

## **Sensory Evaluation of Fruit of Some Scab Resistant Apple Varieties**

Senzorička evaluacija plodova jabuke nekih sorata otpornih na čađavu krastavost

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### **ABSTRACT**

Fruit quality of five scab resistant apple cultivars (Enterprise, Liberty, Nova Easygro, Sir Prize and Rewena) suitable for organic growing systems were tested. External and internal fruit quality was assessed through standard parameters (fruit weight, firmness, soluble solids, malic acid) and sensorial quality by panel tests (fruit size, shape and colour; hardness, texture, juiciness, sweet/acid taste, aroma and overall flavour). Large differences in sensory scores for particular quality attributes were found between cultivars. The hedonic scores showed significantly lower preference for tested scab resistant apple cultivars in comparison to 'Jonagold' as the reference cultivar.

Keywords: *Malus x domestica*, internal and external fruit quality, hedonic scores

### **SAŽETAK**

Istraživana je kakvoća plodova pet sorata jabuke, koje su zbog otpornosti na čađavu krastavost prikladne za sustav organske proizvodnje. Istraživanjima su obuhvaćene sorte Enterprise, Liberty, Nova Easygro, Sir Prize i Rewena. Kakvoća plodova utvrđena je standardnim metodama, pri čemu su kao vanjski parametric kakvoće utvrđeni: masa ploda, tvrdoća mesa ploda, sadržaj topive suhe tvari i ukupnih kiselina. Senzoričko vrednovanje, na osnovi panel testa, uključilo je: veličinu ploda, oblik i boju, tvrdoću, teksturu, sočnost, omjer šećera i kiselina, te aromu i ukupnu senzoričnu vrijednost. Nađene su značajne razlike između sorata glede senzoričnih ocjena. Ukupno gledano, istraživane sorte su, u odnosu na standardnu sortu Jonagold, postizale lošije ocjene.

Ključne riječi: *Malus x domestica*, vanjska i unutrašnja kakvoća ploda, senzoričke ocjene

## INTRODUCTION

For the future development of organic fruit growing as an alternative to the conventional practices, it is necessary to introduce pest and disease resistant or tolerant cultivars. Scab resistant cultivars give growers an opportunity to reduce disease control costs, lessen the risk of environmental contamination associated with fungicide applications, and meet consumer demands for reduced pesticide residue on produce. But the decision which cultivars to choose for future production is not easy for the fruit grower, and the existence of many new, unfamiliar cultivars makes this decision increasingly difficult. For organic fruit growing cultivars need to be well adapted to the local climate and resistant to pests and diseases. However, it has been difficult to grow many of these cultivars on a commercial scale because of inadequate fruit quality. It is crucial that the fruit quality of apple cultivars suitable for organic growing be at least equal to that of currently popular commercial cultivars (Kellerhals et al., 2001). Instrumental texture measurements, as well as sugar and acid contents are standard analysis methods of apple fruit quality. But knowledge on the sensory quality will facilitate the choice among the many scab-resistant cultivars for both the fruit grower and the consumer. Sensory quality of scab resistant apple cultivars was studied extensively (Granger et al., 1992; Stehr, 1997; Kellerhals et al., 1998; Zimmer, 1999; Kuhn & Thybo, 2001), but there has not been enough experience with these cultivars in Croatia.

The objective of this study is to obtain information about the sensory quality of fruit of five scab resistant apple cultivars recommended for growth in Croatia on the basis of preliminary trials.

## MATERIALS AND METHODS

The orchard site was located at Agricultural Institute in Osijek in Croatia. The soil contained 7.4% sand, 32.6% silt, 28.8% loam and 31.2% clay from 0- to 40- cm depth. This soil contained 1.9% organic matter, 19.5 mg P<sub>2</sub>O<sub>5</sub>/100 g soil, 23.9 mg K<sub>2</sub>O/100 g soil, and pH (in KCl) was 6.1.

Climatic conditions in the orchard site were favourable for apple growing. Long-term average temperature in Osijek is 10.8°C. Annual precipitation is about 650 mm.

The experiment was conducted on five apple scab resistant apple cultivars (Enterprise, Liberty, Nova Easygro, Sir Prize and Rewena) grafted on MM106 rootstock, planted at 4 x 3 m, and trained as central leader. Protection against

diseases and pests was carried out with minimal pesticide use approved for the use in integrated fruit production.

A preliminary timetable for picking each cultivar was constructed on the basis of reports in the pomological literature and an expert panel consisting of three people with experience in determining optimal harvest dates from internal quality characteristics of the fruit.

Fruit of all cultivars were stored together in one cool room at 2 °C ( $\pm$  1 °C) and relative humidity 95-100%. In the middle of December, the fruit were taken out of storage and left to ripen at room temperature (20 °C ) for 7 days before analysis.

Ten representative apple fruits of each cultivar were used for physical and chemical analysis of external fruit quality by standard methods:

- titratable acidity was determined as g/l malic acid by titration of the juice with 0.1 M NaOH to pH 8.1.
- firmness was measured with a handheld penetrometer to a depth of 8 mm with an 11 mm probe.
- total soluble solids content was measured with a refractometer (°Brix)

The testers for the sensory evaluation were students of the Faculty of Agriculture (University of Zagreb, Croatia), that were familiar with the sensory attributes of apple fruit. The panel of 30 assessors evaluated the five scab-resistant varieties in four replications with the cultivar Jonagold as a reference sample. Fruit quality was assessed as fruit size, shape and colour; firmness, crispness, juiciness, sweet/acid taste, aroma and overall flavour, using a hedonic scale graded from 1 to 9, with descriptive grading from unsatisfactory to excellent (Pigott, 1988).

The samples were analysed in a randomised order. Four apples were used for evaluation of the external quality characteristics. The sensory analyses of internal quality attributes were performed also in four replications with a total randomisation of cultivars and replications. One slice of each apple cultivar was served per assessor. Samples were served without peel.

Analysis of variance was performed using SPSS for Windows 10.0 procedures. The differences were compared using LSD test at  $P=0.05$ .

## RESULTS AND DISCUSSION

### Physical and chemical analysis

The cultivars were different regarding physical and chemical qualities parameters of fruit at the time of evaluation in the middle of December (Table 1). Among the examined cultivars 'Jonagold', 'Nova Easygro' and 'Sir Prize'

fruit had much lower acidity. In comparison to the other cultivars, significantly lower firmness was observed for fruit of 'Sir Prize'. Differences in fruit soluble solids content were small.

**Table 1. Average sensory scores for main quality attributes**

**Tablica 1. Prosječne ocjene za glavne pokazatelje kakvoće plodova**

	External quality (shape, skin colour) Vanjska kakvoća (oblik, boja ploda)	Texture (firmness, crispness, juiciness) Tekstura (tvrdoća, hrskavost, sočnost)	Taste (sweet/acid taste, aroma, overall flavour) Okus (šećer/kiseline, aroma, ukupni utisak)
Braeburn	3,31 ab	3,77 ab	3,06 bc
Fuji	3,75 a	4,28 a	4,02 a
Golden Delicious	3,20 b	3,37 b	3,40 b
Granny Smith	3,41 ab	3,50 b	2,75 c
Hi Early	3,04 bc	2,77 c	2,71 c
Idared	2,89 c	3,07 bc	2,50 c
Jonagold	3,39 ab	3,43 b	3,51 b
Jonagored	3,26 b	3,27 b	3,01 bc
Značajnost Significance	*	*	*

*Means followed by the same letters are not statistically different at  $P=0.05$*

*Vrijednosti označene istim slovom – nema značajnih razlika pri  $P=0,05$*

### Sensory quality of apple cultivars

An ANOVA analysis of the sensory data revealed significant differences between apple samples for the main sensory attributes: external quality, texture and taste (Table 2).

Significantly higher average scores for appearance (external quality) were obtained for 'Enterprise', 'Sir Prize' and 'Jonagold' (Table 2, Fig. 1-3). No difference in external quality between 'Liberty', 'Nova Easygro' and 'Rewena' was found.

The cultivars were very different regarding fruit texture (Fig. 4-6). 'Rewena' was very firm, crispy and juicy. 'Enterprise' was firm, but was not very crisp and juicy. Among the tested cultivars the lowest average score for fruit firmness, crispness and juiciness was obtained for 'Nova Easygro' (Fig. 4-6). Average scores of texture showed that 'Rewena', 'Enterprise' and

‘Jonagold’ had significant higher texture preference than ‘Liberty’, ‘Nova Easygro’ and ‘Sir Prize’ (Table 2).

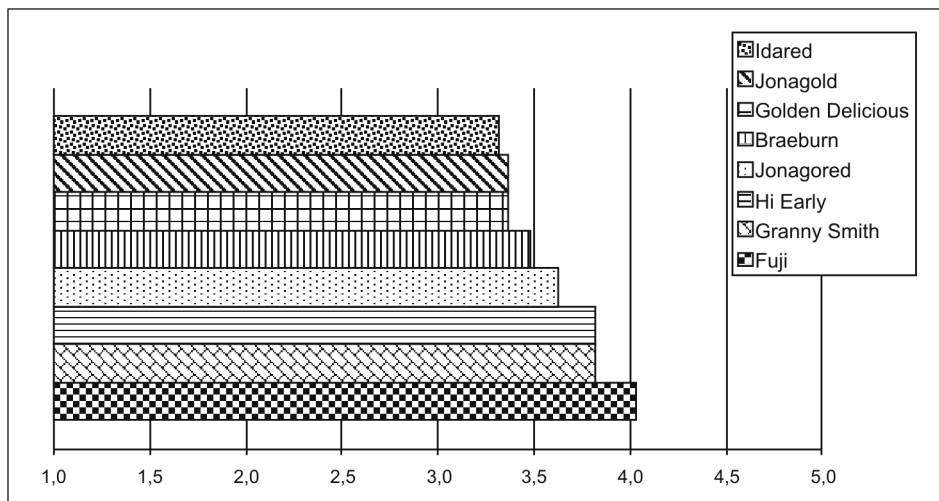
**Table 2 Average sensory scores for quality attributes depending on tester's sex**

**Tablica 2. Prosječne ocjene za kakvoću plodova prema spolu ocjenjivača i ukupno**

	Average – male Prosjek – muški	Average – male Prosjek – muški	Average fruit quality Ukupni prosjek
Braeburn	3,40 b	3,36 b	3,38 b
Fuji	3,94 a	4,21 a	4,08 a
Golden Delicious	3,09 bc	3,47 b	3,28 b
Grany Smith	3,09 bc	3,41 b	3,25 b
Hi Early	2,97 c	3,11 bc	3,04 bc
Idared	2,85 c	2,97 c	2,91 c
Jonagold	3,31 b	3,47 b	3,39 b
Jonagored	3,01 bc	3,37 b	3,19 bc
Značajnost Significance	*	*	*

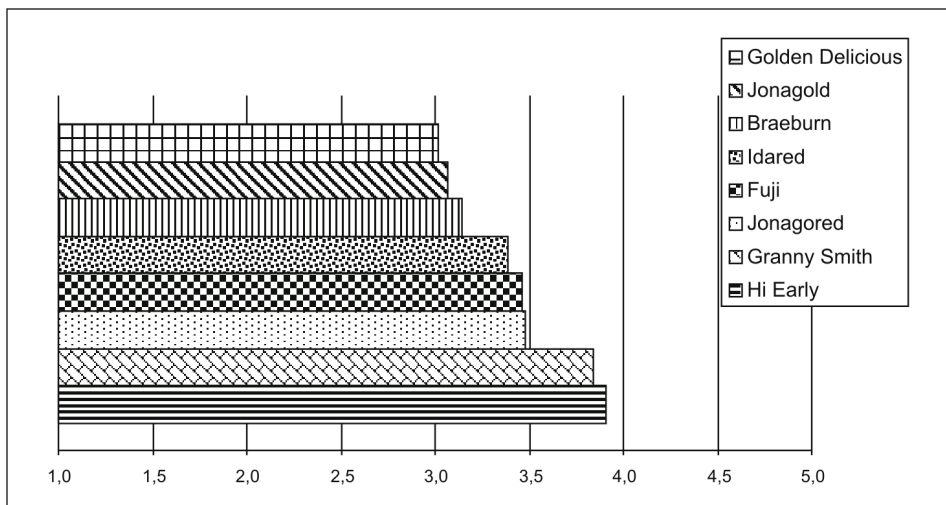
Means followed by the same letters are not statistically different at  $P=0.05$

Vrijednosti označene istim slovom – nema značajnih razlika pri  $P=0,05$



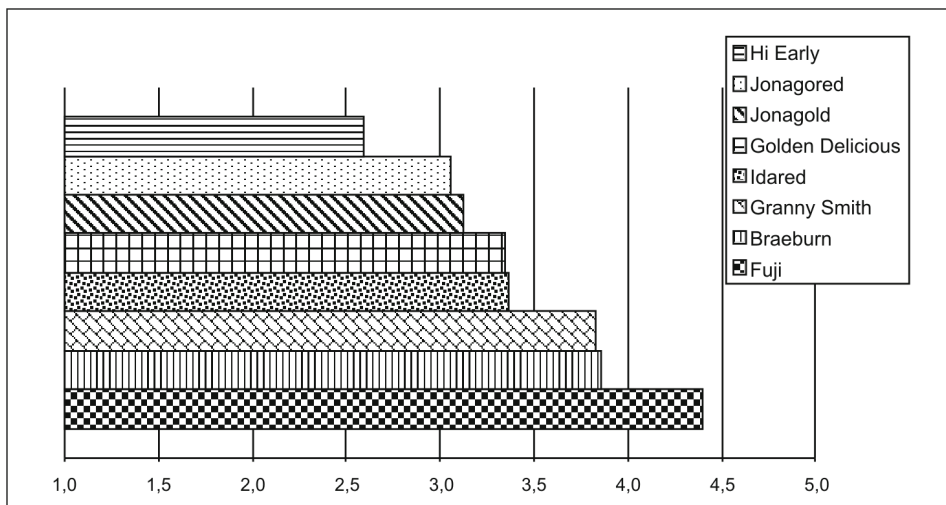
**Fig. 1. Average scores for fruit shape**

**Graf. 1. Prosječne ocjene za oblik ploda**



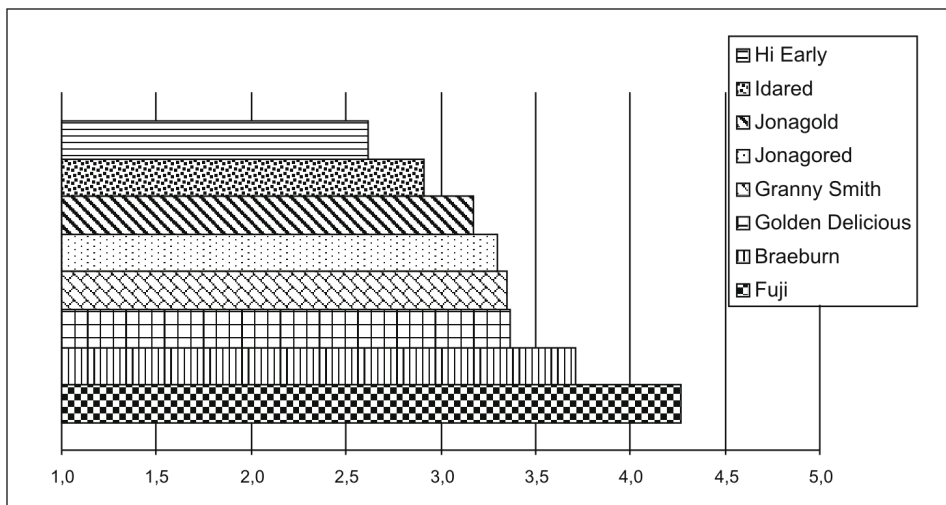
**Fig. 2. Average scores for fruit colour**

**Graf. 2. Prosječne ocjene za boju ploda**



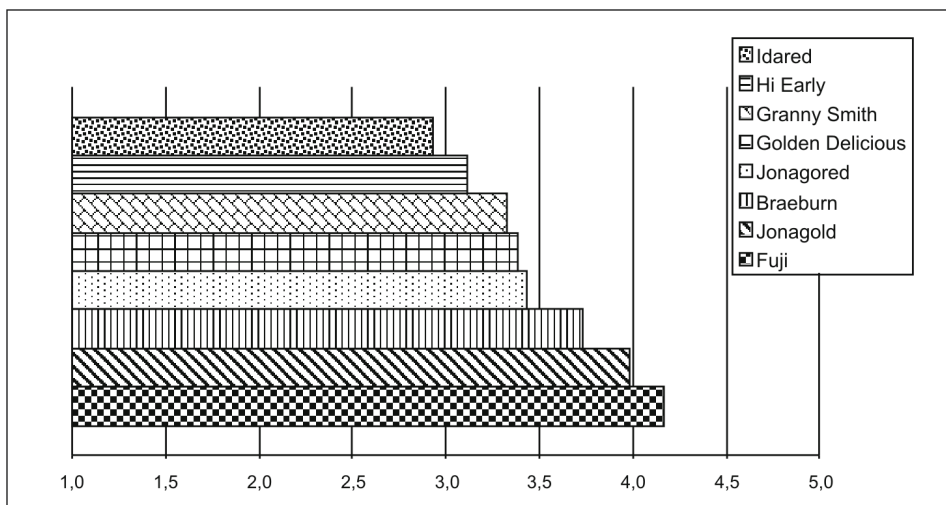
**Fig. 3. Average scores for fruit firmness**

**Graf. 3. Prosječne ocjene za tvrdoću ploda**



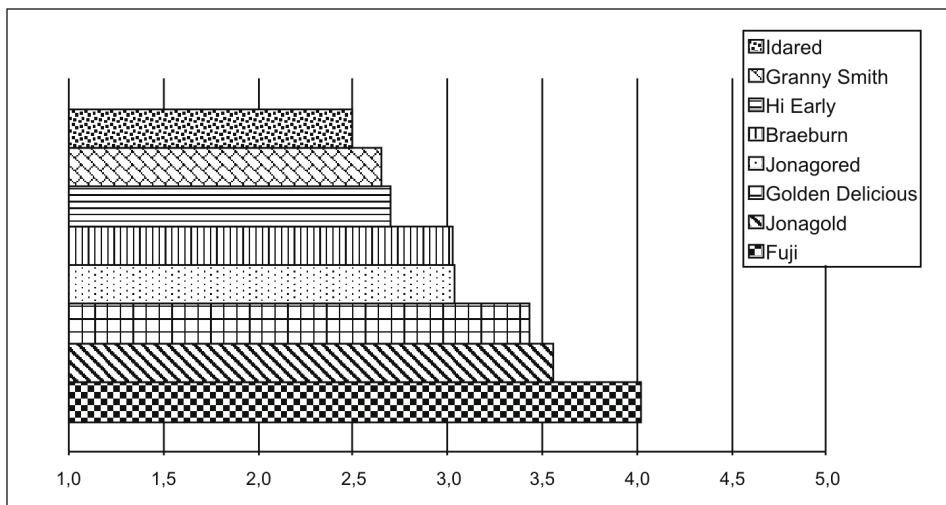
**Fig. 4. Average scores for fruit crispness**

**Graf. 4. Prosječne ocjene za hrskavost ploda**



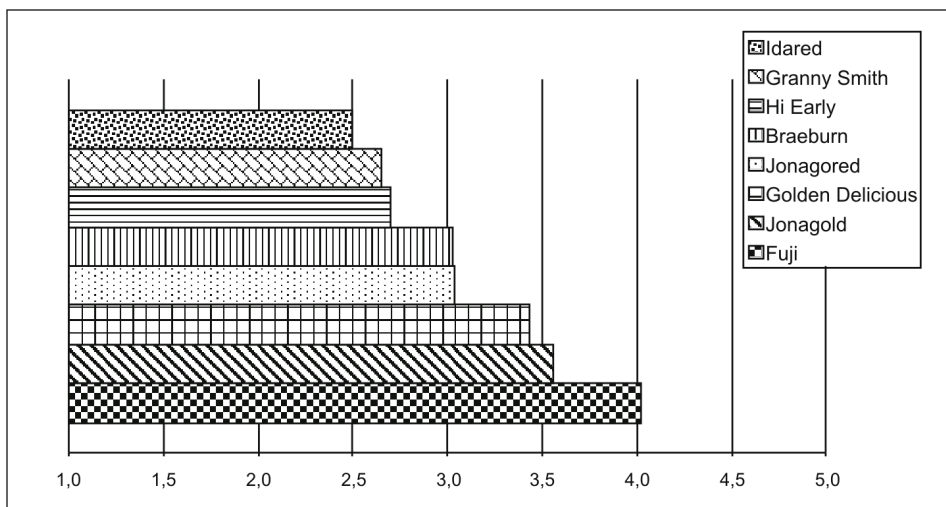
**Fig. 5. Average scores for fruit juiciness**

**Graf. 5. Prosječne ocjene za sočnost ploda**



**Fig. 6. Average scores for fruit sweet/acid taste**

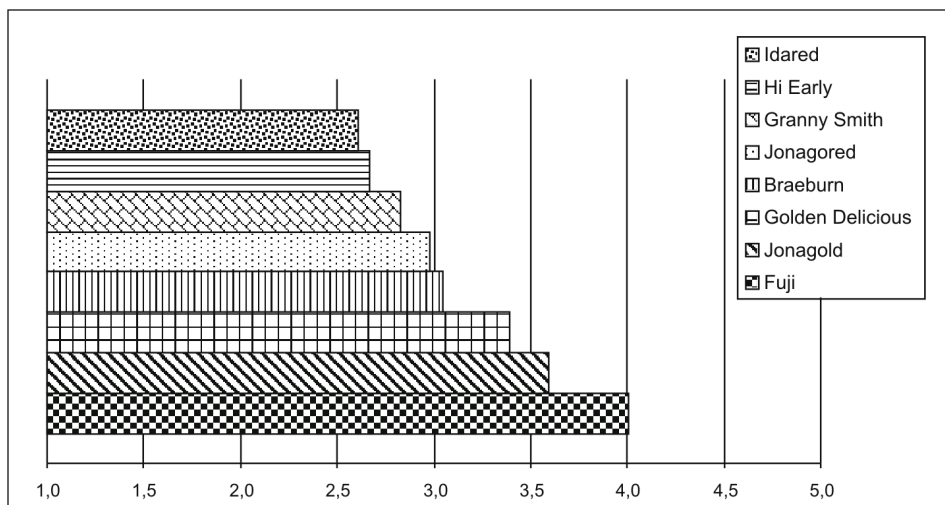
**Graf. 6. Prosječne ocjene za skladnost okusa ploda (omjer šećera i kiselina)**



**Fig. 7. Average scores for fruit aroma**

**Graf. 7. Prosječne ocjene za aromu ploda**





**Fig. 8. Average scores for fruit overall flavour**

**Graf. 8. Prosječne ocjene za ukupnu kakvoću ploda**

Large differences in sensory scores for fruit taste were found between cultivars (Fig. 7-9). Among the scab resistant apple cultivars, 'Nova Easygro' scored significantly lower for fruit acid/sweet taste, aroma and overall flavour (Table 2, Fig 7-9). 'Liberty' also achieved very low scores for taste (Table 2, Fig 7-9). The reference cultivar 'Jonagold' had the highest preference for all parameters of fruit taste.

Average scores for all fruit quality (external, texture, taste) showed that 'Jonagold' had higher preference than the scab resistant apple cultivars (Table 2). Among the scab resistant cultivars 'Enterprise' had higher preference, following 'Rewena' and 'Sir Prize'.

## CONCLUSION

The instrumental and sensory investigations into the five scab resistant apple cultivars showed a large variation in the chemical, physical and sensory quality. The large quality variation gives rise to the observed preference differences between apple cultivars and is further contributing to an understanding of the differences in preference.

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