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Effect of Low and high Temperature on Tomato Fruit Pigments When Harvested at Mature-green Stage.

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Abstract: Fruits of four tomato (*Lycopersicon esculentum* Mill) cvs; Aziza (hybrid), Olympe (hybrid), Dombito (hybrid) and Tropic (hybrid), produced in hydroponic culture were harvested at mature-green stage and stored at three temperature regimes, i.e. 10, 25, and 35°C. The low temperature significantly delayed chlorophyll degradation. The low and high temperature significantly reduced carotenoids biosynthesis. The temperature of 25°C is preferable for tomato colour.

Additional key words: Tomato, hydroponic, chlorophyll, carotenoids, temperature.

INDTRODUCTION

After Harvest, tomato fruits are often exposed to high temperatures during the marketing channel from the farm until reaching ultimate consumer. Since tomato fruits can be harvested at mature-green stage and then ripen off the vine, low and high temperature adversely affect the colour of the tomato fruits through inhibiting the chlorophyll degradation and pigment formation. Many investigators such as Dugger (1913), Goodwin and Jamikron (1952), Tomes (1963), Mughrabi (1983) and Yakir et al. (1984) reported poor colour and reduction in carotenoids in tomato fruits when ripened at temperature of 30°C and above.

Little information is available on chlorophyll degradation as affected by temperature during the ripening process. The effect of high temperature on carotenoids of tomato fruits was investigated well since carotenoids contribute to the final colour of the tomato fruits. Colouring of tomatoes was slow at 16-18°C, most rapid at 24-25°C and slower at 30°C (Rosa, 1926). The optimum temperature for lycopene formation in tomato fruits was found to be 24°C (Vogele, 1937). Sato et al. (1979) stated that the maximum accumulation of lycopene and beta-carotene was observed at 23°C.

This study was conducted to investigate the effect of low and high temperature on tomato fruit pigments, namely, chlorophyll breakdown and beta-carotene and lycopene formation during repening.

MATERIALS AND METHODS

Tomato seeds of four cultivers, Aziza (hybrid), Olympe (hybrid), Dombito (hybrid) and Tropic (hybrid) were planted in hydroponic culture inside a greenhouse at Dirab Experimental Research Station, College of Agriculture, King Saud University. The fruits were picked at the mature-green stage from the fourth cluster of the plants. Furits were brought to laboratory for storing and analysis and equally divided among three different temperatures, 10, 25 and 35 $\pm$ 1°C in refrigerator, laboratory room and growth chamber, respectively. Light and moisture content were mainatined identical in the three media. After 11 days of storage, tomato fruits were collected for pigments analysis. Chlorophylls were extracted from 10 g of tomato fruits and determined at 645 and 663 nm according to methods of Bruinsma (1963). Lycopene and beta-carotene were extracted from 10 g fruit tissues, lycopene was measured at 505 nm (Dostal and Leopold, 1967). The extinction coefficient for lycopene was 315 L/g.cm (Stecher et al., 1968). Beta-Carotene was determined at 436 nm (Al-Shaibani and Greig, 1979). The extinction coefficient for beta-carotene was 196 L/g.cm (Beadle and Zscheile, 1942).

Data were analyzed using split plot design with three replications and the least significant difference was used to compare among means according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

Temperature:

The analysis of variance are summarized in Table 1 and Figures 1,2 and 3. Chlorophylls A and B and A + B content of tomato fruits stored for ripening at 10, 25 and 35°C showed significant differences (Table 1). At the storage temperature of 10°C chlorophyll degreadatioin was very slow with significantly high amount of chlorophylls A and A+B compared to the other temperatures, 25°C and 35°C (Firgure 1). The temperature of 10°C tends to hold tomato fruits green which in turn extend the shelf life of the fruits. This concept was in close agreement with that of Ogura et al. (1975). Chlorophylls A and A+B were similarly degraded in storage temperatures of 25 and 35°C (Figure 1). For commercial stand point, it could be suggested that not to store tomato fruits at 10°C for quick ripening.

Lycopene and beta-carotene content of tomato fruits were significantly reduced when stored at either 10°C or 35°C (Figure 2). Lycopene was severely affected at 35°C, being insignifincantly lower than that of 10°C, being lower of 43% at tmeperature of 35°C. On the other hand, beta-carotene which significantly synthesized at storage temperature of 25°C (Figure 2) insignificantly increased at the temperaure of 35°C compared to 10°C, being higher of 6% at the temperature of 35°C. The finding is in solid agreements of many investigators (Goodwin and Jamikron, 1952; Mughrabi, 1983; and Yakir et al., 1984). For quick ripening of tomato fruits, it could be suggested that not to store tomatoes at 35°C.

Cultivars:

Tomato fruits of the four cultivars, Aziza, Dombito, Olympe and Tropic showed no significant differences among them in chlorophyll contents (Table 1 and Figure 3 upper). Cultivar of Tropic, on the other hand contains insignificantly higher content of both chlorophyll A and

Table 1 Effect of Temperature and cultivars on tomato fruit pigments.

Source of variation	df	(1) Ch A	Ch B	ChA+B	B-Caro	Lyco
Temperature (Temp)	2	(2) * *	NS	* *	* *	* *
Cultivars (CV)	3	NS	NS	NS	* *	* *
Temp x CV	6	NS	NS	NS	* *	* *

(1) Ch A = Chlorophyll A, Ch B = Chlorophyll B, Ch A+B = Chlorophyll A+B, B-Caro = Beta Carotene, Lyco = Lycopene.

(2) * * = Significant at 0.01 level, NS = Not significant.

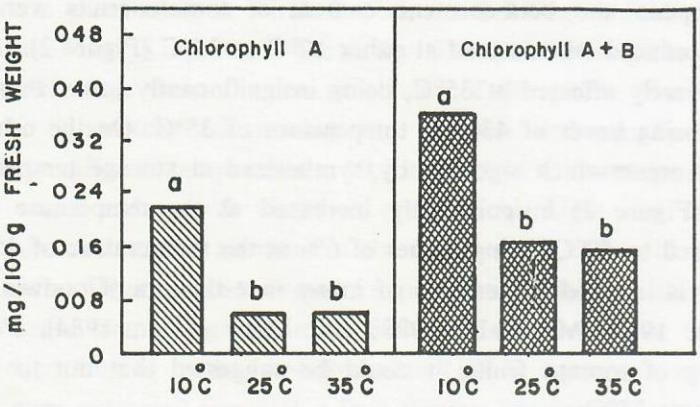

Fig. 1 Effect of Temperature on chrolophylls, A, A+B degradation in detached tomato fruits ripened at 10,25 or 35°C. Bars not labeled by the same letter differ significantly according to L.S.D. (0.05)

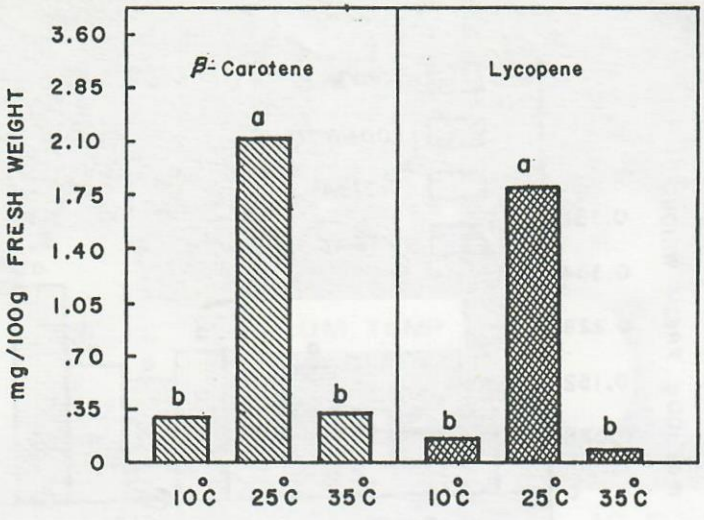

Fig. 2 Effect of temerarture on B - caroteme and lycopene synthesis in detached tomato fruit ripened at 10,25 or 35°C. Bars not labeled by the same letter differ significantly according to L.S.D. (0.05).

A+B than the other three cultivars. Such case is general in tomato fruit constituents which sometimes called cultivar variation. Aziza, Olympe and Dombito showed significant similarity in their contents of chlorophylls (Figure 3 upper). The cultivar of Tropic contains significantly low content of both lycopene and beta-carotene. Such findings were in favor of the concept that chlorphyll component from the degradation utilized back for carotenoid biosynthesis (Khudairi, 1972 and Ramirez and Tomes, 1964).

CONCLUSION

It could be concluded that for commerical quick ripening of tomato fruits, the temperature of 25°C is preferable for chlorophyll breakdown and carotenoid biosynthesis to produce good colour tomatoes.

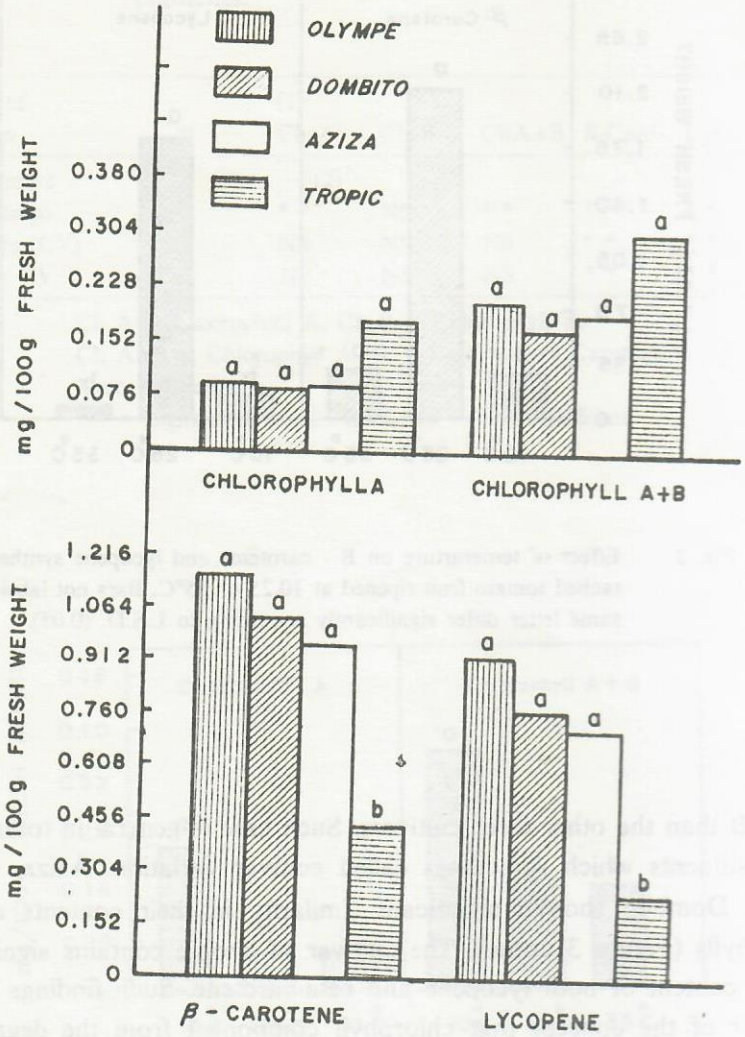

Fig. 3 Chrolophylls, B-carotene and lycopene contents of four tomato fruits cvs Olympe, Dombito, Aziza and Tropic. Bars not labeled by the same letter differ significantly according to L.S.D. (0.05).

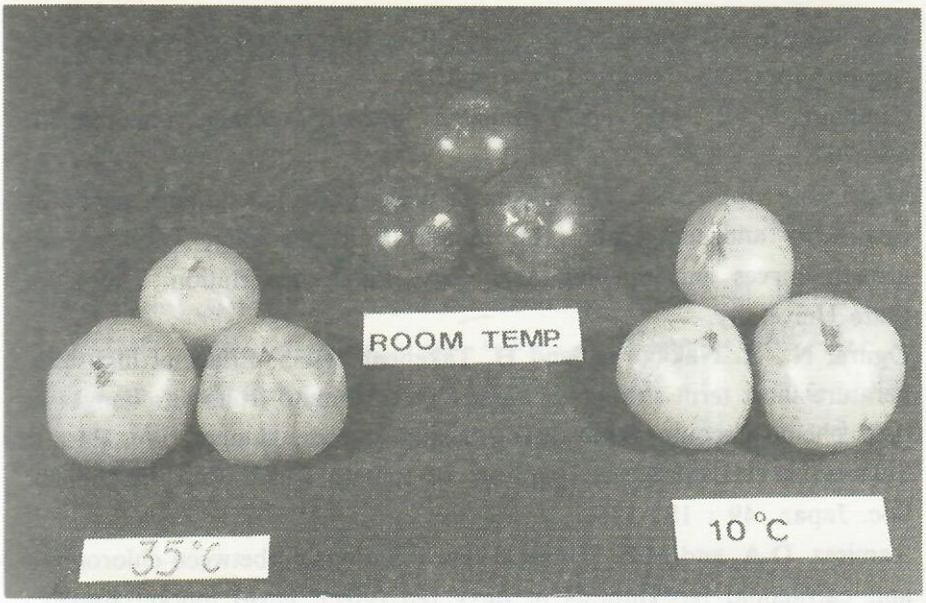

Fig. 4 Tomato fruits stored at 10, 25 and 35°C for ripening.

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