

## The global fight against *trans*-fat: Policy insights and labeling information based on alternative substitutes in Türkiye

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### ABSTRACT

*Trans*-fat consumption is an important risk factor for cardiovascular diseases, which is one of the leading causes of death worldwide. With the 'REPLACE' action plan of the World Health Organization, which aims to zero global *trans*-fat consumption by 2023, steps are taken by the countries of the world to zero *trans*-fat. In this article, *trans*-fat content information of packaged food products was researched in Türkiye. *Trans*-fat content was classified into 4 categories and a total of 1411 packaged food products divided into 11 categories were examined and it was found that 71.2% of them contained *trans*-fat-free content. According to the label information, the usage rate of 'no *trans*-fat or *trans*-fat free' statements in all categories is 25%. In addition, it was determined that 7.1% of these products used vague expressions that did not provide clear information about *trans*-fat content. When evaluated in general, the use of alternative substitutes should be encouraged and effective policies should be developed in order to eliminate *trans* fat in Türkiye as well as in the rest of the world.

**Keywords:** *Trans*-fat, *Trans*-fatty acids, 'REPLACE' action plan, Food labeling, Food security

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## Introduction

Issues such as difficulties in ensuring food safety, barriers to access to healthy food, population growth, and the effects of climate change, slow improvement of food processing conditions, and limits on the use of alternative healthy substitutes increase the importance of food safety issues. In this context, unhealthy eating habits, one of the most important problems of today, should not be seen as an individual lifestyle choice. Health problems that occur as a result of unhealthy nutrition are a reflection of international legal regulations and institutional strategies (Parziale & Ooms, 2019). Fat substitutes with *trans*-fat content are used to meet the expectations of many foods, to gain desired textural, rheological, and sensory properties, and to improve shelf life. For this reason, international roadmaps have been created for the classification and zeroing of foods with *trans*-fat content. The World Health Organization (WHO) has published the 'REPLACE' action package to remove industrially produced TFA from the global food supply by 2023. The REPLACE action package has 6 modules and provides a strategic roadmap for removing industrially produced TFA from national food sources (Ghebreyesus & Frieden, 2018; Huang et al., 2020; Spajić, 2020).

*Trans*-fatty acids (TFA) can be defined as monounsaturated fatty acids (MUFA) or polyunsaturated fatty acids (PUFA) containing at least one carbon-carbon *trans*-double bond in fatty acids. Although the chemical composition of a *cis* and *trans*-fatty acid is the same, this change in bond structure causes changes in many functional properties (Lichtenstein, 2015; Pase et al., 2021). Research so far has shown that frequent consumption of TFA-containing foods causes cardiovascular risks, neuropsychiatric sensitivity, and hyperactive behavior. In addition, it has been reported that oxidative damage in the brain regions of the offspring increases in the case of frequent consumption of foods containing TFA during pregnancy and lactation (Mouratidou et al., 2014; Oteng & Kersten, 2020; Pase et al., 2015; Spajić, 2020; Trevizol et al., 2015; Verneque et al., 2020). *Trans*-fat is one of the major causes of more than 5.7 million deaths per year worldwide, according to 2020 data, due to occlusion of the heart vessels and causing heart attacks (WHO, 2021). In Türkiye (80 million population), approximately one hundred thousand people (23% of all deaths) died due to cardiovascular diseases in 2020. One of the important factors causing death from cardiovascular diseases is the consumption of foods containing *trans* fatty acids (World Health Rankings, 2021). Due to the very high industrial TFA content of some fast-food foods, 10 to 25 g of TFA per day may be consumed in many countries.

It is stated that taking about 5 g of *trans*-fat in daily consumption is associated with a 25 percent increase in the risk of heart disease (Stender & Jorn, 2006).

With the publication of a study in 1993 that TFA consumption increases the risk of coronary heart disease, it attracted media attention, and efforts were made to limit the intake of industrially produced TFA (Willett et al., 1993). In 2003, Denmark became the first country to take legal action to restrict TFA by enacting a law limiting industrially produced TFA to a maximum of 2% in food products (Stender, 2020; Tarar et al., 2020). To date, 62 countries around the world have been involved in the TFA restriction process and have implemented a national policy, strategy and action plan. For 64 countries, it is known that no steps have been taken yet in terms of combating TFA. More than forty percent of the world's population currently lives in countries with mandatory TFA restrictions (WHO, 2020b). Examining the policies to limit TFA across Europe, the EU has agreed to limit industrially produced TFA in all food products to 2 g TFA per 100 g total fat. These regulations will directly apply in all member States of the EU as well as in the European Economic Area (EEA) (Temkov & Mureşan, 2021). Due to its harmonization process with the EU, Türkiye made legal regulations in May 2020 to limit TFA to 2 g per 100 g of total oil. The regulations entered into force in 2021 (WHO, 2020a). In this context, the roadmap created by the WHO specific to *trans*-fat directly affects food packaging, consumer preferences and policies to be created (Hartmann et al., 2018).

### ***REPLACE Action Plan to Limit TFA Consumption***

The REPLACE action package created to reset the industrially produced TFA consists of a strategic roadmap consisting of 6 modules. The first module in this roadmap is defined as 'Review'. This module includes reviewing the available information on industrially produced TFA at the country level, examining the production-consumption processes, determining the policies applied and to be implemented, and gathering information about potential *trans*-fat sources in the market. The ultimate goal is to identify and implement best-practice legislative measures to remove industrially produced TFA from the national food supply (WHO, 2019b).

In general, legislation and regulations do not specify which type of oil should be used instead of industrially produced TFA. Using healthier oils instead of oils containing TFA will meet the health expectations of consumers at the highest level. The second module, 'Promote', provides a roadmap for the development and implementation of strategies for identifying industrially produced oils with the lowest risk of TFA

and promoting the use of these healthier oils. These strategies generally include agricultural policies and industry incentives for healthy fats, covering the whole process from agriculture to industry to government policies in order to facilitate and accelerate the *transition* to healthy fats (WHO, 2019c).

In order to eliminate industrially produced TFA, the selection of policies to be carried out and the framework of these policy arrangements should be well defined. The third module, *Legislate*, provides guidance on designing, enacting and implementing legislation appropriate to each country's structure, or selecting policies so that existing legislation can be updated to reduce industrially produced TFA (WHO, 2019d).

In order to remove TFA from the global food supply in accordance with the REPLACE action plan, it is very important that how many TFA source foods are consumed in countries and that the policies implemented to eliminate TFA be legally followed. The fourth module, *Assess*, was created to guide the necessary practices in order to reset a country according to its TFA consumption rates (WHO, 2019e).

While countries are implementing many practices to eliminate TFA in foods with their policies, they should also develop a communication strategy very carefully. In determining the policies to be implemented, industry representatives should be in communication with regard to cost, management of changes in product formulation. The fifth module, *Create*, addresses the necessity of conducting the communication channels with the most effective methods in policy determination and implementation processes and offers suggestions (WHO, 2019f).

The last module, *Enforce*, includes a series of activities such as informing stakeholders about the new legislation in the implementation of policies for resetting TFA, collecting complaints from consumers, inspections of products and facilities, analysis, control of labeling, and sanctions in case of violation. In general terms, it is stated that the process of resetting the TFA amount will be maintained quite easily when the issues such as establishing a good communication environment in the policy development processes, conducting the audits within a certain plan, and balancing the sanctions in case of violations are taken into account (WHO, 2019g).

### ***Trans-Fat Source PHO and Alternative Fat Replacements***

Unsaturated fatty acids found in vegetable oils naturally have only *cis*-double bonds. The primary source of TFA, which is the focus of the 'REPLACE' action package, is partially hydrogenated oils (PHOs), formed as a result of the partial hydrogenation process (Parziale & Ooms, 2019; WHO, 2019a). Although naturally and industrially occurring TFA is in the

range of 3-6% to oils obtained from ruminant milk and meat sources, it can occur at a rate of about 2% during the refining of vegetable oils, about 3% when exposed to high temperature applications for a long time, and about 25-45% in PHO production (Martin et al., 2007; Temkov & Mureşan, 2021; Van Duijn, 2005). The United States Food and Drug Administration (FDA) defines PHO as 'oils and fats that are hydrogenated but incomplete or not fully saturated and have an iodine value (IV) greater than 4' (Kotoski & Srigley, 2018). It can be listed as an alternative to partially hydrogenated oils; fully hydrogenated oils, natural oils at room temperature (oils rich in oleic acid, oils containing antioxidants and emulsifiers), natural fats at room temperature (animal fats, palm, palm kernel, coconut oils), fractionated oils (liquid palm-olein, solid palm, palm-stearin), interesterified oils (enzymatic, chemically *transformed* oils with fatty acid profile), mixed oils (viscous liquid-solid oil mixture), combination mixtures (a mixture of fractionated oils and interesterified oils) (Dunford, 2017; Van Duijn, 2005).

In the early uses of the partial hydrogenation technique applied to fats, it was assumed that all saturated fatty acids were healthier than unsaturated fatty acids and that replacing saturated fatty acids with unsaturated fats containing *trans*-fatty acids would result in lower cardiovascular disease. Today, it is also clear that reducing the consumption of saturated fatty acids and replacing them with healthier alternatives is beneficial. Therefore, WHO reports (Downs et al. 2018) from time to time state that it is necessary to exclude partially hydrogenated fats from the diet, to limit TFA intake to less than 1% of total energy intake, and to limit saturated fatty acid intake to less than 10% of the total. PHO in products should be replaced with formulations containing as little saturated fatty acid as possible and as much unsaturated fatty acid as possible. Saturated fatty acids should be used in a limited number of applications for which there is no alternative. There is a significant difference between using palm kernel oil high in saturated fat as an alternative to oil high in TFA, and replacing it with a mixture of oils high in unsaturated fat and some saturated fat. The second approach is much healthier (Dunford, 2017; Van Duijn, 2005).

### ***Health Evaluation of PHO Alternatives***

For a fat substitute to be considered healthy, it is generally accepted that Saturated Fatty Acid (SFA) should be as low as possible and PUFA as high as possible, preferably containing both omega-6 and omega-3 fatty acids. In addition, these oil substitutes are expected to have high oxidation resistance (rich in oleic acid). Each step of processing oils and fats for the production of PHO-free oil substitutes (refining, fractionation, hydrogenation, interesterification, blending) incurs

some costs. This makes palm oil, the cheapest oil in the world, indispensable. This oil is about one-third cheaper than even common soybean oil (Spajić, 2020; WHO, 2019c).

For liquid oils, palm oil liquid fractions, animal-derived liquid oils, tropical liquid oils are not recommended for health reasons. Liquid oils with low PUFA and high MUFA content are usable alternatives to oil substitutes, which are not recommended for health reasons. Antioxidant-rich oils containing high PUFA, oils containing high MUFA-medium PUFA are recommended because of their positive health effects. For semi-solid oils, palm oil semi-solid fractions, animal origin oils, tropical oils are not recommended for health reasons. Semi-solid oils obtained by producing hardstocks by interesterification using oils containing low PUFA and blending hardstocks with oils containing low PUFA can also be used as an alternative to fat substitutes, which are not recommended for health reasons (Abramovič et al., 2018; Menaa et al., 2013; WHO, 2019c). Hardstocks produced by interesterification using oils containing high PUFA and semi-solid oils obtained by blending hardstocks with oils containing high levels of PUFA are recommended because of their positive health effects. For solid oils; palm oil solid fractions, fully hydrogenated vegetable oils, coconut oil, palm kernel oil are not recommended for health reasons. Solid fats obtained by producing hardstocks by interesterification using oils containing high PUFA, solid fats obtained by mixing hardstocks with oils containing high PUFA can be used as an alternative to fat substitutes that are not recommended for health reasons. In addition, solid fats obtained by producing hardstocks by interesterification using oils containing MUFA are not highly recommended. Solid fats are generally not recommended due to limited positive health effects (Albuquerque et al., 2011; WHO, 2019c).

The most effective way to completely remove industrially produced TFA from the global food supply, ban or strictly limit the use of TFA-containing foods is to establish and enforce regulations with frequent inspections. A growing number of countries, such as Türkiye, are complying with the WHO's call to remove industrially produced *trans*-fats from their food sources by 2023 and are developing policies to take the necessary measures. As a requirement of the policy of zeroing *trans*-fats worldwide until 2023, this study summarizes the current situation by dividing packaged foods in Türkiye into 4 classes according to their *trans*-fat content.

## Materials and Methods

### Data Collection

Market research on the *trans*-fat content of packaged foods consumed in Türkiye was carried out through five national supermarket chains determined by the preliminary study. In the selection of the five nationwide supermarket chains, the markets with considerably high market share and product variety, reflecting the consumer preferences across the country in the products they sell were preferred. Official permission and ethics committee approval were obtained from all supermarket chains and administrative authorities included in this study. In order to examine the *trans*-fat label information and nutritional value panels of food products in supermarkets, 11 food categories were determined. The categories were determined as bakery products, convenience foods, oils, powdered beverages, spreads-sauces, pastry products, breakfast cereals-baby foods, processed meats, ice creams, chocolates and chips-snacks (Ricardo et al., 2019). It was not necessary to examine packaged food products that do not contain oil and do not have the potential for industrial *trans*-fats (such as beverages, honey products, dairy products).

At least 3 photographs were taken, including the front of each package, the *trans*-fat information panel, if any, the ingredient list, weight and the nutritional value panels. In order to ensure the healthy progress of the data collection process, the photographs taken were quickly saved in the data pool. In order to avoid duplication, product information was entered in detail and codes were entered for each product, taking into account the category it was linked to. Generally, it is preferred to photograph large-sized products in similar products where the package size differs. For this study, data collection, classification and recording were carried out by 2 field workers. The first of the field workers has expertise in the field of dietetics, the second in the field of food engineering. All field workers have training in food composition and labeling. In addition, field workers photographed the products using smartphones with high-resolution cameras. The data collection process was carried out during the summer holidays of 2021 so as not to disrupt the operation of the supermarkets, and photographs were taken on Tuesday, Wednesday and Thursday when the customer density was relatively low. Photographs of the products were taken during the daytime hours and for a maximum of 30 minutes in a way that would not disturb the customers. All photographing processes were completed within 2 months. Field workers kept ID cards during data collection. Field workers tried not to communicate with customers and emphasized that it was an 'ordinary labeling exercise' when necessary. As a result of all this work, 1411 samples were examined one by one and approximately

5049 photographs were taken. All the methods used in the collection and classification of labeling data were developed by Kanter et al. carried out by adapting their working model (Kanter et al., 2017).

### Classification of Trans-Fat Content According to Label Information

Keywords used to identify products with *trans*-fat content are listed in Table 1 (Modified from Ricardo et al., 2019). The term 'specific' is used for products with keywords known to be sources of *trans*-fat. Partially hydrogenated oil, hydrogenated vegetable oil and hydrogenated are selected for this category. Classifications of 'probably' for products likely to be a source of *trans*-fats, 'low possibility' for products that are unlikely to be a source of *trans* fat, and 'uncertain' for products with ambiguous keywords were used. Shortenings and margarines were determined for products probably to be sources of *trans*-fat. Although advanced techniques are applied today to eliminate these products from being a source of *trans*-fat, they are still considered a source of *trans*-fat (Abramovič et al., 2018; Stender, 2020; Tarar et al., 2020).

**Table 1.** Classification of *trans*-fat content according to label information

Classifications of <i>trans</i> -fat	Keywords
Specific	Partially hydrogenated oil, hydrogenated vegetable oil, hydrogenated
Probable	Shortenings, margarine
Low possibility	Fully hydrogenated oil, refined oil, non-hydrogenated oil, palm olein, frying oils, vegetable cream, shea
Uncertain	Organic vegetable oil, oil powder, palm oil fractions, butter flavored vegetable oil, vegetable oil

## Results and Discussion

For the bakery products (biscuits, cakes, crackers and bakery products) category, 312 samples were examined (Table 2). The term 'vegetable oil' is used in the contents of these products at a rate of 92%. The remaining 8% use the terms vegetable oil powder, butter flavored vegetable oil, margarine, vegetable anhydrous oil, Fully Hydrogenated Oil (FHO), PHO and Hydrogenated Oil (HO). Next to these statements on the packages, the current oil content was listed in parentheses. PHOs, which were indicative of the presence of *trans*-fat, were found at an average rate of 3.2% among 312 samples, and contents probable to contain 1.9% of *trans*-fat were

found. Fat content with a low possibility of *trans*-fats was detected in 18% of the products in this category, and ambiguous expressions were used in 3.2%. According to the list of ingredients, 74% of the 312 samples had fat contents without the potential to contain *trans*-fats (Figure 1). In the label information, the statements 'no *trans*-fat or *trans*-fat free' were used in 34.9% and 65.1% of them did not find any information about *trans*-fat (Figure 2).

127 samples were examined for the category of ready-to-eat foods (instant frozen products, instant soups, ready-made desserts, canned foods). The term 'vegetable oil' is used in the contents of these products at a rate of 90% (Table 1). The remaining 10% use the terms frying oil, vegetable refined oil, margarine, vegetable anhydrous oil, FHO and HO. PHO, which was a clear indicator of *trans* fat content, was found at a rate of 0.8% in the content information and contents that were probable to contain 5.5% *trans*-fat have been identified. Low possibility was determined in 15.7% of the products in this category, and uncertain expressions were used in 5.5% of the products. Based on the ingredient list, 72.4% of the 127 samples had a fat content without the potential to contain *trans*-fats (Figure 1). In the label information, the statements 'no *trans*-fat or *trans*-fat free' were used at a rate of 13.4%. No information on *trans*-fat was found in 86.6% (Figure 2). It was useful to underline that packaged foods in this category have the least *trans*-fat content information.

83 products were reviewed for the spreads and sauces category. The term 'vegetable oil' is used in the contents of these products at a rate of 88% (Table 1). The remaining 12% did not use a term related to fat content. PHO, which was a clear indicator of *trans*-fat content, and probable *trans*-fat source content information were not found. Low possibility was determined in 11% of the products in this category, and uncertain expressions were used in 14.5% of the products. According to the ingredient list, 74.7% of the 83 samples examined had a fat content without the potential to contain *trans*-fats (Figure 1). In the label information, the statements 'no *trans*-fat or *trans*-fat free' were used at a rate of 26.5%. No information on *trans*-fat was found in 73.5% (Figure 2).

For the fat category (refined oils, unrefined oils, margarines, shortenings), 52 samples were examined. The term 'vegetable oil' is used in the contents of these products at a rate of 65.4%. The remaining 34.6% were termed margarine and shortening. PHO and HO, which were clear indicators of *trans*-fat con-

tent, were not included in the content information. The content information that there was a probable source of trans-fat is 40.6%. The high value of this value was due to the fact that although margarine production processes have recently been improved with different techniques, they were still considered as a potential source of trans-fat. Low possibility was determined in 4.8% of the products in this category, and uncertain expressions were used in 3.8% of the products. According to the ingredient list, 48.1% of the 52 samples examined had a fat content without the potential to contain trans-fats (Figure 1). In the label information, the statements 'no trans-fat or trans-fat free' were used at a rate of 38.5%. No information on trans-fat was found in 61.5% (Figure 2). These results were low, as expected, since there was no need to use the expression for trans-fat in liquid oils.

53 samples were examined for pastry materials. The term 'vegetable oil' is used in the contents of these products at a rate of 96.2%. The remaining part does not contain a term related to fat content. While PHO and HO content, which were clear indicators of trans-fat content, are 2%, no fat content that could be a probable source of trans-fat was found. Low possibility was determined in 43.4% of the products in this category, and uncertain expressions were used in 3.8% of the products. According to the ingredient list, 50.9% of the 53 samples examined had a fat content without the potential to contain trans-fats (Figure 1). In the label information, the statements 'no trans-fat or trans-fat free' were used in pastry products (Figure 2). According to these results, it was seen that more than half of the pastry products, according to the content information, use fat content with more saturated fatty acids.

117 samples were examined for the snacks category (chips, snacks, corn products). The term 'vegetable oil' is used in the contents of these products at a rate of 94.9%. The remaining part does not contain a term related to fat content. PHO was found at a rate of 4% in the content information no fat content that could be a probable source of trans-fat was found. Low possibility was determined in 46.2% of the products in this category, and uncertain expressions were used in 3.4% of the products. According to the ingredient list, 47% of the 117 samples examined had a fat content without the potential to contain trans-fats (Figure 1). In the label information, the statements 'no trans-fat or trans-fat free' in snack products were found in 52% of all products. No expression of trans-fat was found in the remaining 44% (Figure 2). According to the

results of this category, it can be said that almost half of the products examined consist of products that may contain trans-fat.

For the chocolate and wafer category, 221 samples were examined (Table 2). All of these products use the term 'vegetable oil' in their ingredients. PHO and its derivatives were not found in this category. In addition, there were no ingredients that could be a probable source of trans-fats. In the samples in this category, the rate of low-probability trans fat source was found to be 20.4%. There was no expression that was described as uncertain according to the content information. According to the 221 samples examined, there was a fat content of 79.6% without the potential to contain trans-fat (Figure 1). While it was determined that the expressions 'no trans-fat or trans-fat free' were used for this category at a rate of 40.7%, no information about trans-fat was found at a rate of 59.3% (Figure 2). According to these data, it can be said that three quarters of the products in this category were safe in terms of trans fat content, and the remaining quarter were produced from fat substitutes with a low probability of trans fat content. Despite this, it was noteworthy that 40.7% stated 'no trans-fat or trans-fat free'.

For the ice cream category, 87 samples were examined. The term 'vegetable oil' is used in the contents of these products at a rate of 88.5% (Table 1). In the remaining part, no expression was used regarding the oil content. PHO was not seen in the content information and contents that could probable trans-fats were not detected. In 3.4% of the products in this category, ingredients with a low possibility of trans-fat content were determined, and uncertain expressions were used in 4.6% of the products. According to the ingredient list, 92% of the 87 samples examined had a fat content without the potential to contain trans-fats (Figure 1). In the label information, the statements 'no trans-fat or trans-fat free' were not used in the entire ice cream category (Figure 2). It can be said that the packaged foods in this category were the least likely to contain trans-fat according to the label information.

The number of samples examined for the processed meat category (sausage, salami, sausage, ham, etc.) is 127. The term 'vegetable oil' is used in the contents of these products at a rate of 24.4% (Table 1). This value was low as expected. Also in the content information, the term "animal fat" was used at a rate of 89% and there was no statement about the fat content of 7.9%. Specific ingredients, probable ingredients, low possibility ingredients that were a clear indication of trans-fat

content were not found in the label information. In 9.4% of the products in this category, uncertain expressions were used regarding the oil content. According to the ingredient list, 90.6% of the 127 samples examined had a fat content without the potential to contain trans-fats (Figure 1). In the label information, the statements 'no trans-fat or trans-fat free' were not used in the whole processed meat category (Figure 2). Since the use of industrially produced oils in packaged products produced in this category was limited, the probability of trans-fat content was very low.

The number of samples examined for the breakfast cereals, bars, baby food category is 189. The term 'vegetable oil' is used in the contents of these products at a rate of 75.1% (Table 1). In the content information, in 24.9%, a term related to oil content was not used. Specific ingredients, probable ingredients, low possibility ingredients that were a clear indication of trans-fat content were not found in the label information. In the products in this category, uncertain expressions were used in 24.9% of the products regarding the oil content. According to the ingredient list, 75.1% of the 189 samples examined had a fat content without the potential to contain

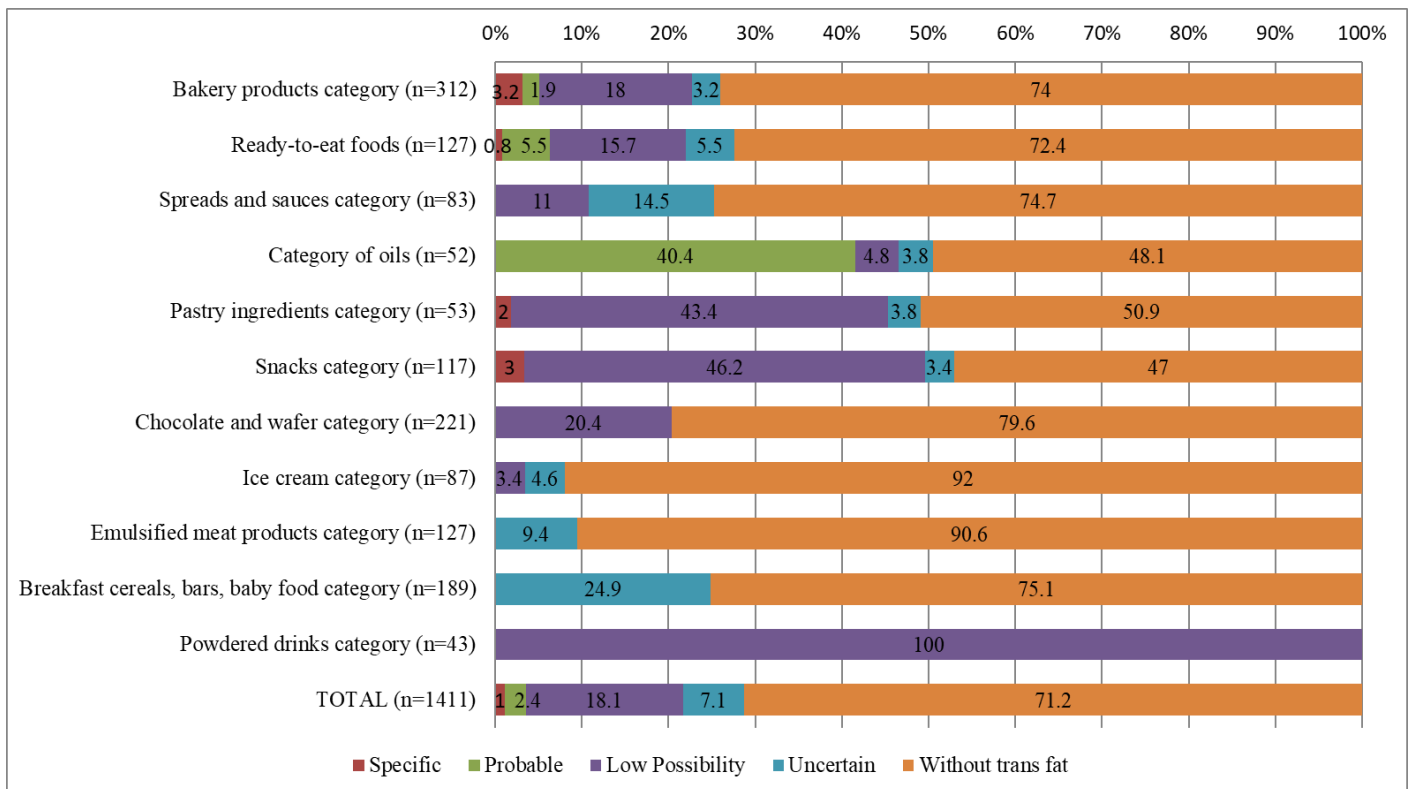
trans-fats (Figure 1). When the label information was examined, the expressions 'no trans-fat or trans-fat free' were used in this category at a rate of 15.9%, while no expression related to trans-fat content was found in 84.1% (Figure 2). The rate of ambiguous statements about the use of industrially produced oils in packaged products produced in this category was quite high compared to other categories. It has been observed that the use of the expressions "no trans-fat or trans-fat free" in the label information is also limited.

The number of samples examined for instant products such as powdered beverages and coffee is 43. All of these products use the term 'vegetable oil' in their ingredients (Table 1). Specific ingredients, probable ingredients, and uncertain statements that were a clear indication of trans-fat content were not found in the label information. It was observed that FHO, which was in the low possibility category related to trans-fat content, was used in all of the products in this category (Figure 1). When the label information was examined, it was determined that the expressions 'no trans-fat or no trans-fat' were never used in this category (Figure 2).

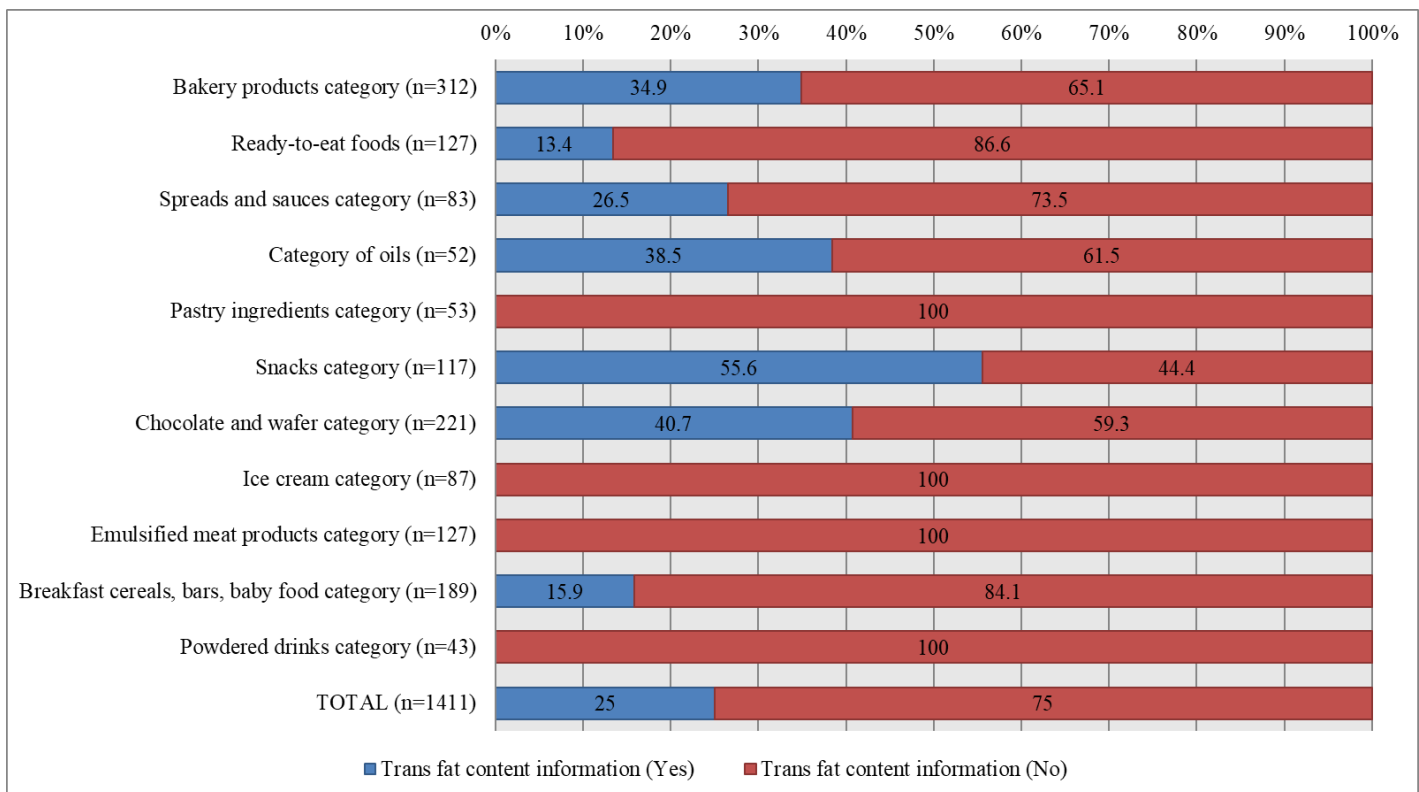
**Table 2.** Number and proportions of packaged foods that contain possible sources of *trans*-fat in the ingredient list and that contain *trans*-fat information (yes/no) on the packaging (n = number of products)

Categories	Number of Products Examined	List of Ingredients															
		Use of the term 'vegetable oil'		Specific (%)		Probable		Low Possibility		Uncertain		Without <i>trans</i> fat		<i>Trans</i> -fat content information (Yes)		<i>Trans</i> -fat content information (No)	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
1	312	286	92	10	3.2	6	1.9	55	18	10	3.2	231	74	109	34.9	203	65.1
2	127	114	90	1	0.8	7	5.5	20	15.7	7	5.5	92	72.4	17	13.4	110	86.6
3	83	73	88	0	0	0	0	9	11	12	14.5	62	74.7	22	26.5	61	73.5
4	52	34	65.4	0	0	21	40.4	4	4.8	2	3.8	25	48.1	20	38.5	32	61.5
5	53	51	96.2	1	2	0	0	23	43.4	2	3.8	27	50.9	0	0	53	100
6	117	111	94.9	4	3	0	0	54	46.2	4	3.4	55	47.0	65	55.6	52	44.4
7	221	221	100	0	0	0	0	45	20.4	0	0	176	79.6	90	40.7	131	59.3
8	87	77	88.5	0	0	0	0	3	3.4	4	4.6	80	92.0	0	0	87	100
9	127	31	24.4	0	0	0	0	0	0	12	9.4	115	90.6	0	0	127	100
10	189	142	75.1	0	0	0	0	0	0	47	24.9	142	75.1	30	15.9	159	84.1
11	43	43	100	0	0	0	0	43	100	0	0	0	0	0	0	43	100
TOTAL	1411	1183	83.8	16	1	34	2.4	256	18.1	100	7.1	1005	71.2	353	25	1058	75

- |   |  |    |  |
|---|--|----|--|
| 1 | Bakery products (biscuits, cake, crackers, and bakery products) category                       | 6  | Snacks category (chips, snacks, corn products) |
| 2 | Ready-to-eat foods (ready frozen products, ready soups, ready desserts, canned foods) category | 7  | Chocolate and wafer category                   |
|   |  | 8  | Ice cream category                             |
| 3 | Spreads and sauces category  | 9  | Emulsified meat products category              |
| 4 | Edible oils category   | 10 | Breakfast cereals, bars, baby food category    |
| 5 | Pastry ingredients category  | 11 | Powdered drinks category                       |



**Figure 1.** The rate of products in five categories regarding the presence of trans-fat content according to label information



**Figure 2.** The yes/no ratios regarding the trans-fat content declared in the information panel of packaged foods

When all these categories were examined in general, a total of 1411 products were examined. 83.8% of these products use the term 'vegetable oil' in their ingredients (Table 1). When examined in general, the use of the term 'vegetable oil' at a high rate of 83.8% is important in terms of minimizing the confusion of concepts. While specific ingredients were found at a rate of 1%, probable ingredients at a rate of 2.4%, and low possibility ingredients at a rate of 18.1%, uncertain statements were found in the label information at a rate of 7.1%. When all categories were examined, 71.2% of all products were not found to contain trans-fat (Figure 1). According to the label information, the use of the expressions 'no trans-fat or trans-fat free' is 25% in all categories. The remaining 75% did not include this information (Figure 2). When all these data were evaluated in general, it is seen that 71.2% of 1411 products do not use industrial oils that can be a source of trans-fat. The low probability content of 18.1% is mostly due to the FHA content. According to the packaging information, more than half of 18.1% FHA usage is palm oil-based FHO usage, which can be considered as an ambiguous figure. This is because many packages only report palm oil content, but do not specify which palm oil derivative is used. It is also noteworthy that ambiguous expressions were used in 7.1% of all these products. Similarly, studies have been carried out in countries such as Portugal (Costa et al., 2016), Slovenia (Kušar et al., 2021), Pakistan (Tara et al., 2020), USA (Albers et al., 2008; Garsetti et al., 2016), Canada (Franco-Arellano et al., 2020), European Union (Mourati-dou et al., 2014), Thailand (Chavasit et al., 2020), Brazil (Ricardo et al., 2019), and Australia (Huang et al., 2020) to determine the trans-fat content of packaged foods available in the market. Many of these sources have investigated trans-fat content by performing analytical analysis with a small number of samples. There are two sources for comparing the data obtained in this study. In the study conducted by Ricardo et al., (2019), specific trans-fat-containing components were found at a rate of 20% in bakery products, 6% in prepared foods, 2% in spreads and sauces, 2% in edible oil, 12% in snacks, and 0.6% in breakfast cereals category. The data obtained were found to be quite higher than the results obtained in this study. Franco-Arellano et al., (2020) scanned industrial trans-fats in their study in 2013-2017 and examined a total of 32875 samples. When each category is examined, it can be said that similar results in trans-fat content of packaged foods are also found in our country.

In general, it is reported that trans-fat content is higher in pastry products, bakery products and ready-made foods compared to other categories. When these studies were examined, it can be said that they were compatible with the data obtained. There are various ways around the world to reset trans fatty acids and meet consumer health expectations. Unsaturated oils containing high levels of both omega-3 and omega-6 polyunsaturated fatty acids and oils with the lowest saturated fat ratio should be preferred as the healthiest oils. In cases where the oil is used only for frying, liquid oils such as canola oil that do not oxidize quickly and contain high oleic acid should be used. For food products where the use of saturated fat is

inevitable, solid fats such as animal fats, fractional oils and fully hydrogenated oils may be more cost-effective. However, it is not recommended to use these oils with high saturated fat content as an alternative to partially hydrogenated oils. For the production of some food products, mixing oils with natural fats with a high saturated fat content is one of the most economical ways to change the proportion of partially hydrogenated oils. For example, mixing 1% or 2% fully hydrogenated oil with oil produces viscous oil that is easy to use. As a result of interesterification processes, in which the fatty acids in the oil molecule are mixed and the fatty acid profile of the oil is rearranged, more solid fat structuring capacity can be formed at lower total saturated fat levels. For example, a baking shortening made by interesterification 25% of palm-stearin with soybean oil will have about 30% saturated fat. Combination blends (a mixture of fractionated oils and interesterified oils) are a very suitable method for formulating the fatty acid profile of products.

## Conclusion

In terms of food security, many countries are taking steps in the global fight against trans-fat and developing policies towards zeroing it. The policies to be developed are the most necessary steps for food safety, and it is imperative to carry out scans related to the current food content in order to develop these policies. Thanks to the policies to be developed, the producer will be directed to healthier alternative substitutes and processing methods and will be supervised. Labeling regulations, on the other hand, will guide the consumer and meet the healthy food expectations they desired healthy food expectations. Labeling information, which directly determines the consumer's choice and perception of food, depends on the contents of packaged food products. While the roadmap created by WHO specifically for trans-fat aims to provide consumers with healthier foods, consumer health also depends on the working performance of those who have the legal authority of the states. The effort and time spent by conscious consumers for food selection can only be facilitated by legal regulations. However, the processing of vegetable oils also needs to be improved to benefit the consumer. Coordinated policies need to be developed on issues such as the selection of oilseeds that can be used to produce healthier substitute oils, improvement of cultivation, harvesting process, production supports, storage, transportation and processing conditions. It is necessary to determine the oil seeds that are currently being produced but with insufficient yield, to carry out Research and Development (R&D) studies to increase their yield, to identify new oilseed varieties that can be used as oil instead, and to adapt to the production conditions. In addition, R&D investment may be needed to develop new oilseed varieties with more attractive health benefits and to improve processing such as refining. In this respect, the success of R&D studies for the vegetable oil industry to reduce the erucic acid content of canola oil from past to present constitute an important example.

When evaluated in general, 25% of packaged food products in Türkiye contain information that can guide the consumer correctly regarding the trans-fat content. It would be expected that the trans-fat content information would be higher especially in bakery products and ready-made foods that contain or may contain trans-fat. The fact that 71.2% of the 1411 packaged food products examined have food ingredients that are not likely to contain trans fats, which is an optimistic rate for consumers. Of course, this ratio needs to be improved in terms of consumer benefit as stated in the PHO substitution alternatives section. In order to improve the consumer's food choice and perception, it would be beneficial to have more information about the trans-fat content of the products, especially in the snacks, chocolate products and bakery products category. Finally, it can be said that packaged foods in Türkiye are in encouraging condition in terms of trans-fat content. However, it should not be forgotten that effective policies should continue to be developed by government institutions in terms of continuity and the supervision mechanism should work effectively in order to lower the current level.

#### Compliance with Ethical Standard

**Conflict of interests:** The author declares that for this article they have no actual, potential, or perceived conflict of interests.

**Ethics committee approval:** The author declares that this study does not include any experiments with human or animal subjects; therefore, no ethics committee approval is needed.

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