

PRESERVATION OF MANGOES WITH FUNGICIDAL WAX EMULSION

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Abstract. Experiments were carried out to determine the suitability of a wax emulsion developed in these laboratories, for extending the storage life of mangoes under ambient conditions. The changes in moisture content, total sugar, vitamin C and acidity of the edible portion of mangoes demonstrated the greater period of storage life in wax treated lot. Spoilage due to mould development and degreening of peels was higher in unwaxed mangoes than in waxed mangoes. The efficiency of the wax emulsion for delaying the ripening process of mangoes was also revealed by organoleptic evaluation.

Mangoes are abundantly produced in Pakistan and a lot of them are wasted due to microbial decay as a result of high temperature during transportation and marketing. High temperature induces quick ripening, and transpiration results in weight loss and subsequent wrinkling of skin. Waxing of mangoes has been attempted in India. Mathur and Shrivastava¹ have studied the effects of a wax emulsion and mineral oil on various varieties of mangoes and observed that wax emulsion gave better results than the mineral oil which caused skin damages. In these Laboratories, a fungicidal wax emulsion was developed for extending the storage life of citrus fruits and which is now being marketed under the trade name of Fruitex.² Application of Fruitex on mangoes did not give encouraging results. Research, therefore, was undertaken to develop a wax emulsion based entirely on indigenous materials for extending the shelf life of mangoes. We have been successful in developing a wax emulsion and techniques for applying the same by means of which the shelf life of mangoes is increased by more than 50%. The formulae of the emulsion is to be covered in a patent to be applied shortly. The objects of the experiments reported here were to investigate treatments of mangoes with the wax emulsion.

Materials and Methods

Dusehri variety of mangoes, were purchased from the local market, water washed and air dried under electric fan. The mangoes were randomized into 4 lots of 25 mangoes each. Two lots were treated with wax emulsion containing 3% solids, and the other two lots served as control. The wax treatment consisted of dipping the fruits in the emulsion for 2 min followed by air drying with an electric fan. The various lots were subsequently stored under ambient conditions of temperature and relative humidity varying between 25 and 36° and 50 and 80% respectively.

The weights of two lots of mangoes, one from treated mangoes and another from control mangoes, were noted after an interval of four days and percentage loss of moisture was calculated. The edible portions of mangoes from both lots were taken and analysed for sugar, acidity (expressed as malic acid), according to AOAC methods³ and vitamin C according to Barkat *et al.*⁴

In another experiment, both lots of mangoes were subjected to organoleptic evaluation by a panel of judges selected from the PCSIR laboratory staff. Total number of mangoes spoiled due to microbial action, as revealed by the decolouration and softening of the peels was noted.

Results and Discussion

Loss of Moisture. Results are shown in Table 1. The rate of loss in weight of the untreated mangoes was much faster than the treated ones at any stage during the storage. Untreated mangoes lost 22% weight on storage for 8 days. In comparison, losses in weight of the treated mangoes were about 9 and 12% on 8th and 12th day of storage respectively under identical conditions. Further treated fruits, retained better appearance and had no sign of shrivelling even after 12 days of storage. Appreciable reduction of weight loss as a result of wax treatment has been noted in case of Dusehri⁵ and other varieties of mangoes^{6,7} Results reported here indicate even higher reduction of weight loss of the treated mangoes under ambient conditions of storage.

Ascorbic Acid. Gradual fall in vitamin C content is characteristic of the ripening process of mangoes^{8,9,10}. From the results presented in Table 2, it is seen that whereas ascorbic acid content of the edible portion of both the lots fell steadily, loss of the vitamin was always higher in the control than in the treated mangoes during the entire storage period.

TABLE 1. PERCENTAGE LOSS IN WEIGHT OF MANGOSE DURING STORAGE AT TEMPERATURE 25 TO 36, HUMIDITY 50 TO 80%. (AVERAGE OF 25 MANGOES).

Lot of mangoes	4th day	8th day	12th day
Control	12.0	22.0	—
Treated	4.4	9.2	12.8

TABLE 2. VITAMIN C IN mg/100 g OF EDIBLE PORTION OF MANGOES.

Lot of mangoes	1st day	4th day	8th day	12th day
Control	40	25	10	—
Treated	40	35	21	14

Acidity and Sugars. Sugar and acid contents are among the important criteria commonly used for the determination of ripening and storage behaviour of mangoes. Ripening of mangoes is characterized by a sharp rise in sugars and gradual decline in acidity^{8,9,10}. Decrease in the acid content of mangoes as a result of ripening during storage is given in Table 3. There was a marked decrease of acidity of the untreated mangoes in the first few days. In contrast the decrease in acidity of the treated mangoes was not as rapid and was markedly less throughout the storage period. Although the sugar contents of the edible portions of mangoes from both lots increased with storage the rate of increase was greater in the control than in the waxed lots (Table 4).

TABLE 3. CHANGES IN TOTAL ACIDITY (AS MALIC ACID) IN mg/100 g OF MANGOES PULP.

Lot of mangoes	1st day	4th day	8th day	12th day
Control	720	300	152	—
Treated		510	350	205

TABLE 4. PERCENTAGE OF SUGAR.

Lot of mangoes	Initial	4th day	8th day	12th day
Control	14	19	25	—
Treated	14	17	19	21

Spoilage. In another experiment, the percentage of wastage of mangoes was higher in control than that in treated mangoes and it was due to mould which started from peel and travelled towards the kernel. Excessive fungal development was evident on the untreated mangoes particularly after 8 days and all the fruits rotted on the 12th day of storage. Spoilage due to fungal rotting was only 5% in case of the treated mangoes at the end of the same period.

Retention of Green Colour of Peel. It can be seen from Table 6 that ripening rate in the case of treated mangoes was slower than that of untreated lot. Peels of all the untreated mangoes changed from green to yellowish green, then to yellow in a week's time. In contrast to this, 50% of the mangoes of the treated lot retained green and 50% yellowish green colour of peels even on the 12th day of storage. This is also an important factor, consistent with delayed ripening of the mango variety under study.

TABLE 5. PERCENTAGE WASTAGE TO DISEASE DURING STORAGE.

Lot of mangoes	4th day	8th day	12th day
Control	10	20	—
Treated	0	5	5

TABLE 6. PERCENTAGE OF MANGOES RETAINING GREEN COLOUR DURING STORAGE.

Lot of mangoes	4th day	8th day	12th day
Control	20	0	—
Treated	100	70	50

Organoleptic Evaluation of Edible Portion of Mangoes. It is apparent from results presented in Table 7 that untreated mangoes were fully ripe on the 4th day of experiment having a sweet taste and flavour. However, on the 8th day they became over-ripe and taste developed off. Although still good in flavour, the mangoes showed excessive wrinkling of the skin on the 8th day and were not presentable due to their undesirable appearance. The treated mangoes on the 4th day of storage were firm and sour in taste and the flavour was not fully developed. On the 8th day, flavour and taste was good and edible portion was still firm. On the 12th day, flavour and taste of mangoes were scored good, but they had fully ripened and had soft texture. However, bad taste and flavour developed after further storage of 2 days and the experiments were discontinued on the 12th day. This experiment clearly showed that the untreated mangoes

TABLE 7.

Lot of mangoes	After 4 days			After 8 days			After 12 days		
	Flavour	Texture	Taste	Flavour	Texture	Taste	Flavour	Texture	Taste
Control	Good	Soft	Good sweet	Good	over ripe	bad	—	—	—
Treated	slight good	firm	sour	good	firm	good	good	soft	good

ripened at a much faster rate than the treated mangoes. The delay in ripening process and control of spoilage by the wax treatment is thus amply demonstrated by the above experiments.

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