doi: 10.17221/232/2014-HORTSCI

Results of public tastings of apple novelties at the end of the storage seasons during the last 10 years

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Abstract

Blažek J., Paprštein F., Zelený L., Křelinová J. (2015): **Results of public tastings of apple novelties at the end of the storage seasons during the last 10 years**. Hort. Sci. (Prague), 42: 53–60.

From a total number of 62 apple samples included in this study, 42 cultivars or selections were evaluated after storing in standard conditions, and the remaining 20 in ultra low oxygen (ULO) storing conditions. The top leader regarding total taste quality was cv. Meteor, which obtained the highest total scoring value, and also in the mean sequence it was the number one cultivar. In the following position with regard to the total fruit quality was cv. King Jonagold. In a decreasing sequence of total fruit quality, the cultivars were classified in the following order: Rosabel, Andera, Angold, Berta and Meteor stored in ULO. In the case of fruit taste alone, Gold Bohemia was the total leader. Followed by cvs Rubinola and Andera. Regarding the character of the taste, cv. King Jonagold was relatively the sweetest, closely followed by cvs Pinova and Goldstar. On the opposite spectrum, with relatively the most acidic taste, were cvs Jonagold, Topaz and Rubin, all of which were stored in ULO conditions. Regarding fruit appearance cv. Melrose was evaluated as the most attractive looking apple. It was followed in this characteristic by the novelty cv. HL 212. Next in sequence were cvs Šampion (ULO), Benet, Gala Must (ULO), Angold and Andera.

Keywords: apples; cultivars; public tasting; fruit quality; fruit appearance; cultivar assessing

Fruit traits desirable for the 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 have been reviewed by Harker et al. (2003).

The general principles and procedures of sensory evaluation have been comprehensively described previously (Heintz, Kader 1983). Sensory characteristics of fruits largely depend on the stage of the fruits' maturity at harvest time and their storage conditions (Watada et al. 1980). Therefore, for a range of cultivars the term used for tasting might be problematic. Frequently, an integral part of the descriptions of new cultivars also include their organoleptic properties (Milosevic et al. 2009). Similarly, tasting properties of fruits are typically used in the description of apple novelties (Funke, Blanke 2011).

At present in the USA, according to the results of an internet questionnaire the following apple cultivars are considered as the best ones possessing taste quality: Cripps Pink, Pink Lady, Gala, Gold Rush, a superior strain of Red Delicious, Jonagold, Paula Red, Kidd's Orange Red, Golden Delicious, Granny Smith and Fuji (Smith 2014). Also the novelty cv. Honeycrisp was considered as the best apple for consumption. It is a product of the renowned University of Minnesota

Supported by the Ministry of Agriculture of the Czech Republic, Project No. RO1514 and 206553/2011-MZe-17253 and within the infrastructure of the project CZ.1.05/2.1.00/03.0116.

doi: 10.17221/232/2014-HORTSCI

apple breeding program and is incomparably juicy and sweet, with a crispness that is somehow apple-defying (Scarano 2014). Another highly promising novelty is cv. Ever Crisp obtained as a controlled cross of cvs Honeycrisp and Fuji (Herrick 2014).

At the Research and Breeding Institute of Pomology, Holovousy public tasting sessions are organized every year in the middle of storage season since 1979. The results summarizing 33 years of these sessions have been published recently (Blažek, Paprštein 2014). In this study 198 cultivars or genotypes in total were included; the best one was cv. Bohemia, followed by the cvs Meteor, Rubín, HL 623, Andera, Gold Bohemia, King Jonagold and Jomured. Regarding fruit taste itself, the top cv. Bohemia was directly followed by Gold Bohemia and then by the selection HL 1834.

Effects of climatic conditions on the fruit quality of apple cultivars assessed by public sensory evaluations were studied in the Czech Republic between 2000–2004 (Paprštein et al. 2006). Rubín and Rubinola were evaluated as the best cultivars in that study. They were followed by cvs Topaz, Angold and Jonagold. In contrast, cvs Golden Delicious, Gloster and Melrose performed well only at warm and moderately warm locations. The cv. Braeburn performed well only at the warmest locations. Among the new cultivars, Meteor was the best performer at moderately warm locations.

The single results of public apple cultivars tastings of performed at the end of the storage seasons have been published in only the in local papers (Blažek, Paprštein 2010, 2012).

MATERIAL AND METHODS

The evaluation of apple cultivars and advanced selections at the end of storage season was organized by the Research and Breeding Institute of Pomology Holovousy Ltd. from 2003 to 2014. The tasting sessions took place quite regularly during the third or fourth week of May. At that time, fruits of particular cultivars have been stored 7 or 8 months since their harvest. The fruits were stored in standard cold storage with a temperature permanently regulated within 1 to 2°C. A certain part (about one quarter) of the harvest was stored in ultra low oxigen (ULO) storage conditions.

Among the regular participants of these sessions were specialists of fruit variety assessment and experienced fruit growers. The number of evaluators supplying completed evaluation sheets fluctuated within the years from 25 to 45 (Table 1).

Table 1. The survey of general information on the tastings

Year	Date	No. of tasters	No. of samples
2003	20.5.	36	49
2004	20.5.	40	50
2005	18.5.	44	48
2006	23.5.	39	50
2007	17.5.	40	55
2008	22.5.	35	48
2009	20.5.	45	46
2010	28.5.	38	42
2011	17.5.	36	43
2012	22.5.	33	26
2013	23.5.	25	40
2014	22.5.	43	38

The total number of apple cultivars or selections chosen for these tastings according to acceptable performance varied within the years between 26 and 55. The parental origin of the evaluated cultivars or selections is given in Table 2. They were included in each evaluation anonymously within a randomized sequence obtained by tossing.

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 on their sheets in the following sequence: smell (odour), skin thickness, consistency of the flesh, its juiciness, taste according to the relation of acidity to sweetness, and taste in general.

The appearance of fruits was evaluated using the same rating scale after the tasting session upon their exhibition, where each item was numerically identified by sequence in the tasting. This subsequent 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 damages.

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 in general.

doi: 10.17221/232/2014-HORTSCI

Table 2. Parental origin of evaluated cultivars

Cultivar or selection	Parents	
	female	male
Andera	Florina	Jarka
Angold	A 28/39 (Antonovka o.p.)	Golden Delicious
Berta	Kidd's Orange	Idared
Felicita	Jonadel	Rubín
Florina	612-1	Jonathan
Fuji	Delicious	Ralls
Gala Must	Kidd's Orange	Golden Delicious
Gloster	Glockenapfel	Richared Delicious
Gold Bohemia	Bohemia	mutant
Golden Delicious	Golden Reinette	Grimes Golden
HL 189	Jonadel	Rubín
HL 212	Granny Smith	Šampion
HL 322	Clivia	Melrose
HL 514	HL III 12/30 (Jonathan × Ontario)	Rubín
HL 782	Rubín	Prisdilla
HL 851	Zuzana	Idared
Idared	Jonathan	Wagener
Jomured	Jonagold	mutant
Jonagold	Golden Delicious	Jonathan
King Jonagold	Jonagold	mutant
Meteor	Megumi	Melrose
Pinova	Golden Delicious	(Cox's Orange Pippin) × Duchess of Oldenburg
Rosabel	Melrose	Rubín
Rubín	Lord Lambourne	Golden Delicious
Rubinola	Prima	Rubín
Rubinstep	Ckivia	Rubín
Rucla	Ckivia	Rubín
Silvia	Glockenapfel	Šampion
Sirius	Golden Delicious	Topaz
Starkresa	HL 223 (Starkrimson Del. × Glockenapfel)	24TRS19T-2
Topaz	Rubín	Vanda

In the final evaluation only those cultivars or genotypes were included that were at least assessed in three different years.

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.

doi: 10.17221/232/2014-HORTSCI

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

RESULTS

Total fruit quality

The assessed cultivars sequenced in descending order of mean fruit quality are presented in Table 3. The best item based on the most important criteria, was unambiguously cv. Meteor. This cultivar obtained the highest total scoring value and also in the mean sequence it was the best one. Concerning fruit taste alone, it was in the mean ranked in the sixth position and according to fruit appearance it was classified as the tenth in the total sequence.

King Jonagold was the second cultivar with regard to point value in the sequence. It was also classified in the same position in the total sequence. This cultivar was evaluated in the 11th position regard-

Table 3. Cultivars with the highest values of mean scoring for the period 2003–2013

Cultivar	No. of replications	Total scores		Taste		Appearance	
		points	sequence	points	sequence	points	sequence
Meteor	7	44.2	6.4	6.3	14.1	7.0	16.4
King Jonagold	5	43.8	9.3	6.2	15.7	6.9	19.8
Rosabel	3	43.6	12.3	6.2	20.0	6.5	28.3
Andera	8	43.4	6.1	6.5	6.7	7.1	12.1
Angold	10	42.8	10.9	6.1	18.0	7.1	10.3
Berta	5	42.7	11.4	6.3	12.2	6.4	27.6
Meteor – ULO	3	42.7	9.9	6.0	20.3	6.8	17.6
Benet	3	42.6	11.0	6.3	12.5	7.2	8.0
Jonagold – ULO	6	42.4	10.0	6.2	13.8	6.8	15.8
Gold Bohemia	5	42.3	16.3	6.6	7.7	7.1	12.3
Gala Must	6	42.3	14.6	6.0	21.4	6.4	23.4
Rubimeg	3	42.1	18.3	5.8	28.3	6.2	29.0
HL 322	6	41.9	19.0	6.0	17.9	6.5	22.8
Silvia ULO	5	41.9	15.0	6.3	11.4	6.4	26.6
Rucla	7	41.8	18.9	6.1	18.5	6.4	26.0
HL 514	5	41.8	18.3	6.0	22.0	6.5	25.2
Rubinoila	6	41.4	21.0	6.5	6.3	6.4	29.0
Gloster	3	41.4	24.5	6.0	22.0	6.6	23.8
HL 2218A*	7	41.3	28.0	5.8	30.0	6.6	20.0
Melrose – ULO	9	41.2	16.7	5.9	19.0	6.2	31.0
Felicita	3	41.2	27.8	5.8	28.8	6.1	31.3
Rubín – ULO	4	41.1	23.3	6.0	20.7	6.9	14.3
Gala Must – ULO	4	41.0	21.8	5.9	22.2	7.2	11.0
Topaz	5	40.9	24.8	6.2	12.4	5.9	39.1
Silvia	7	40.9	24.4	6.1	17.3	6.3	27.3
LSD, $P \geq 0.05$		1.03		0.17		0.22	

*origin of HL 2018A: HL 237 (Starkrimson Delicious × Glockenappfel) × 26 TRS; ULO – ultra low oxygen storing conditions

doi: 10.17221/232/2014-HORTSCI

ing taste. Concerning the appearance of fruits, this cultivar was classified in the 13th position among all the evaluated items.

In the next position with regard to total fruit quality, cv. Rosabel. was classified on the basis of the three latest sessions. Regarding taste, it was placed in the 12th position within the total sequence, and in fruit appearance it was assessed only at the mean level having 6.5 points.

A novelty cultivar named Andera overtook others in the next position in total fruit quality, corresponding to 43.4 points, and at the 6.1 order position in the mean sequence. Regarding taste, it was classified as quite outstanding in the second position with 6.5 points. Concerning fruit appearance it was classified in the 7th position having 7.1 points in the mean for this characteristic.

The next item in the score values was the standard cv. Angold, which also occupied 7th position in the total sequence. It was finally classified in the same position also in fruit appearance; however, concerning taste it was placed only at the 17th place.

Table 4. Cultivars with the highest values of taste scoring

Cultivar	Taste		Acidity		Total scores	
	points	sequence	points	sequence	points	sequence
Gold Bohemia	6.6	7.7	5.6	24.0	42.3	16.3
Andera	6.5	6.7	5.5	29.2	43.4	6.1
Rubinola	6.5	6.3	6.0	16.0	41.4	21.0
Silvia – ULO	6.3	11.4	5.3	28.4	41.9	15.0
Berta	6.3	12.2	6.1	11.8	42.7	11.4
Meteor	6.3	14.1	5.5	29.8	44.2	6.4
Benet	6.3	12.5	5.4	34.0	42.6	11.0
Goldstar	6.2	13.0	6.4	7.3	40.5	32.5
Topaz	6.2	12.4	5.8	20.8	40.9	24.8
G.D. Reinders – ULO	6.2	11.7	6.3	9.3	40.2	18.0
King Jonagold	6.2	15.7	6.6	4.8	43.8	9.3
Rosabel	6.2	20.0	5.7	28.3	43.6	12.3
Jonagold – ULO	6.2	13.8	5.2	32.8	42.4	10.0
Topaz – ULO	6.2	17.0	5.2	30.6	40.8	19.0
Rucla	6.1	18.5	6.1	13.7	41.8	18.9
Silvia	6.1	17.3	5.7	23.2	40.9	24.4
Angold	6.1	18.0	5.8	21.6	42.8	10.9
HL 322	6.0	17.9	5.4	33.9	41.9	19.0
Gala Must	6.0	21.4	6.2	9.0	42.3	14.6
HL 514	6.0	22.0	5.7	25.8	41.8	18.3
Rubín – ULO	6.0	20.7	5.2	38.3	41.1	23.3
Meteor – ULO	6.0	20.3	5.4	29.6	42.7	9.9
Pinova	6.0	17.0	6.5	4.7	40.4	24.0
Gloster	6.0	22.0	5.6	30.5	41.4	24.5
HL 212	6.0	32.0	5.9	15.0	39.4	43.0
LSD, $P \geq 0.05$	0.17		0.31		1.03	

ULO – ultra low oxygen storing conditions

doi: 10.17221/232/2014-HORTSCI

The new cv. Berta, which originated from a crossing of the cvs Kidd's Orange and Idared, followed next in the total sequence. It was classified in the 9th position in the total sequence. Cv. Berta was outstanding in taste, classified in the 4th position, but rather average in fruit appearance.

The subsequent item in the total score was cv. Meteor, in the variant stored in ULO. It ranked 6 positions behind the leader stored in standard conditions, but the best one among all items stored in ULO.

The following cultivars were placed next in sequence in descending order according to the point

Table 5. Cultivars with the highest values of fruit appearance

Cultivar	Appearance		Total scores		Taste	
	points	sequence	points	sequence	points	sequence
Melrose	7.9	1.6	39.4	31.6	5.4	36.8
HL 212	7.3	4.0	39.4	43.0	6.0	32.0
Šampion – ULO	7.2	8.8	38.1	36.8	5.4	36.8
Benet	7.2	8.0	42.6	11.0	6.3	12.5
Gala Must – ULO	7.2	11.0	41.0	21.8	5.9	22.2
Angold	7.1	10.3	42.8	10.9	6.1	18.0
Andera	7.1	12.1	43.4	6.1	6.5	6.7
Gold Bohemia	7.1	12.3	42.3	16.3	6.6	7.7
Felicita – ULO	7.0	12.0	40.8	24.7	5.7	27.3
Meteor	7.0	16.4	44.2	6.4	6.3	14.1
HL 785	7.0	15.0	39.6	36.0	5.4	38.0
Rubín – ULO	6.9	14.3	41.1	23.3	6.0	20.7
King Jonagold	6.9	19.8	43.8	9.3	6.2	15.7
Angold – ULO	6.8	13.0	39.2	32.3	5.6	32.0
Sirius	6.8	14.2	44.9	3.2	7.0	1.6
Jonagold – ULO	6.8	15.8	42.4	10.0	6.2	13.8
Meteor – ULO	6.8	17.6	42.7	9.9	6.0	20.3
Rubinstep – ULO	6.8	18.7	39.8	27.3	5.7	28.3
Florina	6.7	20.0	37.1	40.7	4.8	40.7
Idared – ULO	6.7	16.3	40.7	25.3	5.6	31.0
Goldstar	6.7	19.0	40.5	32.5	6.2	13.0
HL 345	6.6	21.3	40.4	23.5	5.7	28.5
HL 2218A	6.6	20.0	41.3	28.0	5.8	30.0
HL 223	6.6	21.9	39.4	31.3	5.6	29.9
Idared	6.6	21.3	39.0	35.7	5.4	37.2
Pilot	6.6	20.0	37.7	42.7	4.9	44.7
Starkresa	6.6	26.0	40.1	35.3	5.4	37.7
LSD, $P \geq 0.05$	0.22		1.03		0.17	

origin of HL 212: HL 18 (Golden Spur. × Granny Smith) × (HL 26 Golden Delicious × Golden Delicious PL); origin of HL 785: Rubin × Priscilla; origin of HL 345: Golden Spur × Clivia; origin of HL 22: Starkrimson Delicious × Glockenappfel; ULO – ultra low oxygen storing conditions

doi: 10.17221/232/2014-HORTSCI

values for total fruit quality: Benet, Jonagold – ULO, Gold Bohemia, Gala Must, Rubimeg, HL 322, Silvia – ULO, and Rucla. Among this group, cv. Benet had the highest scoring for taste, at 6.3 points, which was the same as the total leader cv. Meteor. On the contrary, cv. Rubimeg scored relatively lowest for taste among the group – at 5.8 points. Regarding fruit appearance, Benet with a scoring value of 7.2 was the best among all cultivars mentioned so far. Also, cv. Rubimeg received relatively the lowest score among the group (6.2) for this characteristic.

Fruit taste

The cv. Gold Bohemia, which was evaluated in five years' sessions, was the overall leader of this characteristic (Table 4). With respect to the mean sequence, two cvs Rubinola and Andera were only, however, very slightly better ranged. Behind these three, the following cultivars were ranged in a descending sequence: Silvia – ULO, Berta, Meteor, Benet, Goldstar, Topaz, Golden D., Reinders – ULO, King Jonagold, Rosabel, Jonagold – ULO and Topaz – ULO. The differences in the point values among these cultivars were more or less minimal.

Regarding the character of the taste, cv. King Jonagold was relatively the sweetest closely followed by cvs Pinova and Goldstar. At the opposite spectrum among the above group, the relatively most acidic were cvs Jonagold, Topaz and Rubin, all stored in ULO conditions. In the case of the standard stored cultivars, the relatively most acidic were cvs Benet and HL 322.

Fruit appearance

The absolutely best cultivar in fruit appearance was standard Melrose (Table 4). Its unique superiority was in particular in the mean sequence 1.6. It was however evaluated only 5 times and unfortunately was not included in the last 3 sessions. The novelty selection HL 212 was evaluated as the second most outstanding cultivar concerning fruit attractiveness. These two leaders were followed in descending order by cvs Šampion – ULO, Benet, Gala Must – ULO, Angold. Andera, Gold Bohemia, Felicita – ULO, Meteor, HL 785, Rubín – ULO and King Jonagold. Among these cultivars, it was interesting to note a somewhat greater incidence of variants stored in ULO conditions.

DISCUSSION

The results presented here are in strong agreement with similar results from the Netherlands. There, cv. Jonagold was the top 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 in the early eighties of the last century (Goddrie 1982). Jonagold is frequently published a taste test winner. Also in the recent study of consumer preferences in the US, Jonagold was very well evaluated in appearance, aroma, texture, flavour, and overall likability expression (Kelley et al. 2010).

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 Golden Delicious fruits considerably depend upon their stage of maturity at the time of tasting. Evaluation of 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 higher scores when 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 to standard ones (Stoeckli et al. 2011).

The unique topmost taste of cv. Gold Bohemia was established at the best cultivar comparisons completed already 10 years ago (Paprštein et al. 2006).

Cv. Melrose is generally considered the best as a particularly attractive-looking apple cultivar (Hirst, Lerner 2003; Jamba 2007).

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Received for publication August 26, 2014
Accepted after corrections January 27, 2015

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