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The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(12): 637-639

www.thepharmajournal.com
Received: 04-09-2021
Accepted: 13-11-2021

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Effect of pre-harvest treatments and bagging on physical characteristics and organoleptic improvement of guava (*Psidium guajava* L.) cv. L- 49 fruits

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Abstract
The investigation was carried out at *Instructional cum Research Fruit Orchard*, Department of Fruit Science, K.N.K. College of Horticulture, Mandsaur (MP), during November, 2019 to January, 2020. The treatments comprised of pre harvest spraying of $CaCl_2$, Ascorbic acid and bagging with Brown paper and Yellow color polythene to study the physical characteristics and organoleptic test of guava fruit. The experiment was laid out in randomized complete block design with three replications. Treatment $CaCl_2$ @ 2% with Brown paper (T_{11}) fruit bagging showed significant effects on different parameters which were studied during the experiment. It was observed that the maximum fruit length (8.25 cm), maximum fruit width (8.72 cm), maximum fruit weight (199.67 g), highest volume (197.67 ml), highest pulp weight (173.40 g), were recorded with the treatment $CaCl_2$ @ 2% with Brown paper (T_{11}), while specific gravity was recorded statistically non-significant. In terms of organoleptic test the highest values of fruit taste (7.33), fruit colour (8.00), fruit texture (7.67) and fruit aroma (7.33) influenced significantly and were recorded under the treatment T_{11} $CaCl_2$ @ 2% with Brown paper.

Keywords: Physical characteristics, organoleptic test, guava

Introduction
Guava (*Psidium guajava* L.) is one of the important fruit cultivated in several tropical and subtropical countries of the world (Pathak, *et al.*, 2007) [8], it belongs to the family Myrtaceae, originated in Tropical America. It is also known as 'Apple of the tropics' or 'Poor man's apple'. Due to hardy nature of the guava fruit plant, it can withstand upto adverse climatic conditions and grows under a wide range of soil types from sandy loam to clay loam (Dhaliwal and Singla, 2002) [4]. In India, Guava is the fourth most important fruit crop in area and production after mango, banana and citrus with production of 42.36 lakh tonnes from an area of 2.76 lakh ha (NHB Database, 2018) [7]. It is an important fruit crop cultivated all over India, especially in the regions of Uttar Pradesh, Madhya Pradesh, Bihar, Maharashtra, West Bengal, Punjab, Chhattisgarh, Haryana, Karnataka, and Gujarat.

Guava fruit of variety Lucknow-49 is a selection from open pollinated population of Allahabad Safeda cultivar from Ganeshkhind, Pune (MH) and is also called as Sardar Guava. Trees are vigorous. The leaves are elliptical-ovate to oblong in shape. Fruits are roundish ovate in shape. Skin color is primrose-yellow. The pulp is whitish, very sweet and tasty with a TSS of 9.5 ^{0}B and vitamin C content 130mg/100g. It has been observed that pectin content is higher in winter guava than the monsoon fruits (Salunke and Kadam, 1995) [11].

Pre-harvest calcium spray is one of the most important practices of new strategies applied in the integrated fruit production systems, improving fruit characteristics to minimize fungicides sprays towards the end of the harvest period, which in turn improves fruit resistance to brown rot (Conway *et al.*, 1994) [3]. Calcium spray during fruit development provides a safe mode of supplementing endogenous calcium to fresh fruits (Raese and Drake, 2000) [10]. Application of Ascorbic acid had many stimulating effects on growth and physiological activities of various plants (Abdou *et al.*, 2015) [2]. Ascorbic acid is a good antioxidant that keeps fruit from darkening and improves destruction of bacteria. Antioxidants are used instead of auxins for improving fruit growth, development and fruiting of trees (Maksoud *et al.*, 2009) [6].

Fruit bagging decreases the defects generated due to diseases and insects, and increased flesh firmness and flavour. The most important role of fruit bagging was to effectively protect fruits from physiological factors which led to the significant decrease of the total damaged,

degenerative and defective fruits (13.7-33.3%), as compared with non-bagging fruits. Bagging is a physical protection technique used extensively in several fruit crops to improve skin colour which also reduce the incidence of disease, insect-pests, mechanical damage, agrochemical residues on the fruit, and bird damage (Xu *et al.*, 2010) [14].

Materials and Methods

The present investigation was conducted during the year 2019-2020 at the *Instructional Cum Research Fruit Orchard*, Department of Fruit Science, K.N.K. College of Horticulture Mandsaur (M.P.). Single spraying of $CaCl_2$ and Ascorbic acid were done at 30 days before harvesting of the fruits. Bagging of fruits with Yellow polyethylene bags and Brown paper bags were done one month before harvesting of the fruits of guava fruits comprised of 21 treatments included control. Without spray and no fruit bagging (open fruit) was treated as control. The experiment was conducted in Randomized Complete Block Design (RCBD) with three replications. The fruits were wrapped with respective bagging materials as per the treatments. Single tree was considered as an experimental unit. Digital Vernier callipers was used for measuring the value of fruit length and fruit width in cm. Fruit weight was measured by electronic balance in gram. The volume of fruit was recorded by water displacement method with the help of measuring cylinder in milliliters. Dividing weight of fruit by volume of fruit gives the value of specific gravity. Reduced seed weight from fruit weight gives the pulp weight.

The guava fresh fruits were subjected to sensory evaluation by a panel of six judges. The fruits were evaluated for fruit taste, colour, texture and aroma was done using Hedonic scale method of Peryam and Pilgrim (1957) [9]. The characters with mean scores of more out of 9 marks were considered acceptable.

Results and Discussion

Present study of pre-harvest treatments and bagging have considerable enhancement on the physical characteristics and organoleptic test of guava and the data regarding this is given in Tables 1.1. Application of $CaCl_2$ and Ascorbic acid along with bagging improves the physical characters of the fruit along with its organoleptic test. Their application alone or in combination influenced significantly the physical parameters of the fruit *viz*. fruit length, fruit width, fruit weight, fruit volume, specific gravity and pulp weight and organoleptic test *viz*. fruit taste, fruit colour, fruit texture and fruit aroma over the control. The maximum specific gravity (1.07) was in treatment T_2 ($CaCl_2$ @ 1.5%), while maximum fruit length (8.25 cm), maximum fruit width (8.72 cm), maximum fruit weight (199.67 g), maximum fruit volume (197.67 ml) and maximum pulp weight (173.40 g), the highest values of fruit taste (7.33), fruit colour (8.00), fruit texture (7.67) and fruit aroma (7.33) with the application of T_{11} ($CaCl_2$ @ 2% with Brown paper) at harvest were significantly superior over control treatment T_0.

The improvement in various physical characteristics is due to optimum supply of proper plant nutrients in right amount during the entire crop growth period causing vigorous vegetative development of the plants and ultimately production of more food material in fruits. The combinations $CaCl_2$, Ascorbic acid and bagging accelerate metabolic activities and maintain higher temperature and provide more availability of nutrient to the fruit. Guava responds well to the application of calcium, hence $CaCl_2$ application improves, fruit character and chemical composition through rapid transformation of plant nutrients along with Ascorbic acid application of different concentrations which has stimulating effects. Similar findings were also reported by many scientists. Same time in bagging (Brown paper and Yellow polyethylene) enhanced much better growth in terms of physical characters which in turn causes increase in size and weight of the fruits and other physical characters. The present findings are in accordance with the results reported by Sarker *et al*. (2009) [12], Abbasi *et al*. (2014) [1], Islam *et al*. (2019) [5]. Fruits treated with $CaCl_2$ @ 2% and bagging with Brown paper were found significantly superior in organoleptic test with highest scores in terms of taste, colour, texture and aroma, respectively and rated as very good. Similarly, earlier workers have also reported that the fruit bagging can improve fruit quality mainly by keeping fruit appearance and preferable uniform coloration of the fruit as reported by Sarker *et al*. (2009) [12] and Singh *et al*. (2017) [13].

Table 1: Effect of pre-harvest treatments and bagging on physical parameters of guava fruit.

Treatments		Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	Fruit volume (ml)	Specific gravity	Pulp weight (g)
T_0	Control	5.57	5.92	122.67	136.30	0.90	99.83
T_1	$CaCl_2$ @ 1%	6.60	6.86	152.45	162.16	0.94	105.22
T_2	$CaCl_2$ @ 1.5%	6.86	6.87	153.89	143.93	1.07	109.56
T_3	$CaCl_2$ @ 2%	7.11	7.34	154.11	152.59	1.05	110.67
T_4	Ascorbic acid @ 200ppm	6.36	7.13	132.67	147.40	1.04	100.20
T_5	Ascorbic acid @ 300 ppm	6.60	7.30	146.63	143.73	0.91	103.23
T_6	Ascorbic acid @ 400 ppm	6.46	7.02	147.67	140.63	1.05	103.33
T_7	Bagging with Brown paper	7.58	8.10	183.00	174.32	1.05	118.58
T_8	Bagging with Yellow polyethylene	7.27	7.09	167.33	159.37	1.05	117.00
T_9	$CaCl_2$ @ 1% with Brown paper	6.58	7.41	193.67	195.60	0.99	146.44
T_{10}	$CaCl_2$ @ 1.5% with Brown paper	7.67	7.96	196.78	183.90	1.07	156.67
T_{11}	$CaCl_2$ @ 2% with Brown paper	8.25	8.72	199.67	197.67	1.05	173.40
T_{12}	Ascorbic acid @ 200 ppm with Brown paper	7.46	7.72	179.72	197.47	0.91	133.22
T_{13}	Ascorbic acid @ 300 ppm with Brown paper	7.05	7.78	187.77	184.00	1.02	134.24
T_{14}	Ascorbic acid @ 400 ppm with Brown paper	6.98	7.07	198.97	185.97	1.07	141.34
T_{15}	$CaCl_2$ @ 1% with Yellow polyethylene	7.49	7.47	174.34	170.90	1.02	112.11
T_{16}	$CaCl_2$ @ 1.5% with Yellow polyethylene	7.01	7.10	169.11	162.66	1.04	114.89
T_{17}	$CaCl_2$ @ 2% with Yellow polyethylene	7.54	7.36	166.33	159.93	1.04	115.40
T_{18}	Ascorbic acid @ 200 ppm with Yellow polyethylene	7.23	7.79	177.13	167.10	1.06	118.00
T_{19}	Ascorbic acid @ 300 ppm with Yellow polyethylene	7.20	7.28	164.33	162.76	1.01	142.22

T_{20}	Ascorbic acid @ 400 ppm with Yellow polyethylene	7.47	7.48	155.11	165.00	0.94	119.67
S.Em. ±		0.12	0.21	6.07	0.79	0.02	6.96
C.D. at 5%		0.33	0.59	17.35	2.27	0.07	19.90

Table 2: Effect of pre-harvest treatments and bagging on organoleptic test of guava fruit.

Treatments		Fruit taste	Fruit colour	Fruit texture	Fruit aroma
T_0	Control	4.33	5.33	4.67	4.00
T_1	$CaCl_2$ @1%	5.67	6.33	6.00	6.00
T_2	$CaCl_2$ @1.5%	6.00	7.00	6.33	6.67
T_3	$CaCl_2$ @2%	6.33	7.33	6.67	6.00
T_4	Ascorbic acid @200ppm	5.67	5.67	6.00	5.00
T_5	Ascorbic acid @300 ppm	6.33	6.33	6.33	5.67
T_6	Ascorbic acid @400 ppm	6.67	6.33	5.67	6.33
T_7	Bagging with Brown paper	5.67	7.33	5.00	6.00
T_8	Bagging with Yellow polyethylene	5.33	7.33	6.00	4.67
T_9	$CaCl_2$ @1% with Brown paper	4.67	6.00	5.67	6.33
T_{10}	$CaCl_2$ @1.5% with Brown paper	6.67	6.00	6.67	6.67
T_{11}	$CaCl_2$ @2% with Brown paper	7.33	8.00	7.67	7.33
T_{12}	Ascorbic acid @200 ppm with Brown paper	6.00	7.33	6.67	6.33
T_{13}	Ascorbic acid @300 ppm with Brown paper	5.33	7.00	6.00	5.67
T_{14}	Ascorbic acid @400 ppm with Brown paper	5.67	6.67	5.67	6.33
T_{15}	$CaCl_2$ @1% with Yellow polyethylene	6.67	6.33	6.67	6.33
T_{16}	$CaCl_2$ @1.5% with Yellow polyethylene	5.00	6.33	5.00	4.33
T_{17}	$CaCl_2$ @2% with Yellow polyethylene	5.67	7.33	6.33	6.67
T_{18}	Ascorbic acid @200 ppm with Yellow polyethylene	5.33	5.67	6.00	6.67
T_{19}	Ascorbic acid @300 ppm with Yellow polyethylene	7.00	6.33	7.33	6.33
T_{20}	Ascorbic acid @400 ppm with Yellow polyethylene	6.33	7.00	6.33	7.00
S.Em. ±		0.29	0.29	0.28	0.31
C.D. at 5%		0.84	0.82	0.81	0.89

Conclusion

All the pre-harvest treatments were found better than control in terms of organoleptic test and physical characteristics of fruit while the pre-harvest treatment of $CaCl_2$ @ 2% with Brown paper was found superior to increase the physical parameters of fruit and organoleptic quality than all other treatments. This treatment was found to have very low spots and no infestation. Hence it should be practiced in guava crop to produce fruits with better quality, good size and weight and better colour as well as texture and aroma with excellent taste.

Acknowledgement

With profound respect I am extremely thankful to Dr. S.K. Rao, Hon'ble Vice Chancellor, R.V.S.K.V.V., Gwalior, Dr. A.K. Singh, Director Instruction and Dr. D.H. Ranade, Dean Faculty of Agriculture R.V.S.K.V.V., Gwalior, M.P. With deepest sense of humility and gratefulness, I feel myself duly bound to express my heartfelt and sincere thanks to Dr. Mridula Billore, Dean, KNK College of Horticulture, Mandsaur. The words at my dominion are really scarce to articulate my deep sense of appreciation to Dr. Roop Narayan Kanpur, Assistant Professor, Department of Fruit Science.

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