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Effect of 1-methylcyclopropene on postharvest chemical changes of 'cherry' tomato fruits (*Solanum lycopersicum* L. var. *cerasiforme*)

INTRODUCTION

Tomato fruits are the main source of lycopene, and important source of β-carotene, the precursor of vitamin A. Physical, chemical and sensory traits of tomato fruit can be modified by environmental factors. Many studies indicate that the key factor for plant growth, yield, fruits quality and their storage ability may be the growing medium used in greenhouse cultivation. Nowadays, the most popular growing medium in a modern soilless vegetable cultivation is a rockwool. However, rockwool is not suitable for recycling, so a new environmental friendly growing medium is needed to protect environment.

MATERIAL AND METHODS

The study was carried out in 2012 in the greenhouse and laboratories of the Department of Vegetable and Medicinal Plants of Warsaw University of Life Sciences. The objective of the study was to determine the effect of different growing mediums on the yield and fruits quality of 'cherry' tomato cultivars. Two cherry tomato cultivars – 'Dasher' and 'Pareso', were taken for the experiment. The seeds were sown in December, seedlings were planted in January to rockwooll and coconut fibre slabs. Fruits were harvested in June at 3rd and 5th stage of maturity, according to USDA classification (light-red) and stored for three and fourth weeks with different concentration of 1-MCP. There were determined total and marketable yield. There were carried chemical analysis for the fruits: dry matter, total sugars, pH of juice, acidity and soluble solids and carotenoids content. The factors for yield were growing medium and cultivar and for chemical part of this experiment were: growing medium, 1-MCP concentration and stage of fruit maturity.

The obtained extracts were filtered with ProFill HPLC Syringe Filter blue, Regenerated Cellulose (RC) membrane, diameter 25 mm, pore size 0.20 µm and subjected to HPLC. The analyses were performed using Shimadzu Prominence Liquid Chromatograph equipped with two LC-20AD pumps, SIL-20AC HT auto sampler, CTO-10AS VP oven, photodiode array detector SPD-M20A and LCsolution software. A modern C-18 reversed-phase column with core-shell technology (Phenomenex Kinetex® 2.6 µm, C18, 100A, 100×4.60 mm i.d.) was used as solid phase. The following conditions were applied: isocratic elution of Methanol (Chromasolv® for HPLC, Sigma-Aldrich) with 9 µM of Triethylamine (Sigma-Aldrich), flow rate 1.4 ml×min-1, injection volume: 20 µl, oven temperature 30 °C, total time of analysis 10 min, UV-spectra were recorded between 190 and 800 nm. Peak identification was confirmed by comparison of retention time and spectral data with adequate parameters of standards purchased from ChromaDex (α-carotene, β-carotene) and Sigma Life Science (RedivivoTM – lycopene). For quantitation of investigated compounds the five-point calibration curve method was used. Methanol stock standard solutions were prepared according to the ChromaDex's Tech Tip 0003: Reference Standard Recovery and Dilution. The solutions (0.5, 1.0, 2.0, 5.0 and 10 µl) were applied on a column in triplicate. The peak table and spectra library (190-800 nm) of individual compounds were created. Detection wave applied: 445 nm (α-carotene), 450 nm (β-carotene) and 470 nm (lycopene).

The results were analysed with one-way ANOVA and Tukey's HSD test at α=0.95 using Statgraphics Plus for Windows v. 4.1 software.

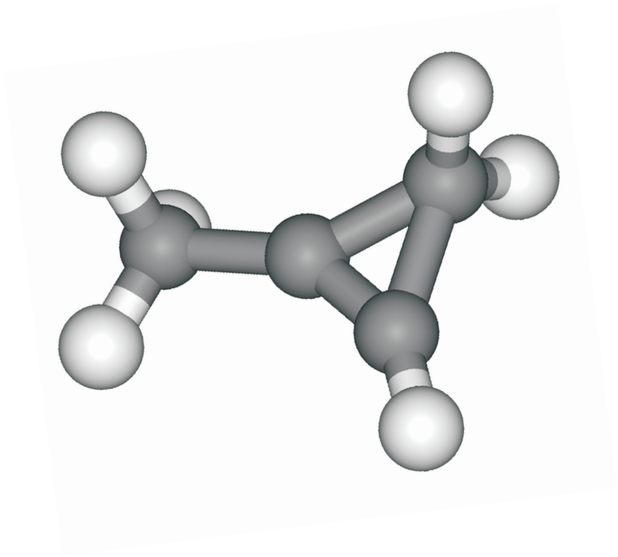

Photo 1. 1-methylcyclopropene (1-MCP)

Photo 2. Fruits on the plant

Photo 3. Fruits in the 3rd stage of maturity

Photo 4. Fruits in the 5th stage of maturity

RESULTS

Table 1. Dry matter of fruits of 'Dasher' cultivar (%)

	Storage duration	0 days	21 days concentration of 1-MCP					28 days concentration of 1-MCP				
Growing medium	Stage of maturity	Fresh fruits	Control	0.5 1-MCP	1.0 1-MCP	Mean for growing medium	Mean for stage of maturity	Control	0.5 1-MCP	1.0 1-MCP	Mean for growing medium	Mean for stage of maturity
Coconut fibre	3rd stage	7.61	7.29	7.49	6.94	7.46 *	3rd stage	7.31	7.2	7.25	7.41 *	3rd stage
	5th stage	8.04	8.06	8.04	6.91		7.12	7.55	7.4	7.73		7.19
Mineral wool	3rd stage	7.60	7.38	6.63	6.96	7.09	5th stage	7.11	7.31	6.98	7.20	5th stage
	5th stage	7.89	6.56	7.51	7.51		7.43 *	7.12	7.27	7.42		7.41 *
	Mean	7.79	7.33 ns	7.42 ns	7.08 ns			7.27 ns	7.29 ns	7.35 ns		

Table 2. Total sugars content in fruits of 'Dasher' cultivar (g 100 g^{-1} FW)

	Storage duration	0 days	21 days Concentration of 1-MCP					28 days Concentration of 1-MCP				
Growing medium	Stage of maturity	Fresh fruits	Control	0.5 1-MCP	1.0 1-MCP	Mean for growing medium	Mean for stage of maturity	Control	0.5 1-MCP	1.0 1-MCP	Mean for growing medium	Mean for stage of maturity
Coconut fibre	3rd stage	4.06	3.35	3.98	3.65	3.99 ns	3rd stage	4.5	4.07	4.03	4.56 *	3rd stage
	5th stage	4.77	4.11	4.56	4.30		3.75	5.19	5.00	4.58		4.43
Mineral wool	3rd stage	4.32	3.94	3.74	3.82	4.01 ns	5th stage	5.46	4.41	4.13	4.45	5th stage
	5th stage	4.61	3.94	4.46	4.17		4.26 *	4.06	4.15	4.46		4.58 *
	Mean	4.44	3.84 b	4.19 a	3.99 ab			4.80 a	4.41 b	4.30 b		

Table 3. Soluble solids in fruits of 'Dasher' cultivar (º Brix)

	Storage duration	0 days	21 days concentration of 1-MCP					28 days concentration of 1-MCP				
Growing medium	Stage of maturity	Fresh fruits	Control	0.5 1-MCP	1.0 1-MCP	Mean for growing medium	Mean for stage of maturity	Control	0.5 1-MCP	1.0 1-MCP	Mean for growing medium	Mean for stage of maturity
Coconut fibre	3rd stage	7.37	7.37	7.47	7.6	7.93 ns	3rd stage	7.28	7.51	7.07	7.61 *	3rd stage
	5th stage	8.55	8.40	8.48	8.27		7.56	7.75	8.38	7.70		7.32
Mineral wool	3rd stage	7.20	7.43	7.88	7.60	7.95 ns	5th stage	7.20	7.34	7.50	7.59	5th stage
	5th stage	8.52	7.98	8.43	8.38		8.33 *	7.87	7.68	7.97		7.89 *
	Mean	7.91	7.80 c	8.07 a	7.96 b			7.53 b	7.51 b	7.73 a		

Table 4. Juice pH of fruits of 'Dasher' cultivar

	Storage duration	0 days	21 days concentration of 1-MCP					28 days concentration of 1-MCP				
Growing medium	Stage of maturity	Fresh fruits	Control	0.5 1-MCP	1.0 1-MCP	Mean for growing medium	Mean for stage of maturity	Control	0.5 1-MCP	1.0 1-MCP	Mean for growing medium	Mean for stage of maturity
Coconut fibre	3rd stage	4.20	4.23	4.09	4.07	4.25	3rd stage	4.37	4.25	4.27	4.35 *	3rd stage
	5th stage	4.43	4.45	4.38	4.28		4.16	4.44	4.46	4.32		4.28
Mineral wool	3rd stage	4.25	4.27	4.17	4.15	4.29 *	5th stage	4.24	4.24	4.29	4.31	5th stage
	5th stage	4.40	4.39	4.37	4.36		4.37 *	4.35	4.35	4.39		4.38 *
	Mean	4.32	4.34 a	4.25 b	4.22 c			4.35 a	4.32 b	4.32 b		

Table 5. Titrable acidity expressed as citric acid equivalents of fruits of 'Dasher' cultivar (%)

	Storage duration	0 days	21 days concentration of 1-MCP					28 days concentration of 1-MCP				
Growing medium	Stage of maturity	Fresh fruits	Control	0.5 1-MCP	1.0 1-MCP	Mean for growing medium	Mean for stage of maturity	Control	0.5 1-MCP	1.0 1-MCP	Mean for growing medium	Mean for stage of maturity
Coconut fibre	3rd stage	5.91	5.77	6.96	7.31	6.10 *	3rd stage	4.35	4.03	5.92	4.48	3rd stage
	5th stage	5.15	5.06	5.44	6.07		6.46 *	4.29	3.60	4.69		5.14 *
Mineral wool	3rd stage	5.73	5.44	6.60	6.66	5.79	5th stage	5.32	5.78	5.44	5.19 *	5th stage
	5th stage	5.23	5.08	5.38	5.57		5.43	4.80	5.06	4.76		4.53
	Mean	5.51	5.34 c	6.09 b	6.41 a			4.69 b	4.62 c	5.20 a		

Table 6. Content of lycopene of fruits of 'Dasher' (mg 100 g^{-1} DW)

	Storage duration	0 days	21 days concentration of 1-MCP					28 days concentration of 1-MCP				
Growing medium	Stage of maturity	Fresh fruits	Control	0.5 1-MCP	1.0 1-MCP	Mean for growing medium	Mean for stage of maturity	Control	0.5 1-MCP	1.0 1-MCP	Mean for growing medium	Mean for stage of maturity
Coconut fibre	3rd stage	1.39	6.50	8.13	5.10	25.55	3rd stage	8.67	9.40	6.03	29.32	3rd stage
	5th stage	42.01	48.93	42.40	42.23		5.35	52.33	53.83	45.67		7.97
Mineral wool	3rd stage	2.46	4.73	4.04	3.60	28.11*	5th stage	7.80	8.03	7.87	31.83*	5th stage
	5th stage	42.52	65.33	47.10	43.83		48.31*	67.60	54.57	45.13		53.19*
	Mean	22.10	31.37 a	25.42 b	23.69 b			34.10 a	31.46 a	26.18 b		

Table 7. Content of β-caroteneof fruits of 'Dasher' (mg 100 g^{-1} DW)

	Storage duration	0 days	21 days concentration of 1-MCP					28 days concentration of 1-MCP				
Growing medium	Stage of maturity	Fresh fruits	Control	0.5 1-MCP	1.0 1-MCP	Mean for growing medium	Mean for stage of maturity	Control	0.5 1-MCP	1.0 1-MCP	Mean for growing medium	Mean for stage of maturity
Coconut fibre	3rd stage	1.31	3.55	3.35	2.62	4.98 ns	3rd stage	6.45	5.87	5.10	10.79*	3rd stage
	5th stage	3.27	6.94	6.61	6.82		3.15	16.13	16.50	14.70		5.73
Mineral wool	3rd stage	1.17	3.61	3.08	2.66	4.94 ns	5th stage	5.83	6.03	5.07	10.29	5th stage
	5th stage	3.34	7.31	6.50	6.47		6.78*	17.03	15.10	12.67		15.36*
	Mean	2.26	5.35 a	4.89 b	4.64 b			11.36 a	10.88 ab	9.38 b		

Means in rows marked with different letters and means in columns marked with asterisk differ significantly at α = 0.05, Tukey's test

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CONCLUSIONS

1. 1-MCP treatment may contribute to extend storage duration.
2. The study showed that both growing mediums used in the experiment allowed to obtain a comparable yield, of similar fruit quality.
3. Fruits harvested at 3rd stage of maturity can be stored longer than fruits harvested at 5th stage.

Photo 5. Fruits of 'Dasher' cultivar

Photo 6. Tomato in greenhouse