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CHARACTERISTICS OF THE PROPERTIES OF CANE SUGAR AND THE ASSESSMENT OF ITS AVAILABILITY ON THE LOCAL MARKET OF WARSAW®

Charakterystyka właściwości cukru trzcinowego i ocena jego dostępności na lokalnym rynku Warszawy®

The article presents issues related to the consumption of sugar in the diet, describes the properties of cane sugar and assesses its availability on the local market, taking into account organic products. The research was based on the information provided by the producers on the packages of cane sugars available in selected stationary and online stores in Warsaw. The research material included 185 samples of sugar cane products, such as: sugar, powder sugar, sugar cubes and sticks, and cane syrup. Market analysis of the cane sugar concerned the availability of cane sugar, the variety of products, the market share of manufacturers and prices per 1 kg of product. The variety of cane sugars offered by online and stationary stores was comparable. Among the analyzed groups of cane products, sugar was the most accessible, whereby Demerara unrefined sugar having the highest market share. More than 1/2 of the cane sugar market was represented by Diamant, Sante and Królewski brands. Organic products accounted for about 30% of all products. The differentiating factor was the price of sugar cane products.

The range of cane sugars available on the market was significantly more expensive than sugar from sugar beets. Organic products were about 2 times more expensive than conventional products. The analysis of the declared energy value of cane sugars showed that most of the assessed products advertised by producers as unrefined may be refined sugar with the addition of cane molasses.

Key words: cane sugar, properties, local market analysis, organic products.

W artykule przedstawiono zagadnienia związane ze spożyciem cukrów w diecie, opisano właściwości cukru trzcinowego i dokonano oceny jego dostępności na lokalnym rynku, z uwzględnieniem produktów ekologicznych. Badania przeprowadzono w oparciu o informacje podane przez producentów na opakowaniach cukrów trzcinowych dostępnych w wybranych sklepach stacjonarnych i internetowych na terenie Warszawy. Materiał badawczy obejmował 185 próbek produktów z trzciny cukrowej, jak: cukier, puder, cukier w kostkach i saszetkach oraz syrop trzcinowy. Analiza rynku cukrów trzcinowych dotyczyła dostępności cukru trzcinowego, różnorodności asortymentu, udziału producentów w rynku oraz ceny za 1 kg produktu. Wykazano, że dostępność asortymentu cukrów trzcinowych oferowana przez sklepy internetowe i stacjonarne była porównywalna. Wśród analizowanych grup produktów trzcinowych najłatwiej dostępny był cukier, przy czym największy udział w rynku miał cukier nierafinowany Demerara. Ponad 1/2 rynku cukrów trzcinowych była reprezentowana przez marki Diamant, Sante i Królewski. Produkty ekologiczne stanowiły około 30 % rynku cukrów trzcinowych. Czynnikiem różnicującym była cena produktów trzcinowych. Dostępny na rynku asortyment cukrów trzcinowych był dużo droższy niż cukier biały buraczany. Produkty ekologiczne były ok. 2 razy droższe niż produkty konwencjonalne. Analiza deklarowanej wartości energetycznej cukrów trzcinowych wykazała, że większość ocenianych produktów reklamowana przez producentów jako produkt nierafinowany mogła stanowić cukier rafinowany wtórnie zmieszany z melasą trzcinową.

Słowa kluczowe: cukier trzcinowy, właściwości, analiza rynku, produkty ekologiczne.

INTRODUCTION

Civilization diseases are a significant social problem in economically developed countries. Qualitative and quantitative inadequate nutrition and physical inactivity are important factors in the etiology of many chronic non-communicable diseases, such as overweight and obesity, insulin resistance, type II diabetes, ischemic heart disease, metabolic syndrome, cancer, non-alcoholic fatty liver disease or tooth decay [11, 12, 17]. Generally, it is believed that the occurrence of the above-mentioned diet-related diseases are caused by the excessive consumption of highly processed, carbohydrate-rich foods, in particular sugars added to food and beverages in the production process during the preparation of sweeteners for food and beverages by consumers [8, 19]. However, it cannot be unequivocally stated that overconsumption determines their formation, because they are most often multi-factorial diseases [2, 5, 8, 11].

The energy of the entire daily diet from sugars naturally occurring in food and added sugars should be 10–15%, as determined by the World Health Organization (WHO) [4]. Standards of total carbohydrate consumption recommended by the Food and Nutrition Institute for the Polish population are 45–65% of the daily energy value of the diet [12]. Intensive sweeteners can be an alternative to sugar consumed and used in the food industry [20].

Contrary to the commonly accepted belief that sugar has a „bad” effect on human health and the legal regulations limiting its consumption [18], the average consumer is not aware of the physiological functions of carbohydrates in the body. Energy obtained from burning sugars is used, among others to maintain body temperature, work of internal organs and physical activity. In turn, the consumed carbohydrates are broken down into monosaccharides and converted in liver into glucose, which is a physiological sugar necessary for the proper functioning of brain, nervous and circulatory system, muscles, intestines and heart [3, 12]. Additionally, sugar supplied to body releases the production of serotonin, which is responsible for improving the well-being [6].

Worldwide, cane sugar is the main source of carbohydrate in the diet, right after beet (white) sugar. Refined sugars contain up to 100% sucrose, therefore refined cane sugar is not a „healthy” substitute for traditional white beet sugar. The energy value of refined sugar is approx. 400 kcal / 100 g (approx. 1700 kJ / 100 g), but unrefined cane sugars, thanks to the natural molasses they contain, differ from refined sugar mainly with less sucrose, color and consistency and a unique taste and aroma. From a health point of view, brown cane sugar contains small amounts of valuable minerals, B vitamins and compounds with bioactive properties [3, 14, 15].

The aim of this study is to present the properties of cane sugar and to assess its availability on the local market, taking into account organic products.

PROPERTIES OF CANE SUGAR

Cane sugar, as the name suggests, is made from sugarcane (*Saccharum officinarum* L.) – a perennial plant grown in tropical and subtropical climates. About 70% of world sugar production is cane sugar and the main producers are: Brazil, India, China and Thailand [6].

Sugarcane is used in traditional Ayurvedic and unani medicine. Sugarcane juice is widely considered a nutritional drink and a unique source of various ingredients with significant biological activity, it is recommended for people with liver and kidney problems. Pharmacological studies based on the assumptions of Indian medicine have shown that sugarcane has anti-inflammatory, analgesic, antihyperglycemic, diuretic and hepatoprotective properties [9, 10, 16]. Research is being conducted on the use of flavonoids contained in by-products from the production of cane sugar for the production of nutraceuticals and pharmaceuticals [10].

Cane sugar has a characteristic caramel taste, specific aroma and color, which depend on the degree of purification of the sugar from molasses. During the refining of cane sugar, most of the bioactive substances present in the juice are removed and only unrefined products may contain some polyphenolic compounds such as phenolic acids, flavonoids and various glycosides [1, 10, 15, 16]. Older people living in Okinawa in Japan attribute their above-average life expectancy to eating kokutou – a natural cane sugar [3].

The production of cane sugar involves many steps, such as extraction of cane juice, clarification, defecation (pH adjustment), filtering, evaporation, crystallization and centrifugation to separate the crystals from the molasses. The raw sugar obtained in this way can be refined, i.e. further purified [3].

Several types of cane sugar are available on the food market [14]. Natural sugars include crude molasses which, depending on the region, are known by different names such as jaggery, panela, gur, chancaca, rapadura, etc. Among the unrefined sugars that have undergone centrifugation or minimal refining, special sugars such as demerara, muscovado and turbinado are mentioned. As a result of refining raw sugar, white or brown sugars are obtained with a sucrose content of up to 100%, a light golden to dark brown color, fine crystals and a moisture content of up to 5% [3]. The content of molasses in the final product has a significant influence on the color of cane sugar. On the other hand, molasses owes its color to caramel and melanoids, which are produced in the technological process [15].

Unrefined cane sugars, as a source of valuable substances with pro-health properties, have been the subject of interest of many researchers [1, 3, 5, 7, 15]. The results of sugar jaggery research indicate that their main ingredient is sucrose (74.3–92.0%), they contain glucose (4.1–14.4%), fructose (3.8–11.2%) and water (1.8–6.4%) and inorganic ash (0.3–3.6%), protein (0.37–1.7%) and fat (0–0.1%) [1, 7]. The following minerals were identified: calcium, potassium, sodium, magnesium, iron, copper and small amounts of manganese and zinc. The presence of B vitamins (thiamine, riboflavin, niacin, pyridoxine, pantothenic acid, folic acid) and vitamin C has been found too.

Barrera et al. [1] prove that the most polyphenols and flavonoids were contained in jaggery and muscovado sugars, and there were trace amounts in refined sugars [15]. Phenolic acids such as cinnamic, chlorogenic, caffeic, sinapic, coumaric and ferulic acids, and flavones such as luteolin, tricetin and apigenin were identified from phenolic profile analysis. Tricetin and apigenin are both considered nutraceuticals [1, 15].

The interests of many researchers [1, 10, 15] also included the antioxidant potential of unrefined cane sugars. It was proved that the antioxidant activity of the assessed products depended on their purification from molasses. Cane honey and jaggery sugars had the best ability to scavenge free radicals. Moreover, some of the analyzed jaggery and muscovado sugar samples showed strong antibacterial properties against *Streptococcus mutant* and *Streptococcus sobrinus* [1].

The results of Eggleston [3] show that unrefined cane sugars contain oligosaccharides with prebiotic properties. These compounds have a positive effect on human health because they stimulate the growth of probiotic bacteria in the large intestine. These include fructo-oligosaccharides and fructans from the kestose group (trisaccharides).

AVAILABILITY OF CANE SUGAR ON THE LOCAL MARKET

The research material consisted of information provided by the manufacturer on the packaging of selected cane sugars and information placed next to these products on the websites of stores. Market research was conducted in January and February 2021.

The cane sugar market assessed 17 stationary stores in Warsaw, including: hypermarkets (Auchan, E.Leclerc, Carrefour, Kaufland), supermarkets (Eurospar, Aldi, Carrefour Express 7–24), discount stores (Biedronka, Lidl), local stores (Carrefour Express, Żabka, Lewiatan, Mokpol, Grosik, Wierzejki) and organic food stores (Organic Farma Zdrowia, BioBrain). Ecological stores were among the 9 evaluated online stores (www.biosklep.com.pl, www.marketbio.pl, www.biogo.pl, www.bioboo.pl, www.organic24.pl) and stores of large retail chains (www.auchandirect.pl, www.carrefour.pl, www.frisco.pl, www.leclerc-online.pl).

Information on 185 samples of sugarcane products was collected in the stores selected for the study (one product is one type of assortment from one manufacturer). The reference samples were beetroot sugars (71 products), including white (88.7%) and brown sugars (11.3%).

The cane sugar market analysis included: availability of cane sugars, variety of assortment, market share of producers, prices per 1 kg of product and availability of cane sugars with a declaration of organic origin.

Comparable amounts of cane sugars were available in online (50.3%) and in stationary (48.6%) stores. In traditional and online stores, 135 sugar samples were available, of which conventional products accounted for 88.9% (120 samples), and organic products – 11.1% (15 samples). Organic food stores, on the other hand, offered 50 products, most of which were organic sugars (82.0%).

Assessing the availability of cane sugar in stationary and online stores of large retail chains, such as Carrefour, Auchan and E.Leclerc, the assortment was richer in stationary stores than online. The differences in the assortment concerned 1–5 products. Perhaps the lower availability of cane sugars in these online stores was due to the fact that during the COVID-19 pandemic, Warsaw residents prefer to shop online without leaving home.

Market analysis in terms of the availability of cane sugars in the analyzed stationary stores (Fig. 1) showed that the largest assortment was available in stores belonging to the Carrefour chain (33.4%). The commercial offer of Carrefour hypermarket included 15 products, on Carrefour Express 7–24 store – 9 products, and in Carrefour Express local store – 7 products. In Kaufland and Eurospar stores, the assortment of cane sugars accounted for approx. 10% of the market, while at discounters Lidl and Biedronka, only one product from the assessed assortment was available.

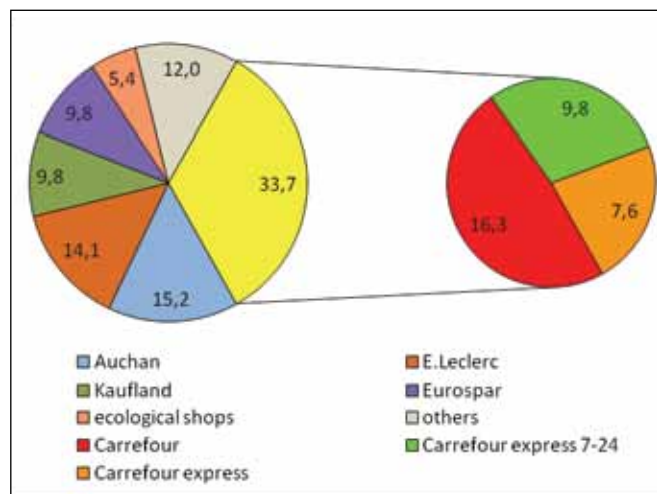


Fig. 1. Availability of cane sugars in stationary stores (%).

Rys. 1. Dostępność cukrów trzcinowych w sklepach stacjonarnych (%).

Source: Own study

Źródło: Badania własne

The data presented in Fig. 2 shows that among the analyzed online stores, the largest assortment of cane sugars was in: Frisco store and Bioboo store with organic food, in which 15 products were available, which accounted for 16.1% of the market. This was followed by Carrefour store (15.1%), organic stores Biogo (12.9%) and Biosklep (10.8%) and E.Leclerc online store (10.8%).

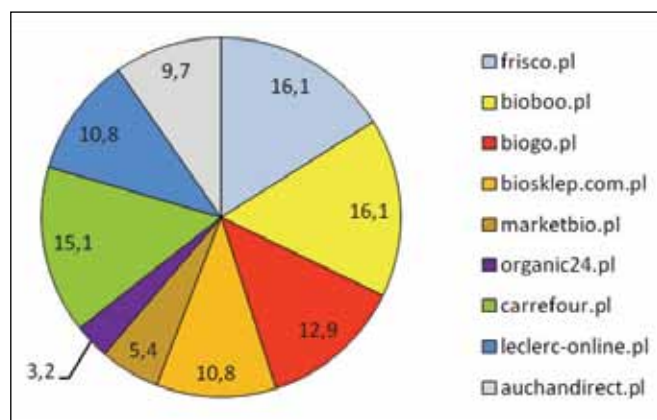


Fig. 2. Availability of cane sugars in online stores (%).

Rys. 2. Dostępność cukrów trzcinowych w sklepach internetowych (%).

Source: Own study

Źródło: Badania własne

The assessment of the local market in terms of the availability of the cane sugar assortment in individual stationary and online stores shows that 11–15 products were available in 26.9% of the analyzed stores. The same percentage (26.9%) was constituted by stores offering 6–10 products, and 3–5 products were sold by 11.5% of stores. 2 products were available in 15.4% of the stores, and one type of cane sugar could be purchased in 19.2% of the evaluated stores.

Five groups of sugar cane products were commercially available (Fig. 3). Sugars constituted 78.5% of the analyzed assortment, cube sugar – 12.4%, sugar sticks – 4.3%, powder sugar – 4.3%, including powder sugar with tapioca starch and invert cane sugar syrup – 0.5%. Diamant golden cane syrup was available only at Auchan hypermarket. Demerara sugars (51.7%) were the most numerous group of the assessed 145 samples of cane sugars, followed by products called cane sugar and unrefined sugar (17.2%), muscovado sugars (9.0%), brown sugars (9.0%), golden sugars (3.4%), light sugars (4.8%), jaggery and panela sugars (4.8%). Among the analyzed sugars, there were 3 gluten-free organic products.

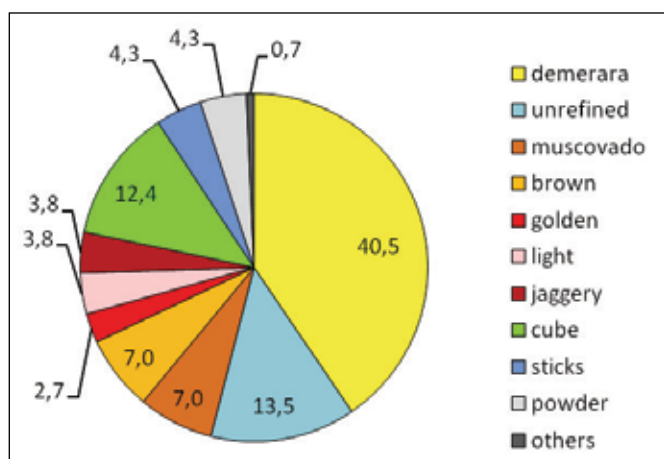


Fig. 3. Availability of the assortment of sugarcane products in the analyzed stores (%).

Rys. 3. Dostępność asortymentu produktów z trzciny cukrowej w analizowanych sklepach (%).

Source: Own study

Źródło: Badania własne

In this study (Fig. 4), 30 brands of cane sugar were available on the market, of which 7 were private labels offered by Carrefour, E.Leclerc, Eurospar and Auchan stores. More than half of the cane sugar market was represented by three brands, incl.: Diamant (22.1%), Sante (17.4%) and Królewski (14.5%). Bio Planet, a brand offering organic products, took fourth place (9.3%). Diamant cane sugars were in the commercial offer of 13 analyzed stores. In turn, Sante products were available in 16 stores, Królewski – in 6, and organic products of the Bio Planet brand in 7 online stores, including 6 organic ones.

The Diamant brand was characterized by the greatest variety of products (8 items). On the other hand, the Królewski and Bio Planet brands had 6 products each, while Sante and Alternativa – 4 products. The remaining brands accounted for 39.2% of the market and were represented by 1–2 groceries.

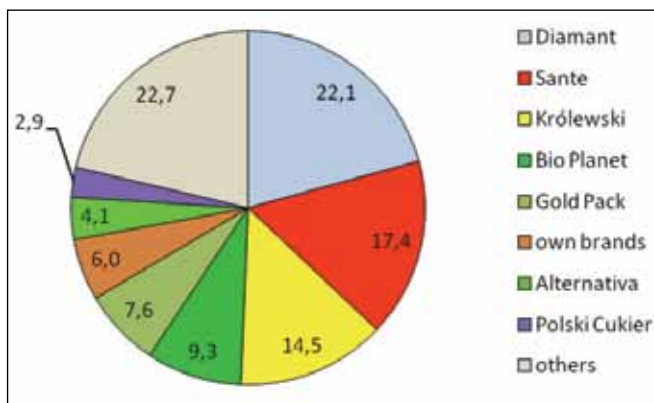


Fig. 4. Availability of the assortment of cane sugars by product brand (%).

Rys. 4. Dostępność asortymentu cukrów trzcinowych marek produktów (%).

Source: Own study

Źródło: Badania własne

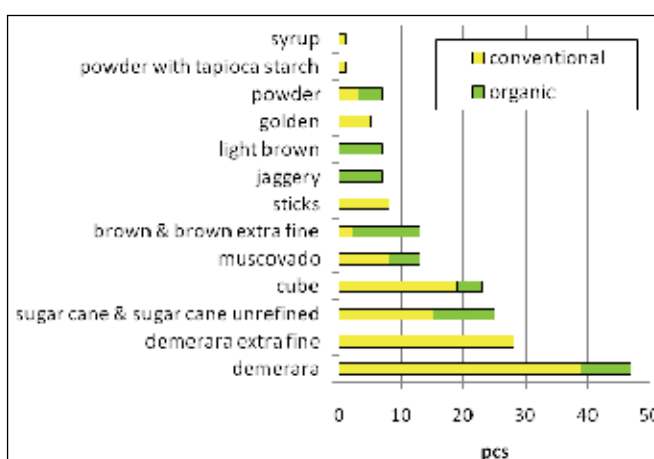


Fig. 5. Availability of the assortment of cane sugars from organic and conventional farming.

Rys. 5. Dostępność asortymentu cukrów trzcinowych pochodzących z upraw ekologicznych i konwencjonalnych.

Source: Own study

Źródło: Badania własne

The assessment of the availability of cane sugars with the declaration of organic origin in the analyzed stores showed that these sugars accounted for 30.3% of the market. The collected data (Fig. 5) shows that among organic products, there were 7 samples of jaggery sugar and 7 samples of light brown sugar, which accounted for 100% of a given assortment on the market. In the case of brown and fine brown sugar – BIO products accounted for 84.6% of this assortment on the market, followed by powder sugar (57.1%), products described as cane sugar and unrefined cane sugar (40.0%), muscovado sugar (38.5%), cubes sugar (17.4%) and demerara brown sugar (10.7%). Conventional products, on the other hand, represented the remaining range of the cane sugar market.

The vast majority of cane sugars marked as BIO were available at organic stores (73.2%), while the remaining were an assortment of purchasing traditional shops. One ecological product each could be found on the shelves of stationary stores

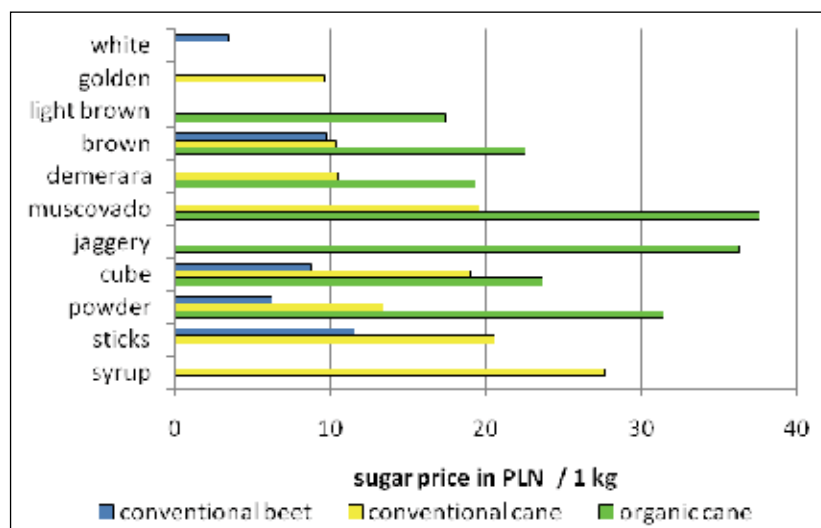


Fig. 6. Average price in PLN for 1 kg of organic and conventional cane sugar compared to beet sugar, depending on the assortment.

Rys. 6. Średnia cena w PLN za 1 kg cukru trzcinowego ekologicznego i konwencjonalnego w porównaniu z cukrem buraczanym w zależności od asortymentu.

Source: Own study

Źródło: Badania własne

such as Auchan, E.Leclerc, Eurospar and the Carrefour group. The Carrefour hypermarket offered 2 organic products, one of which was a private label.

Fig. 6 shows the average prices of 1 kg of organic and conventional cane sugar. The reference samples were beet sugars. Based on the analysis of sugars prices available on the market, it was found that cane sugars were much more expensive (5.99-49.68 PLN / kg) than white beet sugar (3.44 ± 1.05 PLN / kg). On the other hand, the prices of the assortment of cane products, such as powder sugar, sugar in cubes and sticks, were approx. 2 times higher than their beetroot counterparts. Only the purchase cost of brown sugar produced from sugar beet, i.e. white sugar coated with caramel (average 9.78 PLN / kg) was similar to the price of unrefined brown cane sugar (average 10.37 PLN / kg). Therefore, it is assumed that the term „brown sugar” may have been used by the producer of this sugar to mislead the consumer, suggesting that it is cane sugar, which would also be indicated by the price of the product. Consumers should read the information on the packaging carefully to avoid mistakes.

Overall, organic cane sugars cost about 2 times more than conventional products. Among the analyzed BIO cane sugars, the most expensive products were not purified from molasses, i.e. muscovado sugar (average 37.35 PLN / kg) and jaggery sugar (average 36.29 PLN / kg). However, in the case of conventional products, the most expensive product was Diamant golden cane syrup (27.65 PLN / kg), and the cheapest – Sante Golden unrefined cane sugar (8.99–10.44 PLN / kg). Differences in the price of a given product depended on the store, e.g. for Diamant Dry Demerara unrefined cane sugar, available in 8 stores, you had to pay from 9.28 to 13.98 PLN / kg (the difference in the price of 1 kg was 4.70 PLN).

In accordance with the guidelines of the EU Regulation No. 1169/2011 [13], the analyzed cane sugars contained

information about nutritional value in 100 g of the product. The declared energy value of the analyzed sugar samples ranged from 356 kcal / 1491 kJ (jaggery sugars) to 400 kcal / 1700 kJ (unrefined sugars). Data analysis shows that the energy value of the samples of unrefined cane sugar and refined beet sugar was similar. Consequently, it is suspected that producers are deliberately placing various types of cane sugars on the market advertised as „unrefined” because consumers find unprocessed products more attractive. In fact, commercially available brown sugars may be refined products mixed with cane molasses. As reported by Hryszko and Szajner [6], as a result of the implementation of the sugar market reform in Europe, raw cane sugar is imported to Poland for refining, which sugar factories carry out after the end of the beet campaign. Thus, the cane sugar available on the market may come from Polish sugar refineries or directly from import.

According to the principles of healthy eating, limiting sugar consumption and sufficient knowledge of consumers about the calorific value of products, the availability of the assortment of cane sugars on the market and their origin may be helpful in making purchasing decisions and properly balancing the daily diet.

CONCLUSIONS

1. The availability of the assortment of cane sugars offered in online and stationary stores was comparable. Conventional products were available primarily in traditional stores (88.9%), but were also sold in organic stores (18.0%).
2. Five groups of cane products were traded on the market, such as sugar, cube, powder, sticks and syrup. Almost 80% of the products available on the market was sugar, with Demerara unrefined sugar having the largest share in the market (40.5%).
3. More than half of the cane sugars available for sale were represented by the Diamant, Sante and Królewski brands. Next are the ecological products of the Bio Planet brand.
4. Products with an organic farming declaration accounted for around 30% of the cane sugar market. Most of the BIO products were offered in organic stores (73.2%).
5. The range of cane sugars available on the local market was significantly more expensive compared to white beet sugar. Organic products cost about twice as much as conventional products. Among the analyzed products, the most expensive were BIO sugars - muscovado and jaggery.
6. The analysis of the declared energy value of cane sugars showed that most of the assessed products advertised by producers as unrefined may be refined sugar with the addition of cane molasses. The various types of cane sugars available on the market may come from sugar factories refining imported raw cane sugar under the provisions of the sugar market reform in the European Union or directly from import.

WNIOSKI

1. Dostępność asortymentu cukrów trzcinowych oferowana przez sklepy internetowe i stacjonarne była porównywalna. Produkty konwencjonalne były dostępne przede wszystkim w sklepach tradycyjnych (88,9%), ale były też w sprzedaży sklepów z żywnością ekologiczną (18,0%).
 2. W obrocie handlowym znajdowało się 5 grup asortymentowych produktów trzcinowych, jak cukier, kostka, puder, saszetki i syrop. Prawie 80% dostępnych na rynku produktów stanowił cukier, przy czym największy udział w rynku miał cukier nierafinowany Demerara (40,5%).
 3. Ponad połowa dostępnych w sprzedaży cukrów trzcinowych była reprezentowana przez marki Diamant, Sante i Królewski. W dalszej kolejności znalazły się produkty ekologiczne marki Bio Planet.
 4. Około 30% rynku cukrów trzcinowych stanowiły produkty z deklaracją o pochodzeniu z rolnictwa ekologicznego.
- Większość produktów BIO znajdowała się w ofercie sklepów ekologicznych (73,2%).
5. Dostępny na lokalnym rynku asortyment cukrów trzcinowych był dużo droższy w porównaniu do cukru białego buraczanego. Za produkty ekologiczne trzeba było zapłacić ok. 2 razy więcej niż za produkty konwencjonalne. Spośród analizowanych produktów najwięcej kosztowały cukry BIO – muscovado i jaggery.
 6. Analiza deklarowanej wartości energetycznej cukrów trzcinowych wykazała, że większość ocenianych produktów reklamowana przez producentów jako produkt nierafinowany mogła stanowić cukier rafinowany wtórnie zmieszany z melasą trzcinową. Dostępne na rynku różne rodzaje cukrów trzcinowych mogły pochodzić z cukrowni prowadzących rafinację importowanego surowego cukru trzcinowego w ramach postanowień reformy rynku cukru w Unii Europejskiej lub bezpośrednio z importu.

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