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Effect of Drying Techniques and Embedding Media on the Colour, Shape Retention and Overall Acceptability of Palash (*Butea monosperma* Lam.) and Semal (*Bombex ceiba* L.)

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A B S T R A C T

The present experiment on "Effect of drying techniques and embedding media on the colour, shape retention and overall acceptability of Palash (*Butea monosperma* Lam.) and Semal (*Bombex ceiba* L.)" was conducted in the Department of Floriculture and Landscaping, College of Horticulture and Forestry, Jhalarapatan, Jhalawar during March, 2017 to August 2017. The experiment had total 22 treatments combination studied in two flowers, including three drying conditions viz. room condition, hot air oven (40˚C, 50˚C and 60˚C) and microwave oven (2 minutes, 3 minutes and 4 minutes) in combination with three different embedding media sand, borax and silica gel. The experiment was laid out in completely randomized design (CRD) with three replications. Out of the 22 treatments studied, sensory score for colour (8.11, 8.57), shape (7.51, 8.55), overall acceptability (7.75, 8.56) of dried flowers of Palash and Semal were also highest with microwave oven drying for 3 minutes and 4 minutes with silica gel embedding. Therefore, on the basis of results of present experiment it may be concluded that dehydration of flowers of Palash and Semal can be done in microwave oven for 3 minute, 4 minute with silica gel embedding for getting good quality dried flowers.

Introduction

Flowers are mentioned in the social fabric of our country and no function is complete without flowers. It is one of the beautiful creations of God having an excellent potential for commercial purpose. Love for flowers is an inherent instinct of human being which may be attributed to their range of colours, variety of sizes, vivid forms and distinct but pleasant fragrances. It plays a cardinal role in human behaviour and culture, bringing tranquility and peace of mind.

In global floriculture trade, the Netherlands contributed maximum in export of dry flowers to different countries (51.20%) followed by Israel (14.20%), Nigeria (5.60%) and India

(4.80%) (Anonymous, 2014). These flowers have much demand in the international market and exported from India mainly to countries like USA, Europe and Japan. The country has ample scope of developing dry specimens (Swarnapriya and Jayasekhar, 2008). India stands first in dry materials export owing to the availability of variety of plants. It accounted for 70 percent of the total floricultural exports from India. The demand for dry flowers has increased manifold in the last decade and is increasing at an impressive rate of 8-10 percent annually, thus offering their immense scope in the global floricultural trade (Singh, 2009). In India, dry flower industry is mostly concentrated in Tamil Nadu, West Bengal, Andhra Pradesh and Karnataka. Exporting companies at Kolkata in West Bengal, Tuticorin in Tamil Nadu, Mumbai in Maharashtra and Hyderabad in Telangana are earning 10-15 times higher returns than domestic markets. In the recent, export of dry flowers from India during 2013-14 was Rs. 363.3 crores (Perinban *et al.*, 2014).

Palash (*Butea monosperma* Lam.) belongs to the family Fabaceae. It is also called as "the flame of forest" due to its bright orange and scarlet colour of flowers. It is native to India. Flowers have been traditionally used to prepare colours for Holi festival in India. The flowers are also used for herbal colour and dyes to colour the fabrics, which create scope for additional income to the local people particularly tribal people. Similarly, Semal (*Bombex ceiba* L.) is commonly known as red silk cotton tree belonging to the family bombacaceae. Flowers are cup shaped produced in solitary or clusters and consist of five red scarlet petals. It is widely planted in parks and on roadsides for its beautiful red flowers, blooming in February-April. Both these trees produce flowers abundantly in the flowering season, therefore these are important ornamental flowering trees.

Materials and Methods

Palash and Semal trees produce flowers abundantly in the flowering season, february to april nearby College of Horticulture and Forestry, Jhalarapatan city, Jhalawar. The flowers were harvested in the month of february to april 2017. Healthy, disease free and uniform flowers were harvested. Flowers were harvested at full bloom stage in the morning hours between 8.00 am to 9.00 am. Immediately after harvest, the base of the flower stalks were placed in tap water and then brought to the laboratory to give various treatments and put for drying and dehydration as per the treatments. The stem length of each flower was kept at a uniform length of 10 cm. Agro-climatically, Jhalawar district falls in zone-V of Rajasthan. The climate of Jhalawar is typically sub-humid and sub tropical characterized by extreme of temperature in both summer and winter with high rainfall and moderate relative humidity. Maximum temperature in summer 44-46˚C and minimum during winter is 4.1˚C. The corresponding average relative humidity between 20 and 40%. The weather conditions including the temperature and relative humidity (RH) data of the laboratory room during experiment period are presented in Table 1.

Experimental details

The present experiment was conducted on two flowers viz. Palash and Semal. Three experiments were conducted during the course of investigation.

Experimental treatments

The experiment had three drying condition viz. room condition, hot air oven and microwave oven, three different embedding media sand, borax and silica gel were used under the three drying condition. The experiment had in total 22 treatment combination as given Table 2.

Visual Quality Index (VQI) parameters

Visual quality index parameters like colour, shape and overall acceptability by a panal of rewarding score points on a 9 points scale i.e. liked extremely (9 points), liked very much (8 points), liked moderately (7 points), liked slightly (6 points), neither liked nor disliked (5 points), disliked slightly (4 points), disliked moderately (3 points), disliked very much (2 points), disliked extremely (1 points). The observed data of the VQI parameters were analyzed statistically for interpretation of results.

Results and Discussion

Quality of dried flowers

Quality of dried flowers was assessed based on the colour, shape retention and overall acceptability and total score out of 9 was given to different treatments accordingly.

Colour

The colour of fresh flowers and its retention during dehydration is an important factor to obtain good aesthetic quality of dried flower. Significantly overall maximum score in Palash for colour was recorded 8.11 (T_{19}) followed by 8.02 (T_{16}) and least score was recorded without embedding 4.84 (T_1). Similarly in case of Semal (*Bombex ceiba* L.), overall maximum score for colour was recorded 8.57 (T_{19}) followed by 8.44 and least in control 5.0 (T_1) (Table 3).

Hot air oven: The highest score for Palash is 7.89 (T_{13}) and least 6.18 (T_5). Similarly for Semal, the highest score is 8.13 (T_{10}) and least 6.78 (T_6) (Table 3). Kumari and Peiris (2000) reported that colour retention in rose petals was high, when the silica gel desiccant method was used. Singh and Dhaduk (2005), Safeena *et al.,* (2006) have also reported that flowers of chrysanthemum and rose respectively retained best quality.

Microwave oven: The highest score for Palash is 8.11(T_{19}) and least 5.02 (T_{15}) followed by 5.06 (T_{18}). Similarly for Semal, the highest score is 8.57 (T_{19}) and least with T_{15} (5.01) (Table 3). The highest score in microwave oven + silica gel medium could be due to that silica gel prevents the direct removal of moisture from flowers by acting as an intermediate which prevents shrinkage of the flowers and degradation of colouring pigments that could take place when petal tissues are directly exposed to high temperatures and light.

Shape

The sensory scores for shape of dehydrated flowers of Palash and Semal have been illustrated in Table 4. Amongst the all treatments, T_{22} recorded the highest score followed by T_{19} for flower shape in both flowers, while the least score was recorded with ($T_{1)}$ for Palash (4.16) and for Semal (4.97). Least score for shape was noticed with the flowers dried without embedding. It might be due to variations in the humidity level of the microclimatic conditions resulting in uneven drying and cracking leading to loss of shape. These results were in line with the findings of Safeena *et al.,* (2006), who reported that flowers of rose and china aster and chrysanthemum retained best quality when dehydrated by embedding in silica gel for shape retention. Least score for shape of dried flowers was noticed with the flowers dried without embedding (control). Kumari and Peiris (2000) in rose, Bhalla *et al.,* (2006), Dhatt *et al.,* (2007), Nirmala *et al.,* (2008) and Sindhuja *et al.,* (2015) also show similar results. Hot air oven: The highest score of shape in Palash is 7.43 (T_{10}) and least in 5.51(T_{5}). Similarly in Semal, the highest score is 8.33 (T_{10}) and least in 6.86 (T_6). In

both flowers, silica gel embedded flowers best retained their shape (Table 4).

Microwave oven: The highest score in both flowers that is Palash and Semal for shape is 7.51 and 8.55 (T_{22}) respectively and least score in Palash 4.44 (T_{21}); in Semal, 5.79 (T_{15}) (Table 4). The highest score in microwave oven + silica gel medium could be due to that silica gel prevents direct removal of moisture from flowers by acting as an intermediate which prevents shrinkage of the flowers and degradation of colouring pigments that could take place when petal tissues are directly exposed to high temperatures and light. Aravinda and Jayanthi (2004); Dhatt *et al.*, (2007) reported that silica gel embedded flowers retained their shape even after drying. Singh *et al.*, (2004) reported that mechanical support provided by the media throughout the drying process ensured well maintained flower shape in the flowers.

Table.1 Mean weekly temperature and RH (%) data of laboratory room during experiment period

Duration	Temperature ˚C		Relative humidity (%)	
	Max.	Min.	Max.	Min.
28 march – 2 April	35.11	33.90	23.21	20.14
3 April - 9 April	35.44	32.40	21.19	19.65
10 April -16 April	35.77	32.44	23.13	20.22
17 April - 23April	35.84	32.50	23.15	20.44
24 April - 30 April	36.10	33.11	21.22	19.13
1 may-7 May	36.78	33.11	21.09	19.01
8 may – 14 May	36.87	33.22	21.01	19.01
15 may - 22 may	36.94	32.22	20.78	18.86
23 may -29 may	36.77	32.17	20.62	18.77
31 may- 6 June	36.89	32.09	20.44	18.55
7 June -13 June	36.9	32.00	20.32	18.44
14 June- 21 June	37.1	31.89	20.18	18.33
22 June -28 June	37.28	31.72	20.09	18.31
29 June- 5 July	37.21	31.66	44.12	39.78
6 July -13 July	37.15	31.88	44.44	39.83
14 July - 21 July	36.78	29.18	45.55	40.79
22 July - 28 July	36.66	29.20	44.54	42.88
29 July - 4 August	36.33	29.02	46.18	42.97
5 August – 12 August	35.87	28.84	46.35	40.12
13 August-19 August	35.55	28.65	46.55	42.26
20 August- 27 August	33.12	26.88	48.60	42.34

Table.2 Treatment combination

S. No.	**Treatment Notation**	**Treatment Combination**
1.	T_1	Room condition without embedding (Control)
2.	T_2	Room condition + Sand
3.	T_3	Room condition + Borax
4.	T_4	Room condition + Silica gel
5.	T_5	Hot air oven 40^0C + 24 hours dehydration + Sand
6.	T_6	Hot air oven 40^0C + 24 hours dehydration + Borax
7.	T_7	Hot air oven 40^0C + 24 hours dehydration + Silica gel
8.	T_8	Hot air oven 50^0C + 24 hours dehydration + Sand
9.	T_9	Hot air oven 50^0C + 24 hours dehydration + Borax
10.	T_{10}	Hot air oven 50^0C + 24 hours dehydration + Silica gel
11.	T_{11}	Hot air oven 60^0C + 24 hours dehydration + Sand
12.	T_{12}	Hot air oven 60^0C + 24 hours dehydration + Borax
13.	T_{13}	Hot air oven 60^0C + 24 hours dehydration + Silica gel
14.	T_{14}	Microwave oven 360 Hz +2 Minutes + Sand
15.	T_{15}	Microwave oven 360 Hz + 2 Minutes + Borax
16.	T_{16}	Microwave oven 360 Hz + 2 Minutes + Silica gel
17.	T_{17}	Microwave oven 360 Hz + 3 Minutes + Sand
18.	T_{18}	Microwave oven 360 Hz + 3 Minutes + Borax
19.	T_{19}	Microwave oven 360 Hz + 3 Minutes + Silica gel
20.	T_{20}	Microwave oven 360 Hz + 4 Minutes + Sand
21.	T_{21}	Microwave oven 360 Hz + 4 Minutes + Borax
22.	T_{22}	Microwave oven 360 Hz + 4 Minutes + Silica gel

Table.3 Effect of drying techniques and embedding media on colour VQI for of dried flower quality of Palash and Semal

Treatment	Colour	
	Palash	Semal
T_1	4.84	5.00
T_2	5.12	5.14
T_3	5.30	5.54
T_4	7.07	7.38
T_5	6.18	7.03
T_6	7.01	6.78
T_7	7.13	7.03
T_8	6.81	7.11
T_9	7.11	7.01
T_{10}	7.83	8.13
T_{11}	7.17	7.32
T_{12}	7.16	7.02
T_{13}	7.89	7.24
T_{14}	5.11	5.05
T_{15}	5.02	5.01
T_{16}	8.02	8.17
T_{17}	5.18	6.79
T_{18}	5.06	5.04
T_{19}	8.11	8.57
T_{20}	5.17	7.09
T_{21}	5.09	5.05
T_{22}	6.98	8.44
CD at 5%	0.170	0.269
SEm±	0.084	0.133

Table.4 Effect of drying techniques and embedding media on VQI for shape of dried flower quality of Palash and Semal

Treatment	Shape	
	Palash	**Semal**
T_1	**4.16**	**4.97**
T_2	5.29	5.25
T_3	5.37	5.78
T_4	6.64	7.09
T_5	5.6	7.00
T_6	5.51	6.86
T_7	6.73	7.12
T_8	6.42	7.13
T_9	6.1	7.03
T_{10}	7.43	8.33
T_{11}	6.77	7.39
T_{12}	6.22	7.05
T_{13}	7.07	8.14
T_{14}	5.23	7.02
T_{15}	4.37	5.79
T_{16}	7.3	8.37
T_{17}	5.23	7.01
T_{18}	4.33	6.28
T_{19}	7.39	8.52
T_{20}	5.23	7.01
T_{21}	4.44	6.23
T_{22}	**7.51**	**8.55**
CD at 5%	0.119	0.230
SEm±	0.059	0.114

Table.5 Effect of drying techniques and embedding media on VQI for overall acceptability of dried flower quality of Palash and Semal

Treatment	Overall acceptability	
	Palash	Semal
T_1	**4.43**	**5.00**
T_2	5.21	5.19
T_3	5.33	5.66
T_4	6.86	7.23
T_5	5.89	7.01
T_6	6.26	6.87
T_7	6.93	7.06
T_8	6.61	7.11
T_9	6.6	7.02
T_{10}	7.63	8.23
T_{11}	6.96	7.35
T_{12}	6.69	7.04
T_{13}	7.48	7.69
T_{14}	5.17	6.04
T_{15}	4.7	5.39
T_{16}	7.4	8.27
T_{17}	5.19	6.9
T_{18}	4.7	5.66
T_{19}	**7.75**	8.55
T_{20}	5.2	7.05
T_{21}	4.77	5.64
T_{22}	7.25	**8.56**
CD at 5%	0.105	0.161
SEm±	0.052	0.080

Overall acceptability

The data from Table 5 revealed that overall acceptability of dehydrated flowers of Palash and Semal. The maximum score for overall acceptability was recorded with 7.75 (T_{19}) and 8.56 (T_{22}) for Palash and Semal respectively whereas the least score was recorded [Palash (4.43) (T_1) and Semal (5.0) (T_1)]. It is proved from results that the best media for overall acceptability is silica gel. Least score (T_1) was recorded in flowers dried without embedding. Nirmala *et al.*, (2008); Nair and Singh (2011); Sindhuja *et al.*, (2015) reported that overall acceptability was highest when carnation flowers were embedded in silica gel. Hot air oven: The highest score for over all acceptability for Palash is 7.63 (T_{10}) and least 5.89 (T_5). Similarly in Semal, the highest score is 8.23 (T_{10}) and least 7.01 (T_5). Microwave oven: The highest score for both flowers that is Palash and Semal for overall acceptibility are 7.75 (T_{19}) and 8.56 (T_{22}) respectively and least score for Palash and Semal are 4.7 and 5.39 (T_{15}) respectively. Significant differences were observed on overall acceptability score due to different embedding media (Table 5).

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