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Studies on Shelf-Life of Six Promising Mango (*Mangiferindica* L.) Cultivars under Favorable Condition

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ABSTRACT: *Six mango hybrids, Amrapali, Mallika, Neeleshan, Prabhashankar, Ratna, Sabri and Langra were taken as local check to study their shelf life. The PLW and spoilage of fruit increased with prolongation of storage period, regardless of cultivars. On termination day of storage (10^{th} day) the minimum PLW (16.65%) and spoilage (28.36%) was noted in Mallika while highest PLW (32.85%) and spoilage (42.67%) were obtained in check variety Langra. TSS content in fruits increased up to 8^{th} day and further extension in storage period it declined in other cultivars. On concluding day of experiment (8^{th} day) the maximum TSS was noted in Mallika (23.02°Brix) while the lowest was obtained in Langra (18.12°Brix). Total sugar enhanced gradually up to 8th day of storage, except in Mallika which showed increasing trend up to 10^{th} day. On last day of storage the maximum total sugars was noticed in Mallika (14.98%) however, the lowest was recorded in Langra (11.74%). On 8th day of storage Mallika was organoleptically rated as excellent. On last day of storage, Amrapali, Mallika were fair while rest of the cultivars were under poor grade quality. The keeping quality of Mallika, Ratna and Amrapali were better than other hybrids and check variety Langra. Especially fruits of Mallika can be stored for longer period at ambient conditions.*

I. INTRODUCTION

Mango *(Mangifera indica* L.*)* is a diffuse-porous species and one of the most important tropical tree crops (Lu et al., 2000) belongs to the family Anacardiaceae (Morton, 1987). Mango fruits have increasing commercial importance throughout the world and are a valued source of income in all mango producing countries (Siddiqui, 2008; Siddiqui et al., 2014). It is an important fruit crop of India acknowledged as "King of fruits" and the "national fruit of India". Mango is widely grown for its special features like high nutritive value, high productivity, Processing potential, delicious taste and suitability to be grown in widely ecological amplitude. Reputed as fruit for excellence, mango has assumed a leading position among commercial fruits (Singh, 2004). In India, mango accounts approximately 2.70 million hectare area and 18.30 million tonnes production (NHB, 2013) having superior position in the world market. Apart from the use of ripe mango, young and unripe fruits are utilized for culinary purposes as well as for preparing pickles, chutneys and amachur. Like all other fresh commodities, the potential market of mango is directly correlated with the quality of the fruits. To facilitate access to the domestic and offshore markets, mango fruit storage potential and fruit quality consistency needs to be improved (Simmons et al., 1997).Further keeping quality of fruits is also an important criteria during the selection of varieties to a particular region. Most of the present day cultivars appeared to have been selected for characters like size, quality and period of maturity. An increase in the storage life and improvement of mango fruits quality is really desirable to prevent these gluts in the market and to curtail the post-harvest losses (Siddiqui et al., 2014a). So during the selection of a variety, high yield potential with longer shelf life are important aspects to fulfill the demand of the day. Keeping all the above facts under considerations the present investigation was carried out with eleven released hybrids from different parts of the country with local check variety Langra.

II. MATERIALS AND METHODS

Mango Hybrids for Experiment

The experiment was carried out on fruits from the 15 years old healthy plants of six hybrids of mango as well as the most important variety of this region Langra was also included as check. Selected hybrids were Amrapali, Mallika, Neeleshan, Prabhashankar, Ratna, Sabri, and Langra (check) and used as treatments T1, T2, T3, T4, T5, T6 and T7 respectively. All the 6 treatments were replicated thrice times.

Evaluation of shelf life of fruits
All the observations of the fruits under storage were determined at 2 days interval starting from the date of harvesting till the end of storage. The standard methods for the estimation of physico-chemical parameters are described here.

Physiological loss in weight (PLW)
To estimate the PLW, initial weight of fruits under each treatment was measured replication wise at the time of storage and final weight was also measured at end of storage. PLW was computed in terms of percentage of initial weight basis.

Spoilage loss of fruits
The spoiled fruits on each day of observations were separated out from all the treatments and weighed separately. The percentage of spoiled fruits on each day of observation from each treatment was calculated.

Changes in Total Soluble Solids (TSS)
The Total Soluble Solids of fruits was recorded with the help of a hand refractometer (Rangana, 2010). It was determined by applying 2 drops of homogenized juice on the prism of hand refractometer. TSS (°Brix) was noted directly from the digital screen at room temperature (30°C±2).

Organoleptic evaluation
To assess the acceptability of consumer studies on organoleptic evaluation were conducted by score card system with a panel of five semi trained judges. They evaluated the colour, flavour, taste, appearance and overall acceptability of fruits on the basis of 9-point Hedonic scale (Amerineet al., 1965). The observations were conducted when the 75 per cent fruits ripened. Sensory evaluation of mango fruits of different cultivars during storage was recorded from 6th day of storage at three days intervals.

Statistical methods
Observations recorded during the investigation were subjected to analysis of variance using completely randomized design as described by Cooharan and Cox (1975) and the significance of different source of variation was tested by error mean square by 'F' test.

III. RESULTS

The physiological loss in weight (PLW) of fruits during storage was recorded at four day interval**.** It is evident from the Table-1that in all the cultivars as the day of storage increased the PLW gradually and significantly increased till the last day of storage. Atthe last day of storage (10th day) Mallika gave lowest PLW (16.65%) and proved its superiority over remaining cultivars. The highest PLW (40.85%) was observed in check variety Langra followed by
Ratna (31.60%) and Sabri (30.96%).

Spoilage loss of fruits (per cent)
The spoilage losses during storage of different cultivars are presented in Table-2.At the 16thday of storage the minimum spoilage loss (28.36%) was also observed in cultivar Mallika, however, it was found uneconomical due to more than 12% spoilage while the highest spoilage loss (52.67%) was recorded in check variety Langra followed by Ratna (54.51%)and Sabri (51.34%).

Changes in Total soluble solids (0Brix) during storage
The data regarding to total soluble solids (TSS) content of the stored fruits are given in Table-3.The TSS content of mango fruits increased with advancement of storage period up to 8th day of storage, irrespective of cultivars and thereafter it declined on last day of storage (10th day). However, in case of Amrapali and Langra it was declined after 8th day. At the termination day (10th day) of experiment the highest TSS (25.02 0Brix) was noticed in Mallika. While the lowest TSS (14.180Brix) was recorded in check variety Langra followed by Neeleshan (19.960Brix) and Sabri (20.120Brix).

Organoleptic evaluation of fruits
Organoleptic scores (Table-4) increased gradually up to 6th day of storage, irrespective of cultivars except Mallika which showed increasing trend up to 8th day of storage. The maximum organoleptic score (96.64) was obtained on 6th day in check variety Langra and considered as excellent grade which was statistically similar to Amrapali (96.24) followed by Sabri (90.64) while remaining cultivars are organoleptically rated as good. On 8 th day of storage organoleptically excellent rating was obtained only in Mallika (91.33). The cultivars Amrapali

(82.42) were organoleptically rated as good and rest of the cultivars showed either fair or poor grade. On termination of experiment (10th day) none of the cultivars organoleptically rated either as excellent or good grade. Organoleptically fair grade was obtained in Mallika (78.46), Amrapali (74.20) whereas remaining cultivars showed poor grade.

IV. DISCUSSION

Physiological loss in weight (PLW)

During the course of investigation it was observed that physiological loss in weight (PLW) increased significantly with the increasing period of storage, irrespective of cultivars. Similar results were obtained in the work done on banana (Parmar and Chundawat, 1984, Emerald and Sreenarayanan, 1999), Sapota(Siddiqui et al., 2014b,Gautam and Chundawat, 1990, Sarkar et al., 1995) and mango (Singh et al, 1993 and Singh et al., 1998). The lowest PLW was noted in Mallika which showed superiority over remaining cultivars while the maximum PLW was obtained in check variety Langra. The higher rate of PLW in Langra might be due to early ripening consequently enhanced rate of various physiological and degradative metabolic processes during storage.These results get support from the work of Singh et al., (2004) and Gill and Dhillon (2008) in mango. The higher weight loss in mango fruits might be due to greater loss of moisture owing to higher rate of evapo-transpiration and respiration through uninterrupted atmospheric column under higher temperature and low relative humidity. The thinner skinner fruits with less waxy coating may show more PLW while the reverse is true with thick-skinned fruits.

Spoilage of fruits

The spoilage of fruits increased successively with the prolongation of storage period, irrespective of cultivars. The cultivar Mallika gave the lowest spoilage loss during storage at all the days and check variety Langra produced the highest spoilage loss. Similar increase in rotting of fruit with the decline in acid content is at least impart due to utilization of organic acids in energy production and alcoholic fermentation (Purvis, 1933). Delayed ripening, slower rate of physiological events and reduced biochemical degradation might be responsible for high acid in cultivar Mallika. Decline in titratable acidity during storage as a result of conversion of acids into salts and sugars have also been obtained by Gill andDhillon (2008), Kumar et al. (1992) and Joshi and Roy (1985) in mango.

The total soluble solids

The total soluble solids of the mango fruits enhanced gradually and significantly upto 12th day, regardless of cultivars. However in case of Amrapali and Langra it declined after 8th day of storage. During storage TSS of mango fruits increased with the advancement of storage period was also reported by Joshi and Roy (1985), Tirmazi and Wills (1981) and Kumar et al.(1992). According to Stahl and Cambell (1936) the conversion of cell wall materials such as pectin and
hemicellulose in reducing substances during storage are responsible for increasing TSS in fruits. The increase in TSS may be accounted to the moisture loss, hydrolysis of polysaccharides and conversion of organic acids into sugars. The decrease in TSS on prolonged storage could be due to greater utilization of reserved sugars in respiration process during prolonged storage. Slow and gradual increase in TSS in cultivar Mallika might be due to delay in ripening. These findings elucidate the reports of Garget al. (1976), Singh (1988) and Khader (1989), Dutta et al.
(2008) and Gill and Dhillon (2008) in mango.

Organoleptic qualities

The majority of the factors rated good up to 8th day of storage to all the cultivars however Amrapali and Mallika fruits rated good up to 12th day of storage. The faster rate of senescence might beresponsible for the deterioration in the qualities of fruits. The texture becomes soft due to solubilizaiton of pectic substances from the middle lamella whereas loss of the flavour might be due to disintegration of flavouring substances like ketones and aldehydes. The deterioration in shape, colour and general appearance might be due to physiological changes and shrinkage caused by loss of moisture from the tissues of fruits. Kapse et al. (1985),Ranjan (1992) and Gill and Dhillon (2008) also found more or less similar trend of deterioration in mango fruits during storage.

Table 1: Changes in physiological loss in weight (%) during storage

Treatment	Cultivar	Days of storage 0	2	4	6	8	10	Mean
T1	Amrapali	0.00	2.85 (9.72)	5.76 (13.89)		8.62 (17.07)	15.12 (22.88)	26.17 (30.76)	11.70 (18.86)
T2	Mallika	0.00	2.06 (8.25)	3.98 (11.51)		5.65 (14.94)	10.17 (18.59)	18.65 (25.58)	8.10 (16.65)
T3	Neeleshan	0.00	4.10 (11.68)	6.87 (15.19)		12.64 (20.82)	21.16 (27.38)	30.15 (33.30)	14.98 (21.68)
T4	Prabhashankar	0.00	3.49 (10.77)	6.38 (14.63)		11.23 (19.58)	17.26 (24.54)	26.18 (30.77)	12.91 (20.06)
T5	Ratna	0.00	2.12 (8.37)	6.00 (14.18)		10.82 (19.20)	15.31 (23.03)	22.35 (28.21)	11.32 (18.60)
T6	Sabri	0.00	4.30 (11.97)	7.84 (16.26		14.16 (22.10)	22.10 (28.04	30.96 (33.80)	15.87 (22.43)
T7	Langra (check)	0.00	5.61 (13.70)	8.12 (16.55)		16.32 (23.82)	24.81 (29.87)	34.85 (36.18)	17.94 (24.03)
C.D. at 5%	T =1.38							
CV	5.54%							

Table 2: Spoilage Loss (%) in fruits during storage

Treatment	Cultivar	Days of storage 0	2	4	6	8	10	Mean
T1	Amrapali	0.00	0.00	3.16 (10.24)		10.24 (18.66)	18.54 (25.50)	39.26 (38.79)	14.24 (18.64)
T2	Mallika	0.00	0.00	2.08 (8.29)		5.64 (13.74)	10.16 (18.58)	22.36 (28.22)	8.05 (13.77)
T3	Neeleshan	0.00	0.00	5.16 (13.13)		13.12 (21.23)	24.10 (29.40)	45.28 (42.29)	17.53 (21.21)
T4	Prabhashankar	0.00	0.00	5.46 (13.51)		11.89 (20.17)	21.76 (27.80)	41.82 (40.29)	16.19 (20.35)
T5	Ratna	0.00	0.00	3.74 (11.15)		8.24 (16.68)	16.48 (23.95)	32.54 (34.78)	12.20 (17.31)
T6	Sabri	0.00	0.00	6.14 (14.34)		17.26 (24.54)	27.35 (31.53)	51.34 (45.77)	20.42 (23.24)
T7	Langra (check)	0.00	0.00	7.24 (15.61)		18.46 (25.44)	30.42 (33.47)	58.67 (50.00)	22.96 (24.90)
C.D. at 5%	T =0.59							
CV	8.94%							

Table 3: Changes in TSS contents of fruit during storage

Treatment	Cultivar	Days of storage 0	2	4	6	8	10	Mean
T1	Amrapali	16.28	19.35	21.74		24.22	22.96	21.45	21.00
T2	Mallika	11.24	14.65	16.84		19.54	23.56	23.02	18.14
T3	Neeleshan	11.84	12.70	17.95		20.68	21.18	19.96	17.39
T4	Prabhashankar	10.88	12.96	16.88		20.72	22.16	20.65	17.38
T5	Ratna	11.24	16.48	19.35		22.64	23.78	21.06	19.09
T6	Sabri	13.20	15.64	18.84		21.45	22.10	20.12	18.56
T7	Langra (check)	13.75	17.14	19.34		20.84	19.46	18.18	18.12
C.D. at 5%	T =0.52							
CV	2.90%							

Table 4: Changes in organoleptic quality of fruits during storage

Treatment	Cultivar	Days of storage 4	6	8	10	Mean
T1	Amrapali	94.35	96.24	82.42	74.20	86.80
T2	Mallika	76.30	85.28	91.33	78.46	82.84
T3	Neeleshan	73.68	80.31	77.49	61.37	73.21
T4	Prabhashankar	72.32	81.48	76.26	60.17	72.56
T5	Ratna	74.40	82.55	72.42	64.28	73.41
T6	Sabri	78.00	90.64	62.10	58.25	72.25
T7	Langra (check)	90.27	96.46	60.21	40.46	71.85
C.D. at 5% CV	T =1.52 7.58%					

V. CONCLUSION

On the basis of physiological attributes of fruits it can be concluded that the keeping quality of Mallika, Ratna and Amrapali were better than other hybrids and check variety Langra. Fruits of Mallika can be stored for a longer period of storage at ambient conditions. Results clearly indicated that PLW, Spoilage, TSS total sugars were increased however, organoleptic quality reduced during storage period of mango hybrids. It be inferred that cultivars Mallika maintained organoleptically excellent grade up to 8th day of storage while Amrapali rated as good grade. Post-harvest life of all the hybrids under trial was found better than Langra. Mango hybrid Mallika can prefer for long time storage and it would be also helpful in the long transportation.

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