

Development of fruit quality within top apple cultivars based on the consumer preference testing in last 34 years

J. BLAŽEK, F. PAPRŠTEIN

Research and Breeding Institute of Pomology Holovousy Ltd., Holovousy, Czech Republic

Abstract

BLAŽEK J., PAPRŠTEIN F., 2014. **Development of fruit quality within top apple cultivars based on the consumer preference testing in last 34 years.** Hort. Sci. (Prague), 41: 10–18.

Results of all public consumer preference testing sessions included in this study were to be divided into 3 time periods. During the oldest period (1979–1990), with regard to overall qualities and appearance of fruits, the cv. Rubín was the most preferred. Next, it was followed by the cvs Fantazie, McIntosh, Gloster, and Melrose. In the subsequent period (1991–2001), the cv. Bohemia was in the first position in all respects including taste and fruit appearance. Following it in downward sequence were the cvs Rubín, King Jonagold, Jonagold, McIntosh and Melrose. In the latest period (2002–2013), again both in the total scoring and fruit appearance, Bohemia was the most preferred. It was followed in descending order by cvs Orion, Meteor, Jomured, HL 623 and Gold Bohemia. Considering fruit taste alone, however, the most preferred cultivar was Orion. According to the overall results of studies from thirty-three years, in which a total of 198 cultivars or genotypes were included, the most preferred was cv. Bohemia, followed by cvs Meteor, Rubín, HL 623, Andera, Gold Bohemia, King Jonagold and Jomured. Regarding fruit taste itself, the top cv. Bohemia was directly followed by cv. Gold Bohemia and by the selection HL 1834.

Keywords: historic development; overall values; total scores; fruit appearance; cultivar assessing

Since 1979, consumer preference testing of selected apple cultivars and advanced selections involving both specialists in the area and participants from the wide public are annually organized by the Research and Breeding Institute of Pomology Holovousy Ltd., Holovousy, Czech Republic. The main aims of the study were complex results of these testing and stating of long-time trends in development of fruit quality within new apple cultivars.

The results of such consumer preference testing from individual years were usually published annually in journals (PAPRŠTEIN, BLAŽEK 1998; PAPRŠTEIN 1999). Aside from these, there are also published results from similar consumer preference testing held at later dates (BLAŽEK, PAPRŠTEIN 2010, 2012). Similar sensory evaluations of apple cultivars also took place in Germany (STEHR 2011).

Fruit quality assessments of different cultivars based on sensory fruit consumer preference testing were already established as a subject in numerous publications (MEHERIUK, LAU 1979; SCHOLTENS 1980; WATADA et al. 1980; GODDRIE 1982).

Fruit traits desirable for evaluation of apple cultivars include flavour, juiciness, sweetness, firmness, acidity, size, and colour (KELLERHALS et al. 2004; EIGENMANN, KELLERHALS 2007). The general consumer requirements for fruit quality were reviewed by HARKER et al. (2003).

As a standard, the cv. Golden Delicious has been used the most often at sensory apple consumer preference testing sessions. An important factor in the evaluation of fruit quality of different cultivars is a comparable state of their fruit maturity. Total quality flavour among the evaluated cultivars most-

Supported by the Ministry of the Education, Youth and Sports of the Czech Republic, Project No. MSM 2527112101, infrastructure of the Project No. CZ.1.05/2.1.00/03.0116, and by the Ministry of Agriculture of the Czech Republic, Project No. MZE RO0613.

ly coincides with quality colouring in the assessed fruits sampled and in particular with the extent of their red colouring (SCHOLTENS 1980).

General principles and procedures of sensory evaluation were comprehensively described (HEINTZ, KADER 1983). Sensory characteristics of fruits largely depend on the stage of fruits' maturity at harvest time and their storage conditions (WATADA et al. 1980). Therefore, for a range of cultivars the term used for consumer preference testing might be a problem. Frequently, an integral part of the descriptions of new cultivars also include their organoleptic properties (MILOSEVIC et al. 2009). Similarly, consumer preference testing properties of fruits are typically used in the description of apple novelties (FUNKE, BLANKE 2011).

Fruit quality and fruit colouration are important characteristics at present in the European market and new apple cultivars can very significantly contribute positively to the hereunto trend (BLANKE, DIXON 2009). Enhanced fruit quality is one of the main objectives across the range of apple breeding programs. Fruit quality is frequently associated with pest and disease resistance of particular cultivars (STOECKLI et al. 2011).

The successful introduction of new cultivars into the common market is a prolonged process that requires the collaboration of breeders, penologists and wholesalers (BROWN, MALONEY 2009). Aside from fruit characteristics, the suitability of the cultivar for an ecological system of apple production has risen in importance (YUE, TONG 2009). Recently, consumers' preferences and their willingness to pay for new valuable apple cultivars were reviewed in a special study done in the USA (YUE, TONG 2011). The objectives of this study were to determine how much consumers are willing to pay for 13 new and existing apple cultivars, and learn what quality attributes consumers' like or dislike in new vs. older apple cultivars. Results showed that compared with other apple cultivars, participants were willing to pay the highest prices for improved new cultivars.

This report presents results of public consumer preference testing sessions organised during the last thirty-four years by the Research and Breeding Institute of Pomology Holovousy Ltd.

MATERIAL AND METHODS

The public evaluation of apple cultivars and advanced selections was organised by the Research

and Breeding Institute of Pomology Holovousy Ltd. every year since 1979 until 2013. The consumer preference testing sessions took place most frequently during the first weeks of January, and only in six years they were postponed till February. Among the permanent participants of these sessions, fruit growers (both professional and amateur ones) were the most common, but every year various groups of students from a local technical school also participated. The number of evaluators supplying completed evaluation sheets fluctuated from year to year from 142 to 217.

The total number of apple cultivars or selections chosen for this consumer preference testing varied within the years between 41 and 68. Cultivars were included into each evaluation anonymously and randomly sequenced within the tests.

During the evaluation of each item, fruits were sliced into small sections and distributed on plates to each of the testers. They tasted them and subsequently recorded their rating of the evaluated characteristics based upon a 1–9 rating scale (in which 9 designates the best or ideal performance) into their sheets in the following sequence: smell, skin thickness, consistency of the flesh, its juiciness, taste according to the relation of acidity to sweetness, and taste.

The appearance of fruits was evaluated after the consumer preference testing session upon their exhibition, where each item was numerically identified by sequence in the consumer preference testing. This consecutive rating of fruit appearance was based on fruit size and shape, extent of overall colour and its attractiveness, presence and extent of skin russet (negative), and absence of other visual damage.

The total point value was obtained by summing the scores for smell, skin thickness, flesh consistency, flesh juiciness, fruit appearance and double the value of fruit taste.

The final evaluation of cultivars according to the results of all panelises was at first processed using data from 3 consecutive periods, each in the period of eleven years. Consequently, all data were summarized for the whole period of thirty-three years (1979–2013). In this evaluation the year 2012 was not included, because fruits harvested in the previous year were considerably damaged by hail, and particularly from the evaluation of their appearance on this account could not be objective. Only those cultivars or genotypes were included into each of the partial evaluations that were at least assessed in two different years. Similarly, the extent of at least three different years was the condition for their in-

clusion into the results for the entire period of the study. In total, 198 cultivars or genotypes were included in this study, from which 78 cultivars were evaluated in five different years and 26 cultivars among them more than 10 times.

Aside from the values in points, also the mean rating sequence of each cultivar within its entire evaluation period was included in the final tables. Despite the fact that the values of both indicators are mutually closely correlated, higher values of the sequence indicate larger variability within the evaluation of each particular cultivar within individual years.

Standard statistical analysis based on analysis of variance was performed and mean intervals of significant differences were calculated for the mean values.

RESULTS

First period of consumer preference testing

The results from the first summarised stage (1979–1990) are presented in Table 1. With respect to overall quality, the cv. Rubín was in the mean ranked in the first position and its prevalence in points was quite distinct. The very high quality of cv. Rubín was accentuated also by a larger number of its evaluations (upon the use of different clones). Regarding taste, this cultivar was evaluated in the third position and according to fruit appearance it was classified second in the total sequence.

Table 1. Cultivars with the highest values of mean scoring for the period 1979–1990

Cultivar	Number of replications	Total scores		Taste		Appearance	
		points	sequence	points	sequence	points	sequence
Rubín + clones	19	44.2	7.2	6.9	7.6	7.4	5.6
Fantazie	4	43.6	5.8	7.1	2.3	6.7	12.0
McIntosh + clones	10	43.4	10.1	6.3	14.9	6.8	17.0
Gloster	6	43.3	12.8	6.0	20.2	7.6	6.7
Melrose + clones	20	42.7	11.3	6.0	19.9	6.8	14.2
Jonalord	7	42.6	15.3	6.0	22.3	6.8	15.3
Mutsu	2	42.5	7.5	7.1	3.5	5.8	21.5
Elstar	6	42.4	10.2	6.8	4.7	6.3	24.0
H III 25/15 (Zvonkové × J. Grieve)	4	42.2	10.8	6.6	10.8	6.1	25.3
Maigold	2	42.2	10.5	6.0	15.5	6.5	13.0
Jonagold	10	42.1	11.0	6.4	12.7	6.6	16.7
HL VI 37/45 (J. Grieve × Jonathan)	3	41.8	23.3	5.9	30.0	6.9	19.3
Golden Delicious	10	41.7	15.8	6.3	13.7	6.3	22.6
Holday	6	41.7	14.0	6.3	13.8	6.7	13.8
Sentima	4	41.6	26.0	6.0	27.5	5.9	39.3
Spencer	6	41.5	15.7	6.0	19.8	6.4	18.8
Golden Spur	4	41.5	19.3	6.2	18.5	6.1	26.5
Sir Prize	5	41.4	25.2	6.1	21.0	6.0	33.2
Jarka	2	41.3	29.0	6.1	23.0	6.4	34.5
Kidd's Orange	10	41.0	23.1	5.8	25.7	6.6	20.4
Spartan	10	40.8	22.8	5.6	28.9	6.7	18.0
HL III 25/23 (Zvonkové × Jonathan)	3	40.7	32.7	6.1	24.7	5.9	42.0
Empire	6	40.3	17.3	6.0	16.8	6.1	24.0
Chieftain	6	40.2	25.7	5.5	27.8	6.3	19.8
Starkrimson Delicious	9	40.1	28.1	5.0	35.8	6.8	14.4
Gala	4	39.6	36.8	5.9	30.3	5.4	43.3
LSD at $P \geq 0.05$		1.79		0.51		0.52	

The cv. Fantazie was second in the sequence. This cultivar received absolutely the highest mean grade for taste. Concerning appearance of fruits, however, this cultivar was classified in the seventh position. Unfortunately, it was assessed only during four years. Later on, it was not included in the consumer preference testing sessions because this cultivar is very difficult to grow (susceptibility to diseases, alternative bearing). In addition, the storability of its fruits is very short.

In the next position with regard to total fruit quality, the cv. McIntosh was represented by two coloured clones. Regarding taste, it was placed in the 7th position within the total sequence, and in fruit appearance it was assessed as distant as the thirteenth place. The annual variability within the evaluation of both these characteristics was rather high.

A novelty of that time period, the cv. Gloster overtook the next position in total fruit quality, corresponding to 43.4 points and the value of 10.1 in the mean sequence. Regarding taste, it was classified with 6 points and in the 15th position with a very high variability of the sequence. On the contrary, it was the cultivar number one in the evaluation of fruit appearance.

The following cultivars were placed next in the sequence in descending order according to point values for total fruit quality: Jonalord, Mutsu, Elstar, HL III 25/15, Maigold and Jonagold. The differences among them in this respect, however, were minimal. Regarding taste, the cv. Mutsu was outstanding, having the same point value as the top cv. Fantazie. Unfortunately, this cultivar was evaluated only in two years. Next most remarkable in this characteristic was also the cv. Elstar, which was placed in the 4th position. Regarding fruit appearance, the cv. Jonalord was remarkable among the group having the same points as the cv. McIntosh.

The standard cv. Golden Delicious was classified according to total point values as distant as on the 10th position. Regarding fruit appearance, it occupied on average the 13th position and its evaluation in this respect was very variable within the years.

Second period of consumer preference testing

The results from the evaluated period 1991–2001 are presented in Table 2. The cv. Bohemia, which originated as a mutant of cv. Rubín possessing complete solid red fruits, was classified as an uncon-

ditional leader in all the evaluated characteristics. The original cv. Rubín and its other mutants were evaluated in all aspects as next in the sequence with minimal differences from the leader.

The third position in the sequence according to the total scoring and fruit appearance scoring was taken by the cv. King Jonagold, but like a novelty of that time it was evaluated only during four years. Regarding taste, it was scored in the 5th position. Subsequent to the cv. King Jonagold in the range was the original cv. Jonagold. It was slightly inferior to the novelty only in fruit appearance.

In the following position with regard to total fruit quality, similarly to the previous period, cv. McIntosh was represented by two coloured clones. During this period, however, regarding taste it was placed as distant as the 20th position. The annual variability within the evaluation of this characteristic was quite high.

The following cultivars placed next in the sequence in descending order according to point values for total fruit quality: Melrose, Rosana, Bohemia Gold, HL 158, Jonalord and Topaz. The differences among them in this respect, however, were very small. In comparison to the previous evaluation period, cv. Jonalord dropped from the 6th to the 10th position. Concerning taste, cv. Topaz was the best among the group having the 4th position within the overall sequence. The cv. Bohemia Gold was also quite close to it, occupying the 7th position. The relatively worst in taste among the group was cv. Melrose, classified in the 23rd position on the total sequence, and its scoring was very variable within this period.

Regarding fruit appearance, cvs Bohemia Gold and Melrose were best among the group occupying the 4th and 5th positions, respectively, in the total range.

The standard cv. Golden Delicious was classified according to the total point values as far as in the 18th place. Regarding its fruit appearance, it occupied exactly the same position in the total sequence.

Last period of consumer preference testing

The best cultivars or selections arranged according to mean scoring of total fruit quality are presented in Table 3. The unambiguous leader here according to nearly all criteria was the same as in the previous period – cv. Bohemia.

Second from the top regarding total fruit quality was the cv. Orion, possessing a solid yellow colour similar to cv. Golden Delicious. Regarding taste, it was the absolute leader (mean scoring 7.4). Unfortunately, owing to being the latest novelty it was evaluated only during 2 years. Its fruit appearance was evaluated as more or less average in the 17th position, not much better than cv. Golden Delicious.

The third position in the sequence with regard to total scoring was occupied by the cv. Meteor, possessing the potential for very long fruit storage. Its mean scoring for taste, however, at 6.3 points, was

ranged on average in the 14th position from the top just before cv. Golden Delicious. According to the mean sequence, its evaluation of taste was quite variable within particular years. Regarding fruit appearance, the cv. Meteor was classified in the 4th position behind the top cultivar Bohemia.

The novelty cv. Jomured was classified in the next position according to total fruit quality and also fruit taste, but its consumer preference testing took place only during four different years. Regarding fruit appearance, it was classified in the third position just behind cvs Bohemia and Rubin. Very similarly to cv. Jomured, the novelty cv. HL 623 was

Table 2. Cultivars with the highest values of mean scoring for the period 1991–2001

Cultivar	Number of replications	Total scores		Taste		Appearance	
		points	sequence	points	sequence	points	sequence
Bohemia	10	47.9	1.5	7.4	1.8	8.5	10.5
Rubín + clones	13	47.3	3.2	7.3	3.0	8.0	3.3
King Jonagold	4	45.1	6.5	6.8	9.0	7.5	6.3
Jonagold	10	44.8	10.0	6.7	12.3	7.2	10.5
McIntosh + clones	11	44.4	11.5	6.3	21.2	7.2	10.5
Melrose + clones	20	44.3	12.1	6.2	24.3	7.4	10.7
Rosana	4	44.2	13.3	6.5	15.3	7.0	14.8
Bohemia Gold	3	44.0	13.0	6.7	12.7	7.4	4.3
HL 158	3	43.9	10.0	6.5	13.0	7.1	11.7
Jonalord	5	43.8	16.6	6.2	24.6	7.1	15.0
Topaz	8	43.8	14.1	6.8	9.0	6.7	22.3
Elstar	8	43.6	16.0	6.9	8.9	6.3	29.5
Elista	6	43.5	11.8	6.8	9.0	6.4	24.7
Jomured	7	43.4	15.3	6.4	16.9	7.1	15.1
Jantar	7	43.4	15.3	6.6	14.6	6.7	22.4
Gloster	8	43.2	21.1	6.2	25.0	7.2	13.3
HL VI 37/45	2	43.1	22.0	6.1	18.0	6.8	25.0
Golden Delicious	9	43.1	17.2	6.7	11.0	6.7	20.2
Rubinola	8	43.0	18.4	6.6	13.1	7.1	13.6
Sir Prize	9	43.0	16.8	6.5	16.6	6.4	28.0
HL 156	2	42.7	21.5	6.4	20.0	6.6	24.5
Jarka	10	42.6	18.8	6.5	14.8	6.5	25.4
Sentima	10	42.4	23.0	6.1	24.4	6.5	27.5
HL 271	2	42.4	25.5	6.3	28.5	5.8	45.0
Andera	2	42.3	26.5	6.7	15.5	5.7	47.0
Arlet	9	42.3	23.8	6.2	24.8	5.9	38.0
LSD at $P \geq 0.05$		1.53		0.34		0.45	

also evaluated and placed in the subsequent position. Unfortunately, it was evaluated only in two different years.

The cv. Bohemia Gold was classified in the 6th position from the top according to the total fruit quality mean rating. It is by 2 steps of the sequence better than in the previous period of consumer preference testing.

The following cultivars were placed next in sequence in descending order according to point values for total fruit quality: HL 1132, Rubín, Melrose, HL 1834, Andera, Sir Prize and King Jonagold. Regarding fruit taste, the selection HL 1834 was remarkable among

the group; it was classified in the 5th position from the top. Concerning fruit appearance, cv. Rubín was the second, just after the top cv. Bohemia.

During the last period of consumer preference testing the standard cv. Golden Delicious, according to both total point values and fruit appearance, dropped extremely low, to the 26th position in the sequence. Concerning fruit taste, it was classified in the 15th position of the total sequence.

The greatest drop in rating within this evaluation period took place in the case of cv. McIntosh, which dropped down in total point value as far as the 29th position of the total sequence.

Table 3. Cultivars with the highest values of mean scoring for the period 2002–2013

Cultivar	Number of replications	Total scores		Taste		Appearance	
		points	sequence	points	sequence	points	sequence
Bohemia	6	46.6	2.0	7.1	1.8	8.4	1.2
Orion	2	45.6	3.5	7.4	1.0	6.9	10.0
Meteor	10	45.1	4.4	6.3	16.6	7.5	6.5
Jomured	4	44.8	5.3	6.7	7.8	7.7	10.8
HL 623	3	44.9	5.0	6.6	7.7	7.3	7.0
Gold Bohemia	4	44.4	8.8	6.8	6.0	7.3	10.5
HL 1132	3	44.0	10.7	6.3	17.7	7.1	14.7
Rubín + clones	11	43.9	11.5	6.5	12.3	7.8	3.5
Melrose + clones	10	43.9	10.0	6.1	21.9	7.2	10.3
HL 1834	4	43.8	14.8	6.7	11.0	6.5	25.3
Andera	10	43.7	12.3	6.5	11.6	7.0	15.6
Sir Prize	5	43.6	15.0	6.6	12.4	6.4	31.8
King Jonagold	4	43.4	13.0	6.4	14.0	7.4	8.5
Berta	4	43.4	15.8	6.2	20.0	7.1	13.8
Angold	10	43.4	14.0	6.1	23.3	7.1	13.0
Rubinstep	11	43.3	14.2	6.2	21.3	6.8	20.1
Rubinola	6	43.2	16.2	6.5	13.3	7.1	14.7
Rosabel	8	43.1	14.9	6.1	23.1	7.1	5.9
Topaz	11	43.1	15.3	6.6	9.0	6.4	27.2
Jonagold	3	42.8	21.7	6.3	17.7	7.1	13.3
HL 785	4	42.8	17.3	6.2	21.5	6.9	29.8
Rucla	9	42.7	17.0	6.3	16.4	6.5	24.2
HL 322	8	42.6	18.5	6.2	20.5	6.8	20.3
Gloster	10	42.4	19.3	6.1	20.7	7.3	11.6
Silvia	11	42.3	20.5	6.4	14.2	6.8	24.6
Golden Delicious	16	42.2	21.1	6.3	16.5	6.6	23.1
LSD at $P \geq 0.05$		1.14		0.25		0.38	

Summary for the whole period of consumer preference testing

This summary is presented in Table 4. According to the results of all the consumer preference testing sessions, the best cultivars and advanced selections were ranged regarding total point values into the following sequence: Bohemia, Meteor, Rubín, HL 623, Andera, Gold Bohemia, King Jonagold, Jomured, HL 1834, HL 1132, Melrose, McIntosh and Jonagold. The value of the leader is distinctly higher, but differences among the rest of the cultivars are very small. The standard cv. Golden Deli-

cious was classified in this respect as far down as in the 30th position.

The sequence regarding fruit taste is the following: Bohemia, Rubín, Gold Bohemia, HL 1834, Topaz, HL 623, King Jonagold, Rubinola, Jantar, Jomured, Jonagold, Andera, Sir Prize, Meteor, HL 158, Rosana and McIntosh. The standard cv. Golden Delicious was classified concerning fruit taste in the 19th position. This was distinctly better than its rating for total fruit quality.

Regarding fruit appearance, the top cultivars were ranged in the following order: Bohemia, Rubín, Meteor, Gold Bohemia, King Jonagold, An-

Table 4. Cultivars with the highest values of mean scoring for the all thirty-three years

Cultivar	Number of replications	Total scores		Taste		Appearance	
		points	sequence	points	sequence	points	sequence
Bohemia	17	47.7	1.6	7.4	1.7	8.4	1.2
Meteor	11	45.1	4.4	6.3	16.6	7.5	6.5
Rubín + clones	36	45.0	7.2	6.9	7.5	7.6	4.7
HL 623	3	44.9	5.0	6.6	7.7	7.3	7.0
Andera	4	44.7	6.0	6.4	11.5	7.4	6.0
Gold Bohemia	20	44.6	8.3	6.8	7.4	7.5	6.9
King Jonagold	8	44.3	9.8	6.6	11.5	7.4	7.4
Jomured	12	44.0	11.2	6.5	12.8	7.3	13.4
HL 1834	4	43.8	14.8	6.7	11.0	6.5	25.3
HL 1132	4	43.5	15.3	6.2	25.3	6.7	22.0
Melrose + clones	48	43.5	11.5	6.1	22.4	7.1	12.2
McIntosh + clones	26	43.5	13.2	6.2	20.2	7.0	14.5
Jonagold	25	43.4	12.1	6.5	13.2	6.9	20.0
Rosabel	8	43.1	14.9	6.1	23.1	7.1	12.6
Rubinstep	15	43.0	16.5	6.1	23.0	6.7	22.1
Topaz	20	43.0	14.9	6.6	9.3	6.5	25.1
Jonalord	10	42.8	16.7	6.1	24.1	6.9	16.4
Rosana	7	42.8	22.1	6.2	23.4	6.7	22.0
Sir Prize	19	42.7	18.5	6.4	16.6	6.3	30.4
Supermelred	5	42.7	21.6	5.9	34.2	6.8	23.2
HL 322	8	42.6	18.5	6.2	20.5	6.8	20.3
HL VI 37/45	3	42.6	22.0	6.1	23.7	7.0	19.3
Rubinola	15	42.6	16.9	6.6	12.5	7.1	14.1
Jantar	14	42.5	15.2	6.6	13.6	6.6	21.2
Sentima	17	42.4	22.0	6.2	23.7	6.4	29.4
HL 158	5	42.4	17.4	6.2	17.6	6.7	21.2
LSD at $P \geq 0.05$		1.29		0.28		0.31	

dera, Jomured, HL 623, Rubinola, Melrose, Rosabel, McIntosh, HL VI 37/45, Jonagold, Jonalord. The standard cv. Golden Delicious was classified in the 38th position, which was a bit worse than its evaluation of total fruit quality.

DISCUSSION

Generally, the results presented here from recent periods of public consumer preference testing are in good agreement with conclusions from similar cultivar assessments organised by The Central Institute for Supervising and Testing in Agriculture (NESRSTA 2013). However, higher numbers of absolute novelties are usually included.

The results presented here from the oldest period are in good agreement with similar results from the Netherlands. There, cv. Jonagold was the top one followed by cvs Karmijn de Sonnavile, Elstar, Gloster and Empire. Similarly, also cv. McIntosh was relatively well evaluated there. On the contrary, cv. Golden Delicious was ranged much less favourably (SCHOLTENS 1980). The taste of the cv. Jonagold was very well scored already in the early eighties of the last century (GODDRIE 1982).

The improved strains of cvs Jonagold and Elstar possessing attractive red coloration of fruits are assessed much more positively by consumers and, therefore, better sold (FUNKE, BLANKE 2011).

Tasting assessments of cv. Golden Delicious fruits considerably depend upon their stage of maturity. Higher acceptance of the cv. Fuji fruits by its consumers is negatively influenced by its low flavour of flesh and too firm skin. Evaluation of cv. Jonagold regarding its fruit quality is significantly influenced by the stage of fruit in maturity, harvest-time as well as its low flavour of taste. The cvs Jonagold and Wellant reached better scores, if they were assessed before December (STEHR 2011).

A particular problem in the innovation of the present apple assortment is that new cultivars possessing resistance to pest or diseases are still mainly inferior in fruit quality to the standard ones (STOECKLI et al. 2011). The first positive exception in this respect seems to be the cv. Orion, which placed second in the last evaluated period.

Considering the cultivars commonly grown today, only cv. Gala, with the exception of the period 1979–1990, has not been listed in the tables surveying the top ones. The main reason for this is probably its swift decrease of taste and other fruit

characteristics during fruit storage of the cultivar (VOLZ et al. 2003; McCLUSKEY et al. 2007).

Upon the basis of the study apple cultivars distinguished by top quality of fruits are identified. Their acceptance by the market however requires a range of other positive characteristics, first of all these concerning their tree productivity, resistance to diseases, fruit shelf life length etc. The introduction of any novelty into the market is a long-time consuming process that requires sharing of the information among researchers, fruit growers, their distributors and consumers.

CONCLUSION

- Cv. Bohemia has been a stable leader concerning the total taste quality for the last 15 years.
- From the recent novelties cv. Orion possessing a solid yellow colour similar to Golden Delicious seems to be the most promising.
- The third position in the last decade is steadily occupied by the new cultivar Meteor.
- From the commonly grown cultivars cv. King Jonagold, which was evaluated on the 3rd position in the previous decade, has presently damped down to 13th position.

References

- BLANKE M.M., DIXON G.R., 2009. The structure of coloured hail nets affects light transmission, light spectrum, phytochrome, and photosynthesis and apple fruit colouration. *Acta Horticulturae (ISHS)*, 817: 177–184.
- BLAŽEK J., PAPRŠTEIN F., 2012. Výsledky organoleptického hodnocení skladovatelných jablek konaného v Holovousích. [Results from sensory evaluation of storable apples held at Holovously.] *Zahradnictví*, 11: 14–15.
- BLAŽEK J., PAPRŠTEIN F., 2010. Výsledky organoleptického hodnocení skladovaných jablek. [Results from sensory evaluation of storable apples.] *Zahradnictví*, 9: 12–13.
- BROWN S.K., MALONEY K.E., 2009. Making sense of new apple varieties, trademarks and clubs: Current status. *New York Fruit Quarterly*, 17: 9–12.
- EIGENMANN C., KELLERHALS M., 2007. Welche Apfel wollen die Konsumentinnen und Konsumenten? *Agrarforschung*, 14: 6–9.
- FUNKE K., BLANKE M., 2011. Mikroklima-, Färb- und Geschmacksverbesserung durch Licht reflektierende Folie zu verschiedenen Auslegeterminen bei Elstar- und Jonagold Äpfeln unter schwarzem und weißem Hagelnetz. *Erwerbsobstbau*, 53: 1–10.

- GODDRIE P.D., 1982. Kleur en smaak van Jonagold. *Fruitteelt*, 72: 1314–1316.
- HARKER F.R., GUNSON R.A., JAEGER S.R., 2003. The case for fruit quality: An interpretive review of consumer attitudes, and preferences for apples. *Postharvest Biology and Technology*, 28: 333–347.
- HEINTZ C.M., KADER A.A., 1983. Procedures for the sensory evaluation of horticultural crops. *HortScience*, 18: 18–22.
- KELLERHALS M., GANTNER S., KREBS C., 2004. Neue Apfelsorten auf dem Prüfstand. *Schweizerische Zeitschrift für Obst- und Weinbau*, 12: 8–11.
- MCCCLUSKEY J.J., MITTELHAMMER R.C., MARIN A.B., WRIGHT K.S., 2007. Effect of quality characteristics on consumers' willingness to pay for Gala apples. *Canadian Journal of Agricultural Economics*, 55: 217–231.
- MEHERIUK M., LAU O.L., 1979. The relationship of mineral content to quality on Golden Delicious apples. *Canadian Journal of Plant Science*, 52: 525–526.
- MILOSEVIC N., MILOSEVIC T., GLISIC I., 2009. Productive and organoleptic traits of recent apple cultivars. *Acta Horticulturae (ISHS)*, 825: 565–570.
- NEJRSTA D., 2013. Organoleptické hodnocení jablek, jak jej ohodnotila odborná veřejnost. [Organoleptic evaluation of apples, how is it appreciated by expert public.] *Vinař-Sadař*, 1: 60–61.
- PAPRŠTEIN F., BLAŽEK J., 1998. Výsledky degustace jablek 1998. [Results from apple sensory evaluation held in 1998.] *Marketing ovoce*, 5: 8–13.
- PAPRŠTEIN F., 1999. Degustace jablek v roce 1999. [Sensory evaluation of apples held in 1999.] *Informace pro zahradníctví*, 5: 6–7.
- SCHOLTENS A., 1980. Smaaktoets van ooels oo te kerstveiling 1979 te Geldermalsen. [Taste experiment with apples on the Christmas auction market 1979 at Geldermalsen.] *Fruitteelt*, 72: 514–515.
- STEHR R., 2011. Deutsche Konsumenten beurteilen neue Apfelsorten. *Obstbau*, 6: 324–327.
- STOECKLI S., MODY K., DORN S., KELLERHALS M., 2011. Association between herbivore resistance and fruit quality in apple. *HortScience*, 46: 12–15.
- VOLZ R.K., HARKER F.R., LANG S., 2003. Firmness decline of 'Gala' apple during fruit development. *Journal of American Society for Horticultural Science*, 128: 797–802.
- WATADA A. E., ABBOTT J.A., HARDENBURG R.E., 1980. Sensory characteristics of apple fruit. *Journal of the American Society for Horticultural Science*, 105: 371–375.
- YUE C., TONG C., 2009. Organic or local? Investigating consumer preference for fresh produce using a choice experiment with real economic incentives. *HortScience*, 44: 366–371.
- YUE C., TONG C., 2011. Consumer preferences and willingness to pay for existing and new apple varieties: Evidence from apple testing choice experiments. *HortTechnology*, 21: 376–383.

Received for publication November 28, 2013

Accepted after corrections January 21, 2014

Corresponding author:

Ing. JAN BLAŽEK, CSc., Research and Breeding Institute of Pomology Holovousy Ltd., Holovousy 1, 508 01 Hořice v Podkrkonoší, Czech Republic
phone: + 420 493 692 821, fax: + 420 493 692 833, e-mail: blazek@vsuo.cz
