanists for the purpose of identification of various species" (Prasad *et al;* 1997) "In 'The Florist' published in 1860, author describes the techniques of drying red rose, pansies, stock and other single flowers in sand. Though drying of flowers was well known even in the past but for the first time the flowers were dried commercially in Germany" (Jean & Lesley, 1982). "Dried and preserved ornamental products offer a wide range of qualities like novelty, longevity, aesthetic properties, flexibility and year-round availability" (Joyce, 1998). "Dried ornamental plant parts are generally less expensive and are sought for their everlasting and attractive appearance" (Smith, 2000). "Only few research and development projects have been undertaken on the dried flower industry across the globe in contrast to other areas of floriculture" (Joyce, 1998). "Numerous workers have described varied approaches/methods to dehydrate or dry flowers and other ornamental plant parts" (Bhutani, 1995; Desh Raj & Gupta, 2005). "Drying of flowers and foliage by various methods like air drying, sun drying, oven and microwave oven drying, freeze drying and embedded drying can be used for making decorative floral crafts items like cards, floral segments, wall hangings, landscapes, calendars, potpourris etc. for various purposes" (Bhutani, 1990).

"Potpourris being the major segment of drying flower industry valuing at Rs 55 crore in India alone. Dried flowers are a good standby for the florist's, since designs can be made up during the slack periods and arrangements can be displayed where fresh flowers are unsuitable from the growers point of view and the price is less than equivalent fresh flowers" (Salinger, 1987). "The demand for dry flowers and attractive plant parts, dried floral arrangements and floral crafts has increased manifold during the last decade. Dry flowers constitute more than two-thirds of the total floriculture exports. The demand for dry flowers is increasing at an impressive rate of 8-10 per cent annually thus offering a lot of opportunities for the Indian entrepreneurs to enter in the global floricultural trade" (Singh, 2009). The objectives of the experiment were to evaluate the dehydration techniques, suitable desiccant and suitable drying temperature for carnation flower.

2. MATERIALS AND METHODS

The present investigation was conducted in the Laboratory, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the years 2015-16 and 2016-17. The cut flowers of carnation were produced under naturally ventilated polyhouse. Details of the materials used and techniques followed are described in this chapter under appropriate headings. Carnation flowers were cultivated in the naturally ventilated polyhouse. Single standard cultivar Pink Dona of dark pink colour was used. The flowers were harvested at commercial stage when ray florets opened 3/4th. The healthy, disease free and uniform flower stems of carnation were harvested in the morning hours between 8.00 to 9.00 am. Immediately after harvest, the cut ends of the flower stalks were immersed in water. After bringing to the laboratory, the flowers were sorted for petal damage, pests and diseases. Stems of uniform size were selected and trimmed to 6 cm length and the treatments were imposed immediately. In air drying/hang drying under shade flower bunches were hung in a well aerated room in an inverted position for drying.

To overcome the problem of petal shrinkage, the flowers were dried by embedding in borax, sand and silica gel. Plastic containers were used for embedding at room temperature. About one-inch layer of the desiccant was poured into the bottom of container and the flower stems were pushed into the medium. Desiccant was then gently and gradually poured all around and over the flower up to 4 to 5 cm above, so as to fill all the crevices in between the petals without disturbing the shape of flowers. After embedding the flowers with desiccants, the containers were kept at room temperature in a well-ventilated room for dehydration. After dehydration, the containers were tilted for removing the desiccants over and around the flowers. The dried flowers were picked up by hand, cleaned by inverting them and tapping the stems with fingers slowly and gently. Remaining desiccants were finally removed with the help of fine brush. At the end of drying, the petals of the flowers were pressed with fingers to check the presence of moisture. If the moisture was still present, then the flowers were further exposed for drying for complete elimination of moisture. In the glycerine treatment the location was sheltered to avoid direct

sunlight. Temperature and humidity was moderate. Containers were cleaned and filled with required amount of solution. Fresh cut was given immediately before placing stems into solution and adequate air circulation was allowed. Flowers were hang dried for 7 days after rinsing the cut stems.

The significance of the mean difference between treatments was determined by computing the standard error and critical difference as suggested by Panse & Sukhatme, (1985).

3. RESULTS AND DISCUSSION

3.1 Weight of Dry Flowers

As regards, minimum weight of dry flower (2.48, 2.55 and 2.51 g) was recorded in embedding drying in treatmentT_4 (silica gel embedding), Whereas, maximum weight of dry flower (4.23, 4.13 and 4.18 g) was found in treatmentT_5 (1:1 glycerol: water) during the years 2015-16, 2016-17 and in pooled result, respectively.

This might be attributed to the hydro-sorbent nature of silica gel which is manufactured from sodium silicate whereas in air-drying, flowers absorb the moisture from air after drying and sand is not good as compared to silica gel due to particle size. Among the different desiccants used during experimentation, maximum reduction in flower weight was observed when silica gel and borax are used as embedding media for drying of flowers**.** These results are in conformity with the findings of Nirmala *et al.* (2008a).

3.2 Diameter of Dry Flower (cm)

Significantly maximum diameter of dry flower (5.13, 5.23 and 5.18 cm) was recorded in treatmentT_3 (sand embedding drying) whereas, significantly minimum diameter (4.55, 4.33 and 4.44 cm) was found in treatment T_4 (silica gel embedding drying), during the years 2015-16, 2016-17 and in pooled results, respectively.

Significant differences were observed in dry flower diameter due to drying methods. The minimum diameter of flower might be due to maximum removal of moisture from the flowers embedded in silica gel, which is hygroscopic in nature and absorbs maximum moisture during drying and diameter decreases. Nirmala *et al.,* (2008a) reported similar results in carnation.

Table 1. Effect of desiccants on fresh and dry flower weight of carnation flower

Treatment	Weight of fresh flower(g)			Weight of dry flower (g)		
	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
(T_1) Shade drying (Control)	9.95	9.28	9.62	3.85	3.78	3.81
(T_2) Borax embedding	9.90	9.53	9.72	2.83	2.90	2.86
(T_3) Sand embedding	9.75	9.60	9.68	2.93	3.05	2.99
(T_4) Silica gel embedding	9.92	9.95	9.94	2.48	2.55	2.51
(T_5) Glycerol : Water 1:1	9.84	8.81	9.32	4.23	4.13	4.18
(T_6) Glycerol : Water 1:3	9.99	9.90	9.95	3.90	3.88	3.89
F Test	NS	NS	NS	Sig.	Sig.	Sig.
SE (m) ±	0.22	0.21	0.13	0.16	0.16	0.15
CD at 5%	-	-	-	0.49	0.49	0.44

Table 2. Effect of desiccants on fresh and dried diameter of carnation flower

Treatment	Diameter of fresh flower(cm)			Diameter of Dry flower (cm)		
	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
(T_1) Shade drying (Control)	5.46	5.41	5.44	4.84	4.82	4.83
(T_2) Borax embedding	5.36	5.43	5.39	5.10	5.12	5.11
(T_3) Sand embedding	5.44	5.40	5.42	5.13	5.23	5.18
(T_4) Silica gel embedding	5.32	5.29	5.40	4.55	4.33	4.44
(T_5) Glycerol : Water 1:1	5.45	5.30	5.38	4.89	4.94	4.91
(T_6) Glycerol : Water 1:3	5.31	5.36	5.34	5.08	5.12	5.10
F Test	NS	NS	NS	Sig.	Sig.	Sig.
SE (m) ±	0.04	0.04	0.05	0.10	0.07	0.07
CD at 5%	-	-	-	0.31	0.21	0.20

Table 3. Effect of desiccants on percent moisture loss and time taken for drying of carnation flower

Treatment	Percent moisture loss (%)			Time taken for drying (Days)		
	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
(T_1) Shade drying (Control)	61.25 (51.51)	59.29 (50.36)	60.27 (50.94)	13.55	13.13	13.34
(T_2) Borax embedding	71.43 (57.70)	69.56 (56.70)	70.49 (57.12)	8.25	7.75	8.00
(T_3) Sand embedding	69.82 (56.76)	68.30 (55.77)	69.06 (56.26)	10.63	11.13	10.88
(T_4) Silica gel embedding	75.14 (60.10)	74.44 (59.67)	74.79 (59.89)	3.68	3.53	3.60
(T_5) Glycerol : Water 1:1	56.98 (49.02)	53.14 (46.80)	55.06 (47.91)	6.50	6.25	6.38
(T_6) Glycerol : Water 1:3	60.79 (51.27)	60.94 (51.32)	60.87 (51.30)	6.00	6.50	6.25
F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±	1.11	0.94	0.92	0.43	0.43	0.24
CD at 5%	3.34	2.85	2.78	1.29	1.31	0.72

**(Figures in parenthesis are arc sin values)*

3.3 Percent Loss of Moisture

Significantly, maximum moisture loss (75.14, 74.44 and 74.79 % respectively) was observed when flowers embedded in silica gel (T_4,) However, significantly minimum moisture content (56.98, 53.14 and 55.06%, respectively) was observed in a treatment T_5(1:1 glycerol: water), during the years 2015-16,2016-17 and in pooled results, respectively.

Pertuit, (2002) also reported that, “silica gel can absorb about 40 per cent of its weight with moisture. So, it is appropriate for drying flowers with closely packed petals such as rose. On contrary, the less moisture loss in river bed sand might be due to the fact that sand has a larger particle size and is heavier in weight and thus, absorbs less moisture as well as it is not able to retain moisture for longer duration or time consequently, the moisture is re-absorbed by the flowers. Though, the borax is lighter than sand but it is not comparatively as hygroscopic as silica gel”.

Desh Raj & Gupta, 2003 used “the desiccants (boric acid, silica gel, river sand and sawdust) used to standardize the dehydration technology for ornamental plant parts of shrubs from Himachal Pradesh and reported that silica gel (60-120 mesh) has been found best absorbent for removing moisture from flower and foliage followed by boric acid granule”.

3.4 Time Required for Drying (Days)

As regards the desiccants less time (3.68, 3.53 and 3.60 days) was required for drying of carnation flowers in treatmentT_4 (silica gel), when compared with flowers dried in treatment T_1 (air drying) (13.55, 13.13, and 13.34 days) during the years 2015-16, 2016-17 and pooled result, respectively.

This might be due to the strong hygroscopic nature of silica gel. This also attribute to the hydro sorbent nature of silica gel which is manufactured from the sodium silicate. Silica gel is composed of vast network of interconnecting microscopic pores, which attracts and hold moisture by the phenomenon it called physical adsorption and capillary condensation. Through this phenomenon act as a dehydrating agent. These results are in accordance with the Singh *et al.,* (2004) in zinnia flower and Safeen *et al.,* (2006) in rose.

3.5 Reduction in Diameter of Flower (cm)

With respect to desiccants, significantly maximum reduction in diameter of flower (0.77, 0.97 and 0.87 cm) were recorded when flowers embedded in treatment T_4 (silica gel), whereas minimum reduction in diameter of flower (0.23, 0.25 and 0.24) were found in treatment T_6 (Glycerol : Water 1:3), during the years 2015-16, 2016-17 and in pooled results, respectively.

Table 4. Effect of desiccants on reduction in diameter and anthocyanin content of carnation flower

Treatment	Reduction in diameter of flower (cm)			Anthocyanin content (%)		
	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
(T_1) Shade drying (Control)	0.63	0.59	0.61	11.80	11.63	11.71
(T_2) Borax embedding	0.27	0.31	0.29	13.25	13.53	13.39
(T_3) Sand embedding	0.31	0.18	0.24	12.75	12.90	12.83
(T_4) Silica gel embedding	0.77	0.97	0.87	14.80	14.55	14.68
(T_5) Glycerol : Water 1:1	0.57	0.36	0.46	12.75	11.13	11.94
(T_6) Glycerol : Water 1:3	0.23	0.25	0.24	13.00	11.38	12.19
F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±	0.02	0.06	0.06	0.56	0.32	0.33
CD at 5%	0.06	0.17	0.18	1.69	0.96	0.99

Significantly maximum reduction in diameter of flower was observed when flowers dried by embedding in silica gel. Silica gel absorbs maximum moisture and minimum diameter of dry flower was found hence; maximum difference is recorded. These results are in close proximity with the findings of Singh *et al*., (2004) and Nirmala *et al.,* (2008a).

3.6 Anthocyanin Content (mg/ml)

As regards desiccants, significantly maximum anthocyanin content (14.80, 14.55 and 14.68 mg/ml) was observed in treatment T_4 (silica gelembedded drying,) which was recorded at par (13.25, 13.53 and 13.39 mg/ml) with a treatment T_2 (borax embedding). Whereas, it was recorded significantly minimum (11.80, 11.63 and 11.71 mg/ml) in a treatmentT_1 air drying during the years 2015-16, 2016-17 and pooled results, respectively.

4. CONCLUSION

The demand for dry flowers and attractive plant parts, dried floral arrangements and floral crafts has increased manifold during the last decade. Dry flowers constitute more than two-thirds of the total floriculture exports.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Anonymous, (2014). Hand Book on Horticulture Statistics 2014, pp-28.

Bhutani, J. C. (1995). Drying of flowers and floral craft. Advances in Horticulture Ornam. *Plants 12*: 1053-1058.

Bhutani, J.C. (1990). Capturing nature, a way with flower “Everlastings”. *Indian Horticulture. 34* (4): 15-19.

Desh, Raj & P. K. Gupta, (2003). Standardizing dehydration technology for ornamental plant parts of shrubs from mid-hills of Himachal Pradesh. *J. of Ornamental Horti. 6*(4): 357-361.

Desh, Raj & P., K. Gupta. (2005). Standardizing Dehydration Technology for Ornamental Herbaceous Plants from Outer Himalayas *J., of Ornam. Horti. 8*(1): 53-55.

Gurumurti, N. (1997). Dried flowers offer bright prospect for Indian entrepreneur. *Floriculture Today*, *2*(1): 33-34.

Jean, L. & Lesley, G, (1982). The complete guide to drying and preserving flowers. Webb and Bower Ltd, England.

Joyce, D. C. (1998). Dried and preserved ornamental plant material not new, but often overlooked and underrated. *ActaHorticulturae, 454*: 133-145.

Malcolm, H. (1994). Guide to arranging dried flowers. Step by step handbook of growing, drying and displaying, Dorling Kindersley Ltd, London.

Nirmala, A., R., Chandrasekhar, M., Padma & M. Raj Kumar (2008a). Standardization of drying techniques of carnation *(Dianthus caryophyllus) J. of Ornam. Horti., 11 (3): 168-172.*

Panse, V.G. & P.V. Sukhatame, (1985). Statistical methods agricultural workers. ICAR, New Delhi.

Patil, S. K. (2007). Post-Harvest Management and Value Addition of Flowers.www.sikkimfloriculture.com/PDF/Post_Harvest%20pdf.pdf

Pertuit, A. (2002). Drying flowers. Website: *http://www.garden.org/nga/edit/articles/dryflower.*

Prasad, J.J.K., P. K. Pal & S. R. Voleti, (1997). Drying of flowers: An upcoming industry. Floriculture Today, pp 20-23.

Ranjan, J. K. & S. Misra, (2002). Dried flowers: A way to enjoy their beauty for long period. *Indian Horti., 47*(4):32-33.

Safeena, S. A., V. S. Patil & Hemla B. Naik, (2006). Standardization of stage of harvest for better quality of dry flowers of rose. *J. of Ornam. Horti*. *9*(3): 224-226.

Salinger J. P. (1987). Commercial flower growing. Butterworths, Newzealand, 269p.

Singh H.P. (2009). Floriculture industry in India: the bright future ahead. *Indian Horticulture, 54* (1): 3-8.

Singh, A Dhaduk B. K. & Shah R. R. (2004). Effect of different temperatures and embedding media on flower dehydration of Zinnia (*Zinnia linearisBenth*). *Indian Journal of Ornamental Horticulture, 61* (3):249-252

Smith A. (2000). Even better than the real thing. Flower Business International, 25-28 September 2000.

Susan, (1990). Dried flowers. Merchants Ltd, Ferry House, London, 144p.

Peer-review history:
The peer review history for this paper can be accessed here:
https://pr.sdiarticle5.com/review-history/135368