

Changes of Tomato Fruit Composition in Response to Salinity

by

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Dedicated to my parents

LIST OF CONTENTS

	page
SUMMARY	VI
STATEMENT	VIII
ACKNOWLEDGEMENT	IX
LIST OF TABLES AND FIGURES	X
CHAPTER I GENERAL INTRODUCTION	1
CHAPTER II: REVIEW OF LITERATURE	2
2.1. Introduction.....	2
2.2. Salinity and growth.....	3
2.2.1. Adverse water relations.....	3
2.2.2. Specific ion effects.....	4
2.2.3. Impaired nutrition.....	5
2.2.4. Other factors.....	5
2.3. Solute accumulation.....	6
2.3.1. The accumulation of proline.....	6
2.3.2. The accumulation of sugars and polyols.....	8
2.4. Water relations and solute accumulation.....	9
2.5. Ion relations and solute accumulation.....	10
2.6. Abscisic acid and solute accumulation.....	11
2.7. Intracellular pH and solute accumulation.....	13
2.8. Physiological roles of solute accumulation.....	15
2.8.1. Osmoregulation.....	15
2.8.1.1. Compartmentation of organic solutes.....	16
2.8.1.2. Compartmentation of ions.....	18
2.8.1.3. The benefits of osmoregulation.....	19
2.8.2. Enzyme and membrane protection.....	21
2.9. Effect of salinity on tomato fruit composition.....	23

2.9.1. The major composition of tomato fruit.....	23
2.9.1.1. Sugars.....	23
2.9.1.2. Amino acids.....	25
2.9.1.3. Organic acids.....	26
2.9.2. Salinity and tomato fruit composition.....	27
2.10. Effects of salinity on pollen viability and germination.....	29
CHAPTER III. MATERIALS AND METHODS.....	30
3.1. Materials.....	30
3.2. Environmental control.....	30
3.3. Plant culture.....	30
3.4. Imposition of salt stress.....	31
3.5. Plant harvest and tissue preservation.....	31
3.6. Measurement of plant water status.....	32
3.6.1. Water potential.....	32
3.6.2. Osmotic potential.....	32
3.6.3. Turgor potential.....	32
3.7. Pollen viability and germination tests.....	32
3.7.1. Viability.....	32
3.7.2. Germination.....	33
3.8. Fruit quality test.....	33
3.9. Estimation of solutes.....	33
3.9.1. Extraction.....	33
3.9.2. Proline estimation.....	34
3.9.3. Sugars.....	35
3.10. Ion extraction and measurements.....	37
3.10.1. Extraction.....	37
3.10.2. Na ⁺ measurement.....	37

3.10.3. Cl ⁻ measurement.....	37
3.11 Statistical analysis.....	38
CHAPTER IV: RESULTS AND DISCUSSION.....	39
4.1 EXPERIMENT 1: Effect of salinity on tomato fruit composition....	39
4.1.1 Introduction.....	39
4.1.2 Material and methods.....	39
4.1.3 Results.....	40
4.1.4 Discussion.....	47
4.2 EXPERIMENT 2: Developmental changes in tomato fruit composition under salinity.....	56
4.2.1 Introduction.....	56
4.2.2 Material and methods.....	56
4.2.3 Results.....	56
4.2.4 Discussion.....	68
4.3 EXPERIMENT 3: Effect of short term salt shock on the composition of tomato fruit.....	73
4.3.1 Introduction.....	73
4.3.2 Material and methods.....	73
4.3.3 Results.....	73
4.3.4 Discussion.....	76
4.4 EXPERIMENT 4: Effects of salinity at different developmental stages on tomato fruit composition and yield.....	80

4.4.1	Introduction.....	80
4.4.2	Material and methods.....	80
4.4.3	Results.....	81
4.4.4	Discussion.....	87
4.5:	EXPERIMENT 5: Effects of salinity on the leaf and fruit	
	of two wild species of tomato : <i>Lycopersicon. cheesmanii</i>	
	and <i>Solanum. pennellii</i>.....	90
4.5.1	Introduction.....	90
4.5.2	Material and methods.....	90
4.5.3	Results.....	91
4.5.4	Discussion.....	98
4.6	EXPERIMENT 6: Effects of salinity on pollen viability,	
	germination and some components of	
	the tomato flower.....	102
4.6.1	Introduction.....	102
4.6.2	Material and methods.....	102
4.6.3	Results.....	103
4.6.4	Discussion.....	106
CHAPTER V:	GENERAL DISCUSSION.....	113
CHAPTER VI:	BIBLIOGRAPHY.....	118

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 ($\mu\text{mol.g}^{-1}\text{dwt}$) 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 ($\mu\text{mol.g}^{-1}\text{dwt}$) 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 ($\mu\text{mol.g}^{-1}\text{dwt}$), 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 increaseⁱⁿ 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, plants 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 were 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.

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Yuan Gao

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Figures and Tables

	Page
Tables	
Table 1. Taste quality of tomato fruits grown in saline environment.....	44
Table 2. The contents of solutes in tomato fruit as based on dry weight as $\mu\text{mol.g}^{-1}\text{dwt}$	53
Table 3. Effects of salinity (150 mM) on some metabolites of tomato fruit at early developmental stages.....	68
Table 4. Effect of short term salinity on tomato leaves.....	75
Table 5. Effect of salinity on plants with or without fruits ($\mu\text{mol.g}^{-1}\text{dwt}$).....	75
Table 6. Effect of salt shock on tomato fruit (mM).....	77
Table 7. Effect of salt shock on tomato fruit ($\mu\text{mol.g}^{-1}\text{dwt}$).....	77
Figures	
Fig. 1. Chromatograms of authentic sugars and tomato sample.....	36
Fig. 2. Leaf water status of salt-treated tomato leaves.....	41
Fig. 3. Sugar contents of salt-treated tomato leaves.....	41
Fig. 4. Leaf proline content of salt-treated tomato plants.....	43
Fig. 5. Leaf ion content of salt-treated tomato plants.....	43
Fig. 6. Fresh weight, dry weight and water content of salt-treated tomato fruits.....	45
Fig. 7. Duration of tomato fruit development under salinity.....	46
Fig. 8. Fructose and glucose concentration of salt-treated tomato fruits.....	48
Fig. 9. <i>myo</i> -inositol and sucrose concentrations of salt-treated tomato fruits.....	48
Fig. 10. Proline concentration of salt-treated tomato fruit.....	49
Fig. 11. Ion concentrations of salt-treated tomato fruit.....	49
Fig. 12. The correlation between tomato fruit solute concentration and leaf solute content under salinity.....	55
Fig. 13. Water status of tomato leaves under 150 mM salinity.....	58
Fig. 14. Contents of sugars of tomato leaves under 150 mM salinity.....	59

Fig. 15. Content of proline in tomato leaves under 150 mM salinity.....	61
Fig. 16. Content of ions in tomato leaves under 150 mM salinity.....	61
Fig. 17. Total fruit fresh weight, dry weight and water content of tomato fruits under salinity.....	62
Fig. 18. Response of concentrations of sugars (mM) in tomato fruit to salinity.....	63
Fig. 19. Effects of salinity on the contents of sugars of tomato fruit, expressed as $\mu\text{mol.g}^{-1}$. dwt.....	65
Fig. 20. Proline contents of tomato fruit under 150 mM salinity.....	66
Fig. 21. Effect of salinity on tomato fruit ion contents.....	67
Fig. 22. Effect of salinity at different stages of development on tomato fruit fresh weight, dry weight and water content.	82
Fig. 23. Effect of salinity at different stages of development on fructose and glucose concentrations (mM) of tomato fruit.....	83
Fig. 24. Effect of salinity at different stages of development on <i>myo</i> -inositol and sucrose concentrations (mM) of tomato fruit.....	83
Fig. 25. Effect of salinity at different stages of development on fructose and glucose contents ($\mu\text{mol.g}^{-1}$. dw) tomato fruit.....	84
Fig. 26. Effect of salinity at different stages of development on <i>myo</i> -inositol and sucrose contents ($\mu\text{mol.g}^{-1}$. dw) tomato fruit.....	84
Fig. 27. Effect of salinity at different stages of development on proline content of tomato fruit, as calculated as A), mM and B), $\mu\text{mol.g}^{-1}$.dwt.....	86
Fig. 28. Effect of salinity at different stages of development on ion concentration (mM) of tomato fruit.....	88
Fig. 29. Effect of salinity at different stages of development on ion content ($\mu\text{mol.g}^{-1}$.dwt) of tomato fruit.....	88
Fig. 30. Effect of salinity on leaf proline content of two wild tomato species.....	92
Fig. 31. Effect of salinity on fruit proline content of two wild tomato species.....	92
Fig. 32. Effect of salinity on leaf sugar content of two wild tomato species.....	93
Fig. 33. Effect of salinity on leaf ion content of two wild tomato species.....	94

Fig. 34. Effect of salinity on fruit sugar content of two wild tomato species.....	96
Fig. 35. Effect of salinity on fruit ion content of two wild tomato species.....	97
Fig. 36. Effect of salinity on the viability and germination of tomato pollen.....	104
Fig. 37. Effect of salinity on proline content of leaves and components of the flower in tomato.....	104
Fig. 38. Effect of salinity on the fructose content of leaves and components of the flower in tomato.....	105
Fig. 39. Effect of salinity on the glucose content of leaves and components of the flower in tomato.....	105
Fig. 40. Effect of salinity on the <i>myo</i> -inositol content of leaves and components of the flower in tomato.....	107
Fig. 41. Effect of salinity on the sucrose content of leaves and components of the flower in tomato.....	107
Fig. 42. Effect of salinity on Na ⁺ content of leaves and components of the flower in tomato.....	108
Fig. 43. Effect of salinity on Cl ⁻ content of leaves and components of the flower in tomato.....	108