Short Note

Trans fatty acids content of sweets and appetisers traditionally consumed in Jordan

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Received: July 14, 2020
Accepted: November 11, 2020

There is strict regulation regarding the use of food sources of trans fatty acids (TFAs) from food across the world. However, there is a lack of information on the trans fatty acids (TFAs) content in Jordanian foods. The objective of this study was to evaluate the amount of fat, saturated fatty acids (SFAs) and TFAs in 22 traditional Jordanian sweet samples and 6 samples of appetisers. The analysis of SFAs and TFAs was carried out by capillary gas chromatography. The SFAs in these foods varied over the range of 1 to 17g/100g food, whereas TFAs content ranged from ND to 0.4 g/100 g food, which indicates that all the analysed food samples have low TFAs content < 2g/100 g lipid or < 0.4 g/100g food. What emerged is that this level of TFAs may be considered as insignificant.

Keywords: Trans fatty acids, Jordanian sweets, appetisers, gas chromatography,

INTRODUCTION

Trans fatty acids (TFAs) are unsaturated fatty acids with at least one non-conjugated double bond in the *trans* form rather than the typical *cis* structure of common unsaturated fatty acid [1]. The source of TFAs could be industrial or natural. The industrial source results from the partial hydrogenation, refining, frying, and cooking of oils at high temperatures. The natural source of TFAs results from the biohydrogenation (by bacteria) of unsaturated fatty acids in the rumen of ruminant animals [2]. Therefore, natural TFAs occur in meat and dairy products. The TFAS content in milk fat could be 2-6% and may reach 50% in some types of margarine [3, 4].

TFAs have intermediate melting points, which provide favourable texture and mouthfeel. Therefore, partially hydrogenated fat is used in a good number of food products such as margarine, fat spread, shortening, sweets, cakes, donuts, and frying foods.

Epidemiological studies have indicated that an excessive intake of TFAs is a risk factor for cardiovascular disease (CVD) [5, 6] and cardiac sudden death [1]. The consumption of TFAs is also associated with inflammation and endothelial dysfunction [7]. Therefore, food industry and nutritional institutes such as Food Safety and Nutrition, the Institute of Food Research, UK and Agriculture and Food Science, Switzerland increased their effort to reduce TFAs content in processed foods [8]. Furthermore, the European Food and Nutrition Action Plan 2015-2020, recommended the reduction of trans fat to be limited to <1% of the daily energy intake, including those of natural origin [9,10]. Furthermore, WHO has recently announced an initiative called REPLACE to eliminate trans-fat completely from the world by 2023 [5, 11]. In addition to TFAs, saturated fats have been linked with heart disease [12] and it is recommended that their intake should not exceed 5-6% of calories [13]. For example, if average energy

Table I - Food ingredients in prepared Jordanian sweets dishes (per 100 g)

Dish prepared in our kitchen	Description	Ingredients
1-Traditional Sweets		
Konafah na'ema bil jibn	Konafah with cheese	Soaked cheese 360 g, Sugar syrup 250 g, Flour 240 g, Margarine 52 g, Pistachio 10 g, Sugar 12 g, Dried whey milk protein 4 g. Purchased – five brands / source (1:1 ratio)
Qatayif bi jibn Maqli	Fried Qatayif with cheese	325 g Dough (flour 296 g, sodium bicarbonate 9 g, warm water 474 g, liquid milk 250 g, sugar 45 g, fine semolina 165 g, salt 2 g, carbonate 2 g), white desalted cheese 150 g, plant oil for frying, sugar syrup (2:1) 25 g.
Qatayif bi jooz Maqli	Fried Qatayif with walnut	325 g Dough (flour 296 g, sodium bicarbonate 9 g, warm water 474 g, liquid milk 250 g, sugar 45 g, fine semolina 165 g, salt 2 g, carbonate 2 g), 143 g filling (walnut 270 g, sugar 11 g, cinnamon 4 g, blossom water 24 g), plant oil for frying, sugar syrup (2:1) 46 g.
Qatayif bi jibn Mashwi	Roasted Qatayif with cheese	325 g Dough (flour 296 g, sodium bicarbonate 9 g, warm water 474 g, liquid milk 250 g, sugar 45 g, fine semolina 165 g, salt 2 g, carbonate 2 g), white desalted cheese 150 g.
Qatayif bi jooz Mashwi	Roasted Qatayif with walnut	325 g Dough (flour 296 g, sodium bicarbonate 9 g, warm water 474 g, liquid milk 250 g, sugar 45 g, fine semolina 165 g, salt 2 g, carbonate 2 g), 143 g filling (walnut 270 g, sugar 11 g, cinnamon 4 g, blossom water 24 g).
Ma'amool ajwa bil sameed	Semolina Ma'amoul with dates	Fine semolina 1000 g, Chopped dates 600 g, Butter 350 g, Milk 200 g, Corn oil 65 g, Sugar 35 g, Vegetable margarine 35 g, Crushed anise 25 g, Cinnamon 15 g, Mehlab 10 g, fennel 10 g. Purchased – five brands/source (1:1 ratio)
Ma'amool ajwa bi taheen	Flour Ma'amoul with dates	Dates 330 g, Flour 262 g, Butter 125 g, Milk 100 g, Sugar 47 g, Corn oil 30 g, fennel 7 g, Crushed anise 7 g, Vanilla 5 g, Baking powder 3.5 g, Mistika 3 g, Cinnamon 0.5 g. Purchased - five brands/source (1:1 ratio)
Mamool bil jooz	Semolina Ma'amoul with walnuts	Fine semolina 188 g, Butter 62 g, Walnut 35 g, Milk 30 g, Sugar syrup 15 g, Corn oil 13 g, Sugar 7 g, Flower water 5 g, Mehlab 2 g, Crushed anise 2 g, Fennel 2 g. Purchased – five brands/source (1:1 ratio)
Mamool bil fustok	Semolina Ma'amoul with pistachio	Fine semolina 562 g, Butter 188 g, Crushed pistachio 150 g, Milk 100 g, Sugar syrup 60 g, Corn oil 37 g, Sugar 19 g, Flower water 5 g, Mehlab 4 g, Crushed anise 4 g, Fennel 4 g. Purchased – five brands/source (1:1 ratio)
Kollaj nabulsi bil Jibn	Kollaj with cheese	Kollaj dough 500g, Removed salt cheese 500g, Sugar syrup 170g, Vegetable margarine 100g, Lemon juice 10g, Flower water 5g. Purchased – five brands / source (1:1 ratio)
Kollaj nabulsi bil jooz	Kollaj with cheess walnuts	Kollaj dough 500 g, Sugar 500 g, Walnut 300 g, Water 250 g, Vegetable margarine 100 g, Cinnamon 12 g, Lemon juice 5g, Flower water 5g. Purchased – five brands / source (1:1 ratio)
2-Appitizers		
Motabbal bathijan bi tahina	Eggplant dip with oil	Eggplant 490 g, Tahina 60 g, Lemon juice 65 g, Olive oil 15 g, Parsley 5 g, Salt 6 g, Garlic 2 g.
Homoos bi tahina	Chickpea dip	Dried chickpea 80 g, Lemon juice 45 g, Tahina 30 g, Green pepper 3 g, Mashed garlic 3 g, Salt 2.5 g.
Tabbooleh	Tabbooleh parsley	Parsley 300 g, Tomato 250 g, Lemon juice 150 g, Olive oil 135 g, Onion 100 g, Fine semolina 60 g, Chopped mint 35 g, Salt 18 g.

allowances are 2,000 kilocalories/ day, no more than 120 kilocalories of them should come from saturated fat, which is equivalent to about 13 grams of saturated fat per day. The higher consumption of these acids is associated with cardiovascular diseases and is inversely associated with HDL levels [14].

In Jordan only, recommendations for voluntary reduction of *trans* fat have been applied by industries. Furthermore, very little data on TFAs levels in Jordanian foods are available. Thus, the objective of this study is to provide preliminary information on TFAs content in Jordanian food and serve as the basis for a future data collection on TFAs content in some food commercially consumed in Jordan. The results of this survey will enable the Food Safety Administration and the Ministry of Health in Jordan for future policy decisions regarding the TFA content in processed foods.

MATERIAL AND METHODS

SOURCES OF COMPOSITE FOOD RECIPES

This study includes 28 samples of local composite sweets and appetisers, 22 sweets and 6 appetisers.

Table II - Traditional sweets and Appetizers purchased from local market (5 samples each)

English name	Characterizes
1-Sweets	
Ma'mool jooz bil taheen	Flour Ma'amoul with dates with walnuts
Ma'mool fustok bil taheen	Flour Ma'amoul with pistachio
Awameh	Lugmat Al-qadi dumpling
Karabij Halab	Alleppo sticks dumpling
Asabe' Zainab	Zainb stacks dumpling
Baraziq	Baraziq
Beqlawa	Beqlawa
Borma	Borma
Ghoraibeh	Ghoraibeh
Doughnut glaze	Doughnut glaze
Doughnut chocolate	Doughnut chocolate
2-Appetizers	
Falafel	Falafel
Manaqeesh za'atar	Thyme pies
Maqdoos	Eggplants immersed in oil

Fourteen of the selected food samples were prepared in our kitchen using the traditional preparation methods or according to the most used cookbooks in Jordan (Table I). The other 14 samples were purchased from local producers by taking 5 samples of each item from different producers and mixing them with equal amounts to prepare a representative composite sample (Table II). All the recipe ingredients in cups and units were weighed before being added to the rest of the ingredients. A suitable portion from each dish was ground to become homogenized using Food Chopper and kept in the freezer (-18°C) to be analysed.

DETERMINATION OF FAT CONTENT

The fat content of pre-dried food samples was carried out by Soxhlet method [12]. Approximately 10-12 grams of the food samples were defatted using 200 ml of diethyl ether in a Soxhlet extractor for 18 hours. The solvent was subsequently evaporated using a rotary evaporator under vacuum.

FAT EXTRACTION AND FATTY ACID METHYL ESTER PREPARATION AND ANALYSIS

To determine the fatty acid profile, lipids were extracted with chloroform/methanol [2:1 (v/v)] according to the modified Folch method [15]. A 30-g of the raw or cooked sample was added to 200 ml of a chloroform/methanol ($CHCl_3$/CH_3OH) solution (1:1, v/v), homogenised for 30 sec and placed in an oven for 20 min at 60°C, and then 100 ml of $CHCl_3$ were added to the mixture. This gave a final ratio of 2:1 (v/v) of $CHCl_3$/CH_3OH. The mixture was homogenised again for 1 min and filtered to eliminate the solid residue. The filtered fraction was added to 100 ml of 1M KCl and was left overnight at 4°C in a refrigerator. After phase separation, the chloroform phase was evaporated using a rotary evaporator and the lipid fraction was stored at -20°C.

The methyl ester formation of fatty acids is carried out according to the procedure reported by Ratnayake [16]. About 200 mg of the extracted fat containing the internal standard was dissolved in 2 mL toluene in 20 screw cap test tube (20 ml) capacity. An aliquot of 2 mL 7% BF3-methanol reagent was added, and the mixture was heated at 100°C for 45 min in a hot water bath. After that the tube was removed from the hot water bath and allowed to cool to room temperature. Five mL of distilled water, 2 mL hexane, and 1 g sodium sulphate were added. The tube was shaken and then allowed to stand for 10 min and the fatty acid methyl ester (FAME) hexane solution was transferred into a small sealable glass vial. The sample was analysed immediately by gas chromatography (GC). Peaks of GC chromatograms were identified comparing the retention times of a mixture of standard fatty acid methyl esters (Sigma Aldrich, Germany).

GC ANALYSIS

GC operating parameters for the food samples containing fats and oils were carried out according to the method reported by Ratnayake [16]. FAME was analysed by capillary gas chromatography using a Shimadzu GC-2010 Plus equipped with a flame ionisation detector (FID) and a fused silica capillary column (Mega-10) (Bonded 100 percent cyanopropyl, 100 m × 0.25 mm, 0.25 µm film thickness, Mega columns, Italy). The carrier gas was helium and the flow rate through the column was 0.8 ml/min. The split ratio was 1:100. The injector and detector temperature were 250°C and the oven temperature was 180°C (35 min), ramped at 5°C/min to 230°C and held for 10 minutes. The fatty acids were identified by comparisons of their retention times with those of standard purified fatty acids.

RESULTS AND DISCUSSION

To facilitate the discussion of the results, the sweet samples were grouped into 4 groups according to either their similarities in composition and preparation or to their content of moisture, while the appetisers were considered as a separate group (Tab. III). The sweets groups are qatytif, kollaj, ma'amoul, awameh, low moisture sweets (Tab. III). The average SFAs content in the five groups was in the following order: Appetizer group (2.84 g/100 g food) = Qatayif group (3.08 g/100 g food) < ma'amoul group (9.6 g/100 g food) = Kollaj group (9.6 g/100 g food) < Low moisture sweets (11.9 g/100 g food). This result indicates that the consumption of 100 g of ma'amoul, Kollaj, or

Table III - Results of % fat, trans fatty acids (FAs), Saturated fatty acid (SFAs), monounsaturated fatty acids (MUFAs)and polyunsaturated fatty acid (PUFAs)contents in different types of Arabic and sweets an appetizer traditionally consumed in Jordan

Recipe Name		% Fat	Saturated Fatty acids (%)		MUFAs%		PUFA%		TFAs (%)	
			In fat	In food	In fat	In food	In fat	In food	In fat	In food
Arabic sweets groups										
1-Qatayif group										
Qatayif bi jibn maqli	Fried Qatayif with cheese	11.50	26.54	3.05	28.99	3.33	42.76	4.92	0.51	0.059
Qatayif bi jooz maqli	Fried Qatayif with walnut	9.90	10.39	1.03	21.87	2.17	67.89	6.72	0.05	0.005
Qatayif bi jibn mashwi	Roasted Qatayif with cheese	12.63	57.16	7.22	35.43	4.47	8.57	1.08	0.30	0.038
Qatayif bi jooz mashwi	Roasted Qatayif with walnut	22.30	24.65	1.03	23.88	2.17	51.72	6.72	0.03	0.005
2-Ma'amool roup										
Ma'amool ajwa bil sameed	Semolina Ma'amoul with dates	19.55	48.8	9.54	34.21	6.69	14.85	2.90	1.35	0.264
Ma'amool ajwa bil taheen	Flour Ma'amoul with dates	17.91	59.35	10.63	31.48	5.64	6.42	1.15	1.40	0.251
Ma'mool jooz bil sameed	Semolina Ma'amoul with walnuts	28.19	27.61	7.78	24.86	7.01	46.96	13.24	0.55	0.155
Ma'mool jooz bil taheen	Flour Ma'amoul with walnut	37.58	35.03	9.87	22.44	6.33	41.82	11.79	0.63	0.178
Ma'mool fustok bil sameed	Semolina Ma'amoul with pistachio pistachiowalnuts	26.04	33.08	9.33	50.01	14.10	16.44	4.63	0.86	0.242
Ma'mool fustok bil taheen	Flour Ma'amoul with pistachio	29.52	33.22	9.36	51.95	14.64	13.7	3.86	0.70	0.197
3-Kollaj group										
Kollaj nabulsi bil jibn	Kollaj with cheese	26.79	57.26	16.14	31.39	8.85	8.32	2.35	1.35	0.381
Kollaj nabulsi bil jooz	Kollaj with cheess walnuts	14.24	27.47	3.91	26.39	3.76	45.46	6.47	0.10	0.014
Konafah na'ema bil jibn	Konafah with cheese	16.93	52.42	8.87	36.76	6.22	9.73	1.65	1.20	0.203
4-Awameh Group										
Awameh	Lugmat Al-qadi dumpling	6.69	31.64	2.12	34.50	2.31	31.84	2.13	1.10	0.074
Karabij Halab	Alleppo sticks dumpling	13.57	23.14	3.14	31.54	4.28	43.90	5.96	1.47	0.199
Asabe' Zainab	Zainab sticks dumpling	18.61	30.99	5.77	34.95	6.50	33.20	6.18	0.94	0.175
Doughnut glaze	Doughnut glaze	20.27	42.23	8.56	31.98	6.48	24.87	5.04	0.98	0.199
Doughnut chocolate	Doughnut chocolate	17.21	43.66	7.51	29.00	4.99	26.12	4.50	1.29	0.222
5-Low moisture sweets										
Baraziq	Baraziq	33.49	36.86	12.34	40.04	13.41	21.58	7.23	0.66	0.220
Beqlawa	Beqlawa	28.74	31.96	9.19	52.01	14.95	15.63	4.49	0.28	0.081
Borma	Borma	37.56	27.2	10.22	55.80	20.96	16.17	6.07	0.34	0.126
Ghoraibeh	Ghoraibeh	27.69	57.53	15.93	26.06	7.22	5.73	1.59	1.40	0.388
Appetizers										
Motabbal bathijan bi tahina	Eggplant dip with	10.96	17.73	1.94	41.52	4.55	40.74	4.47	0.05	0.005
Homous bi tahina	Chickpea dip	10.55	18.57	1.96	42.68	4.50	38.64	4.08	0.020	0.002

Continua Tabella III

Recipe Name		% Fat	Saturated Fatty acids (%)		MUFAs%		PUFA%		TFAs (%)	
			In fat	In food	In fat	In food	In fat	In food	In fat	In food
Appetizers										
falafel	Falafel	12.59	30.88	3.89	33.81	4.26	34.25	4.31	1.3	0.164
Manaqeesh za'atar	Thyme pies manaqeesh	25.18	20.16	5.08	32.01	8.06	47.67	12.00	0.56	0.141
Tabbouleh	Tabbouleh parsley	10.85	17.98	1.95	70.63	7.66	12.33	1.34	0.0	ND
Maqdoos	Maqdoos	26.90	12.32	2.26	21.92	4.01	65.4	11.97	0.1	0.018

low moisture sweets provides about 74 to 92% of the daily allowances of energy (2000 kcal/day). Therefore, a high consumption of these types of foods should be avoided.

The mean of the total TFA content of the seven fast food groups varied from ND% to 1.47% of total fat in tabbooleh and Karabij Halab, respectively (Tab. III). In Qatayif group which is represented by qatayif bi jibn maqli, qatayif bi jibn mashwi,qatayif bi jooz maqli, qatayif bi jooz mashwi, the highest TFAs were found in qatayif bi jib nmashwi (0.5 g/100 g of lipid) which provides 0.059 g/100 g food.

The TFAs in the Kollaj group, which is represented by kollaj Nabulsi bil jibin, kollaj Nabulsi bil jooz and Kunafeh naemeh bil jibin ranged from 0.1 to 1.35 g/100 g lipid or from 0.014 to 0.381 g/100 g food. The highest TFAs values were detected in Kollaj Nabulsi bil jibin. The data in Table III also revealed that among the samples of these three groups, the samples with cheese had the highest TFAs, while the samples containing jooze (walnuts) had the lowest TFAs content. This is due to the added cheese. It has been reported previously that the content of TFAs in this type of cheese is around 4.9% of fat [17], while that of vegetable oils is usually less than 2%. The TFAs in Kunafah of this study is lower than those found by Mashal et al. [17] that stated that the content of TFAs in kunafah was 3.39 g/100 g lipid (0.63 g/100 g food). This difference might be due to the type of fat used. The fat used in this study is free hydrogenated fat margarine, while ghee is the fat used in the earlier study.

The TFAs content in the ma'amoul group, which includes Ma'amool ajwa(dates) bil sameed, Ma'amool ajwa bil taheen, ma'mool jooz bil sameed, ma'mool jooz (walnuts) bil taheen and ma'mool fustok (pistachio) bil sameed ranged from 0.55 to 1.4 g/100 g lipid or from 0.155 to 0.251 g/100 g food. The highest value was found in ma'mool jooz bi lsameed.

The TFAs content in Awameh group which include awameh, Karabij Halab, Asabe' Zainab, Doughnut glaze and Doughnut chocolate ranged from 0.98 to 0.1.47 g/100 g lipid or from 0.07-0.222 g food. The highest TFAs were found in Karabij Halab (1.47 g/100 g lipid). The TFAs in Doughnuts of this study were much lower than those reported by Mashal et al. [17] that stated that TFAs doughnut was 20.8 g/100 g lipid. They attributed that to the use of hydrogenated margarine in frying. The TFAs content in doughnuts agreed with those of Akmar [18] that stated that the TFAs in doughnuts produced in Malaysia were less than 1.4%. The variation in TFAs was reported by other authors; Jenkins and Campbell [19] reported that the TFAs of glazed doughnuts from 15 food establishments in Northwest Indiana were in the range of 0.5-41%. They attributed the drastic differences in the values of TFAs to the difference in the method of preparation, specifically to the type of oil or fat used.

All members of the low moisture sweet groups were purchased from different local producers and represented by barazeq, beqlawa, borma and ghoraibeh. Although the members of this group contain a relatively high amount of fat, their content of TFAs was low and ranged from 0.28 to 0.66 g/100 g lipids (0.081-0.222 g/100 g food). The highest TFAs content was in barazeq (0.66 g/100 g lipid). The low TFAs in this group indicates that the fat used is vegetable margarine that is free of hydrogenated fat. The TFAs in beqlawa of the present study (0.28 g/100 g lipid) was too much lower than those of Mashal et al [17] who stated that TFAs in beqlawa were in the range of 3.3-4.9 g/100 g lipid. Again, this might be due to the type of fat used in the production of this item. The fat used in this item in this present study was aromatised margarine, while that used in Mashal et al. study was ghee [17].

The appetiser group includes Motabbal bathinjan bi tahina, Homous bi tahina, falafel, Manaqeesh za'atar, Tabbouleh, Maqdoos. Falafel and maqdoos were purchased from the local market, while the other dishes were prepared in our kitchen (Tab.II). The TFAs varied within this group ranging from ND to 1.3 g/100 g lipid (ND -0.16 g/100 g food). The maximum value was found to be in falafel (1.4 g/100 g lipid). The TFAs content in the falafel samples of this study (1.3 g/100 g lipid) was lower than that reported for this item (1.5-7.23 g/100 g lipid) in a previous study conducted in Jordan [17].

Based on the European Union regulation N0 1925/2006 [19], which has been adopted on 24 April 2019, the maximum limit of trans fat, other than trans-fat naturally occurring in fat of animal origin, in food which is intended for the final consumer and food intended for supply to retail, of 2 grams per 100 grams of fat, the TFAs of all samples of this study were below this level. The possible reasons of the low level of TFAs in these products are an absence of mild heat treatments, the use of palm oil or palm olein in frying and the use of margarine in the preparation of some of these foods. The major component of these kinds of margarines is palm stearin or palm oil. These two types of fat are solid in nature that is stable against the formation of TFAs during heat treatments or other production processes [18]

CONCLUSION

Analysing 28 food sample of this study by GC showed the presence of SFAs and TFAs. The SFAs in these foods varied within the range of 1 to 17 g/100 g food and TFAs from ND to 0.4 g/100 g food. Because these values of TFAs were below 0.5 g/1200 g food may be considered as an insignificant source of TFAs.

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