Effect of Modified Atmosphere Packaging on Fresh Sour Cherry Fruit Quality

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Abstract

Storage of fruits in modified atmosphere packaging (MAP) has been shown to be effective in extending the storage life. When handling and packing fresh sour cherry fruit, great care must be taken to assure adequate sanitation. Fruit have a short shelf life, as postharvest deterioration occurs very quickly if adequate precautions are not taken to prevent it. Reduction in the amount of colour, acid and firmness, incidence of decay and stem browning are potential benefits of MAP. In this study, the harvested fruit of 'Érdi jubileum' and 'Érdi bőtermő' sour cherries were stored at 0°C in MAP (15% O_2, 10% CO_2 and 75% N_2) for 6 weeks. Weight loss was reduced significantly under MAP compared with ambient air packaging. Fruits packaged with MAP films maintained higher flesh firmness than did the control. Control fruits had the highest TSS content. During the postharvest period, both titratable acidity and pH increased slightly. Skin colour was lighter (higher "L") and less blue (higher "b") under modified atmosphere than usual air packing.

INTRODUCTION

Iran is one of the biggest cherry producers in the world after Turkey and USA (Vursavus et al., 2006). However, few postharvest technologies are available for fruits and vegetables in the country. Sour cherries (*Prunus cerasus* L.) are highly perishable, non-climacteric fruits. 'Érdi jubileum' and 'Érdi bőtermő' sour cherries have great quality for fresh consumption. Their shelf-life is shortened by loss of firmness, discoloration of the stem, desiccation, and they are not suitable for long storage. Maintaining lower fruit temperatures immediately after harvest results in firmer fruit with reduced decay and greener stems (Schick and Toivonen, 2002). Allende et al. (2007) have suggested modified atmosphere packaging (MAP) as postharvest treatment to control decay of fruit (e.g., strawberries). Hevia et al. (1998) and Alique et al. (2005) reported that the optimum relative humidity for storage of sweet cherries was between 90 and 95%. Tian et al. (2004) compared controlled atmospheres (CA) with a high oxygen concentration to CA with high carbon dioxide concentration. Sour cherry fruits are among the commodities which respond well to elevated concentrations of CO_2. Cherry, nectarine and peach fruits also store better in 10% CO_2 than in air (Lurie, 1992; Patterson, 1982; Retemales et al., 1982).

The objective of this study was to determine the influence of modified and ambient atmosphere packaging on fruit quality of sour cherries in 0°C temperature. The aim of the present work was to evaluate the influence of passive modified atmosphere packaging on the color changes and fruit quality of sour cherries in 0°C temperature.

MATERIALS AND METHODS

The effects of modified atmosphere packaging (MAP) on the storage life of sour cherry fruit (cvs. 'Érdi jubileum' and 'Érdi bőtermő') were investigated. Fruit were harvested at commercial maturity from five trees in a commercial orchard in Mashhad, Iran. The 250 g of fresh fruit was packed by vacuum (Henkelman 200A model, air

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controlled atmosphere packing machine, Co. Henkelman, Netherlands). The thickness of polyethylene covers was 70 μm and included 3 layers PE/PA/PE (polyethylene/polyamide/polyethylene). The fruits were packaged under two different gaseous compositions, ambient air and 10% O_2, 15% CO_2, 75% N_2 in 18x13x5 cm trays restricted by covers. They were kept at 0°C for 42 days. Weight loss, fruit color (L*, a*, b*), fruit flesh firmness (deformation as mm/min), total soluble solids (%TSS), pH, and titratable acid (TA) content (g malic acid/100 ml fruit juice) were evaluated before, and 6 weeks after, storage. TSS was measured as °Brix using a digital refractometer (Palette, PR-101, Japan). TA was assessed by titration with sodium hydroxide (NaOH) (0.1N) and expressed as a percent from malic acid. TSS/TA ratio was calculated and the pH value was measured by a digital pH-meter (Knick, Portamess, Germany). Skin colour was measured on the cheek area of fruits with a Minolta colorimeter CR-200™ model (Minolta Camera Co., Osaka, Japan) having an aperture size of 10 mm for reading small samples without cut-off. Fruit firmness was measured as mm displaced at 60 s in 30 fruit under a 150 g constant load (after Macnish et al., 1997).

All data in the present study were subjected by analysis of variance (ANOVA) and means were separated by Duncan's multiple range tests at $P< 0.05$.

RESULTS AND DISCUSSION

Ambient atmosphere packaging conditions had a greater influence on fruit quality loss compared to MAP conditions. Sour cherry fruits packaged under modified atmosphere conditions could be stored for 42 days at 0°C with a higher quality and minimal risk of disorder development. As expected, weight loss was significantly reduced under MAP and cool storage (0°C) (Table 1). Fruit in MAP had minimal weight loss (5.4 g per 250 g), while ambient air packaged fruit had more weight loss (7.0 g per 250 g) after storage for 42 days at 0°C. The change in pH was significant 6 weeks after storage (Fig. 1) and we observed no difference between MAP and ambient air conditions. There were no differences in organic acid levels between MAP and ambient air; however, TSS values were significantly different (Table 1). The results indicated that MAP with 10% O_2 + 15% CO_2 + 75% N_2 was more effective in reducing fruit decay and TSS/TA ratio in fruit at a later storage period in comparison with ambient air packages. Also, MAP conditions were more effective in retaining the °Brix and TSS/TA ratio compared to ambient atmosphere packaging conditions, which may be the reason why sour cherries stored in MAP conditions had lower TA values than that kept in other conditions.

'Érdi bőtermő' (3.73) had higher pH compared to 'Érdi jubileum' (3.54). The TSS increased while in storage (Fig. 2). The TSS was higher in ambient air packages (21.3%) in comparison with MAP conditions (22.5%) and was similar for both cultivars. Sour cherry organic acid levels (malic acid equivalent) decreased throughout storage. The TA was higher in 'Érdi jubileum' (1.43 mg/100 ml) in comparison with 'Érdi bőtermő' (1.07 mg/100 ml). The TSS/TA ratio increased after 42 days compared to that at harvest. Sour cherry fruits packaged with MAP films maintained higher fruit flesh firmness than control fruits. Fruits in ambient air packaging had the highest TSS. TA values were higher with MAP, but differences were not significant compared to ambient atmosphere packaging. Yaman and Bayoindirli (2002) found that cherries stored at 0°C after 32 days have no change in TSS and sugar and also Alique et al. (2005) obtained this result in MAP conditions. Mangarise et al. (2007) found that storage time was effective in decreasing the TA in peaches. Kupferman and Sanderson (2001) also found that there were no differences in firmness of sweet cherry fruit stored at 1°C after 34 days in MAP.

As seen in Table 1, L*, a*, b* values of peel color were higher in fruit packaged in MAP conditions. The main colour changes were observed for L* value, which diminished during storage from 23.9 at harvest to 23.1 after 42 days of storage (Table 2). However, significant differences were found between ambient atmosphere packaging and MAP for L* value, but a* and b* values were not changed (Table 1). Fruit colour in 'Érdi jubileum' was darker than at harvest in both MAP and ambient atmosphere packaging, while 'Érdi bőtermő' fruit maintained their colour (Table 3, Fig. 3). Generally, fruit colour was

retained in the MAP much more than in ambient atmosphere packaging. In ambient atmosphere packaging, fruit colour was darker. Esti et al. (2002), by holding several sweet cherry cultivars in cool storage, observed no change on colour correlations, except for L* value (which decreased in 'Ferrovia').

CONCLUSIONS

Modified atmosphere packaging was found to be more effective in maintaining sour cherry fruit quality than ambient atmosphere packaging conditions. Also, MAP was found to be beneficial for maintaining quality in both 'Érdi jubileum' and 'Érdi bőtermő' during 42 days storage. MAP did not affect pH, TA and a* and b* values. The major benefits were in decreasing weight loss and retaining colour, TSS and sugar/acid ratio.

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Tables

Table 1. The effect of maintenance time in storage on some qualitative properties of sour cherry fruits.

Treatments	pH	°Brix (TSS)	Titratable acidity (mg/100 ml)	TSS/ TA ratio	Firmness (mm)	Colour coordinate L*	a	b
At harvest	3.5b	20.4b	1.4 a	15.1 b	5.6 b	23.9a	8.2a	2.1a
6 weeks after storage	3.8a	23.4a	1.1 b	22.6 a	6.4 a	23.1b	7.9a	2.1a

In each column, means with the same letters are not significantly different at 5% level of probability using DMRT.

Table 2. The effect of package atmosphere type on some qualitative properties of sour cherry fruits.

Treatments	Weight loss (g)	pH	°Brix (TSS)	Titratable acidity (mg/100 ml)	TSS/TA ratio	Firmness (mm)	Colour coordinate L*	a	b
Ambient atmosphere	7.0 a	3.7a	22.5a	1.2 a	20.2 b	6.2 a	23.3 b	7.8 a	2.0 a
Modified atmosphere	5.4 b	3.6a	21.3b	1.3 a	17.5 a	5.8 b	23.7 a	8.3 a	2.2 a

In each column, means with the same letters are not significantly different at 5% level of probability using DMRT.

Table 3. The effect of cultivars on some qualitative properties of sour cherry fruits.

Cultivars	Weight loss (g)	pH	°Brix (TSS)	Titratable acidity (mg/100 ml)	TSS/TA ratio	Firmness (mm)	Colour coordinate L*	a	b
Érdi jubileum	6.3 a	3.5 b	22.1 a	1.4 a	16.1 b	5.6 b	23.2 b	7.7 a	2.0 a
Érdi bőtermő	6.0 a	3.7 a	21.7 a	1.1 b	21.6 a	6.7 a	23.8 a	8.4 a	2.2 a

In each column, means with the same letters are not significantly different at 5% level of probability using DMRT.

Figures

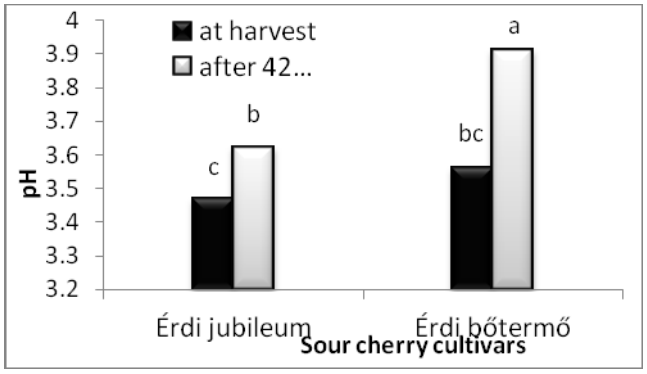

Fig. 1. The effect of storage time in modified atmosphere packaging (MAP) on pH of sour cherry cultivars (Different letters are indicated significant differences between treatments (α =0.05)).

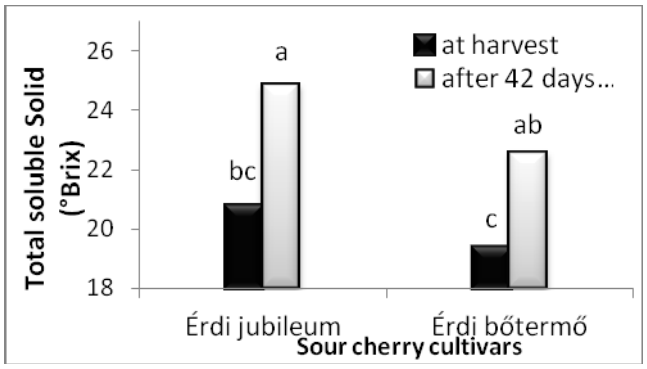

Fig. 2. The effect of storage time in modified atmosphere packaging (MAP) on total soluble solids content of sour cherry cultivars (Different letters are indicated significant differences between treatments (α=0.05)).

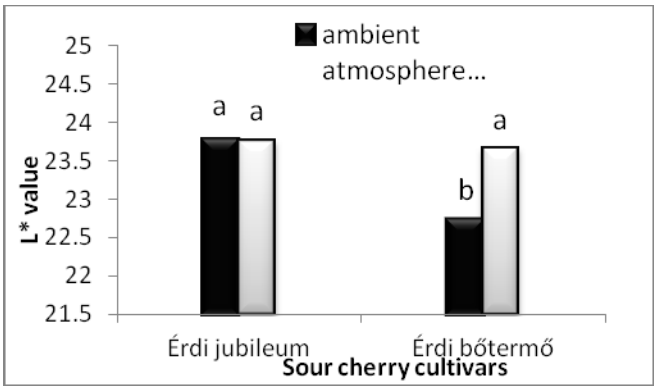

Fig. 3. The effect of ambient air packaging and modified atmosphere packaging (MAP) on the L* value of sour cherry cultivars (Different letters are indicated significant differences between treatments (α =0.05)).