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Chemical Composition and Nutritive Value of Cream-Based Cakes from Different Brands with Special Focus on Saturated and Trans Fatty Acids Hazard

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Abstract

In this study, the selection of samples from different levels of pastry chains and local markets as well aimed to assess the influence of price and brand name; which may be considered at the moment of cake selection, on the nutritional quality and safety of the final served product.The moisture, ash, protein, fat, fiber, and available carbohydrate contents of 30 cake samples produced locally in Egypt from different brands pastry shops divided into international, national, and local brands were determined. Results explored that the highest average moisture content was recorded for the international brand (45.7 %), followed by the local brand (42.8 %), while for the national brand, it was 40.9%. The international brand samples' results were the highest in protein% (4.8) and the lowest in Ash% (3.5), while the national brand samples were the highest in average fat% (19.5) and the local brand samples were the highest in average carbohydrates% (36.1). Average protein content appeared to be very close in percent throw groups with 4.8, 4.5, and 4 in international, national, and local brands, respectively. Also, the total energy in a piece of cake was calculated by analyzing total fat, protein, and carbohydrate contents. The highest average caloric content was found in national brand samples (317.9 Kcal), 53.1% of this energy content was accredited to fat content. Different studies were subjected to the side effect of pastries on human health all over the world but these studies were slightly deficient in Egypt, our study aimed to determine the nutritional quality of cake samples by finding out the type of fatty acids used in processing through analyzing the fatty acid profile (SFA, MUFA, PUFA & Trans FA), in addition, Lipid Nutritional Quality Indices (LNQI) were evaluated from the composition data of fatty acids. Data presented in this study showed bad effect of Cream based cakes consumption in Egypt especially from the local brand shops due to its high saturated fatty acid content with the highest incidence of TFA (4.5%) and high caloric value from carbohydrates content (52.8%) especially on high risk people with chronic disorders and eldery. Also it was noticed that the high price of international brand product is in equivelant with its chemical composition and good quality as it is more healthier than other brands.

KEYWORDS
Cream-based cakes, Chemical composition, Caloric value, Saturated fatty acids, Trans fatty acids

INTRODUCTION

Cakes are a type of confectionaries that consists mainly of fat, water, flour, and sugar, in addition to milk, egg, fruit, or any flavor that could be added, they are served either filled or coated with fruits, nuts, cream, chocolate, jam or custard. The major constituents; fat and sugar, give fundamental structural and textural features, as well as sensory and pleasant properties for cakes, so we must magnify attention on their health side effects, especially from the side of fatty acids. Commonly, choosing the type of fat for cake processing is intensely dependent on technological properties and economic considerations, without bearing in mind the nutritional impact (Voysey and Legan, 2014).

Lately, people became more careful with their daily diet intake and special attention to the fat, protein, and carbohydrate intake regarding their type, amount, and source. European Union standards started from 13th Dec. 2016 to obligate the manufacturers to include nutritional information as part of the necessary food data to the customer, including energy value, total fat content, saturated fatty acids (SFA), carbohydrates, sugars, proteins, and salt (José *et al*., 2020).

Water activity in baked products is a significant element that contributes to microbial stability, the lower the moisture availability the higher the organoleptic and mold shelf life of such products, also, water content regulates the success of food producers in maintaining specific characteristics of cake to reach consumer satisfaction, loyalty, and ultimately revenue and profits (Cauvain and Young, 2010).

Fat is classified into two groups; saturated (SFA) and unsaturated group (USFA) including monounsaturated (MUFA) & polyunsaturated fatty acids (PUSFA), it contains essential fatty acids and the fat-soluble vitamins A, D, E, and K. In addition to protecting body organs from shock, maintaining body temperature, and fostering proper cell function, fat also plays a role in maintaining healthy skin and hair, fat also acts as a helpful barrier against a variety of illnesses (Dariush *et al*., 2006).

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According to the Government of the United Kingdom 1996, each gram of fat when burned or metabolized releases about 9 kcal. An intake of 70 g of fat per day is recommended for a healthy adult (among which 20 g saturated) according to Regulation (EU) no. 1169/2011 (EU, 2011), considering an energy intake of 2000 kcal (8400 kJ) per day.

According to World Health Organization, about one-third of all global deaths were due to cardiovascular diseases such as coronary heart disease and stroke, SFA elevates total and low-density lipoprotein cholesterol especially those of 12—16 carbons, some clinical trials prove that using polyunsaturated vegetable oils instead of trans (TFA) and saturated fatty acids could decrease the risk of coronary heart disease and lower plasma cholesterol concentrations (total and LDL) (WHO, 2003).

In observational epidemiological studies, a high saturated fat intake has been associated with a higher risk of impaired glucose tolerance, higher fasting glucose, and insulin levels, and higher proportions of saturated fatty acids in serum lipid or muscle phospholipid have been associated with a higher risk of type 2 diabetes (WHO, 2003).

Unfortunately, Egypt occupies one of the advanced ranks in the world (ranked third) in the consumption of trans fats, and it is one of the fifteen countries in the world in which deaths occur because of chronic heart diseases (80 % of the total deaths in the world because of chronic heart diseases) (Wang, 2016; Cobb *et al*., 2019).

Partially hydrogenated vegetable oils (PHOs) containing TFA are widely used in the food industry, as they are low in cost compared to other fats, have a longer shelf life, as well as they add desirable characteristics to the food (Zupanič *et al*., 2018). In 2015, the Food and Drug Administration issued a final ruling that PHOs are not generally recognized as safe (GRAS) as they are the primary dietary source of artificial TFA in processed food and were related to serious health concerns. It's crucial to remember that trans-fat will still be present in food because it naturally occurs in very minute amounts in other edible oils and meat and dairy products. The monoglyceride organogels (monoglyceride emulsion and palm oil or monoglyceride and sunflower oil) are used as substitutes for trans- and saturated fats in Europe (Ramon *et al*., 2020). Although different countries have implemented measures for lowering the amount of TFA in different foods, others have implemented specific legislation regarding the content of TFA in foodstuffs, Denmark being the first EU country to set up a maximum of 2% TFA of total fat in products (Tânia *et al*., 2017).

Proteins in food are converted into amino acids through the denaturation process, while some amino acids are converted to glucose or go into the citric acid cycle, some amino acids are needed for the production of protein. Humans must obtain some of the amino acids from the diet [essential amino acids] as they don't have the key enzymes that synthesize these amino acids (Alex and Janet, 2005).

Ash content refers to the total inorganic (mineral) content in foods, high levels of such metals in lipid-rich foods may increase rancidity and limit shelf life, minerals can play an important role from a physicochemical, toxicological, technological, nutritional, and food quality standpoints (Harris and Marshall, 2017).

Carbohydrates are significant components of food and important factor in improving health & fitness, they take place in different forms like sugar, starch, fibers, etc., which are dietary fundamental, and the oxidation of carbohydrates is the central energy-yielding pathway (Suman *et al*., 2008). On the other side, it is believed that eating meals with a high glycemic index increases insulin resistance, which raises the chance of developing diabetes mellitus, obesity, cardiovascular disease, and several malignancies (Neuhouser *et al*., 2006).

Therefore, our study aimed to assess the existing situation on the chemical composition and nutritional value of cream-based cakes with their different categories in the Egyptian market, with special reference to saturated and trans-fats and their impact on human health.

MATERIALS AND METHODS

Sampling

During the period between October 2021 and April 2022, 30 cream-based cake samples were randomly gathered from great Cairo governments pastry shops, collected samples were representative of 3 categories according to shop brand: International chains, national chains, and local shops. Samples were randomly selected with different types of topping, filling, and decoration (plain cream, chocolate cream, caramel, ganache, syrup, fruits, nuts, biscuits, choco chips, and chocolate bars) to cover several types as possible.

Collected samples of brands and categories were selected based on data collected in an online survey including about 1300 Egyptian consumers considering their preferable needs (Esraa *et al*., 2022). Samples were transferred immediately in an insulated ice box to our laboratory for analysis as early as possible without delay.

Samples preparation (Taylor et al., 2015)

Upon reception of samples selected for the study at the laboratory, they were homogenized properly in a blender (Grindomix GM200, Retsch, Haan, Germany) at 5000 rpm for 1 minute, to obtain composites from each sample, prepared samples were stored in tightly closed plastic containers and kept frozen till complete analysis. Analysis was carried out as soon as possible to avoid any chemical changes affecting the accuracy of results.

Samples for Chemical Analysis (AOAC, 2016)

Previously homogenized stored samples were firstly thawed at room temperature then about 10 g of each sample were weighed (using electronic balance HL-523A+) in a porcelain cup for dryness in a hot air oven (Eco cell, Monroe, US) to calculate the moisture and total solids content. Part of the dried samples was subjected to ash content measurement using a muffle furnace (Selecta, MOD. 367 PE), while the fat content was purified from the other part using the Soxhlet method, afterward, fatty acid analysis was performed for 10 randomly selected samples using an automated Gas-Liquid Chromatography (Agilent 6890) equipped with DB23, 60 m × 0.32 mm × 0.25 µm capillary column (Agilent Technologies Inc., CA, USA). Approximately 1g of the homogenized samples was used for the determination of protein content using Kjeldahl Method. The protein content of the cake products was calculated from nitrogen by using a conversion factor of 5.70; suitable for wheat-based products as described in FAO, 2003. Finally, total carbohydrates were calculated by difference (Dashti *et al*., 2001).

Energy content (Regulation EU no. 1169/2011) (EU, 2011)

To obtain energy content in a 100 g cake sample (Kcal), fat, protein, and carbohydrates were multiplied by 9, 4, and 4 factors respectively.

Lipid Nutritional Quality Indices (LNQI) calculation

Lipid Nutritional Quality Indices (LNQI) were evaluated from the composition data of fatty acids. The Atherogenic index (AI) and Thrombogenic index (TI) were calculated according to Ulbricht and Southgate (1991), The nutritional value was assessed by determining the total desirable fatty acids (DFA), total essential fatty acids (EFA), PUFA/SFA, as well as 18:0+18:1/16:0 according to Chen *et al*. (2016).

AI = (C12:0 + (4 × C14:0) + C16:0)/ (ΣMUFA + Σn-6 + Σn-3)

TI = (C14:0 + C16:0 + C18:0)/ [(0.5 × ΣMUFA) + (0.5 × Σn- 6) + (3 × Σn-3) + (Σn-3/Σn-6)]

DFA= MUFA+PUFA+C18:0

EFA= C18:2 + C18:3 + C20:4

RESULTS

Data illustrated in Figure 1 collectively summarized the average composition of the sample from each brand separately and showed that the highest average moisture content was recorded for the international brand (45.7 %), followed by the local brand (42.8 %), while for the national brand, it was 40.9%. The international brand samples' results were the highest in protein (4.8%) and the lowest in ash content (3.5%), while the national brand samples were the highest in average fat (19.5%) and the local brand samples were the highest in average carbohydrates (36.1%). Average protein content appeared to be very close in percent throw groups with 4.8, 4.5, and 4 in groups A, B, and C respectively.

Table 1. Chemical composition of cream-based cake samples from different brands [International, National & Local] (g/100 g).

Sample Serial No.	Brand	Moisture	Total Solids	Fat	Protein	Ash	CHO
1	International (Group A)	33.2	66.8	20.2	2.9	6.2	37.5
2		32	68	21.5	5.8	5.6	35.1
3		57.4	42.6	10.1	4.5	1.7	26.4
4		53.5	46.5	9.2	5.5	2	29.9
5		52.2	47.8	11.2	5.5	2	29.2
Average		45.7	54.3	14.4	4.8	3.5	31.6
SE		2.2	2.2	1.1	0.2	0.4	0.8
6	National (Group B)	34.8	65.2	17.5	5.3	1.9	40.5
7		35.8	64.2	11.8	5.6	4	42.9
8		50.7	49.3	9.8	4	2.9	32.5
9		50	50	7	3	2.4	37.5
10		30.9	69.1	26.7	4.1	4.8	33.4
11		42.1	57.9	31.2	8.9	7.8	10
12		50.4	49.6	29.7	3.8	6.5	9.6
13		55.2	44.8	19.8	3	5.5	16.5
14		20.1	79.9	36.2	4.1	2	37.6
15		38.8	61.2	5.2	3	2	51
Average		40.9	59.1	19.5	4.5	4	31.2
SE		2	2	2	0.3	0.4	2.6
16	Local (Group C)	34.1	65.9	19.9	4.6	6.2	35.1
17		63.3	36.7	8.5	5.4	7.9	14.9
18		32	68	11.4	4.4	2	50.3
19		32.8	67.2	12.3	5.4	2.3	47.3
20		41.8	58.2	11.8	6	3.9	36.6
21		36.9	63.1	16.1	3	4.9	39.2
22		40.1	59.9	11.3	3.9	3.8	40.9
23		45.1	54.9	12.5	4.9	5.8	31.6
24		43.2	56.8	8.5	3.9	1.9	42.5
25		47	53	11.3	3.3	5.6	32.8
26		51.6	48.4	4	3.3	5.6	35.5
27		39.5	60.5	19.1	4.4	6.8	30.3
28		41.8	58.2	15.3	2	2.4	38.5
29		51.7	48.3	9.6	4	4.9	29.9
30		40.5	59.5	19.3	1.5	2.9	35.8
Average		42.8	57.2	12.7	4	4.4	36.1
SE		1.5	1.5	0.8	0.2	0.3	1.5
Average of all samples		42.6	57.4	15.3	4.3	4.1	33.7
SE		1.8	1.8	1.4	0.3	0.4	1.9

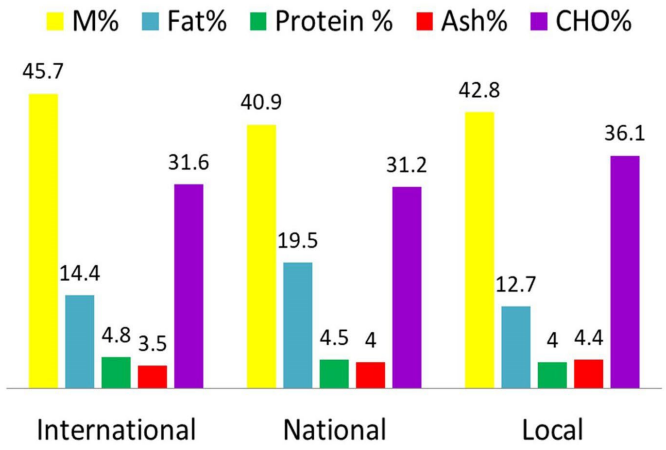

Fig. 1. Average composition of cream-based cake samples for different brands [International, National & Local] (g/100g).

Data in Table 2 explored that the average energy intake from a 100 g edible portion of cream-based cake was 289.3 kcal, 48.1% of this energy came from carbohydrates followed by 45.6% from fat and 6.2% from protein. The highest energy content was 492.7 kcal with an average of 317.9 kcal in group B which is related to high fat% (52.5%), while the lowest was 158 kcal with an average of 274.8 kcal and low fat% (41.0%) in group C. Group A showed an average energy content of 275.6 kcal.

The content of the major Fatty acids found in the studied samples is presented in Table 3; the sums for SFA, MUFA, PUFA and TUFA, and Trans-fat which correspond to all identified fatty acids are also included. The majority (90%) of the analyzed cake samples showed a prevalence of SFA in their composition above 56% of their total fatty acid content with two samples showing an SFA content of above 94%. The exception was found in sample number 8 which had a higher MUFA (oleic) (51.25%) than SFA content (40.2%). Trans fatty acids were found in 80% of examined samples with a maximum percent of 4.5 in sample 10 and minimum percent of 1.9 in sample 8 and an average of 2.5 % in all examined samples, the most abundant TFA was Oleic acid (C18:1n9t) and Linoleic acid (C18:2n6t).

Table 2. Energy content of cream-based cake samples (kcal/100g).

Sample	Brand (Group)	Energy (kcal)	Energy)kj)	% as fat	% as Protein	% as CHO
1	A	343.3	1433.9	52.9	3.4	43.7
2		357.3	1491.7	54.2	6.5	39.3
3		214	897.1	42.3	8.4	49.3
4		224.4	942.3	37	9.7	53.3
5		239	1001.9	42	9.2	48.8
Average		275.6	1153.4	45.7	7.4	46.9
6	B	340.5	1425.1	46.2	6.2	47.6
7		299.8	1259.6	35.3	7.5	57.2
8		234.6	984.7	37.7	6.8	55.5
9		390.8	1627.3	61.5	4.2	34.2
10		320.7	1326	83.3	4.7	11.9
11		255.9	1063	69.5	4.7	25.8
12		356.3	1475.3	78.8	10	11.2
13		492.7	2048.5	66.2	3.3	30.5
14		263	1111.1	17.9	4.5	77.6
15		224.9	947.3	27.9	5.3	66.8
Average		317.9	2326.8	52.5	5.7	41.8
16	C	338.3	1412.9	53.1	5.5	41.5
17		158	660.7	48.6	13.7	37.7
18		221.8	930.6	39	7.1	53.9
19		322.9	1348.2	53.8	1.9	44.4
20		261.8	1102.2	29	6	64.9
21		321	1350.2	31.9	5.5	62.6
22		313.6	1312.5	46.3	3.8	50
23		259.3	1086.2	43.6	7.6	48.8
24		246.3	1032.8	41.3	5.4	53.3
25		276.2	1159.1	38.4	8.6	53
26		321.2	1349.8	34.4	6.7	58.8
27		280.7	1178.9	36.1	5.6	58.2
28		191.5	808.7	18.9	6.9	74.2
29		310.3	1294.9	55.3	5.7	39
30		299.5	1253.6	45.8	2.7	51.5
Average		274.8	1152.1	41	6.2	52.8
Total average		289.3	1210.5	45.6	6.2	48.1
SE		12.2	50.4	2.8	0.4	2.8

DISCUSSION

Cream-based cakes filled with custard, cream, or sauces are considered the most popular pastry product worldwide, their ongoing appeal has sparked the creation of newer, more attractive items that are currently available in the market, they are often the dessert of choice at ceremonial occasions, particularly wedding anniversaries and birthdays.

Recently, numerous studies worldwide directed toward improving the nutritional quality of cakes using different additives and replacers to make cakes good, healthy, safe, and acceptable products to the consumer. In addition to Nermin and Hacer (2013), who tried to improve the nutritional properties of cake with wheat germ and resistant starch, another study was done by Samiha (2015) in Egypt, the author used orange and white sweet potato flour as a replacement for wheat flour in cake production to improve the final product quality and stability during storage.

Lately, food labels in the European Union must include nutritional information expressed in percentage units of "compositional data" for which specific statistical methods and models have been developed (José *et al*., 2020). Therefore, the chemical composition of 30 cream-based cake samples representing different brands (International, national & local) sold in the Egyptian market was studied.

Measurement of moisture is of great economic importance to a food manufacturer, and there are legal limits as to how much water must or can be present in some foods (Mauer and Robert, 2017). Data in Table 1, showed that moisture content for all samples varied from 20.1% to 63.3% with a mean value±SE of 42.6±1.8% (mean value±SE) of which was compatible with the Egyptian Standards for cakes (ES 4037, 2005); at which the moisture content ranged from 14-27% for different types of cakes. The optimal range of moisture content for a typical moist cake as mentioned by Cauvain and Young 2010 is between 25 and 30%. Moisture content in cake is a very important factor regulating the quality and stability of the final product, some cake types with high moisture content and rich nutrients are disposed to deteriorate by microbial contamination, leading to a short shelf-life and public health hazard (Voysey and Legan, 2014).

The dry matter that remains after moisture removal is commonly referred to as total solids (Mauer and Robert, 2017). The highest total solids content was 79.9% in sample 14 representing the national brand, which was linked to its high-fat content (36.2%). While for both international and local brands, the highest total solid percent was 68% which could be attributed to high sugar content (35.1% and 50.3%) international and local brands, respectively (Table 1).

The variable types and quantities of used ingredients affecting the final cake's chemical composition, especially fat content, and quality; were obvious in the data represented in table 1 which showed great variation in fat (4% to 36.2%). Criteria for choosing healthy fatty materials concerning their nutritional value and physical state for obtaining high-quality products are mandatory nowadays. Cake processing fat content doesn't depend only on hard fats but also liquid vegetable oils are extensively used with the aid of many synthetic and natural biopolymer-based stabilizing food additives (Renzyaeva, 2013).

In addition to the nutritive value of protein in any food subject, hydration properties, batter density and viscosity, cake characteristics, and consumer acceptability are affected by pro-

Table 3. Content of fatty acids and average of Saturated, MUFA, PUFA and Unsaturated fatty acids for the analyzed 10 cream-based cake samples (g/100 g).

Brand	1	2	3	4	5	6	7	8	9	10	Avg.
	A		B				C				
C8: 0 Caprylic acid*	1.13	2.45	1.33	0	1.73	1.16	0.81	0.39	1.8	2.46	1.38
C10:0 Capric acid*	1.75	2.88	2.43	1.56	2.41	2.17	1.29	0.71	2.42	2.08	2.05
C11:0 Undecanoic acid *	0	0	0	0	0	0.19	0	0	0	0	0.02
C12:0 Lauric acid *	28.83	40.13	36.47	18.65	26.99	16.02	21.04	10.58	41.51	36.85	28.20
C14:0 Myristic acid *	11.89	15.44	13.18	7.83	10.96	10.47	8.04	4.53	13.7	13.83	11.47
C14:1 w5 Tetradecanoic acid**	0	0	0	0	0.18	0.44	0	0	0	0	0.02
C15:0 Pentadecanoic acid*	0	0	0	2.22	0.21	1.86	0	0	0	0	0.43
C16:0 Palmitic acid*	18.57	12.89	17.05	13.81	22.09	22.7	18.92	13.06	13.1	12.27	16.76
C16:1 w7 Palmitoleic acid**	0.39	0.23	0	0	0.51	1.37	0.24	1.02	0.17	0.27	0.42
C17:0 Heptadecanoic acid*	0	0	0	0	0	0.69	0	0	0	0	0.07
C18:0 Stearic acid*	17.9	20.94	22.09	12.09	19.06	14.05	13.5	9.03	13.19	10.06	16.00
C18:1 w5 (6-Octadecosaenoic acid)**	0	0	0	0	0.15	0.85	0	0	0	0	0.1
C18:1 W9 Oleic acid**	9.66	3.59	3.05	38.23	10.11	17.91	18.35	49.17	7.24	13.3	17.32
C18:1 n9t Oleic acid***	2	0	2.5	0	0.22	1.03	1.8	1	2	1.7	1.2
C18:1 W7 Vaccinic acid**	0.39	0.31	0	0.98	0.69	1.42	0.51	1.06	0.33	0.43	0.61
C18:2 W6 Linoleic acid**	5.7	0.68	0.75	4.61	2.25	5.28	12.68	7.9	2.24	3.76	4.59
C18:2 n6t Linoleic acid***	1.2	0	1	0	1.9	1.22	1.7	0.9	2	2.8	1.3
C18:3 W3 Linolenic acid**	0.39	0	0	0	0.14	0.34	0.12	0.18	0	0	0.12
C18:4 W3 Octadecatetraenoic acid**	0	0	0	0	0	0.23	0	0	0	0	0.02
C20:0 Arachidic acid*	0.24	0.22	0.15	0	0.22	0.16	0.31	0	0.21	0.18	0.18
C20:4 W6 Arachidonic acid**	0	0	0	0	0	0	0	0.23	0	0	0.02
C22:0 Behenic acid*	0	0	0	0	0	0	0.32	0	0	0	0.03
Σ SFA	83.41	94.95	95.7	56.2	85.87	72.16	66.73	40.2	89.9	81.23	76.63
Σ MUFA	10.44	4.13	3.55	39.2	11.56	21.55	20.1	51.25	7.74	15	18.45
Σ PUFA	6.09	0.68	0.75	4.61	2.39	5.85	12.8	8.31	2.24	3.76	4.75
Σ USFA	16.53	4.81	4.3	43.8	13.95	27.4	32.9	59.56	9.98	18.76	23.20
Σ trans Fat	3.2	0	3.5	0	2.12	2.25	3.5	1.9	4	4.5	2.5

*: Saturated fatty acids, **: Unsaturated fatty acids, ***: Trans fatty acids

Table 4. Lipid Nutritional Quality Indices (LNQI): AI, TI, DFA, EFA, 18:0+18:1/16:0, PUFAs/SFAs and n-6/n-3 of 10 samples of cream-based cakes.

Sample	TI	AI	DFA	EFA	18:0+18:1/16:0	PUFAs/SFAs	n-6/n-3
1	5.41	5.81	34.43	6.09	1.61	0.07	14.6:1
2	20.49	23.86	25.75	0.68	1.93	0.01	N.C
3	24.99	25.87	26.39	0.75	1.53	0.01	N.C
4	1.54	1.46	55.89	4.61	3.71	0.08	N.C
5	4.6	6.87	33.01	2.39	1.4	0.03	16.1:1
6	3.18	3.03	41.45	5.62	1.44	0.08	N.C
7	2.52	2.33	46.4	12.8	1.68	0.19	105.7:1
8	0.91	0.73	68.59	8.31	4.24	0.21	45.2:1
9	8.82	11.76	23.17	2.24	1.74	0.02	N.C
10	4.14	5.57	28.82	3.76	2.24	0.05	N.C

Note: NC in the table refers to results of n-6/n-3 which couldn't be calculated in samples; n-3 was not found with high n-6 content.

tein content in the cake recipe (Marta *et al*., 2018). The average protein content appeared to be very close in the three brands; 4.8, 4.5 and 4.0% for international, national, and local brands, respectively (Fig. 1). Samiha, 2015 attributed the decrease in the protein content of the composite cakes to high temperature and duration of the healing process of the batter which led to the destruction of nutrients.

Lately; a significant increase in celiac disease has forced the rapid growth of gluten-free-based bakeries (Manuel, 2022). The gluten-free concept has been applied to the cake using various flours, including rice flour, pea, egg white, and whey flour (Marta *et al*., 2018).

The ash content in flour is an important parameter in the assessment of flour quality, it consists mainly of phosphorus, potassium, magnesium, and calcium. (Tomasz *et al*., 2020). The average ash content wasn't highly variable between the three brands as shown in Fig. 1 (3.5, 4.0, and 4.4% for international, national, and local brands, respectively) wi

th a total average of 4.1±0.4% (Table 1). All the examined samples were compatible with the Egyptian Standards for cakes (ES, 2005) which referred to an ash content of 0.1% for different types of cakes.

The highest ash (7.9%) was attributed to sampling 17 from the local brand; this result was explained by Tomasz *et al*. (2020) who concluded that high ash content is affected by flour purity and its extraction rate during milling which affect the final product quality.

Sugar content in cakes is of great importance on different scales; its nutritive value, energy supply, product preservation, and also final product quality and textural parameters (Meera *et al*., 2016). On heating, starch granules swell in the presence of water and form a gel which is important for the characteristic textures and structures of baked goods (Samiha, 2015). The differences in total carbohydrates content between the international brand samples were little ranged from 26.4 to 37.5%, while the variation between samples in the other categories was more observable, as it ranged from 9.6 to 51.0% in the national brand and from 14.9 to 50.3% in the local brand (Table 1).

Nowadays, using sucrose replacers in baking has a great interest because of their lower glycemic index and prebiotic nutritional benefits. Numerous researchers have reported studies on cookies made with various sugar replacers, but there have been fewer studies on cakes (Meera *et al*., 2016).

Groups of international, national, and local brands showed no large variation and difference in average moisture, fat, protein, and carbohydrates content, the average results for all examined samples were 42.6%, 15.3%, 4.3%, and 33.7%, respectively (Table 1), which differ from results obtained by José *et al*. (2020) for pastry samples which were 17.8%, 29.4%, 9.55%, and 44.25%, respectively. Such differences in compositional analysis for samples appeared to be due to different ingredients used for each product.

We can consider the cake a highly nutritious food product for humans if we compare its composition with cow's milk; which shows fat constitutes approximately 3 to 4 % of the solid content, protein about 3.5 %, and lactose 5 % (FAO, 2022). The need to establish food composition tables for cakes has been emphasized by many scientists and specialists in the food and health area. Such data could be used in designing suitable diets, nutritional assessment of food, and clinical nutrition research.

The body needs major six nutrients to stay healthy; carbohydrates, proteins, minerals, vitamins, and water. Of these six nutrients, carbohydrates, protein and fats provide calories. The metabolization of one gram of carbohydrate and protein releases about 4 calories/gram as compared with the metabolization of one gram of fat release about 9 calories (FAO, 2003).

The report of WHO (2019) on healthy diet recommends that fat energy should not exceed 30% and CHO energy less than 10% of total energy intake. The detailed energy contents of cream-based cakes presented in Table 2 showed that average fat energy (45.7%, 52.5%, and 41.0%) exceeded these limits, while average protein energy (7.4%, 5.7%, and 6.2%) and average CHO energy (46.9%, 41.8% and 52.8%) was above limits in international, national and local brands, respectively, although the total energy intake from a piece of cake (100 gm) could be accepted as a part from the daily energy intake (2000 kcal / day) in a healthy balanced diet (EU, 2011).

The effect of unhealthy fatty diets on health and food-related diseases, such as coronary heart disease (CHD), diabetes, hypertension, and obesity, has always been critical to health professionals, which is proven when the United States prevented around 7000 deaths from CHD annually by removing partially hydrogenated oils (Cobb *et al*., 2019).

The choice of a source of fat (margarine, butter, partially hydrogenated vegetable oils, and shortening) for the production of cakes is strongly dependent on technological properties and economic parameters, without considering the nutritional impact (Tânia *et al*., 2017). Milk fat contains approximately 400 different fatty acids, about 70% saturated with nearly 11% short-chain fatty acids, of which butyric acid makes up about half, about 2.3% are polyunsaturated, with an omega-6/omega-3 ratio of about 2.3:1. Nearly 25% of the milk fatty acids are monounsaturated (Helena, 2008).

WHO/FAO (2008) has set not more than 10% for SFAs, not more than 1% for trans fatty acids, and 6–11% for PUFAs as a recommended dietary intake. It is well known that diets high in fat, especially saturated fat is the main cause of obesity, cardiovascular diseases, and death (Dashti *et al*., 2001). Lately; there is focusing on the cut down of saturated fat intake and an increase in the refined carbohydrates in the diet, with a certain interest in the relationship between processed carbohydrates and obesity (Jibran *et al*., 2020)

The fatty acid profile of (10 samples; 33.3 % of the total examined samples) showed that the prevalence of SFA was more than 56% of the total fatty acid content in the majority of samples

(90%) with an average content of 76.63% and unsaturated fatty acids (23.20%) expressed as 18.45% MUFA and 4.48% PUFA. The results of our study complied with those recorded by Diana *et al.* (2013); Flávia *et al.* (2015) and Sofia *et al.* (2015) on different bakery products, while Luísa *et al.* (2015) found SFA in a percentage more than 50% in only 60% of the total examined samples.

On the other hand; the remaining samples (10%) had a higher MUFA (Oleic) (51.25 %) than SFA content (40.20 %). This result was in agreement with that obtained by Tânia, 2017, who reported that the plain sweet cookies group had a lower SFA (38.60%) than MUFA content (46.40%), and contrary to Aftab *et al.* (2008) who reported a higher proportion of MUFA than SFA in twelve brands of biscuits.

Lauric acid (C12:0) was the major SFA found in examined cake samples representing 17.02 to 41.51% of their total fatty acids, it increases total serum lipoproteins, especially high-density lipoprotein (HDL) (Mensink *et al*., 2003).

The only MUFA that represented more than 10% in 6 samples was Oleic acid (C18:1) with exceptions in samples 8 and 4 where it was (49.17%) and (38.23%) respectively. Oleic acid is the most common MUFA in nature, it is a hypotensive agent and it regulates body weight. FDA approved that the use of such fatty acids reduces the risk of coronary heart disease (FDA, 2018).

In the last years, due to the high cost of using milk fat, butter, and cream in the industry; several manufacturers replaced part or all of this natural fat with other fat replacers such as margarine, hydrogenated oils, fractionated oils, and some other plant oils. Unfortunately, the extensive use of these replacers lowered the fat quality and nutritive value of cakes, in addition to their adverse health effect (List, 2014).

Results presented in table (3) explored surprisingly that, Butyric acid (C4:0) and Caproic acid (C6:0) couldn't be found in any of the examined samples, even in the high-price samples (milk-based cream cakes, expressed in Egypt as Labany cream cakes) from some pastry shops. These shocking results mean that the cake industry in our markets from different brands (international, national & local) depends mainly on a fatty source other than natural milk fat even for the topping and filling whipping cream.

Trans-fatty acids (TFAs) are found in two major forms; industrially produced and ruminant TFAs with the same positional trans isomers, but differ in amount and distribution. Partially hydrogenated oils are the primary sources of industrial form and are found in margarine, shortenings, baked goods, and some popular processed and frozen foods (Cobb *et al*., 2019). Approximately 2.7% of the fatty acids in milk composition in normal are trans-fatty acids with one or more trans-double bonds (Helena, 2008).

In a study, carried out in 1998, the estimated daily intake of TFA varied between 1.5 and 4.5 g/day, and the food groups that most contributed to this intake were very different between countries, but bakery products have a remarkable contribution ranging from 6.6 to 20.6% of the daily intake (Hulshof *et al*., 1999). Data in Table 3 showed that trans fatty acids were found in 80% of examined samples with an average of 2.5 %, the most abundant TFA was Oleic acid (C18:1n9t) and Linoleic acid (C18:2n6t).

From the consumer point of view; Lipid Nutritional Quality Indices (LNQI) including atherogenic index (AI), thrombogenic index (TI), desirable fatty acids (DFAs), essential fatty acids (EFAs), 18:0+18:1/16:0, PUFAs/SFAs and n-6/n-3 have been developed to assess the nutritional and health benefits of lipid fractions. EFA and DFA have an important role in biological activity. EFAs are very important for humans because they cannot be synthesized in the body and must be obtained through dietary supplements (Chen *et al*., 2016).

The thrombogenic index (TI) and atherogenic index (AI) are important tools that indicate a potential for stimulating platelets aggregation and development of coronary heart diseases; low values of such indices show healthier food with greater potential for prevention of such diseases (Weber *et al*., 2008). In this point, nearly 70% of the analyzed samples were considered healthy as they showed low values (lower than 10) of the AI and TI index (Table 4).

PUFAs/SFAs ratio can be used to estimate the dietary quality of the lipid fraction. In this framework; the United Kingdom Department of Health recommended a PUFAs/SFAs ratio of ≥0.4 for healthier diets (UK Department of Health and Social Security, 1984). Accordingly; none of our examined samples appeared as a healthy diet (PUFA/SFA < 0.4) (Table 4).

The n-6/n-3 ratio represents an important lipid quality index. Nevertheless, eating habits have intensely changed through the years, and today Western diets became poor in n-3 PUFAs and rich in n-6 PUFAs, resulting in an unhealthy n-6/n-3 ratio of 17 to 20: 1 (Artemis, 2016), compared with a healthy ratio of 2.5 to 8: 1 (WHO/FAO, 2003). A maximum ratio of 10:1 has been recommended to avoid the risks of cardiovascular diseases, obesity, and chronic diseases (Artemis, 2016). All the n-6/n-3 ratios obtained in this study were not matching with the recommended limit as n6 was highly elevated in all samples than n3 which was found in a very low amount or even not found in some samples (Table 4).

As an overall judgment for LNQI on the studied cake samples; the major causes for considering cake as an unhealthy diet are low PUFAs/SFAs ratio (< 0.4) and high n-6/n-3 ratio (> 8:1).

CONCLUSION

Hopefully, we could increase consumer awareness to be more careful while eating and selecting cakes, especially those at high risk with chronic diseases. As the data presented in this study showed adverse health effect of Cream based cakes consumption in Egypt due to its high caloric value which is correlated to its high fat content. Between different brands, samples from local brand shops had a high saturated fatty acid content with the highest incidence of TFA (4.5%) which reflected badly on its LNQI, in addition to its high caloric value from carbohydrates content (52.8%). On the other side, it was noticed that the high price of international brand product is in equivalent with its chemical composition and good quality which is healthier than other brands; indicating the influence of cake brand and price on quality and safety to the consumer. Also, attention must be kept to producers to apply nutritional identification labels on the sold products. Our recommendations for authorities and legislation institutes is to modify the legal requirements for cakes to include the chemical composition and fatty acid profile including TFA level. There is a great demand for producing highly nutritional cakes using other replacers containing healthier constituents and lower synthetic additives; such as carbohydrate replacers, healthy fat, natural additives, antioxidants, and natural preservatives.

CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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