



## Differential accumulation of flavonoids by tomato (*Solanum lycopersicum*) fruits tissues during maturation and ripening

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### ABSTRACT

*Objective:* Little is known about physiological functions of flavonoids, specifically in the course of maturation and ripening of fruits. Spatiotemporal changes in the levels of flavonoids were investigated in the present study with focus on possible functional differentiation of individual compounds as related to the maturation or ripening of tomato fruits.

*Methodology and results:* The contents of flavonoids in different tissues of tomato fruits at increasing maturation and ripening stages were determined using high performance liquid chromatography – mass spectrometry. The levels of eriodictyol, kaempferol-glc-rhamnose, naringenin, naringenin-chalcone-hexose and quercetin-glc-rhamnose remained almost constant in the mesocarp and endocarp. The contents of eriodictyol, dicaffeoylquinic acid, naringenin and naringenin-chalcone-hexose significantly ( $P < 0.05$ ) increased in the epicarp from ripening stage 1 onwards. The concentration of dicaffeoylquinic acid increased significantly ( $P < 0.05$ ) in both the mesocarp and endocarp of tomato fruits from ripening stage 1 onwards. Gradual increases in the levels of caffeic-acid-hexose and caffeoylquinic acid in the epicarp and endocarp of tomatoes were observed. The level of kaempferol-glc-rhamnose decreased gradually in the epicarp. The content of quercetin-glc-rhamnose was always higher in the epicarp than in the mesocarp and endocarp. The results obtained indicated increases in the endogenous levels of some flavonoids in the epicarp (especially naringenin) with the onset of the ripening. There was also a gradual decrease and increase in the levels of respectively kaempferol-glc-rhamnose in the epicarp and caffeic-acid-hexose in the endocarp. Thus, an increase in the level of naringenin in the epicarp could be considered as physiological index for the ripening whereas high levels of kaempferol-glc-rhamnose in the epicarp and caffeic-acid-hexose in the endocarp could serve as characteristic traits for respectively immature and red-ripe state of tomato fruits. On the whole, the results point to specific roles of individual flavonoids as some might be involved in the regulation of either the maturation or ripening of tomato fruits whereas others might functionally be needed throughout both processes, and that there would be a specialization of tissues in the synthesis of specific types of flavonoids.

*Conclusions and application findings:* The degree of accumulation of flavonoids in tomato varied according to the nature of the tissue, and the maturation and ripening stages. It is hypothesized that an increase in the contents of naringenin and caffeic-acid-hexose may be part of natural mechanisms by which ripe tomato fruits prevent the over ripening when they are still attached to the mother plant. Consequently, the enhancement of the levels of these compounds by genetic engineering, conventional breeding or cultural practices could be a novel strategy for extending the shelf-life of tomato fruits.

**Key words:** Naringenin, caffeic-acid-hexose, kaempferol-glc-rhamnose, fruit maturation, ripening, *Solanum lycopersicum* L. cv Balkonstar