Maturity Index and Cold Storage Effects on Postharvest Quality of 'Packham's Triumph' and 'Rocha' Pears

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Abstract

Pears have been grown in the south region of Brazil, where the climatic conditions are favourable. The aim of this work was to determine the harvest maturity index as well as maximum storage period of 'Packham's Triumph' and 'Rocha' pears to maintain quality attributes. The 'Packham's Triumph' fruit were harvested from a commercial orchard at 7 days intervals and flesh firmness was used as a maturity index (MI1=76, MI2=67 and MI3=58 N). 'Rocha' pears were harvested twice and they were considered as MI1 and MI3 because of the firmness values. The fruit were stored at 1±1°C and 90-95% RH for 15, 30, 45 and 60 days and evaluated at the end of each storage period and after five days at room temperature (24±1°C), simulating a shelf-life period. Flesh firmness, water loss, peduncle dehydration, epidermis colour, soluble solids, titratable acidity were measured. 'Packham's' pears harvested at MI1 and MI2 showed firmness loss after 30 days of cold storage, whereas fruit harvested at MI3 retained the initial values, resulting in firmer fruit after 60 days (P<0.001). Fruit harvested in MI3 had less firmness loss after 5 days at room temperature following 45 and 60 days of cold storage. 'Rocha' pears harvested in MI1 and MI3 showed firmness reduction during cold storage, which was intensified at room temperature. Maximum values of water loss approached 6%. Fruit peduncles of both cultivars dehydrated after 60 days of cold storage, but their colour remained green, independent of harvest maturity index. 'Packham's Triumph' and 'Rocha' pears harvested at MI3 showed better quality attributes after 60 days of cold storage plus 5 days of shelf-life than fruit harvested at other maturity stages.

INTRODUCTION

Considering the temperate climate fruits, pears are the third most consumed and imported by Brazil (Nakasu et al., 2003). In 2008, 143,000 tons were imported on average, whereas, the production in Brazil came to 17,391 ton. Rio Grande do Sul State produced 45.7% of the pear production from 2001 to 2005 (Fioravanço, 2007), and together with other States there were 1651 ha with pear trees in 2007 (IBRAF, 2010). The European pears 'Packham's Triumph' and 'Rocha' stand out among the promising cultivars for the south region of Brazil, and these are harvested from mid-January to late February.

European pears are usually harvested at pre-climacteric stage and the maturity for harvest depends on their final destination. However, harvesting too early results in off-flavor and poor coloured fruits whereas late-harvested fruit is more susceptible to decay than fruit harvested at optimum maturity. Some maturity indexes have been developed to identify the maturation and ripening processes as well as to indicate the harvest time (Garriz et al., 2008). According to Benítez (2001), the maturity indexes recommended for harvest of 'Packham's Triumph' pears grown in the North of Patogonia, Argentina, are flesh firmness between 68 and 78 N and soluble solids from 10 to 11°Brix, whereas the recommendation for 'Rocha' pears is flesh firmness between 54 and 64 N and soluble solids from 11 to 13°Brix (Madeira et al., 2005; Silva et al., 2005).

Considering that the storage potential and the sensory quality of fruits are related to maturity at harvest and the harvest date varies with region, climatic conditions, soil,

root-stock, solar radiation, water availability, among other factors (Avelar and Rodrigues, 1999), the aim of this work was to determine the harvest maturity for 'Packham's Triumph' and 'Rocha' pears grown in the Campos de Cima da Serra region, RS State, Brazil, as well as to establish the maximum cold storage period that provides the preservation of quality attributes.

MATERIAL AND METHODS

'Packham's Triumph' pears were harvested from a commercial orchard located at Campos de Cima da Serra region, Rio Grande do Sul State, Brazil, every seven days intervals (27 January, 3 and 10 February 2009). Flesh firmness was used as a maturity index for harvest (27 January, MI1=76N; 3 February, MI2=67N and 10 February, MI3=58 N). 'Rocha' pears were harvested only on 27 January and 3 February, and they were considered as MI1 and MI3, respectively, based on their flesh firmness.

Fruit were carefully harvested early morning. To avoid mechanical injuries during transportation, trays and plastic boxes were used, and fruit were taken to the Postharvest Lab. at National Research Centre for Grape and Wine, Bento Gonçalves, RS, where they were selected and defective fruit were eliminated.

Fruit were stored at 1±1°C and 90-95% RH for 15, 30, 45 and 60 days and evaluated at the end of each storage period and again after five days at room temperature (24±1°C), simulating a shelf-life period.

The quality attributes flesh firmness (N), water loss (%), peduncle dehydration, epidermis colour, soluble solids (°Brix), titratable acidity (% malic acid) and their ratio were determined. Firmness was measured, after removing skin, on two opposite sides of each fruit, with a penetrometer (TR-Fruit Pressure Tester, Model 53205) fitted with a 11-mm probe. Water loss was determined by the difference between initial and final mass. The peduncle dehydration was evaluated by a rating scale ranging from 0 to 4 (0: peduncle without dehydration; 1: dehydration just in the cut region; 2: 50% dehydration; 3: >50 to 90% dehydration; 4: more than 90% dehydration). The CIE $L^*a^*b^*$ colour values were measured with a colorimeter (Minolta CM-508d) with hue angle calculated as arctan b^*/a^*. SS and TA were determined on flesh juice extracted by an automatic juicer. SS was measured using a portable refractometer (PR-101, Atago) and TA was measured with a digital titrator by titrating 10 ml of juice with 0.1N NaOH to pH 8.1 endpoint. Results are presented as % malic acid. Ratio SS/TA was also calculated.

The experiment was arranged in a completely randomized design with five replications. Each replication was composed of five fruits. Data were submitted to an analysis of variance (ANOVA) and means compared by Tukey's test at $P<0.05\%$ using SAS for Windows.

RESULTS AND DISCUSSION

Flesh Firmness

The initial significant differences in flesh firmness of 'Packham's Triumph' pears at the 3 harvest maturities persisted up to 15 days of cold storage. From 30 days of cold storage on, two different behaviours were noticed. There was a remarkable decrease in the fruit firmness harvested at MI1 and MI2, whereas fruit firmness of late harvested MI3 remained with little change (Fig. 1). Similarly, Moya-Léon et al. (2006) reported remarkable decrease in fruit firmness of 'Packham's Triumph' pears harvested on two dates and stored for up to 2 months under regular cold storage (0°C, 90-95% RH). Pears from the first harvest, which correspond to those from the commercial harvest of the orchard, showed a decrease from 79.2 to 27.1 N, while the second harvest, had firmness declining from 67.2 to 24.0 N. MI3 harvested pears had firmness values between 51.1 and 59.7 N throughout the cold storage period. These fruits showed lower percent firmness loss during the shelf life periods after 30, 45 and 60 days of cold storage.

'Rocha' pears harvested at MI3 showed higher firmness values than those harvested early even at the end of cold storage period (Fig. 1). Similarly, 'Rocha' pears

harvested in Bombarral, Portugal, with 67, 57 and 51 N and stored at -0.5°C, 90-95% RH and 2.5 kPa O_2+0.7 kPa CO_2 up to 240 days retained the significant differences in flesh firmness at harvest throughout the storage period (Silva et al., 2010). MI3 harvested pears showed a lower percent firmness loss than those harvested early in the shelf life periods after 45 and 60 days of cold storage.

Water Loss

'Packham's Triumph' pears showed water loss values between 0.62 and 3.2% during cold storage period and maximum values (4.8%) in the shelf life period after 60 days of cold storage. 'Rocha' pears had higher % water loss than 'Packham's Triumph' pears in the same storage conditions, especially at the end of cold storage period, when MI1 harvested pears reached 6.2% of water loss (Fig. 2).

Peduncle Dehydration

Fruit peduncles of both cultivars reached index 3 for dehydration occurring on no more than 90% peduncle length after 60 days of cold storage, but their colour remained green, independent of the harvest maturity.

Epidermis Colour

Hue angle of 'Packham's Triumph' pears declined only slightly during storage and hue values were lower for the MI3 stage fruit. The fruits harvested at MI1, MI2 and MI3 showed remarkable colour changes during shelf life after 45 days or longer of cold storage. 'Rocha' pears had a more yellowish colour (lower hue) during cold storage, that became more pronounced in the shelf life periods (Fig. 3).

Soluble Solids, Titratable Acidity and Ratio

'Packham's Triumph' pears harvested at MI1 and MI3 showed a remarkable increase in soluble solids after 15 days of cold storage, with significantly higher values than MI2 fruits. At that same cold storage period, MI3 fruits had a decrease in titratable acidity and these values remained the same up to the end of cold storage (data not shown). As a result of the changes observed in soluble solids and titratable acidity, the MI3 harvested pears showed a higher ratio (SS/TA) up to the end of cold storage. 'Rocha' pears harvested in MI3 had ratio values higher than MI1 fruits up to 30 days of cold storage resulting, mainly, from the lower levels of titratable acidity (Fig. 4).

CONCLUSIONS

'Packham's Triumph' and 'Rocha' pears harvested at MI3 showed better quality attributes after 60 days of cold storage plus 5 days of shelf-life. It is recommended that fruit be harvested at a later stage of maturity for short periods of cold storage.

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Figures

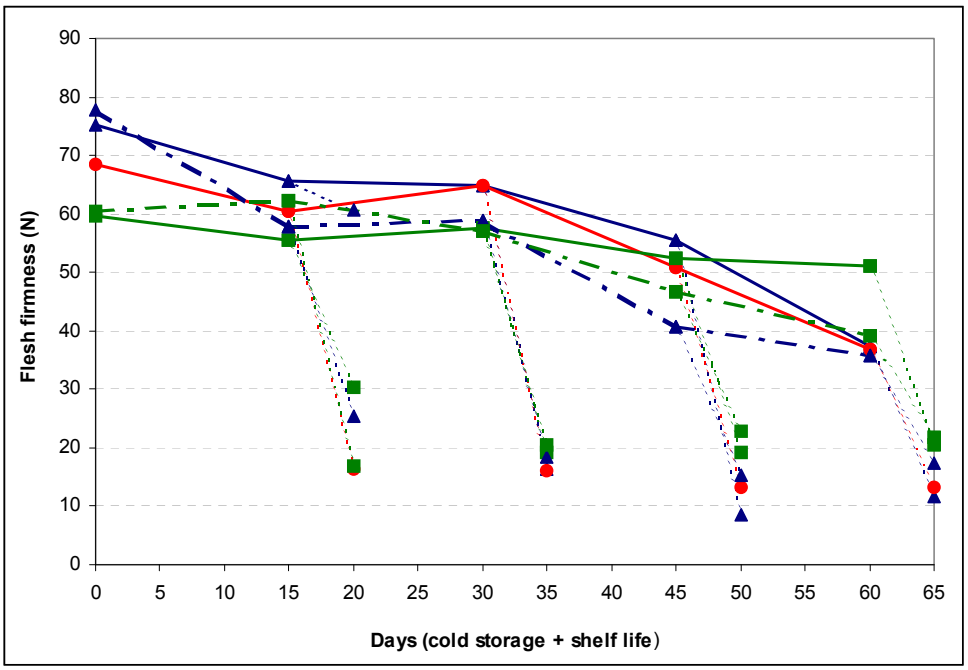

Fig. 1. Flesh firmness (N) of 'Packham's Triumph' (——) and 'Rocha' (-·-·-) pears harvested at different maturity indexes (▲MI1: 76, ●MI2: 67 and ■MI3: 58 N) and stored at 1±1°C and 90-95% RH for 15, 30, 45 and 60 days plus five days at room condition (24±1°C), simulating shelf-life period (.....).

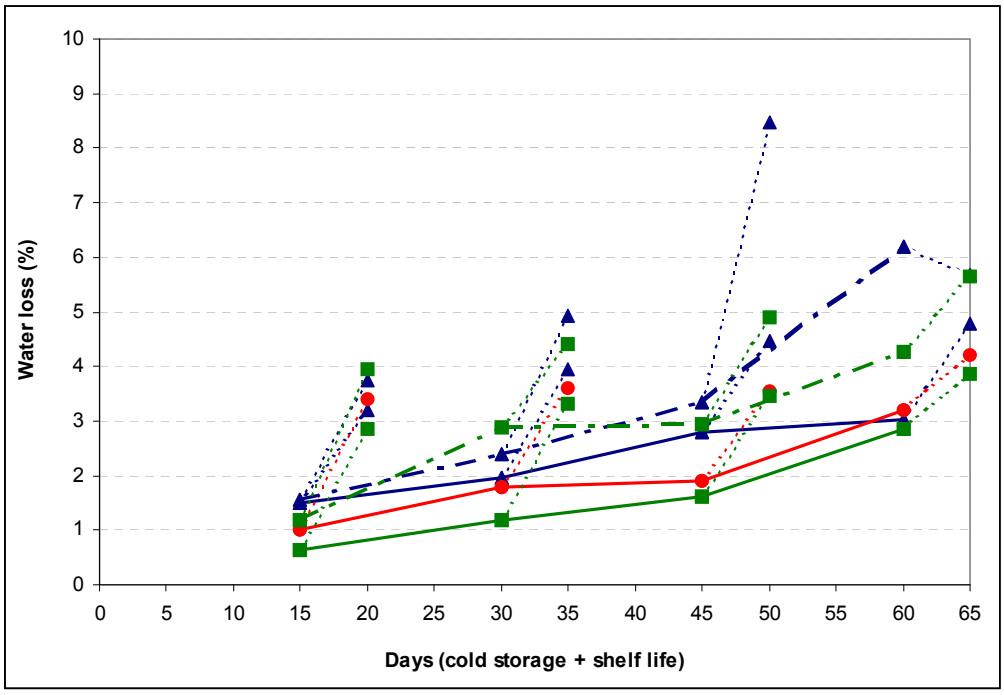

Fig. 2. Water loss (%) of 'Packham's Triumph' (——) and 'Rocha' (-·-·-) pears harvested at different maturity indexes (▲MI1: 76, ●MI2: 67 and ■MI3: 58 N) and stored at 1±1°C and 90-95% RH for 15, 30, 45 and 60 days plus five days at room condition (24±1°C), simulating shelf-life period (.....).

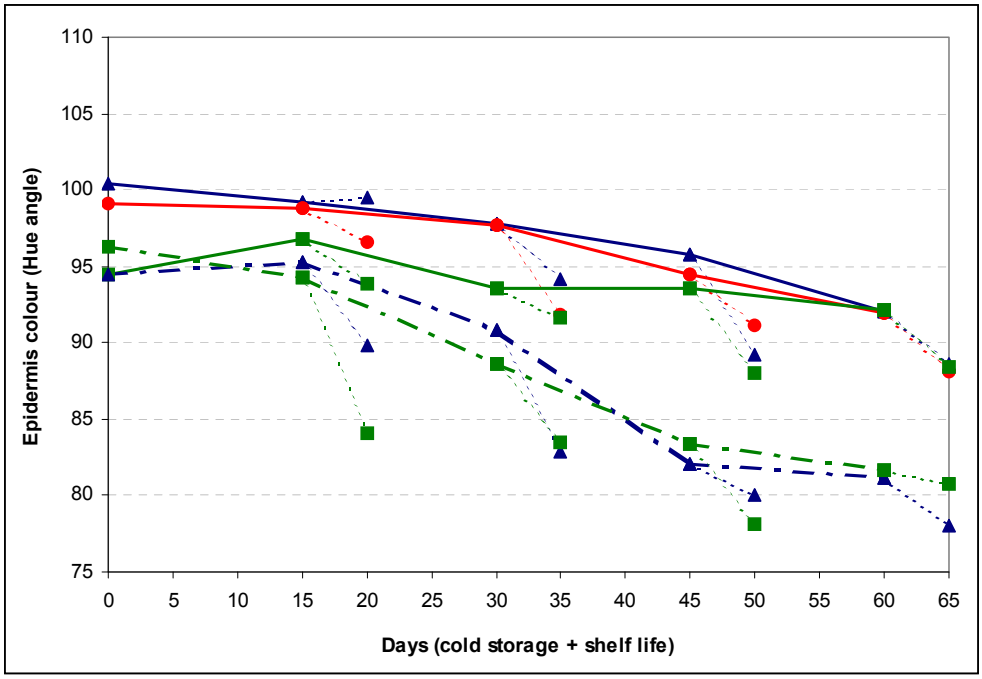

Fig. 3. Epidermis colour (Hue angle) of 'Packham's Triumph' (——) and 'Rocha' (-·-·-) pears harvested at different maturity indexes (▲MI1: 76, ●MI2: 67 and ■MI3: 58 N) and stored at 1±1°C and 90-95% RH for 15, 30, 45 and 60 days plus five days at room condition (24±1°C), simulating shelf-life period (.....).

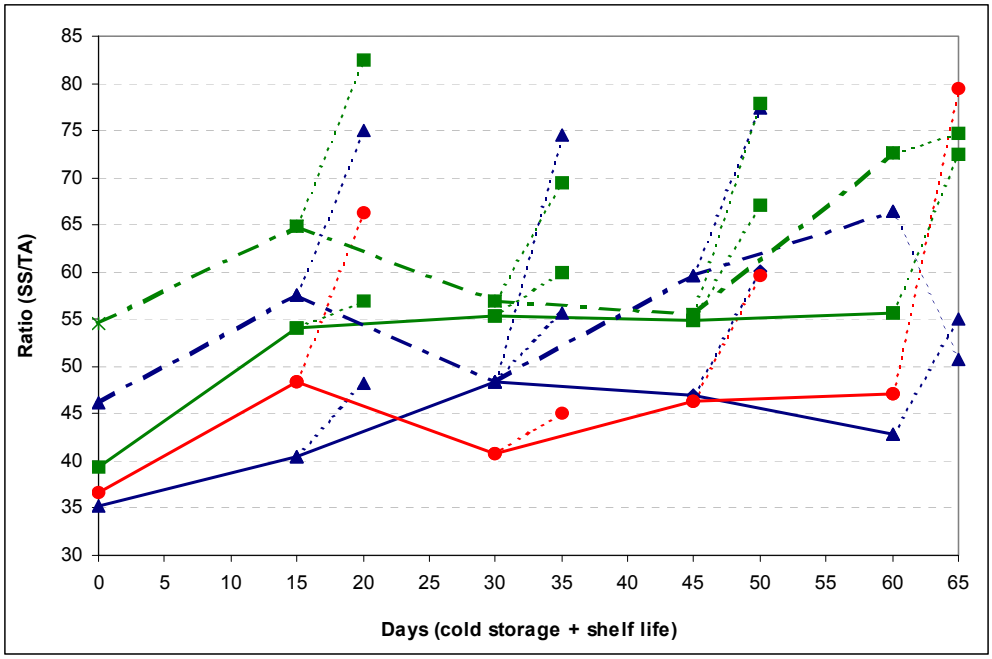

Fig. 4. Ratio SS/TA of 'Packham's Triumph' (——) and 'Rocha' (-·-·-) pears harvested at different maturity indexes (▲MI1: 76, ●MI2: 67 and ■MI3: 58 N) and stored at 1±1°C and 90-95% RH for 15, 30, 45 and 60 days plus five days at room condition (24±1°C), simulating shelf-life period (.....).