

## SENSORY ANALYSIS OF CUCUMBER VARIETIES AT DIFFERENT HARVEST TIMES I. SALAD CUCUMBERS

### СЕНЗОРЕН АНАЛИЗ НА СОРТОВЕ КРАСТАВИЦИ ПРИ РАЗЛИЧНИ СРОКОВЕ НА БЕРИТБА I. САЛАТНИ КРАСТАВИЦИ

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#### ABSTRACT

During the period 2001-2002 sensory analysis of six salad cucumber varieties was carried out. The aim of this experiment was to assess the influence of the harvest time on the fruit sensory properties. Flesh colour was the most stable character while appearance, skin colour, aroma, texture, taste and total sensory evaluation varied during the three investigated harvest periods. Two-way analysis of variance proved significant effect of the varieties, harvest time and its interaction on all sensory characters. Depending on the harvest time some of the varieties changed their places one toward other by total sensory evaluation. Therefore, it could not be made reliable conclusions of data obtained from one harvest time. The number of harvest times as well as the number of vegetations should be more than one in order to receive more accurate information for sensory characteristics.

**KEY WORDS:** *Cucumis sativus*, harvest time, fruit sensory properties

#### РЕЗЮМЕ

През периода 2001-2002 год се извърши сензорен анализ на шест салатни сорта краставици с цел оценка влиянието на срока на беритба върху сензорните качества на плодовете. Цветът на месото беше най-стабилният показател, докато външният вид, цветът на кората, ароматът, текстурата, вкусът и общата сензорна оценка варираха през трите изследвани беритбени дати. Двухакторният дисперсионен анализ доказа съществено влияние на сорта, срока на беритба и тяхното взаимодействие върху всички сензорни показатели. В зависимост от срока на беритба, сортовете сменяха местата си един спрямо друг по обща сензорна оценка. Това ни дава основание да твърдим, че не бихме могли да направим коректни изводи от данните, получени само от един срок на реколтиране. За получаване на по-точна информация е необходимо беритбите в рамките на вегетацията, както и броят на вегетациите да бъдат повече от една.

**КЛЮЧОВИ ДУМИ:** *Cucumis sativus*, срок на беритба, сензорни качества на плодовете

## ПОДРОБНО РЕЗЮМЕ

Целта на настоящето проучване е чрез провеждане на сензорен анализ на сортове и линии салатни краставици, да се оцени влиянието на срока на беритба върху органолептичните свойства на плодовете. Експериментът се извърши през периода 2001-2002 г. в полиетиленова оранжерия. Проучиха се 6 салатни сорта с различни характеристики: Бистренски – монооecious, Мидори  $F_1$  – гинооecious, Десислава  $F_1$  – гинооecious, Гергана – монооecious, Линия 61 – монооecious и Лора  $F_1$  – партенокарпен, гинооecious. Семената се засяваха в края на март и растенията се отглеждаха до края на юли. Плодовете се анализираха в три беритби през 15 дни в периода на масово плододаване. Сензорният анализ се проведе по показателите: външен вид, цвят на кората, цвят на месото, аромат, текстура и вкус. В зависимост от динамиката на микроклимата в оранжерията, по време на плододаване сортовете реагираха по различен начин по отношение на техните сензорни отличителни черти. Единствено при Гергана се наблюдаваше постоянство в оценките по някои от проучваните показатели. Значението на срока на реколтиране върху изследваните сензорни показатели се потвърди и от данните на двуфакторния дисперсионен анализ. Най-слаб бе ефектът върху цветовите характеристики – цвят на кората и цвят на месото. При другите сензорни показатели се установиха съществени различия за влиянието на проучените фактори (А – сорт и В – срок на беритба) върху оценките от панелния тест през отделните години. Варирането в стойностите на корелационните коефициенти, отчитащи връзката между сензорните оценки в различните срокове на беритба, е показател за неравномерна промяна на оценките една спрямо друга при различните беритби.

Проведеното от нас проучване спомага методически да се изясни моментът за взимане на проби за сензорен анализ. За да се характеризира селекционен материал от салатни краставици, не е достатъчно да се преценят плодовете само от една беритба, както и само от една вегетация. За получаване на по-точна информация е необходимо беритбите в рамките на една вегетация, както и броят на вегетациите да бъдат повече от една, в зависимост от възможностите за преценка.

## INTRODUCTION

Fruits of salad cucumbers possess comparatively poor nutritive substances. They have a biological value which is lower than many others vegetable crops. Nevertheless

cucumbers are consumed in high quantities during all seasons in Bulgaria. It is due to the pleasant awareness they arouse with their saturated aroma, crisp texture and fresh taste.

Cucumbers are mainly preferred for their sensory traits. This fact demands the breeders to work not only for increasing of productivity and resistance to economically important diseases, but to direct a special attention to the sensory properties of the fruits.

Cucumber sensory characteristics are measured instrumentally or using a panel test [6, 7]. According to Abott [1] the instruments can approximate human judgment by imitating the way people test the product or by measuring fundamental properties and combining those mathematically to categorize the quality. The people are these, who can evaluate the quality by their senses.

For salad cucumbers, sensory characteristics can be established by inquiring large groups of people or by carrying out a panel test with a number of assessors [2]. The second way is more appropriate for breeding process goal because it allows more characters to be included in the evaluation and to obtain wider information for the sensory properties of cucumber fruits from different varieties and lines.

The theoretical basis of sensory analysis has been known for a long time [8]. But its application on the different groups of food (dairy, meat, corn, fruit, vegetable and ect.) demands additional investigations, concerning the specificity of each one. It is very important to clear methodologically the moment for carrying out sensory analysis. The fact that the harvest is done by multiple pickings, the fruits are formed under different microclimate and the plants are at different stage of growing has to be taken into account.

The aim of this study was to assess the influence of the harvest time on the fruit sensory properties of cucumber breeding material, picked in different period of plant development.

## MATERIALS AND METHODS

The experiment was performed during the period 2001–2002 in plastic greenhouse. Six salad varieties with different characteristics were studied: Bistrenski – monoecious type, 20–24 cm fruit length; Midori  $F_1$  – gynoecious type, 18–20 cm fruit length; Desislava  $F_1$  – gynoecious type, 22–25 cm fruit length; Gergana – monoecious type, 28–30 cm fruit length; Linia 61 – monoecious type, 28–30 cm fruit length; Lora  $F_1$  – parthenocarpic, gynoecious type, 33–35 cm fruit length. The trial was carried out by block method in four replications at 100 + 50 x 45 cm scheme of planting and

Table 1. Sensory traits of salad cucumber fruits  
 Таблица 1. Сензорни показатели на плодове от салатни краставици

Variety Сорт	Harvest Беригба	Appearance Външен вид		Skin colour Цвят на кората		Flesh colour Цвят на месото		Aroma Аромат		Texture Текстура		Taste Вкус		Total sensory evaluation Обща сензорна оценка	
		2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002
Midori	I	4.79 a	4.88 a	4.73 a	4.70 a	4.46 n.s.	4.37 n.s.	4.36 b	4.82 a	4.44 b	4.71 a	4.42 b	4.70 a	4.38 b	4.69 a
	II	4.42 b	4.53 b	4.46 ab	4.50 a	4.42 n.s.	4.43 n.s.	4.75 a	4.66 ab	4.73 a	4.79 a	4.76 a	4.59 ab	4.72 a	4.59 ab
	III	4.35 b	3.91 c	4.30 b	4.07 b	4.34 n.s.	4.29 n.s.	4.75 a	4.49 b	4.58 ab	4.44 b	4.37 b	4.34 b	4.38 b	4.35 b
Bistrenski	I	3.44 ab	3.92 a	3.41 n.s.	3.88 a	3.93 n.s.	4.04 n.s.	4.40 b	4.18 n.s.	4.14 ab	4.25 a	3.90 b	3.90 n.s.	3.94 ab	3.97 a
	II	3.69 a	3.28 b	3.53 n.s.	3.63 ab	4.16 n.s.	4.10 n.s.	4.67 a	4.13 n.s.	4.42 a	3.94 b	4.36 a	3.65 n.s.	4.14 a	3.59 b
	III	3.05 b	3.44 b	3.26 n.s.	3.36 b	4.20 n.s.	4.04 n.s.	4.17 c	3.96 n.s.	3.87 b	3.82 b	3.87 b	3.82 n.s.	3.80 b	3.85 a
Gergana	I	4.21 n.s.	4.62 n.s.	4.37 b	4.60 n.s.	4.44 n.s.	4.22 n.s.	4.04 n.s.	4.47 ab	4.11 n.s.	4.35 n.s.	3.76 c	4.22 n.s.	3.91 b	4.34 n.s.
	II	4.51 n.s.	4.73 n.s.	4.68 a	4.73 n.s.	4.33 n.s.	4.31 n.s.	4.42 n.s.	4.24 b	4.21 n.s.	4.32 n.s.	4.48 a	4.36 n.s.	4.48 a	4.41 n.s.
	III	4.48 n.s.	4.56 n.s.	4.51 ab	4.59 n.s.	4.29 n.s.	4.38 n.s.	4.04 n.s.	4.70 a	4.39 n.s.	4.38 n.s.	4.10 b	4.34 n.s.	4.13 ab	4.38 n.s.
Desislava	I	4.34 n.s.	4.54 a	4.55 n.s.	4.80 a	4.35 n.s.	4.12 n.s.	4.41 a	4.34 n.s.	4.15 ab	4.18 a	4.09 a	4.00 a	4.16 ab	4.28 a
	II	4.21 n.s.	4.28 b	4.51 n.s.	4.83 a	4.29 n.s.	4.19 n.s.	4.41 a	4.22 n.s.	4.34 a	3.97 ab	4.48 a	4.00 a	4.50 a	4.22 a
	III	4.22 n.s.	3.88 c	4.34 n.s.	4.28 b	4.17 n.s.	4.01 n.s.	3.58 b	4.09 n.s.	3.88 b	3.84 b	3.53 b	3.72 b	4.00 b	3.84 b
Lora	I	4.02 a	4.81 a	4.58 a	4.56 a	4.56 a	4.21 b	4.48 a	4.73 a	4.34 a	4.66 a	4.39 a	4.57 a	4.42 a	4.56 a
	II	3.62 a	4.27 b	4.46 a	4.40 a	4.42 a	4.64 a	4.63 a	4.64 a	4.07 ab	4.64 a	4.05 b	4.63 a	4.05 b	4.60 a
	III	3.07 b	3.81 c	3.97 b	4.00 b	4.00 b	4.05 b	3.79 b	4.32 b	3.87 b	3.87 b	3.78 b	3.84 b	3.78 c	3.76 b
Linia 61	I	4.41 a	4.31 a	4.48 a	4.11 ab	4.07 b	4.27 n.s.	3.76 a	3.50 b	3.90 a	4.63 a	3.91 a	3.31 b	3.91 a	3.50 b
	II	4.05 b	4.27 a	3.84 b	4.28 a	4.42 a	3.94 n.s.	3.91 a	4.05 a	3.98 a	3.99 b	3.91 a	3.86 a	3.97 a	3.97 a
	III	3.71 c	3.87 b	3.58 c	3.84 b	3.88 b	3.90 n.s.	3.42 b	3.93 a	3.25 b	3.66 b	3.13 b	3.58 ab	3.20 b	3.61 b

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

Table 2. Two-way analysis of variance for studied sensory traits of salad cucumber fruits depending on variety (factor A) and harvest time (factor B)

Таблица 2. Двухфакторен дисперсионен анализ на сензорните показатели на плодове от салатни краставици в зависимост от сорта (фактор А) и срока на беритба (фактор В)

Sensory traits Сензорни показатели	Factors influence /Факторно влияние (η%) - 2001				Factors influence /Факторно влияние (η%) - 2002			
	Variety Сорт (A)	Harvest time Срок на беритба (B)		Error Грешка	Variety Сорт (A)	Harvest time Срок на беритба (B)		Error Грешка
		A x B				A x B		
Appearance/Външен вид	54.45***	8.62***	9.58***	27.35	43.39***	22.90***	10.04***	23.67
Skin colour/Цвет на кората	54.63***	7.64***	8.01***	29.72	50.92***	10.36***	8.07***	30.65
Flesh colour/Цвет на месото	16.50***	8.79***	19.27***	55.45	16.67***	3.96*	12.51*	66.87
Aroma/Аромат	32.76***	17.45***	12.28***	37.51	44.59***	0.37	13.91***	41.14
Texture/Текстура	32.00***	11.75***	9.17*	47.09	31.09***	20.04***	14.40***	34.47
Taste/Вкус	25.52***	19.68***	14.63***	40.17	50.57***	4.43***	12.41***	32.58
Total evaluation/Обща оценка	31.76***	16.44***	13.28***	38.52	49.83***	8.24***	16.57***	25.36

3.4 m<sup>2</sup> area of an experimental plot with 10 plants per each one. The seeds were sown at the end of March and the plants were cultivated up to the end of July. The fruits were analyzed in three harvests every 15 days during the mass fruiting period. Sensory analysis was done on 10 fruits from each replication no later than three hours of their harvesting. It was carried out on the traits: appearance, skin colour, flesh colour, aroma, texture and taste. A five-point scale with 0.25 steps was used. The total sensory evaluation was formed on the basis of complete perception, but not as an arithmetic average from evaluation for individual sensory traits. One and the same expert-assessors have participated during the both experimental years.

The results were processed by Duncan's multiple range test [3] using "synthetic standard method" for preliminary preparation of data [5]. Correlation analysis and two-way analysis of variance were also used [4].

## RESULTS AND DISCUSSION

The flesh colour was the most stable character reported on the panel test in different salad cucumber varieties (Table 1). It was established that varieties Midori, Bistrenski, Gergana and Desislava in whole experimental period and Linia 61 in 2002 had not significant differences between their assessments at the three harvest times. The assessments for the other traits of sensory analysis differed at least in one of the experimental years.

The varieties had different reaction in respect to their sensory characteristics depending on dynamics of microclimate in greenhouse during the fruiting period. In Gergana variety some traits had constant value of

assessments (Table 1). Appearance of fruits had not significant differences. They kept healthy, uniform in shape and size. The flesh colour was homogenous, saturated and fresh. The texture was tender, compact and crisp. Statistical differences were proved during the three harvest times in the other traits and in the total sensory evaluation. It was established that assessments of sensory traits were more different in the other varieties depending of the harvest time.

Total sensory evaluation is a general trait that characterizes cucumber fruits. The highest value was reported in variety Midori that differed from Bistrenski and Linia 61 in the whole experimental period (Fig. 1,2). These results showed that despite of the variation of the total sensory evaluation during the individual harvests the contrast varieties clearly distinguished in relation to their sensory characteristics. In this case it could be maintained that in a number of variants it is possible to differentiate the best from worst ones doing sensory analysis only in one harvest. In the other site, this statement is wrong for varieties with closely sensory properties. For example, during the first harvest in 2001 Lora and Midori obtained the highest evaluation while in the second and third ones the evaluations were significantly lower for Lora. Similar results were obtained in the second year. The low sensory values of Lora at third harvest time during the both years could be explained by the fact that the variety is parthenocarpic and falls in unfavourable conditions. The high temperature and low air moisture probably contributed to deterioration of the sensory qualities.

Undoubtedly, there is some subjectivism during the panel test performance, nevertheless the experts are with large experience and they have exact criteria for assessment.

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Table 3. Coefficients of correlation between the studied sensory traits of salad cucumbers at the three harvest times

Таблица 3. Корелационни коефициенти между изследваните сензорни показатели в трите срока на беритба

← 2002				← 2002			
	I	II	III		I	II	III
I	◆	0.754	0.543	I	◆	0.883	0.771
II	0.748	◆	- 0.142	II	0.755	◆	0.847
III	0.774	0.987	◆	III	0.711	0.967	◆
2001 →				2001 →			
a) Appearance / Външен вид				b) Skin colour / Цвят на кората			
← 2002				← 2002			
	I	II	III		I	II	III
I	◆	0.307	0.373	I	◆	0.848	0.735
II	0.611	◆	0.484	II	0.864	◆	0.557
III	0.233	- 0.342	◆	III	0.380	0.766	◆
2001 →				2001 →			
c) Flesh colour / Цвят на месото				d) Aroma / Аромат			
← 2002				← 2002			
	I	II	III		I	II	III
I	◆	0.713	0.181	I	◆	0.838	0.702
II	0.590	◆	0.672	II	0.193	◆	0.627
III	0.795	0.888	◆	III	0.320	0.850	◆
2001 →				2001 →			
e) Texture / Текстура				f) Taste / Вкус			
← 2002				← 2002			
	I	II	III		I	II	III
I	◆	0.781	0.621	I	◆	0.781	0.621
II	0.290	◆	0.470	II	0.290	◆	0.470
III	0.438	0.906	◆	III	0.438	0.906	◆
2001 →				2001 →			
g) Total sensory evaluation / Обща сензорна оценка							

This subjectivism even though minimum also contributes to variation of sensory evaluations. The fact that the Duncan test gives differences between the harvests concerning almost all sensory traits proves the important role of term of harvest on results of analysis.

The significance of the harvest time on the investigated sensory traits was also confirmed by the data of two-way analysis of variance (Table 2). The effect was weaker on colour characteristics – skin colour and flesh colour. In the other sensory traits significant differences for influence of investigated factors (A – variety and B – harvest time) on the assessments from panel test were established during the years. Comparatively large value of interaction (AxB) is a proof for presence of linkage between factors, i.e. the varieties show differences in their sensory properties in separate harvest time. There is an interaction genotype x environment and therefore only one vegetation is not

sufficient in order the precise sensory evaluation of salad cucumbers properties to be obtained.

The absolutely value of the assessments is not always important when we do comparatively investigations to select breeding materials with better sensory characteristics. In this case, it is more important the varieties do not exchange significantly their positions one toward other in respect of investigated trait under different conditions of growing.

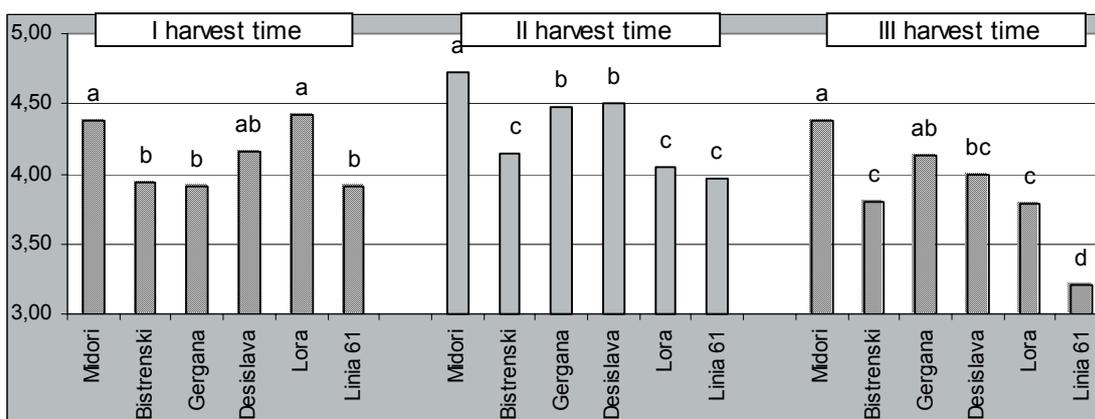
In this aspect it is significant to examine the correlation coefficients reporting the relation between sensory values in different time of harvest and to estimate how the change (increase or decrease) of these assessment values is adequate depending on the chosen date of harvest. The value of correlation coefficients is over 0.700 only for skin colour trait regardless of experimental years (Table 3). High correlation coefficients were recorded

between sensory values in first and second harvest time in appearance and aroma. The variation of other coefficient values is an indicator of irregular change of assessments one toward other at deferent harvest time. These coefficients combined with differences in value of assessments for sensory traits established by Duncan's test and two-way analysis of variance show that it could not be made correct conclusions based on data received only at one harvest time.

**CONCLUSION**

Sensory analysis of salad cucumbers is essential part

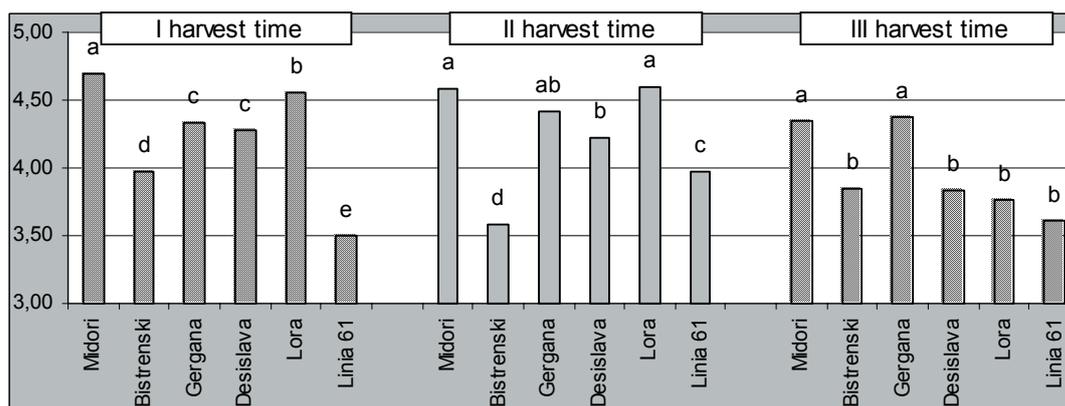
of breeding on quality. It is mainly included at the beginning for selection of initial components and at the end for evaluating the created breeding lines and hybrids. Realization of the fruits on the market depends on the possession of good sensory characteristics. That is why, it is important to do sensory analysis correctly. This investigation is a trial to define methodically the right moment to take the samples for assessment. Characterization of the breeding material from salad cucumbers only at one harvest time in one year is not enough. To get correct information it is necessary the harvest times in one year as well as the number of vegetations to be more.



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

Figure 1. Comparing of the total sensory evaluations between the studied varieties during the three harvest times in 2001

Фигура 1. Сравняване на изследваните сортове по обща сензорна оценка в трите срока на беритба през 2001 г.



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

Figure 2. Comparing of the total sensory evaluations between the studied varieties during the three harvest times in 2002

Фигура 2. Сравняване на изследваните сортове по обща сензорна оценка в трите срока на беритба през 2002 г.

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