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Nutritional Challenges and Health Implications of Trans-Fat in Fast and Traditional Foods in Oman

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Abstract

This study was designed to evaluate the nutritional characteristics of certain fast and trans fatty acid (TFAs) content. Eleven fast foods (Fried Chicken Meal One, Fired Chicken Meal Two, Pizza meal One, Pizza Meal Two, Meat Burger Meal One, Chicken Burger Meal, Meat Burger Meal Two, Cheese Burger Meal, Meat Burger Meal Three, Meat Sandwich Meal, and Chicken Sandwich Meal) and three traditional foods (Harees, Shuwa, and Korose) were used. Five replicates from each fast foods were purchased from takeaway food suppliers, while the traditional foods provided from different Omani families. All the foods were dried separately using a thermo freeze dryer for 5 days, then grinded. The protein, fat, ash, salt contents of each sample was determined. Fatty acids were quantified according to standard methods using gas chromatography. Although, significant differences in nutritional values between the selected foods used, high fat content with fast foods ranged from 10.96 to 28.01% and those of traditional foods ranged from 8.35 to 36.23% were the most common features found. The most common SFAs was myristic acid (C14:00) with a range from 3.28 to 47.3 g/100g and from 13.7 to 43.2 g/100 g for fast and traditional food samples, respectively. TFAs constitute almost 37% to 93% and 46% to 74% of total fatty acids of fast and traditional food samples, respectively. The most common TFA in fast and traditional foods was linolenic acid (C18:3w3) followed by Oleic acid (C18:1w9). This study showed high TFAs contents in fast and traditional foods consumed and which are much higher than the recommended amounts by dietary guidelines.

Keywords: *Fast Food; Traditional Food; Trans Fatty Acid; Saturated Fatty Acid; Nutritional Value*

Introduction

Changing consumer behavior and demography have taken place in many countries worldwide over the last few decades, which have an impact on food consumption patterns and human health [1,2]. One of the most prominent trends is the increasing frequency of meals which are consumed outside home [3-6]. In addition, even meals consumed at home are often purchased from catering outlets that offer

takeaway or home delivery service [2]. The Omani people are facing a shift in dietary patterns like other countries worldwide. The traditional Omani family meals is increasingly being changed by eating "fast food" at various locations throughout the day and in particular among the young generation. Food consumed outside home is becoming an important and regular component of many society's diets [2]. A number of studies have shown increased frequency of fast food consumption worldwide [3-6]. Fast food is particularly popular among adolescents, with particular students and people working away from home. For instance, in western and Asian societies, 70 - 75% of teenagers consumed fast-foods at least once a week [2]. According to Poti and Popkin study [7] among children and teenagers a further increase to 13% of total daily energy intake are from fast foods. Energy content consumed by the children of outside home meals is 55% higher than of in-home meals. Therefore, consumption of fast food on a regular basis leads to an excess energy intake which in its turn leads to an increased risk of overweight and obesity [8]. Fast food consumers are characterized by higher intakes of energy, fat, saturated fatty acids, TFAs, added sugar and salt, and lower intakes of fiber, macronutrients, and vitamins in comparison to those who do not consume outside-home foods [9,10].

TFAs are unsaturated fatty acids with at least one unsaturated, non-conjugated double bond in the trans configuration [11]. TFAs occur naturally in fat from ruminant animal fat and milk and artificially industrially hardened vegetable oil. It has been shown that fast foods contain high amounts of TFAs and saturated fatty acids in addition to high cholesterol levels which may have a negative effect on human health [2]. Frequent fast food consumption is a major health concern as most fast food are rich in unhealthy nutrients which are associated with hypertension, elevated cholesterol, and low-density lipoprotein (LDL) and decreased high density lipoprotein (HDL), cardiovascular diseases and type 2 diabetes [2,12,13]. The high TFA intake is alarming, particularly among young age groups, reaching at least double the WHO maximum recommendation [14]. Therefore, this study was designed to evaluate the nutritional values, SFAs and TFAs of Eleven fast foods (Fried Chicken Meal One, Fired Chicken Meal Two, Pizza meal One, Pizza Meal Two, Meat Burger Meal One, Chicken Burger Meal, Meat Burger Meal Two, Cheese Burger Meal, Meat Burger Meal Three, Meat Sandwich Meal, and Chicken Sandwich Meal) and three traditional foods (Harees, Shuwa, and Korose) which are considered the most common foods consumed in the country.

Materials and Methods

Sampling plan

No representative national nutrition survey has been carried out in Oman, therefore, it was not possible to select the fast or traditional foods to be analyzed according to their relative contribution to the fat consumption in the country. Therefore, fast and traditional foods were selected according to their expected total fat, TFA, SFA contents. All selected fast foods were purchased from different takeaway food chains in Oman between September and November 2019. Three homemade traditional Omani foods were used in this study because they are popular among Omani people.

Sample description and handling

A total of 70 food samples were purchased representing the most consumed fast and traditional foods among local people. Eleven fast food samples included: Fried Chicken Meal Brand One (3 pieces of fried chicken and fries) Fired Chicken Meal Brand Two (3 pieces of fried chicken and fries), Pizza meal Brand One, Pizza Meal Brand Two, Meat Burger Meal Brand One, Chicken Burger Meal, Meat Burger Meal Two, Cheese Burger Meal, Meat Burger Meal Brand Three, Meat Sandwich Meal, and Chicken Sandwich Meal and three traditional foods included Harees, Shuwa and Korose were randomly selected and used. Five replicates from each food samples were used in this study. All foods were transported by cool box to the laboratory, then frozen at -20ºC and dried in a freeze dryer (MODULOD Freeze Dryer thermo electronic corporation) for five days under 100-mbar pressure at -50°C. The samples were reweighed after complete drying, then ground to a homogenous mass through a 1 mm mesh in a micro-Wiley mill, stored in plastic airtight containers and kept at 4°C for chemical analysis.

Proximate analysis

The chemical composition of the selected food samples was determined by proximate analysis according to the standard methods of the AOAC [15]. Protein was determined using a Foss Kjeltec 2300 nitrogen/protein analyser (method 976.95). Fat was determined by Soxhlet extraction method using petroleum ether (method 920.39). Ash content was determined by ashing samples in a muffle furnace at 500°C for 24h (method 942.05). Sodium and potassium contents from each sample were determined following 2 phases, digestion and analyses. Standard (1000 mg/L) solutions (Sigma-Aldrich; Chemie GmbH. Steinheim Germany and Sherwood: Paddocks, Cambridge, UK) were used to determine Na, and Cl of the foods. Digestion of one gram freeze dried meat samples was completed using a CEM microwave system Model Mars 907511 (CEM Cooperation, Mathews, North Carolina, USA) with a maximum temperature of 200°C in closed polytetrafluoroethylene (PTFE) vessels. Ten milliliter of concentrated HNO_3 was added to each digestion vessels and heated to 200°C for a period of more than 30 minutes. The digest obtained was collected in 100 ml volumetric flasks and made up to volume. Measurements of minerals (g/100g DM) were carried out on an Atomic Absorption Spectrophotometer (AAS) system type Shimadzu Model AA-6800, equipped with GFA-EX7 240V CE Graphite Furnace, HVG-1 Hydride Vapor Generator, MVU-1A Mercury Vaporizer and ASC-6100 Auto Sampler (Japan).

Analysis of fatty acids

The fat content of each food sample was extracted following the method 991.36 [15] using petroleum ether for 8 hrs. The fatty acid profiles were quantified following the method described by Ayerza., *et al* [16]. Briefly, 0.2g of this extracted fat sample was mixed with 4 ml of chloroform: methanol (2:1), 1 ml of internal standard [heneicosanoic acid (C21)] was added and the mixture was left overnight at -20ºC. The mixture was then dried in a rotary evaporator at 40°C, suspended in 6 ml of diethyl ether, transferred to a test tube, dried under a stream of nitrogen, reconstituted with 1 ml of NaOH (0.5M), heated for 15 minutes at 100°C and then cooled in water. Two ml of BF_3/CH_3OH was added, mixed thoroughly, heated for 5 minutes at 100°C and then cooled. One ml of hexane and 2 milliliter of distilled water were added, mixed for 15 seconds and centrifuged at 3000 rpm for 5 minutes. The upper hexane layer was collected and extracted with 1 ml of hexane. Hexane extracts were passed over anhydrous Na_2SO_4 and transferred into a 2 milliliter GC vial, GC Agilent 6890N with flame ionization detector were used to quantify fatty acids. Fatty acids were separated with a SUPELCO SP-2560 (100m length x 0.250 mm I.D. x 0.200 µm film thickness). Helium was used as a carrier gas at a constant flow of 1.0 mL/min. The injection and detector temperatures were 250°C and 255°C, respectively. The oven temperature program was 80°C at a rate of 4°C/min and then was held at 240°C for 15 minutes. Fatty acids were identified by comparison of their retention times with that of the Heneicosanoic acid internal standard (ISTD). The total fatty acid content was calculated as mg/g = (area of sample/area of ISTD) × (amount of ISTD (mg)/sample weight (g) = mg/g. Sigma-Aldrich, CH9471, Buches, 081/75525-11 (Germany) were used as standards to identify individual fatty acids. The long-chain n-3 PUFAs (viz EPA, DPA and DHA) have not been measured.

Statistical analysis

Statistical analysis was carried out using the analysis of variance procedure [17] to evaluate the effect of food types (fast and traditional foods) on proximate analysis, minerals, fatty acids, and TFAs concentrations. A General Linear Model procedure (PROC GLM; SAS, Institute, Inc., Cary, NC, USA [18] was used. A nested ANOVA model was used in which concentration of nutrients was nested within each food type. All statistical tests of LSM were performed for a significance level $P < 0.05$, $P < 0.001$ and $P < 0.001$. Significant differences between means were assessed using the least-significant-difference procedure.

Results

The variation in nutritional values between the different food samples may reflect the different ingredients used and cooking methods applied for each food type (Table 1 and 2). The results shows that a significant variations in moisture content between different fast foods, with the highest value for the MBM3 sample and the lowest in the PM1 sample (Table 1). PM1 sample had significantly ($P < 0.001$) higher protein content (20.32%) than CBM (3.21%) with the other fast foods sample protein values were in between. A significant differences in

salt content between 11 fast food samples, with the MBM3 sample had significantly ($P < 0.01$) higher salt (1142 µg/kg) than FCM1 sample (947 µg/kg). Similar pattern was found in traditional food samples, with the Harees sample had significantly ($P < 0.01$) higher moisture (76.74%) and salt (1211 µg/kg) than shawa sample (52.43% moisture and 594 µg/kg salt). However, for Protein content, Shawa sample had significantly higher ($P < 0.01$) protein (22.61%) than Korose (3.21%) (Table 2).

Fast Food Type	Moisture %	Protein %	Fat %	Ash %	Salt µg/kg
FCM1	42.65	10.21	27.03	5.47	0947
FCM2	43.13	10.09	28.01	5.67	0957
PM1	31.27	20.32	11.05	4.45	1083
PM2	32.02	19.03	12.54	4.56	1091
MBM1	48.14	17.91	22.54	3.47	0320
CBM	49.33	19.00	18.56	3.56	0323
MBM2	42.38	12.72	24.50	3.61	0120
CBM	40.96	03.21	23.93	3.34	0923
MBM3	52.56	11.23	20.79	3.17	1142
MSM	32.46	19.02	12.09	4.42	1057
CSM	34.02	18.92	10.96	4.34	1051
Significant[1]	***	***	***	NS	**

Table 1: *Proximate composition (mean of 5 fast food samples) of Fried Chicken Meat One (FCM1), Fried Chicken Meal Two (FCM2), Pizza Meal One (BM1), Pizza Meal Two (BM2), Meat Burger Meal One (MBM1), Chicken Burger Meal (CBM), Meat Burger Meal Two (MBM2), Cheese Burger Meal (CBM), Meat Burger Meal Three (MBM3), Meat Sandwich Meal (MSM), Chicken Sandwich Meal (CSM).*

*[1]NS: Not Significant, **(P 0.01), ***(P < 0.001).*

	Moisture %	Protein %	Fat %	Ash %	NaCl µg/kg
Harees	76.74	22.61	20.80	4.69	1211
Shuwa	52.43	38.79	36.23	1.77	594
Korose	56.68	5.34	8.35	4.82	916
Significant[1]	**	***	***	**	***

Table 2: *Proximate composition (mean and SEM) of Harees, Shuwa, and Korose as a selected traditional Omani foods.*

*[1]NS: Not Significant, ** (P 0.01), *** (P < 0.001).*

The total fat content in the present study ranged from10.96 to 28.01% in the fast food samples, and from 7.99 to 36.23% in selected traditional food samples. Six fast foods samples contained more than 20% (20.79 - 28.01%) total fat and in five samples the range of total fat was between 10.96-18.56% (Table 1). The three traditional foods analyzed had a total fat content between Korose (8.35%) and shuwa (36.23%) with Harees (20.86%) in between.

The fatty acids content in each food samples are presented in table 3 and 4. Higher amounts of SFAs were found in the PM2, PM1, MBM2, CBM, MSM, CSM, MBM1 and CBM (96.1, 91.7, 85.7, 57.5, 55.8, 59.5 and 58.8 g/100g, respectively). Myristic acid (C14:0) was the most common SFA, followed by lauric acid (C12:000) and then margaric acid (C17:00) in the selected food types (Table 3 and 4).

Fatty acid (g/100g)	FCM1	FCM 2	PM1	PM2	MBM1	CBM	MBM2	CBM	MBM3	MSM	CSM	Sign.[1]
Saturated fatty acids (SFA)[2]												
C10:00	1.36	1.37	0.75	0.78	1.34	1.33	5.17	1.23	2.34	1.33	1.25	NS
C12:00	0.61	0.63	5.46	5.87	11.7	11.5	31.7	30.1	12.7	11.5	11.1	**
C14:00	3.28	3.34	35.6	36.8	32.1	31.7	47.3	46.9	21.4	30.8	30.1	***
C15:00	0.03	0.04	29.8	30.5	0.01	0.02	0.05	0.02	0.04	0.01	0.01	***
C16:00	0.02	0.03	0.01	0.02	0.01	0.03	0.01	00.0	0.01	0.02	0.02	NS
C17:00	0.30	0.32	13.4	12.6	8.51	8.66	0.28	0.31	2.76	8.21	8.01	***
C20:00	0.01	0.02	10.2	10.6	5.64	5.46	7.07	7.01	3.01	5.51	5.23	***
C21:00	0.74	0.75	0.11	0.16	0.07	0.05	0.05	0.03	0.01	0.06	0.05	NS
C24:00	1.89	1.98	0.70	0.69	0.07	0.06	0.07	0.05	0.02	0.06	0.04	*
Total SFA	8.27	8.48	96.1	98.0	59.5	58.8	91.7	85.7	3,80	57.5	55.8	**
TFAs TFA)[3]												
C14:1w5	0.01	0.02	2.58	2.59	0.01	0.01	0.01	0.01	0.01	0.01	0.01	*
C18:1w9	12.6	12.6	18.9	19.2	11.6	11.9	0.11	0.01	2.85	11.1	11.0	***
C18:3w3	29.8	30.2	11.5	11.8	10.5	10.4	10.1	10.0	28.1	10.2	10.0	**
C20:2w6	8.89	8.91	20.9	21.4	0.03	0.02	35.5	33.6	9.15	0.02	0.01	***
C19:2w2	0.02	0.03	0.03	0.05	66.7	65.7	0.20	0.19	0.11	35.7	34.9	***
C22:1w9	2.28	2.30	0.01	0.03	1.29	1.21	0.15	0.02	0.02	1.25	1.23	***
C22:2w6	1.02	1.05	10.6	10.7	2.54	2.45	7.48	5.98	9.68	2.35	2.23	**
C24:1w9	0.07	0.09	0.12	0.11	0.03	0.02	0.05	0.35	0.17	0.02	0.02	NS
C22:6w3	0.43	0.45	0.14	0.12	0.02	0.02	0.66	0.06	0.47	0.01	0.01	NS
Total TFA	55.1	55.7	64.8	66.0	92.7	91.7	54.3	50.2	50.6	60.7	59.4	**
Total FA	63.4	64.2	160.9	164	152.2	150.5	146	135.9	54.4	118.2	115.2	***
%TFA	86	86	40	40	60	60	37	37	93	51	51	**

Table 3: *Total fatty acids, SFA and TFA composition (g/100g) of fast meal samples (Fried Chicken Meat One (FCM1), Fried Chicken Meal Two (FCM2), Pizza Meal One (BM1), Pizza Meal Two (BM2), Meat Burger Meal One (MBM1), Chicken Burger Meal (CBM), Meat Burger Meal Two (MBM2), Cheese Burger Meal (CBM), Meat Burger Meal Three (MBM3), Meat Sandwich Meal (MSM), Chicken Sandwich Meal (CSM)).*

*[1]Signi: NS not significant, * (P < 0.05), ** (P < 0.01), *** (P < 0.001).*

[2]: Saturated fatty acid: Capric acid C10:0 (Decanoic acid, Methyl ester), Lauric acid C12:00 (Dodecanoic acid, methyl ester), Myristic acid C14:00 (Methyl Teradecanoate), Pentadecylic acid C15:00 (Pentadecanoic acid, Methyl ester), Palmetic acid C16:00 (Hexadecanoic acid, methyl ester), Margaric acid C17:00 (Heptadecanoic acid, methyl ester), C20:00 (Docosanic acid, Methyl ester), C21:00 (Heneicosanoic acid, methyl ester), C24:00 (Tetracosanoic acid, methyl ester).

[3]TFAs: Tetradecenoic acid C14:1w5 (Methyl Myristoleate), Oleic acid C18:1w9 (9-Octadecenoic acid (Z), methyl ester), Alpha linolenic acid C18:3w3 (9-12-15-Octadecenoic acid, methyl ester), Arachidonic acid C20:2w6 (cis-11,14-Eicsadienoic acid, methyl ester), Linoleic acid C19:2w2 (9,12,15-Octadecatrienoic acid, Methyl ester), Erucic acid *C22:1w9 (13-Docosenoic acid, methyl ester), Docosadienoic acid C22:2w6 (cis-13-16-Docasadienic acid, methyl ester), Nervonic acid C24:1w9 (15-Tetracosenoic acid, Methyl ester), Doscosahesaenoic acid C22:6w3 (4,7,10,13,16,19-Docosahexaenoic acid, methyl).*

Fatty acid	Hareese	Shuwa meat	Korose	Sig.[1]
Saturated fatty acids[2]				
C10:00	0.43	0.55	5.26	**
C12:00	3.48	6.29	4.96	NS
C14:00	13.7	43.2	10.6	***
C15:00	0.06	38.8	0.17	***
C16:00	0.00	0.02	0.02	NS
C17:00	0.09	13.6	0.46	***
C20:00	3.88	11.7	1.04	**
C21:00	0.36	0.27	0.07	NS
C24:00	0.56	0.47	0.02	NS
Total Saturated Fatty Acid	22.6	114.9	22.6	***
Trans fatty acid[3]				
C14:1w5	0.04	10.0	0.07	***
C18:1w9	15.6	49.1	0.19	***
C18:3w3	37.7	24.4	0.24	***
C20:2w6	6.97	2.78	39.2	***
C19:3w3	0.01	0.01	0.08	NS
C22:1w9	0.99	1.28	0.09	NS
C22:2w6	3.30	10.9	4.66	*
C24:1w9	0.04	0.04	0.02	NS
C22:6w3	0.24	0.46	0.87	NS
Total Trans FA	64.9	99.0	45.4	**
Total Fatty Acid	87.5	213.9	68.0	***
%TFA	74	46	66	*

Table 4: *Total fatty acid, SFA and TFA composition of Omani traditional food meal samples (Harees, Shuwa, and Korose).*

*[1]Signi: NS not significant, *(P < 0.05), **(P < 0.01), ***(P < 0.001).*

[2]Saturated fatty acid: Capric acid C10:0 (Decanoic acid, Methyl ester), Lauric acid C12:00 (Dodecanoic acid, methyl ester), Myristic acid C14:00 (Methyl Teradecanoate), Pentadecylic acid C15:00 (Pentadecanoic acid, Methyl ester), Palmetic acid C16:00 (Hexadecanoic acid, methyl ester), Margaric acid C17:00 (Heptadecanoic acid, methyl ester), C20:00 (Docosanic acid, Methyl ester), C21:00 (Heneicosanoic acid, methyl ester), C24:00 (Tetracosanoic acid, methyl ester).

[3]TFAs: Tetradecenoic acid C14:1w5 (Methyl Myristoleate), Oleic acid C18:1w9 (9-Octadecenoic acid (Z), methyl ester), Alpha linolenic acid C18:3w3 (9-12-15-Octadecenoic acid, methyl ester), Arachidonic acid C20:2w6 (cis-11,14-Eicsadienoic acid, methyl ester), Linoleic acid C19:2w2 (9,12,15-Octadecatrienoic acid, Methyl ester), Erucic acid C22:1w9 (13-Docosenoic acid, methyl ester), Docosadienoic acid C22:2w6 (cis-13-16-Docasadienic acid, methyl ester), Nervonic acid C24:1w9 (15-Tetracosenoic acid, Methyl ester), Doscosahesaenoic acid C22:6w3 (4,7,10,13,16,19-Docosahexaenoic acid, methyl).

TFAs were found in all fast food samples, with concentration ranging from 39% to 93% of total fatty acids (Table 3). Similar pattern was found in the traditional food samples with the range from 46% to 74% (Table 4). The most common TFA in fast foods is linolenic acid (C18:3w3) which is commonly presented in all fast food samples (range from 10 to 30.2 g/100g). Linolenic acid (C18:3w3) was significantly ($P < 0.01$) higher in FCM2, FCM1, MBM3 (30.2, 29.8 and 28.1 g/100g, respectively) than PM2, PM1, MBM1, CBM, MBM2, CBM, MSM and CSM (11.8, 11.5, 10.5, 10.1, 10.1, 10.0, 10.2, and 10.0 g/100g respectively). The second most abundant TFA was oleic acid (C18:1w9) followed by Arachidonic acid (C20:2w6). MBM3 and PM1 samples contain the highest amount of oleic acid (C18:1w9), while MBM2 and CBM had significantly ($P < 0.001$) the highest arachidonic acid (C20:2w6) than the other fast food samples. The most abundant TFA in traditional foods was linolenic acid (C18:3w3). The Harrees had significantly ($P < 0.05$) the highest linolenic acid (C18:3w3: 37.7 g/100g than Showa (24.4 g/100g) and Korose (0.24 g/100g). However, Showa meat sample had significantly ($P < 0.05$) higher oleic acid (C18:1w9: 49.1 g/100g) than Harress (15.6 g/100g) and Korose (0.19 g/100g). On the other hand, Korose sample had significantly ($P < 0.05$) higher Arachidonic acid (C20:2w6: 39.2 g/100g) than Harress (6.97 g/100g) and Showa meat samples (2.78 g/100g). The present study revealed that the total fat, SFAs, TFAs or salt with selected fast and traditional foods meals exceeding the recommended levels for all measures. The majority of the selected foods provided total fat, SFA, TFAs and salt more than a guideline daily amount in a single meal, which is of particular concern. The guideline daily amount is not a target for consumption, and so its use is a relatively conservative approach, and replacing SFA with PUFA will reduce risks of heart disease.

Discussion

The results of this study revealed significant differences in nutrient composition of eleven fast foods and three traditional food meal samples in Oman. This large variation reflects the current situation of the literature. The total fat content does not only vary depending on the food product, but can also vary for the same product of one company when purchased in different countries; for instance, the total fat content of a fast food snack consisting of 171g French fries and 160g chicken nuggets ranged from less than 1g in Germany to 24g in Hungary [19]. Similarly, studies showed significant differences in the nutrient composition of different types of food meals (Indian, Chinese, English, pizzas, kebabs) [20] as well as between fast food meals options of a similar type [21,22]. The levels of salt are of even more concern. Salt consumption has a profound effect on hypertension and the risk of heart disease.

Consumers have no ability to recognize the nutritional and energy density of fast and traditional foods consumed and how to regulate the amount of food eaten to maintain energy balance. According to Rolls [23], people tend to consume a similar amount of food every day regardless of variations in energy density, which it may result in an increase in energy intake. Most of the studies support the conclusion that the energy density of consumed food is a crucial determinant of energy intake [24]. A positive relationship was observed between the energy density of the diet and fast food consumption [10]. The current study showed that most of the selected food items contained high amount of fat (high energy), which may have a negative impact on consumers' health. The high levels of fat intake commonly associated with fast food consumption may be a factor leading to obesity development that is independent of total energy intake. Epidemiological studies showed a relationship between fast food consumption and increased body mass index (BMI) and obesity [25,26]. Fat intake has a higher adipogenic effect than total energy intake [27]. Overweight and obesity are now dramatically on the rise in Oman and around 60% of adults in Oman were overweight or obese. Overweight and obesity are major risk factors for a number of chronic diseases, such as diabetes, cardiovascular diseases and cancer. Body mass index was increased by 0.14 and 0.53 kg/m^2 for every 500 kcal of total energy intake and 500 kcal energy derived from fat, respectively. Schröder., *et al.* [28] stated that consumption of fast food more than once a week increased the risk of being obese by 129%. Furthermore, consumption of fast food two times or more per week associated with a 25 to 31% higher prevalence of moderate abdominal obesity [10]. On average, regular consumption of fast food meals was related to an increase in energy intake of 56 kcal/day [29] and 187 kcal/day [10] among adults and children, respectively. It has been shown that a fast food meal tends to be energy dense and contains twice the recommended energy density of a healthy diet [30]. In addition, there is evidence that increased density of fast foods is associated with increased consumption of fast foods and levels of obesity. Amount of fat content and the type of fatty acids in fast and traditional foods are important. The present results revealed that high saturated fatty acids

in the fast and traditional foods used may not only lead to a higher risk of obesity development, it may also have other adverse health effects. Although not all saturated fatty acids affect plasma lipid and lipoprotein concentrations in the same manner, they can increase total and HDL levels [31]. According to Parodi [32], despite increase low density lipoprotein (LDL) levels, saturated fatty acids also increase the high density lipoprotein (HDL) level. Similar to saturated fatty acids, TFAs increase plasma LDL level but did not increase HDL level [33]. According to Risérus., *et al.* [34] a diet rich in saturated fatty acids is associated with a higher risk of impaired glucose tolerance, insulin resistance, and type 2 diabetes. Kurahashi., *et al.* [35] found that myristic and palmitic acids increased the risk of prostate cancer in a dose-dependent manner. There is also evidence suggesting a possible relationship between saturated fatty acid intake and a modest increase in breast cancer risk [36]. On average, fast food is characterized by a high total fat and saturated fatty acid content. According to Stender., *et al.* [37], french fries and fried chicken purchased from McDonald's and KFC outlets in 35 countries worldwide, total fat content varied from 41 to 74g depending on the country. Similar values were found in the current study in fast food meals available in local markets. Some of saturated fatty acid values in the present study are higher than those reported by Dunford., *et al.* [38] which found that fast foods such as burgers, chicken products, sides, or pizzas contained between 10 and 13g of total fat and between 3.9 and 4.9g of saturated fatty acids per 100g. In the current study, Myristice acid (C14:00) was the major saturated fatty acid component, in range of 3.28 in FCM1 to 47.3 g/100g in MBM2 and margaric acid (C17:00) in a range of 0.30 in FCM1 to 12.6 g/100g in PM2. In this respect, Seddigheg., *et al.* [39] reported that stearic acid was the major saturated fatty acid component followed by palmitic acid in fast food samples. Total fat intake was significantly higher among people who consumed fast food meals (burgers, fried chicken, fried fish, Chinese food, pizzas, or Mexican food) at least once a week when compared to those who had never consumed fast food meals [40].

In general, most of the fast foods contain high amounts of saturated and TFAs were likely to be fat blends containing fat from both industrial and ruminant origins. In equal amounts, the major ruminant TFA is as bad for LDL cholesterol as industrially produced TFAs, but the latter are easier to remove from foods [41]. Furthermore, C18:1 trans isomer comprises of approximately 80 - 90% of total TFA in fast foods [42]. Unfortunately, it should be mentioned that most of the TFAs found in fast foods contain trans C18:1 isomers. Elaidic acid (C18:1 9t) typically is the major isomer in industrially-produced TFA. The concentration of the C18:1 [43] trans isomer was from 0.1 % (in sausage) to 0.3 % (in pizza). Plasma concentration of elaidic acid (C18:1 9t) is higher in colon adenoma patients than that in healthy controls, which may lead to cancer development [44,45], Moreover, formation of TFAs during food frying is related to the temperature and the number of time of usage of fat or oil, which is nutritionally undesirable [46,47]. Fast food outlets in some countries have been successful at maintaining the quality of their food products while considerably reducing their TFA content. In the current study, high levels of TFA were found in selected fast or traditional food meals, and TFA is a chemical to be scrupulously avoided because TFAs are linked with poor health outcomes, therefore, their levels should be reduced. In Oman, the content of TFAs in fast and traditional foods can be reduced by decreasing the amount of partial hydrogenated fat usage in the preparation of foods. Governmental legislation to subsidize un-hydrogenated rather than partially hydrogenated oils would be a good strategy in this regard. It is entirely legitimate for the authorities to consider the powers they have to enforce a TFA reduction, as a response to traditional public health issues.

Although, TFAs are one component in triacylglycerol and phospholipids and exist in foods consumed every day, they are undesirable components of the diet due to negative physiological effects. The TFA content of fast foods in traditional markets ranged from 39% in MBM2 and 93% in MBM3, while the same type of fatty acids in traditional food samples was ranged from 46% in Shawa meat to 74% in Harress. Similar study was carried out by Seddigheg., *et al.* [39] in Middle East fast foods and found the range from 24% to 31%, which is lower than that of the present findings. However, this is the first study that measures the TFA content of the fast and traditional food types. Many studies demonstrated numerous health adverse effects associated with consumption of TFAs such as inflammation, diabetes, insulin resistance, obesity, decreased HDL and apolipoprotein A1 concentrations, and increased total cholesterol, lipoprotein, apolipoprotein B levels and coronary heart disease [2,33,48-52]. In this respect, de Souza., *et al.* [53] reported that a 2% increase in energy intake from TFAs was associated with a 25% increase risk of coronary heart disease and 31% increase in coronary heart disease mortality. The study of Nagao., *et al.* [54] indicated that the addition of trans-5-18:1 significantly increased the secretion of apolipoprotein B among isomers

that suggested the adverse effects of TFAs were also affected by the double bond position of TFAs. From these studies, it is clear that the quality of TFA isomers must be considered when investigating the role of TFA consumption on heart disease. Recently, Gotoh., *et al.* [55] stated that the intake of TFAs in fast foods changes the ratio of LDL to HDL in blood, which causes cardiovascular disease. The negative health effects of TFA have been attributed mainly to TFA in general or TFA of industrial origin and some studies have suggested that natural TFA might have beneficial properties [56]. It should also be mentioned that TFAs are transferred from the mother to the fetus across the placenta and present in breast milk [57]. Zhao., *et al.* [51] stated that TFAs are pro-inflammatory due to the fact that it involves TFAs incorporation into endothelial cell, white blood cells and adipocyte cell membrane. The latest authors concluded that some of the deleterious actions of the TFAs such as increasing insulin resistance have been attributed to its pro-inflammatory action. Therefore, the TFAs concentration in fast and traditional foods might have an important role in these kinds of diseases among Omani population. According to the different levels of fats and oils used in manufacturing, the TFAs content of fast foods, vary greatly between countries. The present study showed that fast foods, particularly meat, cheese and deep-fried chickens contained a high amount of TFAs. It has been reported that a single meal of fried chicken (160g) purchased from fast food suppliers provided from 0.3 to 24g of TFAs [37], which lower than those reported in the present study (63.4 and 64.2 g/100g for FCM1 and FCM2, respectively). Moreover, a study by Tyburczy., *et al.* [58] showed that the content of TFAs in 32 different fast-food samples ranged from 0.1 to 3.1 g per serving. It has been assessed that individuals who frequently consume fast-food meals could be receiving between 6 and 12% of their dietary energy from TFAs and a single meal of fried chicken with chips may deliver four times more TFAs than the daily recommended. TFA might be generated during the deodorization step of edible oil refining therefore, attention should be directed towards oils used when investigating TFA. In Oman, legal requirements regarding the use of TFAs in fast foods should be implemented. The initiative obligate all fast food outlets to use oils, shortenings, and margarines containing less than 0.5g of TFAs per serving and involve reformulating all food items to contain less than 0.5g of TFAs per serving. Furthermore, legislation on fast food labeling, such as the mandatory warning of "high salt product" on food products in which the salt concentration exceeds set limits, has been shown to be a useful tool to reduce salt intake in the population. Suitable guidelines should also be developed in Oman to stop the practice of re-using the same oil and maintaining a specific temperature during frying because repeat heating/frying will increase the TFAs as well as saturated fatty acids. The collaboration of nutritionists, chefs and government authorities should require the alteration of the fast food processes with the goal of improving the nutritional value of meals. These restrictions will result in significant decreases in the TFA content and improve the nutritional quality of fast foods consumed.

Conclusion

People in Oman are exposed to large portion sizes and high levels of fats, SFAs, TFAs and salt in fast foods and certain traditional food meals. They have limited options to break out of these readily accessible and cheap fast foods. A government authority is required to intervene by the use of planning and regulatory powers; educational interventions targeting consumers and businesses; stimulating demand for healthier meals; adapting the roles of Council enforcement officers to persuade the industry to promote healthy food preparation techniques; and launching a traditional social marketing campaign. Further study should determine the amount of TFAs intake from fast foods consumed by Omani with their age categories, as well as determining the possible effects on human health.

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Declaration of Interest

The authors have no relevant interests to declare.

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