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Storage behaviour of ber cultivars under semi-arid environment

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Abstract

Physico-chemical changes and economic shelf life of ber fruits cvs. Gola, Goma Kirti, Umran, Seb and Mundia were studied during storage at ambient temperature under semi-arid environment of Gujarat during the year 2001 and 2002. Increase in physiological loss in weight (PLW), spoilage percentage, total soluble solids, total sugar and reducing sugar and decrease in acidity and ascorbic acid with advancement of storage period were the general trends in all the cultivars. In the present study, Umran recorded the least physiological loss in weight (23.10%) and spoilage loss (20.10%) and exhibited 7 days economic shelf life. Goma Kirti could also be stored up to 7 days during storage. However, Gola recorded maximum physiological loss in weight and spoilage loss and showed only 3 days economic shelf life. In respect of storability, Seb proved to be better than Gola and could be stored up to 6 days at ambient temperature. The lowest rate of respiration rate (0.37 mg CO_2/kg/h) was noted in Umran closely followed by Goma Kirti (0.41 mg CO_2/kg/h) however, Gola showed highest respiratory activity (0.56 mg CO_2/kg/h) on the last day of storage.

Key words: *Ambient temperature, physiological loss in weight, spoilage loss, economic life, respiration rate*

Introduction

Ber (*Ziziphus mauritiana* Lam.) is one of the important commercial fruits owing to its hardy nature and commercial yield potential without much care on marginal lands and is being grown in arid and semi-arid regions of western India. Several biochemical changes occur during ripening and storage of fruits. These changes have significant influence on the nutritional, processing qualities and storability of the fruits. Gola is one of the leading early cultivars of ber but it suffers due to very poor shelf life at room temperature. Goma Kirti is the newly released variety of this research station (Hiwale, 2005) which requires to be compared with the local leading cultivars like Gola, Umaran, Seb and Mundia. Though the fruits of ber are firm and can easily be transported to the distant market, but the potentiality of its storage stability needs to be explored particularly under harsh semi arid ecosystem of Gujarat. The fruit respires and transpires continuously resulting into high weight loss and then becomes susceptible to various diseases, which ultimately reduce the saleable tonnage. Due to prevalence of high temperature (12 ± 2°C - 28 ± 2°C) during the time of harvesting, fruits start spoiling rapidly. So far as research on ber cultivars for evaluating their storage behaviour is concerned, efforts have been made under different climatic conditions (Sharma *et al.*, 2000; Sharma and siddiqui, 2004 and Ghosh and Mitra 2004). To regulate the marketing for consumers'acceptability and greater remuneration, it is necessary to study the storage behaviour of ber cultivars. Storage studies under ambient condition for ber cultivars were lacking particularly under harsh semi arid environment of Gujarat. Therefore, the present studies were conducted to evaluate the post harvest physiological changes and economic shelf life of fruits during storage at room temperature, which will be useful to orchardists, traders and processors.

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Materials and methods

The hand picked mature and healthy fruits of uniform size, free from pest and diseases, injuries, bruises and blemishes were selected from the experimental orchard of Central Horticultural Experiment Station, Vejalpur (Godhra) during the year 2001 and 2002. The ber fruits selected for the study were Gola, Goma Kirti, Umran, Seb and Mundia. The experiment was laid out in factorial completely randomized design with four replications. Fruits were stored at ambient temperature ranging between 12 ± 2°C (minimum) and 28 ± 2 °C (maximum) with a relative humidity 65 ± 3% at 8 a.m. The physiological loss in weight, spoilage loss, total soluble solids and acidity were determined by standard methods. Economic life (in days) of fruits was determined by counting the number of days, on the date after which cumulative spoilage percentage of fruits in particular cultivar exceeded 12%, from the date of harvest of

the fruits (Singh *et al.*, 2003). Ascorbic acid and total sugar content were determined by the methods advocated by AOAC (1980). The respiration rate was measured as suggested by Loomis and Shull (1973).

Results and discussion

The physiological loss in weight (PLW) was found gradually increased in all the cultivars as the storage period advanced (Table 1). Umaran was the most efficient in retaining the PLW in all the days of observations and showed only 23.10 % PLW on 9th day of storage followed by Goma Kirti, Seb and Mundia. Gola was found to be most inferior in this respect and recorded 29.37% PLW on 9th day of storage. The critical observation showed that the rate of loss in weight was much faster in Gola, it was 6.90% on 3rd day of storage, while Umaran and Goma Kirti recorded 3.90% and 4.00% weight loss on that day, respectively. The weight loss with advancement of storage period might be due to the loss of moisture and food substances affected by the process of transpiration and respiration. The variation in physiological loss in weight among the cultivars may be attributed to genetical, textural and skin characteristics. Similar trend was also recorded by Hoda *et al.* (2000), Ghosh and Mitra (2004) and Singh *et al.* (2005) during storage of mango, ber and aonla under various climatic conditions. Spoilage of ber fruits started on 3rd day of storage in all the cultivars (Table 1). The maximum percent of spoilage was recorded in Gola (52.10%) while minimum was in Umaran (20.10%) on 9th day of storage. These findings are in consonance with that of Kananan and Susheela Thirumaran (2003) and Ghosh and Mitra (2004) in ber.

On the basis of spoilage within 12%, the maximum economic shelf-life was exhibited by Umaran and Goa Kirti i.e.7 days, however, Gola had least economic shelf life (3 days) during storage. Varietal differences in respect of shelf life have also been reported by Singh *et al.* (2003) and Singh *et al.* (2005) in aonla. Total soluble solids (TSS) content increased in all the cultivars till the 9th day of storage except 'Gola' in which it increased up to 7th day of storage and then declined (Table 2). Maximum TSS content was recorded in Gola (22.20%) followed by Goma Kirti (21.30%) and Umaran (21.20%) till the termination of storage period (9th day) however, it was noted least in Mundia (19.70%). Increase in TSS during storage might be associated with the transformation of pectic substances, starch, hemicellulose or other polysacharides in soluble sugar and also with the dehydration of fruits (Hoda *et al.*, 2000 and Singh *et al.*, 2004). Similar trend was also recorded during storage of mandarin fruits under ambient conditions (Bhardwaj *et al.*, 2005). During storage, the titratable acidity gradually decreased in all the cultivars (Table 2). The minimum acidity (0.10%) was recorded in Gola on the last day of storage, while the maximum was found in Umaran (0.18%). The reduction in acidity during storage might be associated with the conversion of organic acids into sugars and their derivatives or their utilization in respiration. (Singh *et al.*, 2003; Singh *et al.*, 2004 and Madhavi *et al.*, 2005). Kananan and Susheela Thirumaran (2003), Singh *et al.* (2002) and Kamble and Chavan (2005) also recorded the

Table1. Physiological loss in weight, spoilage loss and economic life of ber fruits during storage

Cultivars	Physiological loss in weight (%)				Spoilage loss (%)				Economic life (Days)
	Days after harvest				Days after harvest				
	3	5	7	9	3	5	7	9	
Gola	6.90	16.34	23.14	29.37	11.10	18.45	30.00	52.10	3
Umaran	3.90	6.80	13.80	23.10	2.00	5.00	11.12	20.10	7
Goma Kirti	4.00	7.00	14.10	24.10	2.50	6.12	11.50	20.50	7
Seb	5.00	8.12	16.10	20.50	3.00	7.00	13.00	24.00	6
Mundia	5.50	12.10	18.14	27.10	6.10	14.20	20.00	43.10	4
C D at 5%	Treatments (T) = 0.14, Days (D) = 0.19, D x T = 0.25				Treatments (T) = 0.07, Days (D) = 0.11, D x T = 0.24				

Table 2. Changes in TSS and titratable acidity during storage of ber fruits

Cultivars	T S S (%)					Titratable acidity (%)				
	Days after harvest					Days after harvest				
	1	3	5	7	9	1	3	5	7	9
Gola	19.50	21.00	22.10	22.70	22.20	0.36	0.26	0.20	0.13	0.10
Umaran	18.80	19.00	19.95	20.90	21.20	0.30	0.28	0.24	0.20	0.18
Goma Kirti	18.90	19.20	20.00	21.00	21.30	0.31	0.27	0.23	0.18	0.17
Seb	18.50	18.70	19.00	19.80	19.90	0.32	0.26	0.18	0.14	0.13
Mundia	18.20	18.50	18.90	19.60	19.70	0.33	0.27	0.19	0.16	0.14
C D at 5%	Treatments (T) = 0.08, Days (D) = 0.16, D x T = 0.24					Treatments (T) = 0.03, Days (D) = 0.02, D x T = 0.02				

Table 3. Changes in ascorbic acid and respiration rate during storage of ber fruits

Cultivars	Ascorbic acid (mg/ 100g) Days after harvest					Respiration rate (mg co_2/kg/h) Days after harvest				
	1	3	5	7	9	1	3	5	7	9
Gola	95.00	83.10	70.12	62.13	50.10	0.19	0.24	0.73	0.63	0.56
Umaran	97.00	90.00	82.00	74.00	62.10	0.14	0.19	0.28	0.42	0.37
Goma Kirti	98.10	92.00	83.00	75.00	65.00	0.16	0.20	0.30	0.46	0.41
Seb	90.00	86.00	76.10	69.20	58.00	0.17	0.21	0.32	0.50	0.43
Mundia	88.00	84.00	74.20	66.10	56.20	0.18	0.22	0.53	0.58	0.54
C D at 5%	Treatments (T) = 3.15, Days (D) = 4.12, D x T =4.10					Treatments (T) = 0.02, Days (D) = 0.08, D x T = 0.07				

Table 4. Changes in total sugar and reducing sugar during storage of ber fruits

Cultivars	Total sugar (%) Days after harvest					Reducing sugar (%) Days after harvest				
	1	3	5	7	9	1	3	5	7	9
Gola	14.00	14.20	14.50	14.90	14.80	5.10	5.30	5.53	5.63	5.60
Umaran	12.75	13.00	14.00	14.50	14.70	4.90	5.26	5.42	5.50	5.55
Goma Kirti	12.80	13.10	14.10	14.60	14.80	4.92	5.30	5.45	5.53	5.58
Seb	11.10	11.34	12.10	12.45	12.70	3.95	4.10	4.25	4.60	4.90
Mundia	11.00	11.30	12.00	12.30	12.60	3.92	4.00	4.20	4.50	4.70
C D at 5%	Treatments (T) = 0.93, Days (D) = 0.14, D x T = 0.22					Treatments (T) = 0.07, Days (D) = 0.08, D x T = 0.12				

similar results in ber and custard apple.

The ascorbic acid content of fruits decreased gradually during storage in all the cultivars (Table 3). Maximum ascorbic acid content (65.00 mg /100 g) was retained by Goma Kirti on last day of storage, closely followed by Umaran (62.10 mg/100g), while it was recorded the least in Gola (50.10mg/100g). Variation in decreasing trend might be associated with genetic variability among the cultivars. During storage, oxidizing enzymes like ascorbic acid oxidase, peroxidase, catalase and polyphenol oxidase might be causing decrease in ascorbic acid of the fruits (Singh *et al.*, 2003 and Singh *et al.*, 2005). This finding are in agreement with those of Kananan and Susheela Thirumaran (2003) and Ghosh and Mitra (2004) in ber.

Fruits of different cultivars showed continuous increase in respiratory activity till the last day of storage (9th day). The highest respiratory activity was noted in Gola (0.56 mg CO_2/kg/h), while Umaran recorded the lowest respiration rate (0.37 mg CO_2/kg/h), which was closely followed by Goma Kirti (0.41 mg CO_2/kg/h) on the last day of storage. The present observations are in consonance with the findings of Singh *et al.* (2003) in aonla under semi arid environment of western India.

Total sugar and reducing sugar contents increased in all the cultivars till the 9th day of storage except Gola in which it increased up to 7th day of storage and then declined (Table 4). Gola recorded maximum sugar content unto the last day of storage, while the least sugar content was found in Mundia on the same day. These findings are in close agreement with the findings of Hoda *et al.* (2000) and Singh *et al.* (2005) in mango and aonla, respectively. The changes in sugar content during storage are very much related with TSS. An increase in sugars during storage was probably due to conversion of starch and polysaccharides into soluble sugars and dehydration of fruits (Hoda *et al.*, 2000). On the basis of spoilage loss and fruit quality attributes, it may be concluded that Umaran and Goma Kirti may be stored up to 7 days during storage at ambient temperature under semi arid environment of Gujarat. However Gola showed only 3 days economic shelf life under ambient conditions.

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