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Studies on the Efficacy of Natural Dye Extracts for Tinting of Tuberose Cut Spikes

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ABSTRACT: The present investigation 'Studies on the efficacy of natural dye extracts for tinting of tuberose cut spikes' was carried out at Floricultural Research Station, ARI, Rajendranagar, Hyderabad, during the year 2022-23. The experiment was carried out in Completely Randomised Design with 8 treatments, viz., T_1-Beetroot peel, T_2- Fully opened flowers of *Butea monosperma*, T_3-Fully opened blue butterfly pea flowers, T_4-Seeds collected from freshly harvested annatto pods, T_5-Red amaranthus leaves, T_6-Fully opened Four 'o' clock flowers, T_7-Pomegranate peel and T_8-Indigo leaves. The natural dye extracted from the treatments was used for tinting tuberose spikes. The results of the experiment revealed that, among all treatments, treatment T_5- Red amaranthus leaves along with citric acid -300ppm and 2% sucrose recorded maximum vase life 9.04 days and colour retention 9.04 days of tuberose spikes. Maximum colour intensity L 25.3 a 21.6 b 0.9 with red colour group and high dye solution uptake 6.49 ml/spike, change in fresh weight 29.06 %, basal floret diameter 2.83 cm was recorded in treatment T_1-Beetroot peel. Whereas Least time was taken for treatment T_5-Red amaranthus leaves 4.90 hrs.

Keywords: Natural dyes, Tinting, *Butea monosperma*, chromometer.

INTRODUCTION

In most of the countries, per capita consumptions of flowers is increasing day by day. Cut flower marketing speedily expanding as a global enterprise in today's world but the perishable nature of flowers poses a threat to the success of floriculture industry. So, to enhance the success of floriculture in market, diversification of product is the possible way. The product diversification can be achieved by converting floral commodity to a value-added product.

Value addition from flowers includes extraction of oil, colouring of flowers, dry flower products, tinting, herbal gulal, herbal teas, veni preparation, corsage, artistic garlands, floral ornaments, bouquets and buttonholes, hair care products, flavours in confectionaries and cosmetics etc. This technique adds up to 5 to 10 times of value to floral commodities (Mekala *et al.*, 2012).

Due to the lack of colour pigments in white flowers, tinting is a value-adding technique. Food (edible) dyes are used to colour flowers, which enhances their aesthetic appeal and boosts their market value. This method improves the aesthetic sense and offers a wide variety of colours. Colouring white flowers is an easy approach to get the colour of interest for decorative purposes where a certain colour is needed (Sowmeya *et al.*, 2017). Tinting is done in commercial flowers like gladiolus, tuberose, gerbera etc. Tinting tuberose flowers with dyes can enhance the value of flowers, helps the farmers earn more from their produce (Kumari and Deb 2018).

Natural colourants can be broadly classified based on natural occurance of pigments. They are chlorophylls, carotenoids, betalins and anthocyanins. Chlorophylls impart green colour but are oil soluble, unstable and heat sensitive pigments (Marquez and Sinnecker 2008). Carotenoids are lipid soluble pigments. Responsible for many of the brilliant red, orange and yellow colour. They are classified into carotenoids and xanthophylls. Carotenoids naturally occur in orange , yellow coloured fruits and flowers like *Butea monosperma* Betalins are water-soluble pigments, which exhibit red-purple, yellow colour depending upon pigment structure. They are classified into two groups, betaxanthins (Yellow pigment) and betacyanins (red-purple) (Chandrasekhar *et al*., 2015). Betalins are heat sensitive and also colour changes in relation to pH. They are stable at pH 3 to 7 and at pH 3 converts from red to violet (Henry, 1996).

Anthocyanins are water soluble pigments found in many flowers, fruits and leaves which impacts various shades of orange, red or blue. Anthocyanins colour changes based upon number of hydroxyl and methoxyl groups in the structure. More the hydroxyl group

exhibits more bluish shade. Whereas methoxyl group exhibits more redness. (Delgado-vargas *et al.,* 2003). Anthocyanins are also influenced by Ph, heat, light, oxygen and sugars (Rodriguez-soana *et al.*,1999).

As natural dyes are eco-friendly and do not cause any harmful effect on human health, while synthetic dyes do. Preparation of natural dyes using flowers can reduce the market glut, post harvest loss of flowers and create the demand for the flowers so that it enhances the income of farmers. Keeping in view of the above information, the present research work entitled 'Studies on the efficacy of natural dye extracts for tinting of tuberose cut spikes' was taken up.

MATERIALS AND METHODS

The experiment was conducted during the year 2022-23at Floricultural Research Station, ARI, Rajendranagar, Hyderabad, Telangana which is situated at an altitude of 542.3m above mean sea level at 78°29' East longitude and 17°19' North latitude. The experiment was laid out in Completely Randomized Design with 8 treatments replicated thrice.

The treatments include natural dyes used in the experimentation were extracted from the beetroot peel, fully opened flowers of *Butea monosperma,* fully opened blue butterfly pea flowers, seeds collected from freshly harvested annatto pods, red amaranthus leaves, fully opened Four 'o' clock flowers, Pomegranate peel and Indigo leaves.

Aluminum sulphate (alum) was used as a mordant. It also regulates the pH of dye.

Different types of materials like conical flasks, weighing balance, vernier calipers, secateurs, scissors, water, RHS colour chart, pH paper strips and other laboratory equipment were used from Floricultural Research Station, ARI, Rajendranagar, Hyderabad.

Dye extraction procedure.A desired plant material is taken from different plant sources and cut into small pieces. For 1kg plant material: 650 ml. of water is added and kept boiled at 50°C. The plant material is then squeezed to extract the dye. A pinch of alum was added to regulate pH from 4.5 to 5.0. This dye is kept in a Jar for further use.

Method of Tinting. Tuberose spikes of 30 cm stalk length were given a slant cut at the base to have maximum dye absorption. The cut spikes were kept in a vase solution containing dye solution 100 ml + 2% sucrose and 300ppm citric acid.

The observations recorded were time taken for colour uptake (hr), colour (using RHS colour chart), quantity of dye uptake (ml/spike), colour intensity (Chromometer), change in fresh weight (%), basal floret diameter (cm), vase life (days) and days to colour retention

RESULTS AND DISCUSSION

Colour group (as per RHS colour chart). The colour development in the petals after immersion of tuberose cut spike in the dye solution was recorded and presented in Table 1. The petal colour was noted as White Group NN 155D before placing it in the dye solution. The sensory evaluation for colour group using the RHS colour chart was done after tinting spikes with different natural dyes along with preservatives sucrose 2% and citric acid 300ppm.

Among all the different treatments, treatment T_1 - beetroot peel dye imparted Red Group 59A, treatment T_2 - flame of the forest flowers dye imparted Yellow Orange Group 9A, while treatment T_5 - red amaranthus leaves dye imparted Red Group 59 B and treatment T_6 - four 'o' clock flowers dye imparted Red Group 53A with RHS colour chart (Royal Horticulture Society) reading. The remaining dye solutions of butterfly pea flowers, annatto seeds, pomegranate peel and indigo leaves did not impart any colour to the floret and they remained White Group NN 155D in colour. The darkest shades were obtained in T_1 - beetroot peel dye and the lightest shade was obtained in T_2 - flame of the forest flowers among all natural dyes.

The natural dyes containing anthocyanins, betalins, buteins are easily water soluble where as carotenoids and flavonoids are lipid soluble (Ngamwonglumlert *et al.,* 2017). Therefore as the treatments containing water soluble pigments might have been absorbed by the tuberose flower spikes and imparted respective colour.

These results were in accordance with Sung *et al.* (2012) in tinting of rose. The colour shade obtained depends on the concentration of the dye used and the time of immersion. The results of dyes used and colour shades obtained were in accordance with Mekala *et al.* (2012) in tinting of tuberose, Patil and Dhaduk (2008) in tinting of *Pimpenella monoica*.

Colour intensity (chromometer). The colour intensity of different treatments was recorded using a chromometer after tinting spikes with natural dyes. Depending upon the dye used, the colour change was noticed. There was a significant effect of varying levels of colour intensity among treatments and the corresponding data is presented in the Table 1.

The treatments, T_1 - beetroot peel dye, T_5 - red amaranthus leaves, T_6 - four 'o' clock flowers imparted a shade of red colour, and T_2 - flame of the forest flowers imparted yellow colour. The remaining dye solutions of butterfly pea flowers, annatto seeds, pomegranate peel and indigo leaves did not impart any colour to the floret as they remained white in colour. Among all the treatments darkest shade was observed in treatment T_1 - beetroot peel dye with a maximum intensity of L 25.3, a 21.6, b 0.9, and the lightest shade was observed in treatment T_6 - four 'o' clock flowers dye with a low intensity of L 57.2, a 20.4, b 0.7.

The darker shades (Lower L values) of T_1 and T_5 treatment natural dyes might be due to the easily soluble betalins and anthocyanin pigments present in the dye extracts. Further maximum quantity of dye uptake might also have been resulted in darker colour intensities in these treatments (Ngamwonglumlert *et al.,* 2017).

The colour intensities of chromometer readings are in accordance with the work done by Chi-wai *et al.* (2014) on fading of dyed cotton.

Time taken for colour uptake (hrs). Data on time taken for color uptake upon tinting of tuberose flowers

treated with different natural dyes along with preservatives are presented in the Table 2.

There was a significant difference in the time taken for color absorption among the various natural dyes. Among all the treatments, shortest duration of 4.90 h for colour uptake was recorded in the treatment T_5 - red amaranthus leaves followed by T_1 - beetroot peel which took 5.90 h and the maximum time taken for colour absorption was observed in the treatment T_2 flame of the forest flowers(8.15 h).

The higher colour intensity and uptake of T_5 treatment might be attributed to the fact that anthocyanins present in amaranthus leaves, betalins present in beetroot peel are more easily soluble in water than betaxanthin and butien present in four 'o' clock flowers and flame of the forest respectively leading to faster uptake of dye solution by tuberose spikes. Carotenoids present in annatto seeds and chlorophyll present in spinach leaves are lipid soluble therefore no dye uptake was observed by tuberose spikes. Similar results were reported by Sowmeya *et al.* (2017) in tinting techniques in cut flowers (Rose and Carnation).

Quantity of dye solution/water up take by the tuberose spikes (ml/spike). The dye uptake by the spikes immersed in natural dye solutions along with preservatives is presented in the Table 2.

The quantity of dye uptake in tuberose cut spikes varied significantly depending upon the type of natural dye extract used. Among all the different treatments, treatment T_1 - beetroot peel dye recorded maximum quantity of dye uptake (6.49 ml/ spike) followed by T_5 - red amaranthus leaves (5.42 ml/spike). While minimum quantity of dye uptake (4.38 ml/ spike) was observed in treatment T_2 - flame of the forest flowers.

The maximum quantity of dye uptake recorded in T_1 - beetroot peel and T_5 - red amaranthus leaves may be attributed to the antioxidant activity of betalins and anthocyanins which might have prevented vascular blockage thus leading to more translocation of the dye (Ngamwonglumlert *et al.,* 2017).

The results are in accordance with Dhaduk and Naik (2003) in tinting of tuberose, Mekala *et al.* (2012) in tinting of tuberose and Patil and Dhaduk (2008) in tinting of lady's lace cutflower.

Change in fresh weight (%). A significant variation was observed among the treatments in terms of change in fresh weight percentage and the corresponding results are presented in the Table 2.

The maximum per cent increase in fresh weight (29.06%) was recorded in treatment T_1-beetroot peel which was on par with T_5 - red amaranthus leaves (28.97%), T_6 - four 'o' clock flowers (28.67) and the minimum percent increase in fresh weight was recorded in treatment T_8 - Indigo leaves with 24.16%. This can be related with the fact that as the quantity of dye uptake was recorded highest in treatment T_1 and T_5 treatments, correspondingly the change in fresh weight also increased. Change in fresh weight was also observed in non tinted treatments like annatto seeds, butterfly pea flowers, indigo leaves, spinach leaves due to the uptake of water from the vase solution.

These observations are in line with the finding by Jain *et al.* (2015) in tinting of cv. Calcutta double tuberose. Similar observations was also given by Kumar *et al.* (2015) in tuberose. Tinting along with the vase solutions has increased the change in fresh weight. Similar results were also reported by Baidya and Chakrabarty (2020) in tuberose.

Basal floret diameter (cm). The floret size varied significantly among different treatments. The Table 2 represents the diameter of the 2nd fully opened floret from the base of the spike after tinting.

Among all the treatments, maximum floret size 2.83 cm was recorded in treatment T_1 -beetroot peel followed by T_2 - Flame of the forest flowers and T_4 - Annatto seeds with 2.67cm whereas the minimum 2.59cm was reported in the treatment T_6 - four 'o' clock flowers. Only little change in floret size was found with different dyes used but it was significant.

The addition of sucrose 2% and citric acid 300ppm in the vase solution might have enhanced a higher rate of respiration necessary for cell division, cell expansion and providing carbon skeleton for the tissue structure contributing to floret expansion, and formation of cell constituents and thus causing increased floret size according to Kumari and Deb (2018) in tinting of tuberose, Singh *et al.* (2005) in tinting of gladiolus cut spikes.

Tinting along with the vase solutions has increased the floret diameter. Similar results were also reported by Baidya *et al.* (2020) in tinting of tuberose and Kumar *et al.* (2015) in tinting of gladiolus.

Vase life (days). Vase life is the period during which a cut flower remains in a presentable/acceptable form in the vase. The vase life of tuberose spikes was recorded from the time it was placed in the vase containing dye + vase solution till 50% of fresh open florets had withered off. There was a significant difference between the treatments concerning the vase life of tuberose spikes. The results are presented in Table 2 and the data indicate that the floral preservatives had a significant effect on vase life. The vase life ranged from 7.05 days to 9.04 days in different treatments. Among all the tinted tuberose cut spikes maximum vase life was observed in treatment T_5 - red amaranthus leaves with 9.04 days followed by T_6 - Four 'o' clock flowers with 8.33 days, T_1 - Beetroot peel with 8.00 days and minimum vase life was recorded in treatment T_2 -flame of the forest flowers with 7.05 days. The tinted spikes had no significant effect on the vase life as compared to non-tinted spikes

Treating the flowers with sucrose along with tinting improves the effect of cytokinins in delaying the senescence of cut flowers by reducing the ethylene action, which ultimately increases the shelf-life of cut flowers, as compared by Suresha *et al.* (2009) in cut chrysanthemum. Sucrose also has a great value in prolonging vase life, promoting opening, and improving the colour and size of petals. Similar views have been reported by Pun *et al.* (1999) in tinting of carnation, Donoghue *et al.* (2002) in sandersonia (*Sandersonia aurantiaca*) flowers and Mayak *et al.* (1973) in tinting of cut gladiolus flowers.

Colour retention (days). Colour retention (days) of cut tuberose spikes tinted with different natural dye treatments varied significantly and the data is presented in the Table 2.

Among all the tinted tuberose cut spikes maximum colour retention was observed in treatment T_5 - Red amaranthus leaves with 9.04 days and minimum colour retention was recorded in treatment T_2 -flame of the forest flowers with 7.05 days.

The floret retained the till the termination of vase life of tinted tuberose cut spikes. Therefore, days to colour retention was recorded same as the readings of vase life days. The dye uptake is directly proportional to the colour retention according to Patil and Dhaduk (2008) in tinting of lady's lace cut flowers.

Table 1: Efficacy of natural dye extracts from different plant sources on colour group and colour intensity of tinted tuberose spikes.

Treatments	Colour group (RHS colour chart)		Colour intensity		
	Before tinting	After tinting	L	a	b
T_1 - Beetroot peel	White NN 155D	Red 59 A	25.3	21.6	0.9
T_2 - Flame of the forest flowers	White NN 155D	Yellow 9 A	35.1	0.8	23.7
T_3 - Butterfly pea flowers	White NN 155D	White NN 155D	-	-	-
T_4 - Annatto seeds	White NN 155D	White NN 155D	-	-	-
T_5 - Red Amaranthus leaves	White NN 155D	Red 59 B	34.2	16.9	1.8
T_6 - Four 'o' clock flowers	White NN 155D	Red 53 A	57.2	20.4	0.7
T_7 - Pomegranate peel	White NN 155D	White NN 155D	-	-	-
T_8 - Indigo leaves	White NN 155D	White NN 155D	-	-	-

L - Lightness; a - Red (+) or Green (-); b - Yellow (+) or Blue (-)

Table 2: Efficacy of natural dye extracts from different plant sources on time taken for colour up take (hrs), quantity of dye solution up take (ml/spike), change in fresh weight %, basal floret diameter (cm), vase life (days), colour retention (days) of tinted tuberose spikes.

Treatments	Time taken for colour up take (hrs)	Quantity of dye solution/ water up take (ml/spike)	Change in fresh weight %	Basal floret diameter (cm)	Vase life (days)	Colour retention (days)
T_1 - Beetroot peel	5.90 (2.62)	6.49	29.06	2.83	8.00	8.00
T_2- Flame of the forest flowers	8.15 (3.10)	4.38	27.25	2.67	7.05	7.05
T_3- Butterfly pea flowers	0.00 (1.00)	5.01	25.03	2.60	7.84	7.84
T_4- Annatto seeds	0.00 (1.00)	4.16	25.06	2.67	7.60	7.60
T_5- Amaranthus leaves	4.90 (2.16)	5.42	28.97	2.64	9.04	9.04
T_6- Four 'o' clock flowers	6.91 (3.00)	4.72	28.67	2.59	8.33	8.33
T_7- Pomegranate peel	0.00 (1.00)	4.95	26.13	2.56	7.82	7.82
T_8- Indigo leaves	0.00 (1.00)	4.06	24.16	2.42	7.71	7.71
SEm ±	0.01	0.08	0.38	0.02	0.14	0.14
CD at 5%	0.03	0.26	1.16	0.07	0.44	0.44

Values in parentheses are square root $\sqrt{((X)+0.5)}$ transformed values

T_1- Beetroot peel T_2 - Flame of the forest flowers T_5-Amaranthus leaves T_6-Four 'o' clock flowers

Tinted tuberose flowers with different treatments

CONCLUSIONS

It can be concluded from present study that naturally available dyes extracted from different plant sources like T_1- Beetroot peel, T_2- Flame of the forest flowers, T_5- Red amaranthus leaves, T_6- Four 'o' clock flowers are suitable for tinting of tuberose spikes.

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Conflict of Interest. None.

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