

EVALUATION OF YIELD POTENTIAL AND FRUIT QUALITY OF SOME STRAWBERRY VARIETIES CULTIVATED UNDER SOUTHEAST CONDITION OF ROMANIA

EVALUAREA POTENȚIALULUI AGROPRODUCTIV AL CALITĂȚII FRUCTELOR LA UNELE SOIURI DE CĂPȘUN CULTIVATE ÎN CONDIȚIILE DIN SUD-ESTUL ROMÂNIEI

ILIE Alina¹, PETRIȘOR Cristina¹, DUMITRU Maria¹
e-mail: alisa_ilie@yahoo.com

Abstract. Phenological and quality of seven strawberry cultivars was evaluated in two seasons under the climatic conditions of south-east of Romania to select some cultivars to improve assortment and using in breeding program. We determined the blossom period, ripening period, fruit weight, soluble solids, titratable acidity, anthocyanin level, ascorbic acid content. We also determined the yield of fruits per plant. The highest average yield was obtained in Elsanta cultivar followed by Marmolada cultivar. The earliest to ripen were berries of the cultivar Premial and Coral but Bolero, Marmolada and Idea was late ripening cultivars. The highest of vitamin C content was obtained in Elsanta cultivar (59.8 mg/100g). Idea cultivar have a high content of dry matter (10.9 mg/100 g).

Key words: fruit, yield, quality, strawberry

Rezumat. Au fost evaluate șapte soiuri de căpșun din punct de vedere fenologic și calitativ pe parcursul a două sezoane în condițiile climatice specifice zonei sud-estice a României, pentru selectarea unor soiuri în vederea îmbunătățirii sortimentului și utilizării în programele de ameliorare. S-a determinat momentul înfloritului, stadiul de maturare a fructelor, greutatea fructelor, substanța uscată solubilă, aciditatea titrabilă, conținutul în antociani, conținutul în acid ascorbic. De asemenea, s-a determinat producția fructelor pe plantă. În cazul soiului Elsanta a fost înregistrată cea mai mare producție, urmat de soiul Marmolada. Soiurile Premial și Coral sunt cele mai timpurii, în timp ce soiurile Bolero, Marmolada și Idea sunt cu maturare târzie. Cel mai mare conținut în vitamina C a fost obținut la soiul Elsanta (59.8 mg/100 g). Soiul Idea a avut conținutul cel mai ridicat în substanță uscată (10.9 mg/100 g). S-au evidențiat ca și conținut de antociani soiurile Marmolada, Premial și Korona.

Cuvinte cheie: fructe, producție, calitate, antociani

INTRODUCTION

Strawberry (*Fragaria x ananassa* Duch.) is an important fruit of family Rosaceae and occupies an important place among the small fruits (Sharma and Thakur, 2008). Fruits can be obtained early in the season when there is no fresh

¹ Research Station for Fruit Tress Growing of Băneasa, Bucharest, Romania

fruits in the markets its marketability is high. Beside it is being a fresh table fruit, it can be used in processing industry for jam, marmalade, juice, ice cream or frozen fruit (Ilgin et al., 2006; Ozuygur et al., 2006; Wang and Galletta, 2002).

The phenological and productivity characteristics of strawberry are well studied by various authors, who have made classification by ripening group, starting from the early varieties to the late ones, classifications according to fruit mass, yield, quality of fruits and a different level of resistance to disease (Rahman et al., 2013, Antunes et al. 2010; Ilgin et al., 2006, Ozuygur et al., 2006)

In this paper, we aimed to evaluate the phenological and quality characteristics of 7 selected strawberry cultivars.

MATERIAL AND METHOD

Seven strawberry cultivars (Premial, Coral, Elsanta, Marmolada, Bolero, Idea, Korona), for their phenological and quality characteristic, grown in experimental field of Research Station Baneasa where used in investigation. The following characteristics were studied: period of blossom and ripening, fruit weight, yield per plant. Fruits were harvested at full maturity at the beginning of the strawberry harvest season (middle of May). The following physico-chemical parameters were determined: dry matter, soluble solids, titratable acidity, soluble solids/titratable acidity, ascorbic acid content, anthocyanins and polyphenols. Each measurement had three replications, three separate extractions from different samples.

Weight of fruit was determined using a sample of 20 fruit, determined by measurement with electronic balance(Precisa XT 220A) making it an average weight fruit. It is expressed in grams.

The percent of dry matter was determined by drying the slices of fruit to a constant weight in an oven at 105° C. The results was presented in percentage.

Content of soluble solids was determined by using Abbe refractometer with temperature correction. The results were expressed in ° Brix.

The titratable acidity was determined by titration of a known amount of fruits juice with 0.1N NaOH using phenolphthalein as an indicator. It was expressed as g citric acid / 100 g fresh weight.

Assessment of ascorbic acid content was achieved by quantitative reduction of 2,6-dichlorophenolindophenol and the excess of dye was spectrophotometrical determination at 500 nm. The results were expressed as mg/100g fresh weight.

Total anthocyanins content of the samples were determined using the pH differential method previously described by Giusti & Wrolstad, 2001. Results were expressed as mg cyanidin-3 glucoside equivalents/100g fresh weight.

The phenol content of berries ethanolic extracts was assessed by using the Folin-Ciocalteu reagent method (Aaby et al., 2012; Singleton & Rossi, 1965). Total phenolic content was expressed as gallic acid equivalents in mg per 100 g fresh weight (mg GAE/100gfw).

RESULTS AND DISCUSSIONS

Table 1 show time of blossoming strawberry cultivars. The average blossoming period is 28 days, while the full blossoming period amounts to 35 days. The Premial and Idea cultivars have the shortest blossoming period (25-26

days), while Coral and Elsanta cultivars had the longest (30 days). The earliest blossoming period was recorded in 9 April.

Table 1

Time of blossoming					
No.	Cultivar	Year	Date		Number of days
			Beginning	End of blossoming	
1	Premial	2010	9.04	3.05	25
		2011	17.04	12.05	25
		Average	13.04	8.05	25
2	Coral	2010	9.04	6.05	27
		2011	18.04	20.05	32
		Average	13.04	13.05	30
3	Korona	2010	12.04	3.05	21
		2011	18.04	21.05	33
		Average	15.04	12.05	27
4	Elsanta	2010	12.04	7.05	25
		2011	20.04	25.05	35
		Average	16.04	16.05	30
5	Bolero	2010	14.04	7.05	23
		2011	20.04	25.05	35
		Average	17.04	16.05	29
6	Idea	2010	12.04	3.05	21
		2011	22.04	23.05	31
		Average	17.04	13.05	26
7	Marmolada	2010	15.04	10.05	25
		2011	22.04	26.05	34
		Average	19.04	18.05	30
Average		2010	12.04	5.05	24
		2011	20.04	22.05	32
		2010/2011	16.04	13.05	28

The cultivars have a fruit ripening period from 8 May to 25 June, in an interval of 27 days (Table 2). Early ripening cultivars are Korona, Coral, Premial and late ripening cultivars are Elsanta, Bolero, Idea and Marmolada.

Table 2

Time of ripening					
No.	Cultivar	Year	Date		Number of days
			Beginning	End of ripening	
1	Premial	2010	8.05	3.06	25
		2011	10.05	5.06	25
		Average	9.05	4.06	25
2	Coral	2010	9.05	3.06	25
		2011	14.05	8.06	24
		Average	11.05	5.06	24
3	Korona	2010	12.05	4.06	22
		2011	11.05	8.06	27
		Average	11.05	6.06	24

4	Elsanta	2010	17.05	12.06	25
		2011	25.05	18.06	23
		Average	21.05	10.06	24
5	Bolero	2010	18.05	12.06	24
		2011	18.05	22.06	34
		Average	18.05	17.06	29
6	Idea	2010	17.05	15.06	28
		2011	22.05	25.06	33
		Average	19.05	20.06	30
7	Marmolda	2010	18.05	20.06	32
		2011	22.05	25.06	32
		Average	20.05	22.06	32
Average		2010	14.05	9.06	26
		2011	17.05	16.06	28
		2010/2011	15.05	12.06	27

According to Popovski and Popovska, 2012, Marmolada and Elsanta start blossoming in the first decade of April, while the blossoming comes to a close in the first decade of May. Also, they determine duration of blossoming of the Elsanta and Marmolada varieties between 27 and 30 days.

The results obtained in the experiment demonstrated that the tested cultivars displayed yield between 166 g/plant and 620.4 g/plant. These results are lowest to those obtained by Antunes et al., 2010. Our results are superior compared with data obtained by Ilgin et al., 2006, but its close with result of Popovski and Popovska, 2012, Rahman et al., 2013. However, Popovski and Popovska, 2012 obtained for Marmolada and Elsanta cultivars small yield compared with our yields for these cultivars.

In terms of average fruit weight were not significantly different recorded in two seasons (Table 3). In relation to the mean fruit weight per plant, Marmolada (18.7 g) showed the highest weight, while Bolero had the lowest weight 9.8 g. The fruit weight registered in this study was much higher than that reported earlier (Sharma and Thakur, 2008) but much smaller than wight of corean cultivars (Kim et al., 2013).

Table 3

Fruit weight and yield of cultivars studied

No.	Cultivars	Fruit weight (g)			Yield (g/plant)		
		2010	2011	2010/ 2011	2010	2011	2010/ 2011
1	Premial	13.9	12.7	13.3	284.9	205.1	245.0
2	Coral	9.7	12.1	10.9	158.6	192.8	175.7
3	Korona	16.3	14.6	15.4	393.8	428.9	411.3
4	Elsanta	13.8	14.9	14.3	354.2	410.4	382.3
5	Bolero	9.2	10.4	9.8	141.4	190.6	166.0
6	Idea	15.3	13.8	14.5	387.7	331.2	359.4
7	Marmolada	19.6	17.9	18.7	643.5	597.3	620.4
	Average	13.9	13.7	13.8	337.7	336.6	337.1

Significant differences of the chemical composition among the cultivars were observed (table 4).

The dry matter content ranged from 7.3 % in Premial cultivar to 10.9% Idea cultivar. The soluble solid content (SSC) is an important quality attribute influencing the fruit taste. The SSC of strawberry were mainly affected by cultivar. In our research, the level of soluble solids ranged from 6.5 (Premial) to 9.9 ° Brix (Idea). The obtained data are in accordance with the investigation of Laugale and Bite, 2006; Voca et al., 2008.

Significant differences in ascorbic acid content were found among cultivars. Ascorbic acid content of all tested cultivars ranged from 46.6 mg/100 g fresh weight (Coral) to 59.8 mg/100 g fresh weight (Elsanta). This data was similar to the previous studies of Voca et al., 2008, however level is highest compared with other authors (Kim et al., 2013; Olsson et al., 2004). Marmolada and Elsanta cultivars showing the highest value of ascorbic acid content among studies cultivars.

Table 4

Chemical composition of strawberries cultivars studied

Cultivars	Dry matter g%	Soluble solids content (SSC)° Brix	Titrateable acidity (TA) ac.galic/100ml	SSC/AT	Ascorbic acid mg/100g f.w.	Anthocyanins mg/100g f.w.	Total phenols mg/100g f.w.
Premial	7.3	6.5	0.90	7.2	49.9	16.8	78.5
Coral	10.4	9.8	0.95	10.31	46.6	14.9	71.3
Korona	7.2	7.1	0.81	8.76	56.1	32.3	139.8
Elsanta	8.3	8.2	0.96	8.54	59.8	11.6	57.2
Bolero	8.5	8.4	0.94	8.93	53.2	12.8	60.3
Idea	10.9	9.9	0.96	10.36	57.8	10.81	54.4
Marmolada	10.2	9.5	0.98	9.69	59.4	27.64	135.3

There were significant differences in anthocyanins content among cultivars (table 4) Anthocyanin content of strawberries ranged from 10.81 mg/100g FW (Idea) to 32.3 mg/100g FW (Korona). Marmolada and Korona cultivars have the highest anthocyanin content of all experiment cultivars.

The level of anthocyanins from cultivars studied by us is lower than found by other authors (Kim et al., 2013; Antunes et al., 2010). These authors obtained higher values for the strawberries cultivars studied. However our results are in range obtained by Aaby et al., 2012, Panico et al., 2009.

Total phenolic content in fruit of 7 cultivars of strawberry were quantified. Phenolic content varied among cultivars from 54-139,8 mg/100g of fresh weight.

The phenols content of the fruit were lower than those of other studies Panico et al., 2009 but similar to those reported by Wang et al., 2012.

CONCLUSIONS

1. Climatic and pedological from south-east of Romania are particularly favorable for strawberry crop;
2. In terms of yield during 2010-2011 period were highlighted the cultivars: Marmolada (620.4 g/plant), Korona (411.3 g/plant), Elsanta (382.3 g/plant), Idea (359.4 g/plant);
3. Regarding the chemical composition of fruit, Elsanta and Marmolada cultivars were evidenced by the high content of ascorbic acid.

REFERENCES

1. Aaby K., Mazur S., Nes A., Skrede G., 2012 - *Phenolic compounds in strawberry fruits: composition in 27 cultivars and changes during ripening*, Food Chem., 133(1): pp. 86-97
2. Antunes L.E.C., Ristow N.C., Krolow A .C. R., Carpenedo S., Junior C. R., 2010 - *Yield and quality of strawberry cultivars*. Horticultura Brasileira 28: p. 222-226.
3. Giusti M., Wrolstad R., 2001 - *Characterization and measurement of anthocyanins by UV-visible spectroscopy. Current protocols in food analytical chemistry* . John Willey and Sons, New York.
4. Ilgin M., Colak A., Kaşka N., 2006 - *Effects of the different growing media on the yield and quality of some strawberry (Fragaria x ananassa) cultivars*. Journal of Biological Sciences 6 (3): pp. 501-506.
5. Kim S.K., Bae R.N., Na H., Ko K. D., Chun C., 2013 - *Changes in physicochemical characteristics during fruit development in june-bearing strawberry cultivar*. Hort. Environ. Biotechnol. 54(1): pp. 44-51.
6. Laugale V., Bite A., 2006 - *Fresh and processing quality of different strawberry cultivars for Latvia*. Acta Hort. 708: pp. 333-336.
7. Olsson M. E., Ekvall J., Gustavsson K.E., Nilsson J., Pillai D., Sjöholm I., Svensson U., Akesson B., Nyman M.G.L., 2004 - *Antioxidants, low molecular weight carbohydrates, and total antioxidant capacity in strawberry (Fragaria x ananassa): Effects of cultivar, ripening and storage*. J. Agr. Food Chem. 52: pp. 2490-2498.
8. Ozuygur M., Kargi S.P., Kafkas E., 2006 - *Investigation on yield, fruit quality and plant characteristics of some local, European and American strawberry varieties and their hybrids*. Agriculturae Conspectus Scientificus 71 (4): pp. 175-180.
9. Panico A.M., Garufi F., Nitto S., Mauro R.Di, Longhitano R.C., Magri G., Catalfo A., Serrentino M.E., Guidi G.De, 2009 - *Antioxidant activity and phenolic content of strawberry genotypes from Fragaria x ananassa*. Pharmaceutical Biology, 47(3): pp. 203-208
10. Popovski B., Popovska M., 2012 - *Phenological and production characteristics of some strawberry varieties in the region of Skoje*. Agrožnanje, 13 (4): pp. 517-525.
11. Rahman M.M., Rahman M.M., Hossain M.M., Mian M.A. K., Khaliq Q.A., 2013 - *Characterization and field performance of 15 strawberry germplasm under Bangladesh conditions*. SAARC J. Agri., 11 (2), pp. 81-94.
12. Singleton VL, Rossi JA, 1965 - *Colorimetry of total phenolics with phoshomolybdic-phosphotungstic acid reagents*. Am J Enol Vitic 16, pp. 144-158.
13. Sharma G., Thakur M.S., 2008 - *Evaluation of different strawberry cultivars for yield and quality characters in Himachal Pradesh*. Agric. Sci. Digest, 28 (3), pp. 213-215;
14. Voca S., Dobricevic N., Dragovic-Uzelac V., Duralija B., Druzic J., Cmelik Z., Babojelic S, 2008 - *Fruit quality of new early ripening strawberry cultivars in Croatia*. Food Technol. Biotechnol. 46 (3): pp. 292-298.
15. Wang S.Y., Galletta G.J., 2002 - *Compositional change in Colletotrichum (Antracnose) infected strawberry fruit*. Acta Hort. 567, pp.815-819.