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Technical Article

Determination of Sugar Content in Flavored Waters

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Abstract: Flavored waters mostly consists of water, natural or artificial flavorings, and sugar or artificial sweeteners. This work aimed to assess total sugar content in 25 different flavored water samples commercially available from the Slovenian local market by using an high pressure liquid chromatography (HPLC) method with refraction index detection (RID). HPLC (Agilent 1200 Series) was performed with an isocratic elution of mobile phase 15 mM K_2HPO_4 water solution. Degassed and diluted samples were analyzed on Supelcogel K column (300 x 7.8 mm, with 9 μm particles size), at 80 °C and 0.5 $mLmin^{-1}$ flow rate. The total sugar content in flavored waters varies according to the types and brands, from 11.0 g/L to 44.1 g/L. Concentration values of sucrose, glucose and fructose were found to be in the ranges (g/L): 10.0 – 32.8; 1.3 - 21.7 and 3.0 -37.2, respectively. The results suggest caution in the use of high amount of flavored waters especially by diabetic patients.

INTRODUCTION

Over 70% of all food consumed by humans contain some quantities of sugar. In the same time, consuming of different non alcoholic drinks increased about five times from 1950s till now. Meta analysis showes that consumption of sweetened drinks is related to different disseases such as diabetes, metabolic syndrome and cardiovascular disease development, in the adults as well as in children (Bray and Popkin, 2013).

Phrase „flavored water“ could seem like water with healty fruit flavorings, but ingredients varies from brand to brand. It is well known that flavored waters contain plane water, any variety of added fruit ingredients and other flavorings, and sugar. In the comparison with recommendation from medical experts that eight glasses of plane water is required for daily usage it is very sad truth that small bottles of flavored waters contain sugar content which is equal to the amount of sugar in some desserts. Although, water consumption is quality and tastefull hidratation, drinking of 500 ml flavored water means that adult person could take 1/3 daily recommended sugar quantities. That fact was a reason that some world companies had to avoid advertising for vitaminin supllemented water products and flavored waters. It was not possible to convince their consumers that these products are healthy and harmless even if 420 ml water contain about 42 g of sugar content.

That is why, especialy children should not drink any other water than plane water. It is necessary to insist that children do not drink this type of water, cause during the groving period, sugar is the main reason for teeth decay. Adults who still like to drink aromatized waters should be aware that these waters are full of sugar and some negative efects of it could be avoided only with extreme physical activities (Bray and Popkin, 2013).

MATERIAL AND METHOD

Material: 25 different flavored water samples commercially available from the Slovenian local market: 1.DANA with flavor of lemon & melissa (Dana d.o.o. Mirna Slovenia), 2.DANA with flavor of forest strawberries & aloe vera (Dana d.o.o. Mirna Slovenia), 3.DANA with flavor of orange & Echinacea purpurea (Dana d.o.o. Mirna Slovenia), 4.DANA with flavor of pomegranate, blueberry aroma & ginseng (Dana d.o.o. Mirna Slovenia), 5.DANA with flavor of plum & green tea (Dana d.o.o. Mirna Slovenia), 6.DANA sport with taste of pink grapefruit (Dana d.o.o. Mirna Slovenia), 7.COSTELLA with flavor of limes & Kumquat (Uskok d.o.o. Kostel Slovenia), 8.COSTELLA with flavor of peach (Uskok d.o.o. Kostel Slovenia), 9.COSTELLA with flavor of blackberries, blueberries & forest strawberries (Uskok d.o.o. Kostel Slovenia), 10.COSTELLA with flavor of grapefruit & aloe vera (Uskok d.o.o. Kostel Slovenia), 11.OAZA with flavor of tangerine (Radenska d.d. Radenci Slovenia), 12.OAZA with flavor of apricot & white tea (Radenska d.d. Radenci Slovenia), 13.OAZA with flavor of cherry & white tea (Radenska d.d. Radenci Slovenia), 14.ZA LIFE with flavor of apple (Pivovarna Union d.d. Ljubljana Slovenia), 15.ZA HARMONY with flavor of white peach (Pivovarna Union d.d. Ljubljana Slovenia), 16.ZA SYMPHONY with flavor of pears (Pivovarna Union d.d. Ljubljana Slovenia), 17.ZA SPORT ISOTONIC (Pivovarna Union d.d. Ljubljana Slovenia), 18.WATER WITH TASTE - lemon (for Mercator produces Radenska d.d. Radenci Slovenia), 19.WATER WITH TASTE – apple & cranberry (for Mercator produces Radenska d.d. Radenci Slovenia), 20.JANA with flavor of strawberry & Guana (Jamnica d.d. Zagreb Croatia), 21.JANA with flavor of lemon & limes (Jamnica d.d. Zagreb Croatia), 22.JANA with flavor of blueberry & cranberry (Jamnica d.d. Zagreb Croatia), 23.NATIVA WATER with flavor of green tea & peach (Rauh Fruchsäfte Rankweil Austria), 24.NATIVA WATER with flavor of jasmine tea & passion fruit (Rauh Fruchsäfte Rankweil Austria), 25.VIVIA LIFE with flavor of lemon & limes (Vitinka a.d. Kozluk Bosnia and Herzegovina).

Method: 25 different flavored water samples commercially available from the Slovenian local market were analyzed by using high pressure liquid chromatography (HPLC) method with refraction index detection (RID). HPLC (Agilent 1200 Series) was performed with an isocratic elution of mobile phase 15 mM K_2HPO_4 water solution. Degassed and diluted samples were analyzed on Supelcogel K column (300 x 7.8 mm, with 9 μm particles size), at 80 °C and 0.5 $mLmin^{-1}$ flow rate.

RESULTS

Table 1. Content of sucrose, glucose and fructose (g/L) in flavored waters

Sample	Sucrose content [g/L]	Glucose content [g/L]	Fructose content [g/L]
1	28.2	4.7	6.0
2	21.8	7.0	8.1
3	10.4	15.4	13.3
4	28.9	5.7	6.5
5	15.4	13.6	10.9
6	0.0	20.8	17.9
7	0.0	20.7	15.7
8	0.0	21.2	16.2
9	0.0	21.7	17.0
10	0.0	21.0	17.3
11	13.7	6.1	19.1
12	0.0	4.7	30.2
13	0.0	4.9	31.4
14	32.8	4.2	5.8
15	32.2	5.2	5.9
16	28.9	6.9	8.3
17	0.0	0.0	37.2
18	23.8	1.3	2.5
19	25.8	1.5	3.0
20	18.4	5.0	5.6
21	10.0	4.4	5.0
22	19.4	5.0	5.3
23	0.0	0.0	11.2
24	0.0	0.0	11.0
25	22.4	7.2	9.3

Results showed the highest sucrose content in sample of ZA LIFE with apple (32.8 g/L). The highest content of glucose was determined in sample of COSTELLA blackberries, blueberries & forest strawberries (21.7g/L). The highest content of fructoze was in sample of ZA SPORT ISOTONIC (37.2 g/L).

Table 2. Determined and declared content of total sugar in flavored waters.

Sample	Determined content of total sugar[g/L]	Declared content of total sugar[g/L]
1	38.9	42.0
2	37.0	42.0
3	39.1	42.0
4	41.1	42.0
5	39.9	42.0
6	38.7	No data
7	36.4	40.0
8	37.4	40.0
9	38.7	40.0
10	38.4	40.0
11	38.9	40.0
12	34.9	38.4

13	36.2	38.0
14	42.8	43.0
15	43.3	42.0
16	44.1	43.0
17	37.2	42.0
18	27.6	31.0
19	30.3	31.0
20	28.9	29.0
21	19.5	20.0
22	29.7	29.0
23	11.2	16.0
24	11.0	16.0
25	38.9	No data

Results showed the highest total sugar content in sample of ZA SYMPHONY with pears (44.1 g/L). The highest contribution in the total sugar content in this flavored water is from sucrose.

DISCUSION

In the last decades, consumption of sugar-sweetened beverages (SSB) generally increased between world populations. These beverages included different types of non alcoholic drinks and different types of flavored, enhanced or vitamin waters. Only few of the sugars occurring in nature are used extensively as sweeteners in these beverages. Besides sucrose, other important sugars like glucose maltose, lactose and fructose are imported to SSB. These saccharides are physiologically interesting. Whether compounds will be successful as a sweetener depends on nutritional, physiological and processing properties, cariogenicity as compared to sucrose, economic impact, and the quality and intensity of the sweet taste. New and functional sugar isomaltulose is compound used in the production of food and beverages with low glicemic index. Commercial isomaltulose is produced from sucrose by enzymatic rearrangement. From intravenous studies it can be assumed that any systemic isomaltulose would be hydrolyzed as well, or excreted in urine. In several subchronic toxicity studies, the administration of large doses (up to 7.0 and 8.1 g/kg body weight/day in male and female rats, respectively) of isomaltulose, did not result in adverse effects (Lina, Jonker and Kozianowski 2002). Unfortunately, physiological effects of isomaltulose on humans are not completely described (Duffey and Popkin, 2008; Holub et al., 2010).

SSB are the main source of added sugars in the food. High consumption of SSB has been linked to unhealthy weight gain and nutrition related chronic disease. (Malik et al., 2006; 2010). Growing evidence supports a mechanistic link between the high sugar, and specifically high fructose, content of SSBs,and the risk of chronic disease and excess weight gain. The unique metabolic and hormonal effects of fructose are linked to a number of adverse short-term effects including enhanced de novo lipogenesis and triglyceride production resulting in dyslipidemia, increased systolic blood pressure, reduced insulin and leptin sensitivity, impaired appetite control and visceral adiposity (Basciano, Federico and Adeli, 2005; Jalal et al., 2010; Stanhope et al., 2009; Teff et al., 2004).

These conditions may contribute to an increased risk of longer term chronic health conditions such as type 2 diabetes, cardiovascular disease, cardio-renal disease, and obesity (Johnson et al., 2007). As common caloric sweeteners such as sucrose, high fructose corn syrup and fruit juice concentrate have relatively high concentrations of fructose they have similar metabolic effects (Malik et al., 2010).

CONCLUSIONS

The results suggest caution in the use of high amount of flavored waters especially for diabetic patients. Used HPLC-RID method could be performed for fast determination of total sugar content and sugar composition in flavored waters.

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Summary/Sažetak

Aromatizirane vode se sastoje uglavnom od vode, prirodnih ili vještačkih aromatizera i šećera ili vještačkih zaslađivača. Cilj ovoga rada je određivanje ukupnog sadržaja šećera u 25 različitih aromatiziranih voda, koje se mogu nabaviti na slovenačkom lokalnom tržištu, korištenjem metode visokotlačne tekućinske hromatografije (HPLC) sa detekcijom refrakcijskog indeksa (RID). HPLC (Agilent 1200 Series) izvedena je izokratskim eluiranjem mobilne faze 15 mM K_2HPO_4 vodene otopine. Degasirani i razrjeđeni uzorci analizirani su na Supelcogel K koloni (300 x 7.8 mm, sa veličinom zrnaca 9 μm), na 80 °C i protokom od 0.5 $mLmin^{-1}$. Ukupni sadržaj šećera u aromatiziranim vodama varirao je od brenda do brenda , od 11.0 g/L do 44.1 g/L. Vrijednosti koncentracije saharoze, glukoze i fruktoze kretao se u rasponima (g/L) : 10.0 – 32.8; 1.3 - 21.7 and 3.0 -37.2, respektivno. Rezultati sugeriraju oprez prilikom upotrebe velikih količina aromatiziranih voda posebno za dijabetičare.