

**The evaluation of cucumber fruit quality
(*Cucumis sativus* L.) transgenic line
with thaumatin gene**

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ABSTRACT

The aim of the experiments carried out from 2001 to 2002 was to evaluate the cucumber fruits quality, in particular to compare the results of sensory evaluation of the cucumber transgenic line with thaumatin gene, with diploid cultivar Borszczagowski. The results of the research indicate that the fruits harvested from the transgenic plants gained high acceptance with regard to the examined features, particularly the sweet taste, which indicates the expression of the thaumatin gene in the examined transgenic line of cucumber.

INTRODUCTION

One of the most important value of cucumber fruits as a vegetable is its taste. Sweet taste of plant products originates not only from reducing sugars (fructose and glucose), but also from other groups of organic compounds, e.g. proteins. One of the sweetest plants products are the tubers of perennial African plant *Thaumatococcus daniellii* Benth (100 000 times sweeter than sucrose) (Van der Wel and Bel 1980). The predominant thaumatins (I and II) have been characterized chemically by Iyengar et al. 1979 and De Vos et al. 1985. Recently, in the Department of Plant Genetics, Breeding and Biotechnology of Warsaw Agricultural University, the transgenic lines of cucumber with thaumatin gene (originated from *Thaumatococcus daniellii* Benth) have been obtained (Szwacka et al. 1996, Szwacka et al. 1998, Szwacka et al. 2002).

The aim of the present study was to evaluate the cucumber fruits quality, in particular to compare the results of sensory evaluation of the cucumber transgenic line with thaumatin gene, with diploid cultivar Borszczagowski.

MATERIAL AND METHODS

The transgenic cucumber line 210 06 was obtained by vector transformation method, using gene construct that contained cDNA of thaumatin II. The gene construct was received from A.M. Ledebouer, Unilever Laboratory, Vaardingen, The Netherlands. During research five generations (T_5) seeds line 210 06 were used.

The experiments were carried out in 2001 – 2002 at the Department of Vegetable and Medicinal Plants at Warsaw Agricultural University. The transplants were planted in spacing 20 x 120 cm to the soil covered with black foil, 16 plants on each plot, in 4 replications.

The fruits for sensory evaluation were collected in the middle of the harvest period, about five weeks after planting. The fruit length was 8-10 cm and weight approximately 50 g. The total proteins were determined by Kiejdhal method, reducing sugars by HPLC and total sugars were analysed according to Luff-Schoorl method. Scaling method was used for sensory analysis (Baryłko-Pikielna 1992). Ten panellists trained in techniques of sensory evaluation estimated the samples of cucumber fruits in three replications. The attributes such as: sweet taste, bitter taste and off-taste were evaluated. Each panellist marked the subjective evaluation of the investigated sample on a scale – a segment of a straight line with border marks. The marked notes were converted to numerical values in the stipulated units from 0 to 10.

Statistical analysis was performed with the use of the multivariate analysis of variance. The differences between the sources of variance were examined by the Fisher-Snedecor test at $\alpha = 0.05$. A detailed comparison of the mean values was made by using the Tukey multiple range test.

RESULTS AND DISCUSSION

Introduction of a sweet protein into the cucumber changed the composition of inorganic substances and the nutritional value of the fruit. In the pure form thaumatin, a protein consisting of 207 amino acids and characterized by solubility and good digestibility by humans, has a tendency to form complexes with anionic polysaccharides (Gibbs et al. 1996). The previous researches of Kosieradzka et al. (2001) indicated, that the fruits of transgenic cucumber contained more total protein, and less crude fibre when compared with non-transgenic fruits. The similar results were obtained in present work. The cucumber fruits of 210 06 line were characterised by significantly higher value of total protein in comparison to the fruits of Borszczagowski cultivar (Table 1). The differences in the content of reducing and total sugars in cucumber fruits between the years of experiment depended on such environmental factors as temperature and soil moisture. However, the mean content of total and reducing sugars (glucose and fructose) in the cucumber fruits of transgenic line were significantly lower than in the fruits of Borszczagowski cultivar (Table 2).

The most important factors determining fruit flavour are among others, sugars and other organic compounds (Abbot 1999). In the present work the sweet taste evaluation of the cucumber fruits showed the significant differences between the transgenic line and the control cultivar. The sweeter taste was characteristic for the fruits of the line 210 06 in a comparison to the fruits of the control cultivar, which indicates the expression of the thaumatin gene in the examined transgenic line of cucumber. The evaluation of the bitter taste in the cucumbers showed that all the fruits of the examined objects were characterised by this feature. The higher perception of the bitter taste characterised the fruits of the Borszczagowski cultivar in comparison to the fruits of the line 210 06. In the sensory analysis of the cucumber fruits, the evaluation of the off-taste was also carried out. The perception of this taste was clearly noticed in the fruits of the control cultivar and significantly low perception of this taste was characteristic for the fruits of the line 210 06 (Table 3). The results of the experiments indicate that the fruits of the transgenic plants gained the high acceptance with regard to the examined features.

Table 1. The total protein content in the cucumber fruits (%)

Examined object	Total protein		
	Years of cultivation		
	2001	2002	mean
Line 210 06	0.21 a*	0.51 a	0.36 a
Borszczagowski	0.16 b	0.37 b	0.26 b

* values designated with the same letters within column do not differ significantly at $\alpha=0.05$

Table 2. The reducing sugars and total sugars in the cucumber fruits ($\text{g } 100\text{g}^{-1}$)

Examined object	Glucose			Fructose			Total sugars		
	Years of cultivation								
	2001	2002	mean	2001	2002	mean	2001	2002	mean
Line 210 06	0.84 b*	0.58 a	0.71 b	0.71 b	0.60 a	0.65 b	2.71 a	1.64 b	2.17 b
Borszczagowski	1.00 a	0.59 a	0.79 a	0.99 a	0.58 a	0.78 a	2.68 ab	1.84 a	2.26 a

* values designated with the same letters within column do not differ significantly at $\alpha=0.05$

Table 3. Sensory attributes of cucumber fruits (0-10; scale of converted units)

Examined object	Sweet taste			Bitter taste			Off-taste		
	Years of cultivation								
	2001	2002	mean	2001	2002	mean	2001	2002	mean
Line 210 06	3.70 a*	3.58 a	3.64 a	0.32 b	0.43 b	0.37 b	0.42 a	0.05 b	0.23 b
Borszczagowski	3.47 ab	1.92 b	2.69 b	0.50 a	0.57 a	0.53 a	0.25 b	0.65 a	0.45 a

* values designated with the same letters within column do not differ significantly at $\alpha=0.05$

CONCLUSIONS

1. The fruits of the transformed cucumber line were characterised by the higher content of total protein and lower content of reducing and total sugars in a comparison to the fruits of standard Borszczagowski cultivar.
2. The higher marks for the sweet taste determined the high level of the thaumatin gene expression in the fruits of the transgenic cucumber line.
3. The fruits of the transformed cucumber line with thaumatin gene were characterized by less bitter and off-taste in comparison with the fruits of Borszczagowski cultivar.

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OCENA JAKOŚCI OWOCÓW OGÓRKA (*CUCUMIS SATIVUS* L.) LINII
TRANSGENICZNEJ Z GENEM TAUMATYNY

Streszczenie: Celem badań przeprowadzonych w latach 2001–2002 była ocena jakości owoców ze szczególnym uwzględnieniem analizy sensorycznej smaku owoców z genem taumatyny w porównaniu z owocami odmiany diploidalnej Borszczagowski. Wyniki badań wskazują, że owoce zebrane z roślin transgenicznych uzyskały wyższą akceptację pod względem badanych cech, a przede wszystkim smaku słodkiego, co świadczy o ekspresji genu taumatyny w badanej linii transgenicznej ogórka.

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