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Quality Evaluation of Some Commercially Fried Fast Food

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Abstract

Frying process is popular among all classes of people for being a rapid food preparation process and for the unique characteristics of flavor and appearance. However, the frying oil eventually contains a number of harmful components affect the oil quality and therefore affects the quality of foods. The objective of this work was to determine the quality of 50 fried fast food samples (ten for each), french fries, burgol kuba, under pressured breaded chicken, meat pastry and falafels collected randomly from restaurants. Chemical composition was analyzed for all samples and the oil was extracted. The samples extracted oil were analyzed for level of oxidation by measuring acid value (AV), peroxide value (PV), thiobarbituric acid-reactive substances (TBARS), conjugated dienes and triens and color index. Free radical scavenging activity was also determined by measuring the decrease in the visible absorbance of 2, 2-diphenyl-1-picrylhydrazyl (DPPH) at 517nm. Our results indicate wide variations in the composition and degree of oxidation of the extracted oils across all samples. Fat content the most important parameter here ranged from 8.25 in falafel to 22.10 % in burgle cuba.Falafel and French fries samples exceed the criteria of PV< 10 mequiv/kg. All samples complied with the limits of acid value < 2.5 mg/g. Except for meat pastry all samples were in permissible limits of TBARS. The DPPH test showed that all tested samples have free radical-scavenging activity ranged from 72.2 in French fries to 82.6%in Falafel. Falafels samples showed darkening of oil color significantly higher than all samples followed by French fries. The data highlight the need to evaluate the antioxidant activity of food itself not only the oil used for frying and enforcing legal regulations to maintain food quality in fast food restaurants.

Keywords: fast food, oil stability, antioxidant activity.

1. Introduction

Frying is one of the oldest methods known to human kind for preparing food. Fried foods are among the favorites for people around the world (Dunford, 2006). Frying process is complex, and it involves many factors, some of which are dependent on the process itself, and others on the food and type of fat used Saguy and Pinthus (1995). One of the critical aspects is the high amount of oil that is absorbed during the frying process, reaching 10–20% of the total food product weight, and in some cases reaching up to 40% Bouchon, (2009). The other critical aspects during deep-fat frying are thermal oxidation, polymerization, cyclization, and hydrolysis take place in the frying fat (Romero et al., 2001, Romero et al., 2003) and (Paul and Mittal, 1997). In addition the discontinuous frying process, the oil is repeatedly heated at high temperatures (160–200 °C) in the presence of air, and water vapor is released from the food being fried. As a result, undesirable changes may occur concurrently with desirable modifications, one such change being the loss of nutrients, and especially vitamins, during the frying process. Vegetable oils contain vitamin E at a concentration of between 15 and 49 mg a-tocopherol equivalents/100 g and it is lost along with the oxidation of unsaturated fatty acids during heating (Andrikopoulos et al., 2003 and Ghidurus et al., 2010). Trans fatty acids are produced during hydrogenation, a process that is commonly used to increase thermal stability of frying oils, but they can be also generated during high thermal processing, such as deep fat frying (Choe and Min, 2007). Cyclic fatty acid monomers (CFAM) are considered to be the most toxic compounds formed during deep-fat frying because they are readily absorbed by the intestinal mucosa (Martin et al., 2000).Plant-based foods and vegetable oils contain different varieties of phytosterols, chemically related to cholesterol. Therefore, phytosterols are also oxidized and numerous possible phytosterol oxidation products (POPs) can be formed both from ring structure and side chain structure (Johnsson and Dutta, 2003). Oxidative reactions are enhanced after mincing, cooking, salting, and refrigerated storage due to the interaction of unsaturated fatty acids with prooxidant substances (Estevez and Cava, 2004; Goulasand Kontominas,2007; Tichivanganaand Morrissey, 1985).Antioxidant activity can be evaluated as total free radical-scavenging capacity, by spectrophotometrically measuring the disappearance of the free 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical. The DPPH test has previously been successfully employed in assessing the antioxidant activity of crude oils (Ramadan, Kroh, & Morsel, 2003).To prepare fries in fast food restaurants, deep-frying media are used for various periods at high temperatures. Preparing prefried fries which are already deep-fried for a short period, additional heating is recommended before serving (usually 20–30 min at 225–250 °C).It is difficult to use one analytical index to evaluate the quality of frying oil. Although many countries have already established regulations or recommendations against the use of deteriorated frying oils (Paul and Mittal 1997), the greatest challenge in implementing such regulationsis still the absence of a suitable frying oil quality sensor for use in restaurant environs (Billek et al. 1978).The aims of this study have been to evaluate some fried fast food samples collected randomly from local restaurants by assessing the quality of their extracted oil.Not only by measuring the oxidation index of the extracted oil but also by measuring the antioxidant activity capacity of these foods extracted oil.

2. Materials and methods

2.1. Materials

Total of fifty samples of most popular fast food fried in vegetable oils, French fries, , burgolkuba (fried burgol-meat balls), under pressured breaded chicken, meat pastry (deep fried) and falafels (ten for each product) were randomly collected from the fast food restaurants. Most restaurants in Egypt use mixed oils for frying falafel and French fries. Mixed oils are blending from two or more different kinds of vegetable oils (sunflower, sayabean, cotton seed oils…etc.). However most animal based food, burgolkuba, under pressured breaded chicken, meat pastry, mostly fried in palm oil.

1.1. Methods

The whole fried foods were thoroughly homogenized. Moisture contents of the collected samples were analyzed at the same day of collection. The remaining samples were stored in deep freezer until analysis. Moisture, crude protein, crude fat, crude fiber and ash contents were determined by the standard procedures of the AOAC (2000). Under room temperature, lipids were extracted from samples according to Dutta (1997). For oil index; acid value and peroxide value were determined by various standard AOCS methods (1985). The TBARS, malondialdehyde (MDA) content as lipid oxidation index was determined according to the method of Hongxia and Hongjun (2008). The degree of oxidation was measured spectrophotometrically by determining the absorption value at 232 and 270 nm for conjugated dienes andtrienes, respectively (AOCS, 1985). Color Index (CI) was also measured by determining the absorbance of 2.5% w/v oil in isooctane at 420nm (Yoshida and Kajimoto, 1989).

The free radical scavenging activity (FRSA) or the antioxidant activity of each sample was measured in terms of hydrogen donating or free radical scavenging activity, using the stable radical DPPH according to Brand-Williams et al.,(1995). The radical scavenging activity was calculated using the following formula:

% inhibition of DPPH = $\{(AB - AA)/AB\} \times 100$ where AB is the absorption of blank sample and AA is the absorption of tested samples at 517 nm.

Statistical Analysis:

Experiments were statistically analyzed for the five products. All analyses were run in ten replicate for each product (n = 5 X 10). Data analysis was subjected to GENSTAT statistical program.

3. Results and discussion

Frying condition and some chemical values of frying oils before frying are showed in table (1)

3.1. The proximate analysis

Table (2) showed the proximate analysis of 50 tested fast food samples fried in vegetable oils collected from different restaurants. The mean of moisture content ranged from 35.11 in meat pastry to 53.29 % in falafel samples. The moisture content of meat pastry as mean value (35.11 %) were significantly ($P \geq 0.05$) lower than the rest samples. Breaded chicken significantly ($P \geq 0.05$) recorded the highest protein and ash content compared to other tested products, mean value was 17.75 and 4.14 %, respectively. This increasing in ash content may be due to the coated layer of bread and spices upon the chicken. These findings are in agreement with Dashti et al., (2001). Fat content is the important parameter here it varied between13.46 in breaded chicken to17.88 %in meat pastry. The highest amount of fat in meat pastry was due to the high ability of to absorb fried oil during cooking. No significant difference ($P \geq 0.05$) was detected between the tested samples. These data agreed with Dashti et al. (2001) and Lake and Scholes (1997).

3.2. Peroxide value (PV)

Hydroperoxides are the primary products of lipid oxidation; therefore, determination of peroxides can be used as an oxidation index for the early stages of lipid oxidation. Data in Table (3) showed the peroxide values in the tested samples. The falafel and French fries samples were significantly ($p<0.05$) higher than others with mean values of 11.18 and 10.89 meq/kg, respectively. Fried breaded chicken samples showed significant lowest mean value with PV less than10meq/kg (1.21to 5.85meq/kg) this may referred to that breaded chicken samples were fried in palm oil (PV= 0.28 meq/kg) . It was noticed that the highest PVs were in plant based samples, fried in mixed oil with highest PV of 5.90 meq/kg. Such increase in peroxide values had been reported by Neff et al., (1994), Liu and White, (1992) and Adnan et al.(2009.)

3.3. Acid value

Table (3) showed the acid value which considered one of the indicators used to access oil quality. In our study all samples complied with the limits of European regulations of maximum levels allowed in frying oil mg. KOH / g. oil that acid value should be less than 2.5 mg/g (Dobarganes, 1998 andOllé, 1998).

Acid values ranged from 0.38 to 0.9 mg KOH / g oil in falafel and 0.35 to 0.97 mg. KOH / g oil in French fries which seemed to be significantly lower than other tested samples. This may due to the increase in acid value of mixed oil (0.18 mg KOH / g oil)used in these samples compared to the acid value of palm oil (0.58 mg KOH / g oil) used in other samples. The acid values may not be quantitatively related to the acidic products formed during oil deterioration as FFAs may be lost through volatilization at the high temperatures of frying. Loss of acidic products may also occur due to the neutralization effect of food being fried (Che Man et al., 1999). However, the higher values were observed in meat pastry (1.72 mg. KOH / g. oil) this increase may be due to the low moisture content of meat pastry sample which led to the decrease in volatilization of the free fatty acids.

3.4. Thiobarbituric acid Reactant Substances (TBARS)

The results of the TBARS are present in Table (3). Ninety percent of meat pastry samples exceed 1 mg malonaldehyde /kg and was significantly higher than other samples and this may referred to the type of oil used in the frying process. It is known that polyunsaturated oils are more liable to oxidation and peroxidation rather than saturated oiland this liability is positively correlated with the number of double bonds (Matthaus 2006).

However no significant difference was observed between the rest samples which mostly showed TBARS within the permissible limit as mean values.From an older paper in the literature that indicates that a TBA value >1 is an indication of rancidity. Recent studies in meat such as beef, however, indicate thatTBARS values of 2 or greater are considered to be rancid (Suman et al., 2010).

3.5. The free radical scavenging activity

Percentage inhibition of DPPH is parameter widely used to measure antioxidant/free radical scavenging power. The higher the % inhibition of DPPH absorbance the higher the FRSA. Hence from this study, The DPPH test showed that all tested samples have free radical-scavenging activity ranged from 72.2 to 82.61% with no significant difference between samples (table 3).The falafel samples showed narrow range (80.05-89.73%) compared to burgle cuba, fried potato and meat pastry which ranged widely. The observed antioxidant activity may due to the high level of antioxidants in the food samples itself and the various spices which extensively used in restaurants to flavoring foods andfor their preservative properties (Janakat and Al-Khateeb 2011)

3.6. Conjugated dienes and conjugated trienes

Conjugateddienes and trienes absorbing at 234 and 268 nm, respectively, are good measure of oil oxidation. (McGinely 1991). They are directly related to hydroperoxides and are often used in addition or in place of PV. Data in table (4) showed that the mean value of conjugated dienes in breaded chicken was significantly the lowest value of 1.06. In contrast, falafel samples showed significant increase of 2.53 the same trend was observed in PV. It is worthy to mention that as in PVs the mean of conjugated dienes values was higher in plant based samples (falafel and French fries), with no saturated fat content. The other reason may be using the mixed oil the most susceptible to oxidation than the palm oil used in frying process of the other animal based samples (meat pastry, burgol cuba and breaded chicken) which seemed to be the main reason here. Meanwhile, the conjugated trienes value was significantly higher in meat pastry samples than others. The higher absorbance for the conjugated dienes and trienes in the oil may pointed to the longer of frying cycles as conclude by El-Sayed and Allam (2003). This trend for conjugated trienes was similar to that seen for TBRSvalue.

3.7. Color index

Increase of photometric color index was noted in table (4); falafels samples showed darkening of oil color significantly higher than breaded chicken this may contributed to the presence of pigments in falafel. However no other significant difference was observed between the samples. Darkening of oil color may be caused by oxidation-type reactions and by Maillard reactions (Maniak et al., 2009).

Generally from all the analyses, it was commonly observed that highest oxidation occurred in falafel samples that showed the highest peroxide value, conjugated diene, and color index these findings may due to the practice of using exhausted oil to fry falafel patties as shown by Amr and Abdullah (2003) who reported that 80% of the frying oil samples collected from different areas of Amman (Jordan) failed to pass the colorimetric test kit sensitive to carbonyl compounds. Surprisingly, the falafel samples still have high antioxidant activity that may due to the short time of the frying process (4 min) and the nature of the food that prepared from chickpeas paste seasoned with garlic, parsley, and special spices (Amr and Abdulla 2003). In contrast, breaded chicken showed the lowest values. The saturated fat content, the type of spices and the type of frying process (under pressure) for breaded chicken are considerable factors that may reduce oxidation.

According to general regulations and recommendations, most collected samples were within the permissible limits and have good quality.

4. Conclusion

From the results it is clear that the quality of food oil is very variable across all samples indicating variations in the composition and extent of degradation of the oils which may refer to many reasons such as (a) the properties and composition of the used oil; b) the nature of the food fried; d) the frying equipment and the process of frying; and e) the evaluation methods of the quality of the frying oil. There may be additional influences on the quality of the frying oil and thus the fried food. The local regulation with respects to frying oil and fast food quality to protect public health are needed.

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Table 1. Frying condition and some chemical values of frying oil before frying

Samples	Frying temperature	Frying time (min)	Type of oil	PV (meq/kg oil)	AV (mg KOH/g oil)
Falafel	165	4-6	Mixed oil	0.28	0.18
French fries	180	4-6	Mixed oil	0.28	0.18
Chicken	121	20*	Palm oil	5.90	0.58
Burgle cuba	180	10-13	Palm oil	5.90	0.58
Meat pastry	175	5-6	Palm oil	5.90	0.58

Table 2. The quality parameters of some fast food extracted lipid collected from the restaurants.

Sample	**Moisture (%)**			**Ash (%)**			**Fat (%)**			**Protein (%)**		
	LV	HV	Mean	LV	HV	Mean	LV	HV	Mean	LV	HV	Mean
Falafel	51.85	55.45	53.29	1.20	1.85	1.52	8.25	19.66	13.83	8.64	19.01	13.71
French fries	40.6	59.4	52.66	1.16	2.91	1.82	9.35	20.47	15.46	2.55	3.75	3.09
Breaded chicken	45.83	58.41	51.81	3.40	4.81	4.15	8.46	17.90	13.46	13.12	24.46	17.75
Burgle cuba	45.81	53.47	50.07	1.70	2.37	1.88	10.32	22.16	17.21	8.39	17.44	10.92
Meat pastry	27.1	42.03	35.11	0.79	3.45	1.99	13.56	21.27	17.88	6.78	10.89	8.02
LSD			7.44			0.71			7.74			4.43

Lowest value

HV: highest value

Mean of 10 samples

Table 3. The Quality parameters of some fast food extracted lipid collected from the restaurants.

Sample	Acid value(mg/g)			Peroxide value (mequiv/kg)			TBARS[a] mg malonaldehyde/kg			Inhibition of antioxidant activity (%)		
	LV	HV	Mean	LV	HV	Mean	LV	HV	Mean	LV	HV	Mean
Falafel	0.39	0.9	0.53	8.80	14.81	11.18	0.31	1.37	0.90	80.05	89.73	82.61
French fries	0.34	0.96	0.58	7.40	13.42	10.89	0.11	1.63	0.72	38.35	88.44	72.20
Breaded chicken	1.14	1.98	1.61	1.21	5.89	2.85	0.42	1.19	0.86	71.29	93.29	81.73
Burgle cuba	0.39	1.58	0.94	3.86	10.33	6.32	0.25	1.33	0.69	46.82	88.43	78.48
Meat pastry	1.19	2.29	1.72	5.10	14.02	9.10	0.85	1.73	1.40	21.09	91.07	73.21
LSD			0.245			0.59			0.43			11.6

aTBARS, thiobarbituric acid-reactive substances.

LV: lowest value

HV: highest value

Mean of 10 samples

Table 4. UV Spectrophotometric determination of the conjugated dienes and trienes in some fast food

Sample	Conjugated dienes Absorption at 234nm			Conjugated trienes Absorption at 268nm			Color Index Absorption at 420nm		
	LV	HV	Mean	LV	HV	Mean	LV	HV	Mean
Falafel	1.995	3.451	2.527	1.995	3.451	2.527	1.995	3.451	2.527
French fries	0.402	3.050	1.940	0.402	3.050	1.940	0.402	3.050	1.940
Breaded chicken	0.341	1.090	1.060	0.341	1.090	1.060	0.341	1.090	1.060
Burgle cuba	0.534	2.080	1.350	0.534	2.080	1.350	0.534	2.080	1.350
Meat pastry	1.410	2.980	2.350	1.410	2.980	2.350	1.410	2.980	2.350
LSD			0.245			0.59			0.43

LV: lowest value

HV: highest value

Mean of 10 samples