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Ripening physiology of five loquat (*Eriobotrya japonica* Lindl.) cultivars

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SUMMARY – The physiological changes related to ripening, such as colour, texture and sugar and organic acid levels and their relation with the plant hormone ethylene were studied in five cultivars of loquat. The five loquat cultivars showed a peak of ethylene production and an increase in 1-aminocyclopropane-1-carboxylic acid associated to the ripening changes in the above-mentioned parameters, although they started when loquat fruits were in an early phase of development when they had reached 60-70% of its final size.

Key words: Climacteric, ethylene, loquat, ripening physiology.

RESUME – *"Physiologie de la maturité de cinq cultivars de néflier (*Eriobotrya japonica *L.)". Nous avons étudié les changements physiologiques en relation avec la maturité, comme la couleur, la texture et les niveaux de sucre et d'acides organiques, dans 5 variétés de néflier et leur relation avec l'éthylène. Les 5 variétés avaient un sommet de production d'éthylène et un accroissement de l'acide 1-aminocyclopropane-1-carboxylique associé aux changements de maturité sur les paramètres ci-dessus. Mais les changements sont apparus quand les néfliers étaient à 60-70% de leur poids final.*

Mots-clés : *Climatérique, éthylène, néflier, maturité.*

Introduction

Fruit ripening is considered a genetically programmed process that involves a series of physical and biochemical changes [such as skin color, flesh texture, total soluble solids (TSS), acidity and volatile aroma], resulting in the characteristic quality that makes the fruit acceptable for consumption. In climacteric fruit, one of the early events of ripening is the onset of ethylene production. This hastens the ripening process and the physicochemical changes associated with it. In non-climacteric fruit ethylene production is very low during ripening, having low or no involvement on this process (Abeles *et al*., 1992; Lelièvre *et al*., 1997; Yang and Oetiker, 1998; Saltveit, 1999). At the moment, there are only a few reports concerning the ripening pattern of loquat fruit, and they show contradictory results. Ding *et al.* (1998) have reported that loquat cv Mogi (the most important in Japan) ripens as non-climacteric fruit, since respiration rate and ethylene production did not increase during ripening. However, Hamauzu *et al.* (1997) found, also in Mogi cultivar, that ethylene production increased simultaneously with the decrease of green color and the appearance of reddish color, corresponding to a climacteric pattern of ripening.

The aim of this work was to comparatively analyze some physicochemical changes (color, flesh texture, and sugars and organic acid levels) related to ripening during development of five cultivars of loquat, and their possible relation to the plant hormone ethylene and its precursor, the 1-aminocyclopropane-1-carboxylic acid (ACC). Through this, it could be established if loquat fruit has a climacteric or non-climacteric ripening pattern, important in determining the changes the fruit is likely to undergo during postharvest.

Materials and methods

The ripening physiology of five loquat cultivars (Algerie, Cardona, Golden, Magdall and Peluche) was studied. A sample of 15 fruits from each cultivar was taken weekly, from the experimental farm

"Cooperativa Ruchey" in Callosa d'Ensarriá (Alicante). In every fruit the physical, chemical and physiological parameters related to growth and ripening, were determined. Ethylene and respiration rate were analyzed by GC (Martínez-Madrid *et al*., 1999). Free and total ACC were extracted with trichloroacetic acid and quantified as described previously (Martínez-Madrid *et al*., 1999).

Results and discussion

Ethylene production was very low during the first weeks of fruit development and increased sharply at ripening in the five loquat cultivars (Fig. 1a). The increase in ethylene production started at the same time that changes occurred in colour, firmness, organic acid and sugars. Maximum ethylene production rate was reached three weeks later, at the same time that loquat fruit reached its final weight. Moreover, the peak of ethylene production in Magdall cultivar (3.39±0.55 nL/g/h) was significantly higher than those of the other loquat cultivars (e.i. 1-2 nL/g/h). In addition, an increase in respiration rate (Fig. 1b) associated with both, the ethylene peak and the changes above mentioned, was found in all loquat cultivars. Therefore, according to the ethylene and respiration data, it can be concluded that loquat fruits from the five cultivars studied show a climacteric type of ripening. Thus, ethylene could be the responsible hormone for the beginning of physico-chemical changes that leads to loquat ripening, as happens in all other climacteric fruits (Abeles *et al*., 1992; Lelièvre *et al*., 1997). However, the maximum ethylene production reached in the different loquat cultivars was significantly lower than for other climacteric fruits, in which an ethylene production as higher as of 100 nL/g/h is reached (kiwi, chirimoya). Accordingly, loquat fruit could be classified as a medium or even low climacteric fruit.

The ethylene precursor, ACC, increased (in both, free and total forms) as did the ethylene production rate until the end of the ripening process in Cardona and Magdall cultivars, while a slight decrease was observed on the last day of sampling in Algerie, Golden and Peluche cultivars (Figs 2a,b).

Conclusions

Thus, it can be concluded that the increase in ethylene production was mediated by a stimulation of ACC-synthase activity, although an increase in ACC-oxidase activity might also have accounted for the rise in ethylene production, as happens with other climacteric fruits (Yang and Oetiker, 1998). However, the diminution in ethylene production in the postclimacteric phase might be due to ACC-oxidase activity since high levels of ACC were present in the mesocarp of all the cultivars when their ethylene production decreased. Accordingly, ACC oxidase activity has been found to decrease in the postclimacteric stage in other climacteric fruits such as Kiwi (Serrano *et al*., 1990), apricot (Amorós *et al*., 1989) and melon (Martínez-Madrid *et al*., 1999). Finally, it is interesting to point out that the ripening process in loquat fruit begin during the phase of fast fruit growth, when they have 60-70% of their final size. So, when loquat fruit are harvested for commercial use they are in post-climacteric stage.

Acknowledgements

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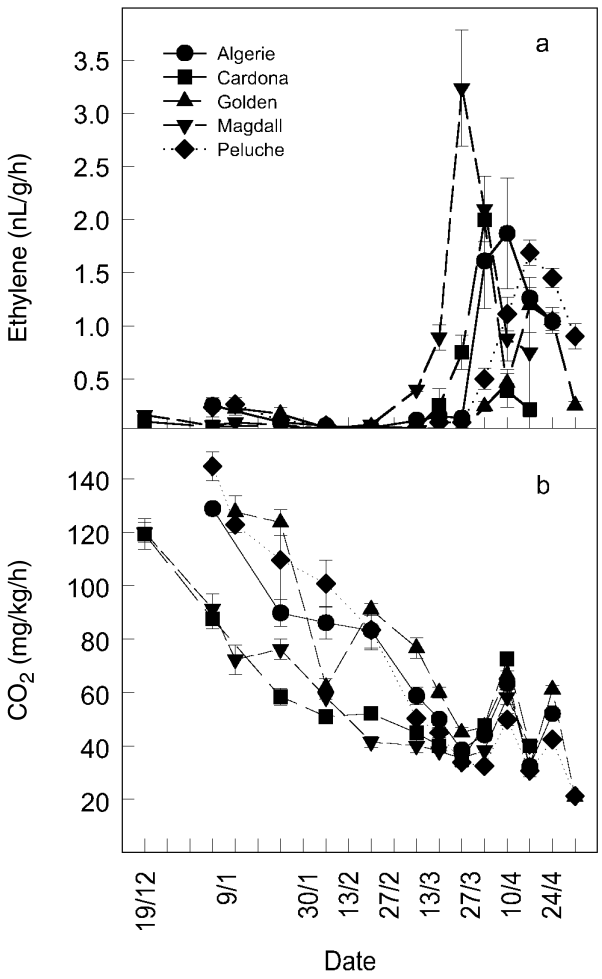

Fig. 1. Ethylene production rate (a) and respiration rate (b) during growth and ripening in the tree of the five loquat cultivars. Data are de mean ± SE of determination made in 15 fruits.

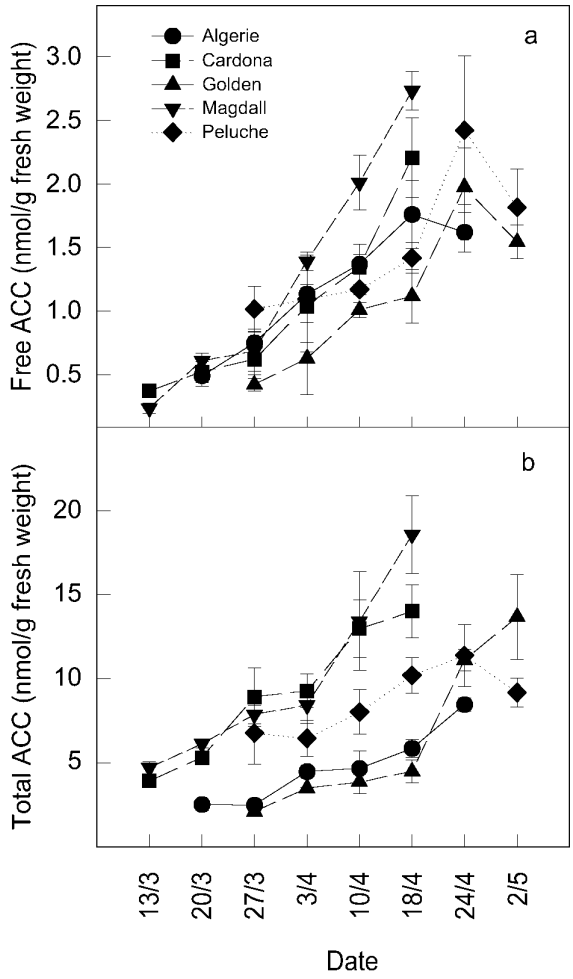

Fig. 2. Free (a) and total (b) ACC levels evolution during growth and ripening in the tree of the five loquat cultivars. Data are de mean ± SE of determination made in 15 fruits.