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Megha Kashyap
Department of Floriculture and Landscape Architecture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Samir Kumar Tamrakar
Assistant Professor, Department of Floriculture and Landscape Architecture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Madhavi Khilari
Department of Floriculture and Landscape Architecture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Corresponding Author:
Megha Kashyap
Department of Floriculture and Landscape Architecture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Evaluation of varying levels of pH, sucrose and colour concentrations on tinting and vase life of Tuberose (*Polianthes tuberosa* L.) cut Spike

Megha Kashyap, Samir Kumar Tamrakar and Madhavi Khilari

Abstract
The present investigation entitled "Evaluation of varying levels of pH, sucrose and colour concentrations on tinting and vase life of Tuberose (*Polianthes tuberosa* L.) cut spikes" was performed in the Floriculture laboratory, Department of Floriculture and Landscape Architecture, College of Agriculture, IGKV, Raipur, Chhattisgarh during 2019-20 in Completely Randomized Design (CRD) with nineteen treatments and three replications. The spikes of tuberose cv. Prajwal were tinted with different concentration combinations of pH, sucrose and food colour.
Although there was no such significant difference on length of spike, diameter of floret and time taken for colour uptake in the different concentration combinations of pH, sucrose and food colour, however, treatment combination of pH 5 + 4 percent sucrose + 40,000 ppm of royal blue colour (T_{15}) showed best results in majority of other parameters like physiological weight loss, colour intensity, floret opening, vase life, and benefit in value addition.
Therefore, tinting with pH 5 + 4 percent sucrose + 40,000 ppm of royal blue colour (T_{15}) in supplemented solution can add colour to tuberose spikes with no detrimental effect on post-harvest qualities. Also, coloured spikes will serve as a value added product to add benefits to farmer's income.

Keywords: Tinting, tuberose, food colour concentration, sucrose, pH, tap water, solution

Introduction
Tinting enhances aesthetic beauty of fresh and dry flowers as single colour limits the flower acceptability and reduces the market value (Chougala *et al.* 2016). At the post harvest stage tinting is outstanding method by which we can change the colour according to our wish and desire (Sowmeya *et al.* 2017) [10]. Inflorescence colouring with food colours intensifies the visual appearance of these flowers and enhances their economic value. White flower tinting is the best way to acquire the colour of interest for decorations where a particular colour is needed. Certified synthetic food colours add an extreme and uniform colour to the tinted flowers although less costly and dangerous. Coloring with dyes at different concentrations also make flowers vulnerable to postharvest losses. Hence, to promote the quality and extend the vase life different floral preservatives are being used that provide water and energy to the cut flowers.
Tuberose (*Polianthes tuberosa* L.) is an important ornamental bulbous flowering plant. It is herbaceous tropical plant belonging to family Agavaceae and is native of Mexico (Benschop 1993). It is commonly known as Rajanigandha or Nishigandha which means 'The Fragrance of the Night'. It is commercially important cut as well as loose flower crop standing fifth in the international trade after rose, carnations, chrysanthemum and gladiolus. It has magnificent inflorescence with pleasant fragrance, shape, size and keeping quality. The long spikes of tuberose cut flower are used for vase decoration and bouquet preparation while loose flowers are used for making floral ornaments, garlands and button holes. The elongated spikes produce cluster of fragrant waxy white flowers that bloom acropetally. The flowers are found only in white colour with an intensity of creaminess as the flowers lack carotenoids and anthocyanin. Only white flowers are available till today for commercial cultivation. Due to monotypic nature it is not possible to induce colour variation through breeding. Induction of mutation through gamma irradiation resulted in colour variation in leaves but not in flowers. Some successful breeding attempts led to expression of colour in the petals at higher altitudes but these hybrids did not exhibit colour at lower altitude. This was due to decrease in anthocyanin content in lower altitude as temperature was high (Huang KL and Chen W S 2002).

Tuberose has a great economic potential for flower trade but its limited genetic variability for flower colour reduces its market value. So, tinting in tuberose could serve the purpose of adding variability in its white coloured flowers. The tinting or artificial colouring is done by using food colours or dyes *viz*. acidic or basic dyes. The food colours are safe and easily available as compared to acidic and basic dyes. They not only impart colour but are also more economical and ecofriendly (Sambandhamurthy and Appavu 1980).

Tinting is one of the important value addition techniques in flowers. Gladiolus and tuberose is also an important cut flower's stand fourth in the international trade after rose, carnation and chrysanthemum because of its magnificent inflorescence, wide array of colour, shape, size and keeping quality, it occupies prime position both in domestic and international market.

Vase life of tinted flowers is also an important consideration, which varies with the dyes, sucrose percentage and pH value. Some chemicals prolong the vase life and some chemicals retards the vase life of flowers. By preparing different level of pH value and different amounts of sucrose percentage in the solution during tinting treatment, it can be seen which pH value and sucrose percentage is good for the flower of tinting. Generally white colour flower of tuberose are available in the local market, but there is lacking of colourful flower of tuberose in local market.

Tinting of white flowers is a simple way to get the desired interesting colour for decorative purpose withuse of certified synthetic food colour for this purpose are helpful in reducing cost. None of the research works on tinting has been carried out till date in Chhattisgarh state. Keeping the above fact in view & find out the appropriate method of tinting with increased vase life of tuberose.

Material and Methods

The experiment was conducted at Laboratory of Department of Floriculture and Landscape Architecture, Collage of Agriculture, IGKV, Raipur, Chhattisgarh in the year 2020. During the experiment period, the average maximum temperature varied from 22.3 to 27.7℃. Whereas, minimum temperature varied from 14.6℃ to 12.9℃. The maximum and minimum relative humidity ranged from 88.3percent to 87.5percent and 28.1percent to 30.4percent respectively. The flower spikes of tuberose were acquired from, horticulture Research cum Instructional Farm, IGKV, Raipur (C.G.). The healthy, good appearance and uniform spikes were selected and harvested at tight bud stage and transported immediately to laboratory. The spikes were then subjected to Precooling in a bucket of cool water before subjecting it to the treatments. different flowers should be harvested at its good stage for tinting to have good vase life. The tight bud stage with 1-2 basal florets showing colour in tuberose. [Varu and Barad (2008)]. The flower spikes of tuberose were prepared for trial through trimming operation and re-cut diagonally using a sharp knife 1-2 cm from the base of the spike to keep all the cut stems at uniform length. The bottom of the cut flower spikes were completely immersed in each treatment solution.

Sucrose solution of 4 percent and 6 percent was prepared by dissolving 40 gm and 60 gm sucrose in 1000 ml tap water respectively. 250 ml of these solutions were taken in each bottle. A pH of 3, 4 and 5 was maintained by adding drop by drop,one, two and three drops of dilute HCl into the solution respectively and caliberating the solution repeatedly to achieve the required concentration of pH. HCl solution was prepared by adding ml of concentrated hcl in 500 ml of water. Colour solution of 20,000 ppk, 30,000 ppm, and 40,000 ppm was prepared by dissolving 20 gm, 30 gm and 40 gm of edible food colour in 1000 ml of water.250 ml of these solution were taken in each bottle. The results obtained were statistically evaluated using ANOVA for Completely Randomized Design (CRD).

Table 1: Details of different treatments

Notation	Treatments
T_1	pH 3 + 4 percent sucrose + 20,000 ppm of royal blue colour
T_2	pH 3+ 4 percent sucrose + 30,000 ppm of royal blue colour
T_3	pH 3 + 4 percentsucrose + 40,000 ppm of royal blue colour
T_4	pH 3 +6 percent sucrose + 20,000 ppm of royal blue colour
T_5	pH 3 + 6 percentsucrose + 30,000 ppm of royal blue colour
T_6	pH 3 + 6 percent sucrose + 40,000 ppm of dark pink colour
T_7	pH 4 + 4 percent sucrose+ 20,000 ppm of royal blue colour
T_8	pH 4 + 4 percent sucrose+ 30,000 ppm of royal blue colour
T_9	pH 4+ 4 percent sucrose + 40,000 ppm of royal blue colour
T_{10}	pH 4 + 6 percent sucrose + 20,000 ppm of royal blue colour
T_{11}	pH 4+ 6 percent sucrose + 30,000 ppm of royal blue colour
T_{12}	pH 4 + 6percent sucrose + 40,000 ppm of royal blue colour
T_{13}	pH 5+ 4 percent sucrose+ 20,000 ppm of royal blue colour
T_{14}	pH 5+ 4 percent sucrose +30,000 ppm of royal blue colour
T_{15}	pH 5+4 percent sucrose + 40,000 ppm of royal blue colour
T_{16}	pH 5+ 6 percent sucrose + 20,000 ppm of royal blue colour
T_{17}	pH 5+ 6 percent sucrose + 30,000 ppm of royal blue colour
T_{18}	pH 5+ 6 percent sucrose + 40,000 ppm of royal blue colour
T_{19}	Tap water (Control)

Results and Discussion

In the present study, the collected observational data was statistically analysed using the method of analysis of variance at 5% level of significance. ANOVA revealed that the different treatments showed significant.

Physiological weight loss of cut spike (percent)

minimum percent physiological weight loss of cut spikes of tuberose (11.85%) was observed in the spikes treated with treatment T_{15} (pH 5+ 4 percent sucrose + 40,000 ppm of royal blue colour) which was significantly superior than all other treatments while maximum percent physiological weight loss of cut spikes (20.74%) was observed in the spikes treated with control *i.e.*, treatment T_{19} (Tap water). This may be due to the fact that original food content that the spikes contained and higher pH of the solution helped in retaining the physiological weight.

Table 2: Effect of Ph, sucrose and colour concentration on physiological weight loss of cut spike (gm)

Notation	Treatment	Initial weight	Final weight	Physiological weight loss (%)
T_1	pH 3 + 4percent sucrose + 20,000 ppm of royal blue colour	40.85	34.95	3.7(14.43)
T_2	pH 3+ 4percent sucrose + 30,000 ppm of royal blue colour	43.66	37.55	3.7(13.99)
T_3	pH 3 + 4percentsucrose + 40,000 ppm of royal blue colour	41.30	35.33	3.8(14.44)
T_4	pH 3 + 6percent sucrose + 20,000 ppm of royal blue colour	43.64	38.32	3.7(14.19)
T_5	pH 3 + 6percentsucrose + 30,000 ppm of royal blue colour	43.81	38.47	3.7(14.17)

T_6	pH 3 + 6percent sucrose + 40,000 ppm of dark pink colour	41.41	35.45	3.7(14.37)
T_7	pH 4 + 4percent sucrose+ 20,000 ppm of royal blue colour	42.13	36.82	3.6(13.59)
T_8	pH 4 + 4percent sucrose+ 30,000 ppm of royal blue colour	41.05	33.68	4.2(17.93)
T_9	pH 4 + 4percent sucrose + 40,000 ppm of royal blue colour	40.73	33.48	4.2(17.78)
T_{10}	pH 4 + 6percent sucrose + 20,000 ppm of royal blue colour	41.19	35.93	3.7(13.75)
T_{11}	pH 4 + 6percent sucrose + 30,000 ppm of royal blue colour	40.97	33.44	4.2(18.39)
T_{12}	pH 4 + 6percent sucrose + 40,000 ppm of royal blue colour	41.23	34.50	4.0(16.32)
T_{13}	pH 5 + 4 percent sucrose+ 20,000 ppm of royal blue colour	43.79	38.37	3.5(12.37)
T_{14}	pH 5 + 4 percent sucrose +30,000 ppm of royal blue colour	43.83	38.53	3.7(14.09)
T_{15}	pH 5 +4 percent sucrose + 40,000 ppm of royal blue colour	44.31	39.05	3.4(11.85)
T_{16}	pH 5 + 6 percent sucrose + 20,000 ppm of royal blue colour	43.94	38.43	3.6(13.54)
T_{17}	pH 5 + 6 percent sucrose + 30,000 ppm of royal blue colour	41.40	35.92	3.6(13.23)
T_{18}	pH 5 + 6 percent sucrose + 40,000 ppm of royal blue colour	41.23	34.49	3.5(12.32)
T_{19}	Tap water (Control)	44.42	35.14	4.5(20.74)
$S.E_{M\pm}$		0.23	0.28	0.69
C.D. at 5percent		0.67	0.81	1.34

Sucrose significantly improved the keeping quality by maintaining fresh weight of spike from reducing physiological loss of weight, might be attributed primarily to greater water retention. Sucrose has been show to act as an oxidisable respiratory substrate and anti desiccant (Marouky, 1969) and thus increases the cut flower fresh weight. Similar results were also obtained by Reddy and Singh (1996), Balakrishna *et al.* (1989), Bhaskar *et al.* (1999), Varu and Barad (2008) in tuberose, Bhattacharjee and Palani Kumar (2002) and Divya *et al.*(2004) in rose and Liao *et al.(*2001) in *Eustoma grandiflorum*.

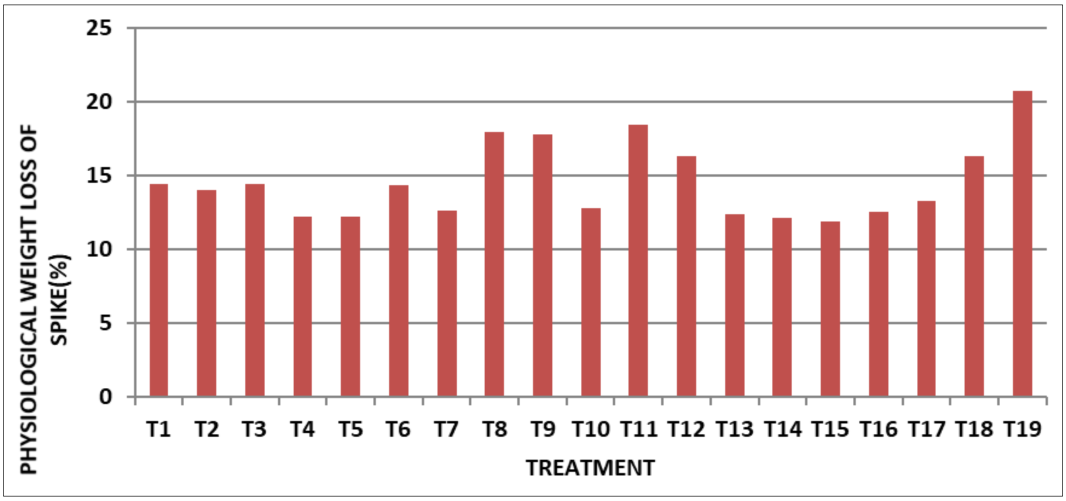

Fig 1: Physiological weight loss of cut spike (%)

Colour Intensity

The sensory evaluation for colour using RHS colour chart was done after tinting spikes with food colour for different concentration and the corresponding data is presented in Table 2 and illustrated in fig 1. The colour of spikes in control T_{19} was recorded as White group. Depending upon the colour concentration of food dye used, the colour change was noticed. As the time of immersion increased from1st to last days, the intensity of colour of food dye increased as recorded through RHS scale. The increase in intensity of colour is concomitant with our results that with increase in immersion time the uptake of dye increased. There was a significant effect of varying levels of pH, sucrose and food colour on the colour intensity. Maximum colour intensity (4.48) was recorded with the treatment T_{15} (pH 5+ 4 percent sucrose + 40,000 ppm of royal blue colour) which was significantly superior than all the other treatments while the minimum colour intensity (1.12) was recorded on the florets of spike dipped in treatment T_{13} (pH 5+ 4 percent sucrose+ 20,000 ppm of royal blue colour). This may be due to the fact that higher colour absorption by the spikes occurred at higher colour concentration of edible dye at an optimum pH level 5. Similar result was confirmed by Sambandamurthy and Appavu (1980), Mekala *et al.* (2001) and Shim *et al.* (2012). The colour of tuberose flowers is creamy white. This may be due to more absorption of dye to the petals through the vasculatory system along with water or dye uptake (Sambandamurthy and Appavu 1980).

Table 3: Effect of ph, sucrose and colour concentration on colour intensity

	Treatment	Colour intensity	
		Initial	Final
T_1	pH 3 + 4percent sucrose + 20,000 ppm of royal blue colour	1.26	1.37
T_2	pH 3+ 4percent sucrose + 30,000 ppm of royal blue colour	2.40	2.61
T_3	pH 3 + 4percentsucrose + 40,000 ppm of royal blue colour	3.09	3.36
T_4	pH 3 + 6percent sucrose + 20,000 ppm of royal blue colour	2.06	2.24
T_5	pH 3 + 6percentsucrose + 30,000 ppm of royal blue colour	2.75	2.99
T_6	pH 3 + 6percent sucrose + 40,000 ppm of dark pink colour	3.09	3.36
T_7	pH 4 + 4percent sucrose+ 20,000 ppm of royal blue colour	2.06	2.24
T_8	pH 4 + 4percent sucrose+ 30,000 ppm of royal blue colour	3.43	3.73
T_9	pH 4+ 4percent sucrose + 40,000 ppm of royal blue colour	3.09	3.36
T_{10}	pH 4 + 6percent sucrose + 20,000 ppm of royal blue colour	2.06	2.24
T_{11}	pH 4+ 6percent sucrose + 30,000 ppm of royal blue colour	3.09	3.36
T_{12}	pH 4 + 6percent sucrose + 40,000 ppm of royal blue colour	2.06	2.24
T_{13}	pH 5+ 4 percent sucrose+ 20,000 ppm of royal blue colour	1.03	1.12
T_{14}	pH 5+ 4 percent sucrose +30,000 ppm of royal blue colour	3.09	3.36
T_{15}	pH 5+4 percent sucrose + 40,000 ppm of royal blue colour	4.12	4.48
T_{16}	pH 5+ 6 percent sucrose + 20,000 ppm of royal blue colour	2.63	2.86
T_{17}	pH 5+ 6 percent sucrose + 30,000 ppm of royal blue colour	2.75	2.99
T_{18}	pH 5+ 6 percent sucrose + 40,000 ppm of royal blue colour	2.06	2.24
T_{19}	Tap water (Control)	0.00	0.00
	$S.E_{m\pm}$	0.03	0.03
	C.D. at 5percent	0.09	0.09

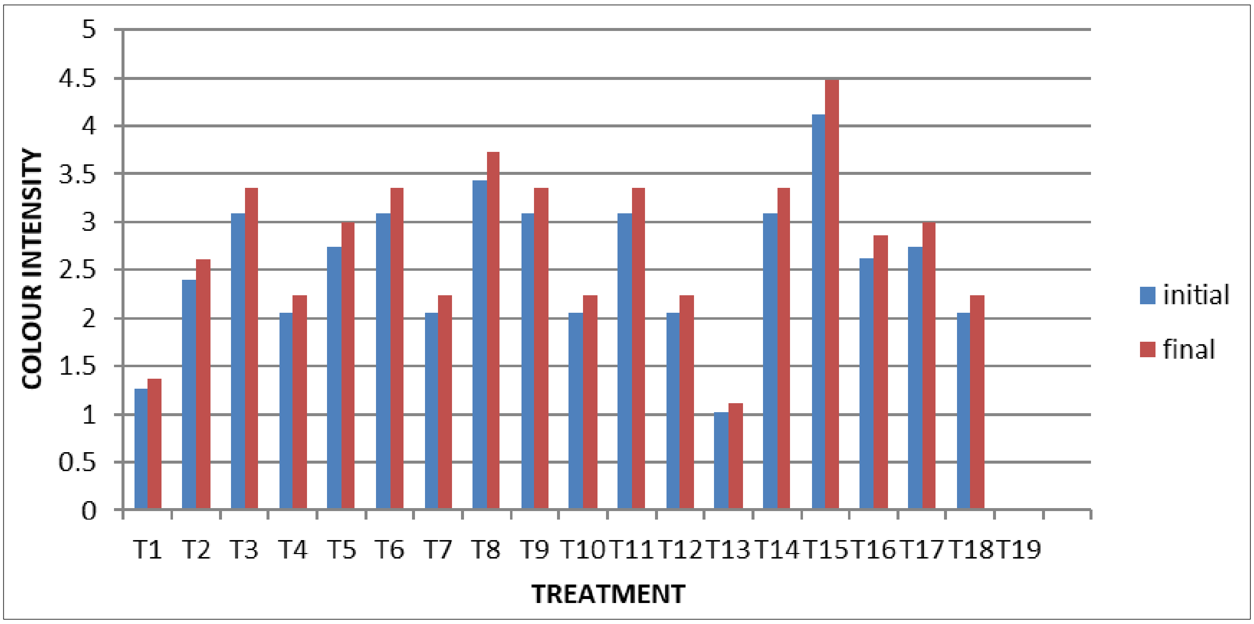

Fig 2: Colour Intensity

Floret opening (Percent)

There was a significant effect of varying levels of pH, sucrose and food colour on the colour intensity. Maximum floret opening (80.66 percent) was recorded with the treatment T_{15} (pH 5+ 4 percent sucrose + 40,000 ppm of royal blue colour) which was found to be significantly superior than all the other treatments followed by treatment T_3 (pH 3 + 4 percent sucrose + 40,000 ppm of royal blue colour)and T_6 (pH 3 + 6 percent sucrose + 40,000 ppm of dark pink colour) while the minimum floret opening (58.02 percent) was recorded on the spike dipped in treatment T_{19} (Tap water).

The per cent opening of florets was recorded to be more in tinting solution with sucrose and citric acid in almost all dyes. This may be due to availability of considerable quantity of respiratory substrate (sucrose) that ensures opening of immature florets and further with increase in immersion time more solutes could be located through xylem (Singh *et al.*, 2000). Hence, adding sucrose to the dye solutions increased opening of florets (Singh and Kumar 2008). Sucrose also increases the vase life of individual florets, may be due to its properties like preventing vascular blockages, greater solution uptake, lowering the petal pH, inhibition of starch hydrolysis with synthesis of starch, stabilizing the anthocyanin and acidifying holding solution, improved the vase life of florests. Similar result was obtained by Varu and Barad (2007) in tuberose.

Table 4: Effect of ph, sucrose and colour concentration on floret opening (%)

Notation	Treatment	Number of opened florets in a spike		
		Total number of flower buds in a spike (initial)	Opened florets in a spike (final)	Floret opening (%)
T_1	pH 3 + 4percent sucrose + 20,000 ppm of royal blue colour	42.85	25.02	7.64(58.38)
T_2	pH 3+ 4percent sucrose + 30,000 ppm of royal blue colour	42.45	29.30	8.30(69.02)
T_3	pH 3 + 4percentsucrose + 40,000 ppm of royal blue colour	32.26	25.04	8.80(77.61)
T_4	pH 3 + 6percent sucrose + 20,000 ppm of royal blue colour	44.26	29.83	8.20(67.24)
T_5	pH 3 + 6percentsucrose + 30,000 ppm of royal blue colour	48.55	31.06	7.99(62.97)
T_6	pH 3 + 6percent sucrose + 40,000 ppm of dark pink colour	41.76	30.37	8.52(72.72)
T_7	pH 4 + 4percent sucrose+ 20,000 ppm of royal blue colour	42.43	30.37	8.45(71.57)
T_8	pH 4 + 4percent sucrose+ 30,000 ppm of royal blue colour	47.77	32.51	8.24(68.05)
T_9	pH 4 + 4percent sucrose + 40,000 ppm of royal blue colour	38.81	27.71	8.44(71.39)
T_{10}	pH 4 + 6percent sucrose + 20,000 ppm of royal blue colour	52.78	31.44	7.71(59.56)
T_{11}	pH 4 + 6percent sucrose + 30,000 ppm of royal blue colour	46.71	30.9	8.16(66.14)
T_{12}	pH 4 + 6percent sucrose + 40,000 ppm of royal blue colour	41.58	27.71	8.13(66.64)
T_{13}	pH 5 + 4 percent sucrose+ 20,000 ppm of royal blue colour	45.11	28.78	7.98(63.79)
T_{14}	pH 5 + 4 percent sucrose +30,000 ppm of royal blue colour	41.17	28.78	8.36(69.90)
T_{15}	pH 5 +4 percent sucrose + 40,000 ppm of royal blue colour	44.40	35.84	8.98(80.66)
T_{16}	pH 5 + 6 percent sucrose + 20,000 ppm of royal blue colour	38.19	26.11	8.26(68.36)
T_{17}	pH 5 + 6 percent sucrose + 30,000 ppm of royal blue colour	41.88	27.17	8.05(64.87)
T_{18}	pH 5 + 6 percent sucrose + 40,000 ppm of royal blue colour	39.08	27.17	7.81(69.51)
T_{19}	Tap water (Control)	28.47	16.52	7.61(58.02)
S.Em±		0.23	0.96	0.78
C.D. at 5percent		NS	3.87	2.24

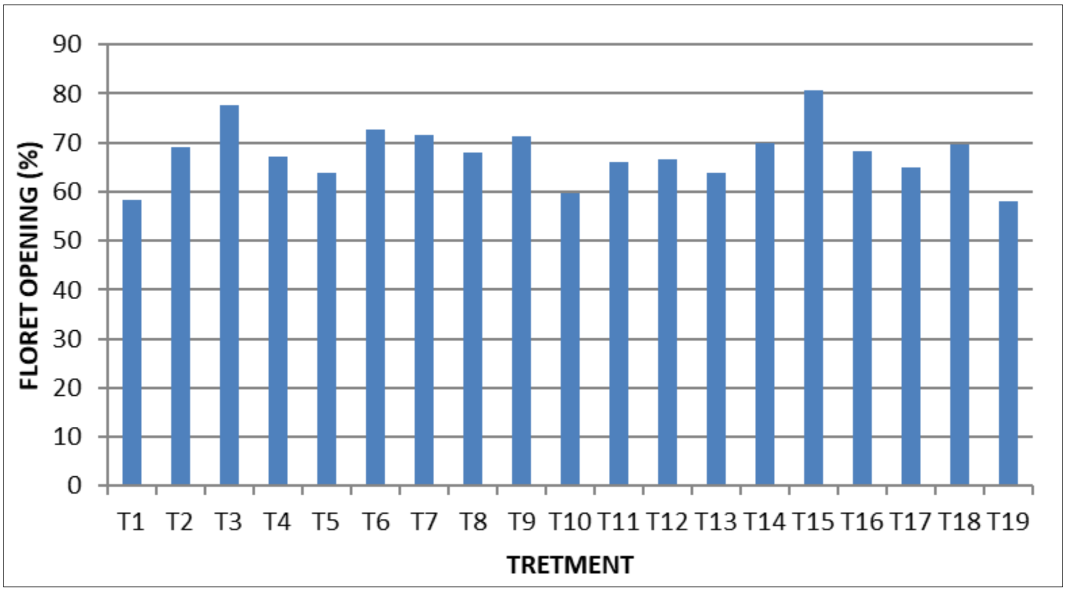

Fig 3: Floret Opening (%)

Water uptake and water loss ratio

The tinting of spikes with T_{15} (pH 5+ 4 percent sucrose + 40,000 ppm of royal blue colour) recorded maximum water uptake/ loss ratio per spike (1.57) which was significantly superior from all the other treatments while the minimum water uptake / loss ratio per spike (1.23) was obtained in T_{19} (Tap water) with a ratio of higher colour concentration of edible dye and pH of 5 percent may have lead to high water uptake and water loss ratio.

Sucrose might be acted to remove vascular blockage and increased absorption of water, ultimately increased the uptake of water in the spike. Sucrose keeps it free from microorganism and helps in preventing plugging of conducting tissues reduces transpiration and stabilize anthocyanin acidification and thereby resulting in greater solution uptake. Similar results were also obtained by Balakrishna *et al.* (1989), Varu and Barad (2008), Chakraborty *et al.*, (2010) in tuberose.

Table 5: Effect of ph, sucrose and colour concentration on water uptake and water loss ratio table

	Treatment	Uptake of water (gm)	Loss of water (gm)	Water uptake water loss ratio
T_1	pH 3 + 4percent sucrose + 20,000 ppm of royal blue colour	135.44	120.40	1.43
T_2	pH 3+ 4percent sucrose + 30,000 ppm of royal blue colour	138.33	122.30	1.37
T_3	pH 3 + 4percentsucrose + 40,000 ppm of royal blue colour	139.57	110.30	1.34
T_4	pH 3 + 6percent sucrose + 20,000 ppm of royal blue colour	139.83	130.23	1.37
T_5	pH 3 + 6percentsucrose + 30,000 ppm of royal blue colour	139.81	124.34	1.44
T_6	pH 3 + 6percent sucrose + 40,000 ppm of dark pink colour	135.44	125.44	1.44
T_7	pH 4 + 4percent sucrose+ 20,000 ppm of royal blue colour	138.33	124.33	1.37
T_8	pH 4 + 4percent sucrose+ 30,000 ppm of royal blue colour	139.57	122.24	1.33
T_9	pH 4+ 4percent sucrose + 40,000 ppm of royal blue colour	139.80	120.23	1.32
T_{10}	pH 4 + 6percent sucrose + 20,000 ppm of royal blue colour	139.81	115.51	1.45
T_{11}	pH 4+ 6percent sucrose + 30,000 ppm of royal blue colour	135.44	125.44	1.44
T_{12}	pH 4 + 6percent sucrose + 40,000 ppm of royal blue colour	138.41	118.33	1.45
T_{13}	pH 5+ 4 percent sucrose+ 20,000 ppm of royal blue colour	135.33	119.57	1.45
T_{14}	pH 5+ 4 percent sucrose +30,000 ppm of royal blue colour	137.57	119.83	1.37
T_{15}	pH 5+4 percent sucrose + 40,000 ppm of royal blue colour	149.83	110.81	1.57
T_{16}	pH 5+ 6 percent sucrose + 20,000 ppm of royal blue colour	139.81	125.44	1.49
T_{17}	pH 5+ 6 percent sucrose + 30,000 ppm of royal blue colour	135.44	118.33	1.46
T_{18}	pH 5+ 6 percent sucrose + 40,000 ppm of royal blue colour	138.30	119.57	1.47
T_{19}	Tap water (Control)	139.57	119.83	1.23
	$S.E_{m\pm}$	1.38	0.63	0.02
	C.D. at 5percent	1.40	0.70	0.06

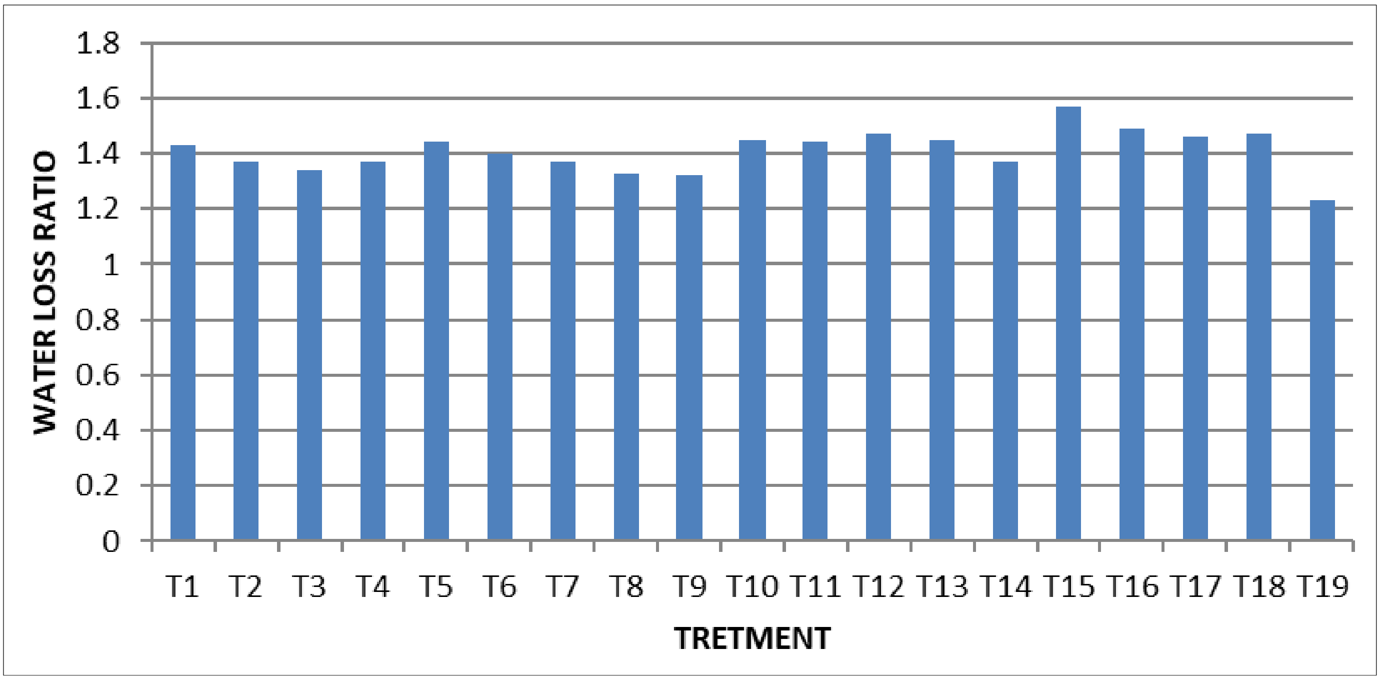

Fig 4: Water Loss Uptake Ratio

Vase life (day)

The data pertaining to vase life of tinted spikes as shown in Table 6 and illustrated in fig. 4. The vase life of non tinted spikes (T_{19}) was recorded to be 4.67 days and maximum vase life of tinted spikes (T_{15}) was recorded to be 12.00 days which was significantly superior. There was no such effect of food colour concentration on the vase life but the variation in vase life was particulary due to the effect of varying pH. Similar results were confirmed by Kumar *et al* (2003). Sucrose and levels of pH was also important and played a decisive role in enhancing vase life of cut spikes of tuberose (Khan *et al*., 2009). This emphasized on improvement of vase life by due to its role in pH of petal, stabilizing the anthocyanin and acidifying the holding water, thus reducing the bacterial growth and improving water uptake (Gowda 1990).

Table 6: Effect of pH, sucrose and colour concentration on effect of pH, sucrose and colour concentration on vase life

	Treatment	Vase life (days)
T_1	pH 3 + 4percent sucrose + 20,000 ppm of royal blue colour	5.78
T_2	pH 3+ 4percent sucrose + 30,000 ppm of royal blue colour	5.44
T_3	pH 3 + 4percentsucrose + 40,000 ppm of royal blue colour	6.11
T_4	pH 3 + 6percent sucrose + 20,000 ppm of royal blue colour	5.78
T_5	pH 3 + 6percentsucrose + 30,000 ppm of royal blue colour	7.22
T_6	pH 3 + 6percent sucrose + 40,000 ppm of dark pink colour	6.67
T_7	pH 4 + 4percent sucrose+ 20,000 ppm of royal blue colour	7.89
T_8	pH 4 + 4percent sucrose+ 30,000 ppm of royal blue colour	8.44
T_9	pH 4+ 4percent sucrose + 40,000 ppm of royal blue colour	8.33
T_{10}	pH 4 + 6percent sucrose + 20,000 ppm of royal blue colour	8.56
T_{11}	pH 4+ 6percent sucrose + 30,000 ppm of royal blue colour	8.33
T_{12}	pH 4 + 6percent sucrose + 40,000 ppm of royal blue colour	8.56
T_{13}	pH 5+ 4 percent sucrose+ 20,000 ppm of royal blue colour	8.22
T_{14}	pH 5+ 4 percent sucrose +30,000 ppm of royal blue colour	9.11
T_{15}	pH 5+4 percent sucrose + 40,000 ppm of royal blue colour	12.00
T_{16}	pH 5+ 6 percent sucrose + 20,000 ppm of royal blue colour	9.56
T_{17}	pH 5+ 6 percent sucrose + 30,000 ppm of royal blue colour	10.22
T_{18}	pH 5+ 6 percent sucrose + 40,000 ppm of royal blue colour	10.11
T_{19}	Tap water (Control)	4.67
	$S.E_{m\pm}$	0.12
	C.D. at 5percent	0.34

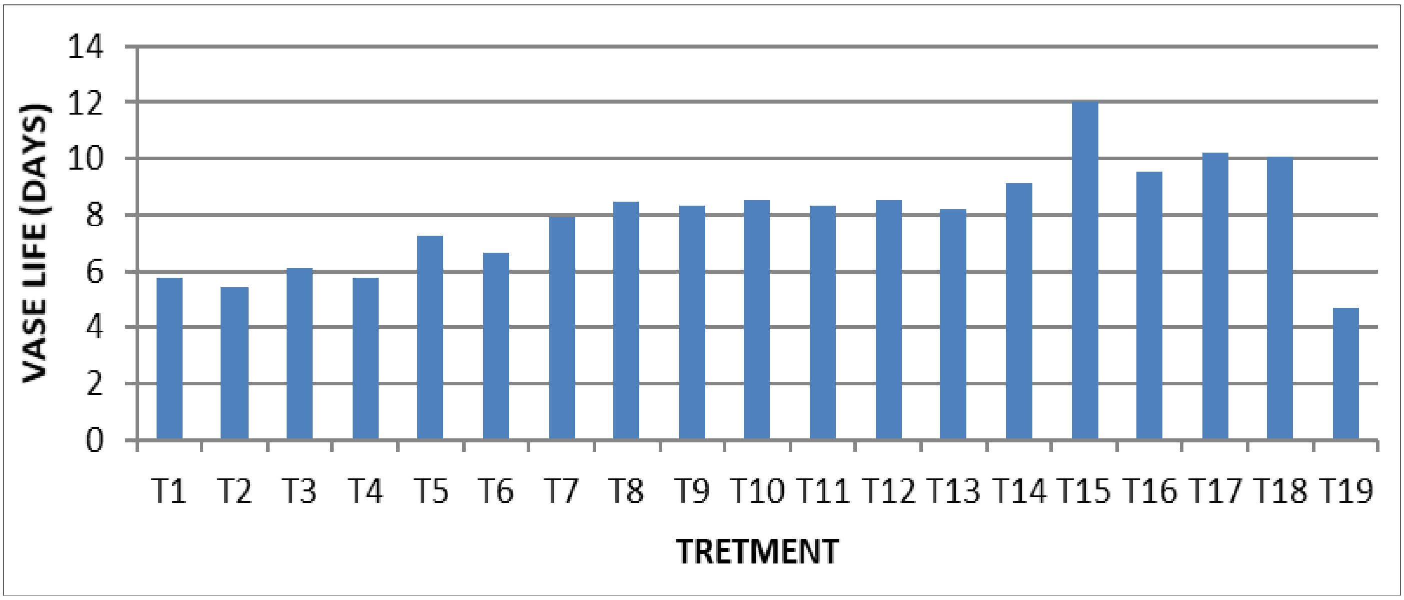

Fig 5: Vase Life (Days)

Spike length, also, has a great influence on the vase life of a flower. Longer spikes have more vase life than shorter spikes. Sangama and Singh (1999) evaluated that enhanced postharvest qualities of cut spikes could be obtained by selecting longer cut spikes of gladiolus cv. Pink Friendship. Barman and Rajni (2002) reported positive correlation between cut spikes length and vase life of gladiolus cv. Eight Wonder and hence longer cut spikes had more vase life

Value addition (Rs.)

There was a significant effect of varying levels of pH, sucrose and food colour on the value addition. Maximum benefit was recorded with the treatment T_{15} (pH 5+ 4 percent sucrose + 40,000 ppm of royal blue colour) while the minimum benefit obtained was with T_{19} (tap water).

Table 7: Effect of PHS, sucrose and colour concentration on value addition

	Treatment	Value addition (R.s)
T_1	pH 3 + 4percent sucrose + 20,000 ppm of royal blue colour	5.29
T_2	pH 3+ 4percent sucrose + 30,000 ppm of royal blue colour	5.15
T_3	pH 3 + 4percentsucrose + 40,000 ppm of royal blue colour	5.28
T_4	pH 3 + 6percent sucrose + 20,000 ppm of royal blue colour	4.23
T_5	pH 3 + 6percentsucrose + 30,000 ppm of royal blue colour	5.22
T_6	pH 3 + 6percent sucrose + 40,000 ppm of dark pink colour	6.22
T_7	pH 4 + 4percent sucrose+ 20,000 ppm of royal blue colour	7.22
T_8	pH 4 + 4percent sucrose+ 30,000 ppm of royal blue colour	8.15
T_9	pH 4+ 4percent sucrose + 40,000 ppm of royal blue colour	5.61
T_{10}	pH 4 + 6percent sucrose + 20,000 ppm of royal blue colour	6.84
T_{11}	pH 4+ 6percent sucrose + 30,000 ppm of royal blue colour	7.96
T_{12}	pH 4 + 6percent sucrose + 40,000 ppm of royal blue colour	8.84
T_{13}	pH 5+ 4 percent sucrose+ 20,000 ppm of royal blue colour	4.89
T_{14}	pH 5+ 4 percent sucrose +30,000 ppm of royal blue colour	6.44
T_{15}	pH 5+4 percent sucrose + 40,000 ppm of royal blue colour	9.20
T_{16}	pH 5+ 6 percent sucrose + 20,000 ppm of royal blue colour	7.44
T_{17}	pH 5+ 6 percent sucrose + 30,000 ppm of royal blue colour	6.29
T_{18}	pH 5+ 6 percent sucrose + 40,000 ppm of royal blue colour	2.13
T_{19}	Tap water (Control)	0.00
	$S.E_{m\pm}$	0.76
	C.D.(at 5percent)	1.97

The cost of coloured spike is generally higher than the white coloured spike in the market. It is observed that the cost of tinted spikes were dependent on the colour intensity During the normal season, the cost of coloured (tinted) tuberose spikes ranges from rupees 20 to 25 per spike while that of white flowers is 10 to 15 rupees. The benefit cost ratio can be obtained by dividing selling price of each tinted spikes (Rs.) with total cost involved in tinting (Rs.). So the maximum benefit cost ratio of tinted spikes was obtained in T_{15} and minimum in T_9.

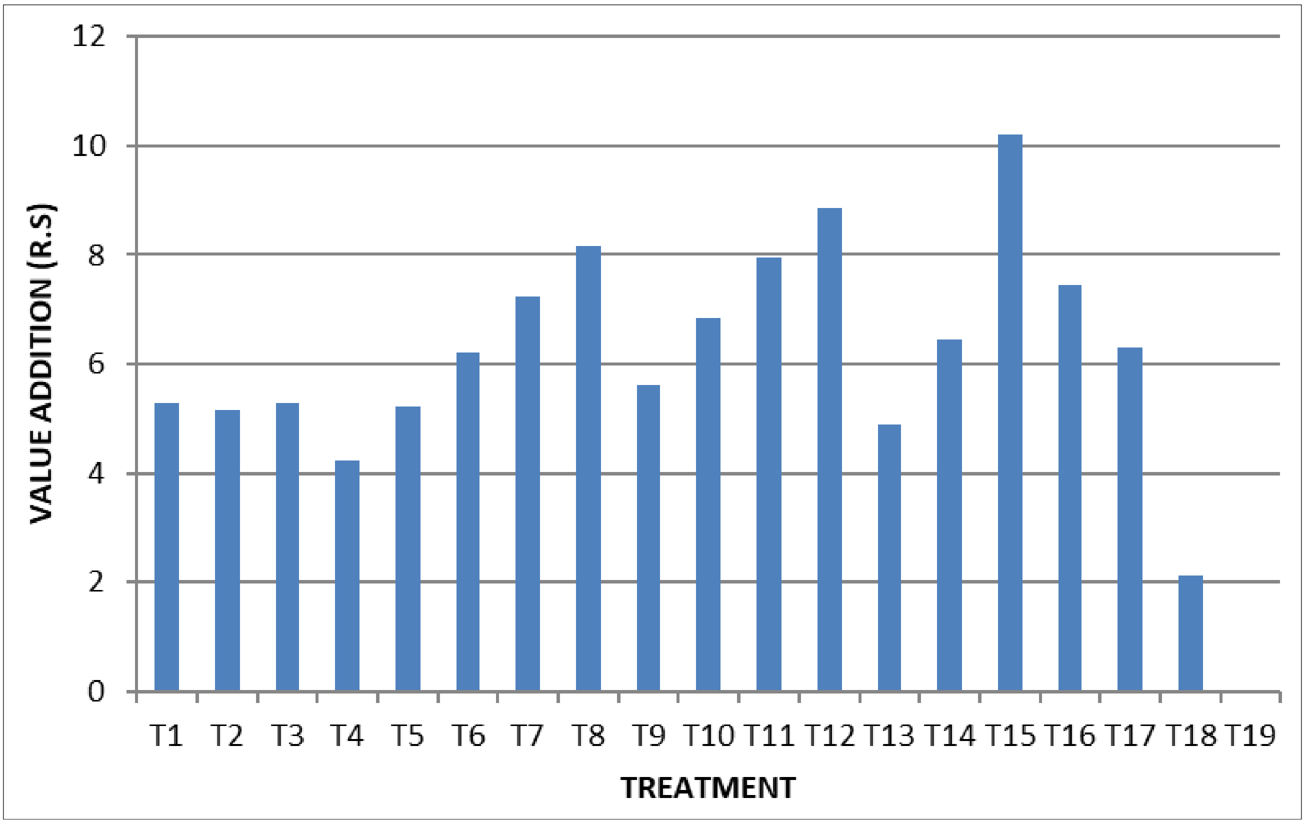

Fig 6: Value Addition (Rs.)

Fig 7: A view of the best result of colour intensity T_{15} (pH 5 + 4 per- cent sucrose +40,000 ppm of royal blue colour combination

Fig 8: A view of the study of vase life treatment T_{15} as compare to T_{19} (control)

Conclusion

From the present study, it can be observed that as treatment T_{15} (pH 5 + 4 percent sucrose + 40,000 ppm of royal blue colour)excelled in majority of parameters *viz*., physiological weight loss, less water loss, high colour intensity, more number of opened florets and prolonging vase life, we can conclude that it is beneficial and economical for tinting the tuberose flowers. Not only in terms of adding colour variation, but also enhancing other post harvest parameters and in terms of economy also, treatment T_{15} had a superior performance. Hence, it can be used for tinting tuberose flower for good results of obtaining color variation and also enhancing its vase life and durability.

Reference

1. Elgimabi MN. Vase life extension of rose cut flowers of Rosa hybrida as influenced by silver nitrate and sucrose pulsing. Amer J Aric Biol Sci. 2011;6:128-33.
2. Faraji S, Naderi R, Ibadli OV, Basaki T, Gasimov SN, Hosseinova S. Effects of post harvesting on biochemical changes in Gladiolus cut flower cultivar (White prosperity). Middle East J Sci Res.2 011;9:572-77.
3. Jeenbuntug J, Buanong M, Knlayanarat S. Study of sucrose pulsing treatment on physiological changes of tuberose (*Polianthes tuberosa*) after harvest. Acta Hortic. 2007;755:425-2.
4. Mekala P, Ganga M, Jawaharlal M. Artificial colouring of tuberose flowers for value Patil S and Dhaduk BK. Value addition of Lady’s Lace (*Pimpinella monoica*) cut flowers by colouring with edible dyes J Orna Hort. 2008-2012;11:32-36.
5. Patil SD, Patil HE.Value addition of candytuft (*Iberisum bellata*) cut flowers by coloured with edible dyes. Asian J Bio Sci. 2008;3:32-36.
6. Prashanth P, Sekhar RC, Reddy KCS. Influence of floral preservatives on scape bending, biochemical changes and postharvest vase life of cut gerbera (*Gerbera jamesoni* Bolus ex. Hook). Asian J Hort.2010;5:1-6.
7. Ranchana P, Ganga M, Jawaharlal M, Kannan M. Standardization of Tinting Techniques in China aster cv. Local White. Int. J Curr Microbiol App Sci. 2017;6:27.
8. Safeena SA, Thangam M, Singh NP. Value addition of tuberose (*Polianthes tuberose* L.) spikes by tinting with different edible dyes. Asian Journal of Research in Biological and Pharmaceutical sciences. 2016;4(3):89-98.
9. Kumari S, Deb P. Effect of tinting on value addition of tuberose (*Polianthes tuberose* L.) cv. prajwal. International Journal of bio-resources and stress Management.2 018;9(3):314-32.
10. Sowmeya S, Kumaresan S, Priya LS. Effect of multi colors in tinting techniques in cut flowers (Rose and Carnation).Chem Sci Rev lett. 2017;6(24):2250-2253.