Harvest-Dependent Chemical Components in *Cucumis sativus L.* Fruits: II. Pickling Cucumbers

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Introduction: A basic purpose in pickling cucumber breeding is development of hybrids suitable for sterilized processing. For the production of high quality processing products (cans) it is necessary to consider the interests both of growers and consumers. The processing industry has specific requirements for fruit appearance and taste characteristics of raw material (greenstock), while the consumer would like higher nutritive and biological value in the product. A part of the nutritive value of cucumber fruits is determined by the content of dry matter, titratable organic acids and monosaccharides. In contrast, biological value of fruit is primarily determined by the ascorbic acid content. Many vegetable crop breeding programs have become focused on the development of germplasm with increased ascorbic acid content, a proven antioxidant (1,3,4). Pickling cucumbers, which pass through thermal processing and the break down of the ascorbic acid during processing. Breeding of germplasm with high ascorbic acid content is a strategy that has potential assisting with this impediment.

In order to develop breeding strategies for this purpose, it is very important to establish optimal harvest times for the analysis of selected chemical components. The aim of the present study was to be determined the optimal sampling times for chemical analysis for dry matter, titratable organic acids , monosaccharides, and ascorbic acid in pickling cucumbers.

Materials and Methods: The experiment was performed during 2001 to 2002 in a polyethylene greenhouse. Pickling cultivars Toni F_1, Iren F_1 and Pobeda F_1 are of gynoecious type and indeterminate growth, and were use in this study. Treatments were arranged in randomized complete block design with four replications at 100 and 50 x 35 cm planting scheme where each experimental plot was given 2.6-m^2 area with 10 plants. The seeds were sown on 23 March, and the plants were maintained until 30 July.
The analysis of the fruits and data processing were according to methods used in the experiment with salad cucumbers (this volume, Part I).

Results and Discussion: Dry matter content in the fruits of pickling cucumbers during 2001 was highest in the second harvest (Table 1). The correlation (r) between the values of this character for three harvests were significant at $-0.738<r<0.935$ (Table 2). Thus, with each harvest dry matter content changed in the three cultivars examined over the harvest periods.

During 2002, the highest content in the parameters studied was recorded at third harvest. However, the correlation coefficients between harvests differed, and they suggest that cultivar differences exist in the second and third harvests.

In content of ascorbic acid, titratable organic acids and monosaccharide concentrations also elicited non-unidirectional changes at each harvests (Tables 1 and 2). Similar to salad cucumbers (this volume, Part I), it can be concluded that only in one harvest is it impossible to be predicted their amount in other harvests during fruit development in pickling cucumbers.

The importance of the time of harvest for the values of chemical characters is expressed in Table 1. In treatments with significant mean differences, the presence of two or three groups

within one cultivar corresponding to any particular harvest was observed.

In contrast from salad cucumbers, the influence of time of harvesting (factor B) on the studied chemical components was more extreme than the effect of the cultivar (factor A) (Table 3). The weaker influence of the factor A is probably due to the fact that the hybrid cultivars examined share the same parent female inbred line.

Considerable differences concerning the ascorbic acid content particularly were established in our previous investigation where a more diverse array of

Table 1. Chemical components in pickling cucumber cultivars

Cultivars	Time of harvesting	Dry matter (%)		Ascorbic acid (mg %)		Titratable organic acids (%)		Monosaccharides (%)	
		2001	2002	2001	2002	2001	2002	2001	2002
Toni	I	5.64 b	5.46 n.s.	10.96 b	12.07 b	0.10 b	0.12 a	2.06 n.s.	1.44 b
	II	5.95 a	5.37 n.s.	16.29 a	13.82 b	0.15 a	0.10 b	2.05 n.s.	1.92 a
	III	5.42 b	5.48 n.s.	15.27 a	19.68 a	0.10 b	0.10 b	1.91 n.s.	1.91 a
Iren	I	5.33 n.s.	5.42 ab	12.96 c	14.03 b	0.10 c	0.14 a	1.86 n.s.	1.42 b
	II	5.64 n.s.	5.36 b	19.55 a	15.42 b	0.15 a	0.11 b	1.82 n.s.	2.06 a
	III	5.32 n.s.	5.48 a	14.84 b	18.56 a	0.12 b	0.14 a	1.88 n.s.	1.98 a
Pobeda	I	5.24 b	5.28 b	12.68 c	13.40 b	0.10 b	0.13 a	1.89 a	1.42 b
	II	5.70 a	5.33 b	18.28 a	16.60 a	0.14 a	0.11 b	1.82 ab	1.93 a
	III	5.20 b	5.50 a	15.27 b	17.94 a	0.12 a	0.11 b	1.80 b	1.80 ab

a, b, c… - Duncan's multiple range test ($p<0.05$), n.s. – not significant

Table 2. Coefficients of correlations between studied chemical components

2002 ←

	I	II	III
I	♦	0.734	-0.208
II	0.898	♦	0.120
III	0.935	0.738	♦

2001 →

a) dry matter

2002 ←

	I	II	III
I	♦	0.008	0.634
II	-0.592	♦	0.176
III	0.951**	-0.516	♦

2001 →

b) ascorbic acid

2002 ←

	I	II	III
I	♦	0.000	0.784
II	-0.400	♦	0.439
III	0.054	-0.542	♦

2001 →

c) titratable organic acids

2002 ←

	I	II	III
I	♦	0.643	-0.507
II	0.788	♦	0.138
III	0.228	0.607	♦

2001 →

d) monosaccharides

Table 3. Two-way analysis of variance for studied chemical components in pickling cucumbers depending on cultivar (factor A) and time of harvesting (factor B).

Experimental year	Chemical components	Factors influence (ŋ %)			
		Cultivar (A)	Time of harvesting (B)	A x B	Error
2001	Dry matter	11.87	50.45*	2.05	35.63
	Ascorbic acid	7.08**	84.91***	6.00**	2.02
	Titratable org. acids	2.67	71.92***	14.64	10.77
	Monosaccharides	44.13*	6.49	10.13	39.25
2002	Dry matter	8.47	31.34	12.37	47.82
	Ascorbic acid	1.91	69.91***	9.15	19.03
	Titratable org. acids	37.23***	37.23***	19.05	6.49
	Monosaccharides	2.73	85.96***	2.04	9.27

cultivars was tested (2). The presence of significant differences between the individual cultivars indicates that chemical components in the cucumber fruits could be increased through breeding. Also of importance is the effect of harvest time on chemical concentration of the characters examined and this should be considered during the breeding process. In the evaluation of breeding material parental components should be characterized or a selection is made. In this case, the average arithmetical value from the chemical analysis performed over a minimum of two harvests should be used as a basis for selection. Multiple determinations of chemical components in cucumber fruit will make the breeding process difficult to a certain extent, but this will guarantee more precise results from which conclusions can be drawn.

Literature Cited

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