

RISK ASSESSMENT OF TRANS-FATTY ACIDS INTAKE THROUGH CONSUMPTION OF DAIRY AND SAUSAGE PRODUCTS IN YEREVAN

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Abstract

The study aims to assess the content of trans fatty acids (TFA) present in dairy and sausage products sold in Yerevan and conduct a dietary exposure assessment. Food consumption data has been collected using a food frequency questionnaire. TFA contents have been determined using gas chromatography. Daily intake values of TFA for studied food products range from 0.004% to 0.246% of total energy intake. Although none of the TFA intake values exceeds the WHO recommended limit ($\leq 1\text{E}\%$), average daily TFA intake through consumption of dairy and sausage products makes 45% of the recommended level. Therefore, further investigation needs to be done to cover other food products that contain TFA.

Keywords and phrases: food frequency questionnaire, daily consumption, trans-fatty acids, total energy.

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Համառոտագիր

Սույն հետազոտության նպատակն է գնահատել տրանսճարպաթթուների (ՏՃԹ) պարունակությունը Երևանում իրացվող կաթնամթերքում և երշիկեղենում և իրականացնել սննդակարգային ներգործության գնահատում: Սննդամթերքի սպառման վերաբերյալ տվյալները հավաքագրվել են սննդի սպառման հաճախականության հարցաթերթի միջոցով: ՏՃԹ պարունակությունը որոշվել է գազային քրոմատոգրաֆիայի միջոցով: ՏՃԹ օրական ընդունման արժեքները տատանվում են ընդհանուր էներգիայի 0.004% -ից մինչև 0.246% -ի սահմաններում: Թեպետ ՏՃԹ օրական ընդունման արժեքներից ոչ մեկը չի գերազանցում ԱՀԿ-ի կողմից առաջարկած շեմը ($\leq 1E\%$), կաթնամթերքի և երշիկեղենի սպառման դեպքում ՏՃԹ օրական միջին ընդունումը կազմում է թույլատրելի շեմի 45%-ը: Անհրաժեշտ է իրականացնել հետագա ուսումնասիրություն՝ ներառելով ՏՃԹ պարունակող այլ մթերքներ:

Բանալի բառեր և բառակապակցություններ. սննդի սպառման հաճախականության հարցաթերթ, օրական սպառում, տրանսճարպաթթուներ, ընդհանուր էներգիա:

ОЦЕНКА РИСКА ПОТРЕБЛЕНИЯ ТРАНСЖИРНЫХ КИСЛОТ ПРИ ПОТРЕБЛЕНИИ МОЛОЧНЫХ И КОЛБАСНЫХ ПРОДУКТОВ В ЕРЕВАНЕ

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Аннотация

Целью данного исследования является оценка содержания трансжирных кислот (ТЖК), присутствующих в молочных и колбасных продуктах, продаваемых в Ереване, и оценка их воздействия на пищевой рацион. Данные о потреблении пищевых продуктов были собраны с использованием вопросника о частоте приема пищи. Содержание ТЖК определяли с помощью газовой хроматографии. Значения суточного потребления ТЖК варьировались от 0.004% до 0.246% от общего количества энергии. Хотя ни одно из значений суточного потребления ТЖК не превышает рекомендованный ВОЗ предел ($\leq 1\%$), при потреблении молочных и колбасных продуктов среднесуточное потребление ТЖК составляет 45% допустимого порога. Поэтому необходимо провести дальнейшее исследование, охватывающее другие пищевые продукты, содержащие ТЖК.

Ключевые слова и фразы: анкета частоты приема пищи, суточное потребление, транс - жирные кислоты, общая энергия.

Trans-fatty acid (TFA) is an unsaturated fatty acid with at least one double bond in the “trans” configuration. TFAs occur, in small quantities, naturally in some food as well as in the stomach of ruminants as a result of anaerobic bacterial fermentation. However, most of the solid fats content of TFAs is produced by partial hydrogenation of oils. Fatty acids are solid at room temperatures and have a long shelf-life. Due to this characteristic, many manufacturers all over the world use them. Trans fatty acids are high in stick margarine, cakes, pastries, doughnuts, shortening, and French fries [3, p. 61], [9, p. 275].

It has been reported that trans fatty acids have a negative effect on health. Industrially produced TFAs can increase the risk for various diseases, including breast and large intestine cancer, nervous system disorders, obesity, allergy, etc. Synthetic TFAs inhibit anti-inflammatory polyunsaturated fatty acids and contribute to cardiovascular disease, stroke, and diabetes [7, p. 509] [14, p. 584-592] [17, page 4]. Every additional gram of TFA intake increases the risk of heart disease by 5% [12, page 1601]. Moreover, compared to saturated fat, TFA can lead to a 10-fold higher risk of heart disease [11, p. 893].

TFA is the most harmful form of fat, but there are healthier alternatives to TFAs, and World Health Organization (WHO) urges governments to eliminate industrially-produced TFAs from food supply [17, p. 4]. Recently, 14 countries have passed and implemented best-practice TFA policies, and 26 countries have passed the same policy that will come into effect in the next two years. Two major best-practice policy options for eliminating industrially produced TFA from the food supply are: 1) limit industrially produced TFA to 2g per 100g of total fat in all fats, oils, and foods, and 2) ban the production and use of partially hydrogenated oils (PHO) [17, p. 3].

Several upper-middle-income countries, including Armenia have adopted mandatory TFA limits. Currently, Armenia adopted less restrictive TFA limits, and the proportion of coronary heart disease due to TFA intake is 4.1% in the country [17, p. 33]. Since Armenia is a member of the Eurasian Economic Union (EAEU), it follows Customs Union Technical regulations for fat-and-oil products [1, p. 1-35]. According to the regulation, as of January 2018, TFA should be limited to 2% in oils and fats in Eurasian Economic Union countries. This regulation defines acceptable contents for TFAs and the requirement for mandatory labelling only for fat-and-oil products. However, there are no requirements for neither TFA contents nor labelling for other processed products. Hence, it is essential also to investigate the

presence of TFA in products that use fat and oil as their raw materials or contain milk fat replacers (vegetable oils). This study aims to assess TFA content and its dietary exposure through the consumption of dairy and sausage products containing fat and oil as their raw materials.

Materials and Methods

Food sampling and determination of TFA content

Dairy and sausage products have been sampled from different selling points of Yerevan. For each type of food product, several sub-samples were collected. At least three sub-samples were pooled to design one composite sample for each food category. Overall, eight composite samples of dairy and sausage products were prepared for laboratory investigation. The descriptive information on samples is presented in Table 1.

Table 1. *Information on investigated food products*

N	Composite food samples	Pooled sub-samples
1	Milk	Pasteurized milk, condensed milk, including product with milk fat replacers
2	Matsun	Matsun samples from different producers
3	Sourcream	Sourcream and milk-containing product* prepared using sourcream technology (named as “curd cheese product”)
4	Yoghurt	Yoghurt and yoghurt produced with milk fat replacers
5	Cheese	Cheese from cow milk, cheese containing milk fat replacer, melted cheese
6	Curd cheese	Curd cheese and milk-containing product* prepared using curdcheese technology (named as “curdcheese product”)
7	Fat-and-oil products	Butter, spread, margarine and cream
8	Sausage products	Different sausages

Note: * - the product also contains milk fat replacers.

TFA contents have been determined in an independent laboratory of “Standard Dialog” LLC accredited by ISO/IEC 17025:2005 standards. Gas chromatography-mass spectrometry has been used for quantifying TFA concentrations in food products. Investigations have been carried out based on GOST 31663-2012 [5, **p. 1-12**] and GOST 32261-2013 [6, **p. 1-23**] standards defined for the determination of trans fatty acid methyl esters. This method is designed to evaluate the level of trans-isomers formed during the hydrogenation of vegetable oils or fats.

Dairy and sausage product consumption and statistical analysis of data

Food consumption data has been collected using a food frequency questionnaire (FFQ). Surveys were conducted in 2020 by the Informational-Analytical Center for Risk Assessment of Food Chain of Center for Ecological Noosphere Studies of RA. Well-trained interviewers have gathered data via face-to-face and telephone interviews in accordance with dietary study guideline implemented by FAO [4, **p. 10**]. Overall, 400 residents of Yerevan city, aged 18 to 65, took part in the survey. The collected data was entered into SPSS software (SPSS Inc., version 22.0) and was subject to statistical analysis.

Daily Intake of TFA

Data on TFA content and food consumption have been used to estimate the daily intake (DI) of TFA (g/day) using the following equation:

$$DI = C \times IR \quad (1)$$

where C is the mean content of TFA in all the studied food products (g in 100 g), IR is the daily consumption of food (g/day).

Daily intake of TFA has been represented as a percentage of total energy using the following equation [8, **p. 479**].

$$E\% = \frac{DI \times 9}{DE} \times 100 \quad (2)$$

where $E\%$ is the daily TFA intake as the percentage of total energy. DI is the TFA intake per day (g/day). The energy transfer index of TFA is 9 kcal/g. DE is the total dietary energy intake (kcal). According to the statistical committee of Armenia, in Yerevan, per capita (daily) consumed dietary energy is approximately 2047 kcal/day [15, **p. 104**].

Results and Discussion

Content of TFAs in dairy and sausage products

Fat content in dairy products ranged from 2,9-82,5%. In sausage products, the fat content was equal to 22,3%. Based on this data, TFA content has been calculated in 100 grams of each food product. According to the results, TFA content

ranged from 0.0706 grams to 3.0912 grams. The average TFA content in 100 grams of studied foods was equal to 0,6267 grams (Table 2). Samples of butter and cheese had the highest TFA contents, amounting to 3.091 g/100g and 0.616 g/100g, respectively.

Table 2. *The contents of TFA in studied food products*

Food products/composite samples	Content of fat in food products (%)	TFA content detected in food products (%)	TFA content in food products (g/100 g)
Milk	3.47	2.359	0.0819
Matsun	2.90	2.490	0.0722
Sourcream	18.75	2.230	0.4181
Yoghurt	8.20	5.555	0.4555
Cheese	50.00	1.232	0.6160
Curd cheese	8.00	2.600	0.2080
Fat-and-oil products	82.50	3.747	3.0913
Sausage products	22.25	0.307	0.0706
<i>The average content of TFA in food samples (g/100 g)</i>			0.6267

To further interpret current levels of TFA in the studied foods, they were compared to similar findings reported in other countries. According to a study conducted in Australia in 2013, the trans fatty acid content in margarine/spread has been 1.9% of total fat. According to the Food Standards Australia New Zealand (FSANZ) study, in 2013, TFA content in sausage rolls has been 0.62 g/100g of food, which is substantially higher than the TFA content (0.07g/100g) determined in sausage products in the current study. In Canada, UK, Netherlands, and Malaysia, the average TFA contents in margarine/spread have been estimated to be 2.7%, 0.7%, 1.4%, and 0.2% of total fat, respectively [18, p. 12]. According to a recent study regarding the TFA elimination policy in EEC member states, in Yerevan, approximately 50% of the fat in foods were TFAs [2, p. 1329].

In Armenia, there is no regulation regarding TFA content in each of the studied food products. In this case, estimation of daily TFA intake is of high importance for measuring the risk of the detected TFA for the population.

Food consumption

Figure 1 summarizes the average daily consumption amount of each food product. Among dairy products, matsun (a fermented milk product of Armenian origin), milk, and cheese have the highest consumption amounts, totalling to 97.7g/day, 49.2g/day, and 34.2g/day respectively (Fig. 1). Based on FFQ survey results, the consumption of fat-and-oil products and sausages is equal to 18.1g/day and 12.3g/day.

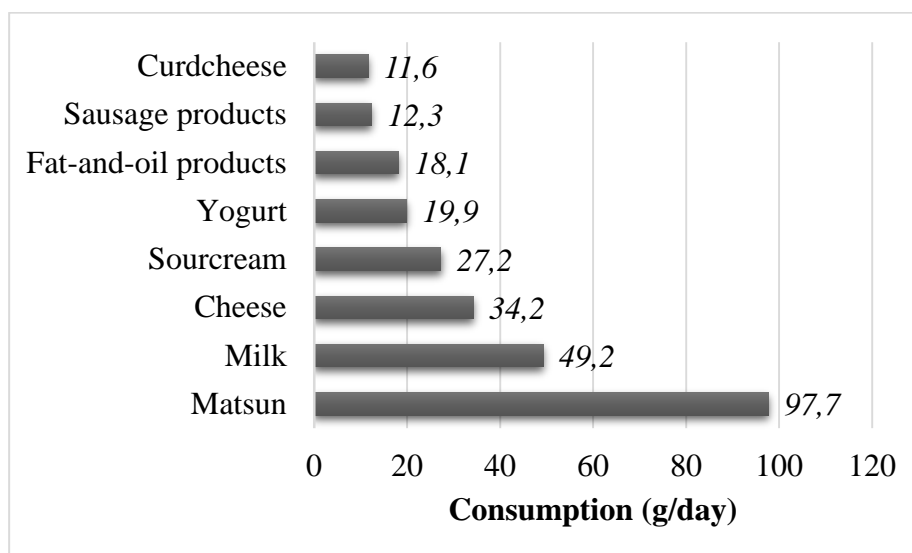


Fig. 1. *Food consumption*
DI of TFA

Since many countries have taken measures to reduce TFA content in the diet, they have adopted best-practice TFA policies. This regulation has been passed in most European countries, including Germany, Sweden, Netherlands, Spain, Belgium, France, etc. A maximum limit of industrially produced TFA of 2 g per 100 g of fat in food has been established. Moreover, the use of PHOs has been banned. Other mandatory TFA limits have been adopted as well. For example, a lot of countries have also made it mandatory to put a declaration of TFA on nutrition labels and impose a tax on food products with high levels of trans fat [17, p. 3].

As a part of a dietary exposure assessment, daily TFA intake has been calculated (Fig. 2 and 3) and compared with WHO's recommended level of less than 2.2 g/day for total TFA intake, which is equal to less than 1% of total energy intake [17, p. 21].

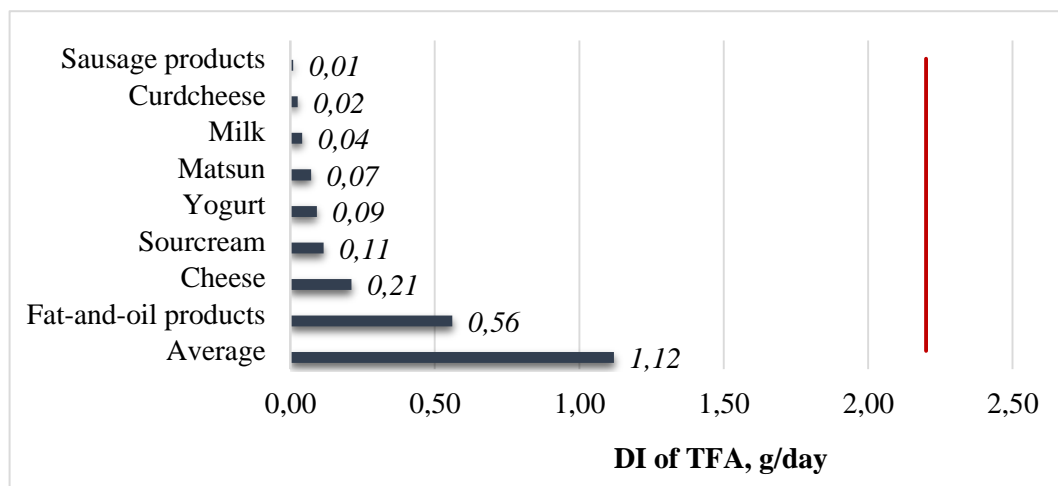


Fig. 2. Daily intake of TFA (g/day) for each food product

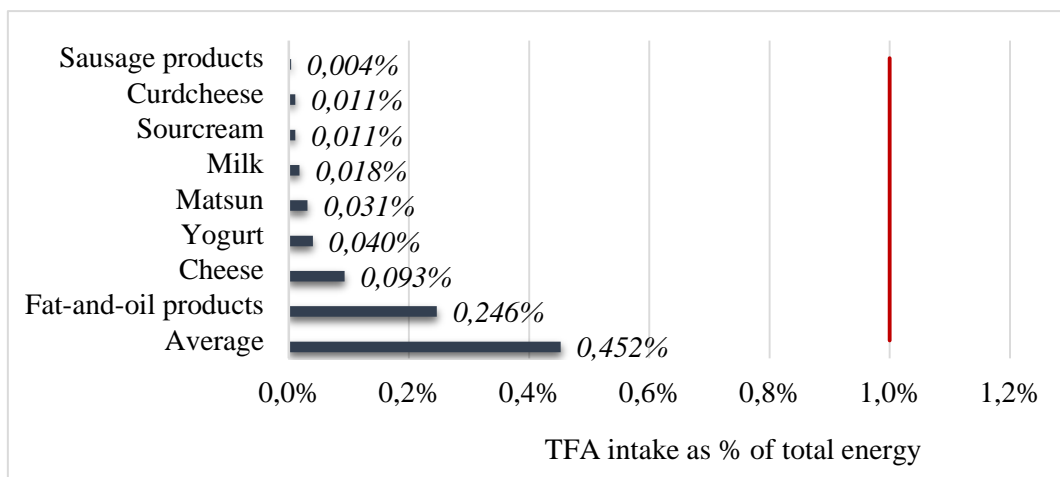


Fig. 3. TFA intake as a % of total energy

Daily intake values of TFA for the studied food products ranged from 0.0004% to 0.25% of total energy intake, with fat-and-oil products being the largest contributors. None of the TFA intake values exceeds the WHO recommended limit of 1% of total energy in case of each product. However, average daily TFA intake through consumption of dairy and sausage products makes 45% (0.45% of total energy intake) of the recommended level. Based on another investigation conducted in Yerevan city in 2020, TFAs have been found in Ice-cream samples. The daily

intake of TFA through ice cream consumption accounted for 0.041% of total energy intake [13, p. 92].

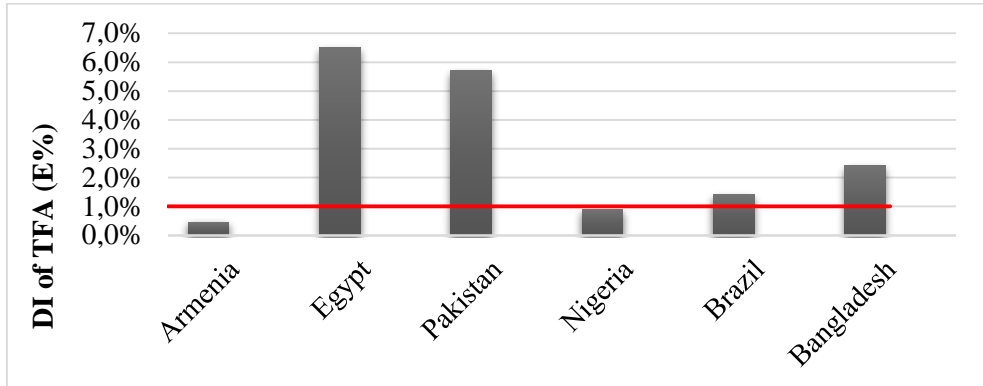


Fig. 4. *TFA intake as a % of total energy in different countries*

Researchers have reported high TFA intakes throughout the world (Fig. 4). TFA intakes have been estimated to be 6.5% and 5.7% of total energy intake in Egypt and Pakistan, respectively. In Nigeria, in 2010, mean TFA intake has been 0.9% of total energy intake [16, p. 8]. In Brazil, based on the Family Budget Survey 2008/2009, mean TFA intake has been 1.4% of the total daily energy intake [10, p. 7]. In 2010, in Bangladesh, the mean TFA intake accounted for 2.4% of total energy intake [16, p. 10].

Conclusion

The current study results indicate that all of the investigated food products contain trans fatty acids, with fat-and-oil products and cheese having the highest TFA concentrations. Although none of the TFA intake values exceed the WHO recommended limit of 1% of total energy, the average daily TFA intake through consumption of dairy and sausage products makes 45% of the recommended level in case of each product.

A limitation of the current study is that it excludes food categories such as pastry, popcorn, baked goods, etc., which are considered to be high sources of TFA. Therefore, it is recommended to conduct an investigation covering a wide range of food products. Moreover, the government should implement actions to replace TFAs with healthier fats, such as monounsaturated fatty acids (MUFA) or polyunsaturated fatty acids (PUFA). Extensive work needs to be done to raise awareness about the TFA regulation and the adverse effects of TFA on health among food producers, consumers and policymakers. Furthermore, continuous monitoring

programs and population intake surveys need to be conducted. The current EAEU regulation can be extended to mandate TFA limits not only for fat-and-oil products but also for other food products. Taking the necessary steps and following the best practice policies will protect the health of the population.

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