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Original Research Article

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Studies on Comparative Techniques For Dry Flower Production

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Abstract: Fresh flowers are pleasing and eye-catching but it is strenuous to continue their charm and fresh look for longer period. To overcome this problem the same flowers can be dried and processed in the form of dry flowers that lasts indefinitely. Dry flowers are the key components of floriculture industry which are rapidly rising up at the international trade. Dry flowers are modest, extensive and hold their aesthetic worth regardless of the period. Dry flowers industry is probably going to concoct a great deal of nation's economy in contrast with cut flowers.The quality of dry flowers greatly depends on flower structure, stage of harvest and on drying techniques. Hence the present study was undertaken with the objective to identify and collect the variety of flowers and foliages and to find the suitable drying technique for the selected plant material. The different drying techniques performed in the study were Air drying, Pressing, Drying with desiccants and Hot air oven drying. By employing all of these techniques in dehydration of flowers and foliages it was found that some of the flowers were successfully dehydrated and respond very well to certain drying techniques. Among the drying methods air drying showed low quality of dried flowers as the flowers obtained were stiff, dark and deformed in shape. The best quality of dried flowers were obtained with hot air oven drying method. Pressing showed the maximum retention of color in most of the flowers and foliages, but flattening of shape was found in some plant material. Borax drying showed good quality of dried flowers. Silica gel was found the most promising desiccant and it showed the better quality of dried flowers.

Keywords: Dry flowers, Air drying, Pressing, Hot air oven drying, Borax drying, Silica gel drying, Employment generation.

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1. INTRODUCTION

The commercial enterprise of floriculture is growing speedily throughout the globe, it has huge potential for export. The integral part of floriculture is cut flowers, but it is hard to maintain the shelf life of fresh cut flowers even by using the best techniques of post harvest technology ([1]). To conquer this problem the flowers and foliages can be dried to prolong their beauty and freshness which hold both economic and aesthetic importance. Dehydration of flowers is the practice of preservation of flowers or the process of abolishing the moisture from flowers. Dry flowers and foliages are attractive and possess number of abilities including ornamental, durable, lifelong and year round availability (Joyce 1998)[2]. The dried flowers and plant parts are natural, inexpensive and have everlasting value with year around availability ([3]). Dry flower industry is most beneficial area in floriculture. The industry has grown rapidly with over 60 percent share of profits belonging to the floriculture industry ([4]). The industry projected annual turnover as of 2003 was more than 150 crores, (Singh 2009)[5]. Potpourris are the major segment of dry flower industry valued at Rs.55 crores in India alone ([6]). The industry in India is more than 40 years old and exports 500 varieties of flowers to 20 countries ([7]). The USA is a largest consumer of dried and artificial flowers estimated at (US $2.4 million) annually followed by Germany and UK ([7]). The necessities of dry flowers and other dried botanicals are accelerating all over the world for the embellishment of living and working places. Dry flowers can be formed by simple dehydration techniques in which along with reduction of water content, color and shape of flowers are retained to a maximum extent so as to preserve the beauty and hence their value. The various methods used for the dehydration of plant materials include air drying, pressing, use of hot air oven, use of borax and silica gel as desiccants. Air drying is the easiest and most economical method for preservation of flowers and foliages. Pressing is the oldest method having its first report in 1820 (Lawrence 1969)[8]which was then used by the botanist for the preparation of herbarium which also become part and parcel of syllabus to study Botany subject. Flowers with heavy moisture content are subjected to dehydration by exposing to desiccants in which water content are totally absorbed by desiccants such as borax and silica gel. Silica gel is effective drying agent used for delicate flowers. Flower drying with hot air oven is the fastest method and also yields more colorful and better quality dry flowers. Whatever the method used, it should aim in retention of shape, color and moreover the overall beauty of flowers totally as such.

Therefore dry flowers can be employed in generating of diverse commercially useful artifacts and can empower people in abundance specifically to rural womens and housewives. Proper financing for research in dry flowers and urgency in the need of awareness about the economic potential of this technology is necessary for the enhancement of dry flower industry in our country.

1.1 Objectives of the study

Our objective of the study is,

1. To identify, select and collect varieties of flowers and foliages for drying.
2. To develop suitable drying technique for the selected plant material.

2. MATERIALS AND METHODS

Present work was carried out in the laboratory of Department of Botany. Prof Ramkrishna More A.C.S College Akurdi, Pune. In the present study, various types of flowers and foliages were subjected to different dehydration techniques (plants under test were already authenticated by referring literature for the identification of plants). Flowers at the peak blooming season of the respective plants were selected and harvested with proper care along with their beauty, mostly flowers with bright color and slightly at immature stage were harvested. Flowers of type Spreading canscora *(Canscora diffusa)* Family Gentianaceae. Starry leucas (*Leucas stelligera)* Family Lamiaceae. Peacock flower *(Cesalpinia pulcherrima)* Family Fabaceae. Fish poison brush *(Gnida glauca)* Family Thymelaeaceae. Blue porter weed (*Stachyotarpeta jamaicensis)* Family Verbenaceae. Lantana *(Lantana camera)* Family Verbenaceae. Red powder puff *(Calliandra haematocephala)* Family Fabaceae. Ferns (*Adiantum pedatum)* Family Pteridaceae. Aster (*Callistphus chinensis)* Family Asteraceae. Chrysanthemum (*Dendranthema grandiflora)* Family Asteraceae. Bougainvillea (*Bougainvillea glabra)* Family Nyctaginaceae. Dahlia (*Dahlia pinnata)* Family Asteraceae. Pentas (*Pentas lanceolata)* Family Rubiaceae. Ixora *(Ixora coccinea)* Family Rubiaceae. Marigold (*Tagetes erecta)* Family Asteraceae. Roses (*Rosa indica)* Family: Rosaceae. Gerbera *(Gerbera jamesonii)* Family Asteraceae. Carnation (*Dianthus caryophyllus)* Family Caryophyllaceae. Gladiolus *(Gladiolus dalenii*) Familyl ridaceae. Orchids (*Dendrobium nobile)* Family Orchidaceae and Zinnia (*Zinnia elegans)* Family Asteraceae were selected, harvested and used in present study. The harvested flowers were then processed for obtaining dry flowers using following dehydration techniques as detailed below.

2.1 Dehydration techniques

Dehydration of flowers were achieved by
(1) Air drying
(2) Pressing
(3) Using hot air oven
(4) Using desiccants such as borax, silica gel

2.1.1 Dehydration by air drying method (Verma 2012)[9]

Plant material *viz.,Tagetes erecta*, *Rosa indica*, *Gerbera jamesonii*, *Dianthus caryophyllus* and *Gladiolus dalenii* were selected and used for the formation of dry flowers by air drying method. Selected floral material was tied to a rope and in some cases to wire and were kept in hanging position in clean, dark and well ventilated area. Flowers were kept in same position and without touch for next 1-3 weeks for absolute drying.

2.2.2. Dehydration by pressing (Bhutani 1990)[10]

Plant material *viz.,Canscora diffusa, Leucas stelligera, Cesalpinia pulcherrima, Gnidia glauca*, *Lantana camera, Stachyotarpeta jamaicensis, Bougainvillea glabra*, *Calliandra haematocephala*, *Pentas lanceolata*, *Ixora coccinea* and *Adiantum pedatum* were selected for pressing. The selected floral material was pressed in between the folds of absorbent paper and appropriate pressure was applied with plant press and was kept in same position for 10-15 days.

2.2.3. Dehydration by using hot air from oven (Battarcharjee& De 2003)[7]

Plant material *viz., Rosa indica*, *Tagetes erecta Callistphus chinensis*, *Gerbera jamesonii*, *Gladiolus dalenii*, *Zinnia elegans* and *Dendranthema grandiflora* were selected and used for hot air oven drying method. In this method flowers were kept in hot air oven at 45-50°C controlled temperature for 1-2 hours. Time and temperature combination were selected on the basis of compactness and thickness of flowers.

2.2.4. Dehydration by use of borax as desiccant (Battarcharjee& De 2003)[7]

Plant material *viz., Rosa indica*, *Callistphus chinensis*, *Dianthus caryophyllus*, *Tagetes erecta*, *Dahlia pinnata*, *Gerbera jamesonii* and *Dendranthema grandiflora* were selected for dehydration by use of borax as desiccant. Desiccant was sufficiently spread at the bottom of the container, the selected flowers were carefully placed according to their shape in proper position and were again covered with sufficient quantity of borax so as to all flower heads gets embedded properly in borax material in container. Containers thus prepared, were kept for drying in a well ventilated area for next 5-14 days and were observed periodically.

2.1.2 Dehydration by use of silica gel as desiccant (Verma 2012)[9]

Plant material selected for this method were the *Gerbera jamesonii*, *Rosa indica*, *Tagete serecta*, *Dendrobium nobile*, *Gladiolus dalenii* and *Dianthus caryophyllus*. Crystals of silica gel were dried properlyat 100-125°C temperature in oven so as to reuse them many times. This totally oven dried silica gel crystals were poured in a container with tight lid, selected flowers were placed in this container and covered to embed in excess silica gel, containers thus prepared, were observed periodically.

3. RESULTS AND DISCUSSION

Twenty one types of fresh flowers were converted to dry flowers by various methods, time required for this conversion was found different for different types of flowers. Results of time period required to develop dry flowers and changes in color and appearance of the flowers and foliages are presented in Table 1 and in Table2. It is seen from the Table 1 that time required for dry flower formation by air drying method was found in the range of 10-12 days. Dry flowers obtained by this method were found stiff and dark. Pertuit (2002)[11] also obtained stiff flowers by air drying method. Verma (2012)[9] reported that the low quality products were obtained due to unfavorable weather, which had reduced the ornamental value. Our results are exactly matching to their results *i.e.* stiff flower yields obtained by Pertuit. The time required for the dehydration of flower by pressing method was found in the range of 5-10 days as observed from Table 1. Retention of original color was reported in most of the flowers and on the other hand flattening of shape was reported in some plant material. Prasad (1997)[12] reported that shape of the material cannot be maintained as it becomes flattened. Time required for the drying of flowers with hot air oven drying was found in the range of 2-3 days as indicated in Table 1. By this method good quality products with very less deformation of shape and color was obtained in shorter time. Excellent dry rose flowers were obtained by this method (Fig.1a). The best quality of roses with hot air oven drying was also acquired by Radha (2015)[1].Verma (2012)[9]reported that, oven drying was the best method to obtain superior products.Time required for the dehydration of flowers using borax as desiccant was found in the range of 8-14 days. This method was found effective for the dehydration of delicate flowers and also reported as least expensive. Sujata (2001)[13]reported that borax crystals and sand in the ratio of 1:1 was the best combination for dehydration of flowers along with the retention of color. It is clear from the Table 1 that time required by the flowers to dry using silica gel as desiccant was in the range of 5-6 days. This method was found more suitable in dehydration of flowers with maximum retention of color and shape (Fig.1b). Our results are exactly same as obtained by Kher and Bhutani (1979)[14]; Champoux (1991)[15]; Sandhu (2002)[16]and Verma(2012)[9].Table 1.

Table 1. Time required in days for the dehydration of flowers by following different techniques

S.NO	Flower Type	Time in days required for the dehydration of flowers &foliages				
		Air drying (1)	Pressing (2)	Hot air oven drying (3)	Borax drying (4)	Silica gel drying(5)
1	*Tagetes erecta*	10	-	03	14	06
2	*Rosa indica*	11	-	02	13	05
3	*Gerbera jamesonii*	12	-	03	14	06
4	*Dianthus caryophyllus*	10	-	-	13	05
5	*Gladiolus dalenii*	10	-	03	-	05
6	*Canscora diffusa*	-	08	-	-	-
7	*Leucas stelligera*	-	08	-	-	-
8	*Gnidia glauca*	-	10	-	-	-
9	*Bougainvillea glabra*	-	05	-	-	-
10	*Calliandra haematocephala*	-	10	-	-	-
11	*Pentas lanceolata*	-	07	-	-	-
12	*Ixora coccinea*	-	07	-	-	-
13	*Lantana camera*	-	07	-	-	-
14	*Stachyotarpeta jamaicensis*	-	07	-	-	-
15	*Adiantum pedatum*	-	10	-	-	-
16	*Callistphus chinensis*	-	-	03	08	-
17	*Dahlia pinnata*	-	-	-	14	-
18	*Dendranthema grandiflora*	-	-	03	08	-

19	*Dendrobium nobile*	-	-	-	-	06
20	*Zinnia elegans*	-	-	03	-	-
21	*Cesalpinia pulcherrima*	-	08	-	-	-

Table 2. Color retention and appearance of flower and foliages after drying in different dehydration techniques.

Plant	Part used	Color after drying					Shape after drying				
		1	2	3	4	5	1	2	3	4	5
Tagetes erecta	Flowers	U	-	S	S	S	D	-	R	R	R
Rosa indica	Flowers	U	-	S	S	S	D	-	R	R	R
Gerbera jamesonii	Flowers	U	-	S	S	S	D	-	R	R	R
Dianthus caryophyllus	Flowers	U	-	S	S	S	D	-	D	D	R
Gladiolus dalenii	Flowers	U	-	U	-	S	D	-	D	-	R
Canscora diffusa	Flowers	-	S	-	-	-	-	S	-	-	-
Leucas stelligera	Flowers	-	S	-	-	-	-	S	-	-	-
Gnidia glauca	Flowers	-	S	-	-	-	-	S	-	-	-
Bougainvillea glabra	Flowers	-	S	-	-	-	-	D	-	-	-
Calliandra haematocephala	Flowers	-	S	-	-	-	-	D	-	-	-
Pentas lanceolata	Flowers and leaves	-	S	-	-	-	-	D	-	-	-
Ixora coccinea	Flowers	-	S	-	-	-	-	D	-	-	-
Lantana camera	Flowers and leaves	-	S	-	-	-	-	D	-	-	-
Stachyotarpeta jamaicensis	Flowers and leaves	-	S	-	-	-	-	R	-	-	-
Adiantum pedatum	Leaves	-	S	-	-	-	-	S	-	-	-
Callistphus chinensis	Flowers	-	-	S	S	-	-	-	D	R	-
Dahlia pinnata	Flowers	-	-	-	U	-	-	-	-	D	-
Dendranthema grandiflora	Flowers	-	-	S	S	-	-	-	R	R	-
Dendrobium nobile	Flowers	-	-	-	-	S	-	-	-	-	D
Zinnia elegans	Flowers	-	-	S	-	-	-	-	R	-	-
Cesalpinia pulcherrima	Flowers	-	S	-	-	-	-	D	-	-	-

1-Air drying, 2- Pressing, 3- Hot air oven drying, 4- Borax drying, 5- Silica gel drying. Color retention after drying- S: Satisfactory; U: Unsatisfactory. Shape retention after drying- D: Deformed; R: Retained shape: The method was not used

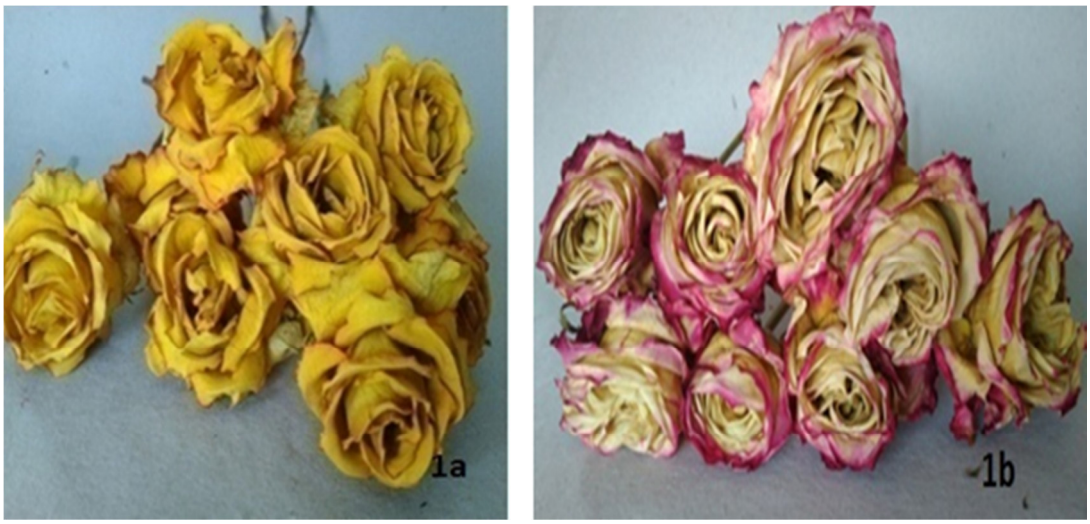

Fig. 1aDry flowers obtained using Oven drying method.
Fig. 1b Dry flowers obtained using silica gel drying method

The plant material suitable for drying among the selected twenty one flowers and foliages were the *Adiantum pedatum*, *Canscora diffusa, Leucas stelligera, Gnidia glauca, Stachyotarpeta jamaicensis, Callistphus chinensis*, *Dendranthema grandiflora*, *Tagetes erecta*, *Rosa indica*, *Gerbera jamesonii*, *Dianthus caryophyllus*, *Gladiolus dalenii* and *Zinnia elegans*. These flowers and foliages were found with the maximum retention of both color and shape after drying. The results obtained from the present study indicated that air drying method was not suitable for drying of the selected plant material as stiffness and darkness in color was found the common problem. In air drying the petals may shrink and sometimes droop down resulting in the loss of decorative value of the product as reviewed by Verma (2012)[9]. Plant material such as *Adiantum*

pedatum ,Canscora diffusa, Leucas stelligera, Gnidia glauca and *Stachyotarpeta jamaicensis were* dried successfully with pressing. The shapes of most of the flowers cannot be maintained in press drying because the fresh material after pressing within the iron or wooden frame tends to stick to the paper as reported by Prasad (1997)[12] but, the original colour of pressed sample is maintained (Datta 1997)[17]. The method hot air oven drying was found suitable in drying of *Tagetes erecta, Rosa indica, Gerbera jamesonii, Dendranthema grandiflora* and *Zinnia elegans* in lesser time. Similar reports of rapid drying of flowers in oven drying was documented by Chen (2000)[18].Plant material suitable for borax drying were the *Tagetes erecta, Rosa indica, Gerbera jamesonii, Callistphus chinensis* and *Dendranthema grandiflora.* Paul and Shylla (2002)[19]reported that both borax and alum were best suited for the dehydration of delicate flowers. On the other hand silica gel drying was found suitable in drying of *Tagetes erecta*, *Rosa indica*, *Gerbera jamesonii*, *Dianthus caryophyllus* and *Gladiolus dalenii*. Verma (2012)[9]Silica gel is best desiccant for getting good quality of dry flowers that retain color and shape. The method such as hot air oven drying and drying with desiccants were found suitable in the drying of most of the selected plant material in study (excluding white colored flowers). However, superior quality products with the maximum retention of both shape and color (especially *Rosa indica*) were obtained with hot air oven drying followed by silica gel drying method

4. CONCLUSION

The results of the present study indicated that different techniques can be followed in dehydration of flowers and foliages, most of the flowers and foliages were well dried and preserved with the maximum retention of color and shape, of all the methods tried the silica gel as desiccant and hot air oven drying yields better quality and superior products. Silica gel being expensive can be substituted with less expensive desiccants *viz.,* sand or borax and both can be used in combination with cornmeal for better results. The dehydrated products obtained by using dry flower technology can be utilized in making of various dry flower arrangements and other profitable craft items, even flattened flowers obtained from pressing can be utilized in making of greetings, wall hanging, table mats, landscapes etc. Beginning with a small scale unit, this technology has the potential to grow into a big industry which in turn will play a vital role in employment generation. Dry flowers obtained by various dehydration techniques have wide scope of use. Dry flowers thus obtained can be preferably used in comparison to acrylic and plastic flowers so as to sustain the environment by avoiding the pollution.

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6. AUTHORS CONTRIBUTION STATEMENT

Dr Saima Rashid Mir devised the project, the main conceptual ideas and proof outline, performed the experiments, analysed data and drafted the manuscript. Dr B.M Shinde provided his valuable guidance and supervised the experiments in study. Dr V.A Patil provided necessary information about the flora of lonavla Maharashtra from where most of the plant material used for press drying was collected and also helps in collection of plants. Dr M.M Jana Helps in the identification of plant materials and provided his valuable suggestions about dehydration techniques. All authors discussed the results and commented on the manuscript.

7. CONFLICT OF INTEREST

Conflict of interest declared none

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