Advanced dehydration techniques standardized for flowers of *Gomphrenaglobosa*L.

Abstract

The present experiment was conducted on standardizing dehydration technique for *Gomphrena globose* flowerby using embedding drying methods in room temperature and hot air oven at 55°C was done. The experiment consisted of 10 treatments with 3 replications designed in completely randomizeddesign. Treatments used were as; T1-Boric acid (room temperature), T2-Silica gel (room temperature), T3-Sand (room temperature), T4-Sawdust (room temperature), T5-Cocopeat (room temperature), T6-Boric acid (hot air oven at 55 °C), T7-Silica gel (hot air oven at 55 °C), T8-Sand (hot air oven at 55 °C), T9-Sawdust (hot air oven at 55 °C), T10-Cocopeat (hot air oven at 55 °C).The most reduction in flower fresh and dry weight, measuring 2.36 and 2.12 g, was observed in Treatment T7 (Silica gel with hot air oven at 55°C), where silica gel was employed as the desiccant. The least reduction in flower fresh and dry diameter, measuring 1.92 and 1.81 g, was observed in Treatment T7 (Silica gel with hot air oven at 55°C), where silica gel was employed as the desiccant. The highest drying duration for gomphrena in T3 (Sand) and T4 (Sawdust)treatments was 234.21 and 210.40 hrs at room temperature. The boric acid and silica gel demonstrated outstanding performance in terms of quality parameters, including texture, color, and overall appearance.Among all treatment, embedding drying with silica with hot air oven dehydration at 55°C was found to be best in term of reduction in weight, diameter and overall colour, appearance and texture of *Gomphrena globose* flowers.

Keywords: *Dehydration; Embedded drying; Flower; Hot air oven; Temperature*

1. Introduction

Gomphrena globosa is an annual plant native to Central America that is extensively grown all over the world for its eye-catching and long-lasting flowers. It is also known by the names Bachelor's Button and Globe Amaranth. Often referred to as the "Everlasting Flower," this plant is mostly planted for its aesthetic qualities[1, 2]. A multitude of hues may be seen in its flowers, such as white, pale orange, pink, violet, purple, magenta, and pink. The subtle real blooms inside these colorful "flowers" are really protected by papery bracts or altered leaves. For decorative reasons, gomphrena globosa is a popular option that may be used in landscaping, potted plants, and cut flower arrangements [3]. Dehydrating these beautiful works of art is a quick way to lower the moisture content while stopping the growth of microbes and limiting biochemical alterations [4]. Some examples of these projects include bouquets, garlands, wreaths, potpourri, greeting cards, topiaries, wall frames, and more.Air drying is the easiest and most economical method of drying, but it can cause flowers and leaves to lose some of their color and to change in shape or form [5]. Conversely, press drying is a simple dehydration method that flattens the three-dimensional structure of flowers and leaves while preserving their hues. The best techniques for maintaining the shape and hue of flowers and foliage are those that include embedding [3, 5].

Dried flowers may be used repeatedly, are accessible year-round, and last a long time. India has a considerable advantage in the international export market because of its wealth of resources, wide range of products, and expertise in the dried flower and plant component industries. The country also benefits from favorable environmental conditions and reasonably priced labor when compared to other countries [6].With over 70% of its total floriculture exports being dried flowers, foliage, and plants, India makes a considerable contribution to the worldwide market despite its relative inexperience with flower dehydration. Interestingly, the export of dried floriculture products has increased dramatically, rising from Rs. 64.35 million to Rs. 695.88 million in just eight years, an almost elevenfold growth[7]. Overall floriculture exports increased from 18.30 crores in 1993–1994 to 127.43 crores in 2001–2002, as seen by this. With over 500 distinct varieties of dried ornamentals, India is a leading exporter of dried flowers and plants to other countries, with yearly sales exceeding Rs. 100 crores [8]. Dried flowers, branches, seeds, barks, fruits, nuts, cones, and more are on this varied range. Press drying, air drying, sun drying, embedded drying (sand, sawdust, cocopeat, silica gel, and borax), oven drying, microwave drying, vacuum drying, and tray drying are the common methods of dehydration [9]. Therefore, another essential necessity in this industry is to improve suitable preservation and post-harvest handling strategies for dried materials. In order to ensure appropriate drying, flowers and leaves are embedded in different media and placed in an open area with direct sunshine, a room with artificial lighting, an oven, or a microwave (at a certain temperature) [10].

Numerous techniques are used to achieve dehydration, with usually favorable results. However, because these methods are more expensive, rural households cannot afford to utilize vacuum drying or microwave drying. If easier, more affordable, and more efficient methods for dehydrating floral objects are discovered, thousands of rural folks may find creative employment in this process[3]. The study was conducted because of the growing potential of the flower drying sector, its importance to our country, and the need for more research in this field.Lack of knowledge has been a key impediment to our country's efforts to boost the dry flower industry. There has been less study into drying and maintaining ornamental materials than in other post-harvest floriculture sectors. Singh and Laishram[5] investigated the dehydration of *Gomphrena globosa* L. flowers and discovered that all drying stages were effective. However, shade drying was better to oven and sun drying for flowers. The primary goal of this study is to provide high-quality dried cut flowers that meet global demand while remaining natural, ecologically sustainable, long-lasting, and cost-effective. Given these aspirations, the current study was initiated to assess the standardizing dehydration technique for *Gomphrena globose* flower.

2. Material and methods

2.1 Geographical location of the experimental site

The research study titled "Standardization of Dehydration Technique for *Gomphrena globose* flower" was conducted at the laboratory of the Department of Horticulture, School of Agriculture, Lovely Professional University, located in Phagwara, Punjab, India.

2.2 Material

The flowers utilized in this research were of the *Gomphrena globosa* variety, known for their striking magenta-hued blossoms. These flowers were specifically selected for their consistent maturity, uniform size, and freedom from any infections or infestations. They were procured from the floriculture field at Lovely Professional University, located in Phagwara, Punjab, India.

2.3Experimental details and methodology

“Experiment consisted of five different embedding material (Boric acid, silica gel, sand, sawdust and cocopeat) used for drying of these flower at two different temperatures (room temperature and in hot air oven at 55 °C). Treatments used were as; T1-Boric acid (room temperature), T2-Silica gel (room temperature), T3-Sand (room temperature), T4-Sawdust (room temperature), T5-Cocopeat (room temperature), T6-Boric acid (hot air oven at 55 °C), T7-Silica gel (hot air oven at 55 °C), T8-Sand (hot air oven at 55 °C), T9-Sawdust (hot air oven at 55 °C), T10-Cocopeat (hot air oven at 55 °C). The present investigation was performed as a Completely Randomized Design (CRD) where different desiccants were used for flower drying”. [20]

A one-inch layer of desiccant according to treatment was put at the bottom of the container, and the flower stems were pressed into the medium. The flowers were kept in an upright position. Desiccants were then softly and gradually poured all around and over the flower, up to about 5cm above, to fill all of the cracks between the petals while preserving the form of the blooms. According to treatment, these containers are stored at room temperature and in a hot air oven. Flowers are dried in an electric hot air oven set to 55℃. All drying procedures involved tilting the containers to remove the desiccants from the flowers after they had been dehydrated. The dried flowers were then manually removed from the trays, cleaned by inverting them, and gently tapped on the stems with the fingers. Observations on fresh and dry flower weight, fresh and dry flower diameter, time taken for drying and quality parameter were studied.

2.4Statistical analysis

The data gathered across various parameters underwent statistical analysis, employing the Completely Randomized Design (CRD) at a significance level of 5%. These analyses were conducted using WASP 2.0 software and superscripts are added by SPSS software version 24.

3. Results and discussion

3.1 Effect on reduction of weight and diameter of flowers

Data related to reduction of fresh and dry weight was presented in Table 1. It was apparent that various desiccants and dehydration techniques exerted a noteworthy influence on the reduction in flower fresh and dry weight. Notably, the most reduction in flower fresh and dry weight, measuring 2.36 and 2.12 g, was observed in Treatment T7 (Silica gel with hot air oven at 55°C), where silica gel was employed as the desiccant. The Treatment T7 (Silica gel with hot air oven at 55°C) followed byT6 treatment (Boric acid with hot air oven at 55°C) and had reduction in fresh and dry weight as 2.32 and 2.08 g. In room temperature drying treatment T2 and T1 had high reduction in fresh and dry weight as (2.24 and 2.08 g) and

(2.14 and 2.01), respectively. Remarkably, the least reduction in flower fresh and dry weight after desiccant treatment at room temperature and hot air oven dehydration was recorded in Treatment T3 and T8, where sand served as the desiccant.The outcomes further revealed that silica gel, as a desiccant at room temperature and hot air oven dehydration, induced the most substantial reduction in gomphrena flower fresh and dry weight after the drying process. This can be attributed to the high moisture-absorbing capacity of silica gel, rendering it suitable for flowers with tightly packed petals, such as roses. This finding aligns with previous reports by Hemant et al. [11] on rose cut flowers andAcharyya et al. [12] on *Rosa damascena*. In contrast, the minimal loss in flower fresh and dry weight following gomphrena drying was observed when sand and sawdust was employed as the desiccant at room temperature and hot air oven dehydration. Sandand sawdust has a lower moisture-absorbing capacity compared to other desiccants used in the experiment and cannot effectively retain moisture over an extended period.

The reduction of fresh and dry diameter was presented in Table 1. It wasillustrated that the influenceof various desiccants and dehydration techniques exerted a noteworthy influence on the reduction in flower fresh and dry diameter. The least reduction in flower fresh and dry diameter, measuring 1.92 and 1.81 g, was observed in Treatment T7 (Silica gel with hot air oven at 55°C), where silica gel was employed as the desiccant. The Treatment T7 (Silica gel with hot air oven at 55°C) followed byT6 treatment (Boric acid with hot air oven at 55°C) and had least reduction in fresh and dry diameter as 1.95 and 1.83 g. In room temperature drying treatment T2 and T1 had least reduction in fresh and dry diameter as (1.95 and 1.85 g) and (1.98 and 1.88 g), respectively. Thehighest reduction in flower fresh and dry diameter after desiccant treatment at room temperature and hot air oven dehydration was recorded in Treatment T3 and T8, where sand served as the desiccant.The maximum reduction in flower diameter after drying occurred in the room drying. Flowers tend to wither and shrink when dried under room conditions, leading to the significant reduction in flower diameter observed. This finding aligns with previous studies conducted by Mandal et al. [13] on chrysanthemumflowers, Nirmala et al. [14] on carnation flowers.The results also highlighted that the minimum reduction in flower diameter was observed in treatments utilizing silica gel as the desiccant. Silica gel, being a fine powder, primarily absorbs moisture while maintaining the flower's overall condition. Consequently, the shrinkage in diameter is minimal. Silica gel is commonly employed to prevent petal shrinkage and preserve flower petal color and shape, as supported by Rani and Reddy[8].

3.2 Effect on time taken for drying of flowers

The effect on time taken for drying of flowers are represented in Table 1. Considerable disparities were notable in the drying time of gomphrena when exposed to various desiccant treatments. The highest drying duration for gomphrena in T3 (Sand) and T4 (Sawdust)treatments was 234.21 and 210.40 hrs at room temperature. Followed by T8 (Sand) and T9 (Sawdust) treatments at hot air oven (55 °C) as 216.45 and 203.20 hrs. This prolonged period can be attributed to the room's inherent humidity, which hinders the drying process, necessitating an extended drying time for the flowers compared to the embedding material. Comparable findings have been reported in studies on roses by Kant[7] and in certain other flowers byLalhruaitluangi[15].

In contrast, silica gel desiccant exhibited the shortest drying time for gomphrena dehydration. This expedited drying can be attributed to the extensive interconnected network of microscopic pores within silica gel. These minuscule pores have the capacity to retain substantial moisture, a phenomenon referred to as capillary condensation. Nirmala et al. [14] observed analogous results in carnations, while Pinder and Namita[16] and Wilson et al. [6] reported similar outcomes in gerbera and chrysanthemum, affirming the efficacy of silica gel desiccant in expediting the drying process.

Table 1. Effect of different desiccants and drying methods on weight reduction, diameter reduction and time taken for drying of *Gomphrena globose* flower

Treatments	Fresh flower weight (g)	Dry flower weight (g)	Fresh flower diameter (cm)	Dry flower diameter (cm)	Time taken for drying (hrs)
T1-Boric acid (room temperature)	2.14	2.01	1.98	1.88	122.13
T2-Silica gel (room temperature)	2.24	2.08	1.95	1.85	102.15
T3-Sand (room temperature)	1.98	1.89	2.19	2.10	234.21
T4-Sawdust (room temperature)	2.02	1.91	2.12	1.99	210.40

T5-Cocopeat (room temperature)	2.10	2.02	2.03	1.93	198.22
T6-Boric acid (hot air oven at 55 °C)	2.32	2.08	1.95	1.83	100.30
T7-Silica gel (hot air oven at 55 °C)	2.36	2.12	1.92	1.81	97.12
T8-Sand (hot air oven at 55 °C)	2.05	1.92	2.16	2.02	216.45
T9-Sawdust (hot air oven at 55 °C)	2.16	1.96	2.10	1.94	203.20
T10-Cocopeat (hot air oven at 55 °C)	2.21	2.04	1.99	1.92	196.20
CD (5%)	0.12	0.09	0.06	0.04	2.36
CV	0.36	0.27	0.18	0.12	7.08

3.3 Effect on quality parameters of flowers

The data related to effect of dehydration and desiccants was *Gomphrena*flower was studied in Table 2. The drying of *Gomphrena* using silica gel and boric acid as a desiccant resulted in excellent outcomes, with a fine-textured appearance and a transformation of the flower's colour to a vibrant lilac shade upon drying. In contrast, treatments T3 (Sand) and T8 (Sand) had low values for appearance and texture and had dark coloured and colour almost faded away. Also, sawdust treatment had yielded less favourable results, particularly regarding the texture of the dried flower. These treatments produced *Gomphrena* with a brown and medium-brown colour appearance, respectively.

Following the dehydration of Gomphrena, boric acid and silica gel demonstrated outstanding performance in terms of quality parameters, including texture, colour, and overall appearance. Boric acid is a preferred choice for preserving the original characteristics of various plant materials, including bougainvillea, candytuft, chrysanthemum, pompon dahlia, gerbera, marigold, and roses, without altering their shape, colour, texture, or form [17]. Preethi et al. [18] also reported that drying zinnia flowers with boric acid resulted in high-quality dried flowers with desirable colour and petal texture. Conversely, drying *Gomphrena* with either sand or sawdust led to a decrease in quality. The texture of the flowers became brittle, and their purple red colour faded to brown, resulting in a less visually appealing appearance. This change in texture and colour can be attributed to the larger particle sizes of sand and sawdust, which may not retain moisture as effectively as silica gel and boric acid, thereby affecting the colour and texture of the flowers. Similar findings were reported byRaghupathi andGantait[4]and Katoch et al. [19] in the dehydration of fresh flowers, foliage, and orchids, respectively.

Table 2. Effect ofdifferent desiccants and drying methods on quality parameters of *Gomphrena globose* flower

Treatments	Colour	Appearance	Texture
T1-Boric acid (room temperature)	Light reddish	3	3
T2-Silica gel (room temperature)	Mahogany red	4	4
T3-Sand (room temperature)	Dark brown	2	1
T4-Sawdust (room temperature)	Brown	2	2
T5-Cocopeat (room temperature)	Brown	3	2
T6-Boric acid (hot air oven at 55 °C)	Mahogany red	4	4
T7-Silica gel (hot air oven at 55 °C)	Mahogany red	5	4
T8-Sand (hot air oven at 55 °C)	Dark brown	2	1
T9-Sawdust (hot air oven at 55 °C)	Brown	3	2
T10-Cocopeat (hot air oven at 55 °C)	Light reddish	3	3

***The appearance and texture of flowers after drying were given rating 1, 2, 3, 4 and 5 (1-Very poor, 2-Poor, 3-Good, 4-Very good, 5-Excellent).**

4. Conclusion and future prospectus

From the present study, it was concluded that hot air oven drying at 55˚C with silica gel as the embedding medium is best for production of quality drying flowers of *Gomphrena globose*.The boric acid also had second highest good results and least parameters are found in sand and sawdust treatments. As silica gel, employed as a desiccant and hot air oven emerged as the preferred method for achieving maximum reductions in flower weight after drying, preventing shrinkage, minimizing post-drying diameter reduction, and expediting the drying process for gomphrena flowers. Overall hot air oven method with silica gel was determined as best for drying *Gomphrena globose*flowers. From future point of view dehydration technique is best for preserving the new flower species (exotic ones too) for long time and enhance their availability in the off seasons.

5. Recommendations

Overall, this study determined the impact of dehydration on*Gomphrena globose*flowers and considered as best technique for preserving the new flower species for long time.

Consent for publication

Not applicable

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5. References

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