Changes of Tomato Fruit Composition in Response to Salinity

by

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Dedicated to my parents

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SUMMARY

This investigation was mainly designed to study the effects of salinity on tomato fruit. Fruit fresh weight, dry weight, water content, sugars, proline and ions were measured from plants subjected to salinity. Fruit fresh weight was reduced by salinity; the reduction was a function of external salt concentration and time of salt application. Higher salinity and treatment at an early development stage resulted in a greater weight reduction than lower salinity and treatment at a later stage of development. Fruit dry weight was nearly unaffected at low salinity, and the reduction at high salinity was not as great as that of fresh weight on a percentage basis. Fruit water content was greatly reduced by increasing salinity, and as a result, the dry weight percentage of the fruit increased (up to 2-fold).

Reducing sugars (glucose and fructose) were the major constituents of cultivated tomato fruit. Fructose content was always slightly higher than glucose in the unstressed fruit. The reducing sugar content ($\mu mol.g^{-1}dwt$) increased gradually with development of the fruit. Salinity significantly increased the concentrations of glucose and fructose based on fruit water content (mM). However, calculation on a fruit dry weight basis ($\mu mol.g^{-1}$ dwt) revealed that the levels were reduced by salinity. This apparent inconsistency arose from differences in water content induced by salinity, the increase in concentration under salinity resulting from the reduced fruit water content. Different patterns of sugars were found in the fruit of wild species; fruit of *Solanum. pennellii* contained twice as much glucose as fructose, while the fruit of *Lycopersicon. cheesmanii* had a much higher fructose than glucose content. The content of both sugars ($\mu mol.g^{-1}$ dwt), especially of glucose in *S. pennellii,* was also reduced by salinity.

myo-inositol was present in small amounts in the fruit. In the control fruit of the *L. esculentum* cultivar Duke, the level decreased with fruit development. *myo*-inositol accumulated in the fruit of cv Duke, *S. pennellii* and *L. cheesmanii* in response to salinity. Sucrose was present in trace amounts in *L. cheesmanii*, at a higher content in *S. pennellii*, and accumulated under salinity in the fruit of cv Duke.

The increase in the concentration of sugars with salinity was responsible for an improvement in taste quality. However, improvement was always accompanied by a reduction in fresh weight. In an attempt to find whether a quality improvement could be achieved with less or without yield loss, plant were subjected to salinity stress at different stages of growth. Salinity treatment at a late developmental stage of the fruit, *eg* the mature green stage or later, produced a higher sugar concentration and minimized the reduction in fresh weight.

Proline, which accumulated significantly in the leaves, also accumulated in tomato fruit under salinity. The accumulation in the fruit of cv Duke probably resulted from translocation from the leaves. Proline in the fruit of two wild species, *S. pennellii* and *L. cheesmanii*., accumulated to high levels; in the fruit of *L. cheesmanii* it was higher than in the leaves under salinity.

Two different mechanisms for ion selectivity was found in cv Duke and the two wild species. Leaves of Duke and *S. pennellii* absorbed higher Na^+ than Cl^- under high salinity, while leaves of *L. cheesmanii* absorbed higher Cl^-. In the fruit, two distinct patterns of ion absorption were also apparent, fruit of cv Duke and *L. cheesmanii* contained higher Cl^- than Na^+ under salinity, while the fruit of *S. pennellii* tended to prevent accumulation of high Cl^- levels.

Failure of seed formation was observed in tomato fruit grown at a high salinity. Pollen viability and germination were reduced by salinity, but failure of zygote development may be the main reason for failure of seed formation.

STATEMENT

I hereby declare that the thesis here presented contains no material which has been accepted for the award of any other degree or diploma in any University and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

I give consent to this copy of my thesis, when deposited in the University Library, being available for loan and photocopying.

Yuan Gao

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