

## STUDIES ON THE POSTHARVEST CHILLING SENSITIVITY OF MANGO FRUIT (*MANGIFERA INDICA* L.)

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**Abstract.** Chilling-injury studies were carried out on two late varieties of mango: 'Samar Bahisht' (Pakistan) and 'Sensation' (USA). Hard green mangoes of these varieties were stored at 6, 9, and 12±1° C for 0, 4, 8, 12, and 16 days and then transferred to room temperature (25-28° C) for ripening. 'Sensation' mangoes developed more skin symptoms due to chilling than 'Samar Bahisht' mangoes. On ripening, the texture of the pulp of 'Sensation' variety remained harder than that of 'Samar Bahisht'. 'Sensation' variety contained more ascorbic acid and total acidity than 'Samar Bahisht' and both these nutrients decreased during storage irrespective of variety. 'Samar Bahisht' mangoes were sweeter than 'Sensation', and had higher sugar acid ratio values.

Fruits of tropical origin exhibit a physiological disorder known as 'chilling-injury' when they are exposed to a temperature below about 10°C but above their freezing points (6, 8, 10). The injury is manifested by discoloration of the skin, skin-pitting and abnormal ripening (9). The market value of the affected fruit becomes low as external appearance of the fruit is deteriorated. Therefore, research has been done the world over to find optimum storage temperatures for different kinds of fruits. Such research has shown that varietal response to this kind of storage disorder is also specific (3). Since 'Sensation' mango variety, a late variety, has recently been introduced in Pakistan from U.S.A., therefore, experiments were carried out to study the postharvest chilling sensitivity of this variety in comparison to 'Samar Bahisht' mango (a late variety). Results of these investigations are reported herein.

### Materials and Methods

Hard green mangoes of 'Samar Bahisht' and 'Sensation' varieties were collected from the Experimental Garden of Ayub Agricultural Research Institute, Faisalabad during the month of August. Fruits were cooled at 15°C overnight and kept in cardboard trays in a single layer after cleaning with soft tissue paper. The containers were lined with newsprint paper of 0.093 mm thickness, each tray containing 15 (5x3) mangoes. Fruit trays (12 in all) were then stored in cooled incubators where the temperature of 6, 9, 12 ± 1°C were maintained. One lot was stored at room temperature (25-28°C) to act as control. After subsequent storage of 4, 8, 12, and 16 days, one tray was transferred to room temperature (25-28°C) for ripening. After 5 days, data on the development of skin damage, fruit texture and

biochemical constituents like ascorbic acid, acidity (citric acid) total soluble solids (TSS) and sugar acid ratio (SAR) due to chilling were estimated. Skin damage was determined by visual observations using 0-10 scale (2) (i.e. 0=no injury, 10=100% surface area affected). Texture of the whole fruit was determined using a modified maturometer (4); ascorbic acid, total acidity and TSS of mango pulp were estimated using methods of Rusk (11) and Hortwitz (7). Data were analysed statistically using analysis of variance (12).

### Results and Discussion

Effect of temperatures on mangoes of 'Samar Bahisht' (Pakistan) and 'Sensation' (USA) varieties on physico-chemical changes with reference to chilling-injury have been examined. It appears from Fig. 1 that the sensitivity of 'Sensation' variety was significantly ( $P<0.05$ ) more than that of 'Samar Bahisht' at all the storage temperatures. The texture of 'Sensation' mangoes was also harder ( $P<0.05$ ) than that of 'Samar Bahisht'. Data on biochemical changes of stored fruits at 6, 9 and 12°C for 4, 8, 12, and 16 days are presented in Tables 1-3. It appears from these tables that ascorbic acid contents of ripened 'Sensation' fruit was more (99 mg/100 g) as compared to 'Samar Bahisht' mangoes (60 mg/100 g) and the differences were significant ( $P<0.05$ ). Storage of fruit at low temperature helped in the retention of ascorbic acid contents in both varieties; however, these contents in 'Sensation' were significantly higher ( $P<0.05$ ) than that of 'Samar Bahisht'. Similar trend in citric acid contents was observed. Sugar contents of 'Samar Bahisht' were significantly ( $P<0.05$ ) more than that of 'Sensation' and the same trend was seen in the SAR. There was no significant effect of chilling temperature on the biochemical constituents of pulp, whereas significant variations in the development of skin damage were observed. When the skin of ripened fruits was peeled

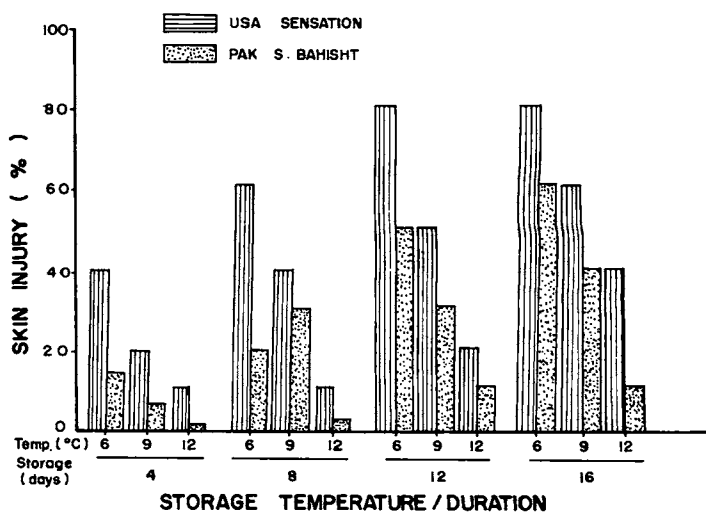


Fig.1 Effect of chilling temperatures on the development of skin symptoms on mango fruit.

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Table 1. Effect of low temperature ( $6\pm 1^{\circ}\text{C}$ ) on the biochemical constituents of mango fruit.

Treatments	Ascorbic Acid (mg/100 g)		Acidity (%)		Total Soluble Solids (%)		Sugar Acid Ratio	
	SN <sup>2</sup>	SB <sup>2</sup>	SN	SB	SN	SB	SN	SB
			0-Day					
FR <sup>3</sup>	120.5	96.15	0.32	0.28	7.0	6.5	21.87	23.21
RP <sup>4</sup>	99.0	60.00	0.16	0.08	14.8	22.5	92.50	281.25
			4-Day					
RP	108.7	80.20	0.20	0.08	16.5	23.0	82.50	287.50
			8-Day					
RP	102.0	78.3	0.21	0.08	16.5	23.0	78.57	287.50
			12-Day					
RP	100.5	66.5	0.25	0.12	17.0	20.2	68.00	168.33
			16-Day					
RP	100.4	80.7	0.21	0.10	16.0	21.1	76.19	211.00

<sup>2</sup>Cultivars: SN = 'Sensation' and SB = 'Samar Bahisht'.

<sup>3</sup>FR = Fresh, hard and green.

<sup>4</sup>RP = Ripened at room temperature ( $25\text{--}28^{\circ}\text{C}$ ).

Table 2. Effect of low temperature ( $9\pm 1^{\circ}\text{C}$ ) on the biochemical constituents of mango fruit.

Treatments	Ascorbic Acid (mg/100 g)		Acidity (%)		Total Soluble Solids (%)		Sugar Acid Ratio	
	SN <sup>2</sup>	SB <sup>2</sup>	SN	SB	SN	SB	SN	SB
			0-Day					
FR <sup>3</sup>	120.5	96.15	0.32	0.28	7.0	6.5	21.87	23.21
RP <sup>4</sup>	99.0	60.00	0.16	0.08	14.8	22.5	92.50	281.25
			4-Day					
RP	105.5	77.4	0.21	0.09	18.0	23.0	85.87	244.68
			8-Day					
RP	97.4	71.5	0.22	0.08	16.5	21.0	75.00	262.50
			12-Day					
RP	104.6	69.7	0.20	0.11	18.0	21.3	90.00	193.63
			16-Day					
RP	94.7	70.8	0.20	0.10	16.5	22.0	82.50	220.00

<sup>2</sup>Cultivars: SN = 'Sensation' and SB = 'Samar Bahisht'.

<sup>3</sup>FR = Fresh, hard and green.

<sup>4</sup>RP = Ripened at room temperature ( $25\text{--}28^{\circ}\text{C}$ ).

it was noticed that the pulp of all the samples was normal in color and taste irrespective of the variety. From the results of external skin damage, biochemical changes in pulp and internal condition of the fruit, it appears that the skin of fruit was more involved in showing chilling injury rather

Table 3. Effect of low temperature ( $12\pm 1^{\circ}\text{C}$ ) on the biochemical constituents of mango fruit.

Treatments	Ascorbic Acid (mg/100 g)		Acidity (%)		Total Soluble Solids (%)		Sugar Acid Ratio	
	SN <sup>2</sup>	SB <sup>2</sup>	SN	SB	SN	SB	SN	SB
			0-Day					
FR <sup>3</sup>	120.5	96.15	0.32	0.28	7.0	6.5	21.87	23.21
RP <sup>4</sup>	99.0	60.00	0.16	0.08	14.8	22.5	92.50	281.25
			4-Day					
RP	103.9	77.5	0.18	0.08	18.5	21.0	102.77	262.50
			8-Day					
RP	98.7	64.4	0.20	0.08	17.5	21.5	87.5	268.75
			12-Day					
RP	103.1	63.6	0.20	0.11	17.5	22.4	87.50	203.63
			16-Day					
RP	93.6	70.4	0.24	0.09	17.0	23.2	70.83	257.77

<sup>2</sup>Cultivars: SN = 'Sensation' and SB = 'Samar Bahisht'.

<sup>3</sup>FR = Fresh, hard and green.

<sup>4</sup>RP = Ripened at room temperature ( $25\text{--}28^{\circ}\text{C}$ ).

than whole fruit. This confirms previous observations recorded on bananas, mangoes and citrus fruits (3, 1, 5).

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