

POSTHARVEST RIPENING OF *ZIZIPHUS MAURITIANA* FRUITS: EFFECT OF 1-METHYLCYCLOPROPENE

N. Sankhla¹, H. S. Gehlot, P. Agarwal, R. Choudhary and S. Joshi

ABSTRACT

Ziziphus spp. constitutes an important source of low cost, nutritive, fresh edible fruits in arid regions of India. Superior cultivars (*Ziziphus mauritiana* cv. Seb) produce big plum sized fruits which are highly prized for fresh consumption. However, fully ripe fruits often become brown, loose their firmness and organoleptic qualities. This study was initiated to monitor changes in certain chemical constituents and quality of fruits of cultivar 'Seb' following pretreatment with 1-methylcyclopropene (1-MCP). Treatment with 1-MCP considerably prevented the decrease in fruit firmness and vitamin C content. 1-MCP treated fruits remained much greener than the control as evidenced by their higher chlorophyll content and exhibited a much lower level of lipid peroxidation. These results indicate the potentials of 1-MCP in delaying fruit ripening and extending the shelf life of *Ziziphus* fruits.

INTRODUCTION

Fruits of some of the newly introduced cultivars of *Ziziphus mauritiana* Lam. (e.g., Seb, Gola, Mundia, etc.), locally known as ber (Fig. 1), have become very popular in the Thar desert region of India. They constitute an important source of locally grown, low cost, highly nutritious fresh edible fruits (Pareek, 2001). The big plum sized fruit of cv. Seb is popularly nicknamed as the apple of the desert. Due to poor harvesting techniques, including post harvest infrastructure and handling, heavy losses are incurred during fruit distribution and marketing. In this region, during the peak season for marketing, the temperatures often exceed 35°C. A high rate of respiration, enhanced ethylene production, fruit softening and pathogen susceptibility further add to the reduction in the quality and market value of fruits. Thus, studies on improving post harvest quality and shelf life of ber fruits have immense importance in management of ber cultivation in Indian desert.

Fruits of ber are considered to have a climacteric type of fruit ripening (Abbas, 1997). It has been reported that ethephon, an ethylene generating compound, not only induces a nearly uniform fruit ripening, but also produces attractive, better quality fruits (Bal, 2001). Thus, it is conceivable that fruit ripening can be delayed or prevented by controlling ethylene production or ethylene perception.

1-MCP is a relatively newly introduced nontoxic compound which blocks ethylene binding at the receptor level (Sisler and Serek, 1997). By inhibiting ethylene perception, it prevents or delays ripening and extends the shelf life of several fruits and leafy vegetables (Blankenship and Dole, 2003). 1-MCP is also quite effective in enhancing vase life and prevention of ethyl-induced shattering of flowers (Sankhla et al., 2001).

¹ Texas A & M Univ. Agric. Res. Center, Dallas, TX, 75252, USA*, and Botany Department, J. N. Vyas University, Jodhpur 342001, India

This study was initiated to evaluate the effect of 1-MCP on some parameters related to post harvest ripening and quality of ber fruits.

MATERIALS AND METHODS

Fruits of ber cv. Seb and Gola were obtained from a local orchard. Over ripened fruits in a batch are likely to trigger ethylene formation and accelerate ripening and senescence of other fruits. Therefore, as much as possible, fruits were reselected for uniformity of size, color and maturity, and only uninjured disease free fruits were used for experimentation. Initial experiments with STS, in principle, clearly demonstrated that prevention of ethylene action may have potential in enhancing fruit longevity, although the pericarp of STS treated fruits, depending on the concentration and duration, developed light brown to intense black color. For 1-MCP treatment the fruits were placed in a Plexiglas chamber fitted with a fan (Sankhla et al., 2001). Different concentrations of 1-MCP (100-400 nl.l^{-1}) were generated using appropriate amount of EthylBloc (Floralife). The treated and untreated fruits were placed at 28-30°C, simulating the prevailing high temperatures that are frequent during the later part of fruit marketing season.

Post harvest changes in the fruit firmness, chlorophyll content, total sugars, ascorbic acid content and lipid peroxidation (malondialdehyde, MDA) were monitored after four days following the methods used earlier (Sankhla et al., 2006). Since the results obtained with cv. Seb and Gola were qualitatively more or less similar, only the results of cv. Seb have been presented here.

RESULTS AND DISCUSSION

Depending upon cultivar, ber fruits are harvested at mature-green and mature-golden yellow stages when they exhibit the best organoleptic qualities. Fully ripe fruits often become red or dark brown and concomitantly lose their firm, crisp and juicy texture. In fruits of ber cv. Seb the change of fruit color from green to light golden yellow is indicative of fruit ripening, while an over-ripened fruit develops brownish red color. A pretreatment with 1-MCP considerably delayed chlorophyll degradation in ber fruits. As such 1-MCP treated fruits continued to show much greener color due to delayed chlorophyll degradation (Table 1). Following 1-MCP treatment, a prevention or delay in chlorophyll degradation has previously been also reported for a wide variety of leafy vegetables and fruits (Blankenship and Dole 2003).

The softening of fruits has been reported due to deterioration of membrane integrity and function. The production of free radicals and lipid hydroperoxides lead to membrane degradation. Enzymes such as lipoxygenase and polygalacturonase are believed to be major contributors to derailment of membrane functions (Paliyath and Droillard, 1992). Previously, it has been reported that 1-MCP effectively suppresses the activities of these enzymes and delays the onset of fruit softening in both climacteric and non-climacteric fruits (Jeong et al., 2003; Cai et al., 2006; Quiping and Wenshui, 2006) including fruits of Chinese and Indian jujube. Our results indicate that in ber cv. Seb also, 1-MCP was found quite effective in preventing a decrease in fruit firmness during post harvest ripening. 1-MCP treated fruits also indicated a low level of lipid peroxidation which is symptomatic of decreased cellular damage. Additionally, we have observed that 1-MCP treated fruits of ber cv. Seb were found to be associated with lower lipoxygenase activity (data not presented).

From the above results, it is clear that 1-MCP treatment not only prevented a decrease in fruit firmness and chlorophyll degradation, but also reduced deterioration of cell membrane integrity and function. Thus, although additional trials are necessary, 1-MCP pretreatment appears to have potential in extending the storage life and maintaining the quality of ber fruits.

LITERATURE CITED

Abbas, M. F. 1997. Jujube. In: Postharvest Physiology and Storage of Tropical and Subtropical Plants (ed. S. K. Mitra), pp 405-415, CAB International, UK Bal, J. S. 2001. Post-harvest handling of ber. <http://www.tribuneindia.com/2001/20010507/agro.htm>

Blankenship, S. M. and J. M. Dole. 1-Methylcyclopropene: a review. Postharvest Biol. Technol. 28: 1-25.

Cai, C., Chen.,K.,Xu, W., Zhang, W. Li, X. And I. Ferguson. 2006. Effect of 1-MCP on postharvest quality of loquat fruit. Postharvest Biol. Technol. 40: 155-162.

Jiang, W., Sheng, Q.,Jiang, Y. and X. Zhou. 2003. Effects of 1-methylcyclopropene and gibberellic acid on ripening of Chinese jujube (*Zizyphus jujube* M) in relation to quality. J. Sci. Food Agric. 84: 31-35.

Paliyath, G. and M. J. Droillard. 1992. The mechanism of membrane deterioration and disassembly during senescence. Plant Physiol. Biochem. 30: 789-812.

Pareek, O. P. 2001. Ber. International Centre for Underutilised Crops, Southhampton, UK: University of Southhampton

Sankhla, N., Mackay, W. A. and T. D. Davis. 2001. Extension of vasselife and Prevention of ethylene-induced flower shattering in *Lupinus havardii* by 1-methylcyclopropene. Acta Hort. 543: 75-78.

Sankhla, N., Gehlot, H. S., Choudhary, R., Joshi, S. and R. Dinesh. 2006. Eco-physiological studies on Indian desert plants: Effect of salt on Antioxidant defense systems in *Ziziphus* spp. In: Ecophysiology of High Salinity Tolerant Plants (Eds. M. A. Khan and D. J. Weber), pp. 201-213, Springer, Dordrecht, The Netherlands

Sisler, E. C. and M. Serek. 1997. Inhibitors of ethylene responses in plants at the receptor level: Recent developments. Physiol. Plant. 100: 577-582.

Qiuping, Z. and X. Wenshui. 2006. Effect of 1-methylcyclopropene and/or chitosan coating treatments on storage life and quality maintenance of Indian jujube fruit. LWT- Food Sci. and Tech. (in press).

Table 1. Effect of 1-methylcyclopropene on post harvest ripening parameters of ber fruits.

Parameter	1-methylcyclopropene (nl·l ⁻¹)			
	0	100	200	400
Chlorophyll	100	160±8	185±8	210±5
Firmness	100	136±6	148±4	160±4
Sugars	100	102±4	110±5	120±6
Vitamin C	100	138±6	170±5	160±4
MDA	100	55±5	50±4	38±2



Fig. 1. Fruits of *Ziziphus* species. Note the extreme variation in fruit size.