

SHORT COMMUNICATION

EFFECT OF DIFFERENT PACKAGES DURING TRANSPORTATION AND STORAGE OF BER FRUITS (*ZIZYPHUS MAURITIANA* LAMK.) ON SHELF LIFE AND QUALITY

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The physiological loss in weight (PLW) and spoilage were increased gradually during transportation and storage in all the packages used whereas fruit acidity, ascorbic acid and organoleptic acceptance were decreased. TSS (total soluble solids) was increased during transportation and up to day 3 of storage and then decreased on subsequent days of storage. Minimum PLW was recorded in the fruits packed in gunny bags lined with polythene. However, performance of corrugated fiberboard (CFB) boxed was found to be the best for transportation and storage of ber fruits. The fruits packed in CFB boxes exhibited maximum TSS, acidity, ascorbic acid with minimum spoilage just after transportation and at the end of storage period. These fruits were acceptable up to day 6 of storage with highest (6.15) organoleptic score. The fruits packed in other packages were acceptable only up to 3-4 days.

Key words: Ber, packages, quality, shelf life, storage, transportation.

A considerable quantity (25-35%) of fruits and vegetables produced in India is lost due to improper post-harvest operations, as a result there is a huge gap between the gross production and net availability. Like other fruits, ber (*Zyziphus mauritiana* Lamk.) has a short shelf life and neither be sent to distant markets nor be stored for longer period without proper packaging. Packaging for transportation and handling requires consideration to protect the produce from suffocation, bruising, vibration and the weight of other stacked containers. The ideal pack consist of a tight fill without a bulge in a filled container having sufficient stacking strength to protect the contents under all handling conditions (Adsule 1996).

Packaging is a fundamental tool for the post-harvest management of highly perishable commodities like fruits. Adequate packaging protects the produce from physical, physiological and pathological deterioration during transportation and storage (Krishnamurthy 1990). The

present packaging and distribution system for fresh fruits still depends on the traditional forms of packages, like bamboo baskets, gunny bags and wooden boxes. The use of baskets and gunny bags besides being unhygienic, prevents convenient handling and stacking and it also reduces the efficiency of capacity utilization in transport system. Wooden packages are not conducive for the packaging of fresh fruits, as they occupy necessary additional volume and contribute to the additional tare weight. Furthermore, continuous use of wooden cases for packing of fruits has resulted in deforestation in many parts of the country. Therefore, the use of alternate packages like corrugated fibreboard boxes have to be encouraged (Krishnamurthy and Rao 2001). CFB boxes are hygienic, light in weight and are recyclable. Indian Institute of Packaging has designed the special CFB cartons for some major fruits like mango, grapes, sapota etc. for the export markets and the same may be used for packaging of other fruits like ber. Therefore, the present

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investigation was carried out to know the effect of different packages during transportation and storage on shelf life and quality of ber fruits.

The investigation was carried out during 1997 to 1999. Physiologically matured fruits of Umran ber having uniform size and shape were harvested at colour turning stage, cleaned with moist cloth and packed in various packages. The packages were (i) Bamboo baskets (BB), (ii) Gunny bags lined with polythene (GBLP), (iii) Gunny bags (GB), (iv) Wooden boxes (WB) and (v) Corrugated fiberboard boxes (CFBB) with ventilation. The packed fruits were transported from Jobner to Nagaur and back, covering a distance of 400 km, which took 12 hours, by jeep. Then these fruits were stored at room temperature (22°C min and 37°C max) with (49-53%) relative humidity.

Various biochemical parameters were studied before transportation, after transportation and during storage. The fruits were obtained from single lot, therefore, the data taken before transportation were not analyzed statistically. Physiological loss in weight (PLW) and spoilage were calculated on percentage loss basis, TSS was determined by 'Zeiss' hand refractometer at 20°C. The fruit acidity and ascorbic acid content were determined by the standard methods described in AOAC (1990). The organoleptic evaluation on the basis of fruit colour, appearance, texture and taste was done by a panel of five judges up to the end of storage. The score was expressed on 0-10 Hedonic scale and averaged (Amerine *et al.*, 1965). The fruits scored less than 5.0 marks were regarded unacceptable. The experiment was laid out in CRD with three replications. Each replication represented by 5 kg fruits. The data of all the three years were pooled and statistically analyzed with the help of method given by Panse and Sukhatme (1985) using PC Excels software.

PLW of the fruits was increased during transportation and storage. Different packages used significantly affected the PLW (Table 1). The minimum PLW (2.74 and 8.35%) was recorded in the fruits packed in gunny bags lined with polythene followed by CFB boxes (6.29 and 12.29%) as compared to maximum in simple gunny bags (10.01 and 16.91%) just after transportation and at day 6 of storage, respectively. Lining of polythene in gunny bags acted as a water vapour barrier between atmosphere and the fruits, thereby reducing the rate of

transpiration. The results are in close agreement with the findings of Kumar *et al.* (2000).

It is revealed from the results that spoilage of the fruits increased during transportation and storage irrespective of the packages used. However, different packages used significantly affected the spoilage of the fruits. Lowest spoilage (2.00 and 6.85%) was recorded in the fruits packed in CFB boxes while it was recorded maximum (9.89 and 18.61%) in the fruits packed in gunny bags lined with polythene just after transportation and at day 6 of storage, respectively. In gunny bags lined with polythene packed fruits spoilage was more as compared to fruits kept in other packages. This may be due to higher temperature and humidity in polythene, which might have created suitable conditions for microflora such as *Rhizopus* and *Panicilium*. Minimum spoilage occurred under CFB boxes because the perforation given in the boxes allowed the moisture to go out and thus minimize the availability of active moisture responsible for growth of pathogens. Sharma and Dashora (1999) in tamato and Kumar *et al.* (2000) in kinnow have reported similar results.

It is obvious from the data (Table 1) that soluble solids (TSS) of the fruits increased during transportation and up to day 3 of storage and then it was decreased on subsequent days of storage. The increase in TSS during transportation and storage was due to the breakdown of complex polymers in to simple substances by hydrolytic enzymes, which may be further metabolized during respiration. Thus, the level of TSS decreased during subsequent storage. A similar trend was reported by Lal *et al.* (2002) in ber. Different packages, improved the TSS content of fruits. At the end of storage period fruits packed in CFB boxes maintained the TSS at maximum level (13.75%) as compared to minimum level (10.98%) in the fruits packed in gunny bags lined with polythene.

The results indicated that there was reduction in acidity and ascorbic acid content of fruits during transportation and storage of fruits in all the packages, however significant differences between packages were recorded (Table 1). The maximum acidity (0.153 and 0.106%) and ascorbic acid (68.76 and 59.48 mg/100 g pulp) were recorded in the fruits packed in CFB boxes as compared to minimum acidity (0.126 and 0.075%) and

Table 1. Effect of different packages during transportation and storage of ber fruits on the physico-chemical characteristics. Data represent the pooled means of three years (1997 to 1999)

Treatment	Physiological loss in weight (%)			Spoilage (%)			Organoleptic score (out of 10 marks)		
	Just after transportation	Day 3 of storage	Day 6 of storage	Just after transportation	Day 3 of storage	Day 6 of storage	Just after transportation	Day 3 of storage	Day 6 of storage
Bamboo Baskets	9.05	10.99	14.98	3.39	5.27	11.08	6.89	4.99	2.16
Gunny bags lined with polythene	2.74	3.50	8.35	9.98	11.99	18.61	4.53	2.81	1.41
Gunny bags	10.01	12.48	16.91	5.22	7.18	13.24	7.23	4.79	2.93
Wooden boxes	7.28	8.71	13.30	2.78	4.37	9.30	8.36	6.39	4.63
Corrugated fiber board boxes	6.29	7.50	12.29	2.00	3.72	6.85	9.25	7.38	6.15
SEm±	0.123	0.248	0.106	0.126	0.160	0.202	0.051	0.129	0.115
CD at 5%	0.359	0.724	0.309	0.368	0.467	0.590	0.149	0.376	0.336

Treatment	TSS (%)			Acidity (%)			Ascorbic acid (mg/100 g pulp)		
	Just after transportation	Day 3 of storage	Day 6 of storage	Just after transportation	Day 3 of storage	Day 6 of storage	Just after transportation	Day 3 of storage	Day 6 of storage
Bamboo Baskets	14.29	13.63	12.79	0.126	0.106	0.085	63.41	50.00	43.99
Gunny bags lined with polythene	11.86	11.33	10.98	0.126	0.092	0.075	60.65	49.06	36.46
Gunny bags	14.18	13.17	11.67	0.138	0.123	0.092	60.71	52.05	47.47
Wooden boxes	14.13	13.72	12.75	0.143	0.109	0.092	60.50	55.81	50.84
Corrugated fiber board boxes	14.14	13.84	13.75	0.153	0.135	0.106	68.76	64.45	59.48
SEm±	0.113	0.086	0.064	0.0007	0.0011	0.0028	0.581	0.358	0.339
CD at 5%	0.330	0.251	0.187	0.002	0.0032	0.0082	1.696	1.045	0.989

Values for organoleptic score (10.00), TSS (11.62%), acidity (0.167%) and ascorbic acid (70.70 mg/100 g pulp) of ber fruits before transportation.

ascorbic acid (60.65 and 36.46 mg/100 g pulp) just after transportation and at day 6 of storage, respectively. The decline in acidity during transportation and storage might be due to rapid utilization of organic acids in the energy production and alcoholic fermentation. The decrease in ascorbic acid content might be due to the acidation and degradation of ascorbic acid molecules forming dehydro ascorbic acid by enzyme ascorbinase, Das and Desh (1967). Similar results were also reported by Kumar *et al.* (1998) in guava.

The investigation indicated that, overall organoleptic score based on colour, aroma, texture and taste of the fruits decreased during the transportation and with the advancement of storage period (Table 1). This might be due to loss of moisture and spoilage resulting in shrinkage of fruits. Different packages used affected significantly the organoleptic score of the fruits. The maximum organoleptic score (9.25 and 6.15) was recorded in the fruits packed in CFB boxes while it was minimum (4.53 and 1.41) in gunny bags lined with polythene after transportation and at the end of storage period, respectively. Fruits packed in CFB boxes were acceptable up to day 6 of storage while the fruits packed in other packages were accepted up to 3-4 days only. Roy and Pal (2000) also advocated the use of CFB boxes in packaging of fruits.

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