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Effect of pre-harvest foliar application of novel compounds on organoleptic traits of Guava (cv. Lucknow-49) fruits

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Abstract
This investigation was carried out to study the impact of pre harvest spray of different chemicals *viz*., calcium nitrate (0.5 and 1%), n-Propyl gallate (200 and 300ppm), salicylic acid (0.4 and 0.6%) and hexanal (1 and 2%) and water as control on organoleptic quality of guava (cv. Lucknow-49) fruits. The treated guava fruits were subjected to sensory evaluation by semi-trained panel to analyse the quality attributes like colour and appearance, mouth feel and texture, taste, flavour and overall acceptability, using 9 point hedonic scale during storage period of 9 days in ambient storage condition. The fruits treated with 1 per cent calcium nitrate (T_3) registered highest mean organoleptic scores with respect to colour and appearance (6.79), mouthfeel and texture (7.02), taste (7.00), flavour (6.87) and overall acceptability (6.96), which was followed by fruits treated with 300ppm n-Propyl gallate and 2 per cent hexanal during the storage period of 9 days. Whereas, the lowest score was obtained in fruits treated with salicylic acid (0.6%) as the treated fruits were severely affected with scorching and cracking.

Keywords: Calcium nitrate, n-propyl gallate, salicylic acid, hexanal and organoleptic quality

Introduction
Guava (*Psidium guajava* L.) being the member of the family Myrtaceae, is the fifth most important fruit crop after mango, banana, citrus and grapes. It is also delicious and highly nutritious fruit of tropical and sub-tropical regions of the world. Even though originated in parts of Central America, its adaptability for various ranging environments makes it a best loved commercial fruit crop all over the world. Guava is one of the choicest fruits due to its delicacy and nutritive value. It exceeds most of the other fruits in productivity which makes it profoundly remunerative. The fruit is an exceptional source of vitamin C, having two to five times more ascorbic acid content than oranges and nearly ten times that of tomatoes. It is also a good source of calcium, phosphorus and iron (Jatav *et al*., 2018) [1].
Guava consists of three flowering seasons *i.e.* ambe bahar, mrig bahar and hasth bahar. Among these, fruits obtained from mrig bahar gives the best quality fruits and ambe bahar gives the poorest one. These fruits have lower shelf life and are usually infested with insect pests and diseases, particularly fruit flies and anthracnose respectively. This may lead to physiological disorders like postharvest peel pitting, chilling injuries, microbial spoilage, changes in fruit texture, flavour and taste, rendering unacceptability towards sensory attributes. By considering these factors in view, a study was conducted to evaluate the effect of pre harvest sprays of different chemicals on organoleptic quality attributes of guava fruits stored under ambient condition.

Materials and Methods
The investigation was carried out in the Department of Post Harvest Technology, College of Horticulture, Bidar, Karnataka, during the year 2019-20. The plants in the experimental plots were monitored regularly and maintained well by taking regular plant protection measures. They were applied with recommended dose of fertiliser (RDF) (50:25:75 N:P:K g/plant) in two equal splits during the month of June and September. Regular orchard sanitation practices were followed and plot was kept healthy and weed free throughout the experimental period. Three years old trees of guava cv. L-49 were selected with 15 plants per treatment. They were treated with different compounds *viz*., calcium nitrate ($Ca(NO_3)_2$) (0.5 and 1%), n-Propyl

gallate (n-PG) (200 and 300ppm), salicylic acid (SA) (0.4 and 0.6%) and hexanal (1 and 2%) as foliar spray, using knapsack sprayer and at the same time control trees were sprayed with water. Two consecutive sprays were taken at 30 and 15 days before harvest and disease free, uniformly sized and firm mature fruits were harvested, collected in trays, washed with clean water, pre-cooled to remove field heat and then stored under ambient condition for study.

Organoleptic evaluation of guava fruits was carried out by a semi-trained panel consisting of officials of College of Horticulture, Bidar. Guava fruits under storage were assessed for various quality attributes like colour and appearance, mouth feel and texture, taste, flavour and overall acceptability, by the panel by means of giving score on the basis of 9-point Hedonic scale (1 - dislike extremely, 2 - like only slightly, 3 - dislike moderately, 4 - dislike slightly, 5 - neither like nor dislike, 6-like slightly, 7 - like moderately, 8 - like very much and 9 - like extremely) (Ranganna, 2003) [2]. Observations were taken at 2 days interval *i.e.* on 3rd, 5th, 7th and 9th day of storage.

Results and Discussion

The data pertaining to colour and appearance of guava fruits as influenced by different treatments under storage period is depicted in table 1. It is evident from the data that, significantly highest score for colour and appearance (7.92) was recorded in T_3–$Ca(NO_3)_2$ @ 1% followed by T_9–hexanal @ 2% (7.83) and T_5–n-PG @ 300ppm (7.58) whereas, T_7–SA @ 0.6% recorded least score (2.33) on 3rd day of storage. After 5, 7 and 9 days after storage (DAS), highest score for colour and appearance of guava fruits were recorded in T_3 (7.17, 6.25 and 5.83), followed by T_9 (6.92, 6.00 and 5.58) and T_5 (6.83, 5.83 and 5.25) while, least score was registered in T_7 (1.92, 1.75 and 1.58). Highest mean score for colour and appearance of guava fruits were recorded in T_3 (6.79) followed by T_9 (6.58) while least score was recorded in T_7 (1.90). This may be due to higher concentration of SA, the treated fruits showed vertical cracking and scorching resulting in deterioration of sensory attributes. Whereas, exogenous application $Ca(NO_3)_2$ and hexanal, delayed process of ripening and senescence and helped in preserving the green colour of fruits for longer days of storage than compared to control fruits.

The interpretation of observations pertaining to mouth feel and texture (Table 1) showed that, highest score for mouth feel and texture (8.25) was recorded in T_3–$Ca(NO_3)_2$ @ 1% followed by T_5–n-PG @ 300ppm (7.75) and T_9 –hexanal @ 2% (7.69) whereas, T_7–SA @ 0.6% recorded least score (5.67) on 3rd day of storage. After 5, 7 and 9 DAS, highest scores were recorded in T_3 (7.08, 6.67 and 6.08), it was followed by T_9 (6.92, 6.33 and 5.83) and T_5 (6.83, 6.25 and 5.92) while, least score was obtained in T_7 (4.33, 3.08 and 2.00). It may be due to calcium nitrate treated fruits maintained higher firmness during advancement of storage period thereby retaining fairly good texture in treated fruits, whereas the control fruits failed to do so (Gill *et al*., 2015) [3].

Taste is most important sensory attribute which determines the acceptability and desirability of consumer. Control fruits recorded maximum (8.33) score on 3rd day of storage and it decreased as the storage days advanced whereas, fruits treated with $Ca(NO_3)_2$, hexanal and n-PG obtained maximum (8.17, 8.08 and 8.00 respectively) score on 5th day of storage and registered higher mean score than compared to other treatments (Table 1). This might be due to fruits treated with calcium nitrate attained maximum TSS during medieval interval of storage period and also maintained higher TSS/ acid ratio up to the end of the storage period.

Similarly with respect to flavour, control fruits recorded maximum (8.00) score on 3rd day of storage and it decreased as the storage days advanced whereas, fruits treated with $Ca(NO_3)_2$, hexanal and n-PG obtained maximum (8.08, 8.00 and 7.92 respectively) scores on 5th day of storage and registered higher mean score than compared to other treatments (Table 2). This may be due occurrence of slower changes in titratable acidity and total sugar content during the stage of ripening and senescence in the treated fruits. These results are in line with Kaur *et al*. (2020) [4] in mango; Mandal *et al*. (2010) [5] in guava; and Gill *et al*. (2015) [3] in guava.

The data demonstrated significant differences among the treatments at different storage intervals with respect to overall acceptability of guava fruits (Table 2). It is evident from the data that highest score for overall acceptability (7.92) was recorded in control fruits followed by fruits treated with n-PG @ 200ppm (7.75) whereas, SA (0.6%) treated fruits registered least score (4.67) among the treatments, on the 3rd day of storage. After 9th day of storage, highest mean score (6.96), for overall acceptability of guava fruits were recorded in fruits treated with $Ca(NO_3)_2$ (1%), it was on par with fruits treated with hexanal (2%) and n-PG (300ppm) while, least (3.50) mean score was obtained in fruits treated with SA (0.6%). This might be due to calcium nitrate application helped in delaying senescence, enhance cell wall integrity thereby retained cellular organization and also helped in retarding the respiration rate in treated fruits (Gill *et al*. 2015) [3]; and also treated fruits maintained all the sensory attributes such as colour and appearance, texture, taste and flavour thereby remained highly acceptable throughout the storage period.

Fig. 1: Salicylic acid treated fruits showing scorching and cracking appearance

Table 1: Effect of pre harvest spray treatments on colour and appearance and mouth feel and texture of guava cv. L-49 fruits under ambient storage condition

Treatments	Colour and appearance					Mouth feel and texture				
	Days after storage									
	3	5	7	9	Mean	3	5	7	9	Mean
T_1	6.92^{c}	5.58^{c}	3.67^{c}	3.17^{d}	4.83	6.42^{bcd}	6.17^{b}	3.92^{de}	3.58^{c}	5.02
T_2	7.75^{abc}	6.75^{ab}	5.67^{a}	5.25^{bc}	6.35	7.25^{abc}	6.67^{ab}	4.75^{cd}	4.33^{b}	5.75
T_3	7.92^{a}	7.17^{a}	6.25^{a}	5.83^{a}	6.79	8.25^{a}	7.08^{a}	6.67^{a}	6.08^{a}	7.02
T_4	7.75^{abc}	6.08^{bc}	5.58^{ab}	5.00^{c}	6.10	7.50^{ab}	6.33^{ab}	4.92^{cd}	4.75^{b}	5.87
T_5	7.58^{abc}	6.83^{a}	5.83^{a}	5.25^{bc}	6.37	7.75^{ab}	6.83^{ab}	6.25^{ab}	5.92^{a}	6.69
T_6	3.92^{d}	2.75^{d}	2.50^{d}	1.83^{e}	2.75	5.83^{cd}	4.92^{c}	3.17^{e}	2.08^{d}	4.00
T_7	2.33^{e}	1.92^{e}	1.75^{d}	1.58^{e}	1.90	5.67^{d}	4.33^{c}	3.08^{e}	2.00^{d}	3.77
T_8	7.00^{bc}	6.08^{bc}	4.83^{b}	4.98^{c}	5.72	7.42^{ab}	6.25^{ab}	5.33^{bc}	5.00^{b}	6.00
T_9	7.83^{ab}	6.92^{a}	6.00^{a}	5.58^{ab}	6.58	7.67^{ab}	6.92^{ab}	6.33^{ab}	5.83^{a}	6.69
Mean	6.56	5.56	4.68	4.28		7.08	6.17	4.93	4.40	
S.Em±	0.29	0.25	0.27	0.19		0.48	0.29	0.44	0.24	
CD @ 5%	0.86	0.74	0.80	0.58		1.42	0.85	1.28	0.70	
C.V	7.62	7.82	10.03	8.00		11.74	7.96	15.22	9.28	

T_1 – Control
T_2 –Calcium nitrate ($Ca(NO_3)_2$)@ 0.5%
T_3 – $Ca(NO_3)_2$@ 1%
T_4 – n-Propyl gallate (n-PG) @ 200ppm
T_5–n-PG @ 300ppm
T_6– Salicylic acid (SA) @ 0.4%
T_7– SA @ 0.6%
T_8- Hexanal @ 1%
T_9- Hexanal @ 2%

Table 2: Effect of pre harvest spray treatments on taste, flavour and overall acceptability of guava cv. L-49 fruits under ambient storage condition

Treatments	Taste					Flavour					Overall acceptability				
	Days after storage														
	3	5	7	9	Mean	3	5	7	9	Mean	3	5	7	9	Mean
T_1	8.33^{a}	6.92^{abc}	4.75^{abc}	3.33^{b}	5.83	8.00^{a}	7.17^{ab}	5.08^{abc}	3.42^{b}	5.92	7.92^{a}	7.08^{ab}	4.83^{abc}	3.83^{b}	5.92
T_2	7.75^{a}	7.33^{ab}	5.33^{ab}	4.25^{ab}	6.17	7.92^{a}	6.83^{abc}	5.83^{ab}	5.00^{a}	6.40	7.75^{a}	7.42^{a}	6.42^{ab}	3.92^{b}	6.37
T_3	7.58^{a}	8.17^{a}	7.08^{a}	5.17^{a}	7.00	7.25^{a}	8.08^{a}	7.08^{a}	5.08^{a}	6.87	7.58^{a}	8.00^{a}	7.33^{a}	4.92^{a}	6.96
T_4	7.83^{a}	7.08^{abc}	5.75^{ab}	4.33^{ab}	6.25	7.75^{a}	6.83^{abc}	5.92^{ab}	4.67^{a}	6.29	7.75^{a}	7.17^{a}	6.08^{abc}	4.25^{ab}	6.31
T_5	7.25^{ab}	8.00^{a}	6.42^{a}	5.00^{a}	6.67	7.25^{a}	8.00^{a}	6.75^{a}	4.75^{a}	6.69	7.33^{a}	7.83^{a}	7.25^{a}	4.83^{a}	6.81
T_6	5.83^{bc}	5.33^{bc}	3.50^{bc}	1.75^{c}	4.10	5.67^{b}	5.50^{bc}	3.83^{bc}	2.33^{bc}	4.33	5.42^{b}	4.92^{bc}	4.08^{bc}	1.75^{c}	4.04
T_7	5.15^{c}	5.25^{c}	2.83^{c}	1.58^{c}	3.70	5.33^{b}	5.08^{c}	3.00^{c}	2.17^{c}	3.90	4.67^{b}	4.17^{c}	3.58^{c}	1.58^{c}	3.50
T_8	7.58^{a}	7.08^{abc}	5.25^{ab}	4.17^{ab}	6.02	7.67^{a}	7.25^{ab}	6.67^{a}	4.75^{a}	6.58	7.67^{a}	7.33^{a}	5.58^{abc}	4.42^{ab}	6.25
T_9	7.25^{ab}	8.08^{a}	6.33^{a}	4.67^{a}	6.58	7.33^{a}	7.92^{a}	6.70^{a}	4.58^{a}	6.63	7.50^{a}	8.00^{a}	7.00^{a}	4.75^{a}	6.81
Mean	7.17	7.03	5.25	3.81		7.13	6.96	5.65	4.08		7.06	6.88	5.80	3.81	
S.Em±	0.49	0.69	0.79	0.40		0.50	0.67	0.82	0.38		0.56	0.76	0.86	0.23	
CD @ 5%	1.44	2.03	2.34	1.18		1.49	1.99	2.44	1.15		1.66	2.24	2.57	0.69	
C.V	11.77	16.90	25.96	18.05		12.24	16.72	25.24	16.33		13.76	19.05	25.82	10.51	

T_1 – Control
T_2 – $Ca(NO_3)_2$ @ 0.5%
T_3 – $Ca(NO_3)_2$ @ 1%
T_4 – n-PG @ 200ppm
T_5– n-PG @ 300ppm
T_6– SA @ 0.4%
T_7– SA @ 0.6%
T_8- Hexanal @ 1%
T_9- Hexanal @ 2%

Conclusion

Application of calcium nitrate (2%) as a pre harvest foliar spray, was found to be most effective in maintaining the sensory attributes such as colour and appearance, mouth feel and texture, taste and flavour and thereby maintained the edible quality and enhanced the shelf life of guava fruits up to 9 days of storage under ambient storage condition whereas, control fruits lost edible quality by 4th day.

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