International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2021; SP-9(1): 204-207

Received: 19-11-2020
Accepted: 24-12-2020

Kumari Punam
Department of Botany, Jai Prakash University, Chapra, Bihar, India

Subhash Chandra
Department of Plant Pathology, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, Uttar Pradesh, India

SKS Rajpoot
Department of Entomology, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, Uttar Pradesh, India

Manish Maurya
Department of Plant Pathology, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, Uttar Pradesh, India

Rajan Kumar
Food Corporation of India, Regional office, Vijaywada, Andhra Pradesh, India

Ujjal Kumar Ghosh
Department of Botany, Jai Prakash University, Chapra, Bihar, India

Corresponding Author:
Subhash Chandra
Department of Plant Pathology, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, Uttar Pradesh, India

Effect of post-harvest treatments on quality attributes like total soluble solids, total sugar and reducing sugar of langra mangoes (*Mangifera indica* L.) during storage

Kumari Punam, Subhash Chandra, SKS Rajpoot, Manish Maurya, Rajan Kumar and Ujjal Kumar Ghosh

DOI: https://doi.org/10.22271/chemi.2021.v9.i1d.11581

Abstract
The effect of calcium salts (calcium nitrate and calcium chloride) and Gibberellic acid on quality attributes and consumer's acceptability of Langra mangoes during storage was examined. The fruits were treated with $Ca(NO_3)_2$ at the concentration of 1, 2 and 3 per cent, $CaCl_2$ at the concentration of 1, 2 and 3 per cent and GA_3 at the concentration of 50, 100 and 150 ppm. Water treated fruits were taken as control. Data were recorded in respect of TSS, reducing sugars and total sugars under influence of these treatments. All treatments were found effective in maintaining the higher level of these quality attributes of fruits during entire course of the experiment. At end of trial, $Ca(NO_3)_2$ at 2% was proved as the best treatment in respect of TSS, reducing sugars and total sugars and was able to maintain the level of these up to 24.32%, 9.00% and 20.05% respectively.

Keywords: Mango, langra, calcium nitrate, calcium chloride, Ga_3, TSS, reducing sugar, total sugar

Introduction
Mango (*Mangifera indica* L.) is a tropical, climacteric fruit that is very popular among million of peoples world-wide. Mango, the king of fruits belongs to family Anacardiaceae. Mango is fifth widely produced fruit crop in the world after banana, apple, grape and orange. India ranks first in term of production in the world. It contributes approximately 50% of the global mango supply. In India, during 2015-16, it was grown in an area of 2.209 million hectares with a production of 18.643 million tonnes and productivity of 8.4 tonnes/ hectare (Anonymous, 2017) [2].

Nutritionally, it contains β carotene, β cryptoxanthin, vitamin C, and dietary fibre (Pal, 1998) [12] as well as soluble sugars and various minerals used as good sources of nutrition, and are readily available and easily assumable in human body (Singh *et al.*, 2000) [1, 18, 19]. Approximately 30-50% fruits wasted during postharvest handling, storage, and ripening. Among the fruits mango manifested high postharvest losses because of its high perishability and climacteric pattern of respiration. Mango always decays after harvest, and postharvest losses can be minimized by applying improved storage technology and prolonging the shelf life of fruits. Among the cultivated varieties of Bihar, the variety Langra is most famous and is one of the most popular cultivars of India (Khara *et al*, 2016) [4]. In domestic market this variety has good demand and is able to fetch highest price in the market of Bihar. However, owing to its highly perishable nature and below average keeping quality, export potential of this variety is yet to be capitalised.

Earlier efficacy of pre and post-harvest applications of certain chemicals and growth hormones in maintaining the quality of fruits during storage has been established. Gibberellins as a pre-harvest spray was reported as an efficient growth regulator in enhancing fruit storability and marketability through its action on cell juvenility and retardation of senescence, fruit coloration and softness (Macleod and Millar, 1962) [9]. Post-harvest spray of calcium increases the productivity of mango due to reduction of abscission and it enhances the fruit quality by increasing the fruit firmness and by maintaining the turgidity of middle lamella cells (Ranjan *et al.*, 2005) [17]. Fruits storability was also improved by $CaCl_2$ under cold storage (Ahmed *et al.*, 2000) [1]. Low fruit calcium levels have been associated with reduced post-harvest life and physiological disorders. Pre-harvest sprays of calcium compounds and GA_3 significantly

retained more sugar content and ascorbic acid in mango fruits along with better consumer acceptability during storage (Rani and Brahmachari, 2003) [16]. Banerjee and co-workers (2016) [3] recorded minimum reduction in TSS and maximum retention of acidity with the application of GA_3 during 17 days of storage of Amrapali mango fruits. Mounika *et al.* (2017) [11] recorded higher level of TSS, sugars and acidity in Amrapali mango fruits treated with calcium salts as post-harvest application. Singh *et al.* (2017) [1, 18, 19] while working on Dashehari and Amrapali cultivars of mango proved the potential of calcium nitrate and calcium chloride in preserving valuable attributes of post-harvest quality (TSS, total sugar and acidity contents) of mango of fruits during storage.

Materials and Methods

The experiment was conducted in the Department of Botany, Jai Prakash University Chapra (Bihar) during the cropping year of 2018-19. The physiologically matured fruits were purchased from the market and carried to the experimental laboratory in bamboo baskets. The maturity was judged on the basis of fruit colour changes from greenish to the pinkish, flatness of the tubercles and smoothness of the epicarp as suggested by Pandey and Sharma (1998) [13, 19]. The fruits divided in different lots were dipped for five minutes in aqueous solution of different chemicals at different concentrations separately. The experiment consisted of 10 treatments which are $Ca(NO_3)_2$and $CaCl_2$ each at 1%, 2% and 3% per cent, and GA_3 at the concentration of 50, 100 and 150 ppm and Control. The control fruits were dipped in water and kept for comparison. Fruits were stored after air drying at room temperature. The storage was terminated on the day when the fruits exhibited 12 per cent or more loss due to rotting under best treatment. The data were recorded on total soluble solids (TSS%), reducing sugar (%), total sugar (%). TSS (%) was determined by putting two drops of homogenized juice on the prism of hand refractometer and values were expressed as percentage. Reducing sugar was estimated by Lane and Eynon (1923) [7] copper titration method. For estimation of total sugar 10 ml of freshly extracted juice was first hydrolysed adding 5 ml of concentrated HCL and then left for 24 hours and after that it was neutralized by adding saturated sodium hydroxide (NaOH) solution. For testing, complete neutralization blue and red litmus papers were used. After this total sugar was estimated using Lane and Eynon (1923) [7] copper titration method.

Result and Discussion

Total soluble solids (TSS %)

The rate of increase in TSS content was greatly influenced by different treatments (Table-1, Fig.-1). In general, initially TSS content was increased and after attaining a peak showed a declining trend. On the last day of storage maximum (24.32%) TSS was with $Ca(NO_3)_2$ at 2 per cent followed by GA_3 100 ppm (24.0 %)and both these treatments were very closed to each other. Whereas, the minimum (17.43%) TSS was noted under control. Observations on similar lines were also noted earlier by Patil and Bodke (2018) [14] in mango and Pimpalpalle *et al*. (2017) [15] in sweet oranges. According to Stahl and Campbell (1936) [20], the conversion of cell wall materials such as pectin and hemicellulose in simpler substances during storage are responsible for increase in TSS content. The higher values under calcium and GA_3 treated fruits might be due to the greater pace of this conversion and slower pace of degradation owing to reduced respiration (Kumar, 2005) [6]. Koksal *et al*., (1994) [5] opined that the decline in TSS content in later days might be due their utilization in evapotranspiration, respiratory process, and other biochemical activities.

Table 1: Total soluble solids (TSS%) of mango fruits during storage under different post-harvest treatments

Treatments	Days in storage						Mean
	0	3	6	9	12	15	
T_1- $Ca(NO_3)_2$ at 1%	7.10	11.03	18.13	22.01	21.37	20.13	16.63
T_2- $Ca(NO_3)_2$ at 2%	7.10	11.16	19.95	21.87	23.72	24.32	18.02
T_3- $Ca(NO_3)_2$ at 3%	7.10	11.11	19.21	21.43	23.23	22.87	17.49
T_4- $CaCl_2$ at 1 %	7.10	10.84	17.94	21.81	20.68	19.65	16.34
T_5- $CaCl_2$ at 2%	7.10	11.26	19.05	22.38	22.67	21.29	17.29
T_6- $CaCl_2$ at 3%	7.10	11.13	18.26	22.00	21.93	20.35	16.80
T_7- GA_3 at 50 ppm	7.10	11.21	18.37	22.00	22.33	20.47	16.91
T_8- GA_3 at 100 ppm	7.10	11.23	19.48	21.19	23.42	24.00	17.74
T_9- GA_3 at 150 ppm	7.10	11.12	19.42	21.57	23.20	22.42	17.47
T_{10}- Control (Water)	7.10	11.45	18.21	21.67	19.37	17.43	15.87
Mean	7.10	11.15	18.80	21.79	22.19	21.29	
SEm±	0.00	0.03	0.21	0.30	0.12	0.13	
CD at 5%	0.00	0.08	0.49	0.70	0.31	0.34	

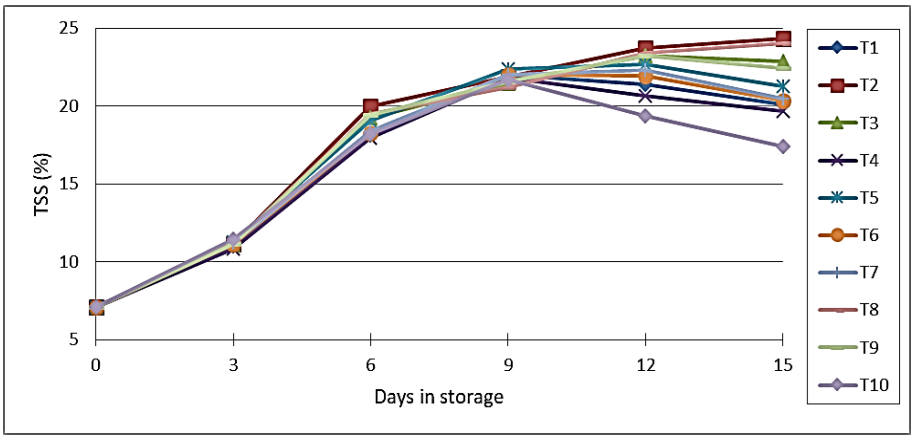

Fig 1: TSS (%) of mango fruits during storage

Reducing sugar (%)

Averagevalues of reducing sugar increased from first day (2.63%) to last i.e. 15th day (7.88%) of storage (Table-2, Fig.-2). The last day observation exhibited significantly higher value (9.00%) of reducing sugar with $Ca(NO_3)_2$ at 2 per cent followed by 8.88% with GA_3 100 whereas, significantly minimum value (6.45%) was recorded under control. These results are in close proximity with those obtained by Kumar (2005) [6] and Mounika *et al.* (2017) [11]. The initial increase in reducing sugars might be due to the hydrolysis of starch into reducing sugars and later on reduction could probably be due to utilization of these sugars in the process of respiration. The increase in reducing sugar content of fruits treated with Calcium salts and GA_3 might be due to reduced rate of catabolic activities like respiration under the influence of these chemicals (Kumar, 2005) [6].

Table 2: Reducing sugar (%) of mango fruits during storage under different post-harvest treatments

Treatments	Days in storage						Mean
	0	3	6	9	12	15	
T_1- $Ca(NO_3)_2$ at 1%	2.63	4.08	6.71	8.14	7.90	7.45	6.15
T_2- $Ca(NO_3)_2$ at 2%	2.63	4.13	7.39	8.09	8.77	9.00	6.67
T_3- $Ca(NO_3)_2$ at 3%	2.63	4.11	7.11	7.93	8.59	8.46	6.47
T_4- $CaCl_2$ at 1 %	2.63	4.01	6.64	8.07	7.65	7.27	6.05
T_5- $CaCl_2$ at 2%	2.63	4.17	7.05	8.28	8.38	7.88	6.40
T_6- $CaCl_2$ at 3%	2.63	4.12	6.76	8.14	8.11	7.53	6.22
T_7- GA_3 at 50 ppm	2.63	4.15	6.80	8.14	8.26	7.57	6.26
T_8- GA_3 at 100 ppm	2.63	4.16	7.21	7.84	8.66	8.88	6.56
T_9- GA_3 at 150 ppm	2.63	4.12	7.19	7.98	8.58	8.30	6.47
T_{10}- Control (Water)	2.63	4.24	6.74	8.02	7.16	6.45	5.87
Mean	2.63	4.13	6.96	8.06	8.21	7.88	
SEm±	0.00	0.02	0.08	0.10	0.5	0.06	
CD at 5%	0.00	0.05	0.20	0.27	0.12	0.15	

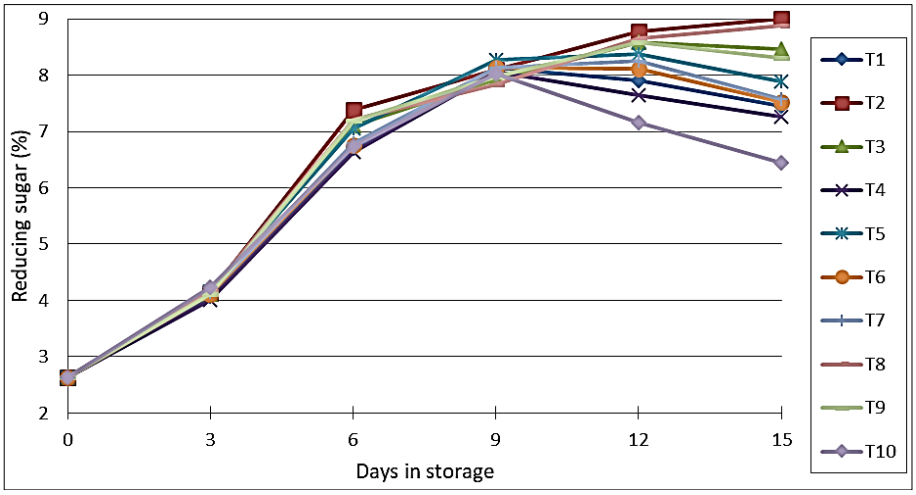

Fig 2: Reducing sugar (%) of mango fruits during storage

Total sugar (%)

The average content of total sugars gradually increased with the advancement of storage period and registered a decline after attaining a peak (Table-3, Fig.-3). At the end, maximum (20.05%) total sugars was recorded with $Ca(NO_3)_2$ at 2 per cent which can be ranked with GA_3 100 ppm having 19.78 per cent total sugars content. On the same day minimum value (14.37%) was with control.The similar effect of calcium salts and GA_3 was reported in pear by Mahajan and Dhatt (2004) [10] and in mango by Mounika *et al.* (2017) [11]. The delayed increase in total sugars over a longer period of time in calcium and GA treated mango fruits might be attributed to delay in ethylene production and respiration rate of fruits.

Table 3: Total sugar (%) of mango fruits during storage under different post-harvest treatments

Treatments	Days in storage						Mean
	0	3	6	9	12	15	
T_1- $Ca(NO_3)_2$ at 1%	5.85	9.09	14.94	18.14	17.62	16.59	13.71
T_2- $Ca(NO_3)_2$ at 2%	5.85	9.20	16.44	18.03	19.55	20.05	14.85
T_3- $Ca(NO_3)_2$ at 3%	5.85	9.16	15.83	17.66	19.15	18.85	14.42
T_4- $CaCl_2$ at 1 %	5.85	8.94	14.79	17.98	17.05	16.20	13.47
T_5- $CaCl_2$ at 2%	5.85	9.28	15.70	18.45	18.69	17.55	14.25
T_6- $CaCl_2$ at 3%	5.85	9.17	15.05	18.13	18.08	16.77	13.84
T_7- GA_3 at 50 ppm	5.85	9.24	15.14	18.13	18.41	16.87	13.94
T_8- GA_3 at 100 ppm	5.85	9.26	16.06	17.47	19.31	19.78	14.62
T_9- GA_3 at 150 ppm	5.85	9.17	16.01	17.78	19.12	18.48	14.40
T_{10}- Control (Water)	5.85	9.44	15.01	17.86	15.97	14.37	13.08
Mean	5.85	9.20	15.50	17.96	18.30	17.55	
SEm±	0.00	0.04	0.13	0.27	0.09	0.11	
CD at 5%	0.00	0.09	0.41	0.60	0.26	0.29	

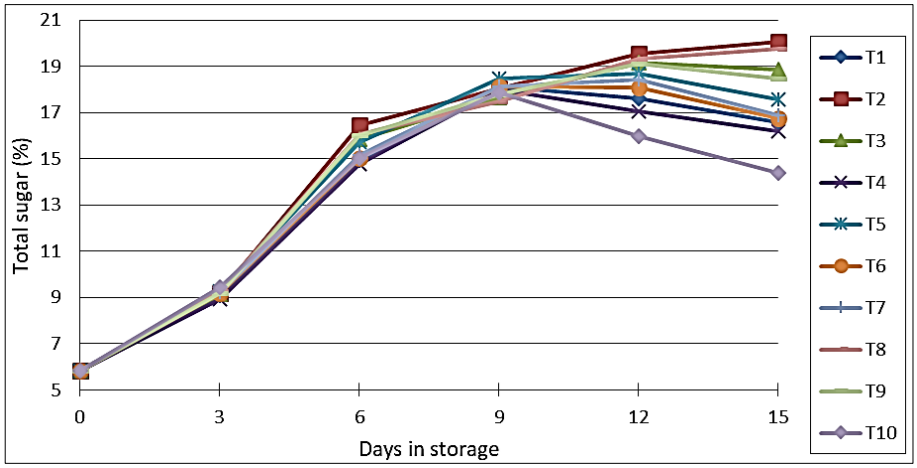

Fig 3: Total sugar (%) of mango fruits during storage

Conclusion

All treatments were found effective in maintaining the higher level of the quality attributes as well as the consumer's acceptability of fruits during entire course of the experiment. At end of trial, $Ca(NO_3)_2$ at 2% was proved as the best treatment in respect of TSS, reducing sugars and total sugars. Hence it can safely be concluded that calcium nitrate at 2 per cent and GA_3 at 100 ppm as post-harvest application can be used during storage of mango fruits in order to improve the quality attributes.

References

1. Ahmed MS, Singh S. Studies on extension of storage life of Amrapali mango. Orissa J Hort 2000;28:73-76.
2. Anonymous. Horticultural Statistics at a Glance 2017, P187, 242, 437.
3. Banerjee S, Sengupta S, Das B. Effect of GA3 and carbendazim as pre-harvest and salicylic acid and 1-MCP as post-harvest treatment on storage and post-harvest life of mango cv Amrapali. Enviro. Eco 2016;34(2A):683-685.
4. Khara SN, Thakur PK, Acharya P, Dhua RS. Characterization of Different Cultivars of Mango Commercially Grown in Malda, India. J Postharv. Tech 2016;04(04):050-055.
5. Koksal AL, Dumanoglu H, Tuna N. The Effect of Semperfresh on the Storage of 'Williams' Pear and 'Starkspur Golden Delicious' Apple Cultivars. Acta Hort 1994;368:793-801.
6. Kumar R. Effect of pre and post-harvest applications of certain chemicals on shelf life of litchi (*Litchi chinensis* Sonn.) var. China. Ph.D. Thesis submitted to R.A.U. Pusa Bihar 2005.
7. Lane JH, Eynon L. Estimation of reducing sugar. J Soc. Chem. Ind 1923;42:32.
8. Lashley D. Advances in postharvest technology, in International Seminar on New Technologies in Food Production for the Eighties and Beyond (Agro-Tech '83), St. Augustine, Trinidad and Tobago 1983, P173-183.
9. Macleod AM, Millar AS. Effect of gibberellic acid on barley endosperm. J Inst. Brewing 1962;68:322-332.
10. Mahajan BVC, Dhatt AS. Studies on postharvest calcium chloride application on storage behaviour and quality of Asian pear during cold storage. J Food, Agri. Environ 2004;2(3&4):157-159.
11. Mounika T, Reddy NN, Jyothilakshmi N, Joshi V. Studies on the effect of post harvest treatments on shelf life and quality of mango (*Mangifera indica* L.) cv. Amrapali. J Appl. Nat. Sci 2017;9(4):2055-2061.
12. Pal RK. Ripening and rheological properties of mango as influenced by ethrel and calcium carbide. J Food Sci. Tech 1998;35(4):358-360.
13. Pandey R, Sharma HC. The Litchi. Indian Council of Agricultural Research, New Delhi 1998, P88.
14. Patil SA, Bodke SS. Effect of post-harvest treatments on biochemical changes of mango (cv. Kesar) fruit during storage. Intl. J Universal Sci. and Tech 2018;3(2):69-73.
15. Pimpalpalle LV, Kapse BM, Kadam AR, Ghawade PM. Combined effect of Gibberellic acid and paraffin wax with modified atmospheric packaging (MAP) during storage at ambient temperature on sweet orange fruit (*Citussinensis*). Intl J Chem. Stud 2017;5(3):779-784.
16. Rani R, Brahmachari VS. Effect of foliar application of chemicals on quality characters of mango during storage. Progres. Horti 2003;35(2):216-218.
17. Ranjan Raj ARN, Prasad KK. Effect of postharvest application of calcium salts and GA3 on storage life of mango (*Mangifera indica* L.) cv. Langra. J App. Bio. Patna India 2005;15:69-73.
18. Singh JN, Pinaki A, Singh BB. Effect of GA_3 and plant extracts on storage behavior of mango (*Mangifera indica* L.) cv. Langra. Hary. J Hortl. Sci 2000;29:199-200.
19. Singh V, Pandey G, Sarolia DK, Kaushik RA, Gora JS. Influence of pre harvest application of calcium on shelf life and fruit quality of mango (*Mangifera Indica* L.) Cultivars. Int. J Curr. Microbiol. App. Sci 2017;6(4):1366-1372.
20. Stahl AL, Champ AF. Citrus fruits. The biochemistry of fruits and their products Ed. A. C. Hulme (1971). 3 Academic Press, London 1936, P107-167.