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VALUE ADDITION OF TUBEROSE (*POLIANTHES TUBEROSA* L.) SPIKES BY TINTING WITH DIFFERENT EDIBLE DYES

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ABSTRACT

A series of experiments were conducted to evaluate the influence of colouring agents on vase life of cut spikes of two tuberose cultivars viz., Mexican Single and Pearl Double. The experiment was laid separately for both the cultivars. Treatments consisted of six different edible dyes viz., Tartrazine, Sunset yellow + Carmosine, Tartrazine + Brilliant blue, Tartrazine + Carmosine + Sunset yellow, Royal blue and Brilliant blue at three different concentrations (0.5%, 1 % and 1.5 %). Various colouring agents successfully induced colour in the cut spikes without affecting their vase life. Results obtained in colour retention at the end of vase life indicated that higher time of immersion (24 hours) and maximum concentration (1.5 %) allowed more dye to be translocated throughout the flower spike. In all treatments, there was no adverse significant effect of dye concentration, time of immersion and combination of both factors on the vase life and quality of tuberose cut spikes.

KEYWORDS

Colouring agents, Edible dyes, Mexican Single, Pearl Double, Spikes and Tuberose.

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INTRODUCTON

Tuberose (*Polianthes tuberosa* L.) is one of the most important tropical ornamental bulbous flowering plants known for its attractive and fragrant long lasting flower spikes. It is popularly known as Rajanigandha or Nishigandha and belongs to the family Amaryllidaceae. It is an important commercial cut as well as loose flower crop due to pleasant fragrance, longer vase-life of spikes, higher returns and wide adaptability to varied climate and soil. Florets of the Single type (single row of perianth) are commonly used for extraction of essential oil, loose flowers, making artistic garlands, floral ornaments, buttonholes, gajras, as offering at

social and religious functions etc. The spikes of Double types (more than two rows of perianth) are used as cut flowers for table decorations, floral arrangements, garden display, floral arrangements and interior decoration. Due to the white colour of the spikes, the growers of tuberose often face the problem of marketing in the peak season of flowering. It is marvellous to have tuberose spikes with blue, red or yellow florets instead of white ones in vase or bouquets with better vase life and keeping quality. A produce when subjected to a change for higher profit, is termed as value addition. Value added tuberose spikes can provide a great variety of colours for aesthetic beautification. Tinting the cut spikes of tuberose with dye chemicals can really enhance the value of these flowers and helps the farmers in earning more from their produce. If farmers could readily adopt this simple technique of artificial colouring of spikes, they can earn more profit by realization of higher prices as compared to white cut flowers. With this background the present investigations were undertaken to evaluate the ability of cut spikes of tuberoses to obtain and retain different colour shades for the elimination of limited acceptability in market because of its white colour.

MATERIAL AND METHODS

The present investigation to evaluate the influence of colouring agents on quality and vase life of cut spikes of two tuberose (*Polianthes tuberosa* L.) cultivars viz., Mexican Single and Pearl Double was carried out in the Laboratory of Horticulture Science Section, ICAR - Central Coastal Agricultural Research Institute, Ela, Old Goa during the year 2014-15.

Plant material

Flower spikes of two tuberose cultivars viz., Mexican Single and Pearl Double were used in the present study.

Experimental design

Flower spikes of two tuberose cultivars viz., Mexican Single and Pearl Double were immersed in six different edible food dyes for three different times of immersion ie) 4 hours (T_1), 15 hours (T_2) and 24 hours (T_3). The edible food dyes used in the present experiment were Tartrazine (D_1), Sunset yellow + Carmosine (D_2), Tartrazine + Brilliant blue (D_3), Tartrazine + Carmosine + Sunset yellow (D_4), Royal blue (D_5) and Brilliant blue (D_6). Food dyes are food colours available in the market. Dye solution was prepared by properly mixing dyes in distilled water. There is growing eco - consciousness towards the use of natural and organic colours (Sankat and Siddique., 2008)[1] for dyeing as natural dyes are non-toxic and do not create environmental problems due to their bio-degradable nature (Grover and Patni, 2011)[2]. After treatment, the basal portions of the tuberose flower stalks were dipped in molten wax which arrested leaking of the chemicals and flower discoloration and were kept in water-filled vases. The experimental design adopted was CRD with three replications.

Based on the results of this experiment-I, best time of immersion (24 hours: T_3) was chosen to determine the best dye chemical and its concentration. The dye chemical and its concentration required for immersion of flower spike were standardised by immersing the flower spikes for 24 hours in six different dye chemicals at three different concentrations. The experiment comprised of six different dye chemicals viz., Tartrazine (D_1), Sunset yellow + Carmosine (D_2), Tartrazine + Brilliant blue (D_3), Tartrazine + Carmosine + Sunset yellow (D_4), and Royal blue (D_5) at three different concentrations (((0.5%, (C_1), 1% (C_2) and 1.5% (C_3)). Coloured solution of 0.5%, 1% and 1.5% concentrations were prepared by dissolving 5,000 mg/l; 10,000 mg/l and 15000 mg/l of colour dye in one litre of distilled water.

Observations such as Volume of water uptake, Vase life, Colour, Appearance / Shape, Freshness, Petal retention, Overall acceptability etc were recorded. Sensory evaluation was carried with a panel of judges. Panel of judges assessed the different flower quality parameters by scoring on a five-point scale *i.e.* very bad, bad, good, very good and excellent with the weight age of 0-0.9, 1.0-1.9, 2.0-2.9, 3.0-3.9, 4.0-5.0 respectively by means of sensory evaluation.

Statistical analysis

Treatments were arranged in a completely randomised design (CRD) with three replications for each treatment. The data on all qualitative and quantitative parameters were subjected to statistical

analysis as per the procedure outlined by Panse and Sukhatme (1985)[3]. The results have been presented and discussed at a probability level of 0.05 or 5 percent probability.

RESULTS AND DISCUSSION

Overall acceptability of tuberose Cv. Mexican Single as influenced by different time of immersion in dye chemicals

The result obtained on the effect of different time of immersion on overall acceptability of flower spikes of tuberose cv. Mexican Single is presented in Table No.1. Result of scores given by the panel members during sensory evaluation of tuberose flower spikes cv. Mexican Single for overall acceptability (Table No.1.) shows that the colour shade obtained on the flower spike was directly dependant on the time of immersion. The score for overall acceptability of tuberose spikes differed significantly due to different time of immersion. The treatment D_2T_1 gave the lightest shade for orange red dye and the darkest shade was observed in D_2T_3 with highest score for overall acceptability. Similar results were obtained with respect to different time of immersion for overall acceptability of tuberose spikes immersed in different edible dyes (Table No.1). It was observed that lesser time of immersion (4 hours) showed the lightest shade of dyes. The shades of the colour deepened as the time of immersion was increased. Among the different times of immersion, the overall acceptability score was highest in tuberose spikes cv. Mexican Single immersed for longer duration (24 hours) which received the maximum score of 4.667, 4.250, 4.033, 3.542, 3.042 and 1.750 for the treatments T_2,T_3 ,T_1 ,T_4 ,T_6 and T_5 respectively. Jeom *et al.*, 2013[4] made possible rainbow - coloured rose by dipping cultivar 'Denice' with three primary colour combination, Hot Pink, True Blue, and Yellow dyes, at the best result conditions of 20℃ solution temperature, 3-4 petals opening stage, 11g/L concentration of dye solution and 3 hours dipping, respectively.

Overall acceptability of tuberose Cv. Pearl double as influenced by different time of immersion in dye chemicals

The results obtained on the effect of different time of immersion on overall acceptability of flower spikes of tuberose Cv. Pearl Double is presented in Table No.2. In Cv. Pearl Double also, similar trend was observed wherein, the overall acceptability score was highest in spikes immersed for longer duration (24 hours) which received the maximum score of 4.342, 4.25, 3.657, 3.208, 3.183 and 1.4 for the treatments T_2,T_3 ,T_1 ,T_4 ,T_6 and T_5 respectively. Thus longer time of immersion was significantly superior for overall acceptability as indicated by tuberose flower immersed for 24 hours recording the highest score, while those immersed for short duration (4 hours) received least points for the same. Similar results were obtained in all the edible dyes which were used for the experiment viz., Tartrazine (D_1), Sunset yellow + Carmosine (D_2), Tartrazine + Brilliant blue (D_3), Tartrazine + Carmosine + Sunset yellow (D_4), Royal blue (D_5) and Brilliant blue (D_6). Lourdusamy *et al.*, 2002[5] reported that the time of dyeing was uniform for all groups with 5, 6 and 7 h for 5, 10 and 15 min of immersion respectively. Colour fading levels were low in gomphrena flowers for the vat group except basic red, compared to the other groups. Ki-Byung Lim *et al.*, 2002[6] opined that dyeing of cut rose 'Akito' using 12 different colours realized various decorative colours available that increased the market value.

Quality attributes of tuberose Cv. Mexican Single as influenced by different edible dyes and their concentrations

Based on the results obtained from the Experiment I to standardise the time of immersion, the best time of immersion (24 hours) was chosen to determine the optimum scores for Colour, Appearance / shape, Freshness, Petal retention and overall acceptability of tuberose spikes. Six different edible dyes viz., Tartrazine (Lemon yellow), Sunset yellow + Carmosine (Orange red), Tartrazine + Brilliant blue (Apple green), Tartrazine + Carmosine + Sunset yellow (Orange) , Royal blue (D_5) and Brilliant blue at three different concentrations (0.5%, 1% and 1.5%) were used for immersion of tuberose spikes. The tuberose spikes were immersed in the edible dyes for 24 hours. Observations with respect to Colour, Appearance / shape, Freshness, Petal retention and overall acceptability are discussed below. Colour of tuberose flower spike Cv. Mexican Single as affected by different edible dyes and their different concentrations is presented in

Table No.3. The edible dyes as well as their concentration influenced the colour of tuberose spikes significantly. The lower concentration (0.5%) of dyes showed the lightest shade of dyes. The shades of the colour deepened as the concentration of the dye was increased. Among the different treatments, D_2 X C_3 gave the highest scores for Colour which recorded maximum score of 4.500 while least score was recorded in the D_5 X C_1 wherein the flower spikes was immersed in royal blue at 0.5 % concentration. Sunset yellow + Carmosine (Orange red) was superior for retention of good colour, which scored maximum points followed by Tartrazine + Brilliant blue (Apple green). Least score for colour was recorded by flower spikes immersed in Royal blue. Bharati *et al*. (2016)[7] opined that colour intensity and colour absorption in case of food dyes were medium to high in ornamental grass *Lagurus ovatus*. Sravan Kumar *et al.,* 2015[8] could impart different shades of respective colours in spikes of gladiolus cultivar white prosperity pulsed with 5% of food dye solution *i.e*. Lemon yellow, Kesar yellow, Kalakatta, Tomato red, Violet, Blue, Orange red and Apple green for two hours. Development of different shades of blue, red, scarlet, rose and yellow by dipping tuberose spikes in different stains was also previously reported by Sambandamurthy and Appavu (1980)[9]. Imparting different colour shades in tuberose by using different stains was made possible by Sangama (2002)[10].

Scores given by the panel members for Appearance / shape, Freshness, Petal retention and overall acceptability during sensory evaluation of tuberose flower spikes Cv. Mexican Single is depicted in Table No.3. The treatment D_2 X C_3 gave the highest scores for Appearance / shape, Freshness, Petal retention and overall acceptability. This can be attributed to higher dye concentration absorbed by the flowers. The higher time of immersion (24 hours) and maximum concentration (1.5 %) allowed more dye to be translocated upto the terminal buds of the tuberose flower spike. The treatment D_2 X C_3 was followed by Tartrazine + Brilliant blue (Apple green) and Tartrazine (Lemon yellow) which recorded scores of 4.250 and 3.720 respectively for overall acceptability. The least score for Colour, Appearance / shape, Freshness, Petal retention and overall acceptability was observed in the treatment D_5 X C_1 (Royal blue). The study conducted by Byun *et al*. (2004)[11] resulted in optimum dyeing condition for artificial blue and green pigments in *Rosa hybrida* Cv. Taeinhe cut flowers at 25^0C and dipping for 60 minutes was found to be best without any adverse effect on vase life. Degree of dyeing state depended on dyeing time and temperature and the colour retention was good in the flowers at the end of the vase life.

The vase life of the tuberose spikes was recorded in all the different treatments. Various colouring agents successfully induced colour in the cut spikes without affecting their vase life. Results obtained in colour retention at the end of vase life indicated that higher time of immersion (24 hours) and maximum concentration (1.5 %) allowed more dye to be translocated throughout the flower spike. In the present study, there was no significant adverse ill effect of dye concentration, time of immersion and combination of both factors on the vase life and quality of the tuberose flower spikes cv. Mexican Single. This can be attributed to the fact that the edible dyes used in the experiment were not toxic to cell metabolism. As a result, no obstruction was created for movement of water and food materials. Hence osmotic pressure of the cell will not be affected thus not altering the cell turgidity. Hence for quicker results, 24 hours of immersion and higher concentration of C3 (1.5 %) can be used for dyeing the flowers without affecting the quality and vase life of cut flower spikes of tuberose. Vinod Kumar *et al.,* (2003)[12] in their series of experiments with five colouring agents (for each chemical 0.1 per cent concentration and 5 hours pulsing duration) induced colour successfully without affecting the vase life of cut spikes of tuberose cv. Suvasini. Sudha and Harshal, 2008[13], reported that higher concentration (1.5 %) can be used for dyeing the flowers without affecting the quality and vase life of cut flowers of candytuft.

Quality attributes of tuberose cv. Pearl Double as influenced by different edible dyes and their concentrations

Observations with respect to Colour, Appearance / shape, Freshness, Petal retention and overall acceptability of tuberose flower spike Cv. Pearl Double as affected by different edible dyes and their

different concentrations is presented in Table No.4. Similar trend was observed wherein the edible dyes as well as their concentration influenced the colour of tuberose spikes Cv. Pearl Double significantly. The lower concentration (0.5 %) of dyes showed the lightest shade of dyes. The shades of the colour intensified as the concentration of the dye was raised. Among the different treatments, D_2 X C_3 gave the highest scores (4.750) for Colour while least score (1.25) was recorded in the D_5 X C_1 wherein the flower spikes was immersed in royal blue at 0.5 % concentration. The flower spikes of Cv. Pearl Double which was immersed in Sunset yellow + Carmosine (Orange red) was superior for retention of good colour, which scored maximum points followed by Tartrazine + Brilliant blue (Apple green). Pathak *et al.,* 2008[14] reported that the tuberose cut spikes can be immersed in edible dyes *viz.,* carmosine red, sunset yellow and tetrazine blue solution at 0.3% concentration to obtain desired colour shades of red, yellow and blue, respectively. Viradia *et al.,* 2015[15] reported that at higher concentration with higher absorption time obtained dark colour shade of spike in tuberose Cv. Double.

Scores given by the panel members for qualitative traits like Appearance / shape, Freshness, Petal retention and overall acceptability during sensory evaluation of tuberose flower spikes Cv. Pearl Double is shown in Table No.4. The treatment D_2 X C_3 gave the highest scores for Appearance / shape, Freshness, Petal retention and overall acceptability with values of 5.250, 4.750, 4.250 and 4.775 respectively. The higher time of immersion (24 hours) and maximum concentration (1.5 %) allowed more dye to be translocated upto the terminal buds of the flower spike of Cv. Pearl double. The treatment D_2 X C_3 was followed by Tartrazine + Brilliant blue (Apple green) and Tartrazine (Lemon yellow) which recorded scores of 4.275 and 3.970 respectively for overall acceptability. The least score for Colour, Appearance / shape, Freshness, Petal retention and overall acceptability was observed in the treatment D_5 X C_1 (Royal blue). It was reported that, the treatment of immersion in edible dyes *viz*., carmosine red, sunset yellow and tetrazine blue solution at 0.3% concentration (3 g/l water) for 1 hour in tuberose cut spikes impart different shades of red, yellow and blue (Chawla, 2009)[16]. Experiments on colour induction were conducted earlier by Patil and Dhaduk (2005)[17] in Candytuft cut flowers.

The vase life of the tuberose spikes of Cv. Pearl Double was recorded in all the different treatments. Different dye chemicals used in the experiment effectively induced colour in the cut spikes of Cv. Pearl Double without affecting their vase life. Results obtained in colour retention at the end of vase life indicated that higher time of immersion (24 hours) and maximum concentration (1.5 %) allowed more dye to be translocated throughout the flower spike as observed in Cv. Mexican Single. There was no adverse ill effect of dye concentration, time of immersion and combination of both factors on the vase life and flower spike quality in Cv. Pearl Double also. The edible dyes must not be interfering with the activities of the florets opening in the spikes thus leaving no significant effect on the opening of the florets on any of the days after immersion in dyes till the end of vase life of the spikes as reported by Anjali *et al*., 2014[18]. The edible dyes used in the experiment did not alter the cell metabolism. Hence no barrier was formed for movement of water and food materials. Therefore osmotic pressure of the cell will not be affected thus not altering the cell turgidity. Patil Sudha and Dhaduk (2008)[19] reported that there was no adverse significant effect of dye concentration, time of immersion and combination of both factors on the vase life and quality of lady's lace. The results of the present study were also in agreement with the earlier reports by Dhaduk and Naik (2003)[20] in tuberose cv. Single local and Double local using Carmozine red, Tetrazine yellow and Falsa blue wherein the vase life of the flower spikes was not affected.

Table No.1: Effect of different time of immersion on overall acceptability of flower spikes of tuberose Cv. Mexican Single

S.No	Treatments	Tartrazine (D_1) (Lemon yellow)	Sunset yellow + Carmosine (D_2) Orange red	Tartrazine + Brilliant blue (D_3) Apple green	Tartrazine + Carmosine + Sunset yellow (D_4)(Orange)	Royal blue (D_5)	Brilliant blue (D_6)
1	T_1 (4 hours)	2.417	3.750	3.292	2.667	1.067	2.083
2	T_2 (15 hours)	3.083	4.083	3.817	3.167	1.500	2.667
3	T_3 (24 hours)	4.033	4.667	4.250	3.542	1.750	3.042
4	SEm	0.367	0.097	0.173	0.104	0.093	0.151
5	C.D (P=0.05)	1.101	0.293	0.520	0.313	0.280	0.452

Table No.2: Effect of immersion time on overall acceptability of flower spikes of tuberose Cv. Pearl Double

S.No	Treatments	Tartrazine (D_1) (Lemon yellow)	Sunset yellow + Carmosine (D_2) Orange red	Tartrazine + Brilliant blue (D_3) Apple green	Tartrazine + Carmosine + Sunset yellow (D_4)(Orange)	Royal blue (D_5)	Brilliant blue (D_6)
1	T_1 (4 hours)	2.250	3.750	3.192	2.183	0.780	1.525
2	T_2 (15 hours)	3.067	4.083	3.747	2.800	1.142	2.250
3	T_3 (24 hours)	3.657	4.342	4.250	3.208	1.400	3.183
4	SEm	0.276	0.094	0.132	0.135	0.149	0.372
5	C.D (P=0.05)	0.828	0.282	0.396	0.405	0.446	1.115

Table No.3: Effect of different edible dyes and their concentration on quality attributes of flower spikes of tuberose Cv. Mexican Single

S.No	Treatments		Volume of water uptake	Vase life	Colour	Appearance / shape	Freshness	Petal retention	overall acceptability
1	Tartrazine (D_1) (Lemon yellow)	D_1 X C_1	31.950	4.050	3.000	2.500	1.750	2.500	2.500
		D_1 X C_2	5.950	4.100	4.250	3.000	2.000	3.750	3.450
		D_1 X C_3	12.950	4.050	4.350	4.500	3.250	4.000	3.720
2	Sunset yellow + Carmosine (D_2) Orange red	D_2 X C_1	19.050	4.100	3.875	3.500	3.875	3.625	3.750
		D_2 X C_2	6.050	4.050	4.000	4.000	4.250	3.875	4.125
		D_2 X C_3	44.950	4.000	4.500	5.00	4.500	4.000	4.525
3	Tartrazine + Brilliant blue (D_3) Apple green	D_3 X C_1	41.950	4.100	3.750	3.125	3.000	3.250	3.325
		D_3 X C_2	29.050	4.050	4.200	4.000	3.250	4.000	3.990
		D_3 X C_3	28.050	4.100	4.500	4.250	4.000	4.500	4.250
4	Tartrazine + Carmosine + Sunset yellow (D_4) (Orange)	D_4 X C_1	34.950	4.050	2.000	2.500	1.750	2.500	2.300
		D_4 X C_2	32.050	3.950	2.750	2.750	2.500	3.000	2.900
		D_4 X C_3	31.950	4.050	3.000	3.500	2.625	3.750	3.175
5	Royal blue (D_5)	D_5 X C_1	21.950	4.100	1.000	1.200	1.000	0.500	0.840
		D_5 X C_2	17.950	4.100	1.750	1.250	1.500	0.750	1.175
		D_5 X C_3	11.950	4.050	2.000	1.500	1.750	1.000	1.450
6	Brilliant blue (D_6)	D_6 X C_1	25.950	3.050	2.500	3.00	2.500	0.625	2.250
		D_6 X C_2	19.950	4.100	3.000	3.500	3.000	1.00	2.750
		D_6 X C_3	25.950	4.050	3.500	3.625	3.500	2.000	3.125
7	SEm		0.049	0.072	0.235	0.251	0.406	0.157	0.349
8	C.D at 5%		0.149	0..216	0.706	0.753	0.812	0.471	1.047

Table No.4: Effect of different edible dyes and their concentration on quality attributes of flower spikes of tuberose Cv. Pearl Double

S.No	Treatments		Volume of water uptake	Vase life	Colour	Appearance / shape	Freshness	Petal retention	overall acceptability
1	Tartrazine (D_1) (Lemon yellow)	D_1 X C_1	32.200	4.300	3.250	2.750	2.000	2.750	3.000
		D_1 X C_2	6.200	4.350	4.450	3.250	2.250	4.000	3.700
		D_1 X C_3	13.200	4.300	4.525	4.275	3.500	4.250	3.970
2	Sunset yellow + Carmosine (D_2) Orange red	D_2 X C_1	19.400	4.350	4.125	3.750	4.125	3.875	4.000
		D_2 X C_2	6.400	4.300	4.250	4.250	4.500	4.125	4.375
		D_2 X C_3	45.300	4.250	4.750	5.250	4.750	4.250	4.775
3	Tartrazine + Brilliant blue (D_3) Apple green	D_3 X C_1	42.250	4.350	4.000	3.375	3.250	3.500	3.575
		D_3 X C_2	29.350	4.300	4.500	4.250	3.500	4.250	4.240
		D_3 X C_3	28.350	4.125	4.600	4.750	4.025	4.525	4.275
4	Tartrazine + Carmosine + Sunset yellow (D_4) (Orange)	D_4 X C_1	35.200	4.300	2.250	2.750	2.000	2.750	2.550
		D_4 X C_2	32.300	4.200	3.000	3.000	2.750	3.250	3.150
		D_4 X C_3	32.200	4.300	3.250	3.750	2.875	4.000	3.425
5	Royal blue (D_5)	D_5 X C_1	22.150	4.350	1.250	1.250	1.100	0.750	1.325
		D_5 X C_2	18.150	4.350	2.000	1.500	1.650	1.000	1.650
		D_5 X C_3	12.150	4.300	2.250	1.750	1.950	1.250	1.940
6	Brilliant blue (D_6)	D_6 X C_1	26.200	3.300	2.750	3.250	2.750	0.875	2.500
		D_6 X C_2	20.200	4.350	3.250	3.750	3.250	1.250	3.000
		D_6 X C_3	26.200	4.300	3.750	3.875	3.750	2.250	3.375
7	SEm		0.027	0.029	0.03	0.038	0.036	0.029	0.035
8	C.D at 5%		0.080	0.088	0.09	0.114	0.107	0.088	0.107

Figure No.1: Spikes of Cv. Mexican single immersed in different edible dyes (1.5 %) Concentration

Figure No.2: Spikes of Cv. Pearl Double immersed in different edible dyes (1.5 %) Concentration

CONCLUSION

Hence for quicker results 24 hours of immersion and higher concentration of C_3 (1.5 %) can be used for dyeing the flowers without affecting the quality and vase life of cut flower spikes of tuberose. The tuberose growers can adopt colouring technique by using edible dyes in white tuberose for inducing different colours as value addition. Value addition ensures high premium to the tuberose grower, while providing more acceptable quality products for the market.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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