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Full Length Research Paper

Realization of half whiteness of botanicals by single step bleaching procedure for dry flower making

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Studies were conducted during 2010 to 2013 to identify the ideal bleaching agents for achieving half whiteness of different parts of plant used in dry flower making. Dried pods of *Acacia auriculiformis, Sesamum indicum, Gossypium hirsutum, Pongamia glabra*, and cones of *Pinus spp* were given bleaching treatment in a single step. Different chemicals viz., sodium hydroxide (10 %), sodium chlorite (10 and 20%), sodium hypochlorite (30%), hydrogen peroxide (10, 20 and 30%), hydrochloric acid (5%) and sodium silicate (1%) were used in 10 different combinations. The time taken for achieving required half whiteness (Yellow White Group – 158 – A) was observed as per RHS colour chart and the percentage of damage was calculated. Strength of whiteness was assessed and evaluated using RHS colour chart. Whiteness index was measured using Mini scan colour measurement system. Botanicals were scored for quality parameter *viz*., shape retention. The results indicated that, the treatment involving 20% sodium chlorite + 5% hydrochloric acid (cold water) proved superior with minimum bleaching time of 6 h and lowest rate of damage with highest whiteness index and maximum score for shape retention.

Key words: Dry flower making, botanicals, bleaching agents, half whiteness, RHS colour chart.

INTRODUCTION

In the present era of eco consciousness, use of natural products like dry flowers and their parts has become the premier choice of the consumers in their life styles for interior decoration. The dry flowers are gaining popularity amongst the floriculturists and buyers as it is an inexpensive, everlasting and eco friendly product available throughout the year (Muthukumaran, 2009). Some dry flower botanicals are too rustic in colour and this interferes with desired colour in dyeing. Otherwise aesthetically attractive plant material which is inherently colored by unwanted pigment and brown lignin can be bleached. Much of the preserved ornamental plant materials are bleached at some stage during preserving process and recolouring with dyes. So before colouring, the materials should be bleached which enhances the colour absorption during treatment with dyes. Bleaching ornamental plant materials lightens the colour of the material and provides a striking contrast and enhances the absorption of dyes (Palisoc and Camalate, 2002). In the process, the appearance and the value of the product are improved.

Different bleaching chemicals can be used but the nature and concentration of the chemical will have influence on the quality of the produce. Oxidative (hypochlorite, chlorite, and peroxide) or reductive (sulfite and borohydride) bleaches were used on ornamental plant materials. The former tend to break down coloured compounds whereas the latter tend to modify them into colourless compounds (Joyce, 1998; Arulmurugan et al., 2007). Literatures were available on bleaching action of different bleaching chemicals. Sodium chlorite was found to be the most commonly used bleach for plant foliage

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owing to its selective mode of action on lignin without damaging the fiber. Also this bleach was reported to remove the entire colour from cellulose based material with minimal damage to the cellulose even during prolonged contact (Masschelein, 1979; Dubois and Joyce, 2005).

Fabian (2001) reported that, sodium chlorite is a very cheap oxidant and has been extensively used in water treatment and as a bleaching agent in paper and textile industries. Peroxides are important industrial bleaching agent for cellulosic products (Hassan, 2003; Khristova et al., 2003; Shatalov and Pereira, 2005; Samanta and Deepali, 2007). Also bleaching with hydrogen peroxide is energy efficient, eco friendly, less expensive, and economical. The addition of magnesium sulphate and sodium silicate to the medium is required to stabilize the peroxide in alkaline conditions. Yogita (2000) conducted studies to standardize bleaching and dyeing technology of hybrid tea roses and *Aerva sp* and found that, sodium chlorite was the most ideal chemical for bleaching roses under distilled water medium. In the same way, Lourdusamy et al. (2002) found that, sodium chlorite was the most effective bleaching agent for gomphrena flowers at a concentration of 10%.

Others factors affecting the whiteness of a bleached material are quality of water and concentration of hydrogen peroxide used (Naresh and Deepak, 2006; Ziaie et al., 2008). However, no standard comprehensive information on effective bleaching related to desired whiteness with less damage is available. Milder bleaches and standardization of bleaching chemical combinations in single step will help to preserve the structure and to prevent damage. The present study was undertaken with an objective to optimize bleaching chemicals to attain half whiteness of botanicals suitable for dry flower making in a single step.

MATERIALS AND METHODS

Experiments were conducted in completely randomized block design with 3 replications to identify the ideal bleaching agents for achieving half whiteness of different plant parts used in dry flower making. Dried pods of *Acacia auriculiformis, Sesamum indicum, Gossypium hirsutum, P. glabra* and cones of *Pinus spp* were collected and given bleaching treatment in a single step. The required solutions were prepared using distilled water. In case of hot water treatment, the distilled water was boiled to 100°C. 250 g of botanicals were soaked in 1 L of different treatment combination solution and kept at room temperature for further observations. Treatment combinations were T_1 - 10% sodium hydroxide, 1% sodium silicate, 10% hydrogen peroxide, T_2 - 10% sodium hydroxide, 1% sodium silicate, 20% hydrogen peroxide, T_3 - 10% sodium hydroxide, 1% sodium silicate, 30% hydrogen peroxide, T_4 - 10% sodium chlorite + 5% hydrochloric acid (hot water), T_5 - 20% sodium chlorite + 5% hydrochloric acid (hot water), T_6 - 10% sodium chlorite + 5% hydrochloric acid (cold water) ,T_7 - 20% sodium chlorite + 5% hydrochloric acid (cold water), T_8 - 30% sodium hypochlorite + 20% hydrogen peroxide, T_9 - 30% calcium hypochlorite + 20% hydrogen peroxide, T_{10} - Control (5% sodium hydroxide, 1% sodium silicate , 10% hydrogen peroxide) .

The required half whiteness was fixed as Yellow White Group – 158 – A as per RHS colour chart. The time taken for achieving required half whiteness was observed at periodical intervals of 3, 6 and 9 h. The pods were thoroughly rinsed in water and shade dried. The strength of whiteness was assessed and evaluated using RHS colour chart. The whiteness index was measured using Mini scan colour measurement system model MS (Hunter Associates laboratory, Reston VA) L values which represent the lightness of sample were recorded before and after bleaching treatments and whiteness index was calculated. L value of 100 represents white while L value of 0 represents black.

The percentage of damage was calculated by assessing initial weight and final weight of dried botanicals. Sensory scores on visual observation were done on quality parameter viz., shape retention. A panel of judges comprising 12 members from all the age groups related to dry flower industry judged the samples by feel and visual method and scored based on the score chart (0-0.4 – very low, 0.5 – 1.4 – low, 1.5-2.4 – medium, 2.5-3.4 – high, 3.5 – 4.0 – very high). In the experiment the data recorded were statistically analysed for standard error of deviation and critical mean difference for significance using single factor analysis of variance (ANOVA) using AGRES (7.01, Pascal International software, USA). When ANOVA showed significant effects, mean separation was done using LSD test ($p < 0.05$).

RESULTS AND DISCUSSION

All the parameters studied in the experiment were significantly (SED., Cd 0.5%) effected by bleaching application. The results indicated in Table 1 that T_7 proved superior with minimum bleaching time of 6 h for dried pods of *A. auriculiformis, S. indicum, G. hirsutum, P. glabra* and cones of *Pinus spp* with required half whiteness (HW). T_4, T_5 and T_6 are on par with T_7 for required whiteness but with less whiteness index values (Table 2). Sharon (2006) reported that, bleaching process works best on woodier dried materials. The botanicals treated under treatment T_7 scored highest whiteness index values (Table 2) for Botanical 1 (53.77), Botanical 3 (52.99), Botanical 4 (46.34), and Botanical 5 (47.67) respectively with minimum percentage of damage, except Botanical 2, followed by Treatment T_5 [Botanical 1 (52.25), Botanical 3 (50.56), Botanical 4 (45.16) and Botanical 5 (45.27) respectively].

The minimum percentage of damage (Figure 1) was observed in T_7 for Botanical 1 (4.64%), Botanical 3 (2.74%) Botanical 4 (0.78%), and Botanical 5 (3.74%) respectively except Botanical 2 followed by T_6 [Botanical 1 (7.88%), Botanical 3 (5.40%), Botanical 4 (3.30 %) and Botanical 5 (4.92%) respectively]. Sensory scores on shape retention were highest in Treatment T_7 with maximum scores for Botanical 1 (3.36) Botanical 2 (3.57), Botanical 3 (3.43), Botanical 4 (3.07) and Botanical 5 (3.43) respectively. Scores on shape retention for all botanicals was minimum in Treatments T_4 and T_5 except *pinus spp*. Since in these treatments hot water was used, more percentage of damage and minimum scores for shape retention was recorded under this treatment.

Exceptionally the cones of *pinus spp* scored high values of whiteness index (60.54) with maximum score for

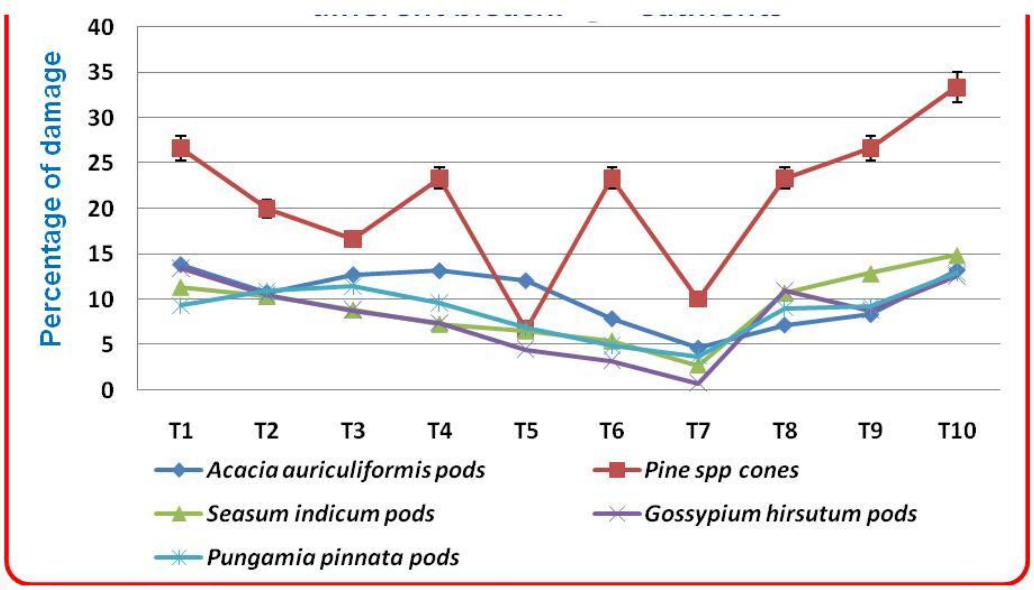
Table 1. Effect of different bleaching agents on time taken for complete bleaching of botanicals to get half whiteness.

Treatment	***A. auriculiformis*** **pods (Botanical 1)**		***Pine spp*** **cones (Botanical 2)**		***S. indicum*** **pods (Botanical 3)**		***G. hirsutum*** **pods (Botanical 4)**		***Pongamia pinnata*** **pods (Botanical 5)**	
	Time taken (h)	**Strength of whiteness**	**Time taken (h)**	**Strength of whiteness**	**Time taken (h)**	**Strength of whiteness**	**Time taken (h)**	**Strength of whiteness**	**Time taken (h)**	**Strength of whiteness**
T_1	9	BL	9	UB	9	BL	9	YL	9	YL
T_2	9	BL	9	YL	9	BL	9	YL	9	YL
T_3	9	BL	9	HW	9	BL	9	HW	9	YL
T_4	6	HW	6	YL	6	HW	6	YL	6	HW
T_5	6	HW	6	HW	6	HW	6	HW	6	HW
T_6	6	HW	6	YL	6	HW	6	YL	6	HW
T_7	6	HW	6	HW	6	HW	6	HW	6	HW
T_8	9	UB	9	UB	9	UB	9	UB	9	UB
T_9	9	UB	9	UB	9	UB	9	UB	9	UB
T_{10}	9	BL	9	UB	9	BL	9	YL	9	UB

HB; Half white, YL; yellowing, UB; unbleached, BL; blackening.

Table 2. Effect of different bleaching agents on L value and whiteness index of botanicals.

Treatment	***A. auriculiformis*** **pods (Botanical 1)**			***Pine spp*** **cones (Botanical 2)**			***S. indicum*** **pods (Botanical 3)**			***G. hirsutum*** **pods (Botanical 4)**			***Pongamia pinnata*** **pods (Botanical 5)**		
	L values		**Whiteness index**	**L values**		**Whiteness index**	**L values**		**Whiteness index**	**L values**		**Whiteness index**	**L values**		**Whiteness index**
	Before bleaching	**After bleaching**		**Before bleaching**	**After bleaching**		**Before bleaching**	**After bleaching**		**Before bleaching**	**After bleaching**		**Before bleaching**	**After bleaching**	
T_1	18.35	12.4	-5.95	14.53	18.53	4	20.23	15.56	-4.67	25.36	52.31	26.95	25.36	57.36	32
T_2	19.26	11.45	-7.81	15.62	56.78	41.16	22.34	16.43	-5.91	24.38	53.42	29.04	26.45	54.36	27.91
T_3	20.36	12.93	-7.43	16.47	69.43	52.96	24.53	15.47	-9.06	27.29	70.23	42.94	25.88	56.12	30.24
T_4	21.15	70.54	49.39	15.34	64.11	48.77	22.81	71.68	48.87	25.47	51.49	26.02	26.85	71.23	44.38
T_5	19.89	72.13	52.25	14.88	75.42	60.54	21.67	72.23	50.56	26.71	71.86	45.16	27.67	72.94	45.27
T_6	20.69	71.45	50.76	15.92	58.46	42.54	22.46	72.01	49.55	24.73	53.18	28.45	26.32	72.4	46.08
T_7	18.76	72.53	53.77	15.34	72.53	57.19	20.46	73.45	52.99	25.81	72.15	46.34	25.78	73.45	47.67
T_8	18.13	23.12	4.99	16.44	17.53	1.09	22.35	19.04	-3.31	24.37	25.34	0.97	26.07	27.53	1.46
T_9	19.43	22.75	3.32	16.23	18.59	2.36	21.49	19.45	-2.04	25.61	26.32	0.71	26.45	27.21	0.76
T_{10}	18.62	9.32	-9.30	14.84	17.34	2.5	21.36	15.01	-6.35	24.32	45.23	20.91	25.72	26.14	0.42
SEd	-	-	0.46	-	-	0.56	-	-	0.46	-	-	0.43		-	0.47
CD (5%)	-	-	1.03	-	-	1.25	-	-	1.02	-	-	0.97		-	1.05



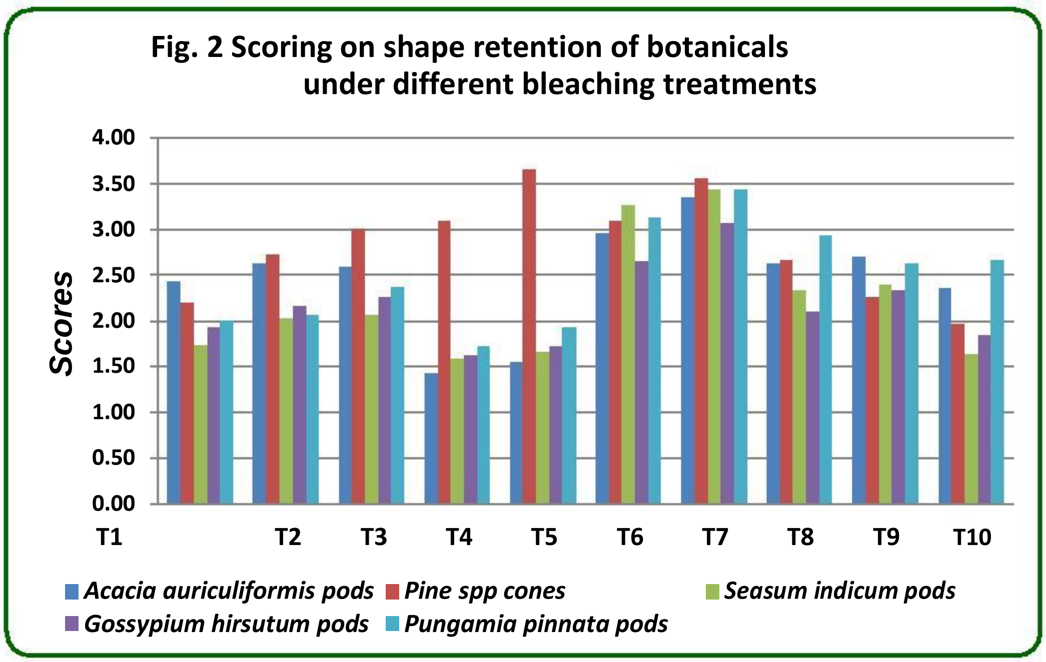


Figure 2. Scoring on shape of botanicals under different bleaching treatments.

shape retention (3.67) and minimum damage of 6.70% under Treatment T_5. It might be due to effective bleaching of hard materials like cones of *pinus spp* hot water treatment is suitable.

The factors affecting the whiteness of a bleached material are temperature of water and concentration of chemicals used (Naresh and Deepak, 2006). This was in accordance with the earlier studies by Lourdusamy et al (2002) who reported that, sodium chlorite is the most effective bleaching agent for gomphrena flowers at a concentration of 10% sodium chlorite is an oxidant particularly adapted for synthetic fiber bleaching (polyamidic, acrylic, polyester) and cellulosic (man-made and natural, particularly for linen) (Figure 2). The principal advantage of sodium chlorite is high degree of brightness (especially for acrylic fibers), negligible degradation of fibres (1 to 2% weight loss for cellulosic fibers and no attack to the polymeric chains in the synthetic fibers), lower environmental impact of wastewaters (Arulmurugan et al., 2007). In the field of synthetic organic chemistry, the most known use of sodium chlorite is in the efficient chemoselective oxidation of aldehydes to the corresponding carboxylic acid (Krapcho, 2006). While treatments involving sodium hydroxide combinations caused blackening in *S. indicum* and *A. auriculiformis* whereas, treatment combinations of sodium hypochlorite and calcium hypochlorite were not effective for any of the botanicals used. This was confirmed by Dubois and Joyce (2002) where materials bleached with sodium hypochlorite showed yellowing while calcium hypo chlorite showed cellulose damage.

Conclusion

Based on the present study, treatment involving 20% sodium chlorite + 5% hydrochloric acid (cold water) proved superior bleaching properties with minimum time of 6 h with highest values for whiteness index and maximum scores for shape retention with minimum percentage of damage. Sodium chlorite effectively bleached the botanicals to required half whiteness in the present experiment. The advantage of bleaching of botanicals suitable for dry flower making with sodium chlorite in the presence of hydrochloric acid is that, the chemical is selective in mode of action to lignin and removes all colours quickly with minimal damage to cellulose.

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