Advances in Bioresearch
Adv. Biores., Vol 9 (6) November 2018: 68-76

Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
DOI: 10.15515/abr.0976-4585.9.6.6876

Advances in Bioresearch

ORIGINAL ARTICLE

Standardization of drying Techniques for different flowers for making potpourris

G. Sunil Kumar, R. Nagaraju, K. Swarajyalakshmi P. Latha and M. Balakrishna
College of Horticulture, Anantharajupeta, Dr. YSR Horticultural University, Andhra Pradesh, India. Email for correspondence – sunilkumarpht.13@gmail.com

ABSTRACT
The present study entitled Suitability and Standardization of drying techniques for different flowers for making potpourris was conducted at Postharvest Technology Laboratory, College of Horticulture, Anantharajupeta, Andhra Pradesh during the year 2017 under Dr. YSR Horticultural University. In the present investigation, five different flowers were tried viz., T_1 (Rose), T_2 (Marigold), T_3 (Chrysanthemum), T_4 (Gomphrena), T_5 (Lotus) and these materials were subjected to five drying methods like D_1 (Air drying) D_2 (Sun drying), D_3 (Silica gel drying) D_4 (Hot air oven drying) D_5 (Microwave oven). Data recorded on different parameters were subjected to statistical analysis with factorial CRD. Among the different flowers selected for study combination of D_1T_2 (air drying + marigold flower) (9.67 g) ended with lowest flower dry weight, whereas highest dry weight was recorded in (38.67 g) D_3T_4 (silica gel drying + gomphrena flowers). Maximum moisture loss (90.33%) *was recorded with air dried marigold flowers (D_1T_2), whereas* minimum moisture loss *was recorded in D_3T_4 (silica gel drying + gomphrena)* (61.33%)*. With regards to the time taken for Air drying gomphrena flowers have taken less number of days (6) for complete drying. Chrysanthemum flowers have taken more time i.e.12 days to dry. Duration of flowers drying was minimum (2 days) for Gomphrena, while maximum of 9 days was taken by Chrysanthemum under the study with reference to time taken for Sun drying. Time taken to dry in Silica gel method Gomphrena flowers completely dried in 2 days, while more time (7 days) taken to dry was recorded for Marigold. Hot air oven drying took flowers are dried in 40°C 19 hours to dry Rose flowers where as maximum of 34 hours 30 minutes was recorded by marigold. The time required to dry flowers in Microwave oven drying showed that Marigold flowers took more number of minutes i.e.8.30 minutes to dry while Lotus flowers took minimum of 4 minutes for drying.*
Keywords: *Flowers, dehydration, air drying, sun drying, silica gel drying, hot air oven, microwave drying, rose, marigold, chrysanthemum, gomphrena and lotus flowers, potpourri.*

Received 09.08.2018 Revised 28.08.2018 Accepted 11.10.2018

How to cite this article:
G. Sunil Kumar, R. Nagaraju, K. Swarajyalakshmi P. Latha and M. Balakrishna. Standardization of drying Techniques for different flowers for making potpourris. Adv. Biores., Vol 9 (6) November 2018: 68-76

INTRODUCTION

Drying is a method to remove moisture from the barks and other plant parts. Dried and preserved ornamental products offer a wide range of qualities like novelty, longevity, aesthetic properties, flexibility and year round availability [6]. The range of dried flowers and other attractive plant parts is quite extensive, namely, roots, shoots, stems, buds, flowers, inflorescences, fruiting shoots, fruit peel, fruits, cones, seeds, foliage, bracts, thorns, barks, lichens, fleshy fungi, mosses and Selaginella [4]. Dried flowers and foliage areused for making decorative floral segments like wall hangings, landscape calendars, potpourris etc., for various purpose with potpourris being the major segment of drying flower industry valuing at Rs. 55 crores in India alone [8]. In India industry provides direct employment to around 15,000 persons and indirect employment to around 60,000 persons. Nearly 60% of the raw materials sourced from natural forests and plains, only 40% of the flowers are cultivated for drying, bleaching and coloring. Easy availability of products from forests, possibility of manpower available for labour intensive craft making and availability of wide range of products throughout the year are the reasons for development of dry flower industry in India. Potpourris are orused fincome generation through drying different plant parts will be helpful to self help groups, young entrepreneur, and unemployed etc., even for empowering women in rural households by income generation. In present modern days people

preference towards aesthetic products like floral segments, wall hangings, landscapes, calendars, potpourris, dry landscapes etc., is increasing day by day. Floriculture has become a profitable industry in many parts of the globe. The export basket comprises dry flowers, fresh cut flowers, live plants, fresh bulbs and foliages among these dry flowers occupy highest percentage than other forms. Dry flowers have good demand both in domestic and international markets. Drying of flowers and foliage by various methods like air drying, sun drying, oven drying, microwave oven drying, freeze drying and embedded drying can be used for making decorative floral craft items i.e. cards, floral designs, wall hanging, landscapes, calendars etc. for various purposes [1, 2]. The development of improved post harvest techniques for enhancing or prolonging the storage life of dehydrated flowers and providing their availability year round can prove out to be an effective measure for enhancing the dehydrating technology. Similarly the development of a commercial scale drier to produce high quality flowers could make a significant contribution to floriculture industry in India.

Roses are of foremost commercial importance and cut roses have the highest demand throughout the world and year round. The cut flowers are used for vase and table decoration. Rose is an ornamental shrub with upright as climbing stems generally with thorns. Rose flowers are beautiful having exquisite shape, size, diverse colours with delightful fragrance. *Gomphrena globosa* L. commonly known as bachelor's button or everlasting is native to India and belongs to the Amaranthaceae family. It is a hardy annual and plants are bushy in nature and may be tall and dwarf. The flowers are round or clover like in shades of white, magenta, orange, red, purple, violet, rose and pink. The dried flowers retain their colour and are useful for table decorations. The chrysanthemum is one of the most important flower crop belongs to family Asteraceae. Chrysanthemum is versatile; it can be planted in the bed, cultured in the pot, used for garland making and also as cut-flower for flower arrangement. Marigold is one of the most commonly flowers garden for garden decoration and extensively used as loose flower for making garlands for religious and social functions. *Nelumbo nucifera* belongs to the family of Nelumbonaceae. Lotus is a perennial, large and rhizomatous aquatic herb with slender, elongated, branched, creeping stem consisting of nodal roots; leaves are membranous, peltate (60-90 cm and above), orbicular and concave to cup shaped; petioles are long, rough with small distinct prickles; flowers are white to rosy.

MATERIAL AND METHODS

The present study entitled Standardization of drying technique for different flowers for making potpourris was conducted at Postharvest Technology Laboratory, College of Horticulture, Anantharajupeta during 2016- 17. For the present experiment different flowers materials used *viz.,* rose, marigold, chrysanthemum, gomphrena and lotus flowers. Drying of flowers were dried under various dehydration methods used *viz.,* air drying, sun drying, hot air oven and microwave oven drying and silica gel drying to carry out present experiment. 100 g of fresh flowers was taken to carried out the experiment and replicated thrice. The experiment was laid out in Factorial Completely Randomised Design with factorial concept with 5 plant materials (F_1) and 5 drying methods (F_2) and their combinations (25) (F_1 X F_2). These combinations were replicated thrice. Observations were recorded for dry weight, moisture loss (%), time taken for drying. The data collected were analyzed statistically using factorial completely randomized design as per the procedure outlined by Panse and Sukhatme [9] and valid conclusions were drawn only on significant differences between treatments mean at 0.05 per cent level of significance.

Air drying The clean, fresh flowers collected in cloth bags were carried to the laboratory and weighed on electronic balance for fresh weight purpose. These materials were transferred to plastic trays containing open ventilation on both sides. Every day readings were taken at regular intervals to record the dry weight and moisture content of the fruit peel.

Sun drying flowers were exposed to the sun daily from 9 am - 4 pm by keeping them in plastic trays. The trays are shifted to laboratory during evening hours and again the next morning they were kept under the sun. This practice was followed till the material dried up completely. The readings were taken at regular intervals to record the moisture content till the moisture % is same, indicating that the drying process is completed.

Silica gel drying the plastic trays which were selected for drying to dry the materials was filled evenly with the silica gel media up to two inches of height. Depressions were made to insert the selected flowers into the silica gel medium. After inserting the flowers, it was covered with silica gel again the media was evenly distributed so as to equalize the pressure on all sides of the plant parts. After drying, the embedded flowers were taken out carefully by tilting the containers. Plant parts were also gently brushed with soft camel hair brush to remove the desiccant completely so that the original colour of the dried flowers could be seen. Standard setting time of 3 hours was maintained.

Hot air oven drying the flowers were kept in the iron trays and placed in an electrically operated hot air oven at two specified temperatures and duration no of hours for drying at (40°C) respectively.

Microwave oven drying Beakers selected for drying were filled evenly with the media up to 2 inches of height. Depressions were made to insert the flowers into the silica gel medium. After inserting it was covered with silica gel. The media was evenly distributed so as to equalize the pressure on plant parts. The plant parts were kept in beaker in upright position and they were dried in microwave oven at different time levels (viz., 30 Sec, 1 minute, 2 minutes, 2.5 minutes and 3 minutes). After drying, the embedded flowers were taken out carefully by tilting the containers. The flowers were rolled down and were collected, plant parts were also gently brushed with soft camel hair brush to remove the desiccant completely so that the original colour of the dried flowers could be seen.

Dry weight (g)

Dry weight of the flowers and other plant parts was recorded during course of study till the moisture completed and expressed in grams. These materials are used for the potpourri preparation.

Moisture loss (%)

The difference between the fresh weight and dry weight gives the actual moisture content of the flowers and other plant parts or loss of moisture. Moisture/ weight loss was calculated as per the given formula [5, 7, 10].

$$\text{Per cent moisture loss} = \frac{FW - DW}{FW} \times 100$$

Where,

FW= Fresh weight of plant materials

DW= Dry weight of plant materials

Time taken for drying (days/hours/minutes)

The time taken for drying of flowers and other plant parts by different methods was recorded as number of hours or number of minutes and number of days at the end of drying.

RESULTS AND DISCUSSION

Dry weight (g)

Different flowers, drying methods and their interactions under study showed significant difference in (Table 1). Minimum mean flower dry weight was observed in T_2 (Marigold) (13.80 g), while maximum was noticed T_4 (Gomphrena) (31.27 g) followed by T_5 (Lotus) (15.87 g). With respect to drying methods, significant difference was observed where lowest dry weight of flowers was recorded in D_1 (Air drying) (13.73 g), while highest dry weight was noticed in D_5 (microwave oven drying) (22.73 g) followed by D_3 (Silica gel drying) (20.93 g)**.**

The interaction effects of flowers and drying methods were found to be significant (Table 4.3). Combination of D_1T_2 (9.67 g) ended with lowest flower dry weight, whereas highest was recorded in (38.67 g) D_3T_4, which was statistically on par with D_5T_4 (36.67 g). Drying of flowers in silica gel resulted in highest weight loss because of hygroscopic nature of silica gel [3]. Minimum dry weight of flowers noticed with air drying but most of the flowers became dark and some flowers turned to brown light colour and faded and became brittle mainly especially in chrysanthemum, lotus, marigold.

Moisture loss (%)

The fresh and dry weights of flowers were taken for calculating the percentage moisture loss. Per cent loss in weight was analyzed with factorial completely randomised design. The data were subjected to arc sine transformation. The data pertaining indicates that the influence of flowers, drying methods and their interactions on per cent loss of moisture (Table 2).

Among the different flowers dried T_2 (Marigold) (85.73%) showed highest moisture loss followed by T_1 (Rose) (84.33%)**,** while minimum was observed in flowers dried by T_4 (Gomphrena) (72.53%) followed by T_3 (Chrysanthemum) (80.67%). Highest moisture loss was recorded in D_1 (Air drying) (86.33%) followed by D_2 **(**Sun drying) (82.13), while lowest was observed in T_5 (Microwave oven drying) (77.27%) followed by D_3 (Silica gel drying) (78.87%).

Significant differences were observed with the interaction effects of flowers and drying methods (Table 2). Maximum moisture loss (90.33%) was recorded with air dried marigold flowers (D_1T_2) which was statistically on par with D_2T_2 and D_2T_3 (88.33%), whereas minimum moisture loss was recorded in D_3T_4 (61. 33%), which was statistically on par with D_5T_4 (63.33%). maximum moisture loss was observed when

dried in air drying and minimum in silica gel drying method. Minimum moisture loss in silica gel might be due to better hydrosorbent properties comparison to other desiccants used Safeena and Patil [12].

Time taken for drying (days/hours/minutes)

The plant materials dried in different methods took different time duration to dry the plant material handled. The time taken to dry varied for days, hours and minutes based on the method of drying process. With regards to the time taken for Air drying (Fig. 1) Gomphrena flowers taken less number of days (6), chrysanthemum flowers have taken more days i.e.12 days followed by marigold (9 days), rose (8 days) and lotus with 7 days for complete drying. In this method most flowers became dark and some turned to brown light colored and become brittle. As a result of the brittle nature of air dried flowers, handling of the material tedious task. Pertuit [11] observed that flowers dried by air drying are extremely stiff once dried. Blue and yellow flowers retain their colour when air dried but pink flowers fade. Duration of flowers drying was minimum (2 days) for gompherina, while maximum of 9 days was taken by chrysanthemum followed by rose (3 days), marigold (8 days) and lotus flower (7 days) under the study with reference to time taken for sun drying (Fig 2).

From the (Fig 3) the time taken to dry in silica gel method gomphrena flower completely dried in 2 days, while more time (7 days) taken to dry was recorded Marigold, followed by other flowers i.e; chrysanthemum (5 days) rose (4 days) and 3 days lotus flower was recorded. The pre and post dried status of the flowers in silica gel drying states that all flowers retained their shape and colour but only red colour becoming darker. Flower shape and colour are natural in this method. The result is matching with the study conducted by Safeena and Patil, [12]. Standardization of drying technology for Dutch Roses "that observed the significant difference in the time taken for drying of flowers due to desiccants, it was lesser when silica gel was used as an embedding medium (5.09 days) which completed the task in almost half the time of sand.

The time taken to dry was influenced by drying temperature in hot air oven. Drying of flowers in hot air oven drying was (Fig 4) completed in 19 hours by rose, maximum 34 hours 30 minutes was recorded by marigold followed 33 hours in gomphrena, chrysanthemum (27 hours) and 21 hours time taken was noticed in lotus flowers. Pre and post dried status of flowers in hot air oven shows that almost all the flowers retained colour but the shape of the flowers shrivel and lose their shape.

The time required to dry flowers in microwave oven drying (Fig 5) was recorded and found that marigold took more number of minutes i.e.8.30 minutes, while rose and gomphrena have taken 6 minutes to dry and other flowers like chrysanthemum has taken only 5 minutes to dry and lotus took minimum of 4 minutes for drying. Flowers dried in this method retained colour and drying time is also less but the shrinkage of flowers is seen in this method.

Table – 1. Dry weight (g) of flowers as influenced by different methods of drying

Method of drying	T1	T2	T3	T4	T5	Mean
D1 (Air drying)	13.33	9.67	14.33	16.67	14.67	**13.73**
D2 (Sun drying)	19.33	11.67	11.67	32.33	14.33	**17.87**
D3 (Silica geldrying)	15.33	15.00	17.67	38.67	18.00	**20.93**
D4 (Hot air oven)	13.00	12.67	15.00	32.00	13.00	**17.13**
D5 (Microwave oven)	17.67	20.00	20.00	36.67	19.33	**22.73**
Mean	**15.73**	**13.80**	**15.73**	**31.27**	**15.87**	

	SED	SE m±	CD at 5%
Treatments	0.37	0.53	1.06
Drying methods	0.37	0.53	1.06
Interaction	0.84	1.19	2.38
CV (%)	7.85		

T1 : Rose flower
T2 : Marigold flower
T3 : Chrysanthemum flower
T4 : Gompherina flower
T5 : Lotus flower

Table 2. Influence of drying methods on moisture loss (%) of different flowers

Method of drying	T1	T2	T3	T4	T5	Mean
D1 (Air drying)	86.67 (68.58)	90.33 (71.95)	85.67 (67.73)	83.33 (65.96)	85.67 (67.76)	**86.33** (68.40)
D2 (Sun drying)	80.67 (63.89)	88.33 (70.03)	88.33 (70)	67.67 (55.33)	85.67 (67.76)	**82.13** (65.40)
D3 (Silica gel drying)	84.67 (66.92)	85.00 (67.19)	81.33 (64.40)	61.33 (51.53)	82.00 (64.91)	**78.87** (62.99)
D4 (Hot air oven)	87.33 (69.15)	85.00 (67.20)	68.00 (55.53)	87.00 (68.85)	72.33 (58.25)	**79.93** (63.79)
D5 (Microwave oven)	82.33 (65.12)	80.00 (63.43)	80.00 (63.42)	63.33 (52.71)	80.67 (63.90)	**77.27** (61.72)
Mean	**84.33** (66.73)	**85.73** (67.96)	**80.67** (64.22)	**72.53** (58.88)	**81.27** (64.52)	
	SED		**SE m±**		**CD at 5%**	
Treatments	0.41		0.58		1.16	
Drying methods	0.41		0.58		1.16	
Interaction	0.92		1.30		2.60	
CV (%)	1.96					

T1 : Rose flower T4 : Gomphrena flower
T2 : Marigold flower T5 : Lotus flower
T3 : Chrysanthemum flower

*Figures in parenthesis are the angular transformed values

Time taken for drying (days/hours/minutes)

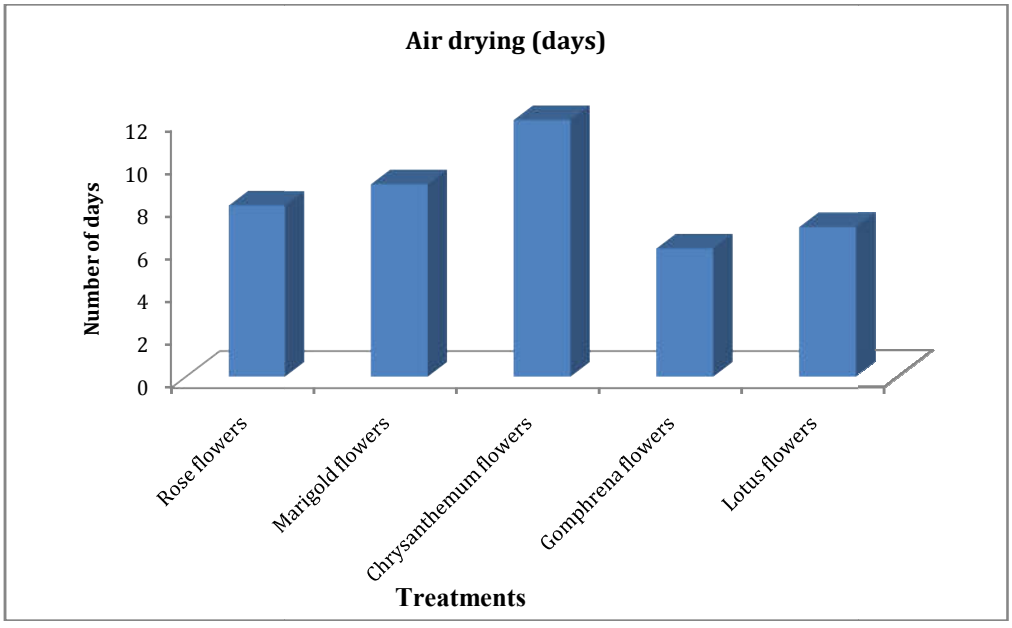


Fig.1. Influence of air drying on time taken to dry different flowers for making potpourris

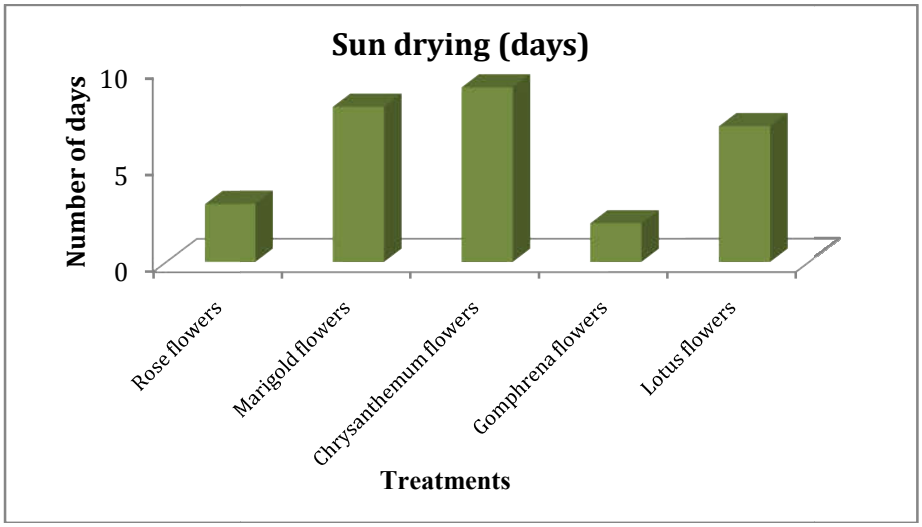


Fig.2. Influence of sun drying on time taken to dry different flowers for making potpourris

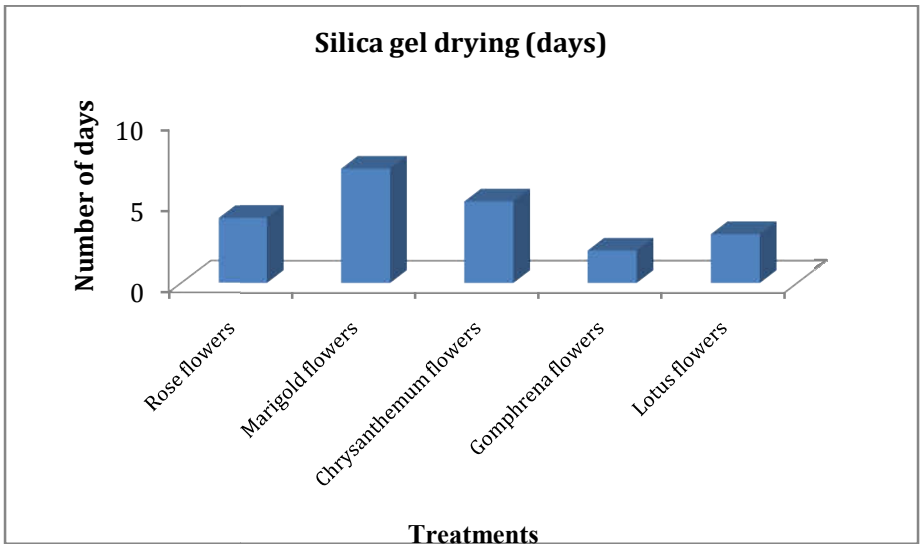


Fig.3. Influence of silica gel drying on time taken to dry different flowers for making potpourris

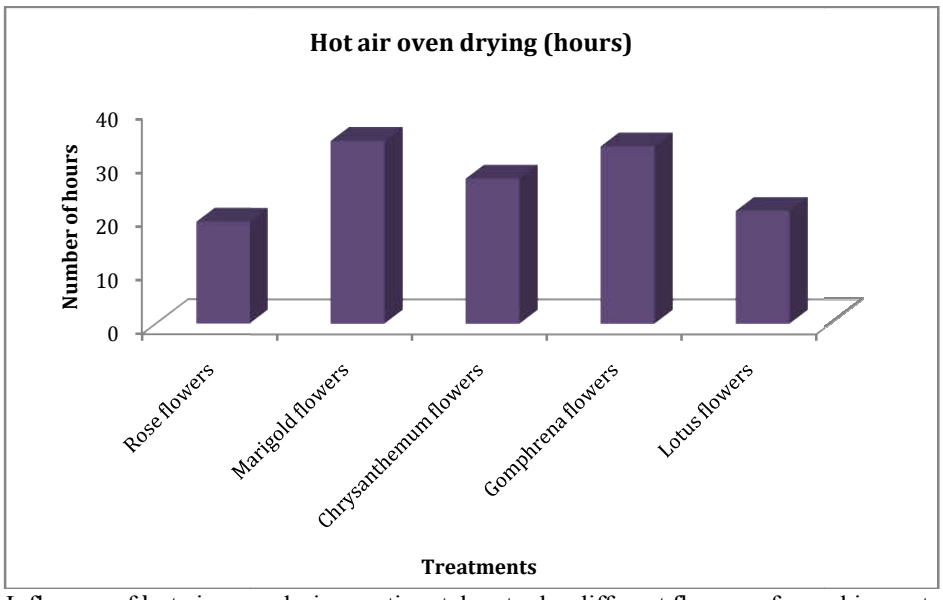


Fig.4. Influence of hot air oven drying on time taken to dry different flowers for making potpourris

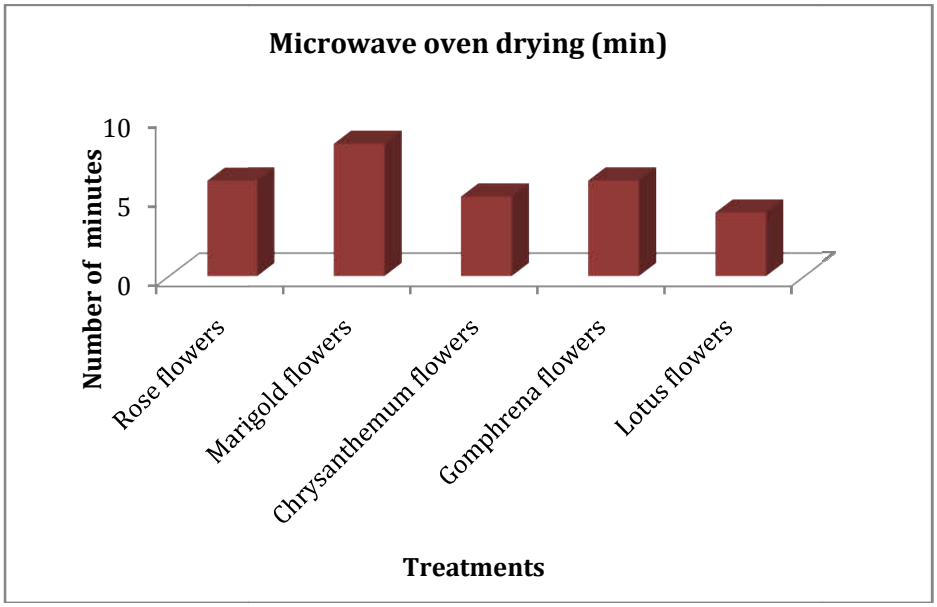
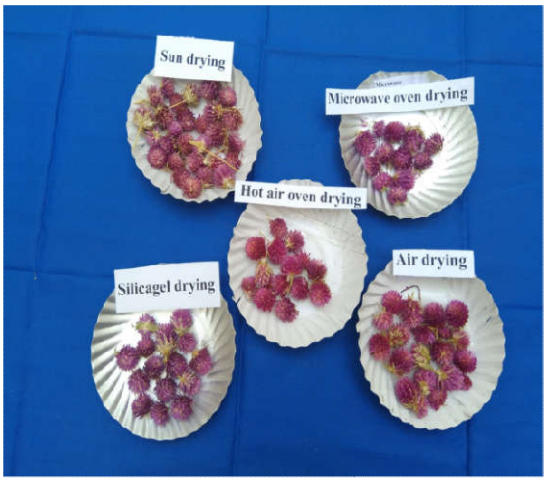


Fig.5. Influence of microwave oven drying on time taken to dry different flowers for making potpourris

GOMPHRENA



ROSE

MARIGOLD

LOTUS

Plate 1. Effect of drying techniques on different flowers

Plate 2. Dried produce arranged as potpourris

Plate 3. dried different flowers used as potpourris

CONCLUSION

From the investigations it can be concluded that effects of flowers and drying methods and their interactions on dry weight and moisture loss. Combinations of D_1T_2 (air drying + marigold flower) (9.67

g) ended with lowest flower dry weight, whereas, highest dry weight (38.67 g) was recorded in treatment combination D_3T_4 (silica gel drying + gomphrena flowers)**.** Maximum moisture loss (90.33%) was recorded with air dried marigold flowers (D_1T_2), whereas minimum moisture loss was recorded in D_3T_4 (silica gel drying + gomphrena) (61.33%). With regards to the time taken for Air drying gomphrena flowers have taken less number of days (6) for complete drying. Duration of flowers drying was minimum (2 days) for Gomphrena under the study with reference to time taken for Sun drying. Time taken to dry in Silica gel method Gomphrena flowers completely dried in 2 days. Hot air oven drying took flowers are dried in 40°C 19 hours to dry Rose flowers. The time required to dry flowers in Microwave oven drying showed that Lotus flowers took minimum of 4 minutes for drying.

From the results of this study it is understood that even though different methods can be used for drying, certain techniques are suitable only to some flowers**.** Of all the methods tried, the method suitable for most off lowers which is economically and commercially air drying, silica gel drying is the best. Gomphrena flowers are best suitable for drying and making preparation of potpourris. The dried flowers in these techniques were used for potpourri**.** Mixture of dry flowers, plant parts and farm plant waste *etc*. with additional natural flavours can be made into potpourris and can generate income out of waste.

REFERENCES

1. Bhalla, R and Sharma, B. (2002). Dry flowers status, scope and potential. In: Choudhary, M.L. et al. (eds.). Production and management of flower crops. *Division of Floriculture and Landscaping*. IARI, New Delhi. 162-71.
2. Bhutani, J.C. (1990). Capturing nature, a way with flower "everlastings". *Indian Horticulture*. 34(3): 15-18.
3. Datta, S.K. (1999). Dehydrated flowers and foliage and floral crafts. In: Bose, T.K. et al. (eds.). *Floriculture and Landscaping*. NayaProkash, Kolkata. 696-703.
4. Deshraj (2001). Making floral crafts from forest product of the Himalayas. *Indian Horticulture*. 45 Oct-Dec: 26-27.
5. Gupta P.K. (1999). Handbook of soil; fertilizer and manure. *Agro Botanica*, Bikaner.431 p.
6. Joyce, D.C. (1998). Dried and preserved ornamental plant material not new, but often overlooked and underrated. *Acta Hortculturae*. 454: 133-45.
7. Marousky F.J. 1973. Recent advances in opening bud cut chrysanthemum flowers. *Horticulture Science* 8(3): 19-20
8. Nirmala, A., Chandrasekhar, R., Padma, M and Rajkumar, M. (2008). Standardization of drying techniques of Carnation. *Journal of Ornamental Horticulture.* 11(3): 168-72.
9. Panse, M. and Sukhathme, K. (1985). Statistical methods for agriculture workers. *Indian Council of Agriculture Research Publications.* 48-67.
10. Parups E.V and Chan A.P. (1973). Extension of vase life of cut flowers by use of isoascorbate containing preservative solution. *Journal of American Society for Horticultural Science* 98: 22-26
11. Pertuit, A. (2002a). Drying flowers. *Website: http://hgic.clemson.edu/factsheets/ hgic1151.htm,1-4.*
12. Safeena, S.A and Patil, V.S. (2013). Effect of hot air oven and microwave oven drying on production of quality dry flowers of Dutch roses. *Journal of Agricultural Sciences.* 5(4): 179-89.