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EVALUAREA CALITĂŢII FRUCTELOR LA CÂTEVA SOIURI DE COACĂZ NEGRU ÎN CONDIŢIILE DIN LUNCA ARGEŞULUI

EVALUATION OF FRUIT QUALITY IN SOME BLACK CURRANT CULTIVARS UNDER CONDITIONS OF MEADOW ARGES

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Abstract

Blackcurrant has nutritional and therapeutic qualities. Organic acids and vitamins are constituents of these fruits with antioxidant character. Comparative studies have shown that black currant fruit is on the first place, as regards the content of C vitamin. The purpose of this paper is to show the characteristics of the chemical changes that are responsible for black currant fruit quality. Research has been carried out during the period 2008-2010, at the Research Institute for Fruit Growing Pitesti, Maracineni, using new varieties of black currant: 'Tines', 'Tisel', 'Ruben', 'Ben Hope', 'Titania', 'Ores', 'Bona', 'Tiben', '124/3'. Fruit samples were collected in the period 1-10 July, in three repetitions of the experiment. Experimental plot consisted of rows with four black currant bushes turn, arranged in three repetitions. Physical measurements, chemical and biochemical determination took into account the following components: total sugar content (%), using the volumetric method of the Fehling-Soxlet, titratable acidity expressed in the content of organic acids – citric acid (%) using titrimetric method with sodium hydroxide reagent, vitamin C mg/100g edible part, who was wrapping by solvent extraction with hydrochloric acid 5% using iodometric method, total solids (%) through the gravimetric method. The data obtained from the analysis of the studied varieties were interpreted using the analysis of variance test Duncan. In these conditions, there have been high levels of total sugar over 12.00 (%) and vitamin C, over 230 mg/100 g fresh fruit to some varieties of black currant. Also the content of organic acids has high values to many of the varieties considered in the study.

Keywords: organic acids, total sugar, vitamin C, black currant
Cuvinte cheie: acizi organici, zahăr total, vitamina C, coacăz negru.

1. Introduction

Recently, large areas of land were planted with shrubs of blueberry and currant species. However currant fruits are used to eating less than most fresh fruits, they are intended large proportion to industrialization.

Many researches on active biochemical compounds in fruits and vegetables show their importance in maintaining health and preventing disease (Glisycyznska - Swiglo, 2003, Lachman et al., 2000, Schmity - Eiberger et al., 2003, Shirrmacher, 2003, Lotito and Frei, 2004). Antioxidants (polyphenols, organic acids, vitamins, carbohydrates and proteins, etc.) are involved in degenerative reactions produced in vivo by inhibition of active oxygen, nitrogen and lipid peroxidation in food (Cevallos-Casals and Cisneros-Zevallos, 2003).

Phenols are also natural compounds with antimicrobial properties to inhibit the development of pathogens (Bowles & Junega, 1998; Davidson and Braner, 1981; Naidu, 2000; Payne, 1989; Sofos, Beuchat, Davidson & Johnson, 1998., On the other some anthocyanins may serve as sources of natural dyes, can even replace synthetic colors in food.

Literature, referring to research conducted so far in some cultivars of black currant (Gherghi et al., 1983, Souci et al., 1981) shows very high values for vitamin C content up to 250 mg / 100 g fresh material and Ben Ben Ard Rua (Rebeca Fitzgerarld, 2007), high contents of organic acids more than 3% (expressed as citric acid %). Vitamin C (ascorbic acid and dehydroascorbic acid) is one of the most important indicators of nutritional quality in many horticultural crops. Vitamin C content of fruit can be influenced by various factors such as genotypic differences, agropedoclimatic conditions, harvesting, post-harvest, etc. (Gherghi et al, 1983, Seung K, 2000).

In this paper we propose an evaluation of the chemical composition of black currant varieties rich in vitamin C, organic acids and carbohydrate substances.

Study objectives were to establish the chemical composition of fruits in active biochemical substances comparison between cultivar analyzed.

2. Material and methods

The research was conducted in the experimental field of shrubs at the Research Institute for Fruit Growing. Experience consisted of rows of black currant bushes, with four bushes on the row, arranged in three repetitions. The soil is from protisoils class, type wet groundwater aluviosoil formed on fluvial deposits with clayey and sandy granulometric composition. The land on which was located the experience is a terrace of river Arges meadow. In terms of the physical and chemical properties of soil, it is characterized by a moderately strong acid reaction, a middle-insurance humus in arable horizon and low digestible phosphorus content.

The biological material was represented by nine blackcurrant cultivar: 'Tines', 'Tisel', 'Ruben', 'Ben Hope', 'Titania', 'Ores', 'Bona', 'Tiben', '124/3'.

Fruit samples were collected in three repetitions in the first decade of July, in the early hours of the morning.

Chemical laboratory measurements consisted of the determination of total sugar content (%), using volumetric Fehling-Soxlet (1965), titratable acidity content expressed as organic acids (citric acid total%) using the volumetric method with sodium hydroxide, vitamin C mg/100 g fresh fruits, which was extracted with hydrochloric acid as solvent extraction using iodometric method, total dry matter% by gravimetric method.

Biometric measurements made at cultivars studied consisted of determinations of weight, diameter and fruit firmness.

All analytical determinations were repeated on three independent repetitions, and the data were subjected to analysis of variance (ANOVA). Differences between varieties studied were analyzed by Duncan test with significance level of P ≤0.05. There were also correlations between indicators and charts made absolute frequency values of quality indicators. Statistical analysis was performed using SPSS for Windows software.

3. Results and Discussion

Chemical data obtained from the fruit of nine cultivars shows high levels of vitamin C, organic acids and total sugar. In some cultivars ('Tisel') content of C vitamin was 255 mg/100g fresh material (comparable to the vitamin C value of gooseberries (Gherghi et al., 1983).

The content of vitamin C is influenced by species and variety (which counts metabolism intensity, pH product). This is found in the comparative study between selected varieties and for total organic acids (titratable acidity expressed as citric acid). Very high citric acid content was obtained for cultivars: 'Tines' (2.58%), 'Titania' (2.89%), 'Ruben' (2.93%), 'Tiben' (over 3%).

Total sugar content values are also higher for cultivars: 'Tisel' (12.72 mg/100 g fresh material), 'Tines' (12.35 mg/100 g fresh material).

The 81 sample values represent the total number of assays of organic acids (expressed as citric acid %) of black currant fruits. Each statistical unit (81) is the average of three annual determinations (2008-2010) made to the fruits of nine black currant cultivars (Figure 1).

In general, a normal distribution is symmetric and has the value asymmetry (skewnes) equal to zero. A significant positively skewed distribution has a long tail to the right, while a negative asymmetry distribution has a tail to the left. A value greater than 1 generally indicates asymmetry of a distribution that differs significantly from a normal distribution.

Sample mean was 2.439 organic acid, content values ranging from 1.52 minimum and maximum values of 3.73, with a maximum of 2.21 oscillation. Analyzing indicators dispersion coefficient of asymmetry has a positive value of 0.16 which shows that the prevailing values are smaller than average and show an abnormal distribution. In terms of the Shapiro-Wilk normality test (also called statistical W) it has value less than 0.05 which indicates that the shape distribution it is not normal.

Sample mean was 9.990% for total sugar content values, as shown in Figure 2. The values of total sugar content ranges from a minimum of 6.80% and 12.92% with a maximum amplitude of 6.12%. Asymmetry coefficient is negative (-0.320), indicating that the predominant values are higher than average, and the distribution it is not a normal trend. Vaulting coefficient (Kurtosis) had a negative value (-1.185), which shows the appearance of excess far from average values. Normality test Shapiro-Wilk strongest is 0.000 which shows that the distribution of values it is not normal (Shapiro-Wilk test p-value is less than 0.05).

In figure 3 there is a distribution of values for vitamin C content positively skewed by 0.032. Sample average was 142.531 mg/100 g fresh material, C vitamin contents ranging from a minimum of 44 mg/100 g fresh material and a maximum of 255 mg/100 g fresh material with amplitude of 211.2.Vaulting coefficient has a negative value -0.092 and indicates an average distance number.

Applying statistical test for testing the Shapiro-Wilk normality distribution was obtained value of 0.000 which causes rejection of normality.

In terms of dry matter, total sample mean was 18.29% (Figure 4). Asymmetry coefficient is negative (-1.708) which indicates the share values higher than average dry matter content of the sample. All our asymmetry indicates the emergence of very low values of the average variable analyzed. Vaulting coefficient (the excess) value was 2.98, which means that the distribution has not normal tendency values (the values lower than -2 and greater than 2 Kurtosis coefficient of normality is rejected). Analyzing the coefficient Shapiro-Wilk W = 0.000 was obtained which also causes rejection of normality.

On average values of organic acids content of varieties analyzed (Figure 5) shows statistically significant differences higher for 'Tiben 'variety to varieties: 'Tines', 'Tisel', 'Titania', 'Ores', 'Bona', '124/3'.

Comparing the values of the columns at the top of the chart, we see three uniform sets (a, c, d). They show statistically significant differences, according to Duncan test between varieties 'Tines', 'Tisel', 'Ruben', 'Ben Hope', 'Titania', 'Ores' (with significant high levels of organic acids) from 'Bona' cultivar and '124/3'.

Chemical data obtained from nine cultivars for the determination of organic acids show significant differences in 2008 and 2009 at 'Tiben' cultivar versus other cultivars studied (Figure 5), continuing the trend highlighted by the mean. Values recorded in 2010 show statistically differences between cultivars 'Ben Hope' and 'Tiben', significant higher cultivar for 'Ben Hope'.

Regarding the average values of total sugar content you notice the appearance of the six homogeneous groups of values (a, b, c, d, e, f), (Figure 6). Statistically differences are found in the cultivars 'Tisel' and 'Tines' (significantly larger) versus cultivars 'Ruben', 'Titania', '124/3', 'Bona', 'Tiben', 'Oresa', 'Ben Hope'. Also there are significant statistically differences between cultivars 'Tisel' and 'Tines'. The trend is observed for the mean total sugar content stored in 2008 and 2009 (Figure 6).

In 2010 year, the 'Tines' cultivar recorded the highest sugar content, differing significantly versus the other cultivars analyzed.

Analysis of the mean ascorbic acid content shows a significantly greater values to cultivar 'Ores' versus all other studied cultivars (Figure 7).The presence of five homogeneous groups of values indicates significant statistically differences between cultivars: 'Tisel' (higher) versus 'Tines', 'Ruben', 'Titania', 'Ben Hope', '124/3', 'Bona', 'Tiben' cultivars.

The average values of total content of condensate indicate differences statistically provided significantly higher for 'Tisel' cultivar versus 'Tines' cultivar and also between the 'Tisel' to 'Ben Hope' and 'Bona'. The trend is not maintained in the three years of study, as shown in Figure 8.

In 2008 there is a single homogeneous set of values that shows that there are differences statistically. In 2009 year and in 2010 year the series appearance a, b, c, d, e, f, g, h, I, shows a different character of the average values obtained. This highlights differences statistically significant between all analyzed cultivars.

In Figure 9, represented by the matrix of correlations, can be observed correlations between biochemical components of fruit quality. There is a negative correlation statistically assured (Pearson correlation coefficient is -0.254) between sugar content and total organic acids in fruit. Also negative correlation, but statistically uninsured were obtained from organic acid content and total dry matter.

Vitamin C content increased with total dry matter content. The correlation is positive as shown in figure 9. Correlation coefficient in this case is 0.275. Various authors (Gherghi, 1983, Seung, 2000) shows that the vitamin C in fruits may be influenced by factors such as genotypic differences, climatic conditions, cultivation, harvesting, post-harvest, etc.

Sugar content and C vitamin in fruits from black currant are negatively correlated, with a statistically negative correlation assured, as can be seen from Figure 9 and Table 2.

4. Conclusions:

1. Vitamin C content is high in some varieties of black currant ('Tisel', 'Ores'). It increases the total dry matter, with a positive correlation statistically assured.
2. Sugar content and vitamin C determined in black currant fruits, are negatively correlated, statistically assured. Total sugar level of fruits was also high in some cultivars ('Tisel' and 'Tines').
3. Organic acids (expressed as citric acid) was highest in 'Tiben' cultivar. This indicator correlates negatively and statistically assured with total dry matter of cultivars fruits analyzed.
4. All quality indicators studied within the cultivars of black currant fruits were rich in active biochemical compounds, intended for fresh consumption.

5. References

1. Bowles, B.L., Junega, V.K., 1998. Inhibition of foodborne bacterial pathogens by naturally occuring food additives. Journal of Food Safety, 18, 101-102.

2. Cevallos-Casals, B.A., Cisneros-Zevallos, L.,2004. Stability of anthocyanin-based aqueous extracts of Andean purple corn and red-fleshed sweet-potato compared to synthetic and natural colorants. Food Chemistry, 86, 97-77.

3. Davidson, P.M., Branen, A.L., 1981. Antimicrobiae activity of non-halogenated phenolic compounds. Journal of Food Protection, 44, 623-632.

4. Gherghi A., Burzo I., Liana Mărgineanu, Steliana Deneş, Dobreanu M., Pattantzus K., 1983. Biochimia şi fiziologia legumelor şi fructelor, Ed. Academiei RSR, Bucureşti.

5. Gliszczynska-Swilo A., Tyrakowska B., 2003. Quality of commercial apple juices evaluated on the basis of the poliphenol content and the TEAC antioxidant activity. Journal of Food Science, 68, 1844-1849.

6. Lachman J., Orsak M., Pivec V., 2000a. Antioxidant complex of bioflavonoids and ascorbic acid in apple (Malus pumilla Mill). Czech. Journal of Food Science, 18, 153-158.

7. Lachman J., Orsak M., Pivec V., 2000b. Enzymic browning of apples by polyphenol oxidates. Czech. Journal of Food Sciences, 18, 213-218.

8. Lotito S.B., Frei B., 2004. Relevance of apple polyphenols as antioxidants in human plasma: Contrasting in vitro and in vivo effects. Free Radical Biology and Medicine, 36: 201-211.

9. Rebeca Fitzgerarld, Chis-Berkers, 2007. www.hill-laboratories.com

10. Romero, M.A., Rodriguez, 1992. Determination of Vitamin C and Organic acids in various fruits by HPLC. Journal of Chromatographic Science, vol. 30, p. 433-437.

11. Schirrmacher G., Schempp H., 2003. Antioxidative potential of flavonoid-rich extracts as new quality marker for different apple varietes. Journal af Apllied Botany- Angewande Botanik, 77, 163-166.

12. Scmitz - Eiberger M., Weber V., Treuter D., Baab G., Lorentz., 2003. Bioactive components in fruits from different apple varietes. Journal of Applied Botany-Angewande Botanik, 77, 16.

Tables and Figures

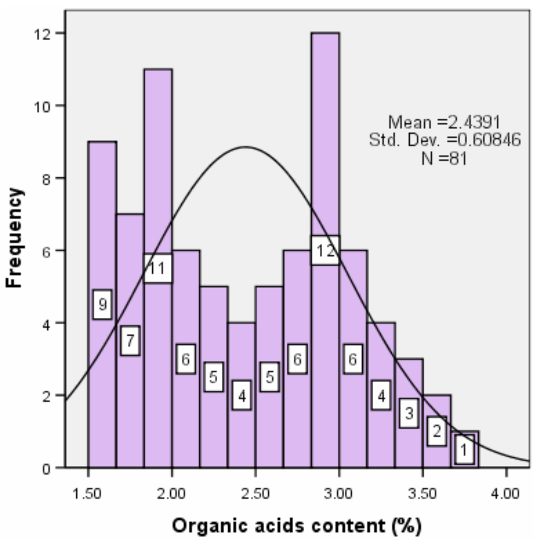


Figure 1. Histogram values of organic acids content in fruits of black currant

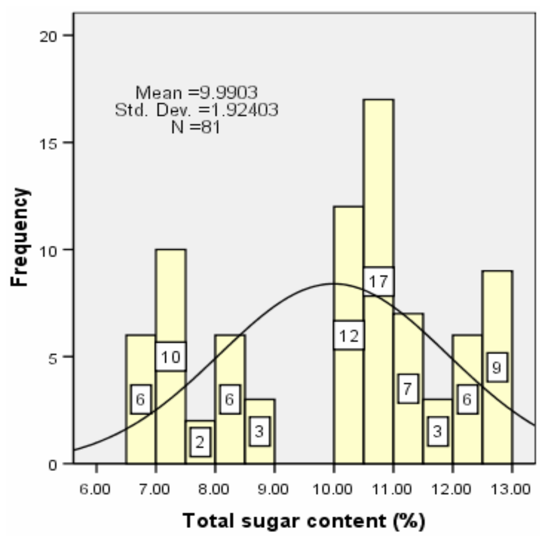


Figure 2. Histogram values of total sugar content of black currant fruit

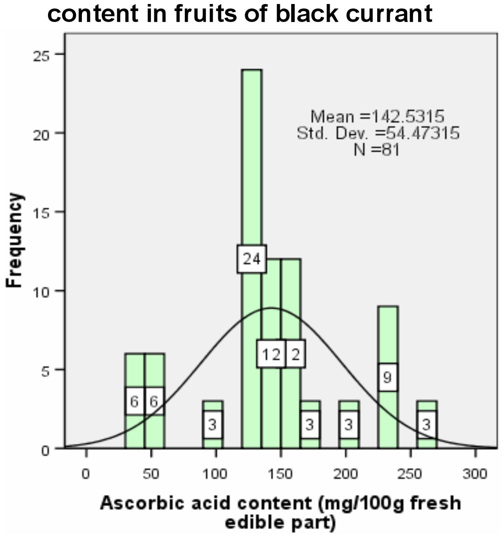


Figure 3. Histogram values for ascorbic acid content of black currant fruit

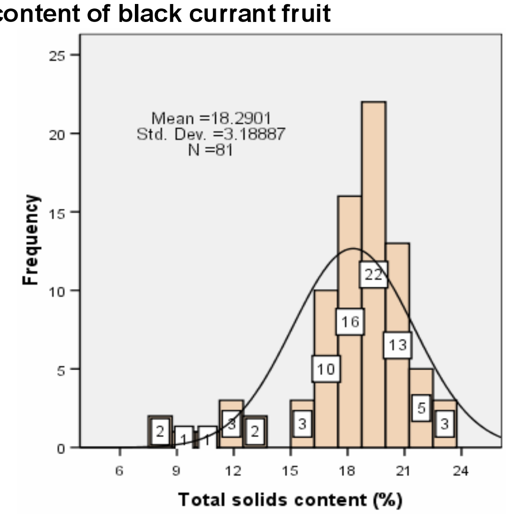


Figure 4. Histogram values of total solids content of black currant fruit

Table 1. Statistics for testing normality of distribution coefficients

		Organic acids content (%)	Total sugar content (%)	Ascorbic acid content (%)	Total solids (%)
N	Valid	81	81	81	81
	Missing	0	0	0	0
Mean		2.4391	9.9903	142.5315	18.2901
Median		2.4100(a)	10.5433(a)	140.6200(a)	18.9800(a)
Mode		1.53(b)	10.80(b)	132.00	19.14
Std. Deviation		0.60846	1.92403	54.47315	3.18887
Skewness		0.168	-0.320	0.032	-1.708
Std. Error of Skewness		0.267	0.267	0.267	0.267
Kurtosis		-1.120	-1.185	-0.092	2.981
Std. Error of Kurtosis		0.529	0.529	0.529	0.529
Range		2.21	6.12	211.20	15.02
Minimum		1.52	6.80	44.00	7.50
Maximum		3.73	12.92	255.20	22.52

a Calculated from grouped data.
b Multiple modes exist. The smallest value is shown

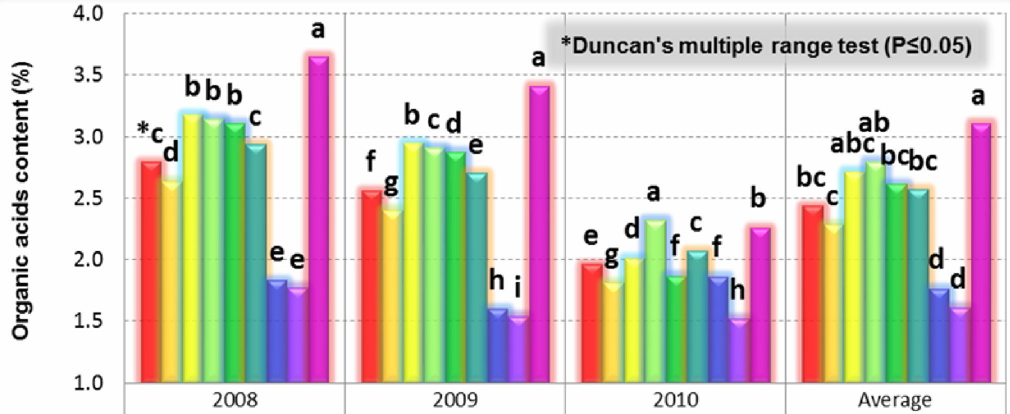
Table 2. Correlations between biochemical components of black currant fruit quality

		Organic acids content (%)	Total sugar content (%)	Ascorbic acid content (%)	Total solids (%)
Organic acids content (%)	Pearson Correlation	1	-0.254(*)	-0.080	-0.061
	Sig. (2-tailed)		0.022	0.480	0.588
	N	81	81	81	81
Total sugar content (%)	Pearson Correlation	-0.254(*)	1	-0.179	0.098
	Sig. (2-tailed)	0.022		0.110	0.385
	N	81	81	81	81
Ascorbic acid content (%)	Pearson Correlation	-0.080	-0.179	1	0.275(*)
	Sig. (2-tailed)	0.480	.110		0.013
	N	81	81	81	81
Total solids (%)	Pearson Correlation	-0.061	0.098	0.275(*)	1
	Sig. (2-tailed)	0.588	0.385	0.013	
	N	81	81	81	81

* Correlation is significant at the 0.05 level (2-tailed).

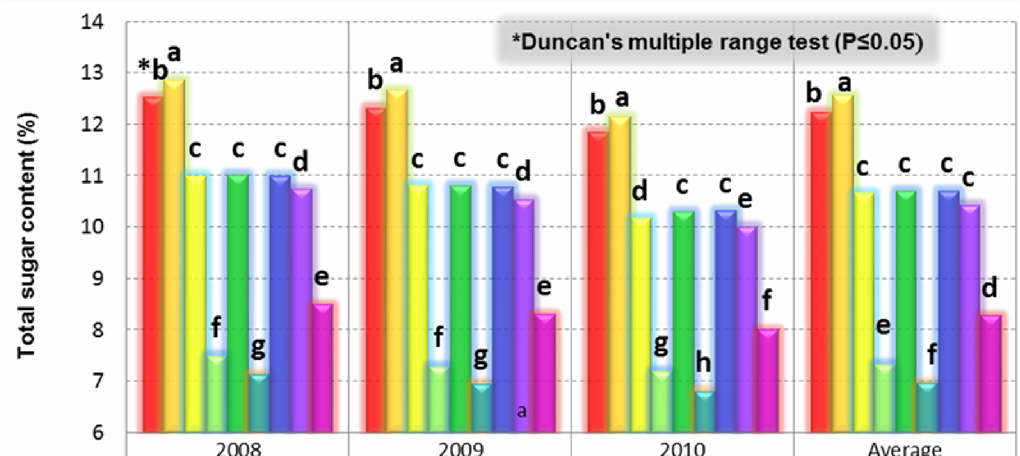
Table 3. Biometric characteristic of black currant fruit (average values)

Cultivars	Average fruit weight (g)	Fruit height (mm)	Fruit diameter (mm)	Firmness (N)
Bona	1.21	12.29	13.32	1.49
Ruben	1.65	12.12	12.89	1.57
Ores	1.01	11.60	12.18	1.24
Ben Hope	0.93	10.91	12.13	1.40
Titania	1.04	10.82	12.21	1.24
123/4	0.68	10.71	11.03	1.32
Tisel	0.90	10.62	10.91	0.72
Tines	0.98	10.30	11.76	1.16
Tiben	0.77	9.98	19.91	1.51



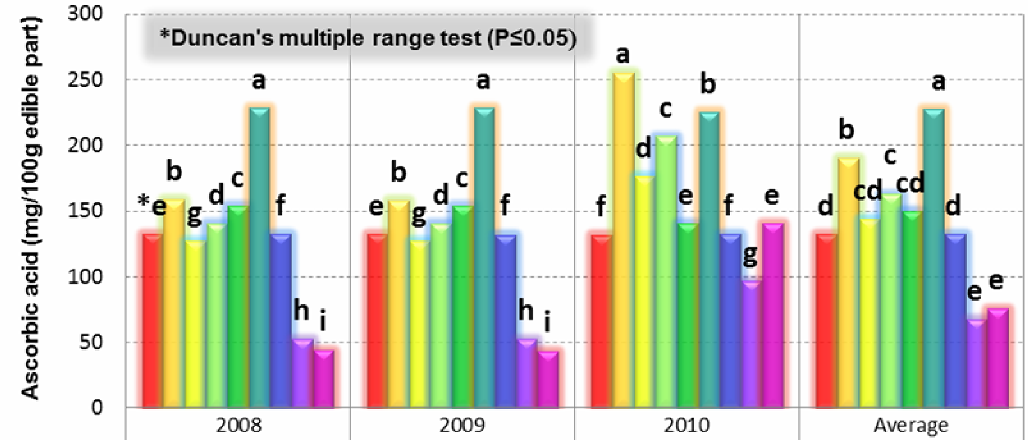
	2008	2009	2010	Average
Tines	2.80	2.57	1.97	2.45
Tisel	2.64	2.41	1.82	2.29
Ruben	3.18	2.95	2.02	2.72
Ben Hope	3.15	2.91	2.33	2.80
Titania	3.11	2.88	1.88	2.62
Ores	2.94	2.71	2.08	2.58
124/3	1.84	1.61	1.87	1.77
Bona	1.78	1.54	1.53	1.62
Tiben	3.65	3.42	2.27	3.11

Figure 5. Cultivar influence on organic acids content (%) of black currant fruits



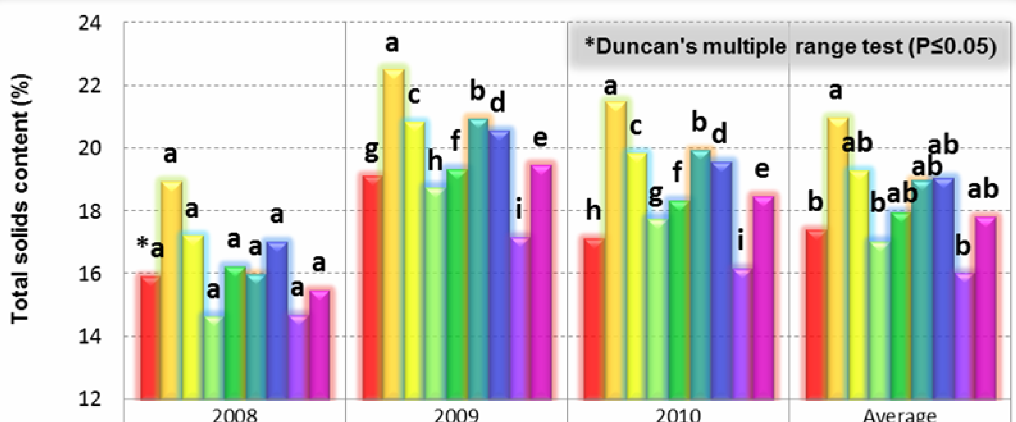
	2008	2009	2010	Average
Tines	12.52	12.32	11.85	12.23
Tisel	12.87	12.67	12.14	12.56
Ruben	11.00	10.80	10.18	10.66
Ben Hope	7.51	7.31	7.22	7.34
Titania	11.01	10.81	10.30	10.71
Ores	7.17	6.97	6.82	6.98
124/3	11.00	10.80	10.32	10.70
Bona	10.74	10.54	10.02	10.44
Tiben	8.51	8.31	8.03	8.28

Figure 6. The influence of cultivar on total sugar content (%) of black currant fruits



	2008	2009	2010	Average
Tines	132.30	132.15	132.00	132.15
Tisel	158.60	158.45	255.10	190.72
Ruben	127.75	127.60	176.13	143.83
Ben Hope	140.95	140.80	206.80	162.85
Titania	154.25	154.10	140.70	149.68
Ores	228.92	228.77	225.30	227.66
124/3	132.18	132.03	132.17	132.13
Bona	52.92	52.77	96.70	67.46
Tiben	44.18	44.03	140.70	76.31

Figure 7. The influence of cultivar on vitamin C content (mg/100 g fresh material) of black currant fruits



	2008	2009	2010	Average
Tines	15.94	19.14	17.15	17.41
Tisel	18.97	22.51	21.5	20.99
Ruben	17.23	20.85	19.85	19.31
Ben Hope	14.66	18.74	17.74	17.05
Titania	16.24	19.34	18.34	17.97
Ores	16.02	20.95	19.95	18.97
124/3	17.05	20.57	19.57	19.06
Bona	14.71	17.18	16.19	16.03
Tiben	15.5	19.48	18.48	17.82

Figure 8. The influence of cultivar on dry matter content (%) of black currant fruits

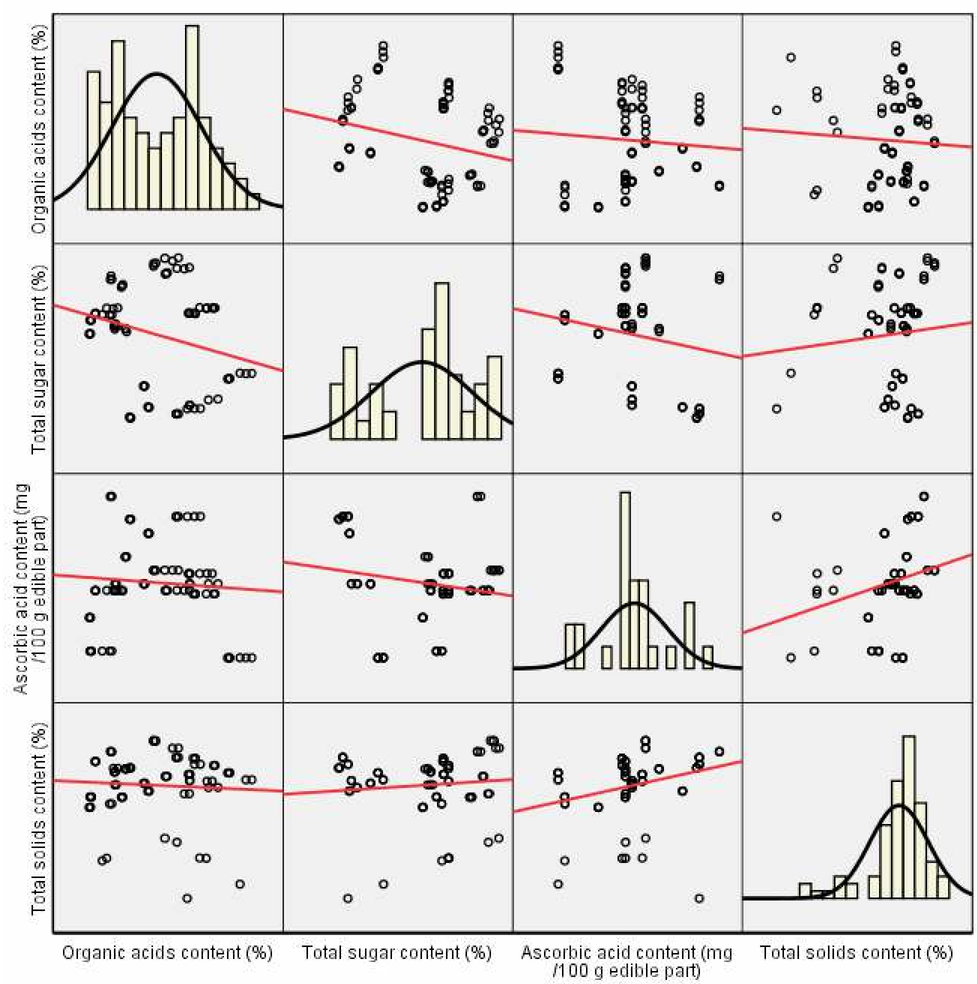


Figure 9. Correlations matrix between biochemical elements of black currants studied