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Integrative approach using multiblock analysis to explain a complex trait of tomato fruit quality: texture

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Tomato fruit texture is one of the most critical quality traits for both the consumer (purchase) and the production chain (transport, handling, storage). It is also involved in sensory perception. Texture is a complex trait for which several QTL and genes were found. However, interactions between the molecular, histological, physical and biochemical components of fruit texture have been rarely investigated. In this work an integrative approach based on multiblock analysis was applied to point out links among the different levels: from protein to fruit, then to identify main physiological mechanisms involved in fruit texture.

Three contrasted parental lines (Cervil, Levovil, VilB) and three derived QTL-NILs harbouring texture QTL on chromosome 4 and 9 were analyzed. Measurements were performed at cell expansion stage, at harvest and after 7-days storage at 20℃. To increase texture variabi lity, water deficit was induced by decreasing water supply by 40% from flowering of the third truss.

To understand the influence of the fruit properties observed at the different levels (molecular, cellular, and tissue) and their interactions on fruit texture, a multiple co-inertia analysis (MCOA) was applied. For that purpose, three data tables were processed: one table included the quantities of 400 proteins (identified by 2D-MS), another one contained biochemical data (vitamin C, soluble sugars, alcohol insoluble solid and dry matter contents), and the last one included mechanical measurements of fruit texture, such as strength and stiffness obtained by compression and puncture tests.

At all levels, multiblock analysis outlined a strong genotype discrimination, indicating that the genetic factor was the main factor of variability, in contrast with water deficit. Results confirmed previous separated studies. For instance Cervil, a cherry tomato, significantly differed from all other genotypes at each level. The links observed between proteins and other fruit variables allowed us to put forward some hypotheses on the physiological mechanisms involved in fruit texture at the three developmental stages.

Thus, multiblock analysis provides an interesting tool to characterize complex trait such as fleshy fruit texture by integrating several levels of studies and by pointing at the influence of each table on global effects. This integrative approach paves the way for a better understanding of the mechanism involved in fruit texture.

Keywords: multiple co-inertia analysis, texture, fleshy fruit, tomato, QTL, water deficit.