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Comparison of the Content Of Monosaccharides and Sucrose in Fruit of Selected Grapevine Varieties Cultivated in an Ecological and in a Conventional Farm in the podkarpacie Region

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Summary. Contents of monosaccharides and sucrose were determined in fruit of selected varieties of grapevine growing in conventional and organic farms in Podkarpacie, and the relevant findings were compared. Specific sugars were identified with high-performance liquid chromatography (HPLC) with evaporative light scattering detector (ELSD). The findings have shown a correlation between the contents of the simple sugars in question and the method of grapevine cultivation. At harvest, fruit of grapevine cultivated using organic methods had significantly higher contents of sugars than fruit of grapevines cultivated using conventional method. The mean content of all the sugars in grapes collected from the organic and the conventional farm was 10.075 g 100 g^{-1} of raw fruit and 7.168 g 100 g^{-1} of raw fruit, respectively.

Key words: fruit of grapevine, high-performance liquid chromatography (HPLC), glucose, fructose, sucrose.

INTRODUCTION

Wine consumption is linked with the culture and lifestyles of many European countries, including Poland. Grapevine arrived in Poland along with Christianity, yet it is only recently that grapevine cultivation and wine-making have become increasingly popular here. The phenomenon was facilitated by the closer contacts with West European cultures, particularly after the integration of Poland with the European Union [1, 9, 7]. The growing interest in wine-making is accompanied by changes in Polish legislation. The act on wine production, in force currently, exempts Polish manufacturers of wine made of grapes, owning their own vineyards, from an obligation to acquire a license for production of wine granted by the Ministry of Agriculture and Rural Development; this considerably simplifies the start-up of such operation. More improvements are being prepared, mainly in the area of the extremely strict Polish excise tax laws, which will give us equal opportunities with wine-makers from the European Union [7].

In accordance with Council Regulation (EC) No. 2165/2005 of 20 December 2005 amending Regulation (EC) No. 1493/1999 on the common organization of the market in wine, the entire territory of Poland was included in the coldest wine-growing area. Taking into account the climate, three wine-growing regions have been distinguished in the territory of Poland. The Podkarpackie Province has been qualified into Region II, along with the southern and south-eastern areas, with frequent cold winters and minimum temperature below –20 °C, –25 °C (the following provinces: Małopolskie, Podkarpackie, Świętokrzyskie and the southern part of Mazowieckie and Lubelskie) [4, 5, 3].

In Poland wine can be cultivated using both conventional and organic methods. Adjustments to the requirements of organic wine-growing in Poland are not only feasible but in fact may be easier than in the typical wine-growing countries, where varieties of common grapevine, susceptible to diseases, are mainly cultivated [7]. More and more frequently vineyards are started by farmers using sustainable methods of cultivation based on ecological trends. Like other traditional organic farms, vineyards are subjected to inspections and must comply with the requirements defined for ecological agriculture. The reasons for starting this type of operation include the higher quality of fruit and, consequently, higher retail prices. Many studies have shown that the produce of ecological farming generally has better health-related characteristics, resulting from higher contents of nutrients and significantly lower level of contamination in comparison to the produce of conventional agriculture [3, 6, 8]. Most importantly, products originating from ecological farms contain lower quantities of residues of crop protection chemicals and more micro and macro elements [4, 10, 6].

Each variety of grapes is characterized by different contents of sugars, because of this some varieties are used in the production of sweet wines and others for manufacturing dry wines. The contents of sugars in fruit flesh as a rule is in the range of 13–25%. These are mainly: glucose, fructose and

sucrose. Ecological methods of cultivation may affect the contents of glucose and sucrose in fruit [4, 6, 7]. Comparison of these parameters may contribute to the knowledge of wine-growers and their ability to modify their crops in order to comply with the standards of organic production. Moreover, ecological methods of growing crops are considered to be environmentally friendly, therefore in combination with its health-related advantages, organic farming may promote the consumer welfare [11].

MATERIALS AND METHODS

The contents of monosaccharides and sucrose were examined in the fruit of five varieties of grapevine grown in the Podkaprackie Province. The samples were collected from a farm whose operation is based on conventional methods, and a farm using ecological methods and included fruit of the following grapevine varieties: Einset Seedless, Gołubok, Reliance, Regent and Seyval Blanc. The conventional wine plantation is located in Księży Lasek (Commune of Lubenia) on IIIb class soils, on a slope with 25% declination southwards. The wine plantation, where no chemical treatments aimed at crop management, no protection and no fertilization were performed, is located in Stobierna (Commune of Trzebownisko) on class IVa soils. The treatments performed during the vegetative period at the conventional plantation included 6 applications of crop protection chemicals as well as (organic and mineral) fertilization, carried out twice. In both the farms, 3 plants were selected for each wine variety, and two grape bunches were collected from each for the analyses. Preparation of the samples and chromatography analysis were performed according to the previously published methods [2].

RESULTS AND DISCUSSION

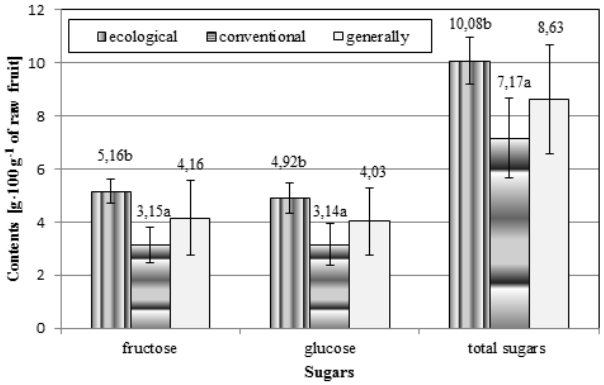
The findings showed varying contents of the sugars in the selected varieties of grapes. The differences were identified between the investigated varieties and between plants of the same varieties grown in the different plantations (ecological and conventional). The mean content of total sugars in fruit of the relevant wine varieties ranged from 4.568 g 100 g^{-1} of raw fruit in grapevine of Seyval Blanc variety, cultivated using conventional method, to 11.68 g 100 g^{-1} of raw fruit in the same variety of grapes from the ecological plantation. The largest contents of fructose and glucose were identified in the fruit of Seyval Blanc wine variety cultivated using ecological method and the respective values were: 5.799 g 100 g^{-1} of raw fruit and 5.886 g 100 g^{-1} of raw fruit. The mean contents of sugars in ethanolic extract and in 100 g of raw fruit in the examined grapevine varieties from the ecological and conventional plantation as well as standard deviations from the mean values are shown in Table 1.

Figure 1 presents mean contents of the examined sugars and total sugars in grapes, relative to the cultivation method (ecological vs. conventional). The findings show a correlation between the content of the examined sugars and the wine cultivation method. The highest contents of total sugars and the specific monosaccharides were identified in the fruit of grapevines from the ecological farm. On the other hand, these contents were significantly lower in grapes from the conventional plantation. Regardless of the farming method, the mean content of total sugars in the investigated grape varieties was 8.622 g 100 g^{-1} of raw fruit. The highest mean content of total sugars, amounting to 10.08 g 100 g^{-1} of raw fruit ± 0.88 g was identified in the fruit of the investigated grapevine varieties grown in the ecological plantation. On

Table 1. Mean content of sugars in ethanolic extract and in 100 g of raw fruit in selected grape varieties from ecological and conventional plantations as well as standard deviations from the mean values

Variety	Cultivation method	Mean content of sugars in ethanolic extract [mg ml^{-1}] ± SD, (n=3) Content of sugar in 100 g of raw fruit [g 100 g^{-1}]			Total sugars [g 100 g^{-1} of raw fruit]
		Fructose	Glucose	Sucrose	
Einset Seedless	ecological	10.684 ± 0.038 5.342	9.964 ± 0.039 4.982	–	10.324
	conventional	8.495 ± 0.017 4.247	7.013 ± 0.035 3.506	–	7.753
Gołubok	ecological	9.692 ± 0.023 4.846	9.434 ± 0.0 4.717	–	9.563
	conventional	6.532 ± 0.034 3.266	5.275 ± 0.074 2.637	5.132 ± 0.019 2.566	8.469
Reliance	ecological	10.301 ± 0.058 5.15	8.894 ± 0.082 4.447	–	9.597
	conventional	6.48 ± 0.053 3.24	6.452 ± 0.062 3.226	–	6.466
Regent	ecological	9.275 ± 0.024 4.637	9.146 ± 0.013 4.573	–	9.21
	conventional	8.494 ± 0.047 4.247	8.681 ± 0.023 4.34	–	8.587
Seyval Blanc	ecological	11.587 ± 0.013 5.799	11.772±0.013 5.886	–	11.685
	conventional	5.087 ± 0.01 2.543	4.051 ± 0.012 2.025	–	4.568

the other hand in the case of grapes from the conventional farm the mean contents of the total sugars was 7.17 g 100 g^{-1} of raw fruit ± 1.51 g, i.e. 29% lower in comparison to grapes from the ecological farm. The largest differences in the contents of the simple sugars in grapes from ecological and conventional plantations were identified in the case of the mean contents of fructose. The mean contents of fructose in the grapes cultivated using ecological and conventional methods differed by more than 36%. The mean contents of glucose in ecological grapes amounted to 4.92 g 100 g^{-1} of raw fruit ± 0.58 g, and in grapes from the conventional farm the value was 3.14 g 100 g^{-1} of raw fruit ± 0.78g. On the other hand, the mean contents of fructose in grapes ranged from 3.51 g 100 g^{-1} raw fruit ± 0.45 g in grapes from the conventional plantation to 5.16 g 100 g^{-1} of raw fruit ± 0.66 g in the organic grapes. The mean contents of fructose and glucose in the produce from both farms was 4.16 g 100 g^{-1} of raw fruit ± 1.42 g and 4.03 g of raw fruit ± 1.25 g, respectively.



*different letters show statistically significant differences at α=0,05

Fig. 1. Mean contents of fructose, glucose and total sugars in relation to the wine cultivation method, and standard deviations from the mean values

The highest content of total sugars, amounting to 9,03 g 100 g^{-1} of raw fruit, was identified in Einset Seedless variety, and the lowest, of 8,03 g 100 g^{-1} of raw fruit in Reliance variety. The contents of fructose in the fruit of the examined grapevine varieties ranged from 3,94 g 100 g^{-1} of raw fruit of Regent variety to 4,19 g 100 g^{-1} of raw fruit in Reliance variety, and the contents of glucose ranged from 3,4 g 100 g^{-1} of raw fruit in Gołubok variety to 4,24 g 100 g^{-1} of raw fruit in Einset Seedless variety. The mean contents of fructose, glucose and total sugars in grapes of the examined varieties, regardless of the cultivation method, and standard deviation from the mean values, are shown in Figure 2.

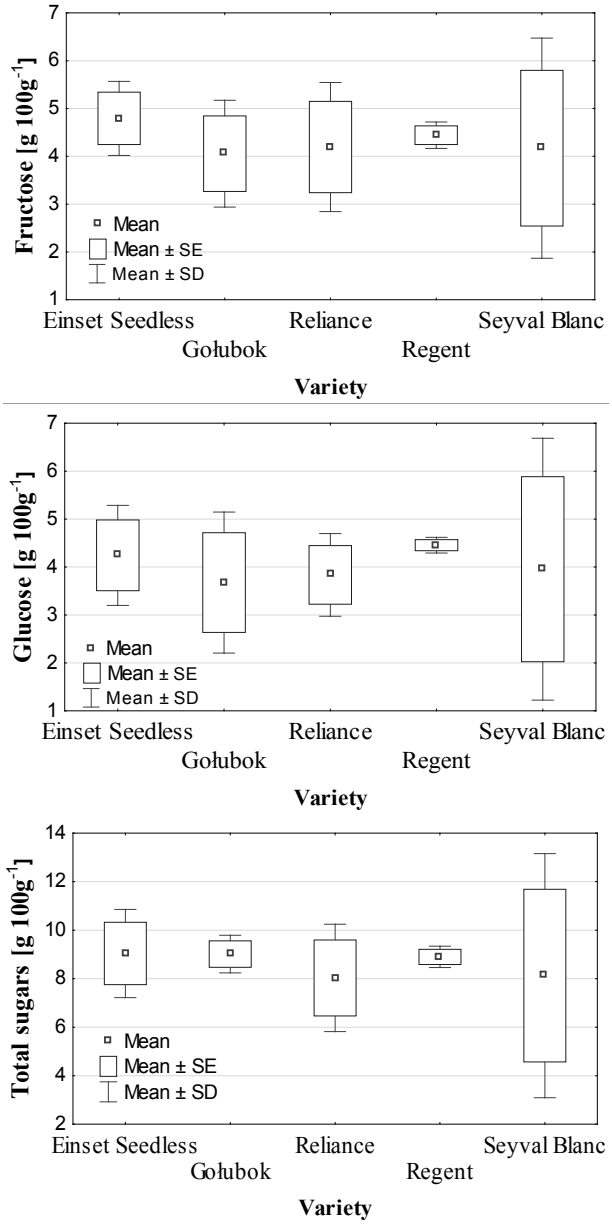


Fig. 2. Mean contents of fructose, glucose and total sugars in the grapes of the examined varieties, and standard deviation from the mean values

CONCLUSIONS

1. The findings show a correlation between the contents of the simple sugars in question and the method of grapevine cultivation. Organic grapes had significantly higher content of sugars than fruit of grapevines cultivated using conventional method.
2. Different contents of the examined monosaccharides and total sugars were observed in grapes from the ecological and conventional plantation. The difference in the total contents of all sugars in question between the grapes from ecological and conventional plantation exceeded 29 %.
3. In the group of the examined varieties the highest content of the relevant sugars, amounting to 11.68 g 100 g^{-1} of raw fruit, was identified in Seyval Blanc variety from the ecological farm. On the other hand, the lowest content of total sugars, found in the grapes of the same variety collected at the conventional plantation, amounted to 4.57 g 100 g^{-1} of raw fruit.
4. Grapes of Gołubok variety, from the conventional farm, were also found to contain sucrose, at the level of 2.56 g 100 g^{-1} of raw fruit.
5. The mean contents of the total sugars in the grapes of the investigated varieties, regardless of the cultivation method, amounted to 8.62 g 100 g^{-1} of raw fruit. The

highest content of total sugars, amounting to 9.03 g 100 g^{-1} of raw fruit, was identified in Einest Seedless variety, and the lowest of 8.03 g 100 g^{-1} of raw fruit was found in Reliance variety.

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PORÓWNANIE POZIOMÓW CUKRÓW PROSTYCH I SACHAROZY W OWOCACH WYBRANYCH ODMIAN WINOROŚLI UPRAWIANYCH W EKOLOGICZNYCH I KONWENCJONALNYCH GOSPODARSTWACH PODKARPACIA

Streszczenie. Zawartość cukrów prostych i sacharozy oznaczono w owocach wybranych odmian winorośli uprawianych w gospodarstwach konwencjonalnych i ekologicznych na Podkarpaciu, a odpowiednie wyniki zostały porównane. Zidentyfikowano specyficzne cukry za pomocą wysokosprawnej chromatografii cieczowej (HPLC) z detektorem par rozpraszania światła (ELSD). Wyniki wykazały korelację między zawartością cukrów prostych przedmiotowych a metodą uprawy winorośli. W zbiorach owoców winorośli uprawianych metodami ekologicznymi wykryto znacznie wyższe zawartości cukrów niż w owocach winorośli uprawianych metodą konwencjonalną. Średnia zawartość wszystkich cukrów w winogronach zebranych w organicznym i konwencjonalnym gospodarstwie wynosiła odpowiednio 10,075 g na 100 g surowych owoców i 7,168 g na 100 g surowych owoców.
Słowa kluczowe: owoc winorośli, wysokosprawna chromatografia cieczowa (HPLC), glukoza, fruktoza, sacharoza.