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Effects of postharvest treatment with N^6-benzyladenine on green olive fruit

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SUMMARY
The effect of N^6-benzyladenine (BA) on ripening processes of green 'Konservolia' olives harvested in October was investigated. Fruits were treated with BA concentrations up to 100 mg l^{-1} and held at 12°C and 25°C. The higher temperature accelerated skin colour development and firmness loss and also increased ethylene production and respiration rates. At both temperatures, BA stimulated colour development, ethylene production and respiration rates but did not affect fruit firmness. The results indicate that CKs may only have a regulatory role on some ripening processes, such as on colour development. The BA stimulatory effects on the two physiological responses may indicate general acceleration of metabolism by CKs during ripening rather than the effects being causally connected to colour development.

Cytokinins (CKs) regulate cell division in fruit (Letham, 1978). However, their role in fruit ripening is not clear. CK activity increased considerably during the maturation of olives (Shulman and Lavee, 1976). This is perhaps the only case observed so far where an endogenous increase in CKs could probably be related to ripening. Harvested olives behave as non-climacteric fruits (Maxie *et al.*, 1960; Rugini *et al.*, 1982). They show no softening or anthocyanin synthesis in response to applied ethylene (Shulman *et al.*, 1974). When CKs were applied at concentrations up to 50 mg l^{-1} on harvested green olives they induced anthocyanin formation but not ethylene production, respiration or softening (Shulman and Lavee, 1971; Shulman and Lavee, 1973). The deep red colour in olives is attributed to anthocyanins (Olias and Garcia, 1997). Promotive effects of CK on red colour development led to the suggestion that CKs act as growth regulators of olive maturation (Shulman and Levee, 1973). Promotion by CKs of red coloration has been shown in other fruits and plant tissues, such as in apples (Smock, 1963) and *Zea mays* seedlings (Rengel and Kordan, 1987). However, their effects on respiration and ethylene production in fruits are conflicting. Post-harvest application of N^6-benzyladenine (BA) resulted in accelerated respiration rate in post-climacteric apples but depressed respiration rate in pre-climacteric fruit (Smock *et al.*, 1962). Kinetin solutions increased both ethylene evolution and respiration rates in pre-climacteric banana fruit slices (Wade and Brady, 1971), but had no effects on avocado fruit (Tingwa and Young, 1975). CKs applied to pre-climacteric and climacteric apple, avocado and tomato fruits resulted in inhibition of ethylene production (Lieberman *et al.*, 1977).

Hormonal response is based on the assumption that there is a relationship between the magnitude of the induced response and the hormone concentration (Firn, 1986). Also, it could be most clearly revealed if experiments are planned to study changes in the rate of continuous processes in tissue treated with a range of hormone concentrations (Knee and Tsantili, 1988). To investigate the role of CKs on olive ripening, we tested applied BA effects, at concentrations up to 100 mg l^{-1}, on ripening processes in green olives held at 12°C and 25°C. These temperatures were selected to investigate whether there is any change in the effects of BA at different temperatures, as found for ethylene effect on olive respiration (Maxie *et al.*, 1960).

MATERIALS AND METHODS

Source of fruits

Olives (*Olea europaea* L. 'Konservolia') were harvested at the green stage from self-rooted trees on a property in Fthiotida, Greece. Harvest dates were 19 October, 1994 and 10 October, 1995. Fruit were used for experiments 5 h after harvest.

BA treatment

Fruit were sorted according to a completely randomized design for treatments. They were immersed in BA solutions (Serva, GmbH & Co., Heidelberg, Germany) at 15°C for 1 h. The BA concentrations used were 0, 25, 50, 75 and 100 mg l^{-1}. BA was dissolved in NaOH. All solutions, including water control, were finally adjusted to pH 7.5 according to Shulman and Lavee (1971) while no wetting agent was added to them. After immersion, treated fruit in groups of eight were held at the relevant temperature. In 1994, all treated fruit were initially held at 12°C. After 13 d, half of the fruit was transferred to 25°C for 7 d, while the other half remained at 12°C for the same time period. In 1995, treated fruit were held at 12°C or 25°C continuously for 10 d. For each concentration, two samples of eight fruit each were used at each

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