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Standardization for drying, bleaching and dyeing processes in dried flowers

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ABSTRACT

An experiment was conducted at Tamil Nadu Agricultural University, Coimbatore, during 2009-2010 to standardize processing techniques for dried flower production. Foliage of silver oak (*Grevillea robusta*), thuja (*Thuja orientalis*) and camellia (*Camellia reticulata*) was best preserved by glycerinization; leaves were soft and pliable, with lowest moisture and highest overall acceptability. In the case of fully-opened flowers in button-type chrysanthemum (*Chrysanthemum grandiflorum*), gerbera (*Gerbera jamesonii)* and plumeria (*Plumeria alba*), a combination of sand and silica gel, and microwave-oven embedded method was found to be suitable for drying, with high overall acceptability. Dried pods of jacaranda (*Jacaranda mimosifolia*) and castanospermum (*Castanospermum australe*) were fully bleached by soaking overnight in 10% sodium hydroxide and subsequent treatment with 2% sodium hydroxide + 2.5% sodium silicate + 35% hydrogen peroxide. Bleached pods were given dye treatments where acrylic dyes showed good dyeing consistency, light fastness, wash fastness and rubbing fastness.

Key words: Dry flowers, glycerinization, desiccants, bleaching, dyeing

INTRODUCTION

In the global market, USA, Germany and United Kingdom are the largest consumers of dried flowers. India, Netherlands, Mexico, Israel and, more recently, Australia are the major exporters in the trade. Indian dried flower export market is classified into three main product segments, namely, a) Dried plant parts in bulk, popularly called 'botanicals' b) Potpourri, and c) Decor products. Globally, India has emerged as a leader in export of dried-flower products, trading dried flowers worth Rs 150 crores annually (Patil, 2007). This constitutes 25% of the global dried-flower market. The industry exports 500 different varieties of dried plant parts to 20 countries. The Indian industry risks losing its competitiveness to suppliers of other origin for lack of reliable processing technologies. To strengthen the dry flower industry, more research is required so as to promote and uplift the industry. Drying, bleaching and dyeing are the essential processing techniques in dried flower making, and these greatly influence quality of the final product, before usage finally. Therefore, a study was undertaken to standardize processes for dried-flower production.

MATERIAL AND METHODS

The present study was carried out at the Horticultural Research Station (Yercaud) and Department of Floriculture and Landscaping (Coimbatore) of Tamil Nadu Agricultural Univeresity, during the year 2009-2010. Fully mature leaves of silver oak, thuja and camellia were applied the following drying treatments: a) Air drying - mature leaves were tied in bundles and hung upside down under ambient temperature, b) Sand drying - mature leaves were embedded horizontally in fine river sand, with 5cm sand each below and above the leaves, c) Microwave drying - mature leaves were dried in this oven for 30 seconds to 4 minutes, depending upon texture of the leaves d) Glycerinization - full dip method: Mature leaves were dipped fully in glycerin-hot water mixture, e) Glycerinization - uptake method: Mature leaves were given a slant cut at 10cm from their stalk and immersed vertically in glycerin-hot water mixture. Fully opened flowers of button-type chrysanthemum (green and yellow), gerbera (YCD1- red) and plumeria (white) were given drying treatments, namely, air-drying and microwave-drying after embedding them in five different media, viz., river sand, silica gel, borax, mixture of sand and silica gel (1:1) and mixture of

Table 1. Effect of drying method on time taken for drying of silver oak (*Grevillea robusta*), thuja (*Thuja orientalis*) and camellia (*Camellia reticulata*) with different drying agents

Treatment	Duration of drying			Moisture loss (%)		
	Silver oak	Thuja	Camellia	Silver oak	Thuja	Camellia
Air drying	3.6 days	10 days	8.2 days	43.53	44.33	53.12
Sand drying	5.8 days	18 days	14.0 days	38.77	47.38	46.58
Microwave drying	1.36 min	3.36 min	3.29 min	42.56	53.27	61.18
Glycerinization(full dip)	3.4 days	2.0 days	6.0 days	11.62	15.72	19.8
Glycerinization (uptake)	2.0 days	12.0 days	10.2 days	17.3	13.24	15.6
SEm ±	0.379	0.447	0.932	2.5	1.3	1.3
CD (*P=0.05*)	0.791	0.932	1.08	5.2	2.7	2.9

sand and borax (1:1). Dried pods of *Jacaranda mimosifolia* and *Castanospermum australe* were given different bleaching treatments, with six bleaching chemicals in nine combinations. Fully-bleached pods were given dyeing treatment with four different dyes, viz., acid dyes, basic dyes, food dyes and acrylic dyes. Experiments were laid out in Completely Randomized Block Design, with five replications. Quality parameters like colour retention, shape retention, brittleness, texture and overall acceptability were visually scored in the experiment on drying. For bleaching pods, scoring was done visually on quality parameters like bleaching consistency (uniform bleaching of the pods), and whitening index, on a score of 0-4, where 0 denoted no colour change and 4 bright white. For dyeing treatments, time taken for dye uptake, dyeing consistency, wash fastness, rubbing fastness and light fastness were recorded immediately after dyeing. In all the processing techniques, a panel of 10 members from all age groups judged the samples visually and scored on a scale of 0 to 4 (very low to very high dye).

RESULTS AND DISCUSSION

Experiment 1: Drying leaves

Results on leaf drying (Table 1) revealed that sand drying took maximum time (18 days) in drying thuja leaves. Minimum time taken for drying was in silver oak leaves with microwave drying. Maximum moisture loss percentage in leaves (61.18%) was observed in microwave drying in camellia leaves. Minimum moisture loss percentage (11.6%) was observed in glycerinization - full dip method in silver oak leaves.This is because glycerin replaces moisture by capillary action when leaves are subjected to the uptake method, whereas, glycerin is taken up through surface of the leaves when the latter are dipped fully (White, 2007). Air-drying is the easiest and low-cost method of preserving flowers and foliage (Susan, 1990) but it causes the flowers to shrink (Bhattacharjee and Palanikumar, 1999; Rengaswamy *et al*, 1998). In the case of microwave-oven

Table 2. Visual score on overall acceptability of dried leaves of silver oak, thuja and camellia

Treatment	Sensory score		
	Silver oak	Thuja	Camellia
Air drying	1.99	1.82	0.35
Sand drying	2.50	1.66	1.30
Microwave drying	2.02	1.44	0.76
Glycerinization(full dip)	3.70	3.87	3.70
Glycerinization (up take)	3.18	3.08	2.74
SEm ±	0.15	0.13	0.17
CD (*P=0.05*)	0.28	0.26	0.35

drying, performance was poor in all the three, i.e., silver oak, thuja and camellia leaves. This is due to the fact that microwave dried materials are susceptible to breakage (Papparozzi and Callister, 1988) although this method takes minimum time for drying.

Consumer acceptability is the ultimate factor for commercializing any dried-flower product. Acceptability depends upon various parameters such as texture, shape retention, colour retention, brittleness and, altogether, these decide overall acceptance. In the present study, the best overall acceptability was obtained with glycerinization full-dip method in thuja (3.87), silver oak (3.7) and camellia leaves (3.7) (Table 2). The next best treatment was glycerinization by the uptake method.

These findings are in accordance with earlier reports of David Trinklein (1998) in maple, magnolia and oaks; Verey (1994) in eucalyptus and hollyhock; Paul Dubois and Daryl Joyce (2005) in luecodendrons; Mercer Jo (1996) in beech; Anon. (2004) in ivy; Deepthi Singh and Santhosh kumar (2008) in camellia and maiden hair fern, and, White (2007) in magnolia and ligustrum. They concluded that glycerinization kept the leaves soft and pliable for easier handling and, hence, was the most suitable method for obtaining most of the visual qualities in dried flowers, especially the foliage part.

Treating foliage with glycerin yields unique results of indefinite flexiblity and pliability and, hence, the glycerinization (uptake) method is suitable in foliage with broad leaves, and glycerinization (full dip) method for single leaves (White, 2007). Further, effect of glycerinization also depend on type of the leaf (Paul Dubios and Daryl Joyce, 2005).

Experiment 2: Drying flowers

Results on drying of flowers (Table 3) indicate that overall acceptability was best in flowers embedded with a combination of silica gel and sand, under microwave-oven drying. Visual score of 3.5 was obtained by chrysanthemum yellow, chrysanthemum green, gerbera and plumeria dried flowers. The next best result was with silica alone, in all the four types of flower.

These findings are in accordance with those of Susan (1990) in rose, zinnia and dahlia; Thomler (1997) in marigold and zinnia; Alleman (1994) in celosia and daffodil; Roberts (1997) in carnation, chrysanthemum and zinnia; Lourdusamy (1998) in zinnia and French marigold. They found silica gel drying to be the most suitable method for achieving most of the desirable visual qualities in dry flowers.

Silica gel is white in appearance and, sometimes, contains blue crystals that act as an indicator for the amount of moisture absorbed. Moisture is absorbed by silica gel from the flowers (Norman Winter, 1998) quickly, compared to borax and sand; and, flower shape is also retained (Nirmala, 2008). Sand drying is the oldest method, least expensive and sand is the best desiccant. It should be dry, fine and washed several times with water to make it salt-free (White, 2007). Microwave-oven drying with embedded desiccants is one of the best methods to obtain superior products. Embedded plant material is placed in a hot-air oven or microwave oven, at controlled temperature for an appropriate amount of time (Anon, 2000).

Table 3. Sensory score on overall acceptability of flowers of chrysanthemum (yellow and green), gerbera and plumeria with various drying agents with microwave drying

Treatment	Sensory scores			
	Chrysanthemum (yellow)	Chrysanthemum (green)	Gerbera	Plumeria
Air drying	0.76	0.78	0.78	0.76
Sand drying	2.83	2.82	2.68	2.8
Silica drying	3.02	3.06	2.77	3.03
Borax drying	0.00	0.0	0.0	0.0
Silica + sand drying	3.56	3.57	3.53	3.55
Borax + sand drying	0.0	0.0	0.0	0.0
SEd ±	0.13	0.065	0.09	0.054
CD (*P=0.05*)	0.06	0.130	0.18	0.12

Table 4. Effect of bleaching agent on time taken for complete bleaching in *Jacaranda mimosifolia* and *Castnospermum australe*

Treatment	Jacaranda pods (hrs)	Castanospermum pods (hrs)	Effect observed
2% NaOH + 2.5% Na_2SiO_3 + 30 %H_2O_2	24	24	Fully bleached
2% NaOH + 2.5% Na_2SiO_3 + 35%H_2O_2	18	12	Fully bleached
2% NaOH + 2.5% Na_2SiO_3 + 40 %H_2O_2	18	18	Fully bleached
30% NaOCl + 10% HCl	24	24	Unbleached
35% NaOCl + 11.5% HCl	24	24	Unbleached
40% NaOCl +13% HCl	24	24	Unbleached
30% $NaClO_2$ +10% HCl	24	24	Partially bleached
35% $NaClO_2$ +11.5% HCl	24	24	Partially bleached
40% $NaClO_2$ +13% HCl	24	24	Partially bleached

Experiment 3: Bleaching pods

Time taken for perfect bleaching was least in the treatment combination of overnight soaking in 10% sodium hydroxide, followed by soaking with 2% sodium hydroxide + 2.5% sodium silicate + 35% hydrogen peroxide, compared to other hydrogen peroxide combinations (Table 4). This is in accordance with findings of Samanta *et al* (2007) where optimum time period required for bleaching at room temperature was 6, 3 and 5h, respectively, for jute, cotton and jute-cotton union fabrics. Time variation between pods may be due to difference in pod thickness, lignin content and cellulose content.

Data on quality of bleaching consistency and whitening index of bleached pods at periodic intervals (Figs. 1 and 2) revealed that bleaching consistency score was maximum (2.23) in pods soaked in 10% sodium hydroxide overnight, followed by treatment with 2% sodium hydroxide + 2.5% sodium silicate + 35% hydrogen peroxide. These findings are in line with those of Gulrajani and Sukumar (1985).

Suitability of hydrogen peroxide as a bleaching agent has been reported by several workers earlier. Peroxides can degrade cellulose, as well as decolourize it, and remove stains (Zeronian *et al*, 1995), are less expensive (Paul

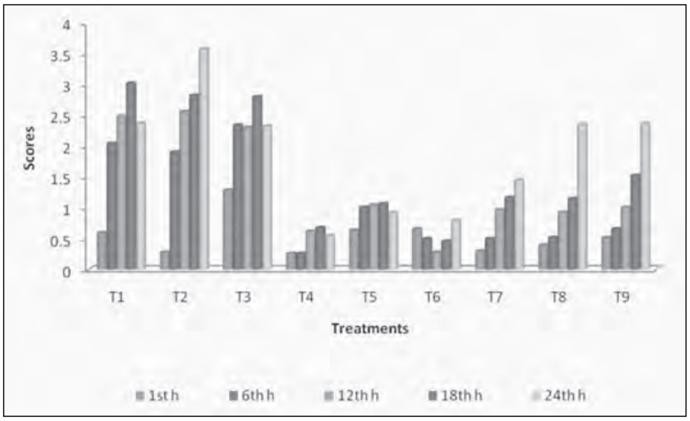

Fig 1. Effect of bleaching at different intervals on visual score for bleaching consistency in *Jacarnda mimosifolia* pods

T_1 - 2% NaOH+2.5% Na_2SiO_3+30% H_2O_2; T_2 - 2% NaOH+2.5% Na_2SiO_3+35% H_2O_2; T_3 - 2% NaOH+2.5% Na_2SiO_3+40% H_2O_2; T_4 - 30% NaOCl+10% HCl; T_5 - 35% NaOCl+11.5% HCl; T_6 - 40% NaOCl+13% HCl; T_7 - 30% $NaClO_2$+10% HCl; T_8 - 35% $NaClO_2$+11.5% HCl; T_9 - 40% $NaClO_2$+13% HCl

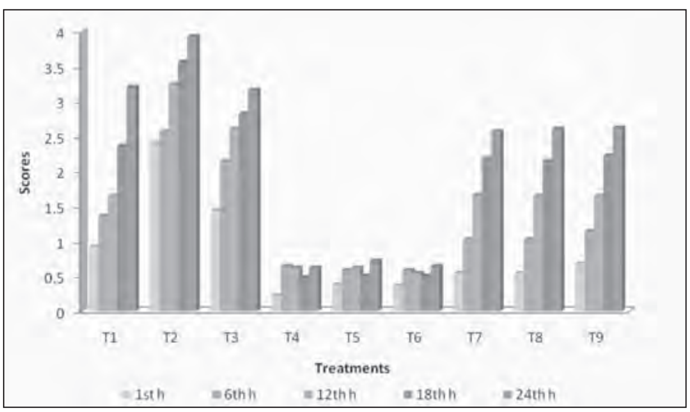

Fig 2. Effect of bleaching at different intervals on sensory score for whitening index in *Castanospermum australe* pods

T_1 - 2% NaOH+2.5% Na_2SiO_3+30% H_2O_2; T_2 - 2% NaOH+2.5% Na_2SiO_3+35% H_2O_2; T_3 - 2% NaOH+2.5% Na_2SiO_3+40% H_2O_2; T_4 - 30% NaOCl+10% HCl; T_5 - 35% NaOCl+11.5% HCl; T_6 - 40% NaOCl+13% HCl; T_7 - 30% $NaClO_2$+10% HCl; T_8 - 35% $NaClO_2$+11.5% HCl; T_9 - 40% $NaClO_2$+13% HCl

Dubios and Daryl Joyce, 2005) and are the best bleaching agents (Lourdusamy, 1998). The reason is that use of hydrogen peroxide at optimum concentrations results in higher rate of degradation of cellulose and hemicelluloses present in the constituent fibres, and improves whitening index. Addition of sodium hydroxide to hydrogen peroxide causes surface-darkening, impairing whiteness and, hence, optimum use of a peroxide stabilizer (sodium silicate) is essential to achieve comparable levels of whiteness. This is probably due to re-deposition of silica particles from sodium silicate onto the bleaching material (Samanta *et al*, 2007).

Experiment 4: Dyeing pods

Time taken for dye uptake was least in acrylic dye treatment for jacaranda (1.4 min.) and castanospermum pods (1.6 min.) (Table 5). Time taken for dye uptake was highest (6 min.) with food dye in both pods of both the species.

Score on visual appearence of rubbing fastness and wash fastness of dyed pods with different dyeing treatments is furnished in Figures 3 & 4. Rubbing fastness was superior in jacaranda pods (4.4) and castanospermum pods (4.3) with acrylic dyes. Wash fastness scores were higher

Table 5. Effect of various dyes on time taken for dye-uptake by *Jacaranda mimosifolia* and *Castanospermum australe* pods

Treatment	Time taken for dye uptake (min.)	
	Jacaranda mimosifolia	*Castanospermum australe*
Acid dye	4	4.6
Basic dye	2	2.2
Food dye	6	6
Acrylic dye	1.4	1.6
SEm ±	0.48	0.36
CD (*P=0.05*)	1.017	0.76

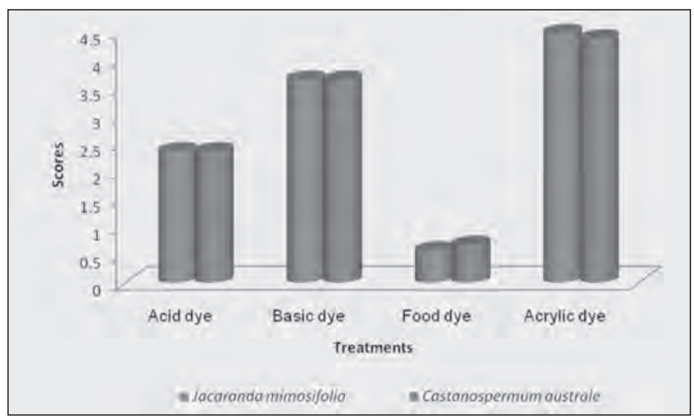

Fig 3. Effect of dyes on sensory score for rubbing fastness in pods of *Jacaranda mimosifolia* and *Castanospermun australe*

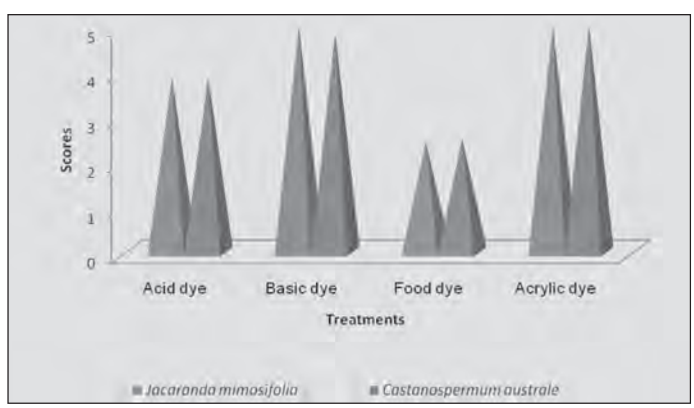

Fig 4. Effect of dye on sensory score for wash fastness in pods of *Jacaranda mimosifolia* and *Castanospermun australe*

for basic and acrylic dyes in both jacaranda and castanospermum pods. These findings are in line with observations of Van Dam Jan *et al* (2002) and Anon (2010).

Wash fastness of a dye is influenced by rate of diffusion of the dye and state of the dye once inside the fibre. The dye has a tendency to aggregate inside the fibre (thereby increasing in molecular size) and, hence, exhibits good wash fastness. These findings are also in agreement with earlier reports (Van Dam, 2002; Anon., 2010)

It is concluded from the above study that glycerinization is the best for preserving foliage in a soft and pliable form. Sand and silica gel, in combination with microwave oven drying, proved superior for retention of flower colour and shape. Bleaching dried pods was best achieved by soaking overnight in sodium hydroxide 10%, followed by treatment with 2% NaOH + sodium silicate 2.5% + hydrogen peroxide 35%. Acrylic dyes were found to be superior for dyeing pods.

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