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Studies on Extending the Shelf Life of Fig (*Ficus carica* L.) Fruits Cv. Dinkar Fig

P. B. Sable[1*] and D. P. Waskar[2]

[1]Department of Horticulture, Shri. Shivaji Agriculture College, Amravati - 444603, M.S., India
[2]Director of Research, Late Shri. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani - 431402, M.S. India

**Corresponding author*

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A B S T R A C T

The present investigation entitled "Studies on extending the shelf life of Fig (*Ficus carica* L.) fruits Cv. Dinkar Fig" was conducted at Department of Horticulture, Late Shri. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, M.S., India during the year 2008-2009. The experiment was conducted in Factorial Completely Randomized Design (FCRD) with six pre-harvest treatments and two storage conditions. The treatments were replicated three times. The pre-harvest sprays (0.5%, 1.0% and control) were undertaken 10 and 20 days before harvesting fruits of fig Cv. Dinkar fig. The fruits were packed in CFB boxes and stored under two environments viz. at room temp. (15.10 to 41.3^{0}C and 49.00 – 71.00% RH) and in cool storage (5^{0}Cand 90-95%RH). The results revealed that there was an increase in TSS, reducing sugars and total sugars with corresponding decrease in acidity of fig Cv. Dinkar fig under both the storage conditions irrespective of pre-harvest treatments. Fruits stored in cool store followed the same trend of physico-chemical changes but at a slower rate. The shelf life of control fig fruits was found to be hardly 2 days at room temperature. However fig fruits of variety Cv. Dinkar fig could be stored upto 4 days at room temperature when these were given spray of $CaCl_2$(1.0%) 10 days before harvesting. The shelf life of untreated fruit of this variety was hardly 5 days in CS. However, it could be further extended upto 8 days when given spray of $CaCl_2$ (1.0%) 10 days before harvesting and stored in CS.

Introduction

Fig (*Ficus carica* L.) belongs to family Moraceac. The main fig growing countries are Italy, Spain, Turkey, Greece, Portugal and Algeria. It is extensively grown in the state of California (USA) and Afganisthan. Total area under fig cultivation in India is about 5600 hectares with the production of 13,802 thousand tones i.e. about 12.32 tons per hectares (Anon, 2018). In Maharashtra, it is cultivated on commercial scale in adjoining area of Pune and Aurangabad Districts. The principal causes for postharvest losses are infection by pathogen, rough handling, improper packaging, improper made of transportation and unhygienic storage conditions. It is estimated that the total losses due to spoilage may be ranging from 30-40 percent (Salunke and Desai, 1984). The research efforts have helped to

increase the production of fig fruit but the purpose of obtaining maximum profit will not be served unless increased production is supplemented with similar efforts to minimize their post harvest losses.

Calcium has received considerable attention in recent years due to its desirable effects particularly it can delay ripening and senescence, increase firmness, vitamin C and phenol contents, reduce transpiration, extend storage life and reduce the incidence of physiological disorders and storage rots. Calcium treatments have known to delay softening and improve the fruits quality.

The variety such as Dinkar fig has been found to give high yield with more total soluble solids. Cool storage of fig fruits is an expensive method and has not been widely adopted by many growers. The information on both such as pre harvest spray of calcium chloride and use of cold storage for extending the shelf life of fig fruits Cv. Dinkar fig that are grown under arid conditions is not available.

Therefore the present investigation was undertaken with the objectives to study the effect of pre-harvest sprays of calcium chloride on the changes in physico-chemical characteristics of fig fruits under various storage conditions.

Materials and Methods

The present investigation was conducted at the Post Harvest Technology Laboratory of the Department of Horticulture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parhani during the year 2008-09 to study the effect of pre-harvest spray of calcium chloride on the changes in physico-chemical characteristics of fig fruits under various storage conditions. The experiment was conducted in Factorial Completely Randomized Design (FCRD) with six pre-harvest treatments and two storage conditions. The treatments were replicated there times. The spray of calcium chloride at 20 and 10 days before harvesting of fig Cv. Dinkar fig were undertaken and different concentrations of calcium chloride were applied as pre-harvest sprays which are T_1-0.5% $CaCl_2$-10 days before harvesting, T_2-0.5% $CaCl_2$-20 days before harvesting,

T_3 – 1.0% $CaCl_2$-10 days before harvesting.

T_4 – 1.0% $CaCl_2$-20 days before harvesting.

T_5 – control (water sprayed) – 10 days before harvesting and

T_6 – control (water sprayed) – 20 days before harvesting.

The fruits of above treatments were harvested early in the morning at proper stage of maturity and graded. The fig fruits were then packed in Corrugated Fiber Board Boxes (CFB) and stored under various environments and room temperature (15.10-41.3^{0}C and 49.00-71.00% RH) and low temperature (5^{0}C and 90-95%RH). For chemical analysis, the sample was first ground finely in mixer and then homogenized in Mortar and pastle for obtaining pulp of uniform consistency. The pulp was analyzed for the content of TSS, acidity, total sugars and reducing sugars. The content of TSS(%) in fresh fig fruits were determined with the help of hand refractometer and the values were corrected to 2^{0}C with the help of temperature correlation chart (A.O.A.C., 1975).

Total titrable acidity of the pulp was determined as per the method advocated by A.O.A.C. (1975). The reducing and total sugars (%) were estimated as per the method given by Lane and Eynon (1923). Analysis of variance for all characters was done as per the method of analysis of variance using Factorial Completely Randomized Block Design given by Snedecor and Cochran (1994).

Results and Discussion

Total soluble solids (TSS)

The data on the effect of pre-harvest sprays of $CaCl_2$ on changes in total soluble solids (per cent) of fig fruits Cv. Dinkar fig during storage at RT have been

given in Table 1. At the beginning of the storage, the value of TSS of fig fruits Cv. Dinkar fig were found to be 18.46, 18.08, 18.77, 18.70, 18.91 and 19.08 per cents for the treatments T_1, T_2, T_3, T_4, T_5 and T_6 respectively. The values of TSS of fig fruits at one end of 4th day of storage at RT were found to be 21.08, 21.80, 20.44, 20.80, 21.59 and 21.79 per cents for the treatments T_1, T_2, T_3, T_4, T_5 and T_6 respectively.

The data on the effect of pre-harvest spray of $CaCl_2$ changes in total soluble solids (per cent) of fig fruits Cv. Dinkar fig during storage at CS have been given in Table 2. Initially values for TSS of fig fruits Cv. Dinkar fig were found to be 18.46, 18.08, 18.77, 18.70, 18.91 and19.08 per cents for the treatments T_1, T_2, T_3, T_4, T_5 and T_6 respectively.

At the end of 8th day of storage in CS, the TSS was found to be the lowest in T_3(20.38%) while the highest in T_6(21.90%). The values of TSS were found to be 21.00. 21.14, 20.38, 20.76, 21.58, 21.90 per cents for the treatments T_1, T_2, T_3, T_4, T_5 and T_6 respectively.

The increase in TSS of fig fruits could be attributed to the conversion of reserved starch and other insoluble carbohydrates into soluble sugars as fig fruits is aclimacteric fruit. These results elucidate the findings of Kardum (2004) in fig under cold storage condition and Lakshmi Narayana and Reddy (1996) in Sapota fruits.

Acidity

It was revealed from data presented in Table 1 that at the beginning of the storage at RT, the values for acidity of fig fruits Cv. Dinkar fig were found to be 0.246, 0.241, 0.256, 0.253, 0.225, 0.223 per cents for T_1, T_2, T_3, T_4, T_5 and T_6 respectively. The values of acidity of fig fruits Cv. Dinkar fig after 4th days of storage period at RT, were found to be 0.226, 0.220, 0.236, 0.227, 0.200 and 0.193 per cent s for the treatmentsT_1, T_2, T_3, T_4, T_5 and T_6 respectively. The data recorded in Table 2 indicated that at the beginning of CS, the values for acidity of fig fruits Cv. Dinkar fig were found to be 0.246, 0.241, 0.256, 0.253, 0.225 and 0.223per cents for the treatments T_1, T_2, T_3, T_4, T_5 and T_6 respectively. The values of acidity of fig fruits Cv. Dinkar fig at the 8th day of storage in CS were found to be 0.198, 0.190, 0.226, 0.215, 0.185 and 0.180 per cent s for the treatments T_1, T_2, T_3, T_4, T_5 and T_6 respectively.

The acidity of fig fruits generally decreased with advancement of storage period (Salunke and Desai, 1984). Decrease in acidity may be attributed to conversion of acids into sugar during respiration. These results are in confirmation with Kardum (2004) in fig.

Reducing sugars (per cent)

The data on the effect of $CaCl_2$ on changes in reducing sugars (per cent) of fig fruits Cv. Dinkar fig during storage at RT have been given in Table 1. At the beginning of RT storage, the values for reducing sugars of fig fruits were found to be 13.45, 13.25, 13.80, 13.56, 13.88 and 13.96 per cents for the treatmentsT_1, T_2, T_3, T_4, T_5 and T_6 respectively. The values of reducing sugars of fig fruits at the end of 4th day of storage period at RT were found to be 15.42, 15.72, 14.98, 15.29, 15.81 and 15.95 per cents for treatments T_1, T_2, T_3, T_4, T_5 and T_6 respectively.

The data presented in Table 2 indicated that at CS initially the values for reducing sugars of fig fruits Cv. Dinkar fig were found to be 13.45, 13.25, 13.80, 13.56, 13.88 and 13.96 per cents for the treatmentsT_1, T_2, T_3, T_4, T_5 and T_6 respectively. The values of reducing sugar on 8th days of storage in CS, were found to be 15.86, 15.74, 15.40, 15.65, 16.28 and 16.39 per cent s for the treatmentsT_1, T_2, T_3, T_4, T_5 and T_6 respectively.

The rate of increase in sugar was found to be faster at RT than in CS. It could possibly due to the fact that higher temperature and low humidity resulted in faster utilization of sugar at RT resulted in shorter shelf life of fig fruits similar reports were given by Khedkar (1998) in pomegranate.

Table.1 Effect of pre-harvest sprays of $CaCl_2$ on physico-chemical characteristics of fig fruits Cv. Dinkar fig during storage at Room Temperature (RT)

Treatment No.	Days after Storage						Total Sugar (%)	
	TSS (%)		Acidity (%)		Reducing Sugar (%)			
	Initial (0)	8 DAS	Initial (0)	8 DAS	Initial (0)	8 DAS	Initial (0)	8 DAS
T_1	18.46	21.08	0.246	0.226	13.45	15.42	15.53	17.85
T_2	18.08	21.80	0.241	0.220	13.25	15.72	15.28	17.99
T_3	18.77	20.44	0.256	0.236	13.80	14.98	15.96	17.39
T_4	18.70	20.80	0.253	0.227	13.56	15.29	15.60	17.56
T_5	18.91	21.59	0.225	0.200	13.88	15.81	16.36	18.43
T_6	19.08	21.71	0.223	0.193	13.96	15.95	16.56	18.65
Mean	18.68	21.23	0.241	0.217	13.65	15.55	15.89	17.97
Pre-harvest treatments	SE± 0.00497	CD at 5% 0.01406	SE± 0.00264	CD at 5 % 0.00747	SE± 0.03315	CD at 5 % 0.09377	SE± 0.03270	CD at 5 % 0.09250
Storage period	0.00544	0.01540	0.00289	0.00818	0.03631	0.05135	0.03582	0.10133
Pre-harvest treatments & Storage period	0.01217	0.03443	0.00647	0.01830	0.08119	0.22968	0.08009	0.22658

Table.2 Effect of pre-harvest sprays of $CaCl_2$ on physico-chemical characteristics of fig fruits Cv. Dinkar fig during storage in Cold Storage (CS)

Treatment No.	Days after Storage						Total Sugar (%)	
	TSS (%)		Acidity (%)		Reducing Sugar (%)			
	Initial (0)	8 DAS	Initial (0)	8 DAS	Initial (0)	8 DAS	Initial (0)	8 DAS
T_1	18.46	21.00	0.246	0.198	13.45	15.86	15.53	18.45
T_2	18.08	21.14	0.241	0.190	13.25	15.11	15.28	18.66
T_3	18.77	20.38	0.256	0.226	13.80	14.74	15.96	17.74
T_4	18.70	20.76	0.253	0.215	13.56	14.78	15.60	18.12
T_5	18.91	21.58	0.255	0.185	13.88	15.30	16.36	19.28
T_6	19.08	21.90	0.223	0.180	13.96	15.36	16.56	19.46
Mean	18.68	21.12	0.241	0.199	13.65	15.02	15.89	18.59
Pre-harvest treatments	SE± 0.18681	CD at 5% 0.52366	SE± 0.00292	CD at 5 % 0.00819	SE± 0.03614	CD at 5 % 0.10132	SE± 0.03816	CD at 5 % 0.10698
Storage period	0.15253	0.42757	0.00239	0.00669	0.02951	0.08273	0.03116	0.08735
Pre-harvest treatments& Storage period	0.45758	9.28270	0.00716	0.02006	0.08853	0.24818	0.09348	0.26204

Total Sugar (per cent)

From the data presented in Table 1, it was revealed that initially, the values for total sugars of fig fruits Cv. Dinkar fig during storage at RT were found to be 15.53, 15.28, 15.96, 15.60, 16.36 and 16.56 per cents for the treatments T_1, T_2, T_3, T_4, T_5 and T_6 respectively.

The values of total sugar of fig fruits Cv. Dinkar fig at the end of the 4th day of storage period at RT were found to be 17.85, 17.99, 17.39, 17.56, 18.43 and 18.65 per cents for the treatments T_1, T_2, T_3, T_4, T_5 and T_6 respectively.

From the data presented in Table 2 it was revealed that at CS initially of the values of total sugars of fig fruits Cv. Dinkar fig were found to be 15.53, 15.28, 15.96, 15.60, 16.36 and 16.56 per cents for the treatmentsT_1, T_2, T_3, T_4, T_5 and T_6 respectively. The values of total sugars of fig fruits Cv. Dinkar fig at the end of the 8thday of storage period were found to be 18.45, 18.66, 17.57, 18.12, 19.28 and 19.46 per cents for the treatmentsT_1, T_2, T_3, T_4, T_5 and T_6 respectively.

The continuous rise of total sugar of fig fruits Cv. Dinkar fig was observed under both the storage conditions. The rate of increase of total sugar was found to be faster at RT than in CS. It could possibly be due to the fact that higher temperature and low humidity resulted in faster utilization of soluble solids and sugars at RT resulted in shorter life of fig fruits. These changes were found to be at slower rate when fruits were stored in CS. Similar reports were given by Kardum (2004) for fig and Khedkar (1998) for pomegranate. Exogenous Ca^{++} has been shown to delay senescence of may fruits tissue slices, in particular ethylene production and the onset of Lipid peroxidation.

Use of calcium chloride at pre-harvest spray and cool storage could be used in order to extend the shelf life of fresh fig fruits. Use of cool storage is helpful in maintaining the physico-chemical characteristics of fig fruits.

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