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SUGAR COMPOSITION OF APPLE CULTIVARS AND ITS RELATIONSHIP TO SENSORY EVALUATION

S u m m a r y

The increasing consumption of sugars is one of the factors contributing to the obesity epidemic. Our research was carried out on the sugar composition of apples. The purpose of the study was to determine the quantitative and qualitative composition of sugars of different apple varieties from the East Bohemia region. In this study dry matter content and sensory characteristics were also evaluated. Apples contain fructose, glucose and sucrose. Fructose is known to be a highly lipogenic sugar that has profound metabolic effects in the liver, and has been associated with many of the components of the metabolic syndrome (insulin resistance, elevated waist circumference, dyslipidemia, and hypertension). Fructose, glucose and sucrose in different apple cultivars were extracted with ethanol, derivatized, and determined by gas chromatography. 17 cultivars of apple were analysed. The average fructose content was 6.52 ± 1 g/100 g of apple (8.1 – 'Golden Delicious', 4.8 – 'Selena'), glucose content 1.46 ± 0.55 g/100 g of apple (3 – 'Red Delicious', 0.9 – 'Ontario'), and sucrose content 4.75 ± 1.35 g/100 g of apple (7.2 – 'Opal', 2.1 – 'Melrose'). The cultivars suitable for nutrition of patients with metabolic syndrome are 'Selena' and 'Ontario'.

Key words: apple cultivars, glucose, fructose, sucrose, dry matter

Introduction

A healthy and sustainable diet is based on high consumption of fresh vegetables, fruits and whole grains, with limited intake of saturated fat, trans fatty acids, sugar and salt [20]. Evidence suggests that a diet high in fruits and vegetables may decrease the risk of chronic diseases such as cardiovascular disease or cancer [13].

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The average fruit and vegetable intake in 2012 for the EU-28 was estimated to be 386.96 g/person per day. In Poland for example, the mean consumption of fruit and vegetables and their products amounted to just 275 g per person a day, which is below the WHO 400 g/day minimum recommendation [4, 17].

There is no universally accepted recommendation on the fruit percentage in that daily target, but diabetics or overweight people are often discouraged from eating fruits because of their high energy content. The lack of clarity over the status of the more controversial foods such as dried fruit or pulses can lead to confusion and uncertainty amongst consumers.

One apple (approximately 125 g) has 65 Calories (272 kJ), the main part of which comes from carbohydrates – 260 kJ. Apples (and most other fruits) contain fructose, glucose and sucrose. The larger apple of about 200 g contains about 20 - 25 g of sugars with fructose/glucose ratio close to 2. The increasing consumption of sugars is one of the factors contributing to the obesity epidemic [3]. Previously, fructose was recommended as a sweetener for diabetic patients. It is now known that fructose, in contrast to glucose, is a potent stimulator of lipogenesis. Unlike glucose it can be converted to glycerol 3-phosphate (required for triacylglycerol synthesis) without passing through the phosphofructokinase pathway, which is an important rate-limiting pathway in glycolysis [11]. Lipogenesis by fructose has negative effects in many diseases, such as diabetes mellitus or metabolic syndrome, and in obesity [15, 16].

The purpose of the study was to determine the quantitative and qualitative composition of sugars of different apple varieties from the East Bohemia region. In this study dry matter content and sensory characteristics were also evaluated.

Materials and methods

The 17 cultivars of apples (Tab. 1) were collected from the Research and Breeding Institute of Pomology. Research at the Institute includes breeding research of apples, collection of regional and primitive varieties of local origin, and the introduction of foreign varieties. Apples were picked at the optimum harvest maturity for storage, as measured by starch test.

Chemicals and reagents were of analytical grade and all were obtained from Sigma Aldrich (St. Louis, USA). Glucose, fructose, sucrose and malic acid were used as standards. Phenyl b-D-glucopyranoside 50 mg in 5 ml sodium azide solution was used as internal standard. All standard solutions were prepared in 0.1 % (w/w) sodium azide solution for stabilization. Ethanol was used for extraction of the apple samples.

A mixture of hydroxylamine hydrochloride in pyridine was used for the first step of derivatization. Dimethylaminoethanol was used for stabilization of the derived oxime. *N*,*O*-bis(trimethylsilyl)trifluoroacetamide (BSTFA) was used for the second step of derivatization, and was obtained from Supelco (Bellefonte, USA).

Dry matter content was determined by moisture analyzer (MB 25, Ohaus, USA). Approximately 3 g of apple homogenate was dried at 105 °C.

Samples of different apple cultivars (50 g) containing malic acid and the sugars fructose, glucose and sucrose were homogenized with 250 ml of ethanol by laboratory homogenizer (Waring 8010, Slovakia). Samples were transferred to Erlenmeyer flasks and the sugars extracted for 1h at 80 °C. After this extraction, the samples were centrifuged and the supernatant was purified by centrifugal filters (Amicon Ultra 30K, Merck Millipore, Ireland). 10 µl of internal standard and 10 µl of sample filtrate were evaporated in a vacuum concentrator at 60 °C (Concentrator 5305, Eppendorf, Germany).

Samples were derivatized with 50 µl of hydroxylamine hydrochloride solution (1 g in 100 ml of pyridine) with dimethylaminoethanol (20 : 1) at 75 °C for 30 min. The second derivatization was accomplished by adding 50 µl BSTFA for 15 min at 75 °C. The glucose and fructose derivatives are depicted in Fig. 1.

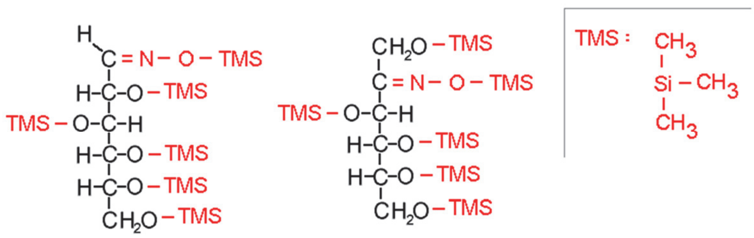

Fig. 1. Derivatives of sugar
Rys. 1. Formy derywatyzowane cukrów

Trimethylsilyl oxime derivatives of the sugar were determined by gas chromatography with flame ionization detection (Fisons Instrument, Great Britain). Injector temperature was 280 °C, detector temperature 330 °C and the oven was programmed as follows: initial temperature 100 °C for 1 min, rate of temperature rise 10 °C/min to 280 °C. Pressure at the column head was 175 kPa. The chromatogram of an apple sample is shown in Fig. 2.

Apple cultivars were stored in ULO (Ultra Low Oxygen) atmosphere 1 % O_2 + 1 % CO_2 at temperature 1 - 1.5 °C. Experimental chambers with ULO technology were established in 2005. Each chamber consists of 6 air-tight ULO boxes with a capacity of 24 standard plastic boxes for fruits with 15 kg carrying capacity [2]. The technology also includes nitrogen generator with active filters, compressor and regulating and control unit with a computer and software for storage under controlled variables.

Sugar content and dry matter changes after 3 months and 6 months of storage were determined using the methods described above.

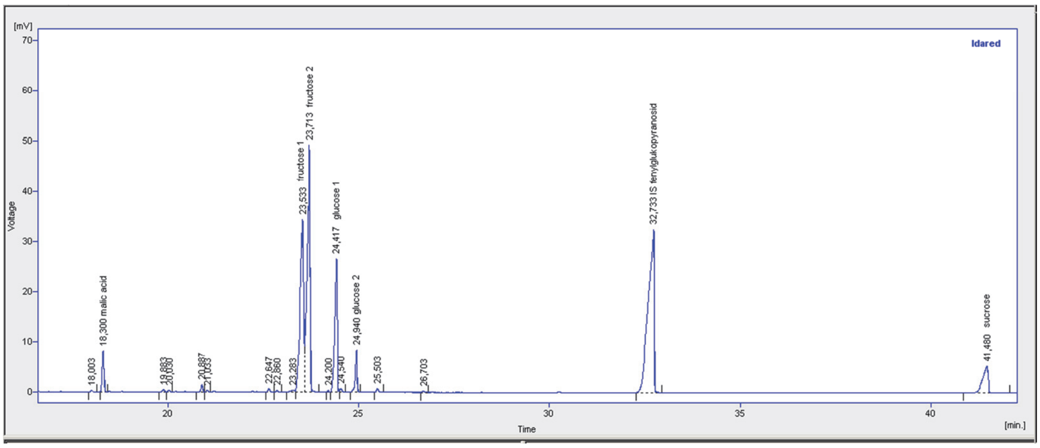

Fig. 2. Chromatogram (GC) of apple sugar samples
Rys. 2. Chromatogam (GC) cukrów w próbkach jabłek

Selected cultivars were tested one day after removal from ULO storage. Evaluated traits were sensory characteristics such as juiciness, acidity and overall taste, and were evaluated according to a nine-point evaluation scale, where nine represents the highest level of the trait:

- juiciness: dry (1) – very juicy (9),
- acidity: acidic (1) – very sweet (9),
- overall taste: very bad (1) – excellent (9).

Sensory evaluation was performed by a fully-trained panel composed of 6 judges, and the results are expressed as an average.

The total sugar, the ratio of fructose to glucose, and the sweetness relative to sucrose were calculated:

Ratio fru/glu = (fructose + 0.5 × sucrose) / (glucose + 0.5 × sucrose) – includes the fructose and glucose from sucrose after hydrolysis in the gut.

Sweetness = 1.5 × fructose + 0.75 × glucose + sucrose – relative to sucrose.

The obtained data were evaluated by One Way Repeated Analysis of Variance and Pearson Product Moment Correlation by Sigmastat software (Systat, USA). The data are presented as mean ± standard deviation.

Results and discussion

The variety is one of the most important factors that have a direct impact on and relationship with the content of both the biologically active components and the other chemical components of apples [19]. Data obtained for the estimation of dry matter and sugar content of individual varieties of fresh apples are presented in Tab. 1. The average dry matter content of material under investigation was 15.56 ± 1.85 % (20 % – 'Boskoopske', 12.4 % – 'Ontario'). Similar results have been reported by Łata [10] for apples of different cultivars grown in Poland, with dry matter content between 13.6 and 19.3 %. Sugars are important compounds for quality evaluation of apple fruits, and in terms of sugar composition, fructose and glucose are the predominant sugars for most apple varieties [12, 21]. In the experimental material the respective sugars were estimated overall as follows: fructose content 6.52 ±1 g/100 g of apple (8.1 – 'Golden Delicious', 4.8 – 'Selena'); glucose 1.46 ± 0.55 g/100 g of apple (3 – 'Red Delicious', 0.9 – 'Ontario'); sucrose 4.75 ± 1.35 g/100 g of apple (7.2 – 'Opal', 2.1 – 'Melrose'). Total sugar content was 12.73 ± 1.72 g/100g of apple (16.1 – 'Boskoopske', 'Opal', 10.1 – 'Selena', 'Ontario'). The average sweetness was calculated as 15.64 ± 2 g/100 g of apple. The highest sweetness was observed for varieties of high total sugar content (19.5 – 'Boskoopske' and 'Opal') and the lowest for 'Selena' and 'Ontario' (12.2).

The next important step was to evaluate the sugar content during storage. The change in sugar content and dry matter during storage is presented in Tab. 2. Data after storage were compared by one-way Anova Repeated Measurement. Results are presented in Tab. 3. and Fig. 3 - 6. The dry matter of apple decreased from 15.6 % to 13.9 % during the period of storage under study. The decrease of dry matter could be explained by weight and moisture loss. Post-harvesting losses increased linearly with increase in storage duration due to water loss and respiration [5]. The intensity of this process depends on external and internal factors [6]. In the presented study a significant increase in glucose content and a decrease in sucrose and total sugar content were observed in line with the storage maturity of the apples. Regardless of the quantitative losses in weight and chemical components, quality changes occur that reduce the consumer and nutritional value of the fruit. The ageing rate of apples depends on many factors, and one of the ways of minimising it is to maintain appropriate conditions during storage [9].

The results of sensory evaluation and the correlation with obtained data are presented in Tab. 4. and Fig. 7.

The term sensory quality of fruits and apples is mainly related to their visual appearance (e.g. colour, gloss, size), smell, texture and palatability, and can be affected by many factors including genotype, cultivation system, picking date, postharvest handling and storage duration and conditions [1, 7, 8]. The quality of apples changes after harvesting and decreases during storage [18]. The results of the sensory evaluation are an interesting finding of the presented study. No correlation was found between the judged sweetness and the measured sugar concentration. A search for the determinant

Table 1. Sugar content and dry matter in apple cultivars without storage
Tabela 1. Zawartość cukrów i suchej masy w nieprzechowywanych odmianach jabłek

Cultivar Odmiana	Fructose [g/100 g of apple] Fruktoza [g/100 g jabłka]	Glucose [g/100 g of apple] Glukoza [g/100 g jabłka]	Sucrose [g/100 g of apple] Sacharoza [g/100 g jabłka]	Ratio fru/glu Stosunek fru/glu	Total sugars [g/100g of apple] Cukry ogółem [g/100 g jabłka]	Sweetness [g/100g of apple] Słodkość [g/100 g jabłka]	Dry matter [%] Sucha masa [%]
'Boskoopske	7.7	1.9	6.5	2.13	16.1	19.5	20.0
Florina	6.5	1.2	5.4	2.36	13.1	16.1	15.7
Golden Delicious	8.1	0.9	4.5	3.29	13.5	17.3	17.3
Chodske	4.9	0.9	5.3	2.13	11.1	13.3	14.5
Idared	6	1.4	3.9	2.37	11.3	14	14.2
Jarka	7.1	2.1	4.4	2.16	13.6	16.6	15.8
Jonagold	6.4	1.2	5.6	2.3	13.2	16.1	15.4
Melrose	6.7	2	2.1	2.54	10.8	13.7	14.1
Ontario	5.6	0.9	3.6	2.74	10.1	12.7	12.4
Opal	7.5	1.4	7.2	2.22	16.1	19.5	18.9
Rajka	7.4	1.8	3.1	2.67	12.3	15.6	14.8
Red Delicious	7.3	3	4	1.86	14.3	17.2	15.1
Rubinola	5.9	1.5	5.3	2.06	12.7	15.3	14.4
Selena	4.8	1.2	4.1	2.11	10.1	12.2	13.5
Sampion	7.8	1.5	3.4	2.97	12.7	16.2	16.8
Topaz	5.4	0.9	7	2.02	13.3	15.8	15.3
Zvonkove	5.8	1	5.3	2.32	12.1	14.8	16.2

Explanatory notes: / Objaśnienia:
fru – fructose / fruktoza, glu – glucose/ glukoza.

Table 2. Descriptive statistic of sugar content and dry matter in apples during storage
Tabela 2. Statystyka opisowa zawartości cukrów i suchej masy w jabłkach podczas przechowywania

Feature Wyróżnik	$\overline{x}$	SD / s	Max	Min	Median Mediana	25 %	75 %	Skewness Wsp. skośności	Kurtosis Kurtoza
Dry matter 0m Sucha masa 0m	15.561	1.905	20.035	12.415	15.29	14.354	16.347	0.891	0.98
Dry matter 3m Sucha masa 3m	14.157	1.483	17.76	11.285	13.875	13.466	14.8	0.409	1.571
Dry matter 6m Sucha masa 6m	13.875	1.354	15.625	11.78	14.23	12.672	14.915	-0.265	-1.52
Fructose 0m Fruktoza 0m	6.524	1.034	8.1	4.8	6.5	5.75	7.425	-0.159	-1.163
Fructose 3m Fruktoza 3m	6.294	1.055	8.6	5.1	6	5.4	7.1	0.841	-0.257
Fructose 6m Fruktoza 6m	6.975	1.643	11.2	5.1	6.9	5.7	7.7	1.538	3.399
Glucose 0m Glukoza 0m	1.459	0.562	3	0.9	1.4	0.975	1.825	1.338	2.164
Glucose 3m Glukoza 3m	1.629	0.584	2.9	1	1.4	1.2	1.975	0.904	-0.288
Glucose 6m Glukoza 6m	1.783	0.595	2.9	1	1.65	1.35	2.25	0.572	-0.513
Ratio fru/glu 0m Stosunek fru/glu 0m	2.368	0.371	3.29	1.86	2.3	2.125	2.572	1.154	1.107
Ratio fru glu 6m Stosunek fru/glu 3m	3.148	1.649	8.29	2.33	2.695	2.39	3.03	3.245	10.885
Ratio fru/glu 3m Stosunek fru/glu 6m	2.439	0.319	3.16	2.04	2.38	2.17	2.672	0.685	-0.18

Sucrose 0m Sacharoza 0m	4.747	1.391	7.2	2.1	4.5	3.825	5.45	0.123	-0.376
Sucrose 3m Sacharoza 3m	3.388	1.274	5.8	1.2	3.2	2.375	4.225	0.216	-0.608
Sucrose 6m Sacharoza 6m	1.9	1.312	3.8	0.4	1.45	0.75	3.2	0.519	-1.429
Total sugars 0m Cukry ogółem 0m	12.729	1.769	16.1	10.1	12.7	11.25	13.525	0.394	-0.0635
Total sugars 3m Cukry ogółem 3m	11.312	1.596	15.1	8.6	11.3	10.575	12.1	0.259	0.978
Total sugars 6m Cukry ogółem 6m	10.658	1.471	13	8.4	10.6	9.45	11.9	0.16	-1.026

Explanatory notes: / Objaśnienia:
0m – without storage / nieprzechowywane; 3m – after 3 months of storage / po 3. miesiącach przechowywania; 6m – after 6 months of storage / po 6. miesiącach przechowywania; $\overline{x}$ – mean value / wartość średnia; SD s – standard deviation / s – odchylenie standardowe; fru – fructose / fruktoza; glu – glucose / glukoza; Wsp. – współczynnik.

Table 3. One way Anova Repeated Measurement - comparison of data during storage of apple cultivars (p-value)

Tabela 3. Jednoczynnikowa analiza wariancji Anova – porównanie danych podczas przechowywania odmian jabłek (poziom istotności p)

Item Wyszczególnienie	0 months/3 months 0 miesięcy/3 miesiące	3 months/6 months 3 miesiące/6 miesięcy	0 months/6 months 0 miesięcy/6 miesięcy
Dry matter Sucha masa	<0.001	ns	<0.001
Fructose Fruktoza	ns	ns	ns
Glucose Glukoza	ns	ns	0.036
Sucrose Sacharoza	<0.001	<0.001	<0.001
Ratio fru/glu Stosunek fru/glu	ns	ns	ns
Total sugars Cukry ogółem	<0.001	ns	<0.001

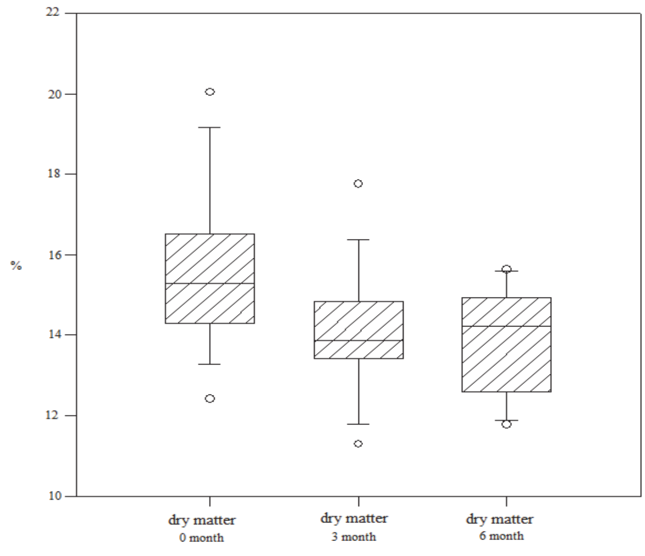

Fig. 3. Box plot – dry matter content of apple cultivars during storage

Rys. 3. Wykres pudełkowy – zawartość suchej masy w odmianach jabłek podczas przechowywania

of sweetness identified it as malic acid; its content was determined in the apple cultivars (Fig. 7). Malic acid is the characteristic acid of apple, and plays an important role in the sour sensation of the apple taste [14].

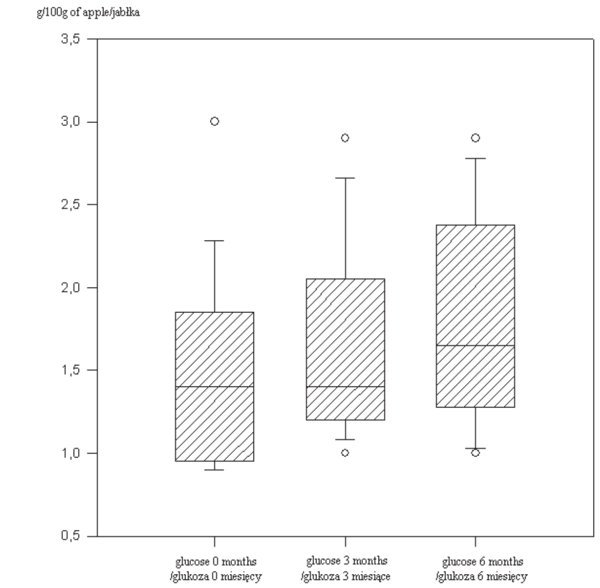

Fig. 4. Box plot – glucose content in apple cultivars during storage
Rys. 4. Wykres pudełkowy – zawartość glukozy w odmianach jabłek podczas przechowywania

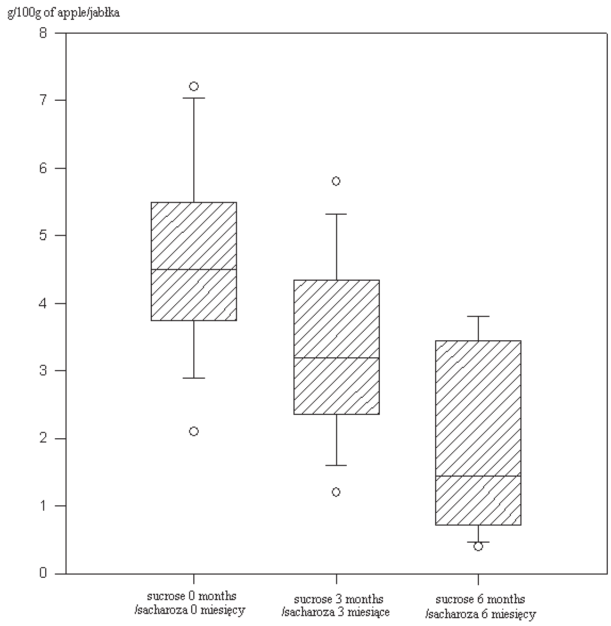

Fig. 5. Box plot – sucrose content in apple cultivars during storage
Rys. 5. Wykres pudełkowy – zawartość sacharozy w odmianach jabłek podczas przechowywania

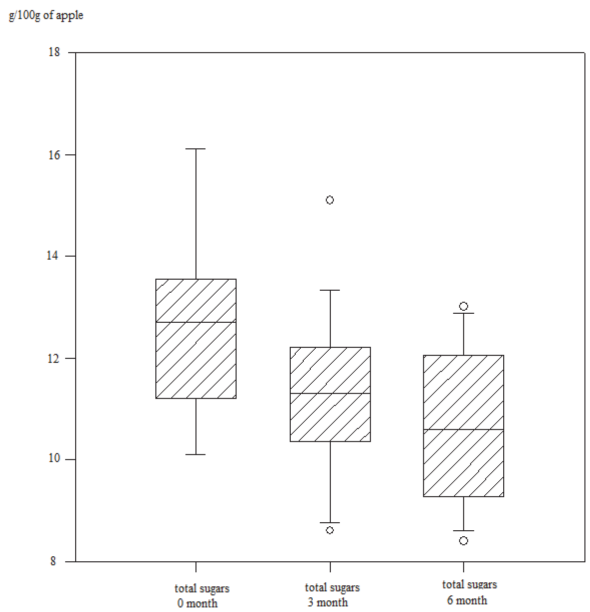

Fig. 6. Box plot – total sugars in apple cultivars during storage
Rys. 6. Wykres pudełkowy – zawartość cukrów ogółem w odmianach jabłek podczas przechowywania

Table 4. Pearson Correlation Coefficients of sensory evaluation and glucose, fructose, malic acid and dry matter content in apple cultivars
Tabela 4. Współczynniki korelacji Persona dotyczące zależności między oceną sensoryczną i zawartością fruktozy, glukozy, kwasu jabłkowego i suchej masy w odmianach jabłek

Sensory evaluation vs: Ocena sensoryczna vs:	Pearson Correlation Coefficient Współczynnik korelacji Persona	P value Wartość p
Glucose / Glukoza	0.287	0.391
Fructose / Fruktoza	0.574	0.0646
Total sugars / Cukry ogółem	0.163	0.632
Malic acid / Kwas jabłkowy	**- 0.743**	**0.00878**
Dry matter / Sucha masa	0.153	0.653

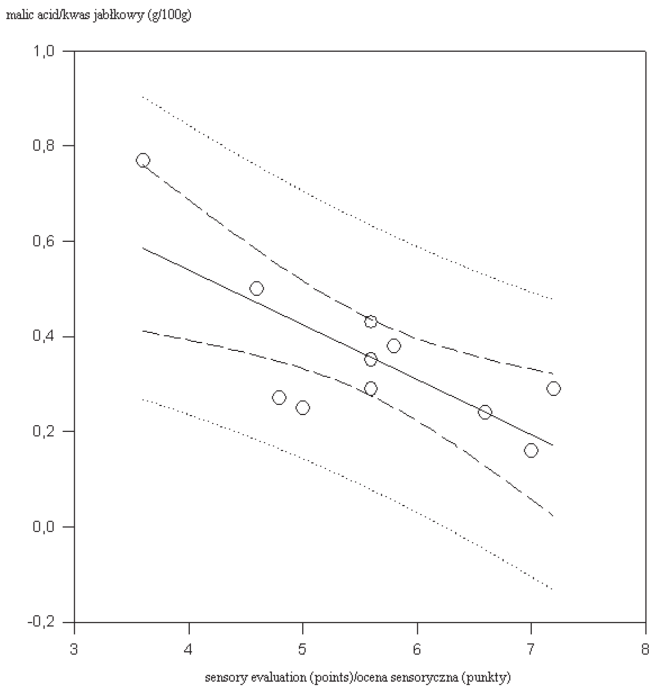

Fig. 7. Regression of malic acid content in apple cultivars vs sensory evaluation
Rys. 7. Zależność pomiędzy zawartością kwasu jabłkowego a oceną sensoryczną odmian jabłek

Conclusions

1. According the obtained results, the cultivars suitable for nutrition of patients with metabolic syndrome and diabetes mellitus are Selena and Ontario.
2. Due to the high energy and sugar content, only a single apple a day can be recommended as a part of a nutritional regimen. The acquired data provide information concerning apple cultivars grown in Czech Republic, and may be used to prepare chemical composition tables.

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References

[1] Adamczyk M., Rembiałkowska E., Wasiak-Zys G.: Porównanie jakości sensorycznej jabłek z produkcji ekologicznej i konwencjonalnej oraz po przechowywaniu. Żywność. Nauka. Technologia. Jakość, 2006, **2 (47) Supl.**, 11-19.

[2] Blazek J., Pistekova I., Matejicek A., Hnatek M.:. Hmotnostni ztraty u vybranych odrud jablek behem dlouhodobeho skladovani v podminkach ULO. Inovace pestovani ovocnych plodin, 2007, 77-83.

[3] Dianne A, Hyson A.: Comprehensive review of apples and apple components and their relationship to human health. Adv. Nutr., 2011, **2**, 408-420.

[4] Freshfel Consumption Monitor: Fresh fruit and vegetable production, trade, supply & consumption monitor in the EU28, 2013.

[5] Ghafir S.A.M., Gadalla S.O., Murajei B.N., El-Nady M.F.: Physiological and anatomical comparison between four different apple cultivars under cold-storage conditions. Afric. J. Plant Sci., 2009, **3**, 133-138.

[6] Jan I., Rab A.: Influence of storage duration on physico-chemical changes in fruit of apple cultivars. J. Anim. Plant Sci., 2012, **22 (3)**, 708-714.

[7] Jha S.N., Rai D.R., Shrama R.: Physico-chemical quality parameters and overall quality index of apple during storage. J. Food Sci. Technol., 2012, **49 (5)**, 594-600.

[8] Kabir Y., Sidhu J.S.: Flavor of fruits and fruit products and their sensory qualities. In.: Handbook of fruits and fruit processing, Eds. Sinha N., Sidhu J., Barta , Wu J., Pilar Cano M., John Wily & Sons, Ltd. USA, 2012, pp. 35-51.

[9] Łapczyńska-Kordon B., Krzysztofik B.: Wpływ sposobów i czasu przechowywania na wybrane właściwości fizyczne jabłek. Inżynieria Rolnicza, 2008, **2 (100)**, 179-185.

[10] Łata, B.: Relationship between apple peel and the whole fruit antioxidant content: year and cultivar variation. J. Agric. Food Chem., 2007, **55**, 663-671.

[11] Kelishadi R, Mansourian M, Heidari-Beni M.: Association of fructose consumption and components of metabolic syndrome in human studies: a systematic review and meta-analysis. Nutrition, 2014, **30 (5)**, 503-10.

[12] Muresan A.E., Musts S., Borsa A., Vlaic R.A., Muresan V.: Evaluation of Physical-Chemical Indexes, Sugars, Pigments and Phenolic Compounds of Fruits from Three Apple Varieties at the End of Storage Period. Bulletin UASVM Food Science and Technology, 2014, **71 (1)**, 45-50.

[13] Oguntibeju O.O., Truter E.J., Esterhuyse A.J.: The Role of Fruit and Vegetable Consumption in Human Health and Disease Prevention, Diabetes Mellitus - Insights and Perspectives, Ed. Oguntibeju O., InTech, 2013. DOI: 10.5772/50109.

[14] Róth E., Berna A., Beullens K., Yarramraju S., Lammertyn J., Schenk A., Nicolaï B.: Postharvest quality of integrated and organically produced apple fruit. Postharvest Biol. Tec., 2007, **45**, 11-19.

[15] Samuel V.T.: Fructose induced lipogenesis: from sugar to fat to insulin resistance. Trends Endocrin. Met., 2011, **22 (2)**, 60-65.

[16] Tappy L., Le K.A., Tran C., Paquot N.: Fructose and metabolic diseases: New findings, new questions. Nutrition, 2010, **26**, 1044-104.

[17] Trajer M., Dyngus M.: Krajowa produkcja, spożycie oraz promocja owoców i warzyw. Biul. Inf. ARR, 2013, **3**, 14-25.

[18] Vieira F., Borges G., Copetti C., Amboni R., Denardi F., Fett R.: Physico-chemical and antioxidant properties of six apple cultivars (Malus domestica Borkh.) grown in southern Brazil. Scientia Hortic – Amsterdam, 2009, **122 (3)**, 421-425.

[19] Wojdyło A., Oszmiański J., Bielicki P.: Zawartość wybranych wyróżników chemicznych w owocach trzech odmian jabłoni z uprawy ekologicznej i konwencjonalnej. J. Res. Appl. Agric. Eng., 2010, **55 (4)**, 173-177.
[20] World Health Organisation. European action plan for food and nutrition policy 2015–2020. Copenhagen, Denmark: Regional Committee for Europe, 64th session, 15-18 September 2008.
[21] Wu J., Gao H., Zhao L., Liao X., Chen F., Wang Z., Hu X.: Chemical compositional characterization of some apple cultivars. Food Chem., 2007, **103**, 88-93.

SKŁAD CUKRÓW W JABŁKACH RÓŻNYCH ODMIAN I ICH WPŁYW NA CECHY SENSORYCZNE

S t r e s z c z e n i e

Zwiększenie spożycia cukrów jest jednym z czynników mających wpływ na epidemię otyłości. Prezentowane wyniki badań dotyczą składu cukrów w jabłkach. Celem badań był wybór odmian jabłek odpowiednich pod względem zdrowego odżywiania, tj. ilościowego i jakościowego składu cukrów. Jabłka zawierają fruktozę, glukozę i sacharozę. Dla przykładu fruktoza jest cukrem wysoce lipogennym, który ma istotny wpływ na metabolizm w wątrobie i wiąże się z wieloma czynnikami zespołu metabolicznego (oporność na insulinę, otyłość brzuszna, dyslipidemia i nadciśnienie). Fruktoza, glukoza i sacharoza z jabłek różnych odmian zostały wyekstrahowane etanolem, derywatyzowane i oznaczane metodą chromatografii gazowej. Analizie poddano 17 odmian jabłek. Zawartość fruktozy kształtowała się na poziomie 6,52 ± 1 g/100 g jabłek (8,1 – 'Golden Delicious', 4,8 – 'Selena'). Zawartość glukozy wynosiła 1,46 ± 0,55 g/100 g jabłek (3,0 – 'Red Delicious', 0,9 – 'Ontario'), a sacharozy – 4,75 ± 1,35 g/100 g jabłek (7,2 – 'Opal', 2,1 – 'Melrose'). Odmiany jabłek 'Selena' i 'Ontario' okazały się jako najbardziej odpowiednie do stosowania w żywieniu pacjentów z zespołem metabolicznym.

Słowa kluczowe: odmiana jabłek, fruktoza, glukoza, sacharoza, sucha masa