



THE POLYGALACTURONASE ACTIVITY IN STORED 'CHERRY' TOMATO FRUITS AS EFFECT OF 1-MCP TREATMENT AND STAGE OF MATURITY

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Introduction

The role of polygalacturonase

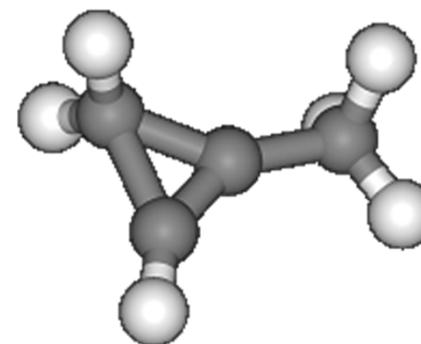
- Pectic substances are the major components of the cell wall and the middle lamella of plant tissues, which undergo structural changes during development and ripening of the fruit, thus contributing significantly to textural softening of these organs.
- Although the mechanisms by which fruits soften during ripening remain unclear, enzyme-catalyzed changes to wall structure and composition are believed to be the major causes.

Introduction

The role of polygalacturonase

- The loss of pectin integrity during tomato fruit ripening has been implicated as the predominant component of ripening associated softening.
- Pectin is degraded by a group of pectinases, which are a group of enzymes and includes polygalacturonases, pectinmethylesterases and pectin lyases. Pectinases are produced during the natural ripening process of some fruit.
- The **polygalacturonase** is a primary enzyme regulating **fruit softening**.

Introduction



The way to 1-MCP

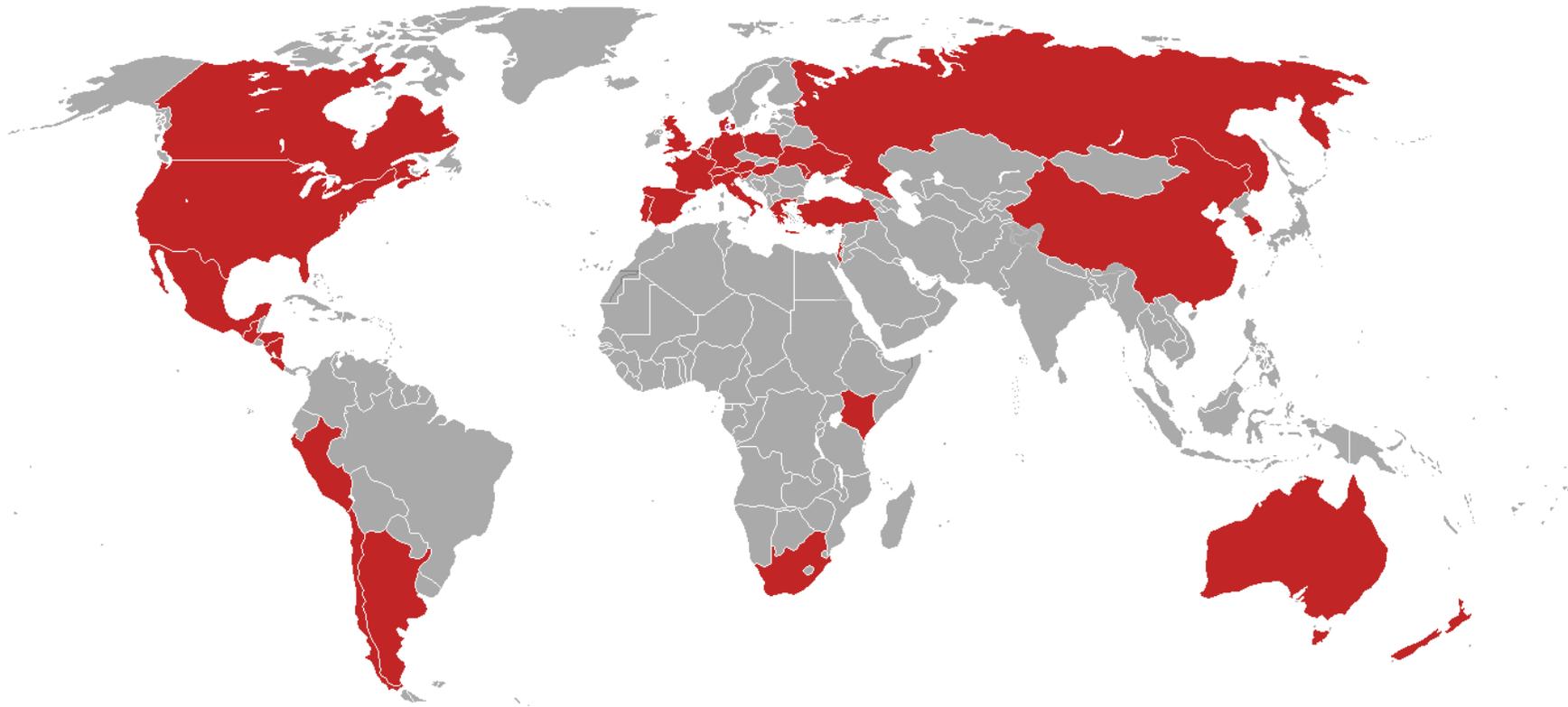
- 1996 – 1-methylcyclopropene was explored and patented as gas, which was especially anti ethylene active¹⁾
- Powdered formulation as effect of cyclodextrin-bound with 1-MCP²⁾

http://cals.ncsu.edu/hort_sci/people/faculty/pages/blankenship.php
<http://www.multibriefs.com/briefs/saf/SAF112812.php>

- 1) Sisler and Blankenship, 1996; Gajewski, 2002; EFSA Scientific Report, 2005; Reid and Staby, 2008; Kostansek, 2010; Yuan *et al.*, 2010
- 2) EFSA Scientific Report, 2005; Reid and Staby, 2008; Kostansek, 2010

United States Patent [19]		[11] Patent Number:	5,518,988
Sisler et al.		[45] Date of Patent:	May 21, 1996
[54] METHOD OF COUNTERACTING AN ETHYLENE RESPONSE IN PLANTS	5,100,462	3/1992	Sisler et al. 71/121
[75] Inventors: Edward C. Sisler, Raleigh; Sylvia M. Blankenship, Apex, both of N.C.	OTHER PUBLICATIONS		
[73] Assignee: North Carolina State University, Raleigh, N.C.	M. C. Pirung; <i>Proposal to the Fred C. Gioeckner Foundation</i> (1991).		
[21] Appl. No.: 253,951	Pirung et al. "Ethylene Biosynthesis, Aminocyclopropene carboxylic acid", <i>J. Chem. Soc., Chem. Commun.</i> , (13), 857-859, 1989.		
[22] Filed: Jun. 3, 1994	Wheeler et al., "Synthesis of 1-aminocyclopropene carboxylic acid", <i>J. Org. Chem.</i> , 52(22) 4875-4877, 1987.		
[51] Int. Cl. ⁶	Primary Examiner—Allen J. Robinson		
A01N 3/02; A01N 27/00; A01N 29/04; A01N 33/04	Assistant Examiner—Brian G. Bembenick		
[52] U.S. Cl. 504/114; 504/115; 504/320; 504/326; 504/353; 504/356; 504/357	Attorney, Agent, or Firm—Bell, Seltzer, Park & Gibson		
[58] Field of Search	[57] ABSTRACT		
504/114, 115, 504/320, 326, 353, 356, 357	A method of inhibiting an ethylene response in a plant is disclosed herein. The method comprises applying to the plant an effective ethylene response-inhibiting amount of cyclopropene, 1.1.1. propellane, or derivatives thereof. Also disclosed are methods of inhibiting abscission in plants and methods of prolonging the life of cut flowers.		
[56] References Cited			
U.S. PATENT DOCUMENTS			
3,879,188	4/1975	Fritz et al.	424/200
		44 Claims, 4 Drawing Sheets	

Introduction



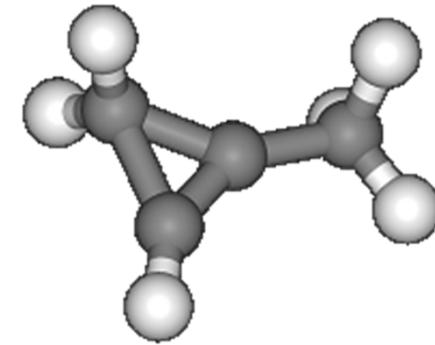
- 2000 – commercialisation of 1-MCP for postharvest treatment on fruits and vegetables to maintain their quality dealt AgroFresh, Inc. – SmartFresh™ or SmartFresh 03VP¹⁾

1) Kostansek, 2010; Yuan *et al.*, 2010

Introduction

How to use 1-MCP?

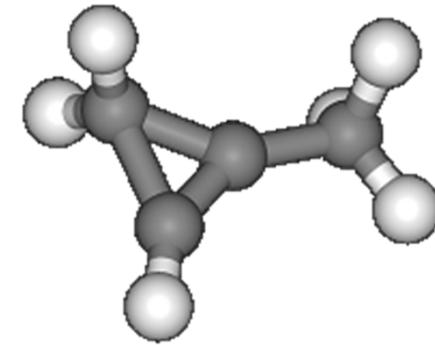
- Application – after dilution in small amount of water, directly after harvest of fruits/vegetables
- An amount depends on cubature of chamber
- Time depends on species of vegetable/fruit and storage temperature
- It can be used in cooling chamber as well as in chamber with modified atmosphere – controlled atmosphere (CA) or ultra low oxygen (ULO)¹⁾



1) Gajewski, 2002

http://krwil.sggw.pl/index.php?section=research&subsection=lab_view&p=storage

Introduction

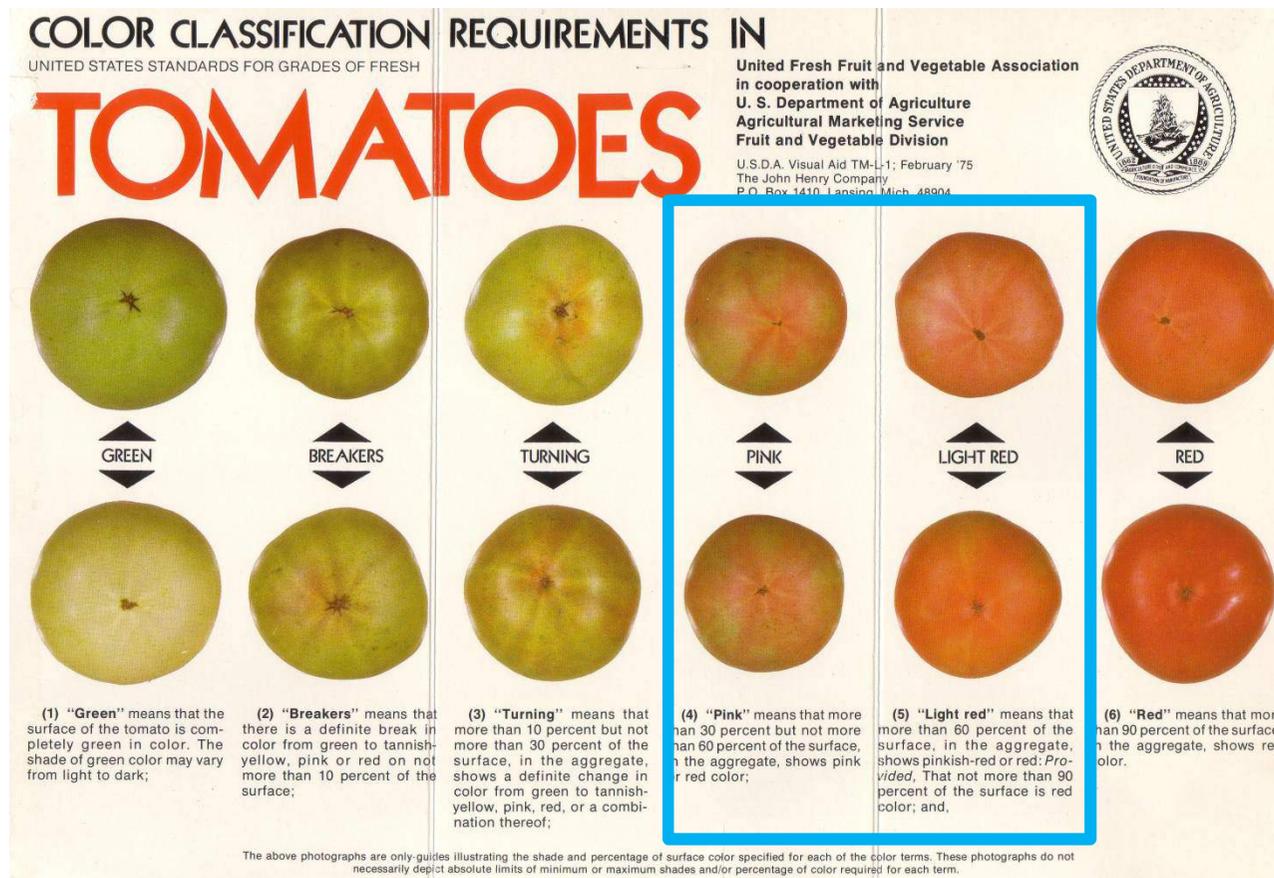


Efficiency of using 1-MCP

- stage of maturity of fruit/vegetable
- gas tightness of storage building/chamber during treatment by 1-MCP
- length of time between harvest and putting products to chamber

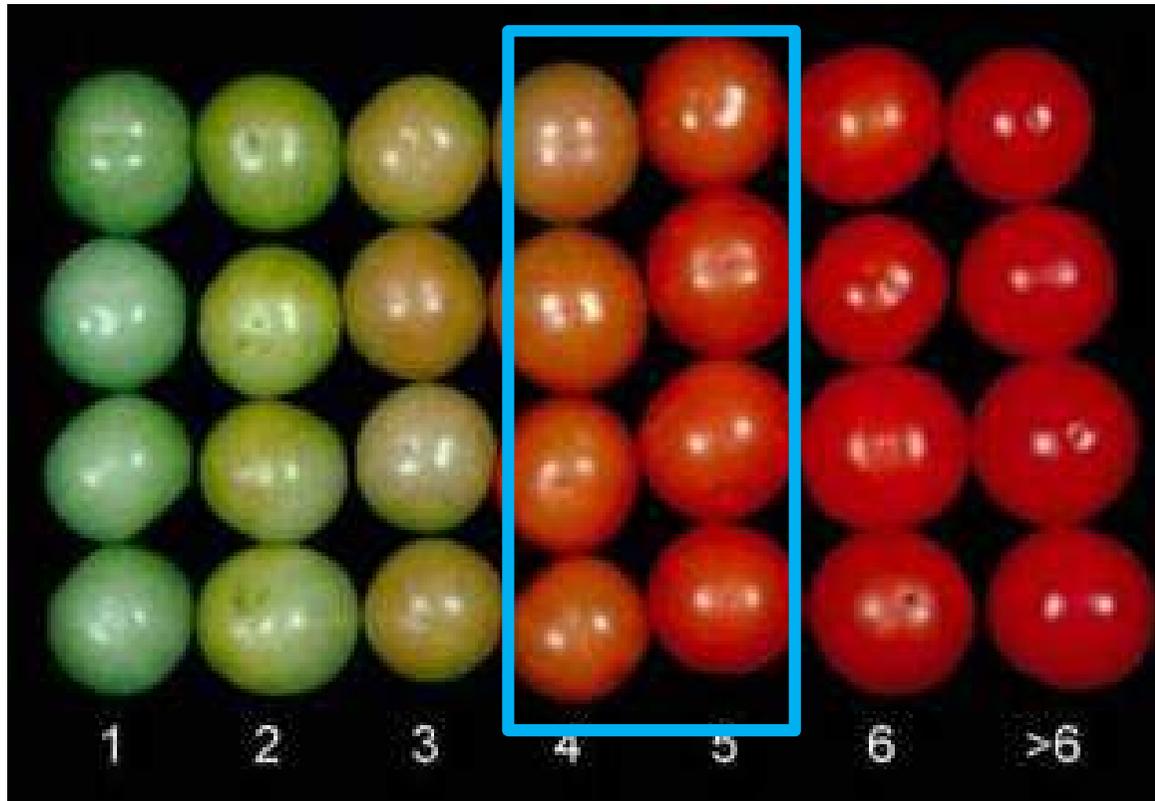
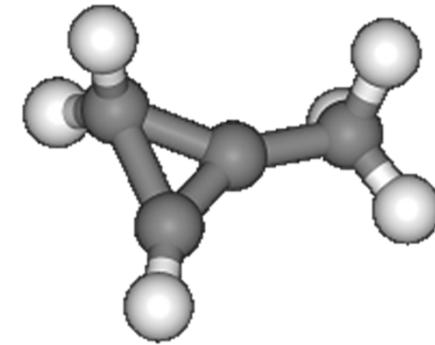
Introduction

Stages of maturity



Introduction

Stages of maturity



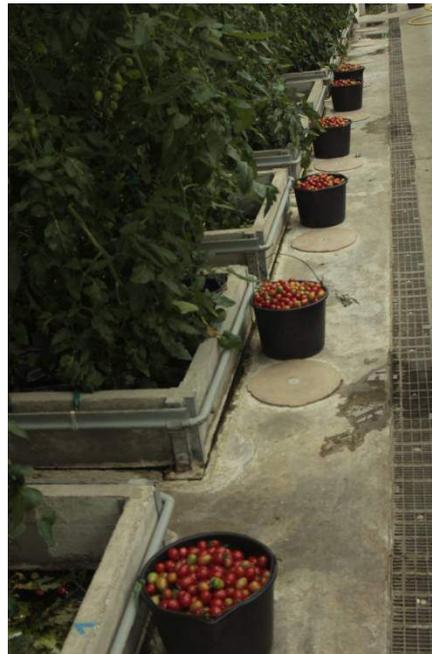
The aim of the study

- The aim of this study was to determine the impact of 1-MCP on polygalacturonase activity in stored 'cherry' tomato (*Solanum lycopersicum* L. var. *cerasiforme*) fruit

Materials and methods

Fruits

- *Solanum lycopersicum* L. var. *cerasiforme*
- 'Pareso' F₁
- greenhouse of WULS, coconut fibre
- harvest – September,
- two year research



Materials and methods

Fruits

- storage chambers of WULS
- 2, 3 and 4 weeks
- 12 °C



Materials and methods

Combination which were used

❑ A – the concentration of 1-MCP

- a1 – control (untreated fruits)
- a2 – $0.5 \mu\text{l} \cdot \text{l}^{-1}$
- a3 – $1.0 \mu\text{l} \cdot \text{l}^{-1}$

❑ B – the stage of maturity

- b1 – pink (3rd)



- b2 – light-red (5th)



❑ C – the length of storage

- c1 – 2 weeks
- c2 – 3 weeks
- c3 – 4 weeks

Materials and methods

Polygalacturonase activity analysis

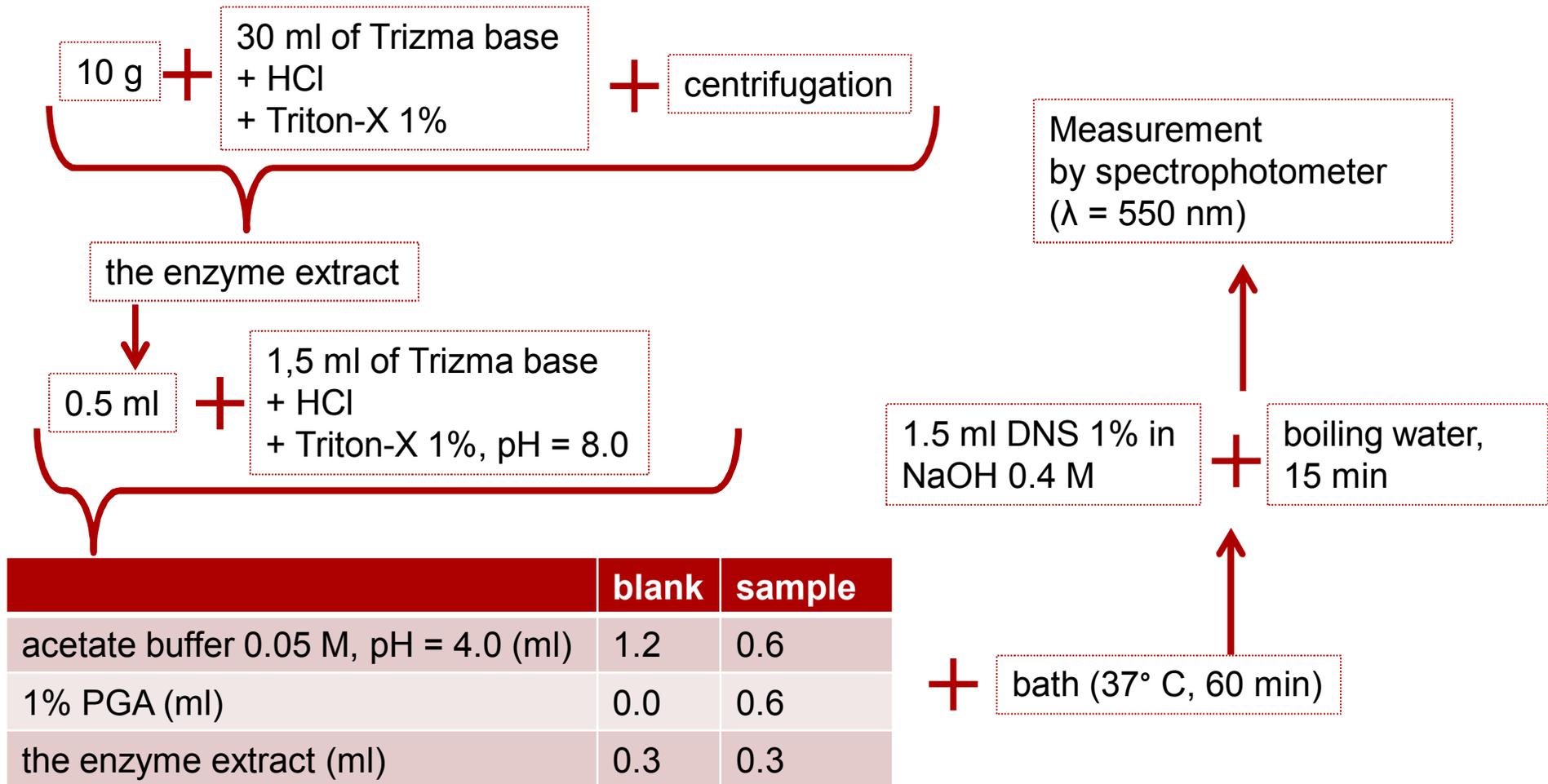
Equipment



J.L. Przybył

Materials and method

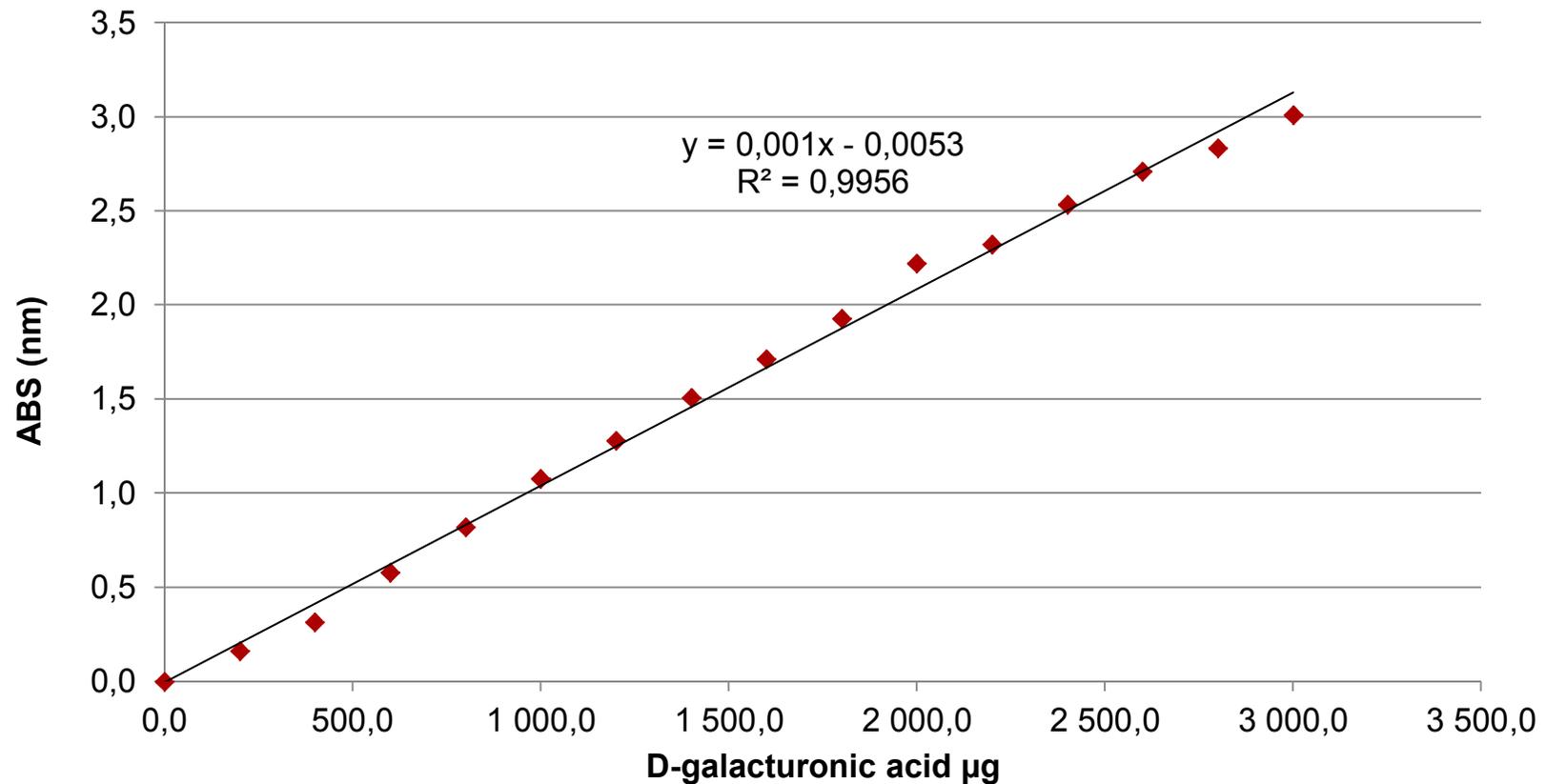
Polygalacturonase activity analysis



Materials and methods

Polygalacturonase activity analysis

Calibration curve



Materials and methods

Hardness determination

- Durometer Firmness Tester (Bareiss, Niemcy)
- Measurement with spherical tip with diameter 2 mm
- Hardness was determined in 3 places on random selected 5 fruits from every combination
- The results were given in HPE from 0 o 100

Materials and methods

Sensory analysis

No.	Descriptors	Definition	Anchoring points
v1	'tomato' odour	characteristic odour of tomato	none – very intensive
v2	off-odour	unusual odour for tomato odour	none – very intensive
v3	flesh colour	intensity red colour for half-cut fruit	pale red – dark red
v4	skin hardness	the resistance of the fruit skin during biting	thin, delicate – thick, hard
v5	flesh hardness	the resistance of the fruit flesh during biting	soft – hard
v6	flesh mealiness	the impression during chewing the fruit	none – very mealy
v7	flesh juiciness	the sensation during fruit tasting related to the flesh structure	not juicy – very juicy
v8	'tomato' flavour	characteristic flavour for the fresh ripe tomato fruits	none – very intensive
v9	sour flavour	the flavour resulting from the presence of organic acids	none – very intensive
v10	sweet taste	the basic taste characteristic for water solutions e. g. sucrose	none – very intensive
v11	bitter taste	the basic taste characteristic for water solutions e. g. quinine or caffeine	none – very intensive
v12	off-flavour	a flavour not typical for the fresh tomato fruits	none – very intensive
v13	overall sensory quality	the general sensory sensation during sample evaluation regarding the attributes of odour texture and flavour	bad quality – very good quality

Materials and methods

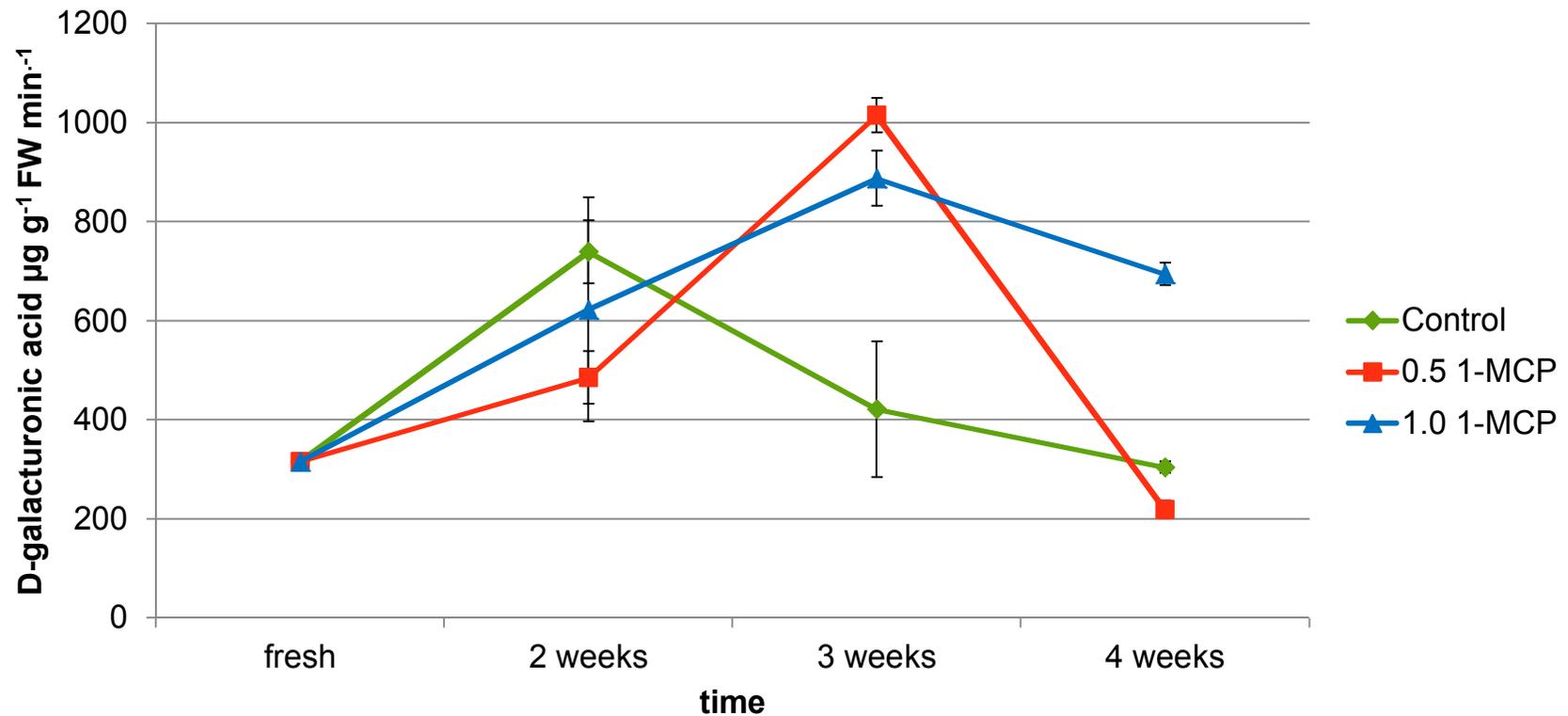
Statistical analysis

▣ StatgraphicsPlus 4.1™ software

- the analysis of variance three-way Anova
- the Tukey's HSD test, $\alpha = 0.05$

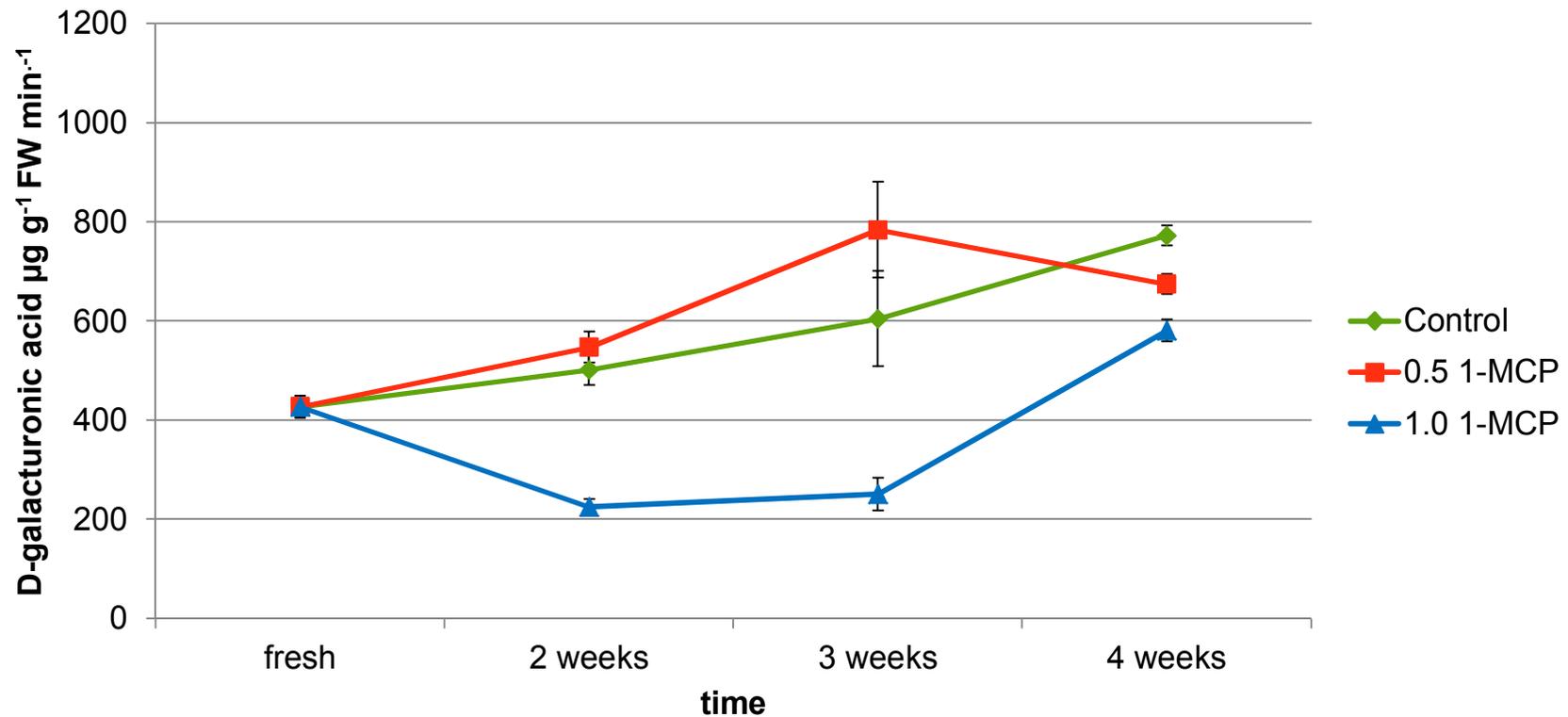
Results

Polygalacturonase activity – fruits in 3rd stage of maturity



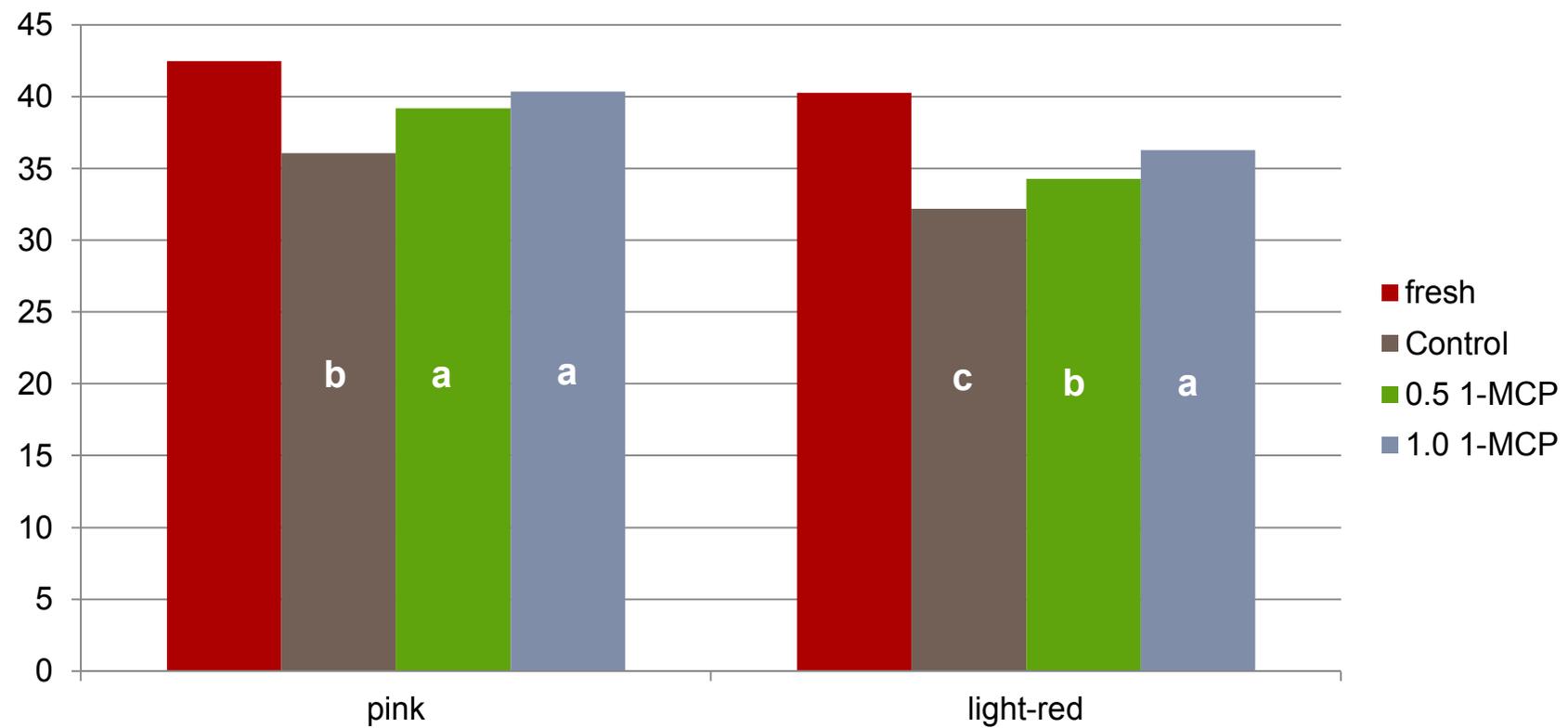
Results

Polygalacturonase activity – fruits in 5th stage of maturity



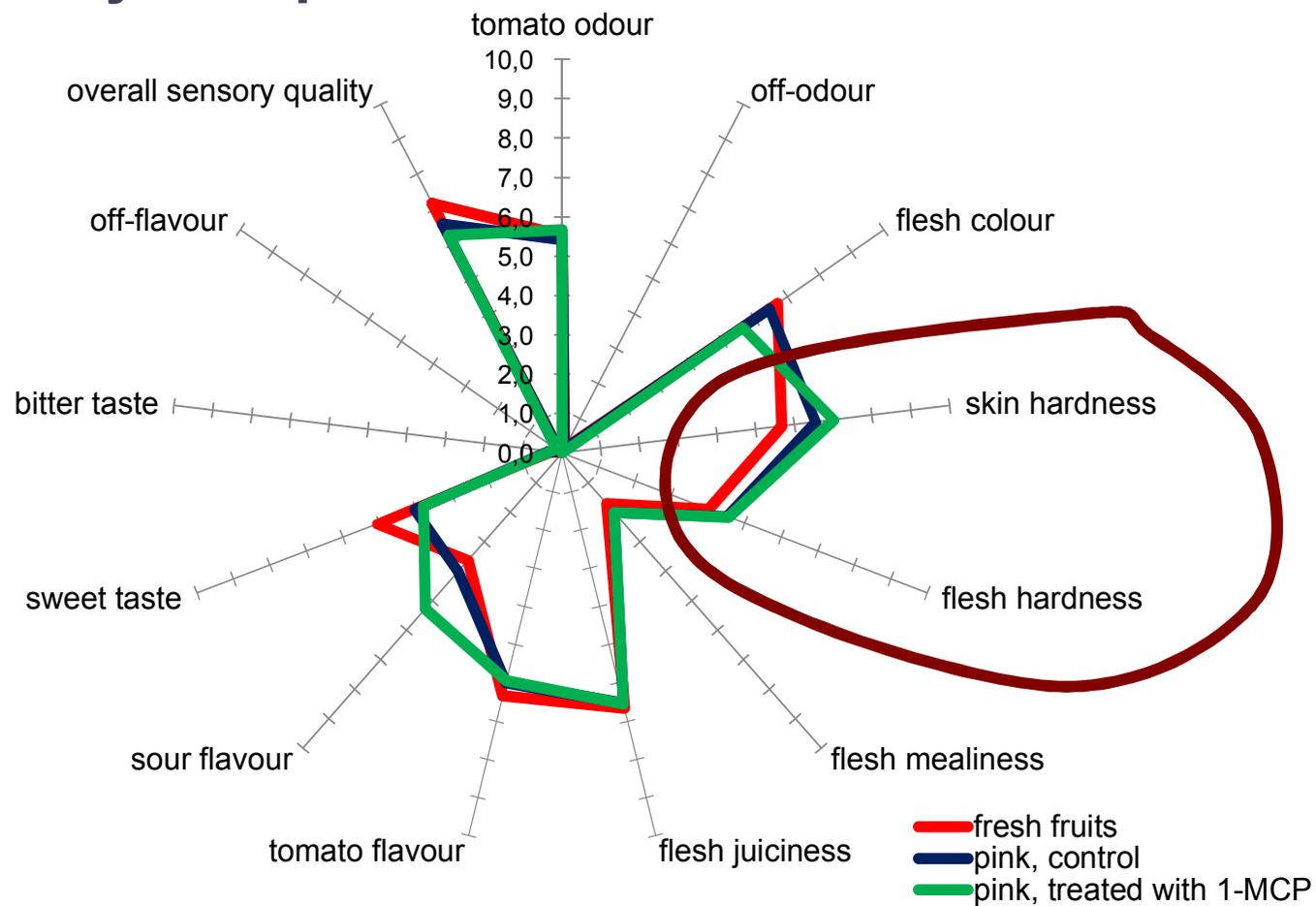
Results

Hardness – after 3 weeks of storage



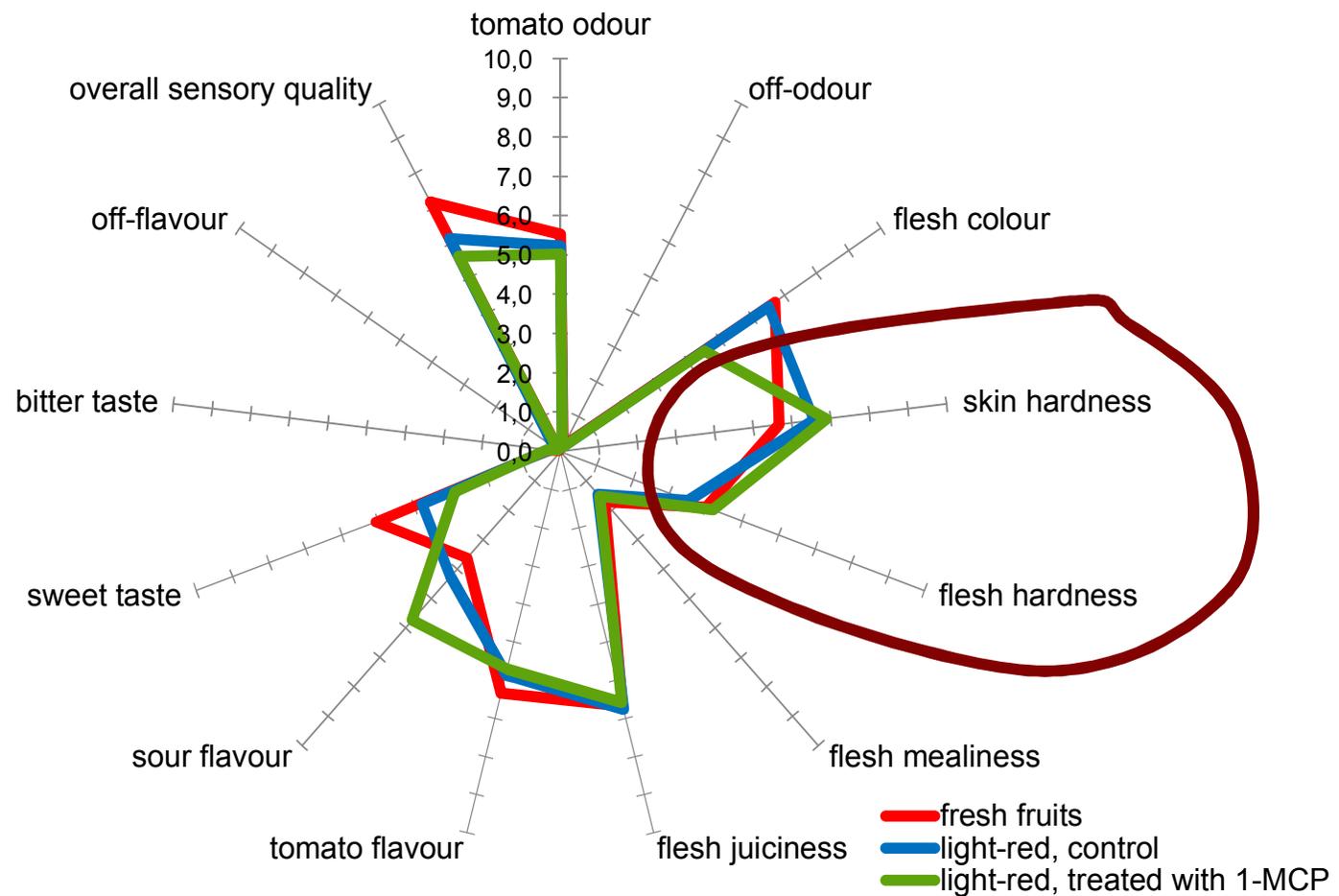
Results

Sensory analysis – profile assessment



Results

Sensory analysis – profile assessment



Conclusions

- 1-MCP treatment was effective in delaying ripening of the fruits: it reduced increasing of fruit's skin softening.
- Fruits harvested in 3rd stage of maturity had lower polygalacturonase activity than fruits harvested in 5th stage.
- Fruits untreated with 1-MCP had peak of polygalacturonase activity about 1 week earlier than fruits treated with 1-MCP, which had the highest activity after 3 weeks.
- In case of fruit harvested in 5th stage of maturity, the highest activity of polygalacturonase was determined after 4 weeks since 1-MCP treatment, while for fruits from combination with lower concentration of 1-MCP and from control combination, peak of polygalacturonase activity occurred after 3 weeks of storage.

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Photos

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- M. Gajewski
- K. Mazur



**WHAT DID THE LATE TOMATO SAY
TO THE EARLY TOMATO?**

I'LL KETCH UP

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