Changes in organic acid and sugars levels during ripening of five loquat (Eriobotrya japonica Lindl.) cultivars

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Changes in organic acid and sugars levels during ripening of five loquat (*Eriobotrya japonica* Lindl.) cultivars

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SUMMARY – Changes in colour and sugar and organic acid content were analysed in five loquat cultivars. Colour changes occurred when loquat fruits were in a phase of fast growth, and concomitantly with both, the decrease in organic acid content and the increase in sugar levels. In the five loquat cultivars malic acid was the prominent organic acid in Algerie cultivar having a significantly higher content at fruit ripening than in the other loquat cultivars. Glucose, fructose and sucrose increased sharply during loquat ripening, while sorbitol concentration was high in young fruits and decreased quickly in the first weeks of fruit development. At commercial ripening stage sugar content was higher in Cardona, Golden and Peluche cultivars than in Magdall and Algerie.

Key words: Loquat, growth, organic acids, sugars.

RESUME – *"Changements des niveaux d'acides organiques et de sucres pendant le mûrissement chez cinq cultivars de néflier (*Eriobotrya japonica *Lindl.)". Les variations de couleur, de sucre et d'acides organiques ont été analysées dans 5 variétés de néflier du Japon. Les changements de couleur sont apparus quand les fruits étaient dans la première phase de croissance rapide et en même temps que la diminution en acides organiques et que l'augmentation en sucres. Dans les 5 variétés l'acide malique était majoritaire, et il était significativement plus élevé dans la variété Algérie que dans les autres fruits jeunes tandis que le glucose, le saccharose et le fructose augmentaient pendant la maturité. Dans l'état de maturité commerciale le contenu total en sucres était plus élevé dans Cardona, Golden et Peluche que dans Magdall et Algérie.*

Mots-clés : *Néflier, croissance, acides organiques, sucre.*

Introduction

The quality of loquats is highly dependent on the degree of ripening at harvest (Uchino *et al*., 1994). Loquats harvested at the fully ripe stage have the optimum quality. However, in commercial situations where transport and shelf-life are involved, loquats are generally harvested before becoming fully ripe, which may result in reduced quality of the fruit. The appearance of skin color and contents of sugar and organic acids are the key components that contribute to a high quality of fresh loquat. So, the aim of this study was to characterize the changes in color and sugar and organic acid content during development of five loquat cultivars in order to determine the optimum moment of harvesting.

Materials and methods

Five loquat (*Eriobotrya japonica* Lindl.) cultivars were studied: Algerie, Cardona, Golden, Magdall and Peluche, from the Cooperativa Ruchey of Callosa d'Ensarriá (Alicante, Spain) during fruit development and ripening. Three trees were randomly chosen for each cultivar and ten fruit were labeled in each one after fruit set. A sample of 15 fruits (similar in size to those labeled) of each cultivar was taken weekely and carried to the laboratory, in which fruit weight, skin color and organic acid and sugar levels (by HPLC analysis) were analyzed.

Results and discussion

Fruit growth

The growth of loquat fruit was slow during the first weeks of fruit development, and increased sharply from the 27th February in the five loquat cultivars (Fig. 1) at time when temperatures rose at the end of the winter in 2001. The second phase of fast fruit growth lasted 4-7 weeks and final fruit weight was reached on different time depending on the loquat cultivar. A correlation was found between the rapid growth period duration and fruit size.

Color development

Changes of surface color of loquat fruit, expressed by the increase in *a* parameter of the color, indicated the evolution from green color towards yellow-orange color of the ripe fruit. In the five loquat cultivars the increase in parameter *a* of the color change started during the fast growth phase, before the fruit reached their final weight, although at different time depending on cultivar (Fig. 2). Parameter *a* of the color was significantly higher in Golden cultivar than in the others four cultivars. Similar increases were found in *L* and *b* parameters of the color, which started a week before than changes in *a* parameter (data not shown).

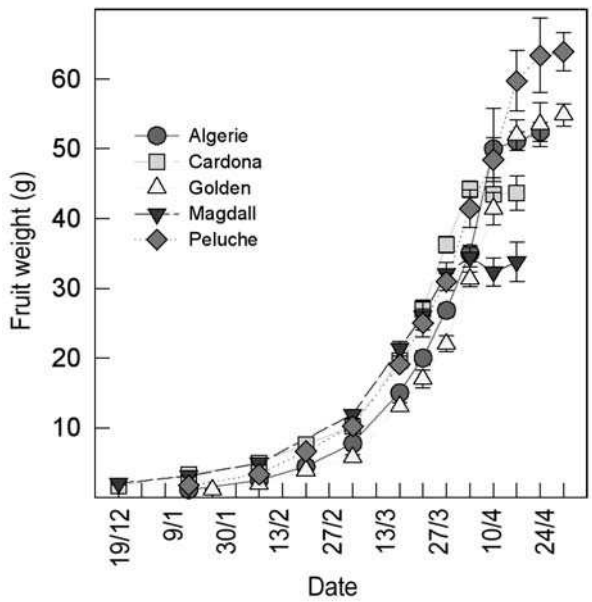

Fig. 1. Fruit weight evolution during development in the tree of the five loquat cultivars. Data are the mean ± SE of determinations made in 15 fruits.

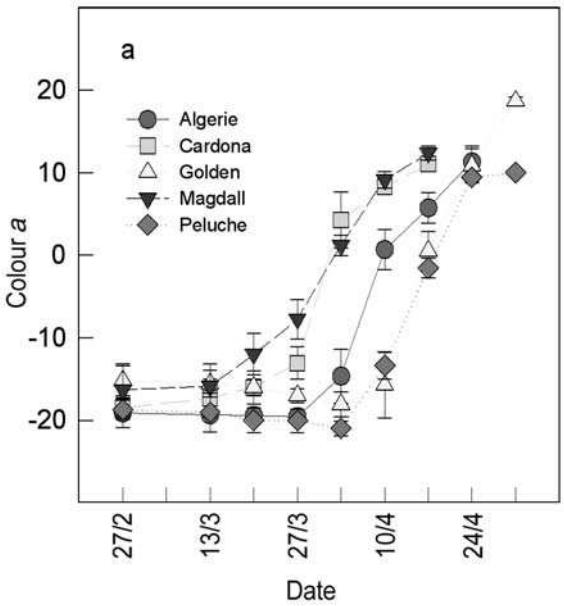

Fig. 2. Color (*a* parameter) evolution during development in the tree of the five loquat cultivars. Data are the mean ± SE of determinations made in 15 fruits.

Changes in organic acid and sugar content

Fruit growth and quality largely depend on the metabolism of cellular components. During fruit development, carbohydrate and acid accumulation depends upon the photoassimilates translocated from the mature leaves, which in loquat are mainly sorbitol, as in other Rosaceous species (Bantog *et al*., 1999). Malic acid was the prominent organic acid and evolved in a similar way to the total acidity. Thus, malic acid content in ripen fruits was the least in Magdall and Peluche (0.25-0.45 g/100 g F.W.), being around 0.65 g/100 g F.W. in Cardona and Golden, while in Algerie malic acid levels were significantly higher, around 0.85 g/100 g F.W. (Fig. 3). Citric, succinic and fumaric acids were present at concentrations ten fold lower than malic one and also decreased during ripening. Ascorbic and tartaric acids were also present in all loquat cultivars but at very low levels. This evolution on organic acids was responsible for changes in total acidity that was very high in the phase of fast fruit growth,

decreasing sharply to reach levels of 0.33-0.40 g/100 g F.W. in Golden, Magdall and Peluche, 0.64±0.08 g/100 g F.W. in Cardona and 0.89±0.02 g/100 g F.W. in Algerie.

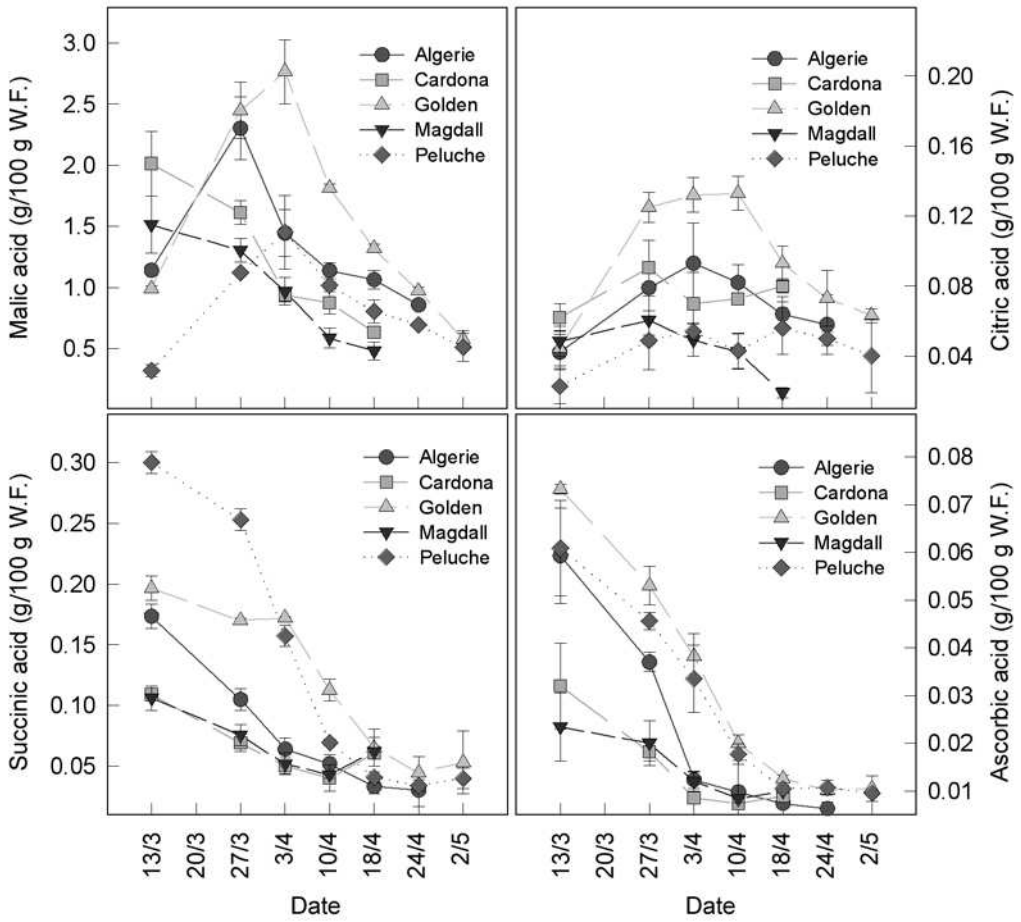

Fig. 3. Evolution of the organic acid content during development in the tree of the five loquat cultivars. Data are the mean ± SE of determinations made in 15 fruits.

Solid soluble content (°Brix) increased sharply in all loquat cultivars as decreased acidity. However, decrease in acidity was faster than the increase in °Brix. At the end of the ripening process ºBrix were 12.23±0.18 in Algerie, between 14 and 15ºBrix in Cardona, Golden and Magdall and significantly higher (17.00±1.19) in Peluche. However, the changes in individual sugars were different along the ripening process. Thus, sorbitol content was relatively high in young fruit before starting the ripening process and decreased quickly. Glucose and sucrose increased sharply during loquat ripening (Fig. 4) coinciding with the color changes in the fruits from green to yellow, being the predominant sugars at ripening in all the loquat cultivars. Fructose was the prominent sugar in green fruits and also increased during ripening (Fig. 4). At commercial ripening stage, Cardona, Golden and Peluche cultivars reached higher levels of total sugar than Algerie and Magdall ones.

Conclusions

Total sugar content increased rapidly during the fast growth phase, the same time that organic acid decreased and color changes occurred. Therefore, the ripening process in loquat fruits begins in a relatively early stage of development, although progressed slowly during 3-4 weeks.

Acknowledgments

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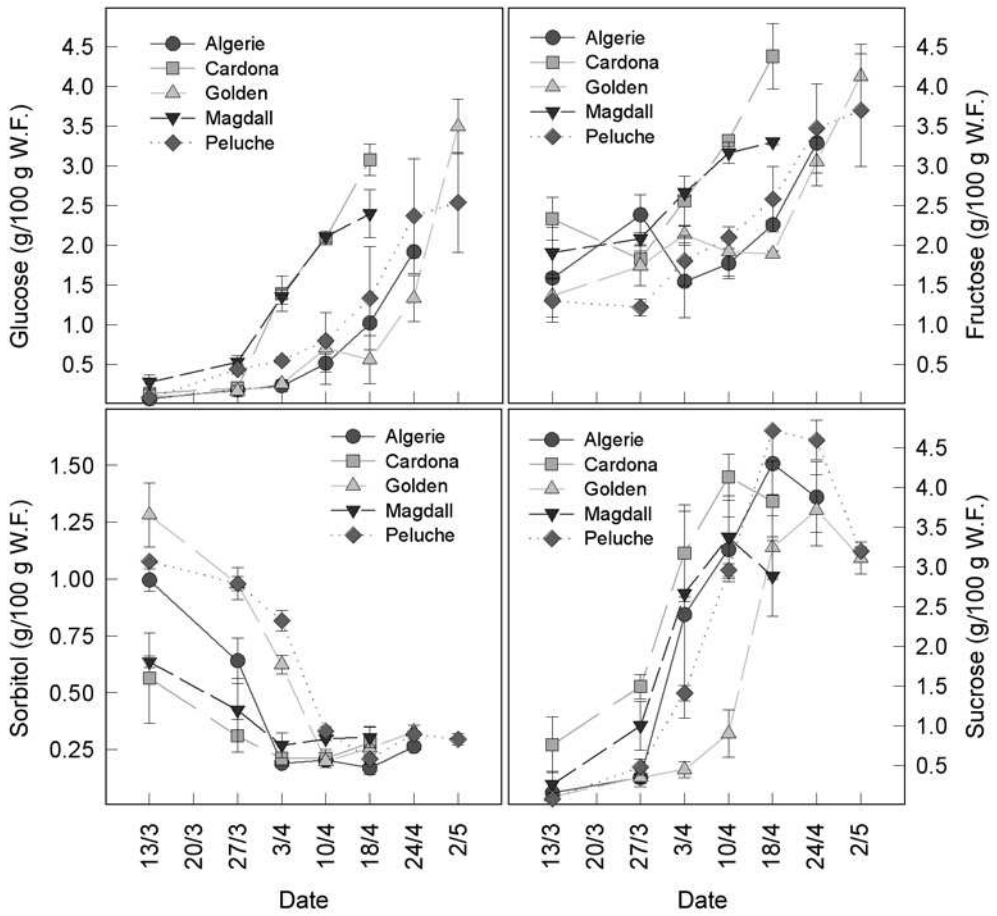

Fig. 4. Evolution of the sugar content during development in the tree of the five loquat cultivars. Data are the mean ± SE of determinations made in 15 fruits.

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