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Trans fatty acids in the Portuguese food market

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ABSTRACT

Consistent evidence exist on the harmful health effects of industrial *trans* fatty acids (TFA). In order to have accurate data on TFA intake and implement adequate measures to reduce their intake, each country should have updated estimates of TFA content in the diet. The objective of the present study was to provide data on the TFA content in food commercialized in the Portuguese market. The results on the TFA content of 268 samples acquired between October and December 2013 are reported. Samples were categorized as margarines and shortenings (n = 16), spreadable chocolate fats (n = 6), fried potatoes and chips (n = 25), industrial bakery (n = 4), breakfast cereals (n = 3), pastry products (n = 120), seasonings (n = 5), instant soups (n = 5), instant desserts (n = 6), chocolate snacks (n = 4), microwave popcorn (n = 4), cookies, biscuits and wafers (n = 53), and fast-food (n = 13), with butter (n = 4) included for comparison purposes. TFA were quantified by gas chromatography. Total TFA content in the fat ranged from 0.06% to 30.2% (average 1.9%), with the highest average values in the "biscuits, wafers and cookies" group (3.4% TFA), followed by the pastry group (2.0%). Fifty samples (19%) had TFA superior to 2% in the fat. These findings highlight there is still much need for improvement in terms of the TFA content in Portuguese foods, particularly in traditional pastry.

1. Introduction

There is consistent evidence of industrial *trans* fatty acids (TFA) adverse health effects, particularly on blood lipoprotein profiles, coronary heart disease, cancer and diabetes, while no reports are available on any beneficial health impact (Mensink & Katan, 1990; Ascherio, 2006; Booker & Mann, 2008; Mozaffarian et al. 2009; Teegala, Willett, & Mozaffarian, 2009; Uauy et al., 2009; Brouwer, Wanders, & Katan, 2010; Bendsen, Christensen, Bartels, & Astrup, 2011). TFA elimination policies have shown huge potential to contribute to a reduction in mortality from NCDs and to reduce socioeconomic inequalities from CHD (Allen et al., 2015). Furthermore the potential for saving lives as a result of such policy has been highlighted elsewhere (Restrepo & Rieger, 2016).

Different approaches have been implemented to reduce TFA amounts in processed foods. Limitations on the content of industrialized TFA were implemented in some countries, as in Denmark since 2003 followed by Austria, Switzerland, Iceland, Norway, Hungary, Sweden (yet to be implemented) and more recently Latvia and Georgia, while others imposed mandatory labeling (USA, Brazil, etc.), or included recommendations for voluntary reduction by the industry, accompanied by nutritional recommendations and awareness programs on the adverse effects of TFA (Uauy et al., 2009; Downs, Thow, & Leeder, 2013). The WHO regional Office for Europe has recently produced a report highlighting the benefits and the importance of a trans-fat ban in Europe followed by a statement submitted by a group of civil society organizations and food industry operators supporting the idea of establishing a legal limit equivalent to a ban (WHO, 2015). Furthermore several member states of the EU have also written to the European Commission requesting it to explore a possible regulatory framework for the reduction of trans-fat.

Several surveys have been implemented in different countries, aiming to clarify the amounts of TFA ingested by different populations worldwide. The first and wider survey was the TRANSFAIR study, which took place between 1980 and 1996, and involved 14 European countries, Portugal included. This study estimated daily ingestions ranging from 1.2 g in Greece and Italy to 6.7 g in Iceland,

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with high variability between countries, food groups, and even genders (Hulshof et al., 1999). A decade later, and based on two surveys dated from 2005 to 2009, Stender, Dyerberg, Bysted, Leth, and Astrup (2006, 2012) concluded that a general reduction was observed, but the consumption of TFA was still potentially high in some populations.

Regulation (EU) Nº, 1169/2011 of the European Parliament on the provision of food information to consumers determined that, by 13 December 2014, data on the presence of *trans* fats in the overall diet of the EU population should be known, in order to implement adequate measures for its reduction. Simultaneously, the European Food and Nutrition Action Plan 2015-2020, focuses on a reduction of diet related noncommunicable diseases, and includes a priority intervention on the elimination of *trans* fat, which should be limited to <1% of the daily energy intake, including those of natural origin (WHO, 2003; WHO, 2011). The recent Vienna declaration on Nutrition and NCDs, in the context of Health 2020 strengths the general commitment of all members to take decisive actions regarding healthier food, including a reduction of products with high TFA amounts, and implementation of common approaches to promote product reformulation (WHO, 2013).

In Portugal, only recommendations for voluntary reduction have been applied. However, while the TRANSFAIR study positioned Portugal within the countries with the lowest TFA contents in the nineties, the 2005 survey implemented by Stender et al. (2006) presented a worse panorama, with up to 43% of TFA in the fat of selected foods. Indeed, national data on table margarines (n = 40) sold in Portugal back in 1991 (Oliveira & Ferreira, 1993) showed a high prevalence of TFA in margarines (0.45%–14.2% in the fat). The two main margarines and shortenings industries in Portugal signed a commitment to reduce TFA in their products back in 1995 (FIPA, 2005) but, despite the visible reduction in 2002 (range 0.2–8.9%), particularly from the signatory industries, 80% of the samples were still prepared with hydrogenated or partially hydrogenated fats (Torres, Casal, & Oliveira, 2002). Latter, a survey of cookies and biscuits sold in Portugal (n = 100) was taken in 2006 (Casal et al., 2008), with a TFA range in the fat from 0.2 to 41.1% (average of 2.8%). Selected samples (n = 12) were reanalyzed in 2012 (Santos, Cruz, & Casal, 2015) with a clear reduction of TFA content, from an average of 5.35%–0.87%, but the general range was still high (0.11%–27.4%). No updated data on other food categories was found.

Based on the reduced and generally outdated information of TFA in Portuguese foods, and being this information mandatory for an accurate estimation of population exposure, the aim of this study was to determine the TFA content in Portuguese foods.

2. Materials and methods

2.1. Sample collection

In the absence of a representative national nutrition survey, with ingestion patterns and relative contributions to fat consumption, a preliminary desk review was performed on literature data, aiming to identify the food categories with potentially higher amounts of TFA from industrial origin in other countries (Hulshof et al., 1999; Chiara, Sichieri, & Carvalho, 2003; Craig-Schmidt, 2006; Stender et al., 2006; Baylin, Siles, Donovan-Palmer, Fernandez, & Campos, 2007; Ledoux, Juanéda, & Sébédio, 2007; Griguol, León-Camacho, & Vicario, 2007; Wagner, Plasser, Proell, & Kanzler, 2008; Richter, Shawish, Scheeder, & Colombani, 2009; Fritsche, Petersen, & Jahreis, 2010; Remig et al., 2010; Cakmak, Guler, Yigit, Caglav, & Aktumsek, 2011; Hissanaga, Proença, & Block, 2012; Roe et al., 2013; Saunders et al., 2008). The following food categories were selected: bakery/breakfast cereals, biscuits/wafers/cookies, bouillon cubes, butter, chocolate snacks, chocolate spreads, fast food, instant desserts, instant soups, margarines/shortenings, pastry, popcorn, and potato chips/French fries. Butter was included only for comparison purposes, as it contains natural TFA.

Based on the aforementioned categories, a total of 268 samples were selectively purchased between October and December 2013. A worst case approach was implemented for each category, selecting samples whose labels indicated the presence of “partially hydrogenated fat” (PH) or “hydrogenated fat” (H) in the ingredients list, samples with insufficient or inexistent label information, and, when unavailable, samples with recognized market shares. Other fat sources found in the ingredients list comprised: vegetable fat (V), vegetable oils (O), mixtures of vegetable oils and fats (O/V), margarine (M), and butter (B). Most products were acquired in six main supermarkets chains in Portugal, being therefore representative of the nation acquisition pattern, and included samples produced in the European Union (EU) and non-EU samples. Due to the recognized importance of local traditional pastry, samples sold by small and privately owned shops were also included, from diverse geographical areas in Portugal.

2.2. Sample preparation

Each sample was carefully weight for dose or unit mass estimation. After being reduced to a homogeneous mass in a food processor, a representative sample portion was refrigerated (4 °C) and analyzed within two or three days. Most samples were analyzed as acquired, except for microwave popcorn and frozen puff sheets that were previously prepared according to manufacturer instructions.

2.3. Lipid extraction

Fat was extracted with a ternary mixture of cyclohexane, 2-propanol and aqueous NaCl solution (0.9%, w/v), enabling a fast and clean separation of the lipid phase (Smedes, 1999; Cruz et al., 2013; Santos et al., 2015). In brief, 500 mg of homogenized sample were extracted with 1.6 mL of 2-propanol and 2 mL of cyclohexane (analytical grade from Carl Roth GmBH, Germany) after addition of an internal standard for total fat estimation (glyceryl triundecanoate, Sigma–Aldrich, Spain). After vortex mixing and overnight maceration at 4 °C, aqueous NaCl was added (1%; 2.8 mL), thoroughly mixed and centrifuged at 5000 rpm for 5 min, and the upper phase was transferred to derivatization vials. After repeating extraction with further 2 mL of cyclohexane, the combined supernatants were evaporated under a stream of nitrogen at 60 °C.

2.4. Fatty acids analysis

Extracted lipids and internal standard were converted into their methyl esters (FAME) by cold alkaline derivatisation, following ISO 12966-2 (2011), using 2 M KOH in methanol. After a brief centrifugation (3000 rpm, 5 min) the supernatants were transferred to injection vials for the gas chromatograph auto-sampler.

The fatty acid composition was determined by gas chromatography on a Chrompack (CP 9001), equipped with a FAME CP-Select CB column (50 m × 0.25 mm x 0.2 μm; JW), with helium as carrier gas at 17 Psi, and a temperature gradient from 140 °C to 200 °C, in a total of 40 min. Injection port was at 250 °C, with a 1:100 split ratio, and the detector was at 270 °C. The fatty acids were identified by comparison with commercial standards form Supelco (Sigma, USA), and from Matreya (USA). A total of 52 fatty acids, with 8–24 carbon atoms, were quantified, including 11 *trans* isomers from C16:1 (n = 1), C18:1 (n = 4), C18:2 (n = 3), and 18:3 (n = 3). Following the recommendations of ISO 15304:2002, and for the purpose of this study (total TFA content estimation), total TFA in the fat is reported