



Bioavailability of Trans and Saturated Fatty Acids in Stuffed Cookies and Wafers Produced in Brazil

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Abstract

Several scientific studies highlight that trans fatty acids are harmful to health. The World Health Organization (WHO) considering the presence of trans fat in food recommends its total elimination by the year 2023. The Brazilian Health Surveillance Agency's (ANVISA) Collegiate Board Resolution (RDC) No. 54, from November 2012, establishes that only foods with trans fat levels lower ≤ 0.1 g per portion can claim zero trans on the label. Stuffed cookies and wafers are important representatives of ultra-processed foods containing high levels of sugars and fats, being widely consumed for their low cost and accessibility. The objective of this study was to evaluate the levels of trans and saturated fat by gas chromatography (AOAC Official Method 996.06) in stuffed cookies and wafers, 31 stuffed cookies and 33 wafers were analyzed in the city of São Paulo, evaluating the amount of trans fats, between 0.01 to 1.56 g/serving and 0.01 and 2.56 g / serving in the filled wafers and cookies respectively. Therefore, it was found that some brands of stuffed wafers and wafers still present large amounts of trans fat in their composition causing risks to the consumer's health.

Keywords: Trans fatty acids; Atuffed cookies; Wafers; Legislation

Introduction

The consumption of trans fatty acids is directly related to cardiovascular diseases, obesity and strokes. Studies show that trans fatty acids are more deleterious to health than saturated fatty acids. Saturated fatty acids increase LDL cholesterol levels and trans fatty acids, in addition to increasing LDL cholesterol levels, lower HDL cholesterol levels [1-3]. Souza et al. demonstrated that the substitution of trans fatty acids by saturated fatty acids can decrease by up to 17% the risk for the development of cardiovascular diseases and the 2% increase in the consumption of trans fats in the diet increases the chance of mortality from coronary heart disease by 25 to 30% [4]. In addition, trans fatty acids compete with the essential fatty acids of the omega-3 and omega-6 families in the desaturation and elongation

reactions, causing the formation of eicosanoids without biological activity [3].

Due to several studies in the world that prove the possible harms of trans fat consumption for health, changes in the regulation of trans fat have occurred. In 1995, The World Health Organization (WHO) recommended that trans-fat intake should be a maximum of 1% of the total energy consumed daily (2 grams of trans fat, based on a diet of 2,000 calories per day), seeking health promotion [3].

In 2003, Denmark was the first country to restrict the use of trans fats, in less than a year trans-fat was decreased from food. Studies indicate that deaths from cardiovascular diseases have been significantly reduced [5]. New York City

passed a law prohibiting the use of partially hydrogenated fat in the preparation of dishes in fast-food establishments [6]. According to Brandt et al [7], between 2016 and 2017 the rate of hospitalizations due to infarction or stroke was 6.2% lower after trans fat restrictions in New York City.

In 2018, WHO announced a plan called "REPLACE" to eliminate global trans fatty acids produced by industries. This campaign is to eradicate trans fats by 2023 and, if it does, could save 10 million lives, according to the organization [8].

Thus, the aim of this study was to determine the composition of fatty acids in stuffed cookies and wafers, and to verify whether the brands analyzed comply with the current legislation of The Brazilian Health Surveillance Agency's (ANVISA - RDC No 54) in the determination of trans fatty acid content.

Material and Methods

Sixty-four samples of stuffed cookies and wafers were purchased in the commercial area of São Paulo, these being: supermarkets, real stores and candy stores. The collection period occurred between May and August 2018. They were manually homogenized and stored in a freezer at 20°C (68°F).

The methodology used to determine fatty acids in wafers was 996.06 of AOAC with modifications, adding triglyceride of tritridecanoic acid with internal standard [9]. For the analysis, fat was extracted and derivatized by the validated AOAC method.

Fatty acid composition was performed by GC1020 Shimadzu gas chromatograph with AOC 20i automatic injector and GC Solution software, SP2560 fused silica chromatographic column (bisycianpropyl polysiloxana) of 100 m long, 0.25 mm internal diameter and 0.2 µm film thickness. The column temperature schedule was isotherm at 140°C (284°F) for 5 min., heating at 4°C (39,2°F)/min to 240°C (464°F), remaining at this temperature for 25 min. The vaporizer and detector temperature were respectively 250°C (482°F) and 260°C (500°F), with helium as carrier gas, flow of 1 mL/min. and sample division ratio in 1:100 injector. A microliter of the methyl esters of fatty acids obtained was injected and the retention times compared to the 189 19 Sigma standard. The quantification of total, saturated, monounsaturated, polyunsaturated and trans fats was based on the addition of the internal triglyceride pattern of tridecanoic acid and the theoretical correction factors of the flame ionization detector, described in the CE 1j-07 method of AOCS, were used [10]. The results were expressed in g/100 g of sample and g/portion. The statistical test performed was the Student test for fixed value, in which the significance level of 1% was fixed ($p < 0.01$).

Results And Discussion

Stuffed Cookies

Thirty-one samples of stuffed cookies were obtained. The results were expressed per portion of 30 g and 100 g of food. Saturated, monounsaturated and polyunsaturated fats present in stuffed wafers are described by 100 g and trans fats are described per portion and per 100g in Table 1.

Number	Brand	S (100g)	M (100g)	P (100g)	T (100g)	T (30 g)	S+T (30g)
1	A	5.64 ± 0.21	11.10 ± 0.31	3.15 ± 0.10	0.22 ± 0.02	0.06 ± 0.00 ^a	1.76 ± 0.07
2	A	6.07 ± 0.34	10.20 ± 0.37	2.28 ± 0.08	0.04 ± 0.01	0.01 ± 0.00 ^a	1.83 ± 0.10
3	A	6.18 ± 0.17	12.16 ± 0.27	2.57 ± 0.06	0.03 ± 0.00	0.01 ± 0.00 ^a	1.86 ± 0.05
4	B	10.42 ± 0.36	6.25 ± 0.21	6.38 ± 0.26	0.14 ± 0.00	0.04 ± 0.00 ^a	3.17 ± 0.11
5	B	9.49 ± 0.23	5.54 ± 0.14	6.12 ± 0.17	0.04 ± 0.01	0.01 ± 0.00 ^a	2.86 ± 0.07
6	B	7.91 ± 0.04	4.90 ± 0.05	5.27 ± 0.04	0.07 ± 0.00	0.02 ± 0.00 ^a	2.39 ± 0.01
7	C	5.64 ± 0.07	2.81 ± 0.04	7.02 ± 0.05	0.03 ± 0.00	0.01 ± 0.00 ^a	1.70 ± 0.02
8	C	5.76 ± 0.47	3.08 ± 0.30	7.90 ± 0.35	0.03 ± 0.01	0.01 ± 0.00 ^a	1.74 ± 0.14
9	C	5.54 ± 0.14	2.83 ± 0.02	7.77 ± 0.05	0.03 ± 0.00	0.01 ± 0.00 ^a	1.67 ± 0.04
10	D	9.61 ± 0.21	7.40 ± 0.12	2.60 ± 0.01	0.22 ± 0.01	0.07 ± 0.00 ^a	2.95 ± 0.06
11	D	8.85 ± 0.12	6.91 ± 0.11	2.17 ± 0.05	0.15 ± 0.00	0.04 ± 0.00 ^a	2.70 ± 0.04
12	D	9.08 ± 0.11	6.94 ± 0.09	2.31 ± 0.10	0.15 ± 0.01	0.04 ± 0.00 ^a	2.77 ± 0.03
13	E	10.70 ± 0.92	7.73 ± 0.47	2.52 ± 0.05	0.32 ± 0.03	0.10 ± 0.01 ^a	3.31 ± 0.28
14	E	10.39 ± 0.13	7.69 ± 0.11	2.48 ± 0.04	0.32 ± 0.01	0.10 ± 0.00 ^a	3.21 ± 0.04
15	F	5.96 ± 0.39	3.29 ± 0.07	8.04 ± 0.14	0.09 ± 0.00	0.03 ± 0.00 ^a	1.82 ± 0.12

16	F	6.00 ± 0.25	3.28 ± 0.12	7.66 ± 0.28	0.11 ± 0.01	0.03 ± 0.00 ^a	1.83 ± 0.08
17	F	4.57 ± 0.56	8.08 ± 0.14	3.89 ± 0.00	2.11 ± 0.16	0.63 ± 0.05	2.01 ± 0.12
18	F	5.11 ± 0.24	6.01 ± 0.03	5.05 ± 0.22	3.11 ± 0.06	0.93 ± 0.02	2.47 ± 0.08
19	F	4.95 ± 0.05	6.15 ± 0.03	5.17 ± 0.01	2.78 ± 0.05	0.83 ± 0.01	2.32 ± 0.03
20	F	4.82 ± 0.11	5.66 ± 0.07	5.09 ± 0.05	2.50 ± 0.04	0.75 ± 0.01	2.19 ± 0.05
21	G	1.97 ± 0.20	3.89 ± 0.11	3.31 ± 0.13	2.03 ± 0.04	0.61 ± 0.01	1.73 ± 0.13
22	G	4.98 ± 0.07	6.49 ± 0.08	4.14 ± 0.01	3.63 ± 0.00	1.09 ± 0.00	2.58 ± 0.02
23	H	7.44 ± 0.08	6.11 ± 0.06	8.00 ± 0.05	0.48 ± 0.01	0.14 ± 0.00	2.38 ± 0.03
24	H	6.23 ± 0.35	5.35 ± 1.03	6.74 ± 1.48	0.34 ± 0.01	0.10 ± 0.00	1.31 ± 0.05
25	H	7.12 ± 0.25	6.27 ± 0.12	7.45 ± 0.45	0.45 ± 0.01	0.13 ± 0.00	2.27 ± 0.08
26	H	6.30 ± 0.38	5.94 ± 0.14	7.66 ± 0.12	0.37 ± 0.01	0.11 ± 0.00	2.00 ± 0.11
27	H	6.81 ± 0.15	5.62 ± 0.03	7.04 ± 0.16	0.40 ± 0.02	0.12 ± 0.01	2.16 ± 0.04
28	H	6.39 ± 0.03	5.70 ± 0.09	7.84 ± 0.08	0.42 ± 0.03	0.13 ± 0.01	2.04 ± 0.01
29	F	4.83 ± 0.37	5.31 ± 0.25	4.92 ± 0.18	2.77 ± 0.06	0.83 ± 0.02	2.28 ± 0.12
30	I	4.88 ± 0.22	6.08 ± 0.15	1.05 ± 0.03	5.06 ± 0.10	1.52 ± 0.03	2.98 ± 0.10
31	I	5.27 ± 0.08	6.54 ± 0.13	1.10 ± 0.03	5.21 ± 0.06	1.56 ± 0.02	3.14 ± 0.04

Letters A to I represent the cookies' brands; S: Saturated fat; M: Monounsaturated Fat; P: Polyunsaturated Fat; T: trans-fat; S + T: The sum of saturated and trans fat; *

Results are expressed as mean ± Standard Deviation of triplicate analysis. The letter "a" means that the samples comply with the legislation and the letter "b" the samples are in disagreement with the legislation (p value <0.01).

Table 1: Composition of saturated, unsaturated and trans fats present in stuffed cookies.

According to the results described in Table 01, all samples have high levels of saturated fats. The values found ranged from 1.97 to 10.70 g per 100g of sample.

Gagliardi et al. analyzed the fat contents of several industrialized foods and verified that there was a reduction in trans-fat in some samples [11], but these presented high levels of saturated fat in their composition. These results are similar to those found in the present study, because some brands decreased the levels of trans-fatty acids, however they increased saturated fatty acids.

Some stuffed cookies, besides having high levels of trans fatty acids, also have high values of saturated fatty acids. The brand "G" presented in the chocolate wafer sample the value of 3.63 grams of trans-fats and 4.98 of saturated fat in 100 g. The brand "I" presented 5.21 g of trans-fats and 5.27 g of

saturated fats, totaling 10.48 in the sum of the two types of fat.

The brands "F", "G" and "I" had higher values in all samples in relation to the daily consumption value of trans fats recommended by the WHO (2.0 g for a diet of 2,000 calories), in total there were 9 samples with values higher than 2 g, totaling 60% of the total of the wafers filled with the indication of trans on the labeling analyzed. The values of trans fats between these brands ranged from 2.03 to 5.21 grams.

Wafers

Table 2 shows the results of thirty-three wafers. The results of saturated, monounsaturated and polyunsaturated fats present in wafers are described by 100 g and trans fats are described per portion and per 100g in Table 2.

Number	Brand	S(100g)	M(100g)	P(100g)	T(100g)	T (30g)	S+T (30g)
1	A	7.77 ± 0.47	6.27 ± 0.37	2.95 ± 0.14	0.13 ± 0.01	0.04 ± 0.00 ^a	2.37 ± 0.14
2	A	7.60 ± 0.13	6.54 ± 0.06	2.15 ± 0.01	0.05 ± 0.00	0.01 ± 0.00 ^a	2.29 ± 0.04
3	B	7.95 ± 0.35	5.22 ± 0.20	6.05 ± 0.25	0.05 ± 0.01	0.02 ± 0.00 ^a	2.40 ± 0.10
4	B	7.24 ± 0.32	5.73 ± 0.23	9.57 ± 0.40	0.04 ± 0.01	0.01 ± 0.00 ^a	2.18 ± 0.09

5	B	6.45 ± 0.05	5.08 ± 0.07	8.35 ± 0.07	0.04 ± 0.00	0.01 ± 0.00 ^a	1.95 ± 0.01
6	C	11.85 ± 0.20	9.17 ± 0.14	3.64 ± 0.06	0.09 ± 0.02	0.03 ± 0.00 ^a	3.58 ± 0.06
7	C	10.79 ± 0.19	8.76 ± 0.15	3.71 ± 0.05	0.07 ± 0.00	0.02 ± 0.00 ^a	3.26 ± 0.06
8	C	12.39 ± 0.30	9.76 ± 0.29	3.79 ± 0.06	0.06 ± 0.00	0.02 ± 0.00 ^a	3.74 ± 0.09
9	D	9.10 ± 0.33	5.79 ± 0.28	1.82 ± 0.04	0.35 ± 0.02	0.11 ± 0.01 ^a	2.84 ± 0.10
10	D	9.52 ± 0.42	5.90 ± 0.39	1.81 ± 0.04	0.37 ± 0.02	0.11 ± 0.01 ^a	2.97 ± 0.13
11	E	7.70 ± 0.27	5.30 ± 0.18	8.43 ± 0.36	0.06 ± 0.01	0.02 ± 0.00 ^a	2.33 ± 0.08
12	E	7.63 ± 0.03	4.93 ± 0.10	7.88 ± 0.18	0.07 ± 0.00	0.02 ± 0.00 ^a	2.31 ± 0.01
13	E	9.57 ± 0.30	6.49 ± 0.20	10.01 ± 0.31	0.10 ± 0.01	0.03 ± 0.00 ^a	2.90 ± 0.09
14	F	13.73 ± 0.08	4.10 ± 0.05	10.13 ± 0.20	0.14 ± 0.00	0.04 ± 0.00 ^a	4.16 ± 0.02
15	F	11.17 ± 1.09	3.59 ± 0.31	9.72 ± 0.89	0.12 ± 0.01	0.03 ± 0.00 ^a	3.39 ± 0.33
16	G	9.68 ± 0.48	5.93 ± 0.36	6.91 ± 0.43	0.07 ± 0.02	0.02 ± 0.01 ^a	2.92 ± 0.15
17	G	8.18 ± 0.13	5.05 ± 0.11	5.77 ± 0.10	0.10 ± 0.00	0.03 ± 0.00 ^a	2.48 ± 0.04
18	G	6.82 ± 0.27	5.27 ± 0.28	8.70 ± 0.31	0.05 ± 0.00	0.01 ± 0.00 ^a	2.06 ± 0.08
19	H	7.05 ± 0.13	5.32 ± 0.47	8.82 ± 0.15	0.05 ± 0.00	0.01 ± 0.00 ^a	2.13 ± 0.04
20	H	6.83 ± 0.10	4.84 ± 0.07	8.81 ± 0.11	0.05 ± 0.00	0.01 ± 0.00 ^a	2.07 ± 0.03
21	H	6.99 ± 0.13	5.04 ± 0.07	8.47 ± 0.12	0.05 ± 0.00	0.02 ± 0.00 ^a	2.11 ± 0.04
22	I	5.51 ± 0.07	9.32 ± 0.21	0.24 ± 0.02	1.46 ± 0.03	0.44 ± 0.01	2.09 ± 0.01
23	I	9.79 ± 0.14	8.43 ± 0.12	5.14 ± 0.09	1.91 ± 0.00	0.57 ± 0.00	3.51 ± 0.04
24	J	6.93 ± 0.08	13.67 ± 0.26	5.23 ± 0.07	8.54 ± 0.00	2.56 ± 0.00	4.64 ± 0.02
25	J	4.16 ± 0.36	7.91 ± 0.56	2.66 ± 0.04	1.49 ± 0.11	1.44 ± 0.13	2.69 ± 0.23
26	J	5.29 ± 0.02	10.22 ± 0.23	0.65 ± 0.47	6.80 ± 0.30	1.99 ± 0.05	3.57 ± 0.05
27	K	3.72 ± 0.29	8.95 ± 0.75	1.75 ± 0.10	3.63 ± 0.28	1.09 ± 0.08	2.20 ± 0.17
28	K	4.09 ± 0.16	10.13 ± 0.57	1.92 ± 0.05	3.43 ± 0.11	1.03 ± 0.03	2.26 ± 0.04
29	L	8.58 ± 0.08	6.97 ± 0.24	2.66 ± 0.04	1.49 ± 0.11	0.45 ± 0.03	3.02 ± 0.03
30	L	7.77 ± 0.03	6.79 ± 0.10	2.95 ± 0.04	0.24 ± 0.01	0.07 ± 0.00	2.40 ± 0.01
31	L	8.18 ± 0.35	5.75 ± 0.16	2.88 ± 0.07	0.71 ± 0.03	0.21 ± 0.01	2.66 ± 0.11
32	L	7.38 ± 0.18	6.15 ± 0.18	4.00 ± 0.02	1.61 ± 0.06	0.48 ± 0.02	2.10 ± 0.04
33	L	7.76 ± 0.35	6.12 ± 0.33	4.23 ± 0.21	0.19 ± 0.03	0.06 ± 0.01	2.38 ± 0.11

Letters A to L represent the cookies' brands; S: Saturated fat; M: Monounsaturated Fat; P: Polyunsaturated Fat; T: transfat; S + T: The sum of saturated and trans fat; * Results are expressed as mean ± Standard Deviation of triplicate analysis. The letter "a" means that the samples comply with the legislation and the letter "b" the samples are in disagreement with the legislation (p value < 0.01).

Table 2: Composition of saturated, unsaturated and trans-fats present in wafers.

Table 2 can verify that, in wafer samples, they all contained large amounts of saturated fat. The values found of saturated fat in wafer samples ranged from 3.72 to 13.73 g per 100 g.

All samples (except samples 09 and 10) are in accordance with RDC 54 in terms of values equal to or less than 0.1 grams of trans-fatty acids per portion to perform zero trans claim on the labels. Through statistical calculations, it was found that all samples are in accordance with the legislation

in force in the trans-fat item ≤ 0.1 g per portion (p value < 0.01). It can be observed that, although these foods do not have high values of trans-fatty acids, they are unhealthy foods, because they have high values of saturated fat in their composition.

The brand “J” (24) presented a value of 2.56 grams of trans fatty acids in only 30 g of food and in 100 grams presented a content of 8.54 g of trans fat. These results are in agreement with Pinto et al. who found high levels of trans-fats in wafers [12], the study presented in a wafer sample the value of 1.90 grams of trans-fatty acids per portion.

Hissanaga-Himmelstein, et al. analyzed 9 types of cookies and 3 types of breads [13]. From the results obtained, it was confirmed that wafers were the ones with the highest amounts of trans-fats in 100g of sample, with an average of 10.76 [14,15].

In Table 2, the brand “K” obtained in the two samples high values of trans-fatty acids, 3.63 g/100g and 3.43 g/100g. Several wafer brands demonstrated in this table reached values close to the maximum value per day recommended by WHO (2 g of trans fats on top of a diet of 2,000 calories) or higher than this value, in 100 g of sample.

Conclusions

The stuffed cookies and wafers presented high levels of total fats and saturated fat. Of the sixty-four cookie samples analyzed, nine stuffed cookies and four wafers had more than 2 g of trans-fatty acids in 100 g of cookies, which exceeded the recommended maximum of trans fat intake by the WHO for a diet of 2,000 calories.

Thirty-seven samples of stuffed wafers and wafers analyzed with the claim of “zero trans” on the labeling were possible to identify that all are in conformity with RDC 54. However, they contained a high amount of saturated fat, showing that despite the zero trans-claim on the labels, these foods are not healthy.

In view of the results obtained, it is of fundamental importance to change the legislation, aiming at the prohibition of trans-fat in industrialized foods according to the World Health Organization (WHO).

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References

- American Heart Association (2017) Trans fat.
- FDA (Food and drug administration) (2017) FDA Cuts Trans Fat in Processed Foods.
- Gazzola, Jussara, Depin, Muriel Hamilton (2015) Association between trans fatty consumption and the development of cardiovascular diseases. Journal. Eletr. of Extension 12(20): 90-102.
- Souza RJ, Mente A, Maroleanu A, Cozma AI, Ha V, et al. (2015) Intake of saturated and *trans* unsaturated fatty acids and risk of all cause mortality, cardiovascular disease and type 2 diabetes: systematic review and meta-analysis of observational studies. British Medical Journal 351: h3978.
- Doell, D Folmer, H Lee, M Honigfort, S Carberry (2012) Updated estimate of *trans* fat intake by the US population. Food Addit Contam Part A Chem Anal Control Expo Risk Assess 29(6): 861-864.
- Angel Sy, Cobb LK, Curtis CJ, Konty KJ, Silver LD (2013) Change in trans fatty acid content of fast-food purchases associated with New York City’s restaurant regulation: a pre-post study. Ann Intern Med. New York 157(2): 81-86.
- Brandt, Erike J, Mayerson, Rebecca, Perrailon (2017) Hospital Admissions for Myocardial Infarction and Stroke Before and After the Trans-Fatty Acid Restrictions in New York. Jama cardiol, USA 2(6): 627-634.
- World Health Organization (2002).
- American Oil Chemists’ Society (2004).
- Gagliardi, Moron AC, Jorge MF, SANTOS, Raul D (2009) Nutritional profile of foods with zero trans fat claims. Journal. Assoc. Med. Bras 55(1): 50-53.
- Pinto, Daiber AL, Miranda, Santos TL, Ferraz, et al. (2016) Determination and verification of how trans fatty is reported on foods labels, especially those expressed as “0% trans-fat”. Braz. J. Food Technol 19.
- Himestein H, Martins V, Oliveira, Santaella M, Vivaz, et al. (2014) Comparison between experimentally determined total, saturated and *trans* fat levels and levels reported on the labels of cookies and bread sold in Brazil. Journal of Food and Nutrition Research 2(12): 906-913.
- Bottan, Tatiane. Evaluation of the content of trans fatty acids in foods sold in the city of São Paulo. Dissertation (Dissertation presented for the postgraduate program in Nutrition in Public Health to obtain a Master of Science degree) University of São Paulo, Brazil, 2009.
- Brazil. Ministry of Health (2012).

