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Assessment of apple varieties based on consumer judgement in integrated production for fresh consumption

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Summary: In a former paper we treated the same relation comparing varieties frown in the biological or organic system of growing, now the tests have been performed with samples grown by the integrated system. The scores registered properties as taste, skin, colour, consistency and size. In addition, we also explored the relation between general impression and the individual properties. As first purpose, we started with collecting primary data on 15 samples taken from fruits grown by the integrated method and kept over 60–90 days in a store, then offered to the consumers. The test is based on an organoleptic assessment (records are registered in a questionary). The individual judgements are processed and coefficients of correlation between the traits (taste, skin, size, colour) calculated. The validity of the mathematically proved relations is considered to be decisive in judging the preferencial consumption of fruits.

Key words: apple, integrated, fresh consumption, attributes of fruit, preference of consumers

Introduction

The development of a new commodity requires an adequate presentation of its attributes in order to distinguish its identity based on observations of the product. Those primary data are raised by inquiry of the potential consumers. The enterprises representing that branch of production are not prepared to perform the tests necessary for an unbiased survey A secondary source of data is still not available, therefore we prefer to raise information by inquiry. That primary information collected is ready to be published and utilised by the practice of the branch.

On the Hungarian apple market, attitudes of consumers has been analysed by *Felföldi* et al. (2008), but also earlier data are available in studies of *Vanczák* et al. (2002) and *Gonda* et al. (2007), but their results refer to another period of production. The frequency of apple consumption is also influenced by the consciousness of the consumers, which was scored recently (*TNS*, 2009).

Our general endeavour is invariably to increase the fresh consumption of apple on the national level by publishing information related to the attributes, which are influenced by the variety as well as by the growing. The targets of the study are:

Apple samples grown by the integrated system should be evaluated according to their taste, skin, colour, consistency and size.

On the samples examined the relation (correlation) between the individual parameters and the general impression is calculated.

Material and methods

By inquiry, we may raise information, which cannot be approached by any other but limited methods applied in research (*Hoffmann* et al., 2001). The present survey was performed in 2008–2009 years with the assistance and supervision of "interrogators". The number of subjects of the inquiry was 110. The fruit samples to be tested were furnished by Institute of fruit growing at Újfehértó. The primary data referred to 15 apple varieties grown by integrated method and are examined organoleptically. The questionnaires were fulfilled for each sample indicating the judgement of the subject over five characters: taste, skin, colour, consistency and size by assigning the sample to a grade of the scale 1 to 5. In addition, the subject expressed his/her "general impression" on the sample also on the same scale 1–5. In order to avoid boring effects, the term given to perform the test was 2–3 hours long.

Between the data of five characters plus the general impression, we calculated the correlation coefficients and compared them using the Kendall-tau-b test.

Results

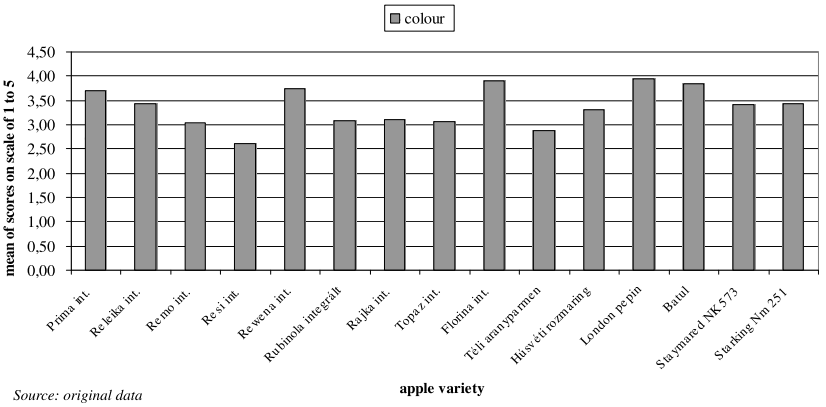
Results of the tests obtained on apple samples grown by the integrated system

The answers given to the different characters of apple samples grown by the integrated system are shown in the

Figures 1 to 5. By practical reasons to identify the varieties, the range of the 15 varieties is always the same on the Figures. In *Figure 1,* the preference of the colour is rated according to the means. The best judgements were given to London pepin and slightly less to Florina, Batul and Rewena.

The red colour dominated in the higher rated samples. London pepin displayed 86% red and dark red colour, which was seen by 50% as red. To this category belong Batul and Rewena. In the case of Florina, red is combined with green, so 1/3 of the subjects considered as green, 2/3 as red, nevertheless this combination was sympathetic. Yellowish and light red colour was much less popular. Most critical was the judgement of the Remo variety, which polarised the subjects. It was seen as being green by 11%, yellow by 15%, light red by 52% and red simply by 20% only.

The rating of size is shown in *Figure 2,* which expresses the size alone but also the variation in size, i.e. size-heterogeneity was a negative trait. Florina and Prima varieties were praised being large in diameter (75-80 mm), but good grades are given to London pepin and Batul. The rest of varieties were less attractive in size and uniformity, so the received the lowest values: Rubinola, Rajka, Topáz and Téli aranyparmen. Rubinola and Topáz had a diameter around 71 mm. Rajka 60-65 mm, whereas Resi 55 mm on the end of the range.



Source: original data

Figure 1: Mean values given to the colour of apple samples

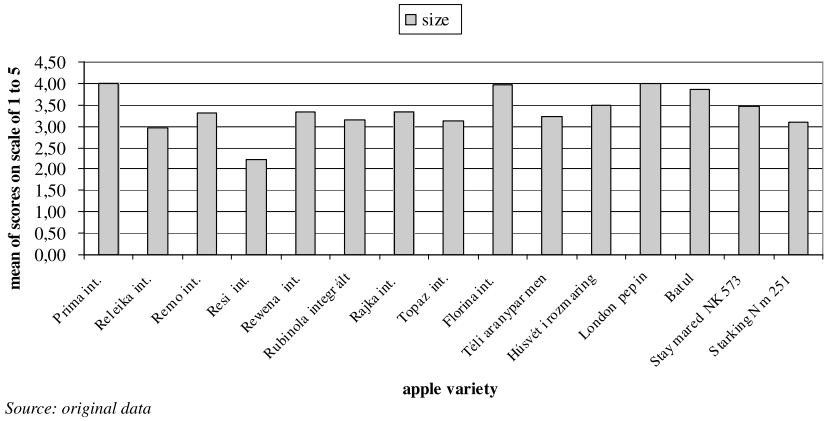


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Figure 2: Scores related to the size of fruits

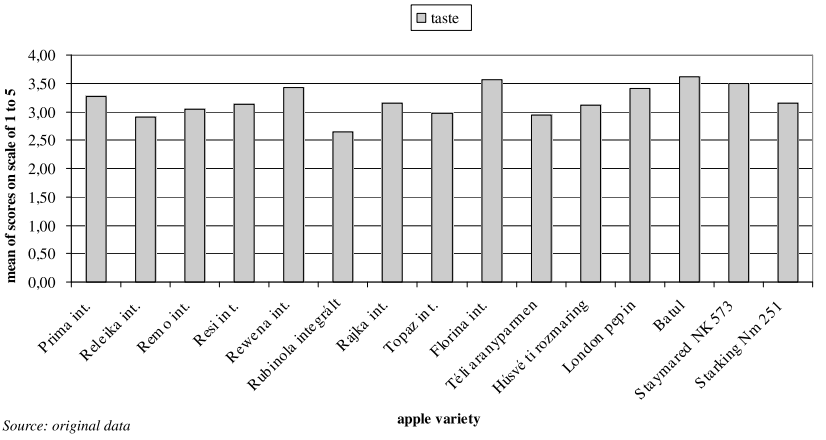

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Figure 3: Means of the scores referring to the taste of apple samples

On *Figure 3* the score of taste is shown in fruits grown by the integrated system. Taste is dependent on sugar and acid content as well as on the ratio of those. Sugar is expressed in Brix° degrees, acids in citric acid equivalents. Best taste was attributed to Batul and Florina.

Florina had high sugar content (13 Brix°) and low acidity (1.9 g/kg), whereas Rewena was also sweet (12.5 Brix°) but moderately acid (2.8 g/kg). Rajka and Resi was less sweet and less acid, but the harmony was favourable. But Remo and Topáz with more than 11.3 Brix° and 3.4 g/kg acid content were lass attractive. The sweet, but weakly acid varieties did not receive high scores, as Releika and Rubinola with 12 Brix° associated with 1.6 and 2.1 g/kg acid content. In an earlier test, the higher sugar content was preferred by the subjects but with lower acid content too. The joint effect of sugars and acids was always a criterion of good taste.

The consistence of the fruit flesh was a very decisive property of the fruit, so the scores of varieties could be clearly divided into two groups: below and above the value 3.5 of the score. The group with higher scores contained the varieties London pepin, Batul, Staymared, Rewena, Florina and Starking. The less preferred variety was Rubinola with the lowest score. (*Figure 4*)

The fruit skin of the varieties was favourably evaluated in Rewena and Batul with 3.66 as mean score, followed by Staymared and Florina (above 3.4). Those four varieties were though outstanding, but numerically their higher scores are pretty near to the mean of the whole series. The les attractive was Rubinola with a mean of 2.84 score (*Figure 5*).

The combined mean scores of five properties (*Figure 6*) allow a distinction of the varieties with higher than 3.5 values: Florina, Batul, London pepin, Rewena, and closely near to them Príma. The rest of varieties received less than 3.5, and the lowest value occurred to Resi with 2.8 as mean score.

The apple samples grown by the integrated system scored according to the scores given to the general impression by the same subjects

The score according the general impression completed the tests. Participants of the tests were asked to rate their general impression on the same scale of 5 degrees *(Figure 7).*

The best scores of general impression was given to Batul, Florina, Rewena, London pepin, which corresponds with the means of the scores given to individual properties. The correlation of scores of individual properties and the general impression was also calculates as presented in *Table 1*. It turned out that every individual component is related significantly with the general impression.

Comparison of pairs by the Kendall-tau-b test gave significant values. Taking the diminishing order of their value, the range of coefficients between individual characters and general impression was: taste, consistency, skin, size, colour. We can state that the taste is most decisive: 0.7, next the consistency: 0.67, the skin: 0.63, the size: 0.514, and the colour: 0.493. It is evident that all those individual characters are significantly influencing the choice of the consumers. This justifies the use those characters to identify consumers' preferences in the choice of varieties.

harmony are also to be considered. High sugar content (13 Brix°) and less acidity (1.9 g/kg) as in Florina, subsequently sweet (12.5 Brix°) and moderately acid (2.8 g/kg) was found in Rewena with good score.

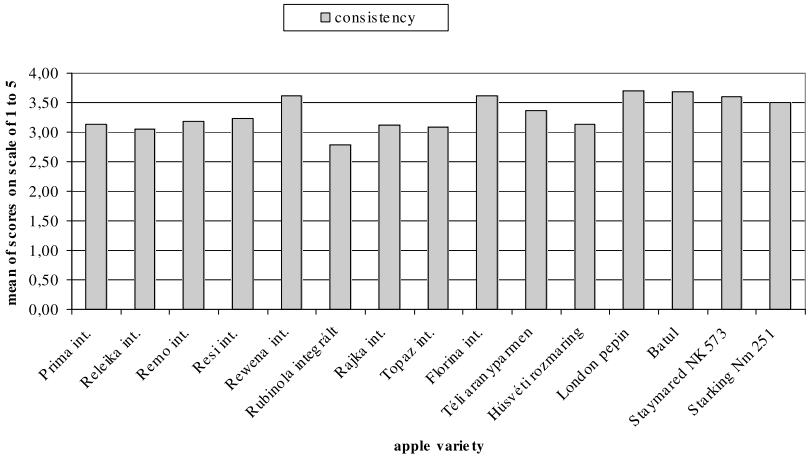

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Figure 4: Mean scores given to the consistency of fruit flesh of apple varieties

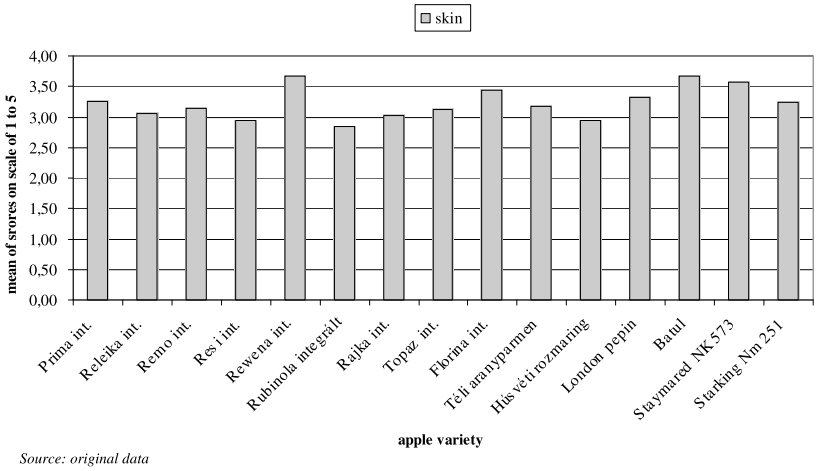

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Figure 5: Mean scores given to the skin of varieties

Conclusions

The consumers preferred the red colour, so the most preferred varieties were red, much less the yellow and light red ones. It is surprising that the combination of colours influenced the consumers differently depending on the extension of the cover colour on the fruit. Such a case is represented by the variety Remo. From the point of view of size, the favoured Florina and Príma were large with 75–80 mm diameter. Also London pepin and Batul received god scores. Regarding the taste, sweet and less acid varieties were liked as learned in earlier tests. Sugar and acids together giving a kind of

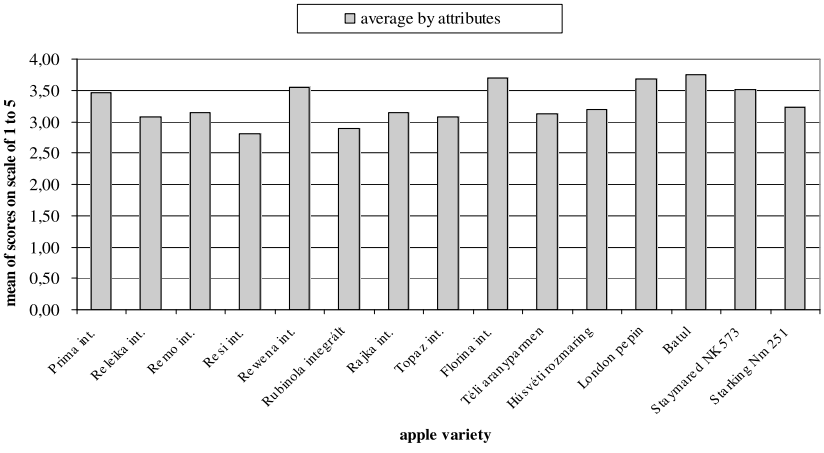

Figure 6: The mean combined scores of the five independent properties evaluated by the same subjects

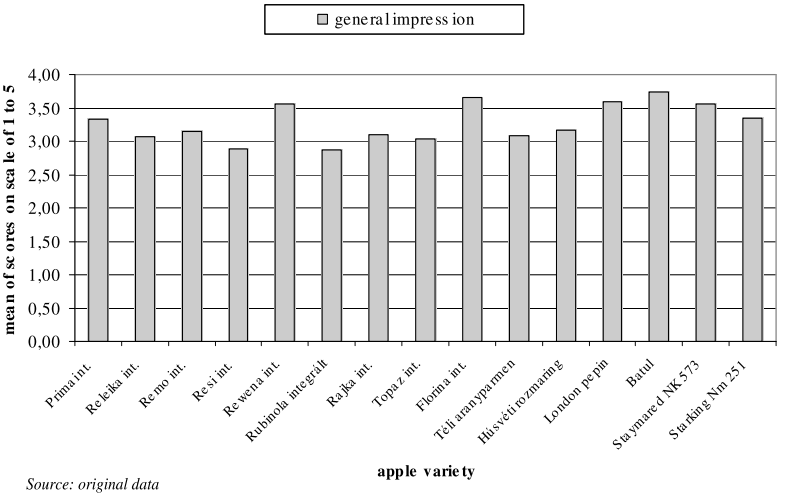

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Figure 7: Mean values of scores given to the general impression of the samples

Table 1: Relation between the scores of individual characters and of general impression

	Kendall's tau_b	*Colour*	*Size*	*Taste*	*Consistency*	*Skin*	*General impression*
Colour	Correlation Coefficient	1	0.505(**)	0.329(**)	0.327(**)	0.364(**)	**0.492(**)**
	Sig. (2-tailed)	.	0	0	0	0	0
	N	1407	1407	1407	1407	1407	1407
Size	Correlation Coefficient	0.505(**)	1	0.351(**)	0.377(**)	0.370(**)	**0.514(**)**
	Sig. (2-tailed)	0	.	0	0	0	0
	N	1407	1408	1408	1408	1408	1408
Taste	Correlation Coefficient	0.329(**)	0.351(**)	1	0.617(**)	0.479(**)	**0.702(**)**
	Sig. (2-tailed)	0	0	.	0	0	0
	N	1407	1408	1408	1408	1408	1408
Consistency	Correlation Coefficient	0.327(**)	0.377(**)	0.617(**)	1	0.545(**)	**0.673(**)**
	Sig. (2-tailed)	0	0	0	.	0	0
	N	1407	1408	1408	1408	1408	1408
Skin	Correlation Coefficient	0.364(**)	0.370(**)	0.479(**)	0.545(**)	1	**0.629(**)**
	Sig. (2-tailed)	0	0	0	0	.	0
	N	1407	1408	1408	1408	1408	1408
General impression	Correlation Coefficient	**0.492(**)**	**0.514(**)**	**0.702(**)**	**0.673(**)**	**0.629(**)**	**1**
	Sig. (2-tailed)	0	0	0	0	0	.
	N	1407	1408	1408	1408	1408	1408

***Correlation is significant at the 0.01 level (2-tailed)*
Source: original data

The consistency of fruit flesh was praised in London pepin, Batul, Staymared, Rewena, Florina and Starking, whereas the lower scores received Rubinola. The skin received good scores in Rewena, Batul, Staymared and Florina, but the were not very different from the rest. In general impression the peak was represented by four varieties: Batul, Florina, Rewena, London pepin, which coincide with the combined score of the five attributes. The numerical range of coefficients of correlation in diminishing order with the general impression was: taste, consistency, skin, size and colour.

Acknowledgment

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