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The results of consumer preference testing of popular apple cultivars at the end of the storage season

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Abstract: The results from 23 tasting sessions of experienced evaluators that took place during the last decade in May are presented in 4 periods which lasted 5 years except for the first one, which was seven-years long. The winner of the first testing period was ‘Bohemia’, ‘Meteor’ was the winner of the second period and ‘Admiral’ was the top rated in the remaining two testing periods. Across all the years, ‘Meteor’ had the highest total punctual value, but it was only about 0.4 points higher than ‘Admiral’. In the next sequence, they were followed by the cultivars ‘Andera’, ‘Rubin’ and ‘Andego’. In the aroma evaluation, ‘Andera’, ‘Gold Bohemia’ and ‘Topaz’ were the best. ‘Admiral’, ‘Gold Bohemia’ and ‘Andera’ were the top rated in flesh consistency. ‘Admiral’, ‘Angold’ and ‘Andera’ were the best in juiciness. ‘Gold Bohemia’, ‘Admiral’ and ‘Meteor’ had the highest values of the general taste. ‘Admiral’, ‘Angold’ and ‘Meteor’ were the most attractive.

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

A consumer preference testing of the most important apple cultivars and the most promising novelties has been annually organised at the end of storage season by the Research and Breeding Institute of Pomology Holovousy since 1994. The results of these single evaluations are usually published in a local horticultural periodical in the Czech language (BLAŽEK, PAPERŠTEIN 1999, 2012; BLAŽEK, KŘELINOVÁ 2013; BLAŽEK et al. 2016). Only a part of these results was summarised and published in a scientific journal (BLAŽEK et al. 2015).

The evaluation of the fruit’s quality across the apple cultivars was frequently published in the past (MURRAY et al. 2001; HARKER et al. 2006; COROLLARO et al. 2013).

New apple selections are usually primarily evaluated in consumer panels. In one of them, consumer preferences were driven by sweetness, lack of tartness and the presence of a fruity flavour. Fruit texture,

preferences were driven primarily by crispness, juiciness and lack of skin toughness while preferences for fruit appearance were driven by a high percentage of red colour and the degree of striping (CLIFF et al. 2016). Consumers base their preferences initially on the fruit’s appearance, then on the fruit’s texture and then on their own personal experience with the cultivar (FENCO et al. 2010). Consistent with this, there were differences in the consumers’ preferences and a willingness to pay between frequent and infrequent apple consumers (YUE, TONG 2011; SEPPA et al. 2015).

At present in the US, according to 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’ (Anonymous 2014). The ‘Honeycrisp’ cultivar

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was considered as the best apple for consumption. It is a product of the renowned University of Minnesota apple breeding programme and is incomparably juicy and sweet, with a crispness that is somehow apple-defying (SCARANO 2014). Another promising variety is 'Ever Crisp' obtained as a controlled cross of 'Honey-crisp' and 'Fuji' (HERRICK 2014).

Very recently a study has taken the approach of merging sensory science with genome wide association analyses in order to map the human perception of an apple's flavour and texture onto the apple genome. The goal was to identify genomic associations that could be used in breeding apples for improved fruit quality. The trained sensory panel scored randomised sliced samples of each apple cultivar for seventeen taste, flavour and texture attributes using controlled sensory evaluation practices. A genome wide association analysis suggested significant genomic associations for several sensory traits including juiciness, crispness, mealiness and fresh green apple flavour (AMYOTTE et al. 2017).

Recently, the relationships between sensory components of a fruit's quality and numerous quantitative trait loci (QTLs) have been detected also, revealing the multigenic control of a fruit's texture traits in apple cultivars (SADOK et al. 2015).

MATERIAL AND METHODS

The evaluation of apple cultivars and advanced selections at the end of storage season was organised by the Research and Breeding Institute of Pomology Holovousy Ltd. from 1994 to 2017. During this testing period, the event was not organised in the year 2000 only because of the severe damage by the late spring frost. Every year's items were pre-selected from a larger scale of candidates and usually included the most promising novelties of the time.

This approach influenced their total number and the number of their replications (Table 1).

The tasting sessions took place quite regularly during the last week of May. At that time, the fruits of the particular cultivars had 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 subset of the items was stored in ultra-low oxygen (ULO) storage conditions.

Specialists of the fruit's variety assessment and experienced fruit growers were among the regular participants/testers of these sessions. The number of evaluators supplying the completed evaluation sheets fluctuated from 25 to 87 across the years.

The total number of apple cultivars or selections chosen for tastings according to the acceptable performance varied between 26 and 55 across the years. The cultivars were anonymously included in each evaluation within a randomised sequence for their identification.

During the evaluation of each item, the fruits were sliced into small sections and distributed on plates to each tester. 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: odour, skin thickness, texture of the flesh, its juiciness, its taste according to the relationship of the sourness to the sweetness, and flavour in general.

The appearance of the fruits was evaluated using the same rating scale, after the tasting session. The way of assessing the fruit's appearance was based on the fruit size and shape, the extent of the overall colour and its attractiveness, presence and the extent of the skin russet (negative), and the 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 doubling the value of the fruit taste in general.

Table 1. The frequency of the tasted cultivars

Number of replications	Number of items	Cultivars		
23	3	Angold	Idared	Zuzana
17–19	3	Glockenapfel	Meteor	Silvia
15 or 16	3	Florina	Rucla	Topaz
11–13	7	Goldstar	Gloster	Silvia
7–10	23			
4–6	48			
2 or 3	80			
1	169			

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The total dates were summarised into four partial seasons of five years in length, with the exception of the 1st one which included a seven-year period from 1994–2002. Only those items that were evaluated in at least during two different years were included into the tables of the means for these periods.

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

(47.1 points) was the best one, followed by ‘Meteor’, ‘Rucla’, ‘Gold Bohemia’, ‘Melrose’ and ‘Jonagold’.

For aroma, ‘Gold Bohemia’ was the best, followed by ‘Bohemia’ and ‘Berta’. ‘Pilot’ had the highest skin toughness followed by ‘Melrose’ and ‘Melrose Beamon’. ‘Angold’, ‘HL 701B’ and ‘Topaz’ were the best ones for flesh juiciness. ‘Zvonkové’ (‘Glockenapfel’), ‘HL 4A’ and ‘Gloster’ were the sourest and ‘Goldstar’, ‘Gold Bohemia’ and ‘Royal Gala’ were the sweetest. ‘Gold Bohemia’, ‘Bohemia’ and ‘Topaz’ were the best in flavour. ‘Rubin’, ‘Bohemia’ and ‘Meteor’ were the most attractive.

RESULTS

The period 1995–2002

The assessed cultivars are listed in a descending order of mean fruit quality (Table 2). ‘Bohemia’

The period 2003–2007

‘Meteor’ (45.3 points) that was newly registered at that time (Table 3) was the best in total fruit

Table 2. The cultivars with the highest values scored for the period 1994–2002

TS	Cultivar	Total points	Odour		Skin toughness		Texture		Juiciness		Sourness – sweetness		Flavour		Appearance	
			points	seqv.	points	seqv.	points	seqv.	points	seqv.	points	seqv.	points	seqv.		
1	Bohemia	47.1	6.4	2	5.0	37	6.9	1	6.7	5	6.4	40	7.3	2	7.9	2
2	Meteor	46.1	5.9	9	6.0	12	6.5	7	6.4	10	5.6	19	6.9	6	7.7	3
3	Rucla	45.9	5.6	14	5.8	17	6.5	4	6.5	7	6.4	10	7.3	3	5.9	21
4	Gold Bohemia	45.6	6.4	1	4.9	38	6.5	8	6.5	7	6.7	44	7.3	1	7.3	5
5	Melrose	44.1	6.0	7	6.8	2	6.8	2	5.6	32	5.9	28	7.1	5	7.1	9
6	Jonagold	43.8	5.8	10	5.3	29	6.2	15	6.1	15	5.9	26	6.6	11	7.4	4
7	Rubín	43.7	5.5	26	5.0	35	6.0	22	6.0	23	5.7	21	6.2	18	7.9	1
8	Melrose Beamon	43.6	5.3	36	6.6	3	6.2	14	6.4	9	5.3	13	6.1	21	6.3	22
9	Angold	43.6	5.8	11	5.7	21	6.4	11	6.9	1	5.4	14	6.3	17	6.8	12
10	Topaz	43.5	6.2	4	4.5	42	6.6	5	6.8	3	6.3	37	7.2	3	5.2	43
11	Goldstar	43.3	6.1	5	5.2	32	6.5	6	6.5	8	6.7	45	6.6	9	6.3	19
12	Berta (HL 728)	43.3	6.3	3	6.3	9	6.3	13	6.0	29	6.4	42	6.4	13	6.1	30
13	HL 701B	43.2	5.7	14	5.1	33	6.4	10	6.9	2	5.5	16	6.6	10	6.0	32
14	HL 322	43.0	5.8	12	5.2	30	6.7	3	6.1	17	5.8	23	7.1	4	7.2	6
15	Rubinola	42.5	6.1	6	4.4	44	6.5	9	6.0	26	6.3	38	6.7	8	6.1	29
16	Silvia (HL 17)	42.4	5.6	18	5.0	34	6.0	21	6.1	19	5.8	25	6.3	16	6.3	21
17	HL 189	42.2	5.6	19	6.2	10	6.1	17	6.3	11	6.2	35	6.1	22	6.0	31
18	King Jonagold	41.9	4.3	45	6.5	5	5.4	38	5.7	31	5.2	12	4.6	45	6.7	13
19	Andego (HL 369)	41.6	5.7	15	4.0	45	6.6	4	6.7	4	5.8	22	6.8	7	6.5	15
20	Gloster	41.6	5.5	27	5.0	36	6.1	18	6.0	22	4.6	3	5.7	31	6.8	11
21	Royal Gala	41.4	5.7	16	5.4	26	6.3	12	6.0	21	6.6	43	6.4	14	5.3	41
22	Silvia (HL 17)	41.0	5.8	13	6.0	14	5.7	29	6.1	18	5.9	27	5.8	28	5.5	38
23	Arlet	41.0	5.6	17	5.2	31	6.1	20	6.0	27	5.7	20	6.4	15	6.5	17
24	Produkta	41.0	5.3	37	4.9	39	6.1	19	5.5	35	4.9	7	5.8	26	6.2	26
25	HL 221	40.9	5.2	40	6.5	4	5.4	37	6.0	25	4.7	6	5.9	24	6.2	25

TS – total sequence; evaluation scale: 1–9; ULO – stored in ultra-low oxygen

Table 3. The cultivars with the highest values scored for the period 2003–2007

TS	Cultivar	Total points	Odour		Skin toughness		Texture		Juiciness		Sourness – sweetness		Flavour		Appearance	
			points	seqv.	points	seqv.	points	seqv.	points	seqv.	points	seqv.	points	seqv.	points	seqv.
1	Meteor	45.3	6.0	6	6.3	6	6.3	8	6.6	3	5.6	17	6.4	7	7.5	2
2	Andera (HL 623)	44.6	6.2	2	5.5	27	6.4	4	6.2	12	5.7	18	6.6	3	7.0	13
3	King Jonagold	44.4	5.9	10	5.2	34	6.2	17	6.5	5	6.5	42	6.4	11	7.9	1
4	Angold	44.2	6.4	1	5.1	38	6.3	7	5.9	25	6.1	33	6.5	5	7.0	9
5	Rubín	43.8	5.9	11	5.5	28	6.2	11	6.7	1	6.0	29	6.3	16	7.0	15
6	Rucla ULO	43.5	5.4	36	6.3	7	6.4	1	6.5	4	5.9	25	6.4	9	6.4	33
7	HL 728 (Berta)	43.4	5.7	17	6.2	11	6.1	20	6.0	22	6.1	34	6.3	12	6.9	17
8	Rucla	43.3	5.5	35	6.0	15	6.1	19	6.1	17	6.4	41	6.3	14	7.0	8
9	Rosabel (HL 617)	43.2	5.9	9	6.2	8	6.2	13	5.9	24	5.7	19	6.2	19	7.0	11
10	HL 1132	43.1	6.1	4	28.0	1	6.3	5	6.6	2	6.4	39	5.0	40	7.4	4
11	HL 1567	43.1	5.7	18	5.8	21	6.2	10	6.2	10	5.6	15	6.2	18	7.3	5
12	HL 221	43.0	5.5	31	6.2	9	6.0	24	5.9	33	5.3	6	6.2	20	6.9	19
13	Fuji Nagafu	42.8	5.3	39	6.2	10	5.8	32	5.9	29	6.6	43	6.1	24	6.9	16
14	Gala Must	42.7	5.7	21	5.6	24	5.9	28	6.1	14	6.3	38	6.0	26	7.5	3
15	HL 514	42.5	5.5	32	6.0	17	6.0	25	5.9	28	5.6	16	6.1	23	7.2	7
16	HL 322	42.5	5.6	29	5.6	26	6.2	15	5.9	26	5.5	12	6.3	15	7.0	14
17	Rubín ULO	42.5	5.6	27	5.2	35	6.4	2	6.3	8	5.6	14	6.6	1	7.2	6
18	DL-11	42.3	5.5	33	5.1	40	6.2	12	6.1	15	6.2	35	6.5	6	7.0	10
19	Rubinola	42.2	5.6	26	4.8	44	6.2	14	6.2	9	5.9	28	6.6	2	6.3	34
20	Topaz	42.2	6.2	3	5.0	42	6.2	18	6.1	19	5.9	26	6.6	4	6.0	38
21	Idared ULO	42.1	6.1	5	6.0	16	6.2	9	6.4	6	5.3	7	6.1	22	6.1	36
22	HL 189	42.1	5.7	19	5.4	31	6.0	23	6.2	13	5.9	27	6.2	17	6.5	28
23	Silvia (HL 17)	41.8	5.7	24	5.4	30	6.2	16	5.9	27	5.6	13	6.4	8	6.7	22
24	Gold Bohemia	41.7	5.9	12	5.1	39	6.4	3	6.0	20	5.7	20	6.3	13	5.8	39
25	Rubimeg	41.7	5.6	25	5.9	20	6.0	22	6.3	7	5.9	24	5.8	29	6.6	25

TS – total sequence; evaluation scale: 1–9; ULO – stored in ultra-low oxygen

quality followed by ‘Andera’ selection number (‘HL 623’). In a decreasing order of the total point values, they were followed by ‘King Jonagold’, ‘Angold’ and ‘Rubin’. The next one was ‘Rucla’, whose fruits were stored under the ULO conditions.

‘Angold’ was best in aroma, followed by ‘Andera’ and ‘Topaz’. The selection ‘HL 1132’ had the highest skin toughness, followed by ‘HL 851’ and ‘Pilot’. ‘Rucla’, stored under the ULO, ‘Rubin’, stored under the ULO, and ‘Gold Bohemia’ were the best for flesh texture. ‘Rubén’ was the juiciest, followed by ‘HL 1132’ and ‘Meteor’. ‘HL 851’, ‘Zvonkové’ (Glockenapfel) and ‘Zuzana’ were the sourest, while ‘Golden Delicious Reinders’, ‘Fuji Nagafu’ and ‘King Jonagold’ were the sweetest. ‘Rubin’ stored under the ULO, ‘Rubinola’ and ‘Andera’ obtained the highest values for the flavour. ‘King Jonagold’, ‘Meteor’ and ‘Gala Must’ were the most attractive.

The period 2008–2012

With regard to the total fruit quality, ‘Admiral’ having the mean total value of 44.65 points (Table 4) was assessed as the best. In the next sequence, ‘Meteor’, ‘Andera’, ‘Meteor’ stored under the ULO, ‘Rubinstep’ stored under the ULO, selection ‘B 171’ and ‘Angold’ were the next placed cultivars.

In the evaluation of the aroma, ‘Topaz’ was the best, followed by ‘Admiral’, ‘HL 855’ and ‘Melrose’. ‘Fuji Nagafu’ stored under the ULO, ‘Florina’ stored under the ULO and ‘Melrose’ stored under the ULO had the highest skin toughness. Regarding flesh texture, ‘Admiral’, ‘Meteor’, ‘Andera’ and ‘Topaz’ stored under the ULO were the top cultivars. ‘Angold’, ‘Admiral’ and ‘Meteor’ were the top cultivars in flesh juiciness. ‘Zuzana’ stored under the ULO, ‘Braeburn’ stored under the ULO and ‘Zuzana’

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Table 4. The cultivars with the highest values scored for the period 2008–2012

TS	Cultivar	Total points	Odour		Skin toughness		Texture		Juiciness		Sourness – sweetness		Flavour		Appearance	
			points	seqv.	points	seqv.	points	seqv.	points	seqv.	points	seqv.	points	seqv.	points	seqv.
1	Admirál	44.4	5.9	6	5.4	37	6.6	3	6.6	6	6.4	4	7.0	2	7.8	2
2	Meteor	43.6	5.7	6	6.0	15	6.4	1	6.6	3	6.0	35	6.7	3	7.5	2
3	Andera	43.1	5.7	7	5.9	19	6.3	2	6.4	9	5.8	27	6.7	2	7.0	7
4	Meteor ULO	42.5	4.8	29	6.3	6	6.1	12	6.6	4	5.6	23	6.3	7	7.1	6
5	Rubinstep ULO	42.3	5.2	16	6.1	13	6.2	4	6.1	15	5.9	32	6.2	10	6.8	9
6	B 171	42.2	5.7	4	5.9	18	6.1	6	6.3	13	7.0	29	5.7	4	6.8	10
7	Angold	41.9	5.5	10	5.7	27	6.1	13	6.7	2	5.7	25	6.1	15	7.2	5
8	Tophola (HL 17)	41.8	5.3	14	5.4	35	5.9	19	6.1	16	5.7	24	6.3	9	6.5	15
9	HL 855	41.7	5.8	2	6.1	12	6.0	14	5.8	31	4.6	5	6.0	17	7.6	1
10	HL 345	41.4	5.1	18	6.1	11	6.0	17	6.3	14	6.2	39	6.2	11	6.5	17
11	Melrose	41.2	5.8	3	5.9	21	5.9	21	5.9	25	5.3	14	5.8	24	6.1	29
12	Angold ULO	40.8	4.9	23	5.9	20	6.0	15	6.5	7	5.1	12	6.0	16	6.9	8
13	Rucla	40.1	5.1	21	5.9	22	6.2	5	6.0	23	6.0	34	6.1	14	6.2	22
14	HL 1042	40.0	5.6	8	5.3	36	6.1	8	6.1	17	5.0	10	6.0	20	5.4	39
15	Melrose ULO	39.7	4.8	26	6.4	3	5.7	27	6.4	12	4.9	9	5.7	25	6.6	14
16	Rucla ULO	39.6	4.7	34	5.1	39	6.1	10	5.6	34	4.8	7	6.2	13	6.8	11
17	Šampion ULO	39.6	4.6	36	5.6	30	6.1	9	6.4	11	6.1	37	5.8	23	6.1	28
18	HL 514	39.6	4.8	28	5.8	24	5.9	23	5.6	33	5.6	22	5.9	21	6.5	16
19	Topaz ULO	39.5	5.4	12	5.6	32	6.2	3	6.5	8	5.8	28	6.7	1	6.8	12
20	Florina ULO	39.4	4.8	27	6.4	2	5.8	26	6.1	18	5.3	15	5.7	29	6.4	18
21	Fuji Nagafu	39.3	5.5	9	6.0	16	5.9	22	6.0	21	6.3	41	5.6	33	6.2	25
22	Pohoda (HL 1711)	39.3	5.3	15	6.3	7	5.4	35	5.1	41	4.8	6	5.6	30	5.9	31
23	HL 189	38.8	4.8	30	5.3	37	5.7	30	5.7	32	6.0	36	6.0	18	6.2	20
24	Fuji Nagafu ULO	38.8	4.5	40	6.9	1	5.4	38	6.4	10	5.7	26	5.6	32	5.9	35
25	HL 851	38.7	5.7	5	4.0	42	6.1	11	31.0	1	6.3	40	6.4	5	5.0	41

TS – total sequence; evaluation scale: 1–9; ULO – stored in ultra-low oxygen

na’ were the most acidic in taste, while ‘B 171’, ‘Admiral’, ‘Fuji Nagafu’ and ‘HL 851’ were the sweetest. ‘Admiral’, ‘Topaz’ stored under the ULO, ‘Andera’ and ‘Meteor’ were the best in flavour. ‘Admiral’, ‘HL 835’, ‘Meteor’ and ‘Jonagold’ stored under the ULO were the leaders in fruit attractiveness.

The period 2013–2017

Concerning the total mean fruit quality, the leader of this period was ‘Admiral’ with 44.8 total points that was evaluated in only 2 years (Table 5). It was followed by ‘Meteor’, ‘HL 1834’ stored under the ULO, ‘Andera’, ‘HL 1132’ and ‘Angold’.

‘Red Cup’ was the best in aroma, followed by ‘Andera’ and ‘Meteor’. ‘Pohoda’ had the highest skin toughness, followed by the selection ‘HL 2350’

stored under the ULO and ‘Zuzana’ stored under the ULO. ‘HL 1934’ stored under the ULO, ‘Admiral’ and ‘Angold’ were the top cultivars in flesh texture. ‘Admiral’, the selection ‘HL 2350’ stored under the ULO and ‘Angold’ were the best in juiciness. ‘Zuzana’, stored under the ULO, ‘Zuzana’ and ‘Zvonkove’ (‘Glockenapfel’) were the sourest in taste, while ‘HL 1132’ ‘Fuji BC 2’, and ‘Red Cup’ were the sweetest. The best in flavour were ‘HL 1834 0’ stored under the ULO, ‘Admiral’ and ‘HL 1132’. ‘Admiral’, ‘Angold’ and ‘Meteor’ were the leaders in fruit attractiveness.

The final survey for all the years

This survey is presented in Table 6. Only the cultivars that were minimally assessed in two previous periods were included using the mean values.

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Table 5. The cultivars with the highest values scored for the period 2013–2017

TS	Cultivar	Total points	Odour		Skin toughness		Texture		Juiciness		Sourness – sweetness		Flavour		Appearance	
			points	seqv.	points	seqv.	points	seqv.	points	seqv.	points	seqv.	points	seqv.	points	seqv.
1	Admirál	44.8	5.7	9	6.0	7	6.4	2	6.6	1	5.6	11	6.6	2	7.6	1
2	Meteor	44.5	6.0	3	5.9	10	5.8	16	6.3	4	5.9	21	6.2	7	7.4	3
3	HL 1834 ULO	43.9	5.7	7	5.1	24	6.8	1	6.5	2	6.1	25	7.2	1	6.5	11
4	Andera (HL 623)	42.2	6.1	2	4.4	30	5.6	25	5.4	24	5.9	23	6.2	8	7.2	5
5	HL 1132	42.0	5.2	24	5.5	20	6.1	5	6.0	9	6.6	31	6.5	3	6.4	14
6	Angold	41.6	5.4	14	5.6	18	6.3	3	6.5	3	5.8	15	6.3	4	7.6	2
7	HL 2010	41.2	5.9	4	5.6	16	5.8	19	5.8	15	5.7	14	6.2	6	7.2	4
8	Braeburn	41.2	5.3	18	5.6	15	5.9	13	6.0	7	5.2	8	5.9	14	6.2	16
9	HL 2350 ULO	41.2	5.3	20	6.3	2	6.0	8	5.7	16	5.8	17	5.9	18	6.8	10
10	HL 345	41.1	5.2	25	5.7	12	5.8	18	5.5	22	6.0	24	5.7	21	7.2	6
11	HL 221	41.0	5.8	5	5.4	22	6.0	10	5.5	23	5.8	19	5.9	13	6.5	12
12	Benet (HL 619)	40.9	5.5	10	3.9	31	6.1	7	5.8	13	4.9	6	6.1	9	7.1	7
13	Rucla ULO	40.8	5.0	28	5.5	21	6.1	6	6.1	6	5.8	16	6.0	11	6.0	17
14	Topaz ULO	40.7	5.3	19	5.0	26	6.2	4	6.2	5	5.2	7	6.2	5	5.9	20
15	Lady Silvia	40.5	5.0	27	5.7	13	5.6	22	5.6	20	5.9	20	6.0	12	5.9	21
16	Fuji BC 2 ULO	40.4	5.3	21	6.0	8	5.8	15	5.8	14	5.7	13	5.5	23	5.5	27
17	Fuji BC 2	40.4	5.4	15	5.7	14	6.0	11	6.0	8	6.6	30	5.8	20	5.6	25
18	Rucla	40.3	4.8	31	5.8	11	5.8	17	5.6	18	5.9	22	6.1	10	7.1	8
19	Zuzana	39.9	5.4	17	6.1	5	6.0	12	5.9	12	4.2	2	5.7	22	5.9	22
20	Melrose	39.9	5.5	11	6.1	4	6.0	9	5.9	11	5.3	9	5.9	17	5.1	29
21	Red Cap	39.1	6.3	1	6.0	6	5.6	23	5.3	25	6.5	29	5.9	19	5.2	28
22	Zuzana ULO	39.1	5.0	29	6.3	3	5.8	14	6.0	10	3.4	1	5.4	24	5.0	30
23	Pohoda (HL 1711)	38.5	5.7	8	6.5	1	5.5	26	5.1	28	4.7	4	5.4	25	6.0	18
24	Lady Silvia	38.2	5.4	13	4.5	29	5.8	20	5.6	19	6.3	26	5.9	15	6.3	15
25	Glockenapfel	37.7	5.8	6	4.9	27	5.7	21	5.6	21	4.5	3	5.9	16	5.7	23

TS – total sequence; evaluation scale: 1–9; ULO – stored in ultra-low oxygen

‘Meteor’ and ‘Admiral’ were placed in first two positions of the total sequence with an expressive difference before the other cultivars. The winning cultivar, ‘Meteor’, had a total punctual value of only about 0.4 points higher than ‘Admiral’. They are followed by the cultivars ‘Andera’, ‘Rubin’, ‘Andego’, ‘Gold Bohemia’, ‘Angold’ and ‘King Jonagold’. The differences in the punctual values among them are, however, already very small.

‘Andera’ was the best in the evaluation of aroma, followed by ‘Gold Bohemia’ and ‘Topaz’. ‘Pilot’ had the highest skin toughness which was followed by ‘Pohoda’ and ‘Idared’ stored under the ULO. ‘Admiral’, ‘Gold Bohemia’, ‘Andera’ and ‘Gold Star’ were the top cultivars in flesh texture. ‘Admiral’, ‘Angold’, ‘Andera’ and ‘Topaz’ stored under the ULO were the best in juiciness. ‘Zuzana’, ‘HL 851’ and ‘Glockenapfel’ were the sourest in taste, while ‘Goldstar’, ‘Fuji Nagafu’ and ‘Gold Bohemia’ were the sweetest. ‘Gold Bohemia’, ‘Admiral’, ‘Meteor’, ‘Rubinola’

and ‘Topaz’ had the highest values in flavour. ‘Admiral’, ‘Angold’, ‘Meteor’ and ‘Rubin’ were evaluated as having the best in fruit attractiveness.

DISCUSSION

Only ‘Jonagold’ and ‘Fuji’ were relatively best placed among the apple cultivars that have been included possessing top fruit quality (GODRIE 1982; Anonymous 2014.; HERRICK 2014) in this study. On the contrary, ‘Melrose’ from the commonly grown cultivars was quite well evaluated here. It was well rated, especially for skin firmness. It is in agreement with our previous findings (BLAŽEK, PAPRŠTEIN 2014). Our rating of the cultivar ‘Melrose’ is similar to the results from Moldova that highlight all its high trade qualities, even after long term conservation (JAMBA 2007).

The very good taste of ‘Gold Bohemia’ was already identified 10 years ago (PAPRŠTEIN at al. 2006). In

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Table 6. The cultivars with the highest values scored for the total assessment period 1994–2017

TS	Cultivar	Total points	Odour		Skin toughness		Texture		Juiciness		Sourness – sweetness		Flavour		Appearance	
			points	seqv.	points	seqv.	points	seqv.	points	seqv.	points	seqv.	points	seqv.	points	seqv.
1	Meteor	45.0	6.0	5	6.0	8	6.2	11	6.3	4	5.8	21	6.8	3	7.6	3
2	Admirál	44.6	5.8	7	5.7	15	6.5	1	6.6	1	6.0	8	6.8	2	7.7	1
3	Andera (HL 623)	42.9	6.2	1	5.0	36	6.0	16	5.8	25	5.8	20	6.4	10	7.1	8
4	Rubín	42.8	6.0	4	5.1	32	6.2	12	6.0	19	5.9	12	6.4	13	7.5	4
5	Andego (HL 369)	42.7	5.8	8	4.8	38	6.2	9	6.2	8	5.8	17	6.6	6	6.9	9
6	Gold Bohemia	42.5	6.2	2	5.0	35	6.5	2	6.3	5	6.2	3	6.8	1	6.6	16
7	Angold	42.4	5.4	21	5.6	19	6.3	5	6.5	2	5.8	18	6.3	15	7.6	2
8	King Jonagold	42.0	5.1	33	5.9	12	5.8	28	6.1	12	5.9	16	5.5	32	7.3	5
9	HL 1132	42.0	5.5	19	5.7	16	6.2	13	6.1	11	6.1	6	6.4	14	6.9	11
10	Rucla	41.9	4.8	31	5.8	14	5.8	24	5.6	31	5.9	22	6.4	11	7.1	7
11	Melrose	41.7	5.5	18	6.1	6	6.0	15	5.9	21	5.3	29	5.9	25	5.1	38
12	Rucla ULO	41.3	4.9	35	5.5	22	6.2	10	5.9	20	5.3	28	6.2	16	6.5	18
13	Rubinola	41.2	5.8	7	4.6	39	6.3	4	6.1	10	6.1	5	6.6	4	6.2	25
14	HL 345	41.2	5.3	26	6.1	7	5.8	27	6.0	16	6.2	4	5.9	22	6.7	15
15	HL 514	41.1	5.2	31	5.9	10	5.9	17	5.8	26	5.6	23	6.0	19	6.9	10
16	Goldstar	41.0	5.9	6	5.4	25	6.4	3	6.2	6	6.4	1	6.5	7	6.0	31
17	Silvia (HL 17)	41.0	5.6	11	5.2	28	6.1	14	6.0	17	5.7	22	6.4	12	6.5	19
18	HL 322	41.0	5.4	23	5.4	24	6.3	6	6.0	15	5.6	24	6.5	9	7.1	6
19	Fuji Nagafu	40.9	5.5	15	6.0	9	5.9	20	6.0	14	6.3	2	5.6	31	6.2	23
20	HL 221	40.9	5.6	14	5.9	11	5.8	23	5.7	30	5.4	26	6.0	20	6.5	17
21	Topaz ULO	40.7	5.4	24	5.3	27	6.2	7	6.4	3	5.5	25	6.5	8	6.3	20
22	HL 189	40.7	5.2	29	5.5	20	5.9	21	6.0	18	6.0	9	6.1	18	6.2	21
23	Topaz	40.2	6.0	3	5.1	29	6.2	8	6.2	7	6.0	10	6.6	5	5.9	34
24	Gloster	40.2	5.7	10	5.1	31	5.9	18	5.9	23	5.0	34	5.8	26	6.8	12
25	Pohoda (HL 1711)	39.5	5.5	17	6.4	2	5.5	34	5.1	38	4.8	35	5.5	33	6.0	30

TS – total sequence; evaluation scale: 1–9; ULO – stored in ultra-low oxygen

this study, it had the highest mean value of flavour, like our previous study (BLAŽEK et al. 2014).

The fruit quality of ‘Rubin’ was very well rated within 50 cultivars grown and tested in the Czech Republic (BLAŽEK 2007). It was especially very well evaluated in Poland, where it was considered as one of the tastiest apples in production (PIESTRZENIEWICZ et al. 2006).

On the grounds of the results from last round of tastings, the most promising seems to be ‘Andera’ (HL623) selected within the progeny obtained by crossing the cultivars ‘Melrose’ and ‘Rubin’ that applied for a grant of plant variety rights in the Czech

Republic in 2014. It has been also included into the international testing variety within the EU and some other countries.

Unfortunately, the promising novelties such as the US ‘Honeycrisp’ and ‘Ever Crisp’ (HEDRICK 2014; SCARANO 2014) could not be included into these tastings.

As the last item of our discussion, we would like to supply our analysis of variety session sequence on the final rating. This factor is analysed in Table 7. Here, the evaluated influence of the sequence within the first five tasted items on their final rating can be found. The mean sequence of the first tasted item

Table 7. The influence of the sample sequence on its overall assessment

Sample sequence	1 st	2 nd	3 rd	4 th	5 th
The mean placement	25.4	25.1	23.4	26.2	26.3
The best placement	3	7	7	1	8
The worst placement	43	42	45	40	48

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was evaluated on the 25th position which is about 5 positions worse than the mean. From these cultivars, the best one was ‘Goldstar’ in 2017 that was classified with 41.89 points in 3rd place. The items that tested second and third in the sequence were classified the highest in the 7th position of the year sequence. Only one winner came from the items that tested 4th in the sequence. It was ‘Andera’, also in the session of 2017, gaining 45.1 points in total.

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