

CALITATEA UNOR SOIURI ROMANEȘTI ÎN RAPORT CU CERINȚELE CONSUMATORULUI

QUALITY OF SOME ROMANIAN CULTIVARS IN CORRELATION WITH CONSUMER PREFERENCES

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Abstract

The fruit quality is a complex of characteristics and traits, such as: fruit size, skin colour, the content of sugar, acids, vitamins, mineral substances, flesh consistence and succulence, flavor, etc. The objective of this study was to analyze fruit quality of apple, pear, plum, sweet and sour cherry cultivars in correlation with consumer preferences. The study was carried out at Genetics and Breeding Department of Research Institute of Fruit Growing Pitesti, Romania on 17 new cultivars of different fruit tree species: 4 apple cultivars ('Romus 3', 'Romus 4', 'Rebra' and 'Rustic'), 4 pear cultivars ('Monica', 'Paramis', 'Paradise' and 'Isadora'), 4 plum cultivars ('Romanta', 'Romaner', 'Roman' and 'Agent'), 3 sweet cherry cultivars ('Severin', 'Daria' and 'Superb') and 2 sour cherry cultivars ('Rival' and 'Tarina'). The following determinations were carried out: fruit size by weighing, flesh firmness with penetrometer non-destructive Qualitest, soluble solids content with digital refractometer and malic, citric and tartaric acids content with Minitrator Hanna Instrument, such as sensory evaluation of fruits using a scale from 1 (very low) to 9 (very good). The results have revealed that Romanian varieties were distinguished by the highest quality fruits. Thus, on the apple, 'Rebra' cv. has been distinguished by its large fruit, firmness and balanced taste. 'Isadora' pear variety can complement the winter assortment, being a variety of large and firm fruit. At plum, 'Romanta' cv. can be expanded in commercial culture for fresh consumption, and the 'Agent' variety for processing. 'Daria' sweet cherry cv. and 'Rival' sour cherry cv. have shown large and attractive fruits. These results could be useful for breeders, farmers and market.

Cuvinte cheie: sortimente pomicele, calitate, evaluare senzorială, cerințele pieței.

Key words: assortment, quality, panel test, market requirements.

1. Introduction

In the national strategy for research and development area, the agriculture should satisfy the demands of healthy and high quality food in accordance with the market requirements (Butac and Bulgaru, 2001; Braniște et al., 2007, 2008).

The assortment must be constantly improved with new and efficient varieties in order to meet the requirements of consumers and also of producers. Efficiency of varieties is determined by the high productivity, the resistance to diseases, pests and environmental factors, but also the fruit quality.

Fruit quality represents an important breeding objective, as the consumer requirements are constantly increasing (Harker et al., 2008, Seppa et al., 2013, Dan et al., 2015, Lace and Lacis, 2015). The new variety will be successful only if certain characteristics are met, such as: fruit size, skin colour, commercial aspect, sweetness, acidity, firmness, flavor, juiciness (Eigenmann and Kellerhals, 2007, Garcia Montiel et al., 2010, Blazek and Paprstein, 2014, Molnar et al., 2016).

Fruit quality assessments of different cultivars based on sensory fruit consumer preference testing were already established as a subject in a lot of papers (Blazek and Paprstein, 2014, Dan et al., 2015, Butac et al., 2015).

From this point of view, in this paper we have proposed to study the fruit quality of apple, pear, plum, sweet and sour cherry cultivars which resulted from the Romanian breeding programs, in correlation with consumer preferences.

2. Material and methods

The study was carried out at Genetics and Breeding Department of Research Institute of Fruit Growing Pitesti, Romania on 17 new cultivars of different fruit tree species: 4 new apple cultivars ('Romus 3', 'Romus 4', 'Rebra' and 'Rustic' versus 'Florina' as control), 4 new pear cultivars ('Monica', 'Paramis', 'Paradise' and 'Isadora' versus 'Packham's Triumf' as control), 4 new plum cultivars ('Romanta', 'Romaner', 'Roman' and 'Agent' versus 'Tuleu gras' as control), 3 sweet cherry cultivars ('Severin', 'Daria'

and 'Superb' versus 'Van' as control) and 2 sour cherry cultivars ('Rival' and 'Tarina' versus 'Mocanesti 16' as control).

On these varieties the following determinations were carried out:

- fruit weight was recorded with a balance in g/fruit;
- fruit firmness was measured with non-destructive penetrometer Qualitest HPE;
- fruit soluble solids content was measured with Digital Sucrose Refractometer – (Hanna Instrument 96801) in units of percent Brix;
- fruit content in malic, citric and tartaric acids and pH of fruits were measured using the device Minitrator and pH meter for fruit juice – Hanna Instrument 84532. Titratable acidity is expressed as g/100 g fresh matter;
- sensory evaluation of fruits was recorded by open taste panels consisting of researchers and students from Faculty of Horticulture. Whole fruits were presented to members on platters (10 typical fruits of cultivars), to rate attractively and flavour, in points 1 to 9 (in which 9 designates the best performance) according to a questionnaire used by the Romanian breeders (Annex 1). The rating of fruit appearance was based on fruit size and shape, skin colour. The rating of intern characteristics of fruit was based on taste, aroma and juiciness. The total point value was obtained by summing the scores for appearance and intern characteristics of fruit.

The differences between varieties were analyzed using analysis of variance (LSD test).

3. Results and discussions

The analysis of the varietal assortment propagated for Romanian orchards shows that the choice of varieties is an important criterion for achievements of quality and quantity crops in correlation with application of modern technologies.

At the **apple**, a species with a significant percentage in fruit consumption during a year and with an important role in the human diet, the existing situation shows that according to the organoleptic characteristics expressed in appearance (color, shape and size), all varieties promoted in the official list correspond to the diversification requirements of the fruit market.

On the Romanian market there are abundant apple fruits, but the majorities are imported from different EU countries (Dan et al., 2015). Even though that Romania was a large producer of apples and a lot of cultivars were created by Romanian breeders (Sestras, 2004, Coman et al., 2012, Militaru et al., 2013, Dan et al., 2015), the assortment available for consumers is covered by worldwide spread cultivars, while Romanian cultivars is not significantly present on the market.

The determinations carried out on the 4 apple varieties obtained in our institute, showed that all apple varieties studied were in the "Extra" quality standard (weighing over 140 g), between varieties being significant differences. 'Rebra' cv. has large fruits (the average weight 206.1 g), exceeding the control 'Florina' cv. 'Romus 3' cv. (summer variety) had the smallest fruit weight (144.5 g), but is characterized by the attractiveness of the fruit, its consistency, its succulence and its good taste (Table 1).

Regarding the soluble solids content, with the exception of 'Romus 3' cv., all three other varieties had slightly higher soluble solid content than of 'Florina' control variety (Table 1).

The flesh firmness is correlated with the thickness of the fruit skin. Among the varieties studied, only the 'Rebra' cv. had a higher fruit firmness than the 'Florina' cv. (respectively 85.17 units of HPE at 'Rebra' cv., compared to 85.01 units of HPE at 'Florina' cv.) (Table 1).

Comparing different fruits, on the pH scale, apples are located between lemons and oranges, with a pH between 3 and 4. The data recorded and shown in table 1 show that the varieties studied correspond within this range. With regard to the fruit content in citric, malic and tartaric acids, all 4 varieties exceeded the 'Florina' control. Thus, the average content of the varieties studied in citric, malic and tartaric acids was lower at 'Florina' cv. (known as variety with sweet taste), and higher at 'Romus 3' and 'Romus 4' cvs. (Table 1).

In Romania, in the **pear** orchards, many cultivars should be replaced by higher quality cultivars and resistant or tolerant to diseases and pests.

Regarding fruit size of all Romanian pear varieties studied, except 'Paradise' cv., was large, over 164 grams, between cultivars being significant differences. The average fruit weight was range between 115.2 g at 'Paradise' cv. and 181.2 g at 'Paramis' cv. (Table 2). The soluble solids content was uniform in all studied varieties ranging from 14.03% Brix ('Paramis' cv.) to 15.6% Brix ('Packham's Triumph' cv.) (Table 2).

Regarding firmness, the most firm fruits had 'Isadora' cv., traits inherited from the species *Pyrus serotina*, one of the parents of this cultivar belonging to this species (Militaru et al., 2010) (Table 2).

The pears fruits are less acidic than the apples fruits, the pH of the fruits in all studied varieties ranging from 3.26 ('Monica' cv.) and 3.56 ('Isadora' cv.). The content of fruits in malic, citric and tartaric acids had values close to those of the control variety (Table 2).

In the **plum**, the species with the widest spread and the most important production in the fruit-growing, the assortment includes a varied range, as a harvest period, but also a fruits quality (Butac, 2010).

Like the other species, in plum assortment structure changes have occurred, mainly due to the spread of plum Pox Virus and to the appearance of new cultivars with excellent fruit quality. The cultivation of 'Tuleu gras' and other cultivars like 'Stanley', 'Anna Spath', d'Agen', 'Vinete romanesti', etc., which have been grown for centuries, have declined due to its susceptibility to PPV. Some new cultivars obtaining in Romanian breeding program can be expanded into commercial culture due to the fruit quality.

That is why the last varieties created at RIFG Pitesti were analyzed in terms of fruit quality in accordance with consumer preferences.

Concerning of fruit weight, it ranged between 33.2 g at 'Agent' cv. and 65.5 g at 'Romanta' cv. In Romania, on the fruit market for the fresh consumption, are preferred plum varieties with large fruits (over 45 g). 'Romanta', 'Romaner' and 'Roman' cvs. have been distinguished by very large fruits (over 50 g) (Table 3).

The soluble solids content of fruit varied between 14.7% for the 'Roman' cv. and 25.7% for the 'Agent' cv., which was also suitable for dehydration. In a study of consumer's acceptance, Vangdal (1980) found that plums with less than 12.5% soluble solids were not acceptable for most of the consumers. The soluble solids content of all varieties studied was below this limit (Table 3).

Regarding the flesh firmness, determined with a non-destructive penetrometer HPE Qualitest, equipped with a plunger of diameter 0.10 cm², it can be observed that the varieties studied had a good flesh firmness, being over 40 HPE units (Table 3).

In terms of acidity, the fruit content in malic, citric and tartaric acids recorded different values, the lowest values being for 'Roman' and 'Agent' cvs., and the highest for 'Romaner' cv. (Table 3).

Compared to the control variety, 'Tuleu gras', known as the "king of plums" from a taste point of view, one can notice that some varieties have higher fruits and others have a higher content in soluble dry matter.

Sweet and sour cherry are the first fruits of the year, being the subject of one of the most effective commercial activities since the second half of May till July (Budan and Gradinariu, 2000).

Of the sweet cherry varieties studied, 'Daria' cv. was noted, with large fruits (8.80 g), sweet taste (16.70% Brix), firms (75.73 HPE units) and an average content in acids. Although they were not as sweet as fruits of 'Van' cv., the 'Daria' cv. gains by higher firmness, but also through earliness (Table 4).

The sour cherry varieties studied compared to the old variety 'Mocanesti 16' were superior from all points of view: larger fruits, attractive, firm and taste better expressed in the sugar-acidity ratio (Table 4).

Sensory evaluation is an important tool for assessing the market potential of varieties in all species. On the basis of the points marked in questionnaires by the researchers from RIFG Pitesti and the students from the Faculty of Horticulture Pitesti, the best score was obtained:

- apple - 'Romus 3' (18.7 total score) and 'Rebra' cvs. (18.3 total score) (Table 5, fig. 1);
- pear - 'Monica' (17.8), 'Paramis' (17.4) and 'Packham's Triumph' (17.4) cvs. 'Paradise' cv. has a lower score, due to the fact that it has small fruit, but this variety has been appreciated at all fruit exhibits by red colour. 'Isadora' cv. though not very appreciated by consumers, gains by winter consumption (Table 5, fig. 2);
- plum - the highest score was registered for the varieties 'Romanta' (19.8) and 'Tuleu gras' (19.9); 'Roman' and 'Romaner' cvs. do not convince themselves about the quality of the fruits, and the 'Agent' cv. loses the overall score by the fact that the fruit is small (Table 5, fig.3);
- sweet cherry – 'Daria', 'Severin' and 'Van' cvs. had the highest score. 'Superb' cv. obtained a small score, but it is remarkable through earliness (Table 5, fig. 4).
- sour cherry - following panel taste, 'Rival' and 'Țarina' cvs. were clearly superior to the 'Mocănești 16' cv. (Table 5, fig. 5).

4. Conclusions

The results have revealed that Romanian varieties were distinguished by the highest quality fruits. These results could be useful for breeders, farmers and market.

Thus, on the apple, the 'Rebra' cv. has been distinguished by its large fruit, firmness and balanced taste.

'Isadora' pear variety can complement the winter assortment, being a variety of large and firm fruit.

At plum, the 'Romanta' cv. can be expanded in commercial culture for fresh consumption, and the 'Agent' variety for processing.

'Daria' sweet cherry cv. and 'Rival' sour cherry cv. have shown great and attractive fruits.

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Annex, Tables and Figures

Annex 1. Questionnaire for assessing fruit quality (cultivars, selections, hybrids)

1. Name						
2. Occupation.....						
3. Tasting location.....						
4. Date of tasting.....						
Analyzed traits	Scale	Sample (cultivar)				
5. Exterior (commercial) aspect of fruits	Marks	1	2	3	4	5
Size	1-9					
Shape	1-9					
Skin colour	1-9					
6. Pulp traits	Marks					
Taste	1-9					
Aroma	1-9					
Juiciness	1-9					

Table 1. Fruit characteristics of apple cultivars studied

No.	Cultivar	Fruit weight (g)	s.u (%)	Firmness HPE units	pH	Malic acid (%)	Citric acid (%)	Tartric acid (%)
1	Romus 3	144.5 ⁰⁰⁰	11.6	75.40 ⁰⁰⁰	3.23 ⁰⁰	1.08 ^{***}	1.04 ^{***}	1.22 ^{***}
2	Romus 4	160.0 ⁰⁰	12.5	81.35 ⁰⁰⁰	3.06 ⁰⁰⁰	0.93 ^{**}	0.88 ^{***}	1.04 ^{***}
3	Rustic	161.6 ⁰⁰	12.8	83.02 ⁰⁰	3.5	0.41	0.39 [*]	0.46 ^{**}
4	Rebra	206.1 ^{***}	13.9 ^{***}	85.17	3.56	0.40	0.37	0.43
5	Florina (Control)	175.2	12.0	85.01	3.46	0.37	0.34	0.41
	LSD 5%	9.503	0.857	1.071	0.124	0.049	0.035	0.025
	LSD 1%	13.509	1.218	1.523	0.177	0.069	0.050	0.036
	LSD 0.1%	19.560	1.763	2.205	0.256	0.101	0.072	0.052

Table 2. Fruit characteristics of pear cultivars studied

No.	Cultivar	Fruit weight (g)	s.u (%)	Firmness HPE units	pH	Malic acid (%)	Citric acid (%)	Tartric acid (%)
1	Monica	164.5 ⁰⁰	14.46 ⁰⁰⁰	70.13 ⁰⁰⁰	3.26	0.25	0.23 ⁰⁰	0.28 ⁰
2	Paramis	181.2 ^{**}	14.03 ⁰⁰⁰	75.05 ⁰	3.50	0.28	0.25	0.30
3	Paradise	115.2 ⁰⁰⁰	14.50 ⁰⁰⁰	73.47 ⁰⁰⁰	3.46	0.29	0.27	0.31
4	Isadora	175.1	14.6 ⁰⁰⁰	85.40 ^{***}	3.56 [*]	0.30 [*]	0.27	0.33
5	Packham's Triumf (Control)	171.7	15.6	76.62	3.40	0.27	0.27	0.31
	LSD 5%	5.569	0.413	1.250	0.141	0.029	0.024	0.023
	LSD 1%	7.917	0.586	1.777	0.200	0.041	0.035	0.033
	LSD 0.1%	11.463	0.849	2.573	0.290	0.059	0.050	0.047

Table 3. Fruit characteristics of plum cultivars studied

No.	Cultivar	Fruit weight (g)	s.u (%)	Firmness HPE units	pH	Malic acid (%)	Citric acid (%)	Tartric acid (%)
1	Romanța	65.5 ^{***}	15.6 ⁰⁰	46.00	3.56	0.57 ⁰⁰⁰	0.55 ⁰⁰⁰	0.64 ⁰⁰⁰
2	Romaner	52.7 ^{***}	17.5	46.89	3.87 ^{***}	0.93 ^{***}	0.89 ^{***}	1.04 ^{***}
3	Roman	55.6 ^{***}	14.7 ⁰⁰⁰	49.21 ^{**}	3.50	0.36	0.34 ⁰⁰⁰	0.41 ⁰⁰⁰
4	Agent	33.2	25.7 ^{***}	42.77	3.53	0.36 ⁰⁰⁰	0.35 ⁰⁰⁰	0.41 ⁰⁰⁰
5	Tuleu gras (Control)	34.5	17.5	42.64	3.50	0.71	0.71	0.83
	LSD 5%	3.359	1.144	4.585	0.163	0.041	0.030	0.053
	LSD 1%	4.775	1.626	6.517	0.231	0.058	0.042	0.076
	LSD 0.1%	6.915	2.354	9.436	0.335	0.084	0.061	0.109

Table 4. Fruit characteristics of sweet and sour cherry cultivars studied

No.	Cultivar	Fruit weight (g)	s.u (%)	Firmness HPE units	pH	Malic acid (%)	Citric acid (%)	Tartric acid (%)
Sweet cherry								
1	Severin	6.67 ⁰⁰⁰	14.72 ⁰⁰⁰	58.77 ⁰⁰⁰	3.66	0.37 ⁰⁰⁰	0.35 ⁰⁰⁰	0.41 ⁰⁰⁰
2	Daria	8.75 ^{***}	16.70 ⁰⁰	74.86	3.73	0.54 ⁰⁰⁰	0.52 ⁰⁰⁰	0.60 ⁰⁰⁰
3	Superb	6.39 ⁰⁰⁰	13.52 ⁰⁰⁰	75.41	3.80	0.60 ⁰⁰⁰	0.57 ⁰⁰⁰	0.67 ⁰⁰⁰
4	Van (Control)	7.95	17.78	72.77	3.83	0.71	0.68	0.80
	LSD 5%	0.319	0.535	6.046	0.189	0.028	0.032	0.029
	LSD 1%	0.464	0.778	8.794	0.274	0.041	0.046	0.043
	LSD 0.1%	0.696	1.167	13.191	0.412	0.062	0.069	0.064
Sour cherry								
1	Rival	6.53 ^{***}	12.19	25.33	3.36	0.85 ⁰⁰⁰	0.81 ⁰⁰⁰	0.95 ⁰⁰⁰
2	Țarina	5.58 ^{***}	14.50 ^{***}	33.38 ^{***}	3.50 [*]	0.99 ⁰⁰⁰	0.95 ⁰⁰⁰	1.11 ⁰⁰⁰
3	Mocănești 16 (Control)	4.11	12.21	21.85	3.17	1.58	1.51	1.77
	LSD 5%	0.332	0.743	4.603	0.221	0.123	0.082	0.034
	LSD 1%	0.503	1.126	6.970	0.335	0.186	0.125	0.051
	LSD 0.1%	0.809	1.808	11.198	0.538	0.299	0.201	0.083

Table 5. Results of sensory evaluation

No.	Species / Cultivars	Score			General score
		Appearance	Pulp traits	Taste and flavour	
Apple					
1	Romus 3	7.0	5.9	5.8	18.7
2	Romus 4	6.8	5.4	4.8	17.0
3	Rebra	7.2	5.8	5.3	18.3
4	Rustic	7.0	5.0	5.0	17.0
5	Florina (Control)	6.8	5.5	5.2	17.5
Pear					
1	Monica	7.0	5.0	5.8	17.8
2	Paramis	6.8	5.3	5.3	17.4
3	Paradise	5.5	5.3	5.0	15.8
4	Isadora	7.0	5.0	5.0	17.0
5	Packham's Triumph (Control)	6.8	5.4	5.2	17.4
Plum					
1	Romanta	9.0	5.8	6.5	19.8
2	Romaner	6.4	5.2	4.9	16.5
3	Roman	8.2	4.5	4.8	17.5
4	Agent	5.5	5.8	6.5	17.8
5	Tuleu gras (Control)	5.8	7.0	7.0	19.8
Sweet cherry					
1	Severin	8.5	8.0	7.5	24.0
2	Daria	9.0	8.2	7.5	24.7
3	Superb	7.0	6.0	6.5	19.5
4	Van (Control)	9.0	8.1	7.5	24.6
Sour cherry					
1	Rival	7.8	7.5	7.0	22.3
2	Țarina	7.5	7.3	7.4	22.2
3	Mocănești 16 (Control)	5.0	6.0	5.3	16.3

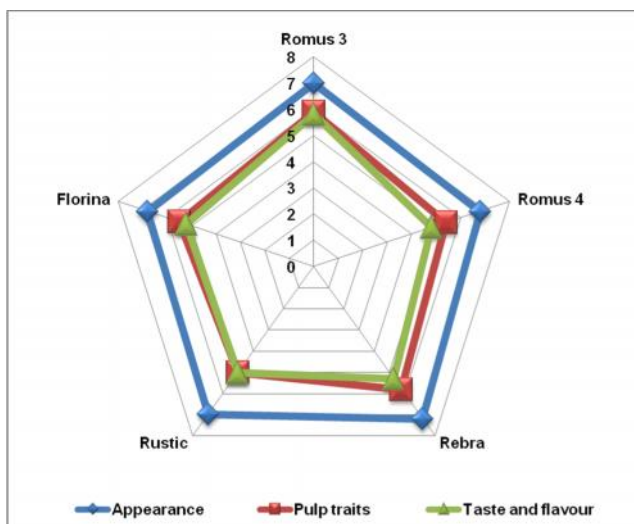


Fig. 1. Line-scale diagram of apple sensory evaluation

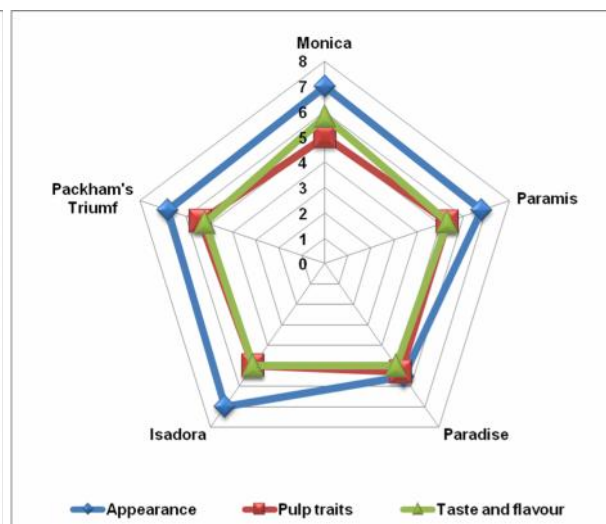


Fig. 2. Line-scale diagram of pear sensory evaluation

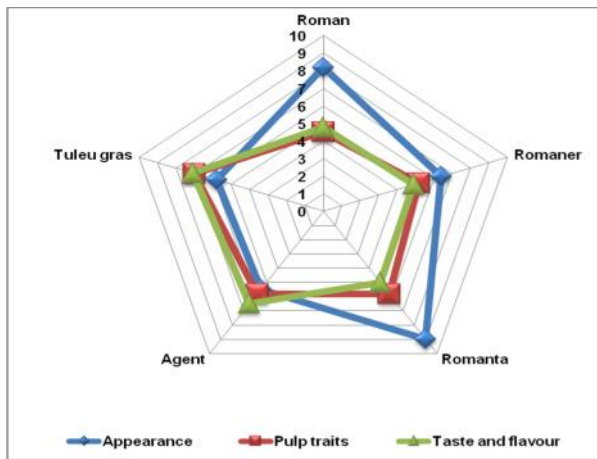


Fig. 3. Line-scale diagram of plum sensory evaluation

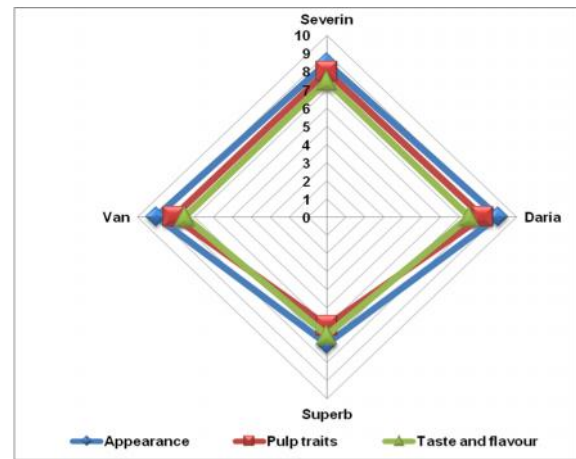


Fig. 4. Line-scale diagram of sweet cherry sensory evaluation

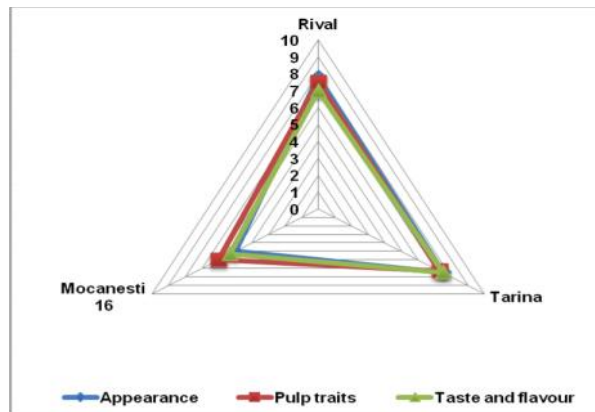


Fig. 5. Line-scale diagram of sour cherry sensory evaluation



Romus 3



Rebra



Paradise



Paramis



Romanta



Agent



Daria



Rival