

Modified Atmosphere/Modified Humidity Packaging for preserving Pomegranate Fruit during Prolonged Storage and Transport

R. Porat, B. Weiss and Y. Fuchs
Department of Postharvest Science
ARO, The Volcani Center
Bet Dagan
Israel

A. Sandman and G. Ward
StePac L.A., Ltd.
Tefen Industrial park
Tefen
Israel

I. Kosto
Ministry of Agriculture, Extension services
Bet Dagan
Israel

T. Agar
Dept. of Horticulture
University of Cukurova,
Adana
Turkey

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Abstract

The limiting factors for prolonged storage of pomegranates are weight loss and shrinkage, decay, appearance of skin blemishes (especially scalds), and impaired quality and taste. Modified atmosphere packaging is a simple and low-cost method that has been proven to alleviate these problems and maintain fruit quality for 3-4 months after harvest. For periods of less than 4 weeks storage, fruit can be held naked in cold storage without any need for modified atmosphere. For moderate storage periods of up to 10 weeks after harvest, it is recommended to pack fruit either in Xtend[®] Easy-Tear or in regular Xtend[®] modified atmosphere/modified humidity (MA/MH) bags in 4-5 kg export cartons. The Xtend[®] Easy-Tear bags contain a notch, which allows the final user to easily tear and remove the top part of the bag for retail display in cartons. The main advantage of packing fruit in Xtend[®] bags within cartons is that the bag maintains fruit quality not only during the storage period, but also during subsequent shipment and marketing. For storage periods of up to 3-4 months after harvest, it is recommended to pack fruit in Xtend[®] 20 kg bulk bags in plastic crates or in Xtend[®] 80 kg bulk bags. This strategy is optimal for storage of large volumes of fruit for long periods, but necessitates resorting and removing damaged fruit after storage before repacking. It is recommended that fruit stored in bulk Xtend[®] bags in crates or bins be repacked in Xtend[®] 4-5Kg bags prior to shipment and marketing. In this way MA storage conditions are maintained throughout the entire storage and supply chain.

INTRODUCTION

The last few years have seen a tremendous increase in trading of pomegranate fruits. Perhaps the aspect that has contributed most to the increased demand for pomegranates is its reputed health promoting effects (Holland and Bar Ya'akov, 2008). Increased trading has necessitated the development of appropriate postharvest operation

techniques for maintaining fruit quality during prolonged storage and transport. The limiting factors to prolonged storage of pomegranates are weight loss and shrinkage, decay, appearance of skin blemishes (especially scalds), and impaired quality and taste. (Elyatem and Kader, 1984; Ben-Arie and Or, 1986; Koksai, 1989). Modified atmosphere packaging has proven to be a successful means of reducing water loss, shrinkage, scald development and decay and can facilitate maintenance of fruit quality for three months or more after harvest (Artes et al., 2000; Nanda et al., 2001). The current paper relates to characteristics of Xtend[®] modified atmosphere/modified humidity (MA/MH) packaging for pomegranates.

MATERIALS AND METHODS

Pomegranate fruits (*Punica granatum* L., cv. 'Wonderful') were harvested in October 2006 from commercial orchards in the central coastal region of Israel. The fruits were transferred to the packinghouse and either stored unwrapped as control or packed in Xtend[®] Easy-Tear bags (StePac Ltd., Israel) in 4-5 kg packages (export cartons). No postharvest chemicals or fungicides were applied. Pomegranates in the Xtend[®] bags were stored along with the naked control for 12 weeks at 6°C, after which the bags were opened and the fruits transferred to a shelf life temperature of 20°C for 1 week. Fruit quality evaluations were performed after storage and shelf life and included visual appearance, color, extent of decay, scald development and taste scores.

RESULTS AND DISCUSSION

Xtend[®] films are characterized by high Moisture Vapor Transmission Rates (MVTR) in comparison to conventional polyethylene and polypropylene films. This assures that excess moisture is eliminated in the event that condensation forms within the bag. This in turn, alleviates decay development and other problems associated with excess moisture. A range of Xtend[®] films with different MVTR values are available and the film selected for any specific produce item is based upon the sensitivity of the produce to excess moisture and its sensitivity to dehydration. The oxygen and carbon dioxide transmission rates of the chosen film are then manipulated using mechanical and laser perforations in order to obtain the desired modified atmosphere for the particular produce, taking into consideration the respiration rate of the produce within the storage temperature range.

Xtend[®] MA/MH packaging for pomegranates reduces weight loss and scald incidence as shown for 'Wonderful' pomegranate fruits in Table 1. Storage of the fruit in commercial Xtend[®] bags also maintains internal quality and taste and is effective in reducing decay on account of the modified atmosphere and the high MVTR. The performance of the packaging in preventing decay can be bolstered by the application of approved postharvest fungicides, although no postharvest chemicals or fungicides were used in this study.

Two basic strategies are offered to growers and export companies for commercial implementation of Xtend[®] technology during storage and transport of pomegranates:

1. Use of Xtend[®] bags in final export cartons when the produce is to be shipped and marketed in less than 10 weeks (Fig. 2A)

2. Use of Xtend[®] bags in large bulk plastic crates or harvest bins if the storage period exceeds 10 weeks (Fig 2B and C)

For commercial use in export cartons, Xtend[®] Easy-Tear or regular Xtend[®] bags are recommended. Xtend[®] Easy-Tear bags include a special notch that allows the retailer to easily tear and remove the top part of the bag for retail display in cartons (Fig. 2A). The main advantage of using this strategy is that the pomegranates remain in the same modified atmosphere packaging throughout the entire supply chain from the moment they are packed, optimizing the effect of the modified atmosphere in preserving fruit quality. Furthermore, since the fruits are directly packed in export cartons after harvest, they can be immediately shipped and marketed after storage without repacking. On the other hand, the disadvantage of packing pomegranates in Xtend[®] Easy-Tear or regular Xtend[®] bags in small export cartons is that it is labor intense, which can be a burden during peak harvest season. Since the fruits packed in the Xtend[®] in export cartons are not sorted after storage, it is mostly suitable for moderate storage periods of up to 10 weeks after harvest.

For storage exceeding 10 weeks, it is recommended to use either 20 kg Xtend[®] bags for use in plastic crates (Fig. 2B) or larger 80 kg bags, 4 of which are placed in each harvest bin that is partitioned using cardboard, which provides physical support to the bags and improve air flow inside the bin (Fig. 2C). The main advantages of using Xtend[®] bags for bulk storage is that the procedure is very cheap, is not labor intense, and effectively maintains fruit quality for relatively long periods of up to 3-4 months after harvest. Furthermore, since after prolonged storage, fruit must be sorted and repacked in export cartons anyway, it is always possible to remove defective fruit showing scald or decay symptoms.

It is recommended to repack fruit that was stored in Xtend[®] bulk packaging into Xtend[®] Easy-Tear or regular Xtend[®] and thereby obtain the benefits of modified atmosphere conditions and prevent further shriveling during subsequent shipment and marketing.

Overall, commercial implementation of Xtend[®] technology is simple and cost effective, maintaining pomegranate fruit quality for up to 3-4 months after harvest. Nevertheless, special effort must be made to pack only sound fruit without signs of decay, bruises or cracks. It is also important to seal the bags only after transferring the fruit to low temperatures in order to avoid water condensation and undesirable gas compositions inside the bags. In addition, application of approved postharvest fungicides is recommended to enhance the performance of the packaging in preventing decay. For long-term storage in bulk packaging, it is recommended that fruit harvested during the middle of the harvest season be packed and not early immature or late over-ripe fruit.

CONCLUSIONS

Xtend[®] MA/MH packaging for pomegranates is a well established technology for maintaining fruit quality during prolonged storage, shipment and marketing. The packaging is available in a range of formats including large Xtend[®] MA/MH bags for bulk storage in plastic crates or harvest bins and smaller Xtend[®] Easy-Tear and regular bags for export cartons and retail display.

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Tables

Table 1. Effect of Xtend[®] bags on postharvest storage performance and quality of 'Wonderful' pomegranate fruit. Observations were made after 12 weeks of storage at 6°C + 1 weeks at 20°C. Note that fruits were not treated with any postharvest chemical or fungicides prior to packing. Different letters within each row indicate significant differences at $P < 0.05$, according to a Student-Newman-Keuls one-way ANOVA test on ranks.

	Control (untreated)	Xtend [®] bag
Weight loss (%)	12.3 a	3.6 b
Decay (%)	2.2 a	2.2 a
Scald (%)	29.0 a	6.0 a
Taste score (0-10)	8.5 a	8.5 a

Figures

After 12 weeks at 6°C + 1 week at 20°C

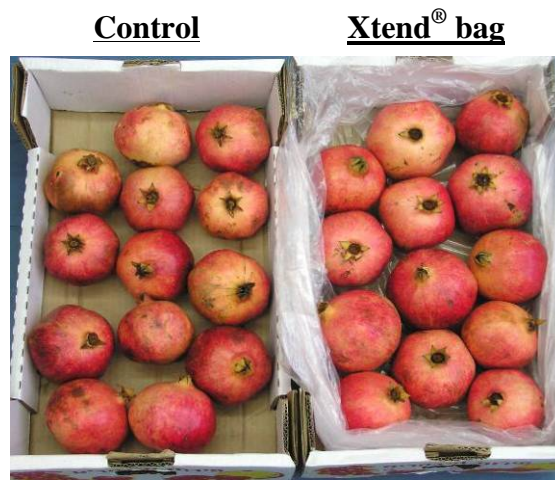


Fig.1. Effects of Xtend® MA/MH packaging on visual appearance of 'Wonderful' pomegranate fruit. The pictures were taken after 12 weeks storage at 6°C + 1 week at 20°C.

A. Export cartons



B. Plastic crates



C. Divided harvest bins*



Fig.2. Different formats of Xtend[®] MA/MH packaging for pomegranates.

*the role of the cardboard separators is to provide physical support to the bags and improve air flow inside the bin.