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# Trans fatty acids content of selected popular Tunisian fast food

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**Abstract –** There are strict regulations regarding trans fatty acid TFA limitation from food supply across the world. However in Tunisia, there is scarcity of data on TFA content in fat, fast food products and their consumption levels. In order to assess fast food's lipid, we measured total fat, fatty acid composition, and trans fatty acid s in the most commercialised fast food.
Samples were categorized as six sandwich's menus (chicken breast, chicken fingers, chawerma, tuna, kaftaji and salami/ham) and pie. Frying fats (oil and margarine) were also studied. Total fat ranged from 7.38 to 50.28 g/100g of fresh product and the maximum was found in pie. About 85% of the tested fast food (sandwich) contained between 0.5 and 2 % TFA and 10% more than 10% TFA. Trans 18:3 isomers were the major group of TFA present in chicken breast sandwich, tuna sandwich, kaftaji sandwich and chawerma sandwich, representing 42.15 to 52.11% of total trans isomers. Trans 18:1 isomers content were also the major fatty acid in chicken fingers sandwich and pie representing 63.95% and 97.31% respectively of total trans isomers. The moderate content of TFA in the studied samples showed similarities to those reported in similar product categories in developing countries.
This study is the first one to report data on the TFA content in fast food and margarines products in Tunisia and the importance of introduce effective policies for reducing the intake of fat and TFA.

**Key words:** Tunisian fast food, Frying oil, Margarine, Trans fatty acids.

## 1. Introduction

Trans fatty acids are unsaturated fatty acids that contain at least one non-conjugated double bond in the trans configuration. The main sources of TFA in the diet are meat and dairy products derived from ruminants, cooking oils/fats, industrial hydrogenation of margarines, and trans isomers produced from their cis counterparts in the deodorization step of vegetable oils (Menaa et al. 2013).
Consumption of TFA increased during the 20$^{th}$ century when oils began to be hardened by a process of hydrogenation (Korver and Katan 2006) and the essential ingredient for snacks and fast-food preparation. Increases in the portion sizes of products (Young and Nestle 2007) and changes in eating patterns, including more frequent snacking, have been identified as contributing to the obesity epidemic and the cardiovascular diseases (Hill and Peters 1998; Young and Nestle 2002).
The intake of energy dense foods and TFA together with low levels of physical activity is leading to promote also incidence of obesity and other related lifestyle diseases like diabetes, hypertension, coronary heart disease and the metabolic syndrome (Mozaffarian et al. 2009).
Recently, food industry and nutritional institutes (Spanish Agency for Consumer Affairs, Food Safety and Nutrition, Institute of Food Research, UK, Agriculture and Food Science, Swiss…) has increased efforts in order to reduce TFA amounts, especially in processed foods, due to the damaging health effects of trans FA consumption (Pérez-Farinós et al. 2016; Richter et al. 2009; Roe et al. 2013).
In 2004, Denmark was the first country in the world to introduce a limitation on the content of industrialized produced TFA in foods (WHO 2015). The exposure to TFA by a high-trans-fat menu in Denmark was reduced from 30 g (industrialized produced TFA) in 2001, to <1 g in 2005. In just a few years, Denmark has thus eliminated a risk factor for ischemic heart disease (Stender et al. 2006).
Limitation on the content of industrialized TFA in processed food were extended to Austria, Switzerland, Icelend, Norway, Hungary, Sweden and more mandatory Latvia and Georgia, while, others imposed mandatory labelling (USA, Brazil) or included recommendations for voluntary reduction by

the industry, accompanied by nutritional recommendations and awareness programs on the adverse effects of TFA (Downs et al. 2013; Uauy et al. 2009).
The European Food and Nutrition Action Plan 2015-2020, focuses on a reduction of non healthy food, and the priority of intervention on the elimination of trans fat, which should be limited to <1% of the daily energy intake, including those of natural origin (WHO 2011). The same action plan was done by the recent Vienna declaration on Nutrition and Non-Communicable diseases, in the context of Health 2020 by TFA reduction and implementation of common approaches to promote product reformulation (WHO 2013).
In Tunisia, only recommendations for voluntary reduction of trans fat have been applied by industrials and data on the presence of trans fats in the overall diet should be known, in order to implement adequate measures for its reduction.
Such developing countries, Tunisia marked the beginning of increased consumption of vegetable oil, specially saturated and trans fatty acids from industrial origin. In fact, it has been reported that the imported vegetable oil increased from 184.5 th tonne in 2000 to more than 360 th tonne in 2011. Food industry is already developing and the TFA content of all fast food available in Tunisian market is largely unknown. The aim of this study was therefore, to determine the trans FA content and isomers distribution of the most fast foods samples in order to get the first overview of the Tunisian TFA situation. Furthermore, we aimed at finding indicators to assess the origins of the trans fatty acids.

## 2. Materials and methods

### 2.1. Sample selection

Fast food items were selected according to the results of a survey (Obe-Maghreb project, supported by the CORUS programme of the French Ministry of Foreign Affairs, contract Corus 6028-2) carried out by the National Institute of Nutrition and Food Technology and the National Institute of Consumption with researchers from Morocco and France. This survey showed that in the last decade, sandwiches are considered among the main sources of total fat and saturated fatty acids. Thirty fort (n=34) fast food menu items (sandwich) and twenty-eight (n=28) samples of frying fat (oil and margarine) were sampled during November 2017 and Mars 2018 from 13 Tunisian fast food restaurants outlets and grouped as:

- ✓ Chicken breast sandwich
- ✓ Chicken fingers sandwich
- ✓ Chawerma chicken sandwich
- ✓ Tuna sandwich
- ✓ Kaftaji sandwich
- ✓ Salami and/or ham sandwich
- ✓ Pie
- ✓ Frying fat

The ingredients of fast food menu are shown in table 1.
All samples were transported to the laboratories of Food Technology Department (INNTA, Tunisia) where they were analysed, pre-dried, homogenized and vacuum-packed in polyethylene bags and stored at -28 °C until analysis. Oils and margarines were kept in a dark and dry place (+4°C).

### 2.2. Moisture

Moisture of the fast food samples was determined according to the AOAC (1990) method by drying in an oven (BINDER FD 23) at 105 °C. Results were expressed as percentage of wet weight (n = 4).

### 2.3. Ash

Ash content was determined by burning sample for 12 h in a furnace (Flli manfredi) at 525 °C according to the AOAC (1995) method. Results were expressed as percentage of wet weight (n = 4).

### 2.4. Protein

Total protein content (% total nitrogen × 6.25) in the homogenized samples was determined by Kjeldahl method (AOAC, 1990) using BUCHI Distillation Unit K-314. Results were expressed as percentage of wet weight (n = 3).

### 2.5. Carbohydrate

Carbohydrate content was obtained by the difference between 100 and the sum of the percentages of crude protein, total fat, moisture, and ash.

### 2.6. Fat extraction and fatty acid methyl ester preparation and analysis

The fat extraction of pre-dried food samples was carried out by soxhlet method (AOAC 1995). Approximately 10 grams of the fast food samples was defatted using 200 mL of petroleum ether (60-80 °C) in a continuous Soxhlet extractor for 24 h. The obtained petroleum ether extract was subsequently evaporated under a stream of nitrogen. In the case of margarine, the fat was extracted according to the method of Folch et al. (1957) by chloroform/methanol (2/1), the lipid fraction was then determined gravimetrically after evaporation in a stream of nitrogen for further drying. Fatty acids methyl esters FAMEs were obtained and analysed using the methods described respectively by the international Organization for Standardization (ISO 15304:2002 ; ISO 5509:1978).
FAMEs were analysed using hp Gaz chromatograph system 6890 series equipped with a flame ionization detector and a CP-Sil 88 capillary column (50 m × 0.25 mm i.d. × 0.2 µm film thickness, Agilent J&W). The oven was keep at 185°C and the temperature of the injector and the detector were both 250°C. Helium was used as a carrier gas with a flow rate of 1 ml/min, split ratio was 1:100.

Peaks were identified by comparison of their retention times with:

- PUFA 3 FAMEs standards (SUPELCO, Bellefonte, PA, USA).
- Trans 11-octadecanoic methyl ester (SUPELCO, Bellefonte, PA, USA).
- Trans 9-octadecanoic methyl ester (FLUKA, Sigma Aldrich).
- Linoleic acid methyl ester mix isomer cis/trans (C18:2 cis-9,cis12; C18:2 cis-9,trans12; C18:2 trans-9,cis12; C18:2 trans-9,trans12) (SUPELCO, Bellefonte, PA, USA).
- Linolenic acid methyl ester mix isomer cis/trans (C18:3 cis-9,cis12,cis15; C18:3 cis-9,cis12,trans15; C18:3 cis-9,trans12,cis15; C18:3 cis-9,trans12,trans15; C18:3 trans-9,cis12,cis15; C18:3 trans-9,cis12,trans15; C18:3 trans-9,trans12,cis15; C18:3 trans-9,trans12,trans15) (SUPELCO, Bellefonte, PA, USA).

Fatty acids are given in % of total fatty acids.

### 2.7. Statistical analysis

Statistical analysis was performed using SPSS software, version 10.0.5. The comparison of analysed parameters was tested using Duncan's test (95% confidence interval) with one-way ANOVA. Data are expressed as mean ± standard error.

## 3. Results and discussion

### 3.1. Samples characteristics

Most of international restaurants in the word reported the composition of their product and frying oil on their Web site or in their nutrition information documents. The use of oil or partially hydrogenated fat was most commonly reported. In Tunisia and such developing countries, they haven't any nutritional information about fast food item and frying fat.
Table 1 shows the total weight and the composition of each analysed fast food menu. Overall, a significant difference were detected, the weight of each menu (means) ranged between 286.16 ±12.29g and 432.37 ±11.62g (exempt pie). The maximum was found in the Tunisian traditional sandwich "kaftaji".

**Table 1:** The contents and weight of all menu and French frie. Results are reported as means ± standard deviation

| Fast food menu | Total weight (g) | French frie (g) | composition |
|---|---|---|---|
| Chicken breast | 379.31 ±8.26 | 95.28 ±7.83 | Bread, harissa (red pepper puree), mayonnaise, mixed salad, grilled chicken breast, fried potato, salt, olive. |
| Chicken fingers | 320.31 ±5.76 | 72.15 ±2.71 | Bread, harissa, mayonnaise, mixed salad, fried chicken fingers, fried potato, salt, olive. |
| Chawerma chicken | 386.35 ±7.05 | 89.63 ±8.22 | Bread, harissa, mayonnaise, mixed salad, chawerma chicken, fried potato, salt, olive. |
| Tuna | 392.13 ±6.41 | 104.17 ±6.41 | Bread, harissa, mixed salad, canned tuna, fried potato, salt, olive. |
| Kaftaji | 432.37 ±11.62 | 102.35 ±9.04 | Bread, harissa, kaftaji (fried eggs, tomato and green pepper), fried potato, salt, olive. |
| Salami and/or ham | 286.16 ±12.29 | 78.19 ±5.13 | Bread, harissa, mixed salad, salami/ham, fried potato, salt, olive. |
| Pie | 95.54 ±3.11 | - | Pasta, eggs, cheese, margarine, chicken/tuna, olive. |

In others countries, the serving size was reported (in grams) by the respective fast food restaurants as the standard amount of food offered per menu item. The target serving sizes of chicken tenders/nuggets and French fries were approximately 130 and 120 g, respectively, equivalent in most cases to a medium-sized serving (Tyburczy et al. 2012).

### 3.2. Proximate composition

Table 2 shows the proximate composition of selected Tunisian fast foods products. The lipid and protein contents found in this study in all samples were ranged from 9,63±2,43 to 50,28±0,26 and from 9,62±0,60 to 16,33±1,42 g/100 g respectively. The high lipid level found in pie and chicken sandwich is related to the ingredients for fast food preparation (oil, margarine, fried potato, fried eggs…).

**Table 2:** Proximate composition of selected Tunisian fast foods products. Results are presented as g per 100 of fast food menu and reported as means ± standard deviation.

| | Moisture | Lipid | Protein | Carbohydrate | Ash |
|---|---|---|---|---|---|
| **Chicken breast sandwich** | 49.30±0.44 | 17.76±0.82 | 14.35±1.03 | 16.06±1.45 | 2.23±0.31 |
| **Chicken fingers sandwich** | 49.80±0.04 | 13.40±2.66 | 15.96±0.90 | 18.44±1.51 | 2.11±0.21 |
| **Tuna sandwich** | 49.17±0.33 | 16.25±1.37 | 11.18±1.08 | 20.96±0.72 | 2.24±0.20 |
| **Kaftaji sandwich** | 48.84±0.25 | 21.18±2.25 | 10.76±0.70 | 16.80±2.85 | 2.22±0.13 |
| **Pie** | 29.83±0.52 | 50.28±0.26 | 9.62±0.60 | 7.52±1.30 | 2.45±0.36 |
| **Chawerma chicken sandwich** | 47.95±0.77 | 16.32±1.38 | 15.65±0.89 | 17.83±1.76 | 1.92±0.32 |
| **Salami and/or ham sandwich** | 48.91±1.34 | 9.63±2.43 | 16.33±1.42 | 22.64±2.62 | 2.24±0.34 |

Such levels are similar than those found in similar fast food products such shawerma, hamburgers, chicken burgers/tenders/nuggets, cheese pizza, French fries and apple pie/turnovers (Fernandez San Juan 1996; Richter et al. 2009; Tyburczy et al. 2012). Generally, lipid content varies within cooking process (frying, grilling…) and ingredient's kind.

According to ash result's, there is no significant difference in ash content for all analyzed fast foods samples (1.92±0.32 to 2.45±0.36 g/100g). Such levels were higher than those found in similar fast foods (Heredia-Blonva et al. 2014). The high ash content was related to salt supply in fried potato and chicken meat preparation. It is estimated that one sandwich menu contain more than 2g of salt (sodium chloride) and the means of the amount of salt consumed by Tunisian people is more than 8g/day (INNTA 2012), witch considered so high compared to human body requires and World Health Organization WHO (5 g per day) (WHO 2012).

Countries like UK, Australia, Finland and Canada are pioneers in the implementation of strategies for salt reduction. Governments in these countries have put a low on the food industry to reduce sodium levels in foods, such as through mandatory nutritional labeling and the establishment of salt targets in specific food categories (Valenzuela and Atalah 2011).

### 3.3. Trans fatty acids analysis

Trans FA were detected in all analysed samples. The mean of total TFA content of the seven fast food groups varied from 0.71±0.07% to 12.27±0.88% of total fat in chicken breast sandwich and pie respectively (Table 3). Thus, samples with the greatest trans fat content were those with the slight serving size. Exempt tuna sandwich and pie, all sandwich items contained less than 1%TFA.

**Table 3:** Trans fatty acids content (%) of selected Tunisian fast foods products. Results are reported as means ± standard deviation.

| | Chicken breast | Chicken fingers | Tuna sandwich | Kaftaji sandwich | Pie | Chawerma chicken | Salami and/or ham |
|---|---|---|---|---|---|---|---|
| **C8:0** | | 0.08 | | | 0.20±0.03 | | 0.15±0.06 |
| **C10:0** | | 0.09 | | | 0.23±0.05 | | 0.10±0.06 |
| **C12:0** | | 0.26±0.13 | | | 1.46±0.03 | | 0.50±0.48 |
| **C14:0** | 0.16±0.03 | 0.84±0.45 | 0.15±0.02 | 0.20±0.04 | 1.54±0.39 | 0.25±0.05 | 0.63±0.47 |
| **C16:0** | 14.07±1.31 | 23.05±1.40 | 13.67±0.93 | 15.64±1.15 | 29.17±1.69 | 15.92±3.02 | 23.54±4.69 |
| **C16:1** | 0.31±0.20 | 0.68±0.55 | 0.18±0.03 | 0.65±0.13 | 0.29±0.05 | 0.80±0.35 | 0.81±0.64 |
| **C18:0** | 4.34±0.34 | 7.01±1.96 | 4.16±0.15 | 4.93±0.28 | 7.07±2.32 | 5.07±0.88 | 5.41±0.77 |
| **C18:1 t** | 0.19±0.05 | 0.55±0.47 | 0.42±0.31 | 0.17±0.09 | 11.94±0.75 | 0.11±0.01 | 0.25±0.08 |
| **C18:1 n-9** | 24.94±1.23 | 35.12±2.37 | 24.28±0.68 | 26.91±0.99 | 23.68±1.64 | 25.39±2.99 | 35.01±1.41 |
| **C18:1 n-7** | 1.32±0.13 | 0.99± | 1.29±0.08 | 1.45±0.05 | 1.24±0.15 | 1.31±0.04 | 1.40±0.07 |
| **C18:2 t** | 0.20±0.04 | 0.29±0.03 | 0.26±0.05 | 0.23±0.04 | 0.15±0.01 | 0.22±0.01 | 0.49±0.36 |
| **C18:2 t** | 0.12±0.01 | | | | | | |
| **C18:2 n-6** | 47.03±2.87 | 29.99±0.61 | 47.52±2.21 | 43.02±2.04 | 19.53±2.14 | 44.45±6.26 | 29.08±3.66 |
| **C20:0** | 0.33±0.03 | 0.37±0.07 | 0.33±0.07 | 0.29±0.01 | 0.41±0.05 | 0.34±0.04 | 0.42±0.08 |
| **C18:3 t** | 0.23±0.01 | 0.04± | 0.27±0.05 | 0.21±0.01 | 0.08±0.01 | 0.21±0.04 | 0.10±0.10 |
| **C18:3 t** | 0.21±0.01 | | 0.24±0.06 | 0.19±0.01 | 0.09± | 0.16±0.06 | 0.09± |
| **C18:3 n-3** | 6.38±0.49 | 0.77±0.27 | 6.68±0.46 | 5.75±0.40 | 2.29±0.14 | 5.43±1.14 | 1.89±1.35 |
| **Trans FA** | 0.93±0.08 | 0.86±0.35 | 1.21±0.41 | 0.81±0.09 | 12.27±0.88 | 0.71±0.07 | 0.92±0.57 |
| **SFA** | 18.91±1.60 | 31.61±1.25 | 18.32±1.07 | 21.06±1.46 | 40.08±0.27 | 21.59±3.95 | 30.75±4.92 |
| **MUFA** | 26.56±1.50 | 36.79±1.11 | 25.75±0.78 | 29.02±1.05 | 25.21±1.44 | 27.50±3.30 | 37.22±0.06 |
| **PUFA** | 53.40±3.32 | 30.76±0.89 | 54.20±2.65 | 48.77±2.41 | 21.82±2.28 | 49.88±7.39 | 30.97±4.90 |

Trans FA: trans fatty acids; SFA: saturated fatty acids; MUFA: monounsaturated fatty acids: PUFA: polyunsaturated fatty acids.

According to margarine's results, a particular attention was given as these are used as ingredients and therefore amongst the main sources of TFA in processed foods. Two separate groups could be identified, the first one (premium margarine) having less than 2 % trans fatty acids and the other one (classic margarine) having up to 9 % TFA (Table 4). Within the last group, all samples (100%) indicated the use of hydrogenated or partially hydrogenated fats, with a TFA average of 11.41%. However, when samples were grouped by origin, the Tunisian margarines had apparently higher TFA average content (5.8 %) than those made in Portugal (0.61%) or European Union (1.2%) (Costa et al. 2016).Fatty acid composition of frying oils reported a similarity profile with soybean oil. Therefore, the use of subsidized oil was done by several restaurants which are illegally by Tunisian low (Table 4). 90% of the analysed French fries and frying oil have less than 1% TFA and 10% between 1 to 4% TFA. Trans 18:3 isomers were the major group of TFA present frying oil. Our results were higher than found by Costa et al. (2016) in Portuguese French Fries samples accompanying the fast food menus which had less than 0.7% of total TFA in the fat.

TFA content in French fries varies strongly with several fast food restaurants (0.45%-34.84%), resuming that fast food restaurants whose French fries exhibited high TFA levels used partially hydrogenated chip fats (Aro et al. 1998).

**Table 4:** Trans fatty acids content (%) of margarine and frying oil. Results are reported as means ± standard deviation.

| Fatty acids | Margarine 1 | Margarine 2 | Margarine 3 | Margarine 4 | Frying oil | Commercial soybean oil |
|---|---|---|---|---|---|---|
| **C8:0** | 0,54±0,01 | 0,30±0,01 | 0,62±0,01 | 0,77±0,05 | | |
| **C10:0** | 0,46±0,01 | 0,28±0,01 | 0,52±0,01 | 0,63±0,04 | | |
| **C12:0** | 5,02±0,09 | 3,82±0,03 | 4,49±0,08 | 5,21±0,23 | | |
| **C14:0** | 2,37±0,02 | 1,79±0,00 | 2,12±0,03 | 2,54±0,07 | 0,13±0,05 | 0,09±0,05 |
| **C16:0** | 30,71±0,03 | 28,54±0,10 | 20,69±0,15 | 23,18±0,15 | 12,69±1,1 | 11,26±0,19 |
| **C16:1** | 0,10±0,02 | 0,08±0,01 | 0,07±0,00 | 0,09±0,01 | | |
| **C18:0** | 4,61±0,05 | 4,67±0,04 | 6,67±0,09 | 4,67±0,03 | 4,45±0,25 | 4,7±0,07 |
| **C18:1 t** | 0,59±0,04 | 0,09±0,01 | 8,81±0,05 | 8,39±0,09 | 0,15±0,07 | |
| **C18:1 n-9** | 28,68±0,08 | 25,66±0,07 | 24,27±0,10 | 29,13±0,12 | 23,55±1,7 | 21,54±0,11 |
| **C18:1 n-7** | 0,77±0,01 | 0,93±0,02 | 1,15±0,01 | 0,33±0,29 | 1,38±0,08 | 1,39±0,13 |
| **C18:2 t** | 0,20±0,03 | 0,61±0,05 | 0,37±0,42 | 0,11±0,04 | 0,21±0,1 | |
| **C18:2 t** | | | 0,11±0,00 | 0,09±0,01 | 0,34±0,19 | |
| **C18:2 t** | | | 0,13±0,01 | 0,12±0,05 | 0,40±0,05 | |
| **C18:2 t** | | | 0,19±0,02 | 0,28±0,05 | | |
| **C18:2 n-6** | 23,21±0,07 | 29,17±0,06 | 25,67±0,18 | 23,57±0,08 | 49,82±2,78 | 53,58±1,21 |
| **C20:0** | 0,30±0,09 | 0,34±0,04 | 0,35±0,01 | 0,31±0,01 | 0,34±0,05 | 0,34±0,06 |
| **C18:3 t** | 0,14±0,14 | 0,31±0,23 | 0,13±0,00 | | 0,19±0,13 | 0,11±0,00 |
| **C18:3 t** | 0,06±0,00 | 0,45±0,01 | 0,16±0,00 | | 0,39±0,17 | 0,07±0,00 |
| **C18:3 t** | 0,07±0,00 | | | | 0,52±0,21 | |
| **C18:3 n-3** | 2,13±0,01 | 2,65±0,02 | 3,12±0,02 | 0,30±0,01 | 5,8±1,17 | 6,23±0,15 |
| **SFA** | 44,01 | 39,74 | 35,47 | 37,31 | 17,61 | 16,39 |
| **MUFA** | 29,55 | 26,67 | 25,48 | 29,55 | 24,94 | 23,02 |
| **PUFA** | 25,34 | 31,83 | 28,78 | 23,86 | 55,62 | 59,81 |
| **Trans FA** | 1,01 | 1,46 | 9,90 | 9,00 | 1,29 | 0,18 |

Trans FA: trans fatty acids; SFA: saturated fatty acids; MUFA: monounsaturated fatty acids: PUFA: polyunsaturated fatty acids.

Tuna and chicken fingers group had some samples slightly exceed 1.2% of TFA in the fat. Therefore, this percentage was related with the presence of natural TFA from cheese (ruminant origin).

Costa et al. (2016) shows in Portuguese fast food (Nuggets, pizza, hamburgers and menus with French fries) that some samples slightly surpassing 2% of TFA in the fat (n = 3). However, it was associated with the presence of high amounts of cheese and meat (cheeseburgers), therefore also with natural trans FA.

There was a variation of the total trans FA content within all groups. In most of the samples (chicken breast, tuna sandwich, kaftaji sandwich, and chawerma chiken) the trans C18:3 represented the largest trans FA fraction followed by trans C18:2 and trans C18:1. However, in chicken fingers and pie samples, trans C18:1 was the major part of the total trans FA.

Trans-C18:1 level has frequently been considered to reflect total TFA contents of foods. However, recent studies are increasingly reporting the different groups of TFA (C18:1, C18:2 and C18:3). This trend is driven, firstly, by the greater detrimental health effects of the trans C18:2 and trans C18:3 as compared to the C18:1 group. Secondly, the isomeric composition and levels of trans fatty acids are indicative of their origin (Roe et al., 2013, Tyburczy et al., 2012). Tyburczy et al. (2012) define the ratio [C18:1-t/(C18:2-t + C18:3-t)] as indicative about the origin of trans FA. The ratio >1 indicate partially hydrogenated oils while ratios <1 are indicative of refined deodorized edible oils.

In our data, the ratio [C18:1-t/(C18:2-t + C18:3-t)]) ranged between 0.19 and 37.31. Only chicken fingers and pie showed level >1. The high ratio found in pie (37.31) indicates strongly the use of partially hydrogenated margarine.

Compared to previous investigations Tunisian fast food items contained reasonable amount of trans fatty acid at that time (exception of pie). The greatest amount was found in tuna sandwich (1.53±0.41%). Such result's was similar that than found by Wagner et al. (2008) and Richter et al., (2009) in Austrian and Swiss fast food. In other countries, such us United States (Elias and Innis. 2002), the trans fatty

acids content of commercial fast food and frying fats used in restaurants appears to be more than in Tunisia. Therefore, the TFA content was 6.8±1.9 % and 27.1±15.8 % respectively in hamburgers and chicken burger. The labelling law is implemented in 2006 in the United States, thereafter, many snack were reformulated and advertised as containing "0 trans".

The report by Stender et al. (2006) on the trans fatty acids content of fast food can varied widely depending on the country and even the city. At McDonald's fast food meal, 5-10g of industrially produced trans fatty acids would be obtained if the meal was purchased in the united states, Peru, United Kingdom, South Africa, Poland, Finland, France, Italy, Norway, Spain, Sweden, Germany or Hungary. Only if the meal was purchased in Denmark would contain less than 1g of trans fatty acids.

## 4. Conclusion

Despite the absence of specific Tunisian legislation, saturated fatty acids content and TFA amounts in most commercial fast food are generally low. Unfortunately, one sample even the seven analysed fast food presented 40.08% and 12.27% of saturated Fatty acids and trans fatty acids respectively, highlighting that the problem is still present. The source of trans FA in the products was partially hydrogenated oils as evidenced by the high level of trans FA in margarines and their trans C18:1/(trans C18:2 + trans C18:3) being higher than the ratio 1.

Furthermore, comprehensive studies on saturated and TFA levels are needed to cover a wider range of fast food, snacks and other processed foods. The adoption of policies for reducing saturated and trans fat intakes are also warranted.

## 5. References

**AOAC (1990)** Official Methods of Analysis of the Association of Analytical Chemists (Edited by K. Helrich), 16th edn. Washington, DC: Association of Official Analytical Chemists.

**AOAC (1995)** Official Methods of Analysis of the Association of Analytical Chemists (Edited by K. Helrich), 16th edn. Washington, DC: Association of Official Analytical Chemists.

**Aro A, Antoine JM, Pizzoferrato L, Reykdal O, Poppel G (1998)** Trans fatty acids in dairy and meat product from 14 European countries: The TRANSFAIR study. J Food Anal 11:150-160.

**Costa N, Cruz R, Graça P, Breda J, Casal S (2016)** Trans fatty acids in the Portuguese food market. Food Control 64:128-134.

**Downs SM, Thow AM, Leeder SR (2013)** The effectiveness of policies for reducing dietary trans fat: a systematic review of the evidence. B World Health Organ 91(4):262-269.

**Elias SL, Innis SM (2002)** Bakery foods are the major dietary source of trans fatty acids among pregnant women with diets providing 30 percent energy from fat. J Am Diet Assoc 102:46-51.

Fernandez San Juan PM (1996) Study of isomeric trans fatty acids content in the commercial Spanish foods. Int J Food Sci Nutr 47:399-403.

**Folch J, Lees M, Stanley GHS (1957)** A simple method for the isolation and purification of total lipids from animal tissue. J Biol Chem 226:497-509.

**Heredia-Blonval K, Blanco-Metzler A, Montero-Campos M (2014)** The salt content of products from popular fast-food chains in Costa Rica. Apetite 83:173-177.

**Hill JO, Peters JC (1998)** Environmental contributions to the obesity epidemic. Science 280:1371-1374.

**INNTA (2012)** National survey on budget, consumption and economic level, 2010. INS Institut National de la Statistique / Ministry of development, investment and International Cooperation, 2014.

**ISO 15304 (2002)** Animal and vegetable fats and oils - Determination of the content of trans fatty acid isomers of vegetable fats and oils - Gas chromatographic method.

**ISO 5509 (1978)** Corps gras d'origines animale et végétale - préparation des esters méthylique d'acide gras.

**Korver O, Katan MB (2006)** The elimination of trans fats from spreads: how science helped to turn an industry around. Nutr Rev 6:275-279.

**Menaa F, Menaa A, Menaa B, Treton J (2013)** Trans-fatty acids, dangerous bonds for health? A background review paper of their use, consumption, health implications and regulation in France. Eur J Nutr 52:1289-1302.

**Mozaffarian D, Aro A, Willett WC (2009)** Health effects of trans fatty acids: experimental and observational studies. Eur J Clin Nutr 63:S5-S21.

**Pérez-Farinós P, Saavedra MADR, Villalba CV, Robledo de Dios T (2016)** Trans-fatty acid content of food products in Spain in 2015. Gac Sanit 30:379-382.

**Richter EK, Shawish KA, Scheeder MRL, Colombani PC (2009)** Trans fatty acid content of selected Swiss foods: the Trans Swiss Pilot study. J Food Comp Anal 22:479-484.

**Roe M, Pinchen H, Church S, Elahi S, Walker M, Farron-Wilson M, Buttriss J, Finglas P (2013)** Trans fatty acids in a range of UK processed foods. Food Chem 140:427-431.

**Stender S, Dyerberg J, Astrup A (2006)** High levels of industrially produced trans fat in popular fast foods. N Engl J Med.345:1650-1652.

**Tyburczy C, Delmonte P, Fardin-Kia AR, Mossoba MM, Kramer JKG, Rader JI (2012)** Profile of trans fatty acids (FAs) including trans polyunsaturated FAs in representative fast food samples. J Agr Food Chem 60:4567-4577.

**Uauy R, Aro A, Clarke R, Ghafoorunissa R, L'Abbe M, Mozaffarian D (2009)** WHO update on trans fatty acids: summary and conclusions. Eur J Clin Nutr 63:S68-S75.

**Valenzuela K, Atalah E (2011)** Estrategias globales para reducir el consumo de sal. Arch Latinoam Nutr 61:111-119.

**Wagner KH, Plasser E, Proell C, Kanzler S (2008)** Comprehensive studies on the trans fatty acid content of Austrian foods: convenience products, fast food and fats. Food Chem 108:1054-1060.

**WHO (2011)** Global status report on noncommunicable diseases. World Health Organization, 176 pp. Geneva.

**WHO (2012)** Guideline. Sodium intake for adults and children. World Health Organization Geneva, Switzerland.

**WHO (2013)** European ministerial conference on nutrition and noncommunicable diseases in the context of health 2020. World Health Organization, 4- 5 July 2013, Vienna, Austria.

**WHO (2015)** Eliminating trans fats in Europe: A policy brief. Copenhagen: World Health Organization WHO, Regional Office for Europe, 13 pp.

**Young LR, Nestle M (2002)** The contribution of expanding portion sizes to the US obesity epidemic. Am J Pub Health 92:246-249.

**Young LR, Nestle M (2007)** Portion sizes and obesity: Responses of fast-food companies. J Pub Health Pol 28:238-248.