International Journal of Research in Agricultural Sciences
Volume 12, Issue 2, ISSN (Online): 2348 – 3997

Influence of Post-Harvest Calcium Chloride and Sodium Chloride Treatments on Physical and Sensory Attributes of Pear CV. Gola under Ambient Storage Conditions

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Date of publication (dd/mm/yyyy): 27/04/2025

Abstract **– An experiment was carried out in year 2024 mid of July-August at Horticulture Laboratory, School of Agricultural Sciences, Shri Guru Ram Rai University, Pathri Bagh, Dehradun to study the influence of postharvest calcium chloride and sodium chloride treatment at different concentrations on physical and sensory attributes of pear cv. Gola under ambient storage conditions. The experiment was laid out in completely randomized design with three replications and ten treatments. Freshly harvested pear fruits were treated with different $CaCl_2$ and NaCl concentrations (1, 1.5 and 2%) for 15 min. The various physical and sensory attributes were studied at different sampling dates (0, 5, 10, 15 and 20th days after treatment). Results revealed that, among different treatments, T_8 ($CaCl_2$ @ 1.5% + NaCl @ 1.5%) was found to be the most effective treatment in terms of fruit length (5.02 cm), fruit diameter (4.6 cm), fruit circumference (4.1 cm), fruit weight (97.54g), fruit volume (108.0 ml). Whereas, treatment T_5 (NaCl @ 1.5%) was found to be the most effective treatment for scoring of sensory attributes *viz.* colour (8.00), taste (8.25), texture (8.25), flavour (7.24) and overall acceptability (7.96).**

Keywords **– Pear, $CaCl_2$, NaCl, Fruit Length, Fruit Weight, Fruit Circumference, Sensory Attributes.**

I. INTRODUCTION

Pear (*Pyrus communis* L.) is occupies an important place among temperate fruit crops after apple in terms of acreage, production and varietal diversity, also it is grown under both temperate as well as subtropical conditions. It belongs family Rosaceae with chromosome number 2n = 34. It is considered to be second of deciduous and fourth among all fruits in its global distribution (FAOSTAT, 2023). It is native to coastal and mildly temperate regions of the Old World, from Western Europe and North Africa east right across Asia. It can tolerate as low as -26°C temperature when dormant and as high as 45°C during growing period. The presence of almost all amino acid makes the fruit nutritionally superior to others. It has anti-carcinogenic, antioxidant and anti-hypoglycemic effects due to presence of several phytochemicals. Pear fruit also contains health promoting bioactive compounds such as carotenoids, anthocyanins, flavones, quercetin, kaempferol, isorhamnetin and plant sterols **(**Andreotti *et al.*, 2022). In Uttarakhand, harvesting of pear starts around July and continues up to September. Generally, this period coincides with heavy rainfall and high temperature which is not conducive for retaining post-harvest quality of fruits and therefore, so have adverse effects on fruit marketability (Dhatt *et al.*, 2003). The growers are forced to sell their produce during this period at very low prices. Pear fruit is a typical climacteric fruit that undergoes increase in respiration with aburst of ethylene production during ripening. As ripening process in pears proceeds quickly, the fruit consumption period is limited and therefore fruits are

transported to markets prior to the stage of their optimum eating quality. Various attempts have been made factually for retaining the storability of different horticultural produce by using various chemicals with variable success rate in different fruit. $CaCl_2$ is well recognized as the commercial fruit firming agent and its post-harvest application has been reported to enhance storability of different fruit via complexed formation with pectic substances like calcium pectate which acts as a cementing material to hold the cellular network together (Ahmad 2008; Dhatt *et al.,* 2004; Sandhu *et al*., 2004 and Bhat *et al.,* 2011). The major portion of calcium is located in the cell wall middle lamella and plasma membrane, where its major role is in lowering down the senescence and ripening of the fruits (Chardonnet *et al.,* 2003). While sodium chloride is widely used as a food additive, few studies have examined it as a postharvest treatment to inhibit browning of fresh-cut produce (Tortoe *et al.,* 2007 and Li *et al.,* 2014). Apart from its acceptability as a food additive, sodium chloride would seem to offer economic advantages due to its very low cost particularly in relation to ascorbate, etc. Literature search indicates that there is limited systematic research work available on postharvest aspects of pear fruit, particularly with respect to 'Gola' cultivar using calcium chloride and sodium chloride. Therefore, the purpose of the current study was to examine how the dipping treatments of calcium chloride and sodium chloride affects the physical and sensory attributes of pear as well as to exploit market potential for fresh fruits and for retaining their storage quality.

II. MATERIALS AND METHODS

Present experiment was under taken at Horticulture laboratory, Department of Horticulture, School of Agricultural Sciences, Shri Guru Ram Rai University, Pathri Bagh, Dehradun, Uttarakhand, India during July-August, 2024 to study the influence of postharvest calcium chloride and sodium chloride treatment at different concentrations on physical and sensory attributes of pear cv. Gola under ambient storage conditions. For the experiment, freshly harvested pear fruits cv. 'Gola' were procured from the high hills of Dangri village, District Pauri - Garhwal (Uttarakhand) to the Horticulture Laboratory, Department of Horticulture on 27 July, 2024. Fully mature pear fruits, using skin colour as a maturity index were collected in cartons and brought to the Horticulture Laboratory. Healthy fruits of uniform shape and size free from any mechanical injuries and defect were sorted, graded and selected for execution of experimental treatment. The selected fruits were pre-cooled with running tap water to remove microbial loads, dusts, dirt and other pesticidal impurities etc. The fruits were distributed into 30 different slots according to the treatment. Each slot were consists of 25 fruits. After that, for treatment application, fruits were dipped in different concentrations of $CaCl_2$ and NaCl according to treatment combinations. The fruit lots were stored at ambient temperature (23.8ºC and 84% RH). The treated fruits were subjected to various physical and sensory evaluation at 0, 5, 10, 15 and 20 days after treatment application. The data was analyzed as per standard methods Panse and Sukhatme (1967). Consumer preferences for experimental fruit samples were assessed through sensory evaluation performed at various intervals during storage by a panel of 10 semi-trained judges. The panelists were given coded samples consisting of whole fruits and slices for giving their views on overall acceptability of fruit on the basis of colour, taste, texture, flavour and overall acce--ptability. The evaluation was done by using the 9-point hedonic scale for each attribute (Amerine *et al*., 1965).

Table 1. Treatment combinations with their concentrations.

Treatments	Treatment Combinations	Concentration
T_1	Calcium Chloride	1.0%

Treatments	Treatment Combinations	Concentration
T_2	Calcium Chloride	1.5%
T_3	Calcium Chloride	2.0%
T_4	Sodium Chloride	1.0%
T_5	Sodium Chloride	1.5%
T_6	Sodium Chloride	2.0%
T_7	Calcium Chloride + Sodium Chloride	1.0% + 1.0%
T_8	Calcium Chloride + Sodium Chloride	1.5% + 1.5%
T_9	Calcium Chloride + Sodium Chloride	2.0% + 2.0%
T_{10}	Control	(100% water)

III. RESULTS AND DISCUSSION

The observations were recorded on 0 day, 5 days, 10 days, 15 days and 20 days after treatment application for physical and sensory attributes of pear cv. Gola. The findings are presented in Tables 2- 5 and Fig. 1-9. The results and discussion pertaining to the experiment are presented as follows:

1. *Physical Attributes*

Change in Fruit Length (cm)

The data recorded on fruit length at 0, 5, 10, 15 and 20 days after treatment (DAT) were presented in Table 2. and Fig. 1. The results showed significant difference among the treatments at different storage intervals. It was depicted from data, the fruit length showed non-significant effect during storage. At 0 DAT, the maximum fruit length (5.55 cm) was recorded in treatment T_4 (NaCl @ 1.0%) and minimum fruit length (4.83 cm) was recorded in treatment T_7 ($CaCl_2$ @ 1%+ NaCl @ 1%). At 5 DAT, the maximum fruit length (5.41 cm) was recorded in treatment T_4 (NaCl @ 1.0%). However, the minimum fruit length (4.55 cm) was recorded in treatment T_7 ($CaCl_2$ @ 1%+ NaCl @ 1%). At 10 DAT, the maximum fruit length (5.01 cm) was recorded in treatment T_1 ($CaCl_2$ @1%). However, the minimum fruit length (4.33 cm) was recorded in treatment T_6 (NaCl @ 1%). At 15 DAT, the maximum fruit length (5.53 cm) was recorded in treatment T_4 (NaCl @ 1.0%) which was at par with treatments T_9 (5.36 cm) and T_2 (5.33 cm). The significant difference were observed in treatments T_6 (4.27 cm) and T_7 (4.07 cm). However, the minimum fruit length (4.07cm) was recorded under the treatment T_7 ($CaCl_2$ @ 1.0% + NaCl @ 1.0%). At 20 DAT, the fruit length was recorded maximum (4.99 cm) under treatment T_1 ($CaCl_2$ @ 1.0%) which was at par with treatment T_2 (4.87 cm) and T_8 (4.63 cm). However, the significance difference was recorded in treatment T_7 (3.86 cm) $CaCl_2$ @ 1.0% + NaCl and the minimum fruit length was recorded (3.86 cm) under treatment T_7 ($CaCl_2$ @ 1.0% + NaCl @ 1.0%). The trend of decreasing fruit length with storage might be due to the reduction in fruit length after treatment during storage caused due to shrinking of fruits by transpiration losses. Application of calcium chloride might have decreased the rate of transpiration as well as length of fruit under ambient conditions. Similar findings were reported by Hinge *et al.*, (2022) in guava and Jain *et al.*, (2021) in apple.

Change in Fruit Diameter (cm)

Table 2. Effect of calcium chloride and sodium chloride dipping on fruit length and diameter of pear cv. Gola at different storage intervals.

Treatments	Fruit Length (cm)					Fruit Diameter (cm)				
	Days after Storage					Days after Storage				
	0	5	10	15	20	0	5	10	15	20
T_1	5.26	5.11	5.01	4.80	4.90	4.96	4.91	5.03	4.80	4.93
T_2	5.03	4.98	4.80	5.33	4.86	5.33	5.18	5.05	5.33	4.96
T_3	4.96	4.80	4.75	5.26	4.56	5.26	5.13	4.55	5.26	4.76
T_4	5.55	5.41	5.35	5.53	5.06	5.53	5.40	4.78	4.24	4.95
T_5	4.88	4.71	4.73	4.85	4.33	4.86	4.71	3.91	3.79	4.86
T6	5.06	4.93	4.33	4.27	4.23	4.95	4.90	3.89	3.82	4.70
T_7	4.83	4.55	4.78	4.07	3.86	5.00	4.86	4.45	4.39	4.67
T_8	4.91	4.88	4.78	4.86	4.63	4.85	4.78	4.70	4.61	4.83
T_9	4.96	4.83	4.80	5.36	4.36	5.36	5.05	4.81	4.59	4.66
T_{10}	4.86	4.81	4.56	5.23	4.10	5.23	5.10	4.83	4.40	4.83
SE(mean)	0.14	0.15	0.18	0.19	0.23	0.16	0.16	0.13	0.18	0.09
C.D $_{0.05\%}$	NS	NS	NS	0.56	0.77	NS	NS	0.40	0.53	NS
C.V.	4.90	5.45	6.80	6.68	9.22	5.42	5.51	5.14	6.88	3.28

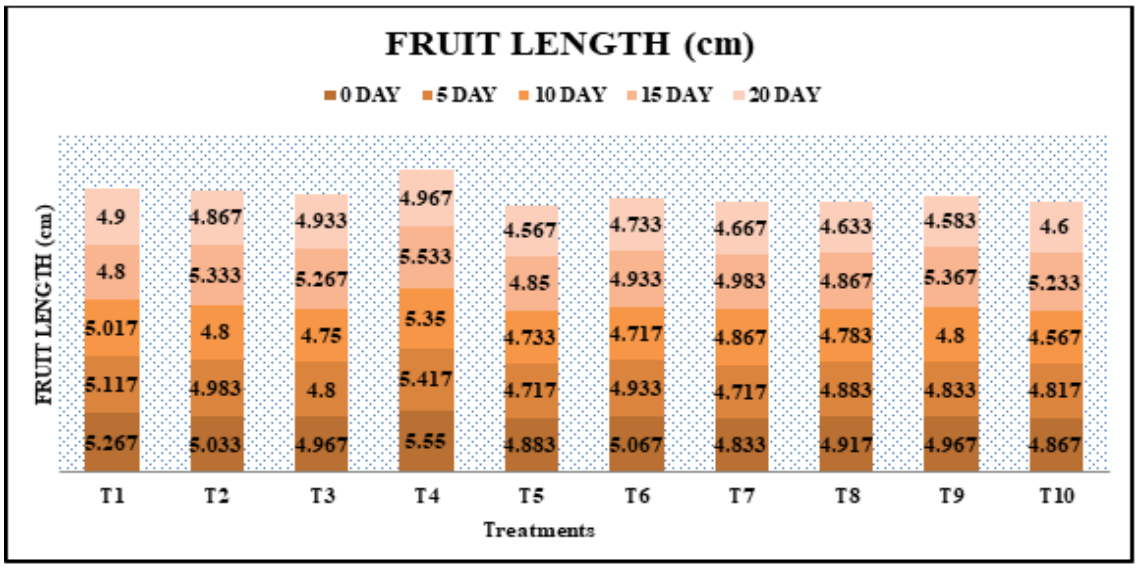

Fig. 1. Impact of Calcium Chloride and Sodium Chloride dipping on Fruit length in Pear cv. Gola at various storage intervals.

The data recorded at fruit diameter at 0, 5, 10, 15 and 20 Days after treatment (DAT) were presented in the Table 2 and Fig. 2. The results showed significant difference among the treatments at different storage intervals. It was depicted from data, the fruit diameter showed non- significant effect during storage. At 0 DAT, the maximum fruit diameter (5.53 cm) was recorded in treatment T_4 (NaCl @ 1.0%). However, the minimum fruit diameter (4.85 cm) was recorded in treatment T_8 ($CaCl_2$@1.5% +NaCl @1.5%). At 5 DAT, the maximum

fruit diameter (5.40 cm) was recorded in treatment T_4 (NaCl @ 1.0%). However, the minimum fruit diameter (4.78 cm) was recorded in treatment T_8 ($CaCl_2$ @ 1.5% + NaCl @ 1.5%). At 10 DAT, the maximum fruit diameter (5.05 cm) was recorded in treatment T_2 ($CaCl_2$ @ 1.5%) which was at par with treatment T_1 (5.03 cm). The significant difference has been observed (3.91 cm) and (3.89 cm) in treatment T_5 and T_6. However, the minimum fruit diameter (3.89 cm) was recorded in treatment T_6 (NaCl @ 2.0%). At 15 DAT, the maximum fruit diameter (5.33 cm) was recorded in treatment T_2 ($CaCl_2$ @ 1.5%) which was at par with treatment T_3 (5.26 cm) ($CaCl_2$ @ 2%). The significant difference has been recorded (3.82 cm) in treatment T_6 (NaCl @ 2.0%) during experimental unit. However, the minimum fruit diameter (3.79 cm) was recorded in treatment T_5 (NaCl @ 1.5%). At 20 DAT, the maximum fruit diameter (4.96 cm) was recorded in treatment T_2 ($CaCl_2$ @ 1.5%). However, the minimum was recorded (4.66 cm) in treatment T_9 ($CaCl_2$ @ 2.0% + NaCl @ 2.0%). This might be due to loss in moisture which leads to loss in fruit size. $CaCl_2$ and NaCl dipping solutions formed a semi-permeable membrane film that regulated a gaseous exchange and thus, reduced the transpiration rate which is determined by the gradient of the water vapor pressure between the fruit and the surrounding. Similar findings were reported by Ganai *et al.*, (2023) in Red Velvox apple and Chawla *et al.*, (2019) in peaches.

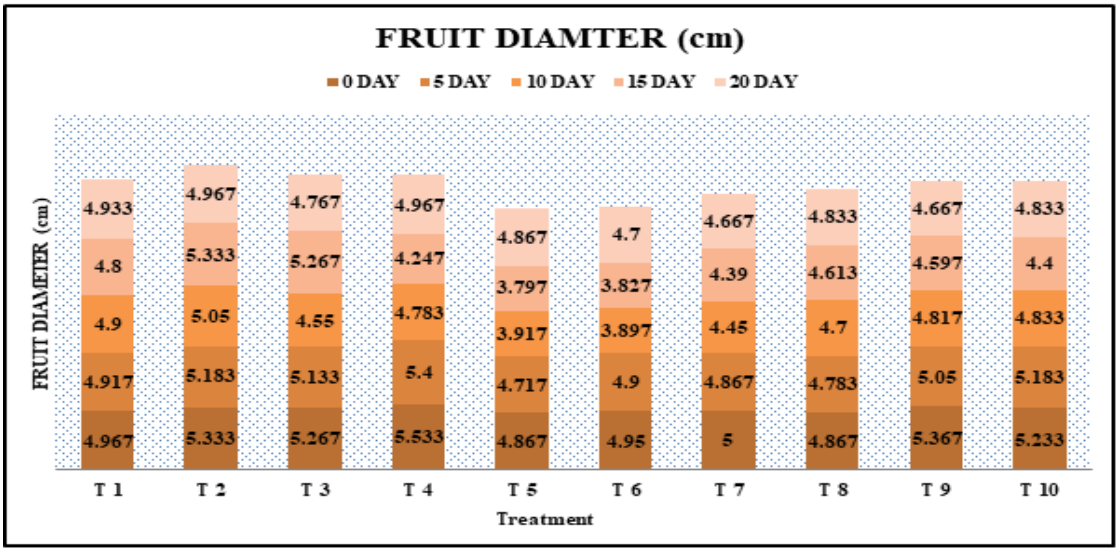

Fig. 2. Impact of Calcium Chloride and Sodium Chloride dipping on Fruit diameter in Pear cv. Gola at various storage intervals.

Change in Fruit Circumference (cm)

The data on fruit circumference at 0, 5, 10, 15 and 20 Day after treatment were presented in the Table 3 and Fig. 3. It was depicted from data, the fruit circumference showed non- significant effect during storage. At 0 DAT, the maximum fruit circumference (5.73 cm) was recorded in treatment T_5 (NaCl @ 1.5%). However, the minimum fruit circumference (4.53 cm) was recorded in treatment T_7 ($CaCl_2$ @ 1.0% + NaCl @ 1.0%). At 5 DAT, the maximum fruit circumference (5.60 cm) was recorded in treatment T_3 ($CaCl_2$@ 2%). However, the minimum fruit circumference (4.40 cm) was recorded in treatment T_8 ($CaCl_2$ @ 1.5% + NaCl @ 1.5%). At 10 DAT, the maximum fruit circumference (5.73 cm) was recorded in treatment T_9 ($CaCl_2$ @ 2.0% + NaCl @ 2.0%). However, the minimum fruit circumference (4.53 cm) was recorded in treatment T_7 ($CaCl_2$ @ 1.0 % + NaCl @ 1.0%). At 15 DAT, the maximum fruit circumference (5.36 cm) was recorded in treatment T_2 ($CaCl_2$ @ 1.5%).However, the minimum fruit circumference (4.30 cm) was recorded in T_{10} (control). At 20 DAT, the maximum fruit circumference was recorded (5.30 cm) in treatment T_2 ($CaCl_2$ @ 1.5%). However, the minimum

fruit circumference (4.5 cm) was recorded in treatment T_6 (NaCl @ 2.0%). Similar decreasing trends were reported by Rymbai *et al*., (2022) in mango cv. Totapuri. This might be due to the microbial action that feed on pear fruits during storage conditions cause them to become smaller and mishappen. The results are in line with Umuhoza *et al*., (2022) in mango cv. Totapuri.

Table 3. Effect of calcium chloride and sodium chloride dipping on fruit circumference and fruit volume of pear cv. Gola at different storage intervals.

Symbol	Fruit Circumference (cm)					Fruit Volume (ml)				
	Days after Storage					Days after Storage				
	0	5	10	15	20	0	5	10	15	20
T_1	5.00	4.76	5.00	4.66	4.76	99.1	98.8	97.0	96.6	95.20
T_2	5.60	5.36	5.60	5.36	5.30	99.9	99.9	99.10	98.8	98.9
T_3	4.80	5.60	4.80	5.10	4.65	99.7	99.2	99.13	98.3	98.7
T_4	5.13	5.03	5.13	5.23	5.16	100.4	98.2	95.70	95.5	94.9
T_5	5.73	5.60	5.73	4.66	4.50	98.4	96.7	95.43	94.6	95.0
T6	5.23	5.00	5.23	4.80	4.66	98.0	96.8	95.90	95.2	95.3
T_7	4.53	4.40	4.53	4.56	4.56	98.3	97.2	97.10	96.0	95.6
T_8	5.06	4.80	5.06	4.76	4.83	100.3	100.3	97.66	96.3	94.3
T_9	5.72	5.50	5.73	5.13	4.60	100.3	100.0	99.40	97.3	95.7
T_{10}	5.53	5.41	5.53	4.30	4.56	100.6	97.9	96.46	96.3	95.3
SE(mean)	0.46	0.46	0.46	0.20	0.26	0.29	0.54	0.81	1.10	1.24
C.D $_{0.05\%}$	NS	NS	NS	0.60	NS	0.87	1.60	2.41	NS	NS
C.V.%	15.3	16.0	15.3	7.28	9.67	0.51	0.95	1.44	1.98	2.24

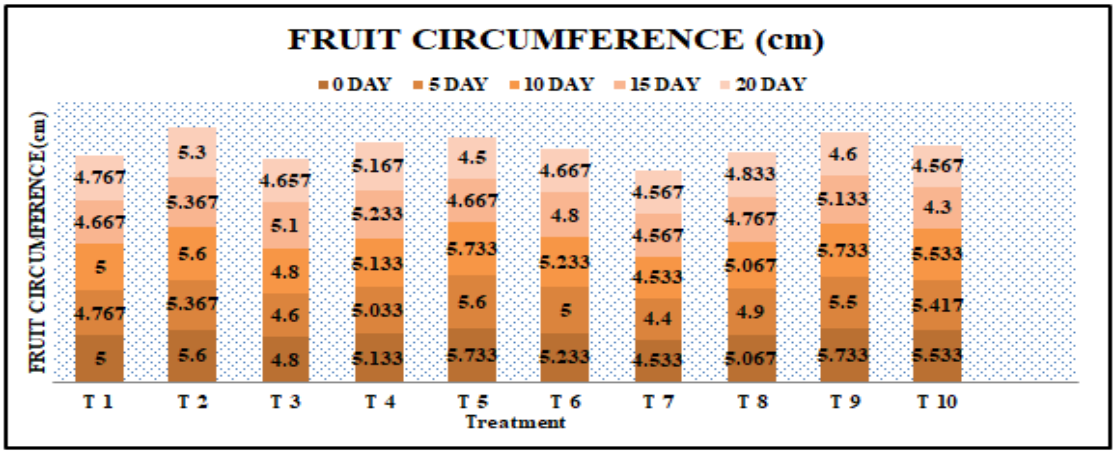

Fig. 3. Impact of Calcium Chloride and Sodium Chloride dipping on Fruit circumference in Pear cv. Gola at various storage intervals.

Change in Fruit Volume (ml)

The data recorded on fruit volume at different 0, 5, 10, 15 and 20 (DAT) were depicted on Table 3 and Fig 4. It was depicted from data; the fruit volume showed a decreasing trend with increase in storage interval. At 0

DAT, the maximum (100.6 ml) volume of fruit was recorded in T_{10} (control) which was at par with treatment T_9 (100.3 ml) However, the minimum fruit volume (98.00 ml) was recorded in T_6 (NaCl @ 1.5%) + ambient temperature. At 5 DAT, the maximum (100.3 ml) fruit volume was recorded in treatment in T_8 ($CaCl_2$ @ 1.5% +NaCl @ 1.5%) which was at par with treatment T_9 (100 ml).The minimum (96.67 ml) fruit volume was recorded under the treatment in T_5 (NaCl @ 1.5%) + ambient temperature**.** At 10 DAT, fruit volume was maximum (99.4 ml) recorded in treatment T_9 ($CaCl_2$ @ 2.0% + NaCl @ 2.0%) which was at par with treatment T_3 (99.1 ml) ($CaCl_2$ @ 2.0%). The significant difference was observed (95.7 ml) in treatment T_4 (NaCl @ 1.0%). However, the minimum fruit volume (95.43 ml) was observed in treatment in T_5 (NaCl @ 1.5%). At 15 DAT, fruit volume was maximum (98.8 ml) was recorded in treatment T_2 which was at par with treatments T_3 and T_4. However, the minimum (96.0 ml) fruit volume was recorded in treatment in T_7 ($CaCl_2$ @ 1.0% + NaCl @ 1.0%). At 20 DAT, fruit volume was maximum (98.9 ml) recorded in treatment under T_2 ($CaCl_2$ @ 1.5%) while the minimum (94.33 ml) fruit volume was recorded in case of T_8 ($CaCl_2$ @ 1.5% + NaCl @ 1.5%). It might be due to the reason that when fruits are exposed to NaCl dipping treatment it creates some osmotic stress, causing the fruit to loose water from its cells, leading to reduction in fruit size and fruit shrinks as it attempts to maintain a balanced internal salt concentration. Similar decreasing trends were reported by Surya *et al.*, (2019) in litchi cv. Rose Scented and Thakur *et al.*, (2023) in mango cv. Amrapalli.

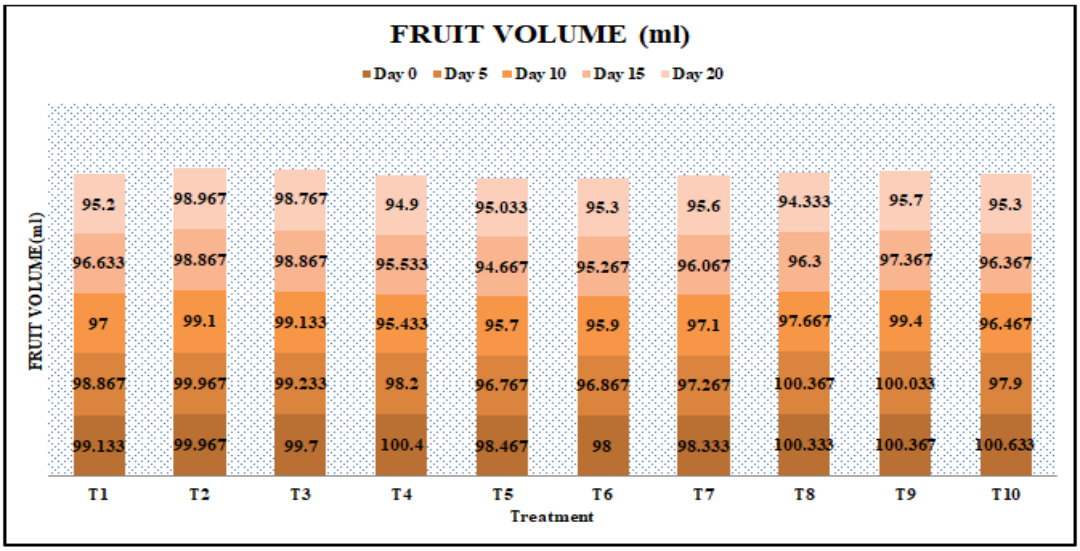

Fig. 4. Impact of Calcium Chloride and Sodium Chloride dipping on Fruit volume e in Pear cv. Gola at various storage intervals.

2. *Sensory Attributes*

Change in Colour

The data recorded on fruit colour at different DAT on 0 day. 5 day. 10 day. 15 day and 20 days were presented in the Table 4 and Fig. 5. At 0 DAT, the maximum colour (9.00) was recorded in treatment T_1 which was par with treatment T_2, T_3, and T_7 and T_{10} under ambient temperature while minimum (8.33) was observed in treatment T_8 and T_9. At 5 DAT, the maximum colour was observed with score (8.68) in treatment T_1 which was par with treatment T_2, T_3 and T_7 + ambient temperature while the minimum (6.67) colour was observed in treatment T_{10} (Control). At 10 DAT, the maximum colour was observed with score (7.00) in treatment T_1 ($CaCl_2$ @ 1.0%) which was at par (6.33) with treatment T_9. The minimum (5.67) colour was observed under the

treatment T_7 ($CaCl_2$ @ 1.0% + NaCl @ 1.0%). At 15 DAT, the colour (6.33) was observed maximum with score in treatment T_8 ($CaCl_2$ @ 1.5% + NaCl @ 1.5%) whereas, the minimum (5.33) colour was observed in treatment T_2 ($CaCl_2$ @ 1.5%). At 20 DAT, the colour was observed maximum with score (6.33) in treatment T_9 ($CaCl_2$ @ 1.5% + NaCl @ 1.5%) while the minimum (5.33) colour was observed in treatment T_3 ($CaCl_2$ @ 2.0%). The highest score for colour in pear might be due to the lesser loss in chlorophyll, lesser production of xanthophylls and reduced other maturity phenomenon from 0 to 20 DAT that all dipped fruits change their colour from green to slight yellow. Similar trends were reported by Ravanfar *et al.*, (2022) in cherries and Sunila *et al.*, (2020) in sweet orange.

Table 4. Effect of calcium chloride and sodium chloride dipping on colour, taste and texture score of pear at different storage intervals.

Symbol	Colour					Taste					Texture				
	Days after Storage					Days after Storage					Days after Storage				
	0	5	10	15	20	0	5	10	15	20	0	5	10	15	20
T_1	8.66	8.00	7.000	6.000	6.00	5.66	8.33	7.00	8.00	5.66	9.00	8.66	7.66	7.66	6.33
T_2	9.00	8.00	6.66	5.33	5.66	5.66	8.33	7.66	8.00	6.33	8.66	7.66	7.33	7.66	7.00
T_3	9.00	8.00	6.00	6.00	5.33	5.33	8.33	7.68	8.02	6.00	8.66	8.00	7.33	8.00	7.00
T_4	9.00	8.00	6.33	6.00	6.00	5.66	8.30	6.00	8.00	5.33	8.32	8.00	7.32	7.33	7.00
T_5	8.66	7.33	7.00	6.33	6.00	7.00	8.33	7.33	7.33	5.66	8.33	7.66	7.00	6.0	7.66
T6	8.33	7.00	6.66	5.66	6.00	5.66	8.00	6.66	7.00	5.64	8.00	8.00	7.00	6.66	8.00
T_7	9.00	8.00	5.66	6.33	5.66	5.33	8.33	7.00	8.00	6.00	8.33	7.33	7.00	6.33	7.66
T_8	8.00	7.33	6.00	6.66	6.00	5.00	8.01	6.66	7.33	6.00	8.66	7.66	9.00	6.33	6.33
T_9	8.33	7.33	6.33	6.33	6.33	5.32	8.66	7.00	7.33	6.00	8.33	8.00	7.00	6.33	7.92
T_{10}	9.00	6.66	6.33	6.66	5.66	5.66	8.33	6.66	6.66	6.66	8.00	7.66	7.00	6.33	5.33
SE(mean)	0.21	0.27	0.40	0.38	0.39	0.47	0.29	0.40	0.27	0.54	0.27	0.40	0.21	0.43	0.44
C.D $_{0.05\%}$	0.62	0.28	NS	NS	NS	NS	NS	NS	0.82	NS	NS	NS	0.62	1.29	1.32
C.V.%	4.19	6.38	11.04	10.73	11.64	14.49	0.62	10.15	0.63	15.9	5.72	8.98	4.95	10.96	10.96

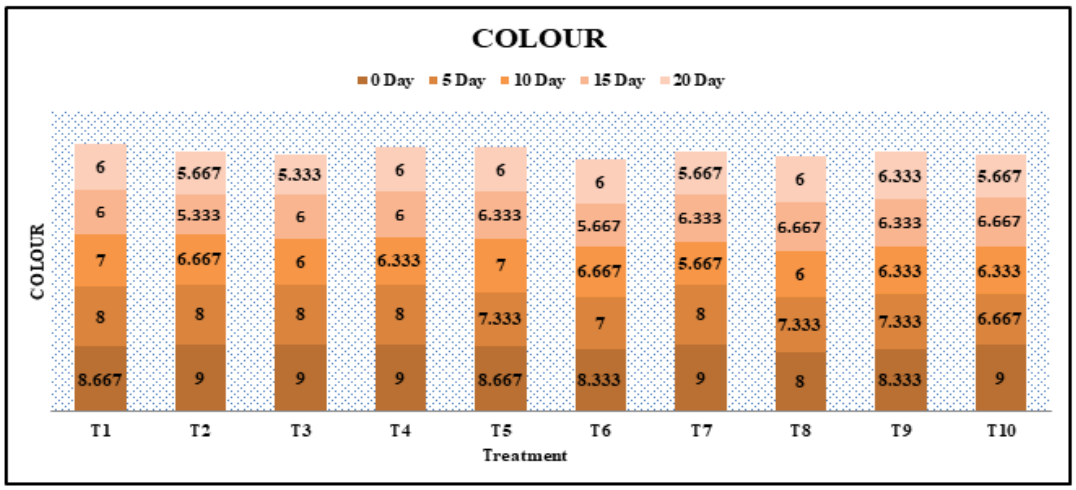

Fig. 5. Impact of Calcium Chloride and Sodium Chloride dipping on sensory attribute 'Colour' of Pear cv. Gola at various storage intervals.

Change in Taste

The observation of fruit taste was recorded at different DAT on 0 day.5 day.10 day.15 day and 20 days were presented in Table 4 and Fig 6. As evident from table, except 15 days storage interval rest all days observation showed non-significant results. At 0 DAT, Taste was observed with maximum score (7.00) in treatment T_5 (NaCl @ 1.5%) and the minimum score was observed (5.00) in treatment T_8 ($CaCl_2$ @ 1.5% + NaCl @ 1.5%). At 5 DAT, Taste was observed maximum with score (8.66) in treatment T_9 ($CaCl_2$ @ 2.0% + NaCl @ 2.0%) and the minimum (8.00) score was observed in treatment T_6 (NaCl @ 2.0%). At 10 DAT, Taste was observed maximum (7.68) with score in treatment T_3 ($CaCl_2$ @ 2.0%) which was at par with treatment T_2 (7.66) and the minimum (6.00) score in taste was observed in treatment T_4 (NaCl @ 1.0%). At 15 DAT, Taste was observed maximum with score (8.02) in treatment T_3 ($CaCl_2$ @ 2.0%) which was at par with treatment T_1 and T_2 (8.00). However, the minimum (6.66) score in taste was observed in T_{10} (Control). At 20 DAT, Taste was observed maximum (6.66) with score in T_{10} (Control) and the minimum (5.64) score in taste was observed in T_6 (NaCl @ 2.0%). It might be due to the fluctuations in pH and acid sugars ratio. Similar results were also reported by Bill *et al*., (2018) in peach, Fatima *et al.,* (2023) in Apricot and Foudhi *et al.* (2020) in guava.

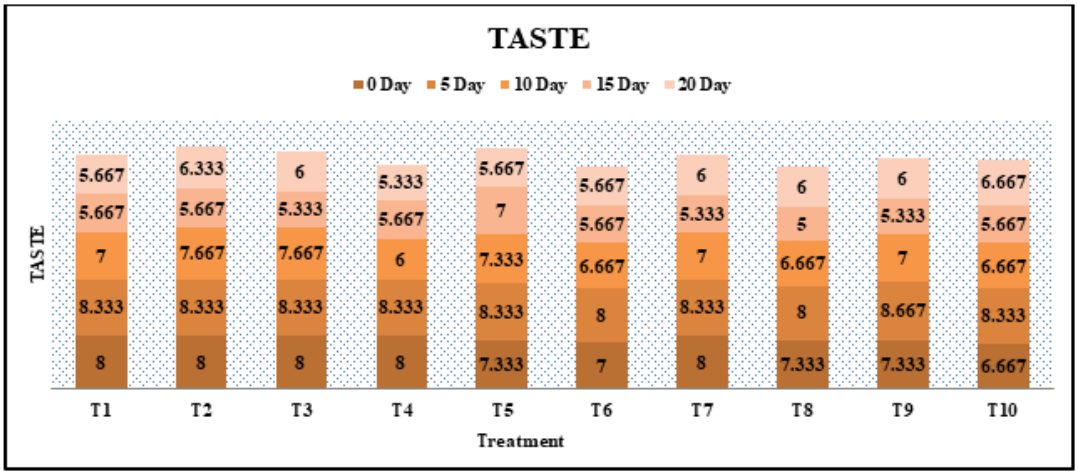

Fig. 6. Impact of Calcium Chloride and Sodium Chloride dipping on sensory attribute 'Taste' of Pear cv. Gola at various storage intervals.

Change in Texture

The observation of texture was recorded at different DAT on 0 day, 5 day, 10 day, 15 day and 20 days were presented in the Table 4 and Fig. 7. During 0 and 5 DAT non- significant differences were observed for texture. At 0 DAT, the maximum (9.00) texture score was recorded in treatment T_1 ($CaCl_2$@1%) and the minimum (8.32) texture score was recorded in T_4 (NaCl @1%). At 5 DAT, the maximum (8.66) texture was observed with score in treatment T_1 ($CaCl_2$ @ 1.0%) and the minimum (7.33) texture was observed in treatment T_7 ($CaCl_2$ @ 1.0% + NaCl @ 1.0%). At 10 DAT, the maximum texture (9.00) was observed with score in treatment T_8 ($CaCl_2$ @ 2.0% + NaCl @ 2.0%). The minimum fruit texture was (7.6) was observed in treatment T_1 ($CaCl_2$ @ 1.0%). At 15 DAT, the maximum texture (8.00) was observed with score T_3 ($CaCl_2$ @ 2.0%) whereas, the minimum fruit texture (6.0) was observed under the treatment T_5 (NaCl @ 1.5%). At 20 DAT, the maximum texture (8.00) was observed in treatment T_9 ($CaCl_2$ @ 2.0% + NaCl @ 2.0%) which was at par with treatment T_9 (7.92). The significant difference was observed with score (6.33) in T_8 ($CaCl_2$ @ 1.5% + NaCl @ 1.5%). However, the minimum (5.33) fruit texture was observed in treatment T_{10} (Control). This might be due to

calcium chloride has a positive impact on the texture of fruits as it makes the fruit firmer and less prone to softening. Similar results were also reported by Nasrin *et al.*, (2019) in peach and Iqbal *et al.*, (2017) in apricot.

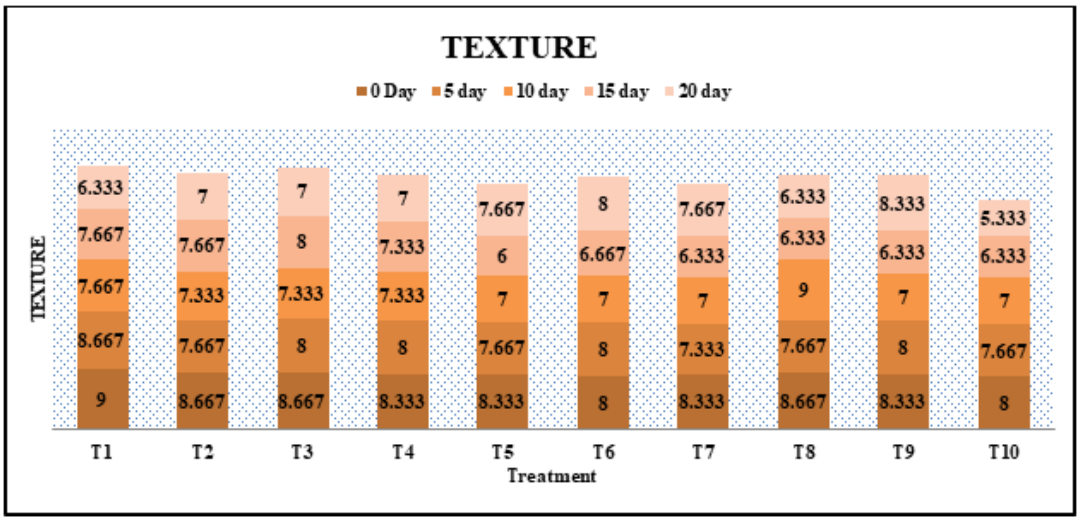

Fig. 7. Impact of Calcium Chloride and Sodium Chloride dipping on sensory attribute 'Texture' of Pear cv. Gola at various storage intervals.

Change in Flavour

The observation of flavour was recorded at different DAT on 0 day, 5 day, 10 day, 15 day and 20 days were presented in the Table 5 and Fig. 8. At 0 DAT, the maximum flavour score (8.66) was recorded in treatment T_4 (NaCl @ 1.0%) which was at par with treatment T_5 (8.32) and T_6 (8.33). However, the minimum score (7.66) of flavour was observed in T_{10} (Control). At 5 DAT, the maximum fruit flavour (9.00) was observed in treatment T_6 and T_7. The minimum score (7.00) in fruit flavour was observed under T_2 and T_3. At 10 DAT, the maximum fruit flavour was observed (8.00) in treatment T_8 ($CaCl_2$ @ 1.5% + NaCl @ 1.5%) which was at par with treatment T_9 and T_{10} (7.66). The minimum fruit flavour was observed (6.00) under the treatment T_1 with ($CaCl_2$ @ 1.0%). At 15 DAT, the maximum score (8.02) in fruit flavour was observed in treatment T_5 (NaCl @ 1.5%). The significant difference has been observed (5.33) in treatment T_7 ($CaCl_2$ @ 1.0% + NaCl @ 1.0%). However, the minimum score (5.20) in fruit flavour was observed in treatment T_8 ($CaCl_2$ @ 1.5% + NaCl @ 1.5%). At 20 DAT, the maximum score (6.34) in fruit flavour has been observed in T_4 (NaCl @ 1.0%) which was at par with (6.33) the treatments T_5, T_9 and T_{10}. The minimum (5.00) score in fruit flavour was observed in the treatments T_1 and T_2. This may be due to the negative effect of calcium and sodium chloride with increasing storage period on the flavour of fruits thus, making them tasteless by reducing sweetness and potentially blander due to its influence on cell wall structure and its ability to reduce the release of volatile aroma compounds. Present results are in conformity with the findings of Ravanfar *et al*, (2024) and Dhali *et al.*, 2024 in banana cv. Jin.

Table 5. Effect of calcium chloride and sodium chloride dipping on flavour and overall acceptability of pear at different storage intervals.

Symbol	Flavour					Overall Acceptability				
	Days after Storage					Days after Storage				
	0	5	10	15	20	0	5	10	15	20
T_1	8.00	7.33	6.00	7.00	5.00	8.00	8.66	8.00	6.66	6.0
T_2	8.00	7.00	6.00	7.00	5.00	8.35	9.00	8.03	7.00	6.66

Symbol	Flavour					Overall Acceptability				
	Days after Storage					Days after Storage				
	0	5	10	15	20	0	5	10	15	20
T_3	8.00	7.00	7.33	7.00	5.33	8.33	8.66	8.02	7.00	6.00
T_4	8.66	7.33	8.00	8.00	6.34	8.00	8.66	6.95	7.00	7.33
T_5	8.32	8.00	8.00	8.02	6.33	8.00	9.00	7.00	6.66	6.00
T6	8.33	9.00	7.66	6.00	6.22	9.00	8.33	7.66	6.62	5.66
T_7	8.33	9.00	7.00	5.33	6.33	8.33	9.00	7.33	6.98	5.00
T_8	8.00	8.00	7.33	5.20	6.00	8.33	8.30	7.00	6.45	5.33
T_9	8.33	8.00	7.66	7.33	6.33	8.33	9.00	8.00	5.00	5.00
T_{10}	7.66	7.00	7.66	6.00	6.33	9.00	9.00	6.66	5.66	5.33
SE(mean)	0.25	0.27	0.29	0.44	0.33	0.43	0.29	0.36	0.19	0.23
CD at 5%	NS	0.70	0.88	1.32	0.99	NS	NS	NS	1.12	1.44
C.V.%	5.47	5.25	7.10	11.1	9.67	8.99	5.89	8.47	9.77	13.9

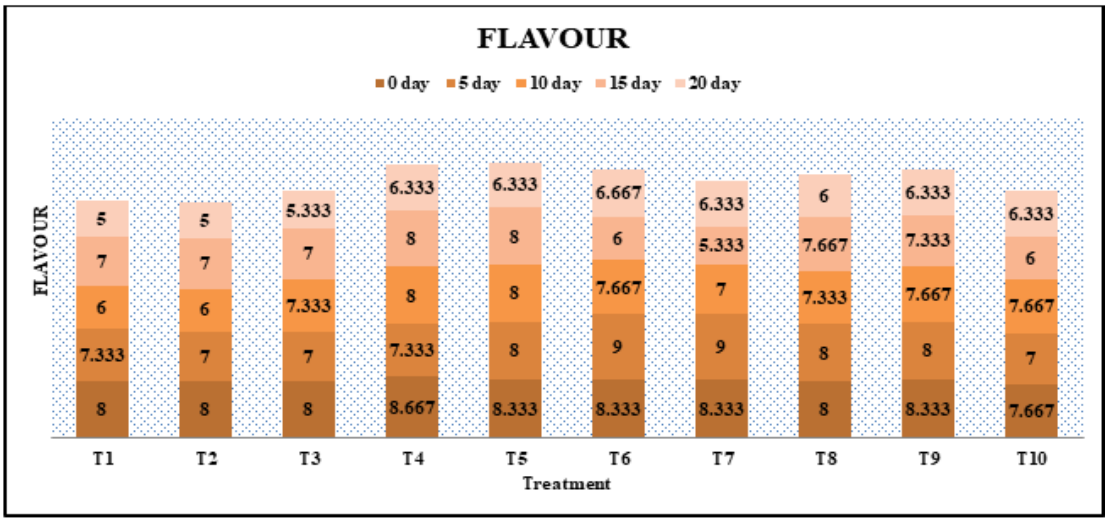

Fig. 8. Impact of Calcium Chloride and Sodium Chloride dipping on sensory attribute 'Flavour' of Pear cv. Gola at various storage intervals.

Change in Overall Acceptability

The observation on overall acceptability was recorded at different DAT on 0 day, 5 day, 10 day, 15 day and 20 days were presented in the Table 5 and Fig. 9. As evident from the data, the overall acceptability, at 0 DAT, was recorded maximum score (9.00) in treatment in T_6 (NaCl @ 2.0%) and the minimum (8.00) was recorded in treatment in T_1 (CaCl@1%). At 5 DAT, the maximum score was recorded (9.00) in treatment T_2, T_5, T_7 and T_9 and the minimum (8.30) overall acceptability was recorded in treatment T_9 ($CaCl_2$ @ 2.0% + NaCl @ 2.0%). At 10 DAT, the maximum (8.03) overall acceptability was observed in T_2 ($CaCl_2$ @ 1.5%) and the minimum (6.95) was observed in T_4 (NaCl @1%). At 15 DAT, the maximum overall acceptability was observed in treatment T_2, T_3 and T_4 (7.00) and minimum overall acceptability score was recorded (5.0) under the treatment in T_9 with ($CaCl_2$ @ 2.0% + NaCl @ 2.0%). At 20 DAT, the maximum overall acceptability was observed (7.3) in

treatment T_4 (NaCl @ 1.0%) and minimum (5.00) was recorded under the treatment T_1. The decrease in sensory rating with the advancement of storage period might be associated with over-ripening, onset of senescence, loss of texture and decrease in acidity. Colour, taste, texture and flavour are important for their role in perception of overall acceptability by the consumers. During ripening, transitions of chlorophyll into carotenoids (Kays, 1991), biochemical conversions of starch into sugars (Martinez *et al.,* 1997), loss of organic acids through oxidation (Campestre *et al.,* 2002) are responsible for the changes in sensory attributes. The initial increase in overall scores could be due to the development of appropriate colour, aroma and taste during ripening while decline towards end of storage could be due to the initiation of senescence. Fruits treated with $CaCl_2$ and NaCl dippings showed slow degradation in overall acceptability by retarding browning incidence thereby maintaining the sensorial quality attributes of pear. Present results are in conformity with the findings of Supapvanich *et al.,* (2022) in mango and Tixier *et al.,* (2021) in banana.

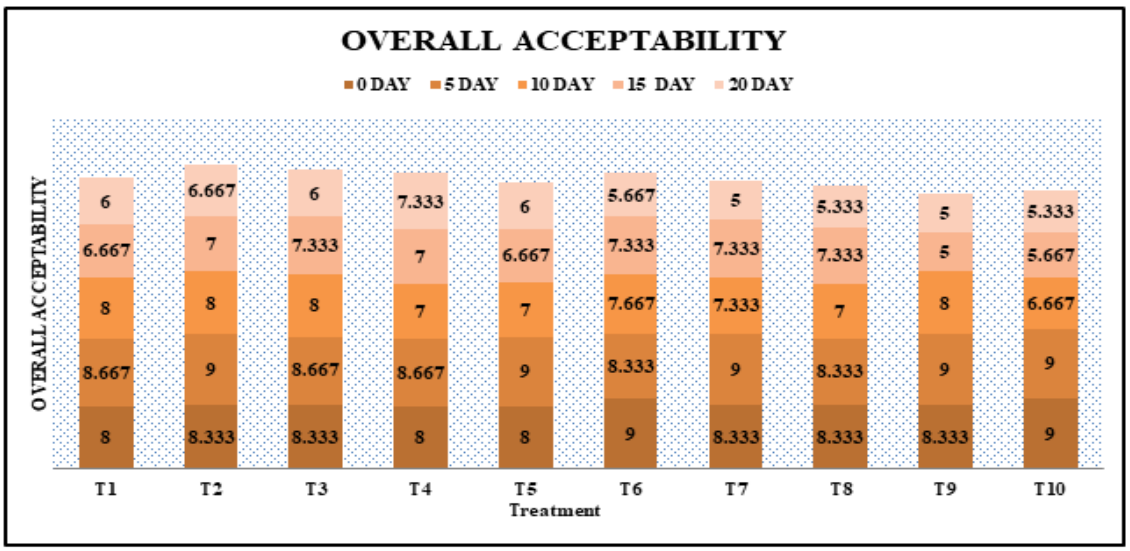

Fig. 9. Impact of Calcium Chloride and Sodium Chloride dipping on sensory attribute 'overall acceptability' of Pear cv. Gola at various storage intervals.

IV. Conclusion

The present study revealed that treatment of CaCl2 @ 1.0% resulted in maintaining the physical attributes viz. Fruit length (cm), Fruit circumference (cm), Fruit volume (ml) of pear cv. Gola and treatment with CaCl2 @ 1.0% + NaCl @ 1.0% proved equally effective in maintaining the sensory attributes i.e., colour, taste, texture, flavor and overall acceptability. Therefore, it can be concluded that calcium chloride and sodium chloride can be used to extend the physical and sensory parameters of pear cv. Gola.

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