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RESEARCH ARTICLE

Saturated and *trans* fatty acids content in unpackaged traditional bakery products in Santa Fe city, Argentina: nutrition labeling relevance

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ABSTRACT

Studies have reported the relationship between the excessive intake of saturated fatty acids (SFA) and *trans* fatty acids (*t*-FA) and an increased risk of cardiovascular disease. Since 2006, the MERCOSUR countries require that the mandatory nutrition labeling should include information not only about the content of SFA but also about the content of *t*-FA. This does not apply to fractionated products at the point of retail, such as bakery products. This paper aimed to determine the total fat content and the fatty acid profile in unpackaged traditional bakery products (breads, biscuits and pastries) in Santa Fe, Argentina. Except for French bread, the contribution of *t*-FA and SFA to the total FA consumption from baked products was high. On the other hand, due to the high variability detected in the FA composition of bakery products between bakeries, it would be necessary to implement regulations making nutrition labeling mandatory in these products.

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Introduction

In recent decades, people have undergone major changes in their eating habits showing increasing consumption patterns of energy-dense foods, high in fat, mainly saturated fatty acids (SFAs) and *trans* fatty acids (*t*-FAs) (WHO 2003). Several studies have reported the relationship between the excessive intake of these fatty acids (FAs) and an increased risk of cardiovascular disease (CVD) (Mozaffarian et al. 2006; FAO 2010), which is the cause of 30% of reported deaths in the world and particularly in Argentina (ENFR 2013).

Industrial *t*-FAs adversely modify the lipid profile, making it more atherogenic than SFAs (FAO 2010). It has also been shown that they increase triacylglycerides, cholesterol, LDL-cholesterol and Lp-a content and decrease HDL-cholesterol levels in plasma (Lichtenstein et al. 2003; Ascherio 2006; Mozaffarian & Willett 2007).

Because of the many adverse effects of SFAs and *t*-FAs, international and national agencies and societies have issued several recommendations concerning their intake. Thus, the WHO and Food and Agriculture Organization (FAO) recommend that SFAs should not exceed 10% of total energy intake (WHO 2003; FAO 2010), while in 2006, the American Heart Association (AHA) suggested the consumption of less than 7% of the total energy intake (Lichtenstein et al. 2006). Furthermore, these organizations indicate that *t*-FAs should not exceed 1% of total energy intake (FAO 2010). Consequently, a diet of 2000 kcal should not include more than 15.6–22.2 g/day of SFAs, and more than 2.2 g/day of *t*-FAs. Since 2006, the MERCOSUR countries (Argentina, Bolivia, Brazil, Paraguay, Uruguay and Venezuela) require that nutrition labeling should be mandatory and include information not only about the content of SFAs but also about the content of *t*-FAs. The Mercosur Food Code, as well as the Argentine Food Code (CAA) do not establish a limit for SFA content. However, since 2010, the CAA established that the content of industrial *t*-FAs in foods should not be greater than 5% of total fat (TF), considering all the *t*-FAs (CAA-Article 155 tris 2010). In Argentina, in studies conducted prior to the implementation of this legislation, it was estimated that the consumption of *t*-FAs was 3% (7.2 g/day) of the total energy intake (OPS 2008), and more recently 1.5–1.6% of the total energy intake (Negro et al. 2010; Rothlisberger et al. 2011).

Even though certain adverse effects of SFAs and *t*-FAs on health are well known and different health societies set limits on the use of these fats, the consumer can only receive information on the SFAs and *t*-FAs content of packaged foods from nutrition labeling. This regulation does not apply to all food that is

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divided and conditioned for distribution, marketing and delivery to the consumer, defined by CAA (2010) in chapter V as "fractionated products" at the point of retail. For example, bakery products that have high SFAs and *t*-FAs content (Karabulut 2007).

In Argentina, about three million tons of bakery products are produced annually (94% corresponds to the traditional bakery products and 6% of industrial goods). The traditional bakery products are characterized by their wide distribution throughout the country (Lezcano 2011).

For the high consumption of traditional bakery products in Argentina and taking into account that there are not enough data available on the content and composition of FAs in them, this paper aims to determine the TF content and the FA profile, including *t*-FAs, in unpackaged traditional bakery products that are sold in bakery establishments in the city of Santa Fe, one of the 10 more important cities in Argentina in term of population.

Materials and methods

Samples and sample preparation

All samples, typical of Argentina, were purchased from six different large scale bakery stores in Santa Fe city, denoted as 1, 2, 3, 4, 5 and 6. These bakeries were selected through a simple random sampling among the ten main bakeries. The samples were divided into three different groups. Group I (breads): French bread (FB), whole wheat bread (WWB) and oil bread (OB). Group II (salty biscuits): biscuit (B) and creole biscuit (CB), defined as a thick biscuit. Group III (pastries): *vigilante* (V), defined as a long and narrow pastry topped with custard; *hojaldre* (H), a puff pastry topped with caramel; *croissant* (C); and *tortita negra* (TN), a crust pastry topped with brown sugar.

For the sample collection, the selected bakeries were visited twice in different weeks. Five units of each sample were randomly selected from each bakery every time. Each sample was immediately homogenized and frozen at −20 °C until analysis. Subsequently, the two homogenate corresponding to each type of sample of the same bakery were mixed and processed by duplicate.

Total fat and fatty acid analysis

Total fat (TF) was determined gravimetrically by extraction with petroleum ether at 65–80 °C (Official Methods 960.39) (AOAC 1999). It is important to consider that unsaturated fatty acids are isomerized by high temperature. For this reason to analyze FA profile, the whole procedure should be made at lower temperature. Thus, lipids were extracted with a mixture of hexane:isopropanol (3:2) and sodium sulfate 6% at room temperature (Wolff 1995). The extracted lipid residue was dried at 40 °C under a stream of nitrogen. For the preparation of fatty acid methyl esters (FAME), a cold method with hexane and 2N KOH in methanol (Bannon et al. 1982) was used. FAME were quantified using a gas chromatograph (Shimatzu GC-2014, Shimadzu Corporation, Kyoto, Japan) fitted with a capillary column CP-Sil 88, 100 m × 0.25 mm id (Varian, Lake Forrest, CA) and flame ionization detector. According to the technique developed by Masson et al. (2015), the injector and detector temperatures were maintained at 250 °C, split ratio 1:100, 1 µL of standard or sample were injected using an autosampler device in each GLC run. The flux of hydrogen was 1 mL/min and the nitrogen flux as make up gas was 25 mL/min. Peak retention times and area percentages of total FAs were identified by injecting known standards. Internal standard (IS) Tritridecanoine [13:0-triacylglycerol (TAG)], external standards GLC-463 Reference Standard containing 52 FAME mixture (purity >99%) and *trans*-mix GLC 481 (purity >99%) were purchased from Nu-Chek (Nu-Chek Prep, Inc., Elysian, MN). Linoleic acid methyl esters, *cis/trans* mix (Catalog n° 47791); FAME mix: C4-C24 unsaturated (Catalog N° 18919) and individual FAMEs from 4:0 to 24:1 chain length saturated and unsaturated were obtained from Supelco (Bellefonte, PA). Mixtures of positional and geometrical FA isomers were provided by the International CYTED Net (208RT0343). The FAMEs were identified by comparing their retention times to those of commercial standards. The values were expressed as a percentage of the total FAME. The lower quantification limit for FAMEs identified ranged from 0.01% to 0.03%. To convert g FAME/100 g FAME to triacylglyceride (TAG) equivalents % (g FA as TAG/100 g TAG) the respective Conversion Factors tabulated in the AOCS Method Ce 1j-07 (2007) were employed (Masson et al. 2015). To estimate the g FA/100 g sample, the g FA/100 g, TAG was multiplied by TF content (%).

Statistical analysis

The statistical analysis was performed using SPSS, version 17.0 (SPSS Inc., Chicago, IL). Data were statistically analyzed by 1 × 3 analysis of variance (ANOVA) (breads) and 1 × 4 ANOVA (pastries). The *post hoc* multiple comparisons were made using Scheffe's critical range test. To compare FA content in biscuits, significant differences between means were established with an unpaired Student t test. Differences were considered statistically significant at $p < .05$.

Results and discussion

Total fat

Table 1 shows that the content of TF in Group I was lower than in Groups II and III, except for TN. Very low values of TF were observed in FB, with a statistically significant difference ($p = .00$) compared with the other breads under study (WWB and OB).

The TF average found in this study for FB was similar to the ones reported in tables of Argentina (ARGENFOODS 2010), Perú (CNAN 2009) and Uruguay (INDA 2002) (0.2 g%) and lower than those reported in tables of Mexico (Villalpando et al. 2007) and Costa Rica (0.7 g %) (INCIENSA 2006). In WWB, the average content of TF was higher than that reported in the tables of Uruguay (INDA 2002) and Argentina (ARGENFOODS 2010) (1.6 g%), in tables of Costa Rica (INCIENSA 2006) (3.8 g%) and was also higher than values found by Fernández et al. (2010) in a study of handmade breads from Chaco, Argentina (0.86 g%). For the OB bread, no data have been found in tables of food composition or scientific reports.

When the content of TF in Group II was evaluated, very high values were observed. The difference between B and CB was not significant. The TF values found were higher than those reported in tables from Costa Rica (INCIENSA 2006) and Argentina (Fernández et al. 2010) (12.9 g% and 14.5 g%, respectively). However, they were similar to those that had been reported in Argentina, namely Table SARA (Sistema Nacional de Análisis y Registro de Alimentos) (SARA 2008).

Excepting TN ($p = .00$), the TF content in Group III was high (9.93–30.31%). Analogous results were found in similar European products. For example, Santos et al. (2015) in puff (29.5%); Ansorena et al. (2013) in mini ensaimadas (23.4–27%) and mini croissants (22.5–30.5%), respectively and Kuhnt et al. (2011) in puff pastries (26%). The TF content in H was the highest of this group, although lower than that reported by tables from Costa Rica (35.7 g%) (INCIENSA 2006). On the other hand, the mean value of TF found in this study for C was lower than the one reported by Uruguayan tables (30 g%) (INDA 2002).

Fatty acid composition: saturated and trans fatty acids

The mean of SFAs content in bakery products was between 24.81% and 51.90% (Table 1), less to that found by Karabulut (2007) (33.36–70.14%). In breads, the content of SFAs was between 16.80–50.04%, in biscuits between 32.46–55.02% and in other specialties between 27.81–57.57%; the lowest value (16.80%) was found in FB and the highest (57.57%) in H. In all cases, the prevalent SFAs were palmitic and stearic acid, ranging from 9.92% in OB to 25.1% in TN and from 1.82% in FB to 24.63% in B, respectively.

On the other hand, *t*-FAs were detected in all analyzed samples except for one FB. A representative chromatogram of a sample with high *t*-FAs content is presented (Figure 1).

A clear separation of 9*t* C18:1, 10*t* C18:1 and 11*t* C18:1 isomers was achieved. However, the peaks of 6*t* C18:1, 7*t* C18:1 and 8*t* C18:1 were overlapped. Similar resolutions were obtained previously by our research group (Masson et al. 2015).

The mean of total *t*-FAs content in the three groups varied from 1.25% in FB to 17.24% in C (Table 1). These values were similar to those found by Karabulut (2007) (0.99–17.77%). Twenty-four samples contained more than 5% *t*-FAs of the TF, and 15 samples more than 20%. The highest amount in a single product was determined in one sample of H (25.94%). Moreover, the mean of total *t*-FAs content in Group II and Group III exceeds the limit of 5% *t*-FAs allowed by the CAA. Furthermore, although the level of vaccenic acid was always greater than the elaidic acid level, other high values of *t*-FAs, like C18:1 10*t* were observed, which characterize some of the partially hydrogenated vegetable oils marketed in Argentina.

When the *t*-FAs content in each group was analyzed, it could be seen that in Group I FB was the one with the lowest percentage of total *t*-FAs compared with other breads. Nevertheless, the total *t*-FAs average found in FB was higher than in the tables from Mexico (0.60%) (Villalpando et al. 2007). In the present study, the total *t*-FAs values of WWB were higher than those observed in the same type of sample by Fernández et al (0.94%) (Fernández et al. 2010), who additionally informed a very high content of elaidic acid (0.55%).

In Group II, the *t*-FAs content in CB was significantly higher ($p = 0.00$) than in B. The percentages of total *t*-FAs in both kinds of biscuits were higher than those reported by Fernández et al. (2.5%) (Fernández et al. 2010).

For Group III, comparing with the present study, Vicario et al. (2003) reported lower percentages of *t*-FAs (5.94%), while Van Erp-Baart et al. (1998) published a similar range of values (3.03–14.6%). In *croissants*, Doménech-Asensi (2016) found lower values of *t*-FAs (1.1 ± 0.3%), and Ansorena et al. (2013) no *trans* fat reported. In other similar products, Santos et al.

Table 1. Fatty acid composition (mean and range) in unpackaged traditional bakery products.

	Group I (breads)			Group II (salty biscuits)		Group III (pastries)			
	French bread ($n=6$)	Whole wheat bread ($n=6$)	Oil bread ($n=6$)	Biscuit ($n=6$)	Creole biscuit ($n=6$) 24.64	*Croissant* ($n=6$)	*Vigilante* ($n=6$) 16.03	*Hojaldrada* ($n=6$) 24.17	*Torta Negra* ($n=6$)
Fat content (g/100 g food)	0.31 (0.01–1.14)[a]	4.22 (3.15–5.12)[b]	3.97 (6.62–2.15)[b]	24.11 (21.10–25.95)	(20.05–27.48)	18.16 (11.97–25.12)[a]	(9.93–22.67)[a]	(17.38–30.31)[a]	6.42 (3.2–11.17)[b]
Fatty acid (g/100 g FAME)	Mean (Range)	Mean (Range)	Mean (Range)	Mean (Range)	Mean (Range)	Mean (Range)	Mean (Range)	Mean (Range)	Mean (Range)
C 14:0	0.51 (0.00–2.26)	1.44 (0.19–2.66)	1.42 (0.37–2.41)	2.68 (2.50–2.87)	1.32 (0.46–2.61)	1.12 (0.22–2.40)	1.19 (0.5–2.38)	1.60 (0.23–3.01)	2.36 (0.77–5.70)
C 15:0	0.11 (0.00–0.46)	0.27 (0.10–0.49)	0.24 (0.00–0.40)	0.47 (0.42–0.51)	0.24 (0.08–0.53)	0.22 (0.00–0.65)	0.24 (0.00–0.65)	0.30 (0.00–0.6)	0.35 (0.11–0.68)
C 16:0	17.58 (13.64–23.70)	19.46 (11.23–23.84)	17.2 (9.92–23.16)	23.63 (22.54–24.40)	17.90 (14.07–24.70)	16.91 (12.53–24.02)	17.47 (13.2–23.99)	19.32 (13.71–24.72)	20.39 (14.67–25.1)
C 17:0	0.27 (0.00–1.15)	0.69 (0.32–1.16)	0.67 (0.15–1.11)	1.22 (1.10–1.32)	0.32 (0.00–1.32)	0.04 (0.00–0.16)	0.63 (0.16–1.43)	0.8 (0.14–1.48)	0.72 (0.22–1.23)
C 18:0	6.12 (1.82–20.44)	13.96 (3.27–21.94)	13.87 (6.70–21.31)	22.29 (18.84–24.63)	18.80 (16.25–23.93)	17.75 (13.16–23.28)	18.92 (15.13–23.94)	20.46 (15.71–24.44)	17.26 (14.23–22.26)
C 19:0	–	0.02 ± (0.00–0.12)	0.04 (0.00–0.15)	0.15 (0.10–0.23)	0.05 (0.00–0.17)	0.44 (0.00–0.77)	0.38 (0.00–0.69)	0.28 (0.00–0.72)	0.05 (0.00–0.17)
C 20:0	–	–	–	0.19 (0.16–0.21)	0.29 (0.19–0.38)	0.34 (0.25–0.44)	0.30 (0.19–0.35)	0.28 (0.19–0.38)	0.24 (0.17–0.33)
C 22:0	0.16 (0.00–0.31)	–	0.28 (0.00–0.57)	–	0.23 (0.00–0.35)	–	–	0.19 (0.00–0.35)	0.2 (0.10–0.32)
Others SFA	0.05 (0.00–0.14)	0.51 (0.00–1.10)	0.58 (0.04–1.05)	1.28 (1.15–1.50)	0.50 (0.00–1.41)	0.75 (0.00–2.55)	0.66 (0.00–.05)	1.03 (0.00–3.28)	1.71 (0.00–5.64)
Total saturated	24.81 (16.80–48.16)	36.34 (20.73–50.04)	34.31 (17.88–49.01)	51.90 (46.87–55.02)	39.67 (32.46–53.41)	37.58 (27.81–52.96)	39.77 (30.33–54.61)	44.28 (31.36–57.57)	43.33 (31.90–53.90)
C 14:1 9*c*	–	0.11 (0.00–0.38)	0.15 (0.00–0.30)	0.31 (0.27–0.38)	0.12 (0.00–0.33)	0.11 (0.00–0.29)	0.09 (0.00–0.28)	0.17 (0.00–0.38)	0.18 (0.00–0.53)
C 16:1 9*c*	0.40 (0.00–1.53)	0.91 (0.25–1.87)	0.91 (0.25–1.63)	1.72 (1.46–1.91)	0.85 (0.28–1.86)	0.23 (0.00–0.67)	0.22 (0.00–0.66)	0.70 (0.00–2.03)	1.14 (0.29–1.59)
C 18:1 6*c*	0.05 (0.00–0.31)	–	–	–	2.27 (0.00–7.07)	2.63 (0.00–8.00)	4.79 (0.00–8.75)	2.73 (0.00–6.25)	1.15 (0.00–6.91)
C 18:1 9*c*	19.54 (14.48–30.40)	25.54 (15.98–33.00)	29.14 (24.48–33.72)	32.41 (30.99–34.28)	25.22 (17.84–31.64)	24.48 (16.30–31.15)	21.72 (17.25–30.23)	23.61 (15.56–32.80)	28.04 (17.84–33.68)
C 18:1 10*c*	–	–	–	–	–	–	–	–	–
C 18:1 11*c*	0.97 (0.50–1.35)	1.19 (1.03–1.40)	1.28 (1.02–1.56)	1.57 (1.35–1.96)	2.18 (0.13–3.01)	2.20 (0.12–3.06)	2.04 (1.44–2.69)	1.76 (0.00–3.30)	1.87 (1.23–2.75)
C 20:1 11*c*	0.51 (0.27–0.74)	0.21 (0.00–0.36)	0.22 (0.17–0.31)	0.17 (0.13–0.21)	0.12 (0.09–0.16)	0.12 (0.05–0.30)	0.06 (0.00–0.15)	0.11 (0.08–0.14)	–
Others MUFA *cis*	0.05 (0.00–0.34)	0.29 (0.00–0.71)	0.56 (0.00–1.39)	1.07 (0.85–1.34)	4.79 (1.64–8.17)	5.54 (1.96–8.85)	3.14 (0.57–6.10)	4.34 (0.88–7.46)	2.62 (0.97–4.44)
Others MUFA	–	–	0.08 (0.00–0.45)	0.07 (0.00–0.23)	0.08 (0.00–0.18)	0.34 (0.19–0.51)	0.40 (0.00–1.85)	0.89 (0.00–2.05)	0.07 (0.00–0.20)
Total Monounsaturated c	22.78 (16.84–37.90)	30.64 (17.76–40.66)	35.23 (27.87–39.69)	41.97 (40.27–44.39)	51.96 (39.63–58.8)	52.64 (38.75–62.90)	49.99 (36.95–56.92)	48.71 (36.76–59.36)	45.09 (37.39–54.95)
C 16:1 9*t*	0.22 (0.00–1.08)	–	0.22 (0.00–0.38)	0.51 (0.27–0.85)	0.19 (0.00–0.61)	0.21 (0.00–0.68)	0.24 (0.00–1.00)	0.32 (0.00–0.76)	–
C 18:1 5*t*	–	0.02 (0.00–0.12)	–	–	–	–	–	0.06 (0.00–0.13)	–
C 18:1 6-8*t*	0.10 (0.00–0.26)	0.19 (0.09–0.29)	0.26 (0.10–0.58)	0.32 (0.20–0.51)	3.00 (0.20–4.71)	2.68 (0.00–5.82)	2.72 (0.24–5.02)	2.40 (0.19–4.91)	1.69 (0.23–3.83)
C 18:1 9*t*	0.13 (0.00–0.36)	0.22 (0.09–0.34)	0.31 (0.12–0.79)	0.35 (0.25–0.62)	3.46 (0.25–6.01)	3.97 (0.45–6.80)	3.44 (0.25–5.66)	2.92 (0.26–5.77)	1.86 (0.23–4.85)
C 18:1 10*t*	0.26 (0.00–0.24)	0.59 (0.09–0.95)	0.77 (0.33–1.44)	1.21 (0.81–1.67)	4.72 (0.65–6.95)	3.42 (0.00–7.89)	4.52 (0.54–6.79)	3.95 (0.42–7.44)	2.94 (0.70–617)
C 18:1 11*t*	0.49 (0.00–2.26)	1.21 (0.00–2.60)	1.33 (0.56–2.09)	2.16 (1.88–2.47)	4.79 (1.87–6.51)	4.97 (1.81–6.48)	4.72 (1.82–6.24)	4.49 (1.81–6.79)	3.44 (1.66–5.63)
C 18:2 9t 12*t*	–	–	0.09 (0.00–0.38)	0.02 (0.00–0.10)	0.34 (0.00–0.67)	0.01 (0.00–0.04)	–	0.01 (0.00–0.07)	0.19 (0.00–0.51)
C 18:2 9c 12*t*	–	0.02 (0.00–0.13)	0.07 (0.00–0.27)	–	0.12 (0.00–0.37)	–	–	0.02 (0.00–0.10)	0.08 (0.00–0.16)
C 18:2 9t 12*c*	–	–	–	0.13 (0.09–0.19)	0.04 (0.00–0.17)	0.23 (0.00–0.45)	–	0.02 (0.00–0.05)	–
C 18:2 *c*9 *t*11 CLA	–	0.13 (0.00–0.33)	0.14 (0.00–0.20)	0.31 (0.24–0.42)	0.20 (0.00–0.38)	0.01 (0.00–0.06)	–	0.13 (0.05–0.24)	0.24 (0.06–0.55)
C 18:2 *c*11 *t*13	–	–	–	–	–	0.01 (0.00 - 0.08)	–		–
C 18:2 *t*11 *c*12 CLA	–	–	–	–	–	0.01 (0.00–0.07)	–	0.02 (0.00–0.07)	–
Total *t*-FA	1.25 (0.00–4.35)	2.54 (0.40–4.30)	3.19 (1.86–5.45)	5.11 (4.46–5.79)[a]	16.86 (4.33–24.20)[b]	17.24 (4.17–25.01)	15.88 (3.99–22.84)	14.72 (4.26–25.94)	10.56 (7.64–21.12)
C 18:2 9*c* 12*c*	48.84 (12.74–59.62)	31.18 (8.42–60.08)	28.96 (9.60–53.23)	4.95 (3.66–7.62)	6.73 (4.37–9.11)	8.42 (3.35–15.32)	8.33 (3.91–13.23)	5.63 (2.61–9.27)	9.94 (7.05–13.41)
C 18:3 *n*-6	0.12 (0.00–0.18)	0.15 (0.00–0.21)	0.20 (0.17–0.23)	–	–	–	–	–	–
C 18:3 *n*-3	2.43 (1.01–3.21)	0.98 (0.35–1.70)	0.84 (0.39–1.40)	0.56 (0.46–0.71)	0.73 (0.44–0.94)	0.11 (0.08–0.16)	0.59 (0.11–0.96)	0.59 (0.10–0.88)	0.17 (0.13–0.23)
Others PUFA	0.41 (0.00–1.14)	0.39 (0.00–1.42)	0.09 (0.00–0.28)	0.14 (0.00–0.36)	–	0.77 (0.31–1.50)	0.81 (0.48–1.09)	0.48 (0.09–1.52)	0.11 (0.00–0.51)
Total polyunsaturated c	51.81 (13.93–63.39)	32.85 (9.5461.52)	30.37 (10.82–54.25)	6.11 (4.71–8.92)	8.17 (5.29–11.47)	9.58 (4.41–17.55)	9.73 (4.74–14.32)	7.01 (3.26–11.94)	10.75 (7.83–14.85)

c: cis; CLA: conjugated linoleic acid; MUFA: monounsaturated fatty acid; PUFA: polyunsaturated fatty acid; SFA: saturated fatty acid; *t*-FA: *trans* fatty acid; *t*: *trans*.

[a,b]Values with different superscript letters were significantly different between subgroups of one Group ($p \leq 0.05$).

Others SFA, others MUFA*cis*, others MUFA, others PUFA: All FAs were identified. By the interest of our research and the scope of the present publication, when "others" is mentioned, it refers to quantitatively unimportant FAs.

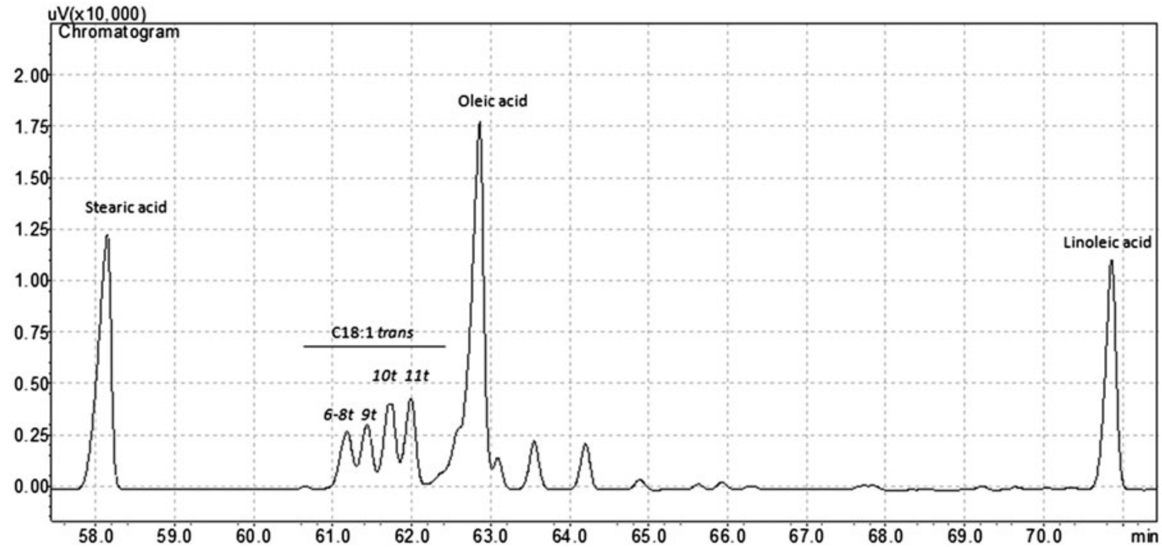

Figure 1. Chromatogram of a high *t*-FA sample.

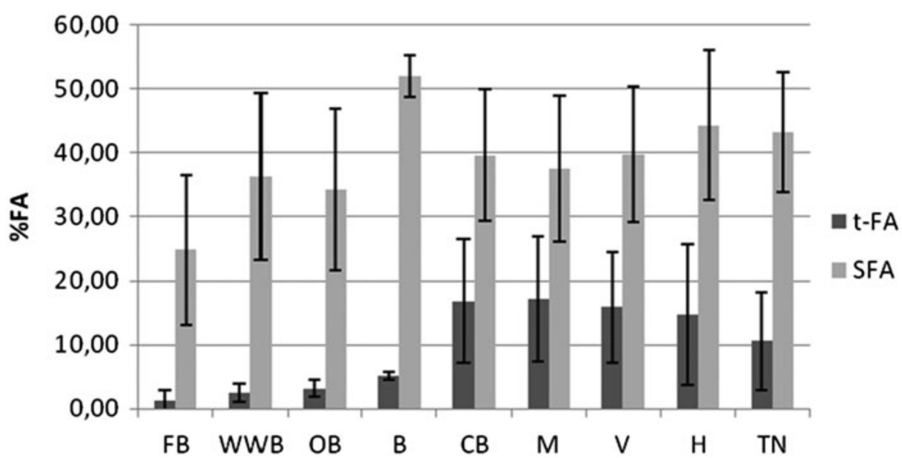

Figure 2. Saturated and *trans* fatty acids content in unpackaged traditional bakery products (means %FA ± SD).

(2015), Costa et al. (2016) and Kuhnt et al. (2011) found lower values in a range of 0.46–2.69%.

It could be seen that about 50% of TF in Group II and Group III was composed of SFAs and t-FAs (Figure 2). Taking into account that these two groups of samples also have a high-fat content, it is likely that the consumer may exceed the WHO and AHA recommendations on the SFA and trans intake. Accordingly, it seems reasonable that the consumer should be provided with appropriate knowledge about the food to be eaten through nutrition labeling.

High *t*-FA values in Group II and Group III suggest that some fats used in the preparation of these products do not comply with CAA legislation.

Variability among bakeries and products

Nine products from six different bakery stores denoted as 1, 2, 3, 4, 5 and 6 were analyzed. For the same product, a huge difference was found in the content of *t*-FAs between bakery stores (Figure 3). Looking for the different *t*-FAs content, it becomes clear that the source of fat varied greatly between bakeries. In this regards, ruminant fats and diverse partially hydrogenated vegetable oils were used.

On the other hand, when the content of TF, SFAs and *t*-FAs was compared between products within a bakery, it could be seen that there were significant differences between FB and other breads. A significant difference was also observed between Group I versus Group II and Group I versus Group III.

SFAs and t-FAs content in bakery products

Total *t*-FAs content per 100 g of sample is given in Table 2. The *t*-FAs average values ranged from 0.01% in FB to 4.23% in CB. In Group I, the *t*-FAs content in FB and WWB was lower than the results presented in

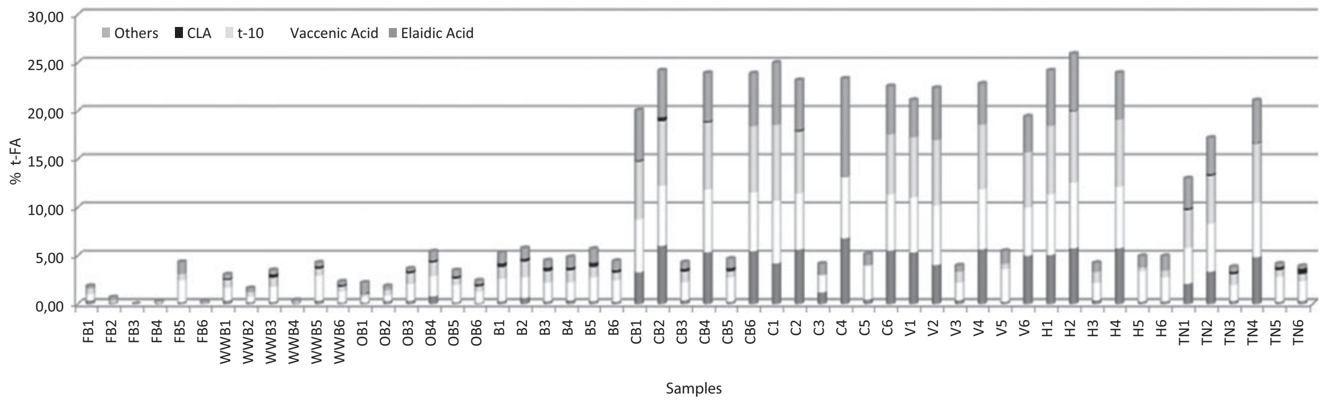

Figure 3. Individual results for t-FA per breads, biscuits and pastries analyzed (% t-FA).

Table 2. Saturated and *trans* fatty acid content (mean ± standard deviation) in unpackaged traditional bakery products.

	g SFA		g *t*-FA	
Samples	100 g sample	Serving[a]	100 g sample	Serving[a]
GROUP I				
French bread	0.12 ± 0.21	0.06 ± 0.11	0.01 ± 0.02	0.01 ± 0.01
Whole wheat bread	1.53 ± 0.61	0.77 ± 0.31	0.11 ± 0.06	0.06 ± 0.03
Oil bread	1.43 ± 0.82	0.72 ± 0.41	0.13 ± 0.07	0.15 ± 0.04
GROUP II				
Biscuit	12.51 ± 1.14	3.75 ± 0.34	1.23 ± 0.16	0.37 ± 0.05
Creole biscuit	9.69 ± 2.46	2.91 ± 0.74	4.23 ± 2.57	1.27 ± 0.77
GROUP III				
Croissant	6.91 ± 3.18	2.76 ± 1.27	3.06 ± 1.98	1.22 ± 0.79
Vigilante	6.32 ± 2.48	2.53 ± 0.99	2.59 ± 1.71	1.04 ± 0.68
Hojaldrada	10.63 ± 3.06	4.25 ± 1.22	3.61 ± 2.92	1.44 ± 1.17
Torta negra	2.84 ± 1.48	1.14 ± 0.59	0.60 ± 0.39	0.24 ± 0.16

[a]According to Código Alimentario Argentino.
SFA: saturated fatty acid; *t*-FA: *trans* fatty acid.

the Costa Rica table (0.02% and 0.15%, respectively), while it was higher in B of Group II and H of Group III (0.94% and 2.62%, respectively) (INCIENSA 2006).

Table 2 shows the content of SFAs and *t*-FAs per serving. The SFAs contribution in Group II and Group III was higher than in Group I, especially in FB. Furthermore, it could be seen that in Group II and Group III the *t*-FAs content was higher than the 0.2 g/serving recommended by the CAA. Therefore, if these products had nutrition labeling, their *t*-FAs levels should be declared. Moreover, with 2 portions of CB, C, V, H, the limits of *t*-FAs intake (FAO 2010) would be exceeded.

Conclusions

The *t*-FAs content in the bread samples complied with the limit recommended by the CAA, while that of the other products exceeded this limit.

Except for FB, the contribution of *t*-FAs and SFAs to the total FA consumption from baked products is high. It is highly probable that the recommendations of the AHA to limit SFAs intake and of the WHO to eat no more than 1% of energy as *t*-FAs are not taken into account.

On the other hand, due to the high variability detected in the content of FA between the various bakeries, it would be necessary to require that nutrition labeling should be mandatory in these products.

In order to improve the consumer knowledge about the *t*-FAs content in unpackaged bakery food products sold in retail, the results of the present study could be submitted to the Argentinean food regulation agencies.

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The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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