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## Recent trends in production of dry flowers and foliages

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### Abstract

Dried flowers in floriculture are gaining knowledge with the booming floriculture industry in India. Dried flowers in the field of floriculture provide an excellent opportunity to increase the income of the farmer throughout the year despite the bad climate hazards. Dehydration techniques help to maintain the original color and shape of flowers for long-term use with little care. A detailed variation in drying time between to all members of the family, farmers can easily earn 1.5 times to 5 times profit from value addition of dried flowers. Input cost is reduced by incorporation of priceless house to get higher returns and waste material available with dried flower used to make floral handicrafts.

**Keywords:** dry flowers, post-harvest, value addition, floriculture, drying method

### 1. Introduction

The dry flower industry was brought to India by British and is almost five decades old. In India, dried flower industries are mostly concentrated in Tamil Nadu, West Bengal, Andhra Pradesh and Karnataka. Exporting companies in Kolkata in West Bengal, Thoothukudi in Tamil Nadu, Mumbai in Maharashtra and Hyderabad in Andhra is earning 10-15 times higher returns than domestic markets (Verma *et al.*, 2012)<sup>[14]</sup>. Dry flower production is labour intensive, carries more self-employment and job opportunities for a huge number of workers and aids in development of subsidiary industries. Fresh flowers are very expensive and short lived as well as available only during a particular season. They are quite attractive. Dried flower products are long lasting and retain their aesthetic value irrespective of the season dried flowers are exported as assortments of value-added products. Dry flower methods mostly used flowers are Allium, Anemone, Carnation, Chrysanthemum, Daffodil, Freesia, Lily, Marigold, Narcissus, Pansy, Eucalyptus, Sweet William, Zinnia, etc. and foliage like Aspidistra, Fern, Rose, Ivy, Magnolia etc. (De *et al.*, 2016)<sup>[3]</sup>.

### 2. Advantages

- Dry flowers are long-lasting and widely available all over the year without much caring
- Dry Products are eco-friendly, biodegradable and doesn't depend on weather condition
- Raw materials are easily available and year-round supplied from a flower garden or forest area
- It requires low-cost machinery as well as less expert knowledge to operate. (Malcolm, 1994)<sup>[6]</sup>
- It is a labor-intensive process that provides job opportunities for poor people and self-employment to huge numbers of workers including housewives, physically challenged person and rural people
- Dry flowers and foliage are cheaper than fresh flowers and used to decorate the home and office interior
- Dry flowers and their products are used for the decoration of bouquets, different floral arrangements and various floral handicrafts such as greeting cards, wall hangings, calendars, candles, floral jewellery, decorative mirroring, glass jar arrangements etc. (Bhutani, 1990)<sup>[1]</sup>.

### 3. Scope and Opportunities in Dry Flower Industry

- Dried flowers and plant parts are long lasting, biodegradable and easily available
- It possesses a great potential in dry flower industry throughout the world especially in the hilly regions of India

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- Almost 80% of flower species can be dried and preserved successfully in world
- Different types of wild plant material available widely in the world also strengthen the establishment of dry flower industry
- Dry flower industry has the great potential to provide employment opportunities to thousands of people specially to housewives and rural women's as unlimited aesthetic value and decorative products can be created by using the dry flower technology
- So, there is a need to strengthen its market value, financial assistance through government and training for entrepreneurship development and awareness about the potential of dry flower technology by workshops, exhibitions and seminars etc.

### 3.1 Techniques of Flower Drying

Different dehydration techniques have been developed for remove the moisture from flowers, twigs, branches, leaves etc., to retain their new form for many months or even a year (Misra *et al.*, 2003) [7]. Several methods are practiced for dehydration of flowers, foliage and other plant parts.

Under Dehydration, removal of moisture is done artificially either by using desiccants or controlled temperature, humidity and airflow and else the quality of the product will be deteriorated (De *et al.*, 2016) [3].

Some techniques of flower drying are discussed as below.

### 3.2 Air Drying

Air drying is a very common and earliest method. This method is very easy and does not require any special equipment. Crisp flowers are mostly dried by this method. Flowers and foliage are harvested at immature stage and ¼th of lower plant parts are removed. The Bunches are tied with thread and hanging down from a rope, this results in straight flower otherwise it will twist. For air drying, a ventilated, low humidity, clean dark room are required (De *et al.*, 2016) [3].

On the other hand, flowers are spread on the clean newspaper or blotting paper and kept under sun or dark room (Datta, 1997) [2].

E.g., Crisp textured flowers are *Acroclinium*, *Anopheles*, *Delphinium*, *Oregano*, *Rumex* and *Holmskioldia* etc. are dried. According to White *et al.* (2002) [14], stated that fleshy flowers and foliage took more time for Air drying.

### 3.3 Press Drying

Presses drying are mostly used for the preparation of herbarium. In this method the flowers don't retain its shape. Flowers are harvested at the right stage and kept on newspaper and cover with another paper. Again, flowers are kept on the paper and this process is repeated. The Arranged papers one above the are appear like a bundle. And then bundles are tied tightly with a rope or thread to make a uniform pressure on it. Corrugated boards are placed between the papers for easy evaporation of vapour from herbarium (Bhutani, 1990) [1]. This process of press drying takes 1-3 weeks which can be speed up by placing the herbarium under hot air oven at 45-55 °C for one day.

E.g., Silver oak, Thuja, Aster, Bougainvillea, Candytuft, Chrysanthemum, Rose, Marigold, Hibiscus, Ixora.

### 3.4 Sun Drying

Deepthi *et al.* (2008) [4] stated that flowers of Marigold, poppy, Zinnia, Chrysanthemum, Acrolium, Carnation and

globe amaranths can be sun dried. (Wilson *et al.*, 2013) [15] stated that sun drying is opposed to air drying; flowers maintain their diameter as fresh flowers because of less shrinkage.

Flowers and foliage are harvested and hanged on the rope in air or dried by using a medium such as silica gel, sand etc. after that exposure to the sun daily for rapid dehydration.

### 3.5 Water Drying

Water drying is suitable method for easily broken petals after drying. Flowers are harvested and remove some lower leaves, kept in water container at few inches depth. The container with flowers is dry, warm dark condition for 7-10 days without exposure in direct sunlight. Hydrangeas, Heathers, Hybrid Delphiniums, Acacia, Gypsophila, bells of Ireland, Protea and Yarrow are dry well this method.

### 3.6 Embedded Drying

This method is suitable to retain their shape, colour, and size of petals. Flowers are harvested at a mature stage and embedded in a desiccant like silica gel, sand, saw dust, borax, perlite or combination of this gel.

This process takes 4-14 days depends upon the thickness of plant material, and requires a well-ventilated room.

Sujatha *et al.* (2001) [12] reported that desiccant borax crystals and sand in the ratio of 1:1 volume by volume basis it results in brightness and colour of plant material. The container may be plastic or metallic or earthen container.

About 5 cm layer of desiccant is poured in the bottom of the container and the flower stems are kept into the medium.

Embedded drying with borax at 50 °C in oven was found successful in *Vanda teres*, *Dendrobium moschatum*, *Arundina graminifolia*, Den. 'Madam Pink', Den. 'Lervia', Den. 'A. Abraham', Phal. 'Casa Blanca', Phal. 'Detroit' and *Oncidium* 'Sweet Sugar' and embedded drying with borax at 60 °C was found successful in *Epidendrum* spp., *Cattleya bowringiana* and *Cattleya* hybrids, Phal. 'Ox Plum Rose x Black Jack' and Den. 'Big White' (Table1)

Embedded drying with borax and silica gel at 50 °C in oven was found successful *Coelogyne flaccida*, *Coelogyne cristata*, *Dendrobium nobile*, *Dendrobium williamsonii*, *Dendrobium aphyllum*, Den, 'Erika', Den. 'Big White 4N', Den. 'Bangkok Blue', *Paphs*. 'Nagasaki' and *Cym*. 'Sungold' (Table2).

**Table 1:** Embedded drying of orchids in oven with borax (Source: Souvenir- kisan mela2017)

Name	Temperature	Duration
Vanda teres	50 °C	36 hours
Den. 'Madam Pink'	50 °C	60 hours
Phal. 'Casa Blanca'	50 °C	180 hours
Phal. 'Detroit'	50 °C	180 hours
Den. 'Lervia'	50 °C	60 hours
Den. Moschatum	50 °C	60 hours
Den. 'A. Abraha'	50 °C	60 hours
Onc. 'Sweet Sugar'	50 °C	60 hours
<i>Arundina graminifolia</i>	50 °C	60 hours
<i>Epidendrum</i> spp	50 °C	27 hours
Blc';	50 °C	21 hours
Guanmiao City',		
<i>Cattleya bowringiana</i>		
Den. 'Big White'	50 °C	21 hours
Phal. Ox Plum Rose × BlackJack	50 °C	9 hours

**Table 2:** Embedded drying of orchids in oven with borax and silica gel (1:1) (Source: souvenir-kisan mela 2017)

Name	Temperature	Duration
<i>Dendrobiummobile</i>	55 °C	10 hours
<i>Dendrobiumwilliamsoni</i>	55 °C	10 hours
<i>Dendrobium aphyllum</i>	55 °C	10 hours
Den. 'Erika	55 °C	12 hours
Den. 'Big White4N'	55 °C	12 hours
Den. 'Bangkok Blue'	55 °C	7 hours
<i>Coelogyne cristata</i>	55 °C	10 hours
<i>Coelogyne Flaccida</i>	55 °C	7 hours
<i>Paph. 'Nagasaki</i>	55 °C	10 hours
<i>Cym. 'Sun Gold</i>	55 °C	14 hours

### 3.7 Glycerine Drying

Glycerine drying is most suitable for foliage rather than flowers. In this technique the moisture in the foliage is replaced in aqueous Glycerine solution (Paul and Shylla, 2002)<sup>[8]</sup>.

Generally matured foliage is harvested and unwanted parts are removed from the stem. Then the stem is cut at certain height and the cut end is crushed by a hammer. The crushed portion is dipped in 33% Glycerine solution at 5cm depth.

The solution is absorbed by the leaves and turn its colour into brown with glossy appearance. This process is completed within a week depend upon the weather conditions. In addition of antibiotic with glycerine prevents microbial growth.

E.g., Eucalyptus, Gypsophilla, Hydrangea, Magnolia, Maple leaves etc.,

### 3.8 Microwave Drying

This is a very fast method and flower quality is not hampered. The container with embedded is placed in the microwave with additional cup of water to avoid excess drying. After that microwave should be closed and set the required temperature and time. Normally, the required time is 10 minutes to few hours. E.g., Golden rod, Lilly, Rose, Dahlia, Violet, Zinnia etc.,

**Table 3:** Time duration of microwave drying for different flowers (Source: Brown *et al.*, 2016)

Flower	Heating time (min)	Standing time (hrs.)
Rose	2.5	Over night
Daisy type flowers, zinnia, marigold.	1.5	10 hrs.
Carnation	1.5	10 hrs.
Large dahlia,	3	36 hrs.
Large chrysanthemum	3	36 hrs.
Peony	3	36 hrs.
Small orchid	1.5	24 hrs.

### 3.9 Freeze Drying (Lyophilization)

The product is obtained from this method retains its original shape, colour, and texture (Sankari and Anand, 2014)<sup>[9]</sup>. This method is more effective and popular also known as Lyophilization, which means lowering the temperature inside the product after that the moisture is removed in the form of vapour. Sublimation is the principle of this technique in which the temperature goes below the freezing point. Liquid state does not occur in this technique (ice to vapour).

The vapour is condensed, collected separately outside the chamber. The moisture removed by partial vacuum pressure. This method is used to decorate cake, table, by scattering of

dried products wedding bouquets. Time consuming is disadvantage in this technique. E.g., Lilly, Carnation, Orchid, Peony, Phalaenopsis, Rose, Gladiolus, Snap dragon etc.

### 3.10 Hot Air Oven Drying

In this method, after completion of embedding the container is placed at 40-50 °C temperature in hot air oven. The temperature and duration of the process varies depend upon the material (Jain *et al.*, 2016)<sup>[5]</sup>.

The flowers like Chrysanthemum, gerbera, Helipterum, are dried under 45 °C temperature within 48 hours where French marigold, African marigold takes 72 hours and 96 hours for complete drying respectively.

### 3.11 Borax Drying

Borax is best suited for dehydration of delicate flowers. These are best mixed with equal parts of sand. Borax being hygroscopic in nature might bleach flower petals if embedded for a long time. Drying through borax will take 2 to 10 days.

To prevent spotting, all the desiccants should be removed from the flowers after drying. A mixture of one part of borax to one to three part of corn meal mixture is satisfactory for rapid drying. One table spoon of salt may be added speed up drying process.

### 4. Other Drying Techniques

Other desiccants used in drying techniques are expanded clay, kitty litter, perlite, dry saw dust, rice husk and corn starch. Under room condition (24-25 °C and 75-79% RH), perlite can be used for drying of spikes and florets of orchids within 15 to 20 days.

### 5. Special Preservation Techniques

#### 5.1 Skeletonizing

It is a semitransparent and it also called fossil leaves. In this process eliminating all tissue from leaves without hampering of veins. In this method heavy textured leaves are suited. Boiled the leaves in 250 ml of water in addition of two table spoon lay for 40 min. Some other time two table spoon household bench is added water to intensifying the colour for 2 hrs.

The leaves are rinsed in cold water and remove the tissue from leaves followed by drying. Different dye is used to easily colouring for enhanced appearance. It is used as gift tag, greeting cards, scrap books, collages, paper making, stamping or decorative wedding or birthday cards.

#### 5.2 Bleaching and Dyeing

It is a process of discolorizing or whitening by using some chemicals. Dehydrated products are used mainly for less colour intensive and reduce the visual appearance. For classy look the flower are first bleached and then follows a dyeing for good absorption. The chemicals used as a bleaching agent are classified to group. They are oxidative bleaching chemical and reductive bleaching chemicals.

Hypochlorite, Chlorite and Peroxide acts as an Oxidative chemical whereas Sulphite and Borohydride are used as Reductive bleaching chemicals. To avoid yellowing of plant material oxidative and reductive bleaching used alternatively.

At the end of the process, to minimize yellowing the products are washed with 2% Barium hydroxide or Calcium hydroxide or Sodium bicarbonate or Aluminium sulphate. Both natural dye and synthetic chemicals are used for coloring the flowers. The synthetic chemicals are enamel paints, interior paints,

poster paints, tube paints etc.

Bleaching with Sodium chlorite (10%) followed by Hydrogen peroxide (30%) was shown effective result on Gomphrena (Sharavani and Divya Sree, 2018) [10].

### 5.3 Sulphuring

In this process precautions are needed to handle the sulphur because it is very toxic. Sulphur granules and dry flowers are brunt under close chamber for 2 hours to check the enzymatic discolouration.

## 6. Dry Flower Products

### 6.1 Potpourri

Potpourri emits a delightful smell. It is a mixture of dried flowers, leaves, seeds, stems and roots. At peak flowering season the oils are found evenly within the flower. The important factor is harvesting at right time of the flowers.

Potpourri are made by two methods i.e., moist and dry. The most common, easiest, and quick method is dry. In this process aromatic oil absorbed properly and release them slowly.

Potpourri are used as a room freshener and also used as a moth repellent. This

### 6.2 Candle Making

In candle making dry flowers are used for attraction. In plain candles outside, dry flowers are simply added for decoration purposes. Or dried flowers are crushed spread over a waxy paper and filled with light melted wax and roll it.

### 6.3 Driftwood

It is a kind of wood. The drift wood has been washed in a sea or river and moved by winds, tides or waves. It can be considered as marine debris. Artificially, drift wood can be prepared by dipping it into the water for 10-12 days and made a dry. By using sand paper and varnish appearance can be enhanced.

Drift wood can also be used for decorative purpose.

### 6.4 Dry Flower Arrangement

Dry flowers as well as fresh flower can be used to decorate a flower vase or bouquets. It is long-lasting with less care. For interior decoration, dried flowers, foliage, grasses, seeds or pods can be used. Mostly dry flowers like Achillea, Rose Larkspur, Nigella, Lavender, Paper flowers, Static, and Strawflower etc. are used.

protects the wooden garments during its storage. In India, Rs.55 crore value of Potpourri are produced in the dry flower industry (De *et al.*, 2016) [3].

Gomphrena, Lotus pods, Marigold petal, Lavender, Rose petals, Mint, Basal, Geranium, etc., are most suited.

## 7. Packing, Storage and Care of Dried Plant Products

Dry flowers need some special care during handling and storage because they are fragile. To minimize bruising injury, the packaging materials gives a protective support during transportation.

Dry flowers and products are always stored under the moisture-proof container to avoid the loss of their shape and appearance in a shorter period. Avoid direct sunlight or areas with high light intensity for better appearance.

To absorb excess moisture from the product, silica gel is used. Hence, silica gel pouches are kept at the bottom of the container before final packing. Before Final packing, the moisture percentages of dried products are ensured.

By using polythene, the packaging materials should be covered tightly which prevents the entry of outside moisture as well as protect from insect- pest.

To retain their colour and shape for a longer time, proper packaging and storage is needed. And also increases the shelf-life of the products.

## 8. Countries Importing Dried Flowers

USA, UK, Netherlands, Germany and the UAE are major countries, where the Indian dry flower products were exported during the same period.

Total floriculture exports, the share of Rs 329.3 Crore comprise dry flowers.

## 9. Dried Flowers Export from India

Dried Flowers is exported to over 59 countries. In the year 2020-2021 (Apr- Nov), India has exported Dried Flowers worth of 4.17 USD million. The total volume of export in 2020-2021 (Apr-Nov) was around 32,84,910. The total volume of Dried Flowers export around the world in year 2018 was 3476469. The figures show the great potential for Indian exporters of Dried Flowers to increase their participation in global trading and improve their numbers. USA is the largest exporter of Dried Flowers.

**Table 4:** Dried Flowers Export from India [Source: connect2India]

Country	Value (USD MILLION)	Share (%)
USA	1.1	26.38
UAE	1.07	25.00
Singapore	0.54	12.95
Germany	0.23	5.52
Canada	0.2	4.8
Malaysia	0.18	4.32
Spain	0.13	3.12
Qatar	0.1	2.4
Kuwait	0.09	2.16
Saudi Arabia	0.09	2.16

Countries which imported the highest dollar value worth of Dried Flowers from India in 2020-2021 (Apr-Nov) The top 5 trading partners of India are USA (1.1 USD Million), United Arab Emirates (1.07 USD Million), Singapore (0.54 USD Million), Germany (0.23 USD Million), Canada (0.2 USD Million) The total export value of Dried Flowers in these countries is 3.14 USD million. These top 5 countries account for over 75.3% of the total Dried Flowers export from India.

## 10. Conclusion

Nearly 80% flowers and foliage suitable for drying. It helps to become a choice over fresh flowers for its long- lasting property. Sophisticated training and expensive equipment are not needed with variety of designs.

Dehydration technique is simple and does not require any expensive equipment's. For best result proper preservation techniques and some precautions are required throughout the process.

This process is simple which can be done physically challenged persons, rural women, housewives, they can also be involve in business and earn money.

For proper guidance and knowledge about dehydration technology they require some awareness programme

Considering the above points, it is concluded that dehydration techniques help in uplifting the economic status of many rural people, floriculturists, traders and entrepreneurs.

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