Nauka Przyroda Technologie

2016
Tom 10
Zeszyt 4
#52

ISSN 1897-7820 http://www.npt.up-poznan.net DOI: http://dx.doi.org/10.17306/J.NPT.2016.4.52

Dział: Nauki o Żywności i Żywieniu

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EVALUATION OF THE FAT CONTENT AND FATTY ACID PROFILE INCLUDING TRANS FATTY ACIDS (TFA) IN CONFECTIONERY PRODUCTS AVAILABLE ON THE POLISH MARKET

OCENA ZAWARTOŚCI TŁUSZCZU I PROFILU KWASÓW TŁUSZCZOWYCH, W TYM IZOMERÓW TRANS KWASÓW TŁUSZCZOWYCH (TFA), W WYROBACH CUKIERNICZYCH DOSTĘPNYCH NA POLSKIM RYNKU

Summary

Background. Confectionery products are easily available and very popular but their nutritional value depends on their composition. Using palm oil and hydrogenated fats in the production process leads to a high content of saturated fatty acids (SFA) and trans fatty acids (TFA) in the product. The aim of the study was to evaluate the fat content and fatty acid profile including trans fatty acids in the popular confectionery products available on the Polish market.

Material and methods. 27 products divided into four groups were subjected to an analysis: chocolate-coated wafers with a filling (nine), wafers with a filling without the chocolate coat (seven), bars (three), as well as breakfast snacks (eight). The product's fat content was defined and the profile of fatty acids was marked using the gas chromatography technique.

Results. The evaluated products were characterized by varied content of fat which oscillated from 8.95 to 31.02%. The participation of the individual fatty acids groups in both wafer groups and bars was close to each other. The composition of the fatty acids in case of breakfast snacks was varied and dependent upon the product type. SFA oscillated from 9.87 to 80.30%, MUFA from 16.24 to 63.67%, PUFA from 3.57 to 29.54% and TFA from 0.12 to 16.87%.

Conclusions. The evaluated chocolate-covered wafers, those without chocolate and bars contained a higher content of fat and SFA share than the breakfast snacks. Majority of the tested products contained more than 50% SFA. MUFA were prevailing only in five of the eight evaluated breakfast snacks. Majority of the products were characterized by a low level, less than 2% of isomers of TFA.

Key words: fat content, trans fatty acids (TFA), saturated fatty acids (SFA), confectionery products, wafers, confectionery breakfast snacks

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Introduction

Presently, confectionery products are very popular. Convenience, size of a serving and price make the products desirable, frequently being a stimulant or creating a need to eat something sweet. Fat content (energetic value) and its type used in the production process (content of SFA and TFA) may pose some objections. Trans isomers of fatty acids in the human diet may come from two sources. The first one are naturally TFA occurring in animal-origin products, mainly milk, butter, and in ruminants' meat. They are produced in small amounts in animals' organisms as a result of natural bio-hydrogenation processes. The other source are TFA built as a result of the industrial hydrogenation process of oils (industrial-TFA, i-TFA) (Norhayati et al., 2011; Shingfield et al., 2008).

Both groups are perceived differently though, taking into consideration the way they influence the human organism. Natural TFA, including CLA (conjugated linoleic acids), can positively influence the organism via increasing the integrity and efficiency of cells, or staying neutral. Moreover, they do not exhibit any connection with the coronary vessels arteriosclerosis or may perform an antioxidative or anti-cancerous action (Przybojewska and Rafalski, 2003). Consumption of industrial-TFA unfavourably influences the blood lipid profile changes increasing a risk of the cardiovascular diseases and increasing the insulin resistance. They may lead to a weakening of the ability to concentrate, body mass gain, disorders of the prenatal development of babies, nervous system, bring about a constricted reproduction, as well as earlier births (Dorfman et al., 2009; Jamioł-Milc et al., 2010; Larqué et al., 2001). The main source of i-TFA in the diet are products fried on hydrogenated oils, as well as confectionery fats commonly used in the production of pastries, cookies, wafers, sweet fillings and creams. The participation of TFA in these products is significantly varied though, and may oscillate from values close to 0 up to a few tens percent of the total fat value.

The first countries to introduce the compulsory marking of trans isomers content in products were Canada (2003) and the USA (2006). TFA content below 0.2 g per serving in Canada, and below 0.5 in the USA are permitted to get a TFA-free label (Krettek et al., 2008). In the European Union, legal regulations regarding the content of trans isomers in the products appeared only in a few countries. The first country to introduce the limitations was Denmark (2004), next Switzerland, Austria, Iceland, Norway, Hungary and Sweden, limiting the TFA content at the level of 2 g per 100 g of fat or oil (WHO, 2015).

Despite a lack of legal regulations in numerous countries a constant decrease in the TFA content in products has been observed for many years as a result of decreasing participation of TFA in industrial fats used for their production. According to the IMACE European Margarine Association (2016), the number of margarines with the maximum 2% TFA level increased from 29 to 93% in the period 2004–2015. The aim of the study was an evaluation of the fat content and fatty acid profile including TFA in the popular confectionery products available on the Polish market.

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Material and methods

Material

27 products were subjected to an analysis. They were commonly accessible brand products, as well as brands of supermarkets offered for sale. The products were divided into four groups: chocolate-coated wafers with a filling (nine), wafers with a filling without the chocolate coat (seven), bars (containing wafer and filling) (three), as well as breakfast snacks (eight). Two single packages of each of the product were purchased (30–140 g), coming from two various production parts, and constituted two separate samples. The analysis was carried out between June and December, 2015.

Methods

Fat content analysis

The content of fat was marked applying a semi-automatic HT6 1043 Soxtec Extraction Unit (Foss) using the extraction-gravimetric method. A product sample was crushed, placed in an extraction thimble with purified sea sand and extracted using petroleum benzine. The content of fat was calculated from the difference of the sample mass and the quantity of the extracted fat.

Fat extraction from the products

The extraction of fat was conducted by Folch method (Folch et al., 1957). A sample was comminuted in a mill, next homogenized in the chloroform-methanol mixture (2 : 1, v:v) and separated in a separatory funnel. The chloroform layer was transferred into glass flask and the solvent was evaporated on a vacuum evaporator at 40°C. The obtained fat was closed under nitrogen and stored at –24°C till the fatty acids profile analysis was carried out.

Fatty acid composition analysis

The fatty acids profile was marked according to the AOCS official method Ce 1h-05 (AOCS, 2009b). A fat sample was dissolved in hexane, transesterified with sodium methylate, and next the methyl esters of fatty acids (FAME) were analysed applying the Agilent 7820A GC (Agilent Technologies) gas chromatograph. The chromatograph was equipped with SLB-IL 100 column (Supelco, 100 m × 0.25 mm × 0.2 μm) and FID (flame ionization detector). The carrier gas was helium of 1 ml/min flow. The temperature of the injector and detector was 250°C. The sample was separated at the temperature from 120°C to 200°C in the split mode (1 : 10) in 90 min time. The fatty acids (FA) were identified by comparison of their retention times with commercially available standards.

Calculation of the iodine value

The calculated iodine value was defined directly from the fatty acids composition according to the AOCS Cd 1c-85 method (AOCS, 2009a).

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Statistical analysis

All assays were performed in two replications. Values of means and standard deviations were calculated with the use of Microsoft Office Excel 2013 (Microsoft Corporation). The significance of differences between means was determined at $p < 0.05$ using the analysis of variance (ANOVA) followed by Tukey's multiple range test with STATISTICA PL 10.0 (StatSoft, Inc.).

Results and discussion

The fat content in the analysed products was varied and oscillated from 8.95 to 31.02%. The slight differences were found between the chocolate-covered and non-covered wafers. The fat content in the first group oscillated from 24.96 to 31.02% (Table 1) and in the second group from 22.60 to 30.49% (Table 2). The fat content in bars

Table 1. The fatty acid profile, fat content and iodine value of the analysed chocolate coated wafers with a filling
Tabela 1. Profil kwasów tłuszczowych, zawartość tłuszczu oraz liczba jodowa analizowanych wafelków z nadzieniem oblanych czekoladą

No. Lp.	ΣSFA (%)	ΣMUFA (%)	ΣPUFA (%)	ΣTFA (%)	Fat content Zawartość tłuszczu (%)	Iodine value Liczba jodowa
1	2	3	4	5	6	7
1A	59.28 ±1.57ab	33.94 ±0.68ab	6.78 ±0.38acd	0.32 ±0.02a	28.44 ±0.71ad	41.15 ±0.65abd
1B	60.83 ±0.56bd	32.63 ±0.13ab	6.53 ±0.26acd	0.40 ±0.04a	27.35 ±0.42ae	39.62 ±0.48abd
2A	56.95 ±0.30ad	35.99 ±0.33abd	7.06 ±0.05cd	1.32 ±0.07a	28.36 ±0.24ad	43.51 ±0.37bd
2B	57.97 ±1.39ab	35.19 ±2.46abc	6.84 ±0.36acd	1.69 ±0.05ab	27.92 ±0.35a	42.44 ±0.61abd
3A	57.41 ±1.23ad	37.64 ±0.74bd	4.96 ±0.29cbcd	6.72 ±0.05ab	28.02 ±0.07ad	41.34 ±1.15abd
3B	58.69 ±1.03ab	36.33 ±1.52abd	4.98 ±0.04abcd	5.34 ±0.04ab	28.14 ±0.02ad	39.96 ±1.22abd
4A	63.00 ±1.72b	31.26 ±0.40a	5.74 ±0.39acd	0.36 ±0.03a	28.73 ±1.41ab	37.17 ±0.32a
4B	63.28 ±0.79b	30.75 ±0.78a	5.97 ±0.17acd	0.28 ±0.02a	28.70 ±0.35ab	37.11 ±0.86a
5A	58.20 ±2.07ad	35.38 ±0.58abc	6.42 ±0.26acd	0.36 ±0.02a	27.30 ±0.34ae	41.79 ±1.10abd
5B	57.51 ±1.22ad	35.16 ±0.09abc	7.34 ±0.24ad	0.49 ±0.05a	28.26 ±0.40ae	43.24 ±0.18bd
6A	54.94 ±0.36a	41.37 ±1.78d	3.69 ±0.06b	7.61 ±0.06b	30.93 ±0.57b	40.39 ±2.90abd
6B	54.93 ±1.82a	40.46 ±0.59cd	4.61 ±0.36abc	7.80 ±0.04b	31.02 ±0.70b	42.88 ±1.34abd
7A	33.44 ±0.96c	60.98 ±1.56e	5.58 ±0.06abcd	16.84 ±0.04c	24.96 ±1.09c	63.31 ±0.51c
7B	35.42 ±0.93c	60.16 ±3.83e	4.42 ±0.04abc	16.84 ±0.08c	25.42 ±0.61ce	59.70 ±1.08c
8A	60.58 ±0.68b	35.37 ±1.90abc	4.05 ±0.01c	2.28 ±0.05ab	28.96 ±0.16ab	37.69 ±0.31a

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Table 1 – cont. / Tabela 1 – cd.

1	2	3	4	5	6	7
8B	57.71 ±1.73ad	37.25 ±0.56bd	5.04 ±0.05abcd	3.02 ±0.06ab	30.35 ±0.71bd	40.93 ±1.35abd
9A	56.26 ±2.12a	36.04 ±0.67abd	7.70 ±0.04d	0.22 ±0.01a	30.08 ±0.02b	44.64 ±0.72d
9B	61.92 ±1.22bd	31.63 ±0.36ab	6.46 ±0.09ad	0.54 ±0.01a	31.02 ±0.28b	38.79 ±0.68ab

ΣSFA – amount of saturated fatty acids, ΣMUFA – amount of monounsaturated fatty acids, ΣPUFA – amount of polyunsaturated fatty acids, ΣTFA – amount of trans isomers of fatty acids.

Means in the same column followed by different letters indicate significant statistical differences ($p \leq 0.05$).

ΣSFA – suma nasyconych kwasów tłuszczowych, ΣMUFA – suma jednonienasyconych kwasów tłuszczowych, ΣPUFA – suma wielonienasyconych kwasów tłuszczowych, ΣTFA – suma izomerów trans kwasów tłuszczowych.

Średnie w tej samej kolumnie oznaczone różnymi literami wskazują na istotne różnice statystyczne ($p \leq 0,05$).

Table 2. The fatty acid profile, fat content and iodine value of the analysed wafers with a filling without chocolate

Tabela 2. Profil kwasów tłuszczowych, zawartość tłuszczu oraz liczba jodowa analizowanych wafelków z nadzieniem bez czekolady

No. Lp.	ΣSFA (%)	ΣMUFA (%)	ΣPUFA (%)	ΣTFA (%)	Fat content Zawartość tłuszczu (%)	Iodine value Liczba jodowa
1A	66.93 ±1.02a	28.45 ±0.52a	4.61 ±0.08a	0.16 ±0.01a	30.30 ±0.28a	32.62 ±0.23a
1B	65.36 ±0.92a	29.79 ±0.71a	4.85 ±0.04a	0.16 ±0.02a	30.17 ±0.83ae	34.19 ±0.61a
2A	74.63 ±0.18b	21.56 ±0.25b	3.82 ±0.14b	0.04 ±0.00a	29.16 ±0.61ade	25.20 ±0.35b
2B	75.54 ±1.27b	20.82 ±0.52b	3.64 ±0.09b	0.09 ±0.00a	29.33 ±0.17ade	24.31 ±0.51b
3A	53.61 ±1.85c	38.08 ±0.79c	8.30 ±0.36c	4.16 ±0.10b	25.64 ±0.21b	47.45 ±1.26c
3B	53.61 ±1.07c	38.04 ±0.53c	8.36 ±0.30c	3.78 ±0.01c	25.24 ±0.35b	47.43 ±0.72c
4A	50.26 ±0.18c	39.77 ±0.06c	9.97 ±0.10de	0.40 ±0.03a	22.60 ±0.13c	51.61 ±0.10de
4B	51.63 ±0.25c	38.61 ±0.27c	9.77 ±0.13de	0.37 ±0.02a	23.02 ±0.04cf	50.25 ±0.05d
5A	52.28 ±1.67c	38.15 ±1.24c	9.57 ±0.41d	0.18 ±0.01a	28.01 ±0.20d	49.52 ±1.10cd
5B	51.29 ±0.91c	39.04 ±0.12c	9.67 ±0.08d	0.27 ±0.02a	28.20 ±0.77de	50.40 ±0.08d
6A	50.28 ±0.31c	39.79 ±0.17c	9.93 ±0.03de	0.41 ±0.02a	25.04 ±1.02bf	51.56 ±0.02de
6B	48.40 ±0.80c	41.27 ±0.59c	10.33 ±0.21e	0.42 ±0.03a	25.25 ±0.71b	51.96 ±2.10e
7A	65.31 ±2.35a	28.57 ±0.49a	6.12 ±0.16f	0.15 ±0.01a	30.14 ±0.27ae	32.38 ±0.30a
7B	63.32 ±1.48a	29.68 ±0.82a	7.00 ±0.17g	0.22 ±0.01a	30.49 ±0.52a	37.66 ±0.99f

Notation – as in Table 1.

Oznaczenia – jak w tabeli 1.

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was significantly different and oscillated from 16.81 to 30.19 (Table 3). The most varied products group was the breakfast snack, where the fat content was from 8.95 to 26.92% (Table 4). The dominant group of fatty acids in the analysed chocolate-covered, as well as non-covered wafers and bars were saturated fatty acids (SFA), followed by monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA). The percentage participation of the saturated fatty acids in the fat separated from the products was from 33.44 to 63.28% in the chocolate-covered wafers (Table 1), from 48.80 to 75.54% in the non-covered ones (Table 2), and from 46.50 to 80.30% in bars (Table 3). MUFA dominated in one case (product 7) in chocolate-covered wafers group. Only a part of the breakfast snacks products was characterized by a prevalence of SFA (products 4, 5 and 7). SFA participation in the breakfast products was from 9.87 to 74.78% (Table 4), while that of MUFA, depending upon the analysed group, oscillated from 30.75 to 60.98% in wafers with chocolate, from 20.82 to 41.27% in filled wafers, from 16.24 to 43.78% in bars and from 18.58 to 63.67% in breakfast snacks. PUFA constituted the least numerous group of fatty acids. Their participation in the chocolate-covered wafers oscillated from 3.69 to 7.70%, in the non-covered ones from 3.64 to 10.33%, in bars from 3.57 to 10.01%, and in breakfast snacks from 5.16 to 29.54% of all the fatty acids. Their lowest participation was observed in the products where SFA participation was higher than 60%. The highest PUFA participation was observed in products in which SFA decreased below 15%. The highest differentiation was observed while evaluating the participation of TFA isomers in the analysed products. Their level in the chocolate--covered wafers oscillated from 0.18 to 16.84%, in non-chocolate wafers from 0.04 to 4.16%, in bars from 0.12 to 0.51% and in breakfast snacks from 0.14 to 16.74%. The analysis of fatty acids profile of fat separated from the products, indicates an insignificant differentiation of the evaluated wafers, no matter whether chocolate-covered or not, which may indicate that the strongest influence on the wafers fat fraction have the com-

Table 3. The fatty acid profile, fat content and iodine value of the analysed bars
Tabela 3. Profil kwasów tłuszczowych, zawartość tłuszczu oraz liczba jodowa analizowanych batonów

No. Lp.	ΣSFA (%)	ΣMUFA (%)	ΣPUFA (%)	ΣTFA (%)	Fat content Zawartość tłuszczu (%)	Iodine value Liczba jodowa
1A	46.52 ±0.16a	43.48 ±0.08a	10.01 ±0.05a	0.33 ±0.05a	29.32 ±0.35a	55.15 ±0.13a
1B	47.04 ±1.17a	43.74 ±0.75a	9.24 ±0.14a	0.38 ±0.01a	30.19 ±0.94a	54.18 ±1.33a
2A	77.81 ±2.06b	17.48 ±0.28b	4.72 ±0.15b	0.51 ±0.05a	19.75 ±0.53b	23.74 ±1.78b
2B	79.37 ±2.93b	17.09 ±0.96b	3.65 ±0.31b	0.40 ±0.01a	20.42 ±0.61b	21.13 ±1.61b
3A	79.59 ±1.45b	16.91 ±0.14b	3.60 ±0.23b	0.13 ±0.02a	16.81 ±0.01c	20.85 ±0.28b
3B	80.30 ±0.48b	16.24 ±0.09b	3.57 ±0.01b	0.12 ±0.00a	17.00 ±0.07c	20.20 ±0.09b

Notation – as in Table 1.
Oznaczenia – jak w tabeli 1.

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Table 4. The fatty acid profile, fat content and iodine value of the analysed breakfast snacks
Tabela 4. Profil kwasów tłuszczowych, zawartość tłuszczu oraz liczba jodowa analizowanych przekąsek śniadaniowych

No. Lp.	ΣSFA (%)	ΣMUFA (%)	ΣPUFA (%)	ΣTFA (%)	Fat content Zawartość tłuszczu (%)	Iodine value Liczba jodowa
1A	31.12 ±2.31a	47.73 ±1.02a	21.15 ±1.11a	16.74 ±1.02a	15.53 ±0.12a	81.98 ±0.86ab
1B	32.43 ±0.10a	46.62 ±0.13ai	20.95 ±0.38a	16.63 ±0.27a	14.61 ±0.52ab	80.62 ±0.07a
2A	18.69 ±0.15b	63.52 ±0.46b	17.79 ±0.15b	0.16 ±0.15b	11.98 ±0.31bcd	84.91 ±0.16b
2B	18.46 ±1.38b	63.67 ±1.27b	17.87 ±0.21b	0.18 ±0.13b	11.98 ±0.61abd	93.30 ±1.04b
3A	13.55 ±0.51c	57.62 ±0.32c	28.83 ±0.32c	9.24 ±0.17c	9.38 ±0.23cd	107.80 ±0.17cd
3B	14.24 ±0.71c	56.86 ±0.60c	28.90 ±0.49c	9.53 ±0.11c	8.95 ±0.13c	107.43 ±0.76cd
4A	68.36 ±2.20d	24.08 ±0.63d	7.57 ±0.15d	0.13 ±0.04b	21.49 ±1.38d	33.87 ±0.25e
4B	68.57 ±0.70d	23.84 ±0.22d	7.59 ±0.18d	0.14 ±0.08b	22.35 ±0.71d	33.69 ±0.32e
5A	74.78 ±5.25e	18.75 ±1.28e	6.47 ±0.61e	0.14 ±0.06b	13.58 ±0.60ab	27.43 ±2.13f
5B	74.69 ±2.89e	18.58 ±1.24e	6.73 ±0.61de	0.25 ±0.11b	13.74 ±0.22ab	27.84 ±1.98f
6A	10.32 ±0.68f	60.76 ±0.43f	28.92 ±0.35c	0.57 ±0.02bd	13.17 ±0.12ab	110.07 ±0.31cd
6B	9.85 ±0.18f	60.61 ±0.27f	29.54 ±0.84c	0.64 ±0.74bd	13.43 ±0.82ab	111.01 ±0.64d
7A	60.54 ±0.54g	33.22 ±0.21g	6.24 ±0.46e	0.82 ±0.39d	26.73 ±2.23e	39.91 ±0.48g
7B	61.11 ±1.33g	33.73 ±0.27g	5.16 ±0.09f	0.80 ±0.10bd	26.92 ±0.10e	38.07 ±0.25g
8A	41.34 ±0.11h	43.60 ±0.15h	15.06 ±0.13g	1.73 ±0.09e	13.33 ±0.23ab	65.34 ±0.03h
8B	41.55 ±0.83h	44.51 ±0.72hi	13.94 ±0.28h	1.42 ±0.02bd	13.42 ±0.61ab	57.56 ±0.10h

Notation – as in Table 1.
Oznaczenia – jak w tabeli 1.

ponents used in the production of their filling mass. The recipe composition also influences the high differences observed in the snacks. The products belonging to the group of the so-called milk sandwiches contained, in majority of cases, from two to a few times more SFA than those composed of confectionery with dried tropical fruits and filling layers. A high content of SFA in confectionery products and bars has been observed for many years in numerous countries all over the world. This is connected with the using of both palm oil and hydrogenated fats for their production (Çakmak et al., 2010; Norhayati et al., 2011; Świderski et al., 2006). The calculated iodine value (CIV) of the fat extracted from the analysed products oscillated from 20.20 (bars) to 111.01 (breakfast snacks). Low CIV's were characteristic for the products rich in SFA. Increase of CIV was related to an increase in oleic and linoleic acids in the composition of the products which may prove that plant oils and non-hydrogenated plant oils were used during their production. Besides the high SFA content, confectionery products are

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a significant source of TFA isomers and of fat in our diet. However, the participation of TFA in a product is dependent upon the type of fat used in its production.

Using hydrogenated fats, being the main source of TFA, in the production process leads to a high level of the TFA in the product. That is why the confectionery products have been viewed, for a long time, as one of the main sources of TFA in the human diet (Kmiecik et al., 2016; Onacik-Gür et al., 2014; Siti Nurshahbani and Azrina, 2014).

However, the situation has been constantly improving. A relatively low level of TFA in many of the evaluated products is a result of the use of fats not subjected to the hydrogenation process but transesterification or recipe modifications (e.g. using shea fat). The tendency has been observed for a few years despite the fact there are no legal regulations concerning the content of TFA in a majority of the world countries (Ansorena et al., 2013; IMACE..., 2016; Richter et al., 2009; Roe et al., 2013; Wagner et al., 2008; WHO, 2015).

Conclusions

1. The evaluated products contained from 8.95 to 31.02% of fat. Chocolate-covered wafers, non-covered wafers and bars showed a higher content of fat than the breakfast snacks.

2. The participation of SFA, in a majority of the evaluated products, was more than 50%. Only in the group of breakfast snacks MUFA were prevailing in five of the eight evaluated products.

3. The participation of TFA was varied within each of the analysed groups and oscillated from 0.13 to 16.84% of the total fat content. 2% TFA value per 100 g of fat was exceeded only in seven of the 27 evaluated products.

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OCENA ZAWARTOŚCI TŁUSZCZU I PROFILU KWASÓW TŁUSZCZOWYCH, W TYM IZOMERÓW TRANS KWASÓW TŁUSZCZOWYCH (TFA), W WYROBACH CUKIERNICZYCH DOSTĘPNYCH NA POLSKIM RYNKU

Streszczenie

Wstęp. Wyroby cukiernicze są łatwo dostępne i bardzo popularne wśród konsumentów, ich wartość odżywcza zależy jednak od składu recepturowego. Wykorzystanie do ich produkcji tłuszczu palmowego oraz tłuszczów uwodornionych może powodować, że są one bogatym źródłem nasyconych kwasów tłuszczowych (SFA) oraz izomerów trans kwasów tłuszczowych (TFA). Celem pracy była ocena zawartości tłuszczu oraz profilu kwasów tłuszczowych z uwzględnieniem izomerów trans kwasów tłuszczowych w popularnych produktach cukierniczych dostępnych na polskim rynku.

Materiał i metody. Analizie poddano 27 produktów podzielonych na cztery grupy: wafelki z nadzieniem oblane czekoladą (dziewięć), wafelki z nadzieniem bez czekolady (siedem), batony (trzy) oraz przekąski śniadaniowe (osiem). W produkcie określono zawartość tłuszczu oraz oznaczono profil kwasów tłuszczowych, wykorzystując technikę chromatografii gazowej.

Wyniki. Zawartość tłuszczu w ocenianych produktach była zróżnicowana i wynosiła od 8,95 do 31,02%. Udział poszczególnych grup kwasów tłuszczowych w obu grupach wafelków oraz w batonach był zbliżony. W grupie przekąsek śniadaniowych skład kwasów był zróżnicowany i zależał od typu produktu. SFA stanowiły od 9,87 do 80,30%, MUFA – od 16,24 do 63,67%, PUFA – od 3,57 do 29,54% i TFA – od 0,12 do 16,87%.

Wnioski. Oceniane wafelki w czekoladzie, bez czekolady i batony charakteryzowały się większą zawartością tłuszczu i SFA niż przekąski śniadaniowe. W większości ocenianych produktów udział SFA wynosił ponad 50%, jedynie w grupie przekąsek śniadaniowych w pięciu na osiem ocenianych produktów przeważały MUFA. Większość produktów charakteryzowała się niskim, poniżej 2%, poziomem izomerów trans kwasów tłuszczowych.

Słowa kluczowe: zawartość tłuszczu, kwasy tłuszczowe trans (TFA), nasycone kwasy tłuszczowe (SFA), wyroby cukiernicze, wafelki, cukiernicze przekąski śniadaniowe

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Accepted for publication – Zaakceptowano do opublikowania:
12.12.2016

For citation – Do cytowania:
Kmiecik, D., Kobus-Cisowska, J., Kotecka, K., Przeor, M., Kulczyński, B. (2016). Evaluation of the fat content and fatty acid profile including trans fatty acids (TFA) in confectionery products available on the Polish market. Nauka Przyr. Technol., 10, 4, #52. DOI: http://dx.doi.org/10.17306/J.NPT.2016.4.52