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ORIGINAL ARTICLE

EVALUATION OF DAIRY PRODUCTS AVAILABLE ON THE POLISH MARKET IN THE CONTEXT OF NUTRIENT PROFILES. CLEAR ARGUMENTS FOR REFORMULATION OF FOODSTUFFS

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ABSTRACT

Background. Dairy products, which are one of the main groups of products in the diet, are expected to have high nutritional value. The development of food technology often involves changing the nutritional parameters of foodstuffs.

Objective. The aim of this study was to determine the nutritional value of dairy products, in the context of nutrient profiles.

Material and Methods. The tested products included yoghurts, yoghurt drinks, kefir, cream cheeses and milk desserts available on the Polish market, basing on the information from unit product packaging.

Results. The average sugar content in the group of all products was 11 g/100 g. Milk desserts contained the largest amount of sugar (average 14.7 g/100g), whereas kefir – the smallest amount (average 6 g/100 g) ($p < 0.0001$). Yoghurts and yoghurt drinks intended for children had higher sugar content than products for the general population (14.4 g vs. 10.5 g/100 g) ($p < 0.0001$). As many as 75% of products were sweetened. Taking into account the natural content of lactose, the estimated amount of added sugar ranged from 6.9 - 12.3 g/100 g. The average fat content in the group of all products amounted to 3.8 g/100 g. In the view of WHO profiles, 71% of products exceeded the permissible sugar content (≤ 10 g/100 g) and 36% exceeded the permissible content of saturated fatty acids (≤ 2 g/100 g). Using more liberal profiles developed by the food industry, the proportion of such products was smaller, but still quite high (34% in case of sugar and 26% in case of saturated fatty acids). In terms of the sugar content, according to regulation introduced in Poland, only 29% of the analyzed dairy products could be offer for children at schools. Among them there are all natural (not sweetened) yoghurts and kefir and only 6% of other sweetened products.

Conclusions. There is a justified need for the reformulation of dairy products, especially in terms of added sugar.

Key words: *dairy products, nutrient profile, sugar, fat, reformulation*

STRESZCZENIE

Wprowadzenie: Od przetworów mlecznych, które są jedną z podstawowych grup produktów w diecie człowieka oczekuje się wysokiej wartości odżywczej. Rozwój technologii żywności często jednak pociąga za sobą zmiany parametrów odżywczych produktów.

Cel: Charakterystyka wartości odżywczej przetworów mlecznych, w kontekście wymagań profili żywieniowych.

Materiał i metody: Ocenie poddano jogurty, napoje jogurtowe, kefiry, serki i desery mleczne dostępne na rynku polskim, bazując na informacjach z opakowań jednostkowych produktów.

Wyniki: Średnia zawartość cukrów w produktach mlecznych wynosiła 11 g/100 g. Największą ilość cukru zawierały desery mleczne (średnia 14,7 g/100 g), a najmniejszą kefiry (średnia 6 g/100 g) ($p < 0.0001$). Jogurty i napoje jogurtowe adresowane do dzieci miały większą zawartość cukru, niż produkty dla ogółu populacji (14,4 g vs. 10,5 g/100 g) ($p<0,0001$). Aż 75% produktów zawierało dodatek różnych form cukru. Po uwzględnieniu zawartości naturalnej laktozy oszacowana ilość cukru dodanego kształtowała się w przedziale 6,9 - 12,3 g/100 g. Średnia zawartość tłuszczu w grupie wszystkich produktów wynosiła 3,8 g/100 g. Dopuszczalną, w świetle profili WHO, zawartość cukru (≤ 10g/100 g) przekroczyło 71% produktów, a zawartość nasyconych kwasów tłuszczowych (≤ 2 g/100 g) 36% produktów. Przyjmując wartości profili opracowanych przez przemysł spożywczy odsetek takich produktów był mniejszy, ale wciąż znaczny (34% w przypadku cukru i 26% w przypadku tłuszczów nasyconych). W świetle wprowadzonych ostatnio wymagań, dotyczących wartości odżywczej żywności oferowanej w szkołach, biorąc pod uwagę zawartość cukru tylko 29% analizowanych produktów mogłoby być przeznaczone dla dzieci. Wśród nich byłyby wszystkie naturalne jogurty i kefiry, a tylko 6% stanowiłby inne słodzone produkty.

Wnioski: Istnieje uzasadniona potrzeba modyfikacji receptur przetworów mlecznych, szczególnie w zakresie ilości dodawanego cukru.

Słowa kluczowe: *produkty mleczne, profile żywieniowe, cukier, tłuszcz, receptury*

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INTRODUCTION

Milk and dairy products are one of the most important groups of products in the diet. For years, they have occupied a central place in the graphic food pyramids in many countries of the world, which proves the stability of view on their role in the diet. It is recommended that adults should consume at least 2 servings, whereas children and adolescents 3-4 servings of milk or dairy products, such as yoghurt, kefir or cheese [1, 6, 18, 36]. However, it is worth to mention that in recent years this opinion in the society began to be undermined, what is undoubtedly supported by controversial monographs, with such titles as "Milk: a silent killer" [24].

The main pro-health nutrients of dairy products without a doubt are calcium, protein and B vitamins [6, 10, 35]. However, currently produced dairy products more and more often contain the addition of many kinds of sugars, additives, and products offered for children also chocolate balls or other sweet dragees included in the package. The studies indicate that over recent years nutritional quality of these products has deteriorated. Energy value, content of sugar and fat increased, whereas the content of protein decreased [34]. This can be even more worrying because it is believed that the consumption of dairy products could compensate for the currently observed decline in the consumption of liquid milk, especially by children [15].

In recently widely discussed nutrient profile models, which are to regulate food advertising directed to children, and the use of nutrition and health claims, the key issue is the limit of adverse nutrients [26, 31, 33]. In the European Nutrient Profile Model, set by the World Health Organization (WHO), the upper limit for the content of sugar in yoghurts and kefir is 10 g/100 g, and the content of fat is 2.5 g/100 g [39]. A growing number of countries also implement regulations on the nutritional value of food offered at schools [2, 38]. In 2015 such requirements were established in Poland, and although this provision leads to much debate, the school without a doubt should not be a place with easy access to food of poor nutritional value [22]. The establishment of nutrient profiles can also accelerate the reformulation of products in the health-oriented direction, because today it is highlighted that voluntary initiatives of the industry are insufficient [12, 19, 26].

The aims of our study was the characteristics of the nutritional value of dairy products available on the market, in particular of sugar and fat content, in the light of the nutrient profiles as well as regulations on food offered at Polish schools.

MATERIAL AND METHODS

The following products have been evaluated: yoghurts, yoghurt drinks, kefir, cream cheeses and milk desserts offered for the general population and these particularly intended for children. The products, whose trade name or graphics of the package contained children's topics, have been considered products for children. The products were collected in January 2015, in the central part of Poland, in a large and small city (Warsaw and Skierniewice) in 9 stores of various sizes (Biedronka, Carrefour, Dino, Intermarche, Kaufland, Lidl, Netto, Tesco, Top Market). The product included in the commercial offer of many stores was counted only once.

The analysis of the nutritional value was carried out on the basis of the data contained on the unit product packaging, including table of nutritional value and list of ingredients. The energy, content of sugar, fat and saturated fatty acids have been estimated only for the products that contained the table of nutritional value, which until 13 December 2016 is the information voluntarily provided by manufacturers. The content of added sugars, which are not listed in the table of nutritional value, was estimated by subtracting the content of lactose (natural milk sugar) from total content of sugars. In the case of sweetened yoghurt and kefir it was assumed that the lactose content is equal to the content of sugars in the natural ranges of such products (not sweetened). In the case of cream cheeses and desserts, the lactose content was assumed to be at a medium level, respectively 2.7 g/100 g and 2.4 g/100 g, according to Polish Tables of Composition and Nutritional Value of Food [14]. A similar method for evaluating the content of added sugars in dairy products was also adopted by the authors of the study in Australia, basing on national tables of food composition [34].

The obtained data on the content of sugar and saturated fatty acids were later compared with the requirements of nutrient profiles for a group of dairy products developed both by the WHO [39], as well as by food industry association [9]. Moreover the sugar content was compared with the set limit in Polish regulations on food offered at schools [22].

The content of nutrients has been presented as the arithmetic average ($\bar{x}$), standard deviation (SD) and range of values (min. - max). To compare the content of nutrients between different types of dairy products and within individual groups, the *Student* test for independent samples was selected. The value $p < 0.05$ was considered statistically significant. Statistical analysis was performed using the computer program Statistica ver. 6.0.

RESULTS

There were 388 ranges of dairy products in the course of trade. The largest group consisted of yoghurts and yoghurt drinks – 213 ranges (55%), and the smallest - kefir - 43 ranges (11%). Of all the products, 322 ranges (83%) were intended for the general population, and 66 (17%), especially for children. The table of nutritional value on the packaging was included of 320 products (83%) (Table 1).

Table 1. Nutritional value of dairy products

Type of product	No. of product ranges N (%)	Sugar content (g/100 g)			Fat content (g/100 g)			Content of saturated fatty acids (g/100 g)		
		range (min.-max)	average ($\bar{x}$ ± SD)	p	range (min.-max)	average ($\bar{x}$ ± SD)	p	range (min.-max)	average ($\bar{x}$ ± SD)	p
Yoghurts and yoghurt drinks, including:	189 (59)	4.1-23.4	10.9 ± 4.3		0.0-10.0	2.9 ± 2.5		0.0-6.8	1.8 ± 1.6	
divided by:										
- for children	27 (14)	10.2-20.7	14.3 ± 2.9		0.0-9.0	2.8 ± 1.9		0.0-5.9	1.8 ± 1.3	
- for general population	162 (86)	4.1-23.4	10.5 ± 4.2	<0.001	0.0-10.0	2.9 ± 2.5	n.s.	0.0-6.8	1.8 ± 1.6	n.s.
divided by:										
- natural	51 (30)	4.1-10.0	5.4 ± 1.1		0.0-10.0	3.8 ± 3.3		0.0-6.8	2.4 ± 2.1	
- flavoured	138 (70)	4.3-23.4	13.0 ± 3.0	<0.0001	0.0-10.0	2.5 ± 2.0	<0.005	0.0-6.4	1.6 ± 1.3	<0.005
divided by:										
- flavored with dragees	16 (12)	11.2-23.4	17.2 ± 3.2		2.0-10.0	4.7 ± 2.3		1.3-6.4	2.9 ± 1.5	
- flavored without dragees	122 (88)	4.3-17.0	12.5 ± 2.5	<0.0001	0.0-8.6	2.3 ± 1.8	<0.0001	0.0-5.8	1.4 ± 1.2	<0.0001
Kefir, including:	35 (11)	2.7-13.0	6.0 ± 3.0		0.0-3.0	1.3 ± 0.8		0.0-1.8	0.9 ± 0.5	
divided by:										
- for children	2 (6)	4.0-4.0	4.0 ± 0.0		1.5-1.5	1.5 ± 0.0		0.9-0.9	0.9 ± 0.0	
- for general population	33 (94)	2.1-13.0	6.1 ± 3.1	n.s.	0.0-3.0	1.4 ± 0.8	n.s.	0.0-1.8	0.8 ± 0.5	n.s.
divided by:										
- natural	27 (77)	2.7-5.1	4.4 ± 0.6		0.0-3.0	1.5 ± 0.8		0.0-1.8	0.9 ± 0.5	
- flavoured	8 (23)	10.5-13.0	11.3 ± 1.0	<0.0001	0.0-1.3	0.8 ± 0.7	<0.05	0.0-0.8	0.5 ± 0.4	<0.05
Cream cheeses including	31 (10)	3.1-19.0	12.5 ± 3.6		0.5-17.0	4.9 ± 2.8		0.1-11.2	3.2 ± 1.9	
divided by:										
- for children	9 (29)	11.9-15.0	13.2 ± 0.9		2.4-6.0	3.6 ± 1.3		1.5-4.0	2.4 ± 0.8	
- for general population	22 (71)	3.1-19.0	12.2 ± 4.2	n.s.	0.5-17.0	5.4 ± 3.1	n.s.	0.1-11.2	3.5 ± 2.1	n.s.
Desserts including:	65 (20)	10.0-25.0	14.7 ± 3.1		0.5-13.4	5.9 ± 3.7		0.3-9.0	3.7 ± 2.5	
divided by:										
- for children	20 (31)	10.8-19.1	14.2 ± 1.8		2.5-13.4	6.9 ± 4.1		2.0-9.0	4.4 ± 2.7	
- for general population	45 (69)	10.0-25.0	14.9 ± 3.6	n.s.	0.5-13.0	5.4 ± 3.5	n.s.	0.3-9.0	3.4 ± 2.4	n.s.

The sizes of unit packaging were very varied and ranged from 50 to 1000 g. On average, the unit packaging had the capacity of 265 g. The energy value of the products ranged from 33 to 257 kcal/100 g, giving the average of 98.5 kcal/100 g. The most energy was provided by desserts – average 135 kcal/100 g, and then cream cheeses - 117 kcal/100 g, yoghurts - 85 kcal/100 g, and the least kefir - 57 kcal/100 g.

Sugar content

Total sugar content in the group of all dairy products ranged from 2.7 to 25.0 g/100 g, and the average was 11.0 g/100 g. A statistically significant difference in the sugar content in different types of products ($p < 0.0001$) was found. The largest amount of sugar was in the desserts (on average 14.7 g/100 g), and the smallest – kefir (on average 6 g/100 g) (Table 1). Kefir and yoghurts were the only products produced without adding sugar (so-called natural), and such ranges constituted 34.8% of their offer in trade. The content of milk sugar (lactose) in these products on average amounted to 5.4 g/100 g of yoghurt and 4.4 g/100 g of kefir. In kefir and yoghurts with the addition of flavoring ingredients (such as sugar, fruit) the sugar content was significantly higher than in natural ones – on average 13.0 g/100 g of yoghurt and 11.3 g/100 g of kefir ($p<0.0001$). Yoghurts with chocolate balls or other sweet dragees included in the package had on average almost one more teaspoon of sugar (4.7 g) than the yoghurts without such additions (average 17.2 g/100 g vs. 12.5 g/100 g) ($p<0.0001$).

Average sugar content in the majority of products intended for children did not differ statistically from products for the general population, with the exception of yoghurts and yoghurt drinks, among which the products for children were much more sweet than for other people (average 14.3 g/100 g vs. 10.5 g/100 g) ($p < 0.0001$) (Table 1).

As many as 75% of products contained of added sugar. The products were often sweetened with various sugars at the same time (40% of total amount of products). Only 35% of products contained sucrose as sugar. Glucose-fructose syrups added to 30.4% of products were the second most popular form of sugar. Only 2.8% of the products contained sweeteners within the meaning of the regulations on food additives [21]. Aspartame and acesulfame K were used most often. None of the products with sweeteners, through the graphics of its packaging, was particularly addressed to children.

Taking into account the natural content of lactose, the calculated quantity of added sugar in the production process was 6.9 g/100 g, in the case of sweetened kefir, 7.6 g/100g sweetened yoghurts, 10.3 g/100 g of sweetened cream cheeses and 12.3 g/100 g, in the case of desserts, which were all sweetened. In the light of the average diet with 2000 kcal and the WHO guidelines, according to which maximum 10% of energy should come from free sugars, it was estimated that an average packaging of a dairy product provides 37-64% of a daily dose of these sugars (Table 2).

Fat content

The overall fat content in the group of all products ranged from 0.0-17.0 g/100 g giving an average of 3.8 g/100 g. Desserts had the highest fat content (average 5.9 g/100 g),whereas kefir the lowest (1.3 g/100 g) (Table 1). 8.6% of products contained fat at the level of ≤ 0.5 g/100 g. The content of saturated fatty acids ranged from 0.0 to 11.2 g/100 g, on average 2.4 g/100 g. As in the case of fat, desserts had the highest content of saturated fatty acids (3.7 g/100 g), and the lowest – kefir (0.9 g/100 g). Differences in the content of fat and saturated fatty acids in the various types of products were statistically significant ($p < 0.0001$). The products intended for children contained almost the same amount of fat as products for the general population (average 3.7 vs. 3.8 g/100 g). No difference was observed in the content of saturated fatty acids (2.4 vs. 2.4 g/100 g) (Table 1).

Table 2. The intake of added sugars, after consuming one sweetened dairy product

Type of sweetened dairy product	Average size of unit packaging (g)	Amount of consumed added sugars (g)	% coverage of daily dose of added sugars, after consuming one commercial serving of the product in the 2000 kcal diet, assuming:		
			25% energy from added sugars (500 kcal)	10% energy from added sugars (200 kcal)	5% energy from added sugars (100 kcal)
Yoghurts or yoghurt drink	243	18.5	15% (74 kcal)	37% (74 kcal)	74% (74 kcal)
Kefir	460	31.7	25% (127 kcal)	64% (127 kcal)	127% (127 kcal)
Cream cheese	205	21.1	17% (84 kcal)	42% (84 kcal)	84% (84 kcal)
Milk dessert	151	18.6	15% (74 kcal)	37% (74 kcal)	74% (74 kcal)

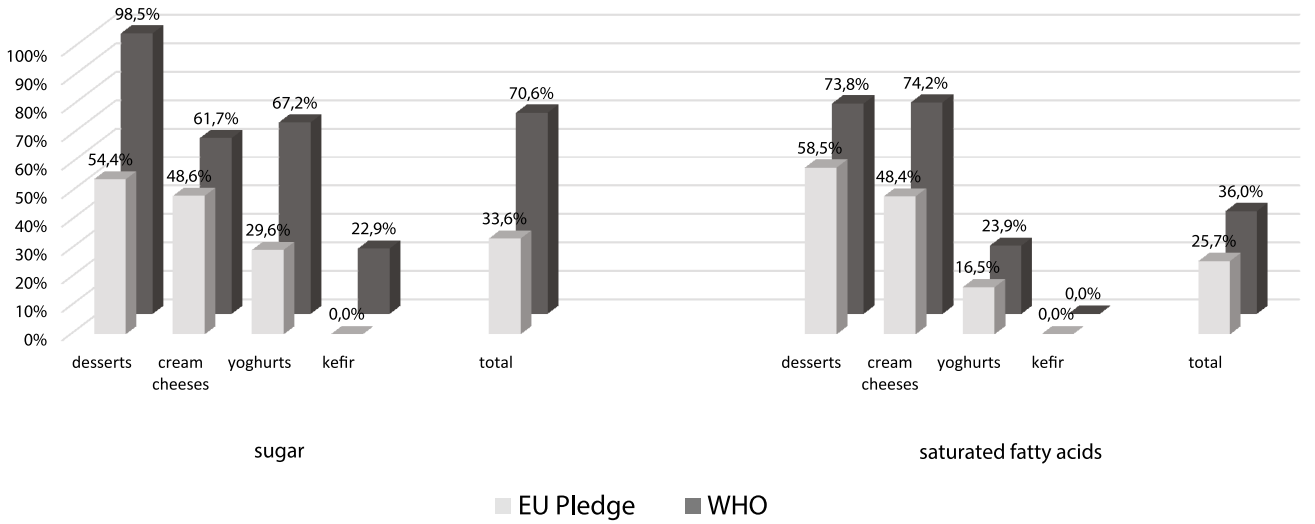

Figure 1. Percentage of products exceeding nutrient profiles, developed by the WHO and food industry (EU Pledge)

The nutritional value of products in the view of nutrient profiles

70,6% of analyzed products exceeded the permissible sugar content in the view of the WHO profiles (≤10g/100 g). This parameter was not fulfilled by almost all desserts (98.5% product ranges), whereas to the smallest extent it concerned kefir (22.9%) (Figure 1). Among products intended for children, as many as 96.3% exceeded the limit of sugar content set by the WHO. Taking the sugar content, according to the profiles developed by the food industry EU Pledge (≤ 13.5 g/100 g) the percentage of products that do not meet the criterion was smaller by a half, but still significant (33.6%) (Figure 1).

In terms of the content of saturated fatty acids, set in the WHO profiles (≤ 2g/100 g), 36% of the analyzed products exceeded the permissible value. Almost three quarters of cream cheeses and desserts did not meet this criterion, whereas all types of kefir present on the market fulfilled it (Figure 1). Using the profiles of the food industry, 25.7% of products exceeded the content of saturated fatty acids (≤ 2.6 g/100 g) (Figure 1). According to new regulations on food at schools introduced in Poland, in terms of the sugar content only 29% of the analyzed dairy products could be offer for children. Among them there are all natural (not sweetened) yoghurts and kefir. Only 6% of sweetened products met these requirements.

DISCUSSION

In the scientific literature, there are few studies on similar topics, with which they obtained results could be compared. One of them is the study of *Walker* et al. covering the group of dairy products on the Australian market [34]. Our examination confirms the results of these authors that nutrient quality of milk products is deteriorating. As many as ¾ of products included the addition of sugars, most commonly several types of sugars simultaneously. It was also found that in the dairy industry, as in other sectors of food industry, currently to a large extent glucose-fructose syrups are used as the form of sugar. These ingredients have recently aroused a lot of controversy and the increase of their consumption is considered in the literature as one of the causes of global obesity [27, 28]. It is estimated that in the American diet high fructose corn syrup provides over 40% of calories from sugars [5, 37]. According to the recommendations of the Polish Diabetes Association of 2015, it is not recommended for people with diabetes to use fructose as a substitute for sugar [29] therefore, the frequent use of fructose syrups in food production may in practice make it difficult for diabetics to implement proper diet.

The amount of sugar added to yoghurts and cream cheeses, i.e. products particularly recommended in the diet, was on average 7.6 g/100 g and 10.3 g/100 g. It should be noted that in the case of products with fruit a certain amount of added sugar may come from fruits. Assuming fruit content in yoghurts at an average level of 8%, and taking into account the natural sugar content (for example, in strawberries 5.4 g/100 g), the calculated amount of sugar provided by fruit is very small and is approx. 0.4 g/100 g of yoghurt. Particularly controversial is the development of the market of yoghurts that have sweet, chocolate balls or other dragees included in the packaging. These products have a much higher sugar content, what significantly worsens their nutritional character.

In the view of the latest WHO guidelines, maximum 10% of energy in the diet should come from free sugars, and preferably only 5% [8, 11, 30]. Using this approach, the consumption of one sweetened yoghurt leaves little place in the diet for sugar from other foods. In practice, without the reformulation of food composition achieving such limit of the intake of added

sugar does not seem real. However, our calculations are based on the theoretical intake. The published data have shown that in the American diet 3.5-6% of consumed added sugars come from dairy foods [3, 7]. In Brazil, dairy products provide only a little more than 4% [17]. However, all authors emphasize that the consumption of dairy products is highly deficient [3, 7, 17]. These data do not refer to a reference intake of added sugars, converted into energy, i.e. 25%, 10%, or, according to the latest recommendations, 5% of the energy in the diet coming from free sugars.

The study found a small range of products containing sweeteners (2.8%) and only 8.6% of the products containing fat at the level ≤ 0.5 g/100 g, what authorizes the producer in the European Union to make a claim "contains no fat" [20]. A small range of these products may result from the fact that consumers in a small degree are interested in light food, because they perceive it as less attractive in taste [4, 13, 23, 25]. Skeptical approach to food with artificial sweeteners is also observed among parents, who do not prefer such choice of products for their children [15]. At this point it is worth to highlight that although in the USA Food and Drug Administration considers intense sweeteners to be safe, in the American recommendations it is emphasized that there is too little amount of data on the long-term effects of consuming sweeteners [8].

The initiatives undertaken in the world aiming at limiting unfavorable nutrients in food products are not consistent [33]. In the case of dairy products in the European Nutrient Profile the maximum level of sugar set by the WHO is 10 g/100 g, but in accordance with the EU Pledge producers' initiative connected with the standards of advertising food for children the criterion is 3.5 g higher [9, 39]. In the United States, in turn, Working Group on Foods Marketed to Children recommends that the limit of added sugars in products advertised for children should not exceed 13 g per serving set by the manufacturer, whereas in the UK the functioning traffic light labeling scheme limits added sugars at the upper level of 12.5 g/100 g [12, 16]. In Poland, in recently introduced requirements for food offered at schools, the maximum sugar content in dairy products was adopted in accordance with the WHO guidelines (10 g/100 g) [22].

The study indicates that the majority (71%) of dairy products on the Polish market exceeds the WHO profiles in terms of sugar content and 36% in terms of content of saturated fatty acids. Using more liberal criteria proposed by the food industry, the proportion of such products is smaller, but still constitutes a large part of product range – almost 34% in case of sugar and 26% in case of saturated fat. Almost none sweetened milk product fulfilled the established requirements on food for sale at schools in Poland. However, all natural (not sweetened) yogurts and kefir are suitable in children's diet.

These results confirm the findings observed on other world markets. On the Australian market as many as 70% of yoghurts and 76% of desserts did not fulfill nutrient profiles existing there and 68% dairy products in Australia and New Zealand would not meet the criteria required to include health claims [19, 34]. In the USA the study *Hingle* et al. demonstrated that among 354 products for children advertised in 2013 only 1.4% fulfilled all parameters of nutritional value established by the Working Group on Foods Marketed to Children. The most problematic was the added sugar content, which was not fulfilled by 89% of products. Better situation was in the case of saturated fatty acids, the level of which was exceeded by 32% of products [12]. The data from the European countries are also worrying, because they show that most of dairy products with nutrition or health claims do not meet nutrient profile models, such as Keyhole or Smart Choices Program functioning in these countries [31].

Due to the growing problem of obesity in all Western countries, it seems that there is currently a multi-sectoral understanding on taking immediate remedial actions. First of all, it is highlighted that there is the need of reformulation of food in health-oriented direction, as well as continues education of consumers. Experts also point to the need for involving government organizations for effective dialogue with food manufacturers, and even the introduction of an additional tax on sweet and high-fat products [8, 32, 34].

CONCLUSIONS

The results of the study confirm the needs of reformulating nutritional value of dairy products, especially in terms of added sugar. The image of these products, as obvious sources of natural nutrients, should not be affected by the addition of an excessive amount of adverse ingredients. Each additional serving of a dairy product in the diet should therefore increase the pool of pro-health nutrients, and not those ones, whose consumption requires limiting.

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Conflict of interest.
The authors declare no conflict of interest.

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