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THE NUTRITIONAL AND HEALTH VALUE OF FRUIT, VEGETABLE AND FRUIT-VEGETABLE JUICES®

Wartość odżywcza i zdrowotna soków owocowych, warzywnych i owocowo-warzywnych®

Juices are obtained from the edible part of one or more types of fruit, which may be fresh or chilled. They are characterized by the color, aroma and taste typical of a given fruit. The main ingredient of juices is water, which is essential for the proper functioning of the body. Fruit juices, as well as vegetable and fruit-vegetable juices are characterized by relatively high nutritional value and concentration of pro-health compounds, the so-called phytochemicals. These are, for example, carotenoids (α - and β - carotene, lycopene, lutein), vitamins A, C, E and B vitamins, as well as polyphenols that have antioxidant properties and reduce the effects of oxidative stress, thus limiting the development of diseases such as cancer, ischemic heart disease or neurological diseases.

Key words: fruit juices, vegetable juices, fruit-vegetable juices.

Soki pozyskiwane są z części jadalnej jednego lub kilku gatunków owoców, które są w stanie świeżym lub schłodzonym. Charakteryzują się typową dla danego owocu barwą, aromatem i smakiem. Głównym składnikiem soków jest woda, która jest niezbędna do prawidłowego funkcjonowania organizmu. Soki owocowe, jak również warzywne i owocowo-warzywne charakteryzują się stosunkowo dużą wartością odżywczą oraz koncentracją związków o charakterze prozdrowotnym, tzw. fitozwiązków. Są to na przykład karotenoidy (α - i β - karoten, likopen, luteina), witaminy A, C, E i witaminy z grupy B, a także polifenole mające działanie przeciwutleniające oraz zmniejszające skutki stresu oksydacyjnego, przez co ograniczają one rozwój schorzeń, takich jak nowotwory, choroba niedokrwienna serca, czy schorzenia neurologiczne.

Słowa kluczowe: soki owocowe, soki warzywne, soki owocowo-warzywne.

INTRODUCTION

According to the definition provided in Directive 2012/12/EU of the European Parliament and of the Council of April 19, 2012 amending Council Directive 2001/112/EC relating to fruit juices and certain similar products intended for human consumption, fruit juices are unfermented products, but capable of for fermentation. They are obtained from the edible part of one or more types of fruit, which may be fresh or chilled. They are characterized by the color, aroma and taste typical of a given fruit [4]. Fruit juices, as well as vegetable and fruit-vegetable juices are characterized by relatively high nutritional value and concentration of pro-health compounds, the so-called phytochemicals. These are, for example, carotenoids (α - and β - carotene, lycopene, lutein), vitamins A, C, E and B vitamins, as well as polyphenols that have antioxidant properties and reduce the effects of oxidative stress, thus reducing the risk of developing diseases such as such as cancer, ischemic heart disease or neurological diseases. The content of phytochemicals in juices depends on the raw material used in the production [4].

DIVISION OF JUICES

Taking into account the raw material used to produce the juice, the following juices are distinguished: fruit, vegetable and fruit-vegetable. Continuing this division, we can distinguish single-ingredient, two-ingredient and multi-ingredient juices. The second criterion according to which juices can be divided is the type of intermediate from which the juice was made. Juices can be natural, i.e. produced simply by squeezing fruit juice or reconstituted from concentrated juices (concentrates). Another division concerns the method of thermal processing of juices. In this case, juices are divided into juices: unpasteurized, pasteurized at low temperature and pasteurized. Juices that have been pasteurized contain fewer compounds (including antioxidants) that are not resistant to elevated temperatures [33]. During production, the juices are thermally fixed by pasteurization at a temperature of about 100° C. The most common method of preserving juices is the HTST method, i.e. the action of the temperature of 95°C for 15-30 seconds and is aimed at inactivating enzymes, microbiological stabilization of the juice, starch gluing and protein denaturation [11].

Juices can also be divided according to their appearance and consistency. Depending on this discriminant, we are talking about the following juices: clarified, naturally cloudy, puree [13,14]. Naturally cloudy and puréed juices, compared to those subjected to clarification processes, contain fiber and contain more substances with antioxidant properties and vitamins [12].

ENERGY AND MACRONUTRIENT CONTENT

The main component of juices is water, which performs many important functions in the body and, above all, is the main component of each emerging cell and tissue, it is an excellent solvent, participates in thermoregulation and plays a protective and moisturizing role. In fresh juices and drinks, its content is in the range of 85-100%, so they can be a source of water in the daily diet [17]. The next nutrient that is found in high levels of juices is carbohydrate. Depending on the type, juices contain from 2.7 g to 15.8 g of carbohydrates in 100 ml of the product, and their calorific value ranges from 18 kcal/100 ml to 67 kcal/100 ml, respectively. Due to the relatively high content of simple sugars in juices, it is recommended to consume no more than one glass of this product per day. Protein and fat are present in a very small amount, while some vegetable and raw juices contain relatively large amounts of dietary fiber [4]. Vegetable juices provide more nutrients, and at the same time are less caloric, because they contain much less carbohydrates, mainly simple sugars, than fruit juices [26]. Juices are a good variety and complement of daily diet. Table 1 shows the energy value and the content of selected macronutrients and dietary fiber in juices [17].

Table 1. Energy value [kcal], content of selected macronutrients [g] and dietary fiber [g] in juices per 100 g of the product

Tabela 1. Wartość energetyczna [kcal], zawartość wybranych makroskładników [g] oraz błonnika pokarmowego [g] w sokach w 100 g produktu

Type of juice	Energy value	Protein	Fat	Carbohydrates	Dietary fiber
Grapefruit	40	0.5	0.1	9.1	0.1
Apple	41	0.1	0.1	10.0	0.0
Carrot	45	0.4	0.1	10.0	1.3
Orange	43	0.6	0.1	9.8	0.1
Tomato	18	0.8	0.2	2.7	1.1
Multi-vegetable	27	1.0	0.3	4.5	1.2

Source: [17]

Źródło: [17]

VITAMINS CONTENT

The vitamin content in freshly squeezed juices is slightly lower than the content of these ingredients in fresh vegetables and fruit, therefore a portion of the juice can be considered a good source of these ingredients in the diet [25].

Some fruit, vegetable or fruit and vegetable juices, especially freshly squeezed, can be a good source of selected vitamins. Examples include juices rich in vitamin C, such as grapefruit, orange or tomato juice. Grapefruit juice provides 76 mg of vitamin C in 200 g, and the average requirement (EAR) for this vitamin for women over 19 is 60 mg/person/day [15]. Table 2 shows the vitamin C content in 100 g of grapefruit juice. More than half of the requirement, because 33 mg of vitamin C is covered by 200 g of tomato juice, in 100 g it is 16.5 mg (tab. 2) [17]. The recommended amount of vitamin C should be consumed daily, because the human body does not synthesize it at all and is stored to a small extent [15].

Vegetable and fruit-vegetable juices, especially carrot and carrot juices, are rich in vitamin A, or actually vitamin A provitamin, which is defined as carotenoids found in plant raw materials (β -carotene, α -carotene, β -cryptoxanthin) [7, 29]. Vitamin A plays an important role in the proper functioning of the immune system, in the processes of cell division and differentiation, as well as in the process of vision. Moreover, vitamin A, and in particular β -carotene, exhibits strong antioxidant properties [9]. Table 2 presents the content of selected vitamins in juices [17].

MINERALS CONTENT

Many vegetables, and thus the juices made from them, are a good source of potassium. Rich in potassium are, among others tomatoes, red beets, spinach, carrots, kale [17]. Potassium is essential for the proper functioning of the body's cells. Responsible for maintaining the proper water and electrolyte balance of the body by regulating the osmotic pressure of cells, as well as for the proper functioning of the heart. Its deficiency in the daily diet may lead to an increased risk of diseases such as hypertension, stroke, ischemic heart disease. Tomatoes contain 282 mg of potassium per 100 g. This amount of potassium covers only about 8% of the norm on the level of sufficient consumption (AI) of this ingredient [15]. As for the portion of juice (200 g), after conversion, it turns out that it covers a total of approx. 15% of the norm for this ingredient [17].

Magnesium is one of the most important minerals. It participates in the formation of proteins, muscle contractions, and also regulates blood pressure and affects the nervous system. Magnesium is contained in chlorophyll, which is why green vegetables contain more of it and can be a source of it. The average demand (EAR) for magnesium for women aged 19 to 30 is 255 mg / person / day, and for women over 30 years of age, it is 265 mg / person / day [15]. A glass of multi-vegetable juice provides 24 mg of magnesium, which is about 10% of the daily requirement for this ingredient [17].

Juices contain relatively little iron, in addition in a non-haem form, which has low bioavailability, but the high amount of ascorbic acid in the juices increases its absorption [17].

In addition to the above-mentioned minerals, juices also contain calcium, sodium, and phosphorus [21]. Table 3 presents the content of selected minerals in juices [17].

BIOACTIVE COMPOUNDS

Juices are a good source of polyphenols, biologically active compounds with antioxidant properties. They have anti-inflammatory, anti-arthritis, antiallergic and also anti-

Table 2. Content of selected vitamins in juices in 100 g of the product

Tabela 2. Zawartość wybranych witamin w sokach w 100 g produktu

Type of juice	Vit. A [μ g]	β -carotene [μ g]	Vit. E [mg]	Thiamine [mg]	Riboflavin [mg]	Niacin [mg]	Vit. C [mg]
Grapefruit	1	6	0.19	0.04	0.020	0.20	38.0
Apple	2	12	0.01	0.01	0.006	0.03	2.3
Carrot	580	3478	0.18	0.02	0.019	0.16	1.2
Orange	13	78	0.10	0.06	0.030	0.30	43.1
Tomato	99	591	1.13	0.06	0.039	0.92	16.5
Multi-vegetable	167	1001	0.48	0.04	0.039	0.63	12.0

Source: [17]

Źródło: [17]

Table 3. Content of selected minerals in juices [mg/100 g]

Tabela 3. Zawartość wybranych składników mineralnych w sokach [mg/100 g]

Type of juice	Sód [mg]	Potas [mg]	Wapń [mg]	Fosfor [mg]	Magnez [mg]	Żelazo [mg]
Grapefruit	1	102	11	9	8	0.1
Apple	2	110	9	6	5	0.2
Carrot	29	99	13	11	6	0.2
Orange	2	175	8	14	11	0.4
Tomato	193	260	8	19	9	0.5
Multi-vegetable	312	190	16	20	12	0.5

Source: [17]

Źródło: [17]

cancer properties [19]. Polyphenols can be divided into phenolic acids and flavonoids, which form a whole group of compounds, which include: flavones, flavonols, flavanols, flavanones, isoflavones, anthocyanins. Their main sources in the diet are drinks, including juices and fruit, especially berries. Anthocyanins, in addition to their functions typical of polyphenols, are responsible for the bright red, blue and purple color of fruits and other parts of plants. Thus, the red color of strawberries or dark eggplant skins is due to the presence of anthocyanins. This is confirmed by the research conducted by Człapka-Matyasik et al. [8], which compared dark-colored juices (chokeberry, currant, grape juice) and citrus

juices (orange, grapefruit juice). Dark-colored juices were characterized by a higher content of anthocyanins. Oranges are a good source of flavanones. Hand-squeezed orange juice contains 839 mg of phenols per liter. It is estimated that a person consumes daily approximately 1-2 g of polyphenols to the diet if you consume the recommended amount of fruit and vegetables. Flavonones, which are the dominant flavonoids found in citrus juices, have a beneficial effect on health, have hypolipidemic, anti-carcinogenic, anti-inflammatory, analgesic and blood pressure lowering effects [23, 35]. Table 4 shows the content of selected polyphenols in juices [36].

Table 4. Content of selected polyphenols in juices [mg/l]

Tabela 4. Zawartość wybranych polifenoli w sokach [mg/l]

Type of juice	Phenolic acids		Flavonoids			
	Derivatives of benzoic acid	Derivatives of cinnamic acid	Anthocyanins	Flavonols	Flavanols	Flavones
Orange		15-20				215-685
Apple				6-52	8	
Grapefruit		15-24				100-650
Lemon						50-300
From red grapes	79					
From white grapes	110					
Cherry		124				
From black currant			130-400			

Source: [36]

Źródło: [36]

HEALTH ASPECTS OF JUICE CONSUMPTION

A balanced diet must include vegetables and fruits because they are rich in nutrients necessary for the proper functioning of the body. Juices that are their products are characterized by a lower concentration of biologically active compounds and in accordance with Directive 2012/12/EU of the European Parliament and of the Council of April 19, 2012 amending Council Directive 2001/112/EC relating to fruit juices and certain similar products intended for consumption by people, it is allowed to enrich juices with vitamins and minerals. The World Health Organization (WHO) recommends consuming 5 servings of vegetables and fruit per day, of which, according to the Food and Nutrition Institute (IŻŻ), 1 serving may be a glass of juice [15]. Therefore, it will be correct to say that regular consumption of fruit, vegetable and fruit and vegetable juices has a positive effect on health and even reduces the risk of developing civilization diseases e.g.: hypertension, stroke, ischemic heart diseases and cancers [1, 2].

Ingredients that are contained in fruits and vegetables, such as, vitamin C, β -carotene, and flavonoids are beneficial to the cardiovascular system. Their antioxidant properties reduce the level of LDL-cholesterol oxidation and the level of platelet aggregation [28]. In addition, folic acid, present in green fruits and vegetables, prevents the development of atherosclerosis, because it participates in the transformation of homocysteine in the human body and thus reduces hyperhomocysteinemia, an independent factor in the development of atherosclerosis. Thus, it can be concluded that the consumption of fruit, vegetable and fruit and vegetable juices containing the above-mentioned nutrients may contribute to reducing the risk of metabolic syndrome [20].

Oxidative stress is the cause of the development of many civilization diseases, including arterial hypertension, coronary artery disease, cancer. Due to this, the presence of antioxidants in the daily diet is necessary [6]. Many studies have been carried out to analyze the ability of compounds with antioxidant properties in juices to remove reactive oxygen species and the impact of these compounds on the reduction of oxidative stress after juice consumption. Wasek et al. [34] observed that chokeberry juice has the highest antioxidant potential, followed by cherry and blackcurrant juice, and the lowest is white grape and apple juices. Another study by O'Byrne et al. [24] showed that the consumption of red grape juice has a positive effect on health. Flavonoids present in it are effective antioxidants, counteract the oxidation of lipids. The results of research conducted by Aviram et al. [3] indicate that consuming 50 ml of pomegranate juice daily contributes to the reduction of lipid peroxidation and to an increase in the concentration of antioxidants in the blood serum.

Orange juice also has a proven beneficial effect on health. Studies by Rampersaud et al. [27] have shown that it is a source of well-absorbed vitamin C, the presence of which is essential for the proper functioning of the body. Vitamin C is involved in a number of biological processes, including in the synthesis of collagen, adrenaline and steroid hormones. In addition, it has an antioxidant effect, prevents the development of such diseases as ischemic heart disease, atherosclerosis, heart attack and neoplastic diseases, mainly of the gastrointestinal tract.

Moreover, it increases the absorption of iron and calcium in the digestive tract [18].

In some juices, especially fresh juices, relatively higher amounts of fiber support proper digestion. It accelerates the intestinal peristalsis, slows down the absorption of carbohydrates, and is also a substrate for the development of the intestinal microflora. Moreover, it has a positive effect on lowering blood pressure, cancer prevention and reducing blood cholesterol levels [32]. Research shows that increasing the daily intake of fiber reduction of the risk of heart disease and to the reduction of mortality due to coronary heart disease [16, 30].

Some studies have shown that fruit and vegetable juices can play a role in delaying the onset of Alzheimer's disease. In studies conducted in this area, a lower risk of disease was observed in people who consumed juices three times a week than in people who consumed juices less than once a week. The results of the research allowed for the conclusion that the risk of Alzheimer's disease was significantly reduced with increasing frequency of juice consumption [5].

Despite many positive aspects regarding juice consumption, it should be remembered that consumed in too large amounts, especially fruit juices, which are a source of simple sugars, may contribute to overweight and tooth decay, especially in children [22]. Therefore, it would be recommended to eat freshly squeezed juices made mainly of vegetables.

JUICE MARKET AND THE VOLUME OF THEIR CONSUMPTION

The juice market in Poland in 2010–2017 was characterized by continuous development. Juice production, with an average annual growth of 2.9%, increased by 22% in those years, from 544 million liters in 2010 to 665 million liters in 2017. The largest share in the production structure was mixed juices – 42%, then apple juices – 28%, then citrus juices – 21% and juices made from one type of fruit or vegetable – 9%. The production of apple juice in 2010–2017 increased by as much as 80%, and mixed juices by 27%, while the production of citrus fruit juices decreased by 8.5%. The production of juices in 2017 accounted for 6.8% of the total production of all non-alcoholic beverages in Poland [31]. The report prepared by the International Network of Audit and Advisory Firms – KPMG (2016) shows that Poles buy a lot of fruit juices, drinks and nectars. Calculated per person, it is 35 liters per year, only 1 liter / person less than the inhabitants of Germany, who ranks first in Europe in terms of consumption of these products.

The development of the juice market in Poland depends on several factors. The main one is the price, the next ones are the quality of the products, consumer awareness of the health-promoting properties of juices and new products introduced to the market. The price mainly determines the choice of the consumer. The low price increases juice consumption, and when the price rises, consumption decreases. Increasingly, however, consumers pay attention not to the price, but to the quality of the product. The European Quality Control System (EQCS) and the European Fruit Juice Association (AIJN) are responsible for the authenticity and control of juices in Poland and Europe. Since 2000, the AIJN Code of Practice has been in force in Poland, which serves as a model in assessing the

authenticity of juices [26]. It contains precise data on the chemical composition of various types of juices, both fruit and vegetable. Due to the constant and objective control of the quality of juices, a reduction in the level of adulteration of these products, especially imported ones, is observed. This allows for fair competition and affects the development of the entire juice market in Poland. The growing awareness of consumers about the health-promoting effect of juice consumption makes them choose them more and more often, and thus contribute to the development of this market sector. The market development is also influenced by new products, such as smoothies. They are pure fruit and vegetable juices with a thick, creamy consistency. However, in order for them to stay on the market and influence its development, it is important to maintain a balance between their quality and price. Poland is one of many European countries that has managed to do so and the smoothie market has developed a lot in recent years [26].

The statistical data of the Central Statistical Office (GUS) shows that in 2000-2008 the consumption of fruit and vegetable juices was gradually increasing [10]. Their average monthly consumption in 2000 was 0.79 liters per person, and in 2008 it was 1.10 liters per person. The highest, almost 21% increase in juice consumption was recorded in the years 2000–2005. After 2008, a decrease in the consumption of juices in households is visible. In 2008–2013, consumption decreased by 24%. Since 2013, another upward trend in consumption of this group of products has been observed. Juice consumption in 2017 was estimated at 0.97 liters / person / month, which is 11% higher than in 2013 [10].

According to the data of the Central Statistical Office (2015), the consumption of fruit and vegetable juices varies depending on the level of education, place of residence, socio-economic conditions, biological type of the farm and the number of people in the household. Research conducted by the Central Statistical Office of Poland in 2014 shows that more juices are consumed by people with higher education than other study participants [10]. The highest consumption of juices was characterized by workers in non-manual positions, and the lowest by farmers. Place of residence also had a great influence on juice consumption. People from cities consumed more juices than people living in the countryside. The highest average monthly juice consumption was recorded in cities with a population of over 500,000. Along with the increase in the number of people in the household, the consumption of juices per person/month decreased [GUS, 2015].

CONCLUSION

Juices can be a good variety and supplement to your daily diet. They are characterized by the color, aroma and taste typical of a given fruit/vegetable. The main component of juices is water, which is essential for the proper functioning of the body. Fruit juices, as well as vegetable and fruit-vegetable juices are characterized by relatively high nutritional value and concentration of pro-health compounds, the so-called phytochemicals. These are, for example, carotenoids (α - and β - carotene, lycopene, lutein), vitamins A, C, E and B vitamins, as well as polyphenols that have antioxidant properties and reduce the effects of oxidative stress, thus limiting the development of diseases such as cancer, ischemic heart disease or neurological diseases. Juices, especially vegetable and non-clarified juices, contain relatively large amounts of dietary fiber, which can help to support the digestive process. Fruit juices, which are higher in simple sugars, can contribute to excess weight or tooth decay if consumed in too much.

PODSUMOWANIE

Soki mogą być dobrym urozmaiczeniem i uzupełnieniem codziennej diety. Charakteryzują się typową dla danego owocu/warzywa: barwą, aromatem i smakiem. Główny składnik soków to woda. Jest ona niezbędna do prawidłowego funkcjonowania organizmu. Soki owocowe, jak również warzywne i owocowo-warzywne charakteryzują się stosunkowo dużą wartością odżywczą oraz zawartością związków o charakterze prozdrowotnym, tzw. fitozwiązków. Są to na przykład karotenoidy (α - i β - karoten, likopen, luteina), witaminy A, C, E i witaminy z grupy B, a także polifenole mające działanie przeciwutleniające oraz zmniejszające skutki stresu oksydacyjnego. Ich spożywanie może ograniczyć rozwój schorzeń, takich jak nowotwory, choroby niedokrwiennej serca, czy schorzeń neurologicznych. Soki, szczególnie warzywne i nie poddane klarowaniu zawierają stosunkowo duże ilości błonnika pokarmowego, wspomagającego procesy trawienia. Soki owocowe, charakteryzujące się większą zawartością cukrów prostych, spożywane w zbyt dużych ilościach mogą przyczynić się do wystąpienia nadwagi lub próchnicy.

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