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Effect of Type of Food on the Trans Fatty Acids Formation and Characteristic of Oil during Frying Process

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ABSTRACT

This study was carried out to investigate the physical and chemical changes which take place in blended oil (sunflower oil: soy bean oil 75: 25 w/w), therefore frying different types of food, such as fresh foods (potatoes, falafel, fish, meat and chicken) and semi-fried Foods (chicken bites koki (nuggets), shish pan koki and farm frites potato) during frying process for 20, 40 and 60 minutes at (180±5°C), also studying the effect of different types of food on the oil uptake and formation of trans fatty acids in oils during frying process. The obtained results as follows: the color (red unit), viscosity, acidity and peroxide value of investigated oils were increased during frying all foods (fresh and semi-fried foods), but the increase was more pronounced in case of frying semi-fried foods, while the referective index of frying oil of semi-fried foods was decreased compared with control oil and frying oils of fresh food. The results indicated that a considerable range of oil uptake quantities during frying as a result of variation type of foods, among all food, finger potato extensive absorption of the frying oil during frying process compared with the other fresh foods, as a results the semi-fried foods will contain a higher percent of oil included the oil of its formation, that during its frying, it was absorbed a few amount of oil. These results indicated that, the percentage of formation trans fatty acid (eliadic acid) in frying oils after 20 and 60 minutes during frying semi-fried foods was more that than frying fresh foods. Also, the results observed that, the percentage of eliadic acid in frying oil of fresh potato was lower than the other frying oils of fresh food, additionally the quality of frying oil of fresh potato finger was the best compared to frying oil of the other food material.

***Key word:** frying oil, physical and chemical properties, trans fatty acid, oil uptake and type of food.*

INTRODUCTION

Frying is one of the most important methods for food preparation, and fried food have always been popular in many countries. In deep frying, the food is completely surrounded by the frying fat. The later reacts with protein and carbohydrate components of food, developing flavors and odors which appeal to consumers [(1)].

There are various factors that influence the deterioration of frying oil: rate of turnover, type of frying process, temperature, intermittent heating and cooling, degree of unsaturation of the oil, type of food material, design and maintenance of the friar and filters used [(2)].

Oxidative alteration in the frying medium due to release of moisture from the food, atmospheric oxygen entering the oil, whereas thermal alteration is caused due to higher frying temperatures. The rate of formation of decomposed products depends on the type of food beginning fried, design of the friar and the operating conditions [(3)] Frying of meat results in leaching of fat from meat into the frying medium, these by mixing with it [(4)]. The quality of sun- flower oil affected by fish (Calla Catla) frying at 180^{0}C for 14 hr., the refractive index, colour and free fatty acid were increased by increasing frying time, but peroxide value first increased up to 12 hr. of frying then decreased [(5)].

During frying, the water present in the raw material evaporates, and is partially replaced by oil. Constituting up to 90% of the finished products, and unsequently influencing its properties. This affects, not only the flavor and aroma of the products, but also the textured, depending on the quantity of oil absorbed during frying.[(6)], also [(7)], studied the effect of pre-frying treatment on the final oil content of tortilla chips fried for 60 sec. The final oil content was found to decrease significantly with increasing baking time. They also concluded that the initial moisture content of fried product greatly influence the final oil content of fried products. The surface coating of the chicken nuggets which comprises of carbohydrates, protein and gelling agents is also expected to be modified by gelatinization and denaturation of these components, there by forming barriers to moisture loss and fat absorption during subsequent frying process [(8)]. Deep fat frying has been considered a source for the production of trans fatty acids, formation of trans fatty acids during frying has been shown to be closely related to process temperature and time. However, in sun-flower oil, the amount of trans isomers where found to be 1.1 % when heated at 200^{0}C for 40 min. as compared to 11.45% at 300^{0}C for the same duration of heating [(9)].

MATERIALS AND METHODS

Materials:

Commercial blended oil (sunflower: soya bean oils 75: 25 w/w), was obtained from the super market.

Fresh foods: Fresh potato fingers, falafel, fish, meat slices and chicken were obtained from the local market.

Semi-fried foods: chicken bites Koki (nuggets), shish pane Koki and Farm frites potato were obtained also from local super market.

All reagents and chemical of analytical grade and standard Fatty acids were purchased from Sigma Chemical Co. (St. Louis, Mo, USA).

Preparation of food:

Fresh fish, chicken and meat: washed and cleaned manually, cut into pieces or slices and mixed with 3% salt, 1% onion, 1% garlic, 1% chilli powder and 1% mix spices contain (cumin, black pepper and coriander 1:1:1 w/w/w). Left for 2 hr. before frying.

Fresh potato: washed, cut into finger, the finger were dipped in a solution containing 3% salt for 2 hr. before frying.

Fresh falafel: were produced from local market and ingredient was beans, onion, garlic, celery, salt, cumin and white pepper.

Ingredient of semi-fried food:

Ingredient chicken bites koki (nuggets): Fresh chicken breast meat, water, phosphate, table salt, garlic, black pepper, white pepper, celery, ginger, wheat flour, monosodium glutamate, dry milk, set in local partially hydrogenated soya oil, fat 15% and carbohydrate 12%.

Ingredient shishi pane koki: Fresh dark meat chicken slices and the same previous content of nuggets.

Farm frites potatoes: potato finger and hydrogenated soya oil.

Frying process:

Each types of food were fried in about 1/2 liter commercial blended oil in a 1L. capacity home type fryer pan at (180±5°c), under atmospheric pressure. Six batches of food samples (approximately weight 100±10g.) were fried for 60 min. Internal temperature was monitored using a thermocouple (Omega, Model

199, Engineering Stanford, T USA) according to [10], and take three samples after 20, 40 and 60 min. from frying (after each two batches).

Sampling of oil analysis:

Samples of the original fresh blended oil and frying oils after 2, 4 and 6 patches for 20, 40 and 60 min. from frying were collected and stored in brown color bottles when the temperature of the frying oil dropped to 60°c. The oil samples were kept at (-20°c) before being analyzed.

Oil content and oil uptake determination:

Fried food samples were collected after 60 min. from frying and take random sample from each food material. Samples were oven dried at 105^{0}c overnight and ground in a waring blender. A Soxhlet extraction (AOAC, 1995) of the dried samples was utilized for fat analysis. The fat absorption was calculated according to the type following formula:

$$\textbf{Fat absorption (\%)} = F_{final} - F_{initial} / F_{final} \times 100.$$

Where $F_{initial}$ and F_{final} are fat contents in raw and fried food samples expressed as percentage on a dry basis according to Mukprasirt *et al.*,[11]

Extraction of oil from semi fried foods:

The chicken bites koki, shish pane koki and farm frites potato were cut into small pieces and placed in conical flask, the oil was extracted by using n-hexane solvent and soaked for 24 hrs., filtered by filter paper whatman No.1, evaporated the solvent under vacuum, the residual oil filtrated in presence of sodium sulphate anhydrous and stored in bottle Brown in refrigerator, the extracted oils were kept a (±4°C) even analysis of fatty acid composition [12].

Analysis of the blended oil and frying oils:

Free fatty acids (FFA) and peroxide value (PV) were determined according to the methods of the AOAC [13]

Refractive index (RI): Refractive index of the oils were determined at 25^{0}c according to AOAC [14]**.**

Colour: was determined as described in the methods of AOAC [12]

Viscosity: viscosity measurements were carried out by using a Brookfield Rheology viscometer RV model DV-III, which is computerized an programmable sample adaptor insulted cap and maintained at 25^{0}C using the Brookfield TC 500 unit. The used spindle was SC4-21 and applied within up and down program (from 25 up to 250 rpm) then declined to 25 rpm with a 30 sec. interval between each speed rotation and the other .The viscosity (Cp) centipoises was automatically calculated by the Rheocalc program software (1-3ver). Rheological model power law was used to fit the data [(15)]

Determination of Fatty acid composition and Trans fatty acid by GLC:

Preparation of fatty acid methyl ester:

The fatty acids methyl esters were prepared using transesterification with cold methanolic solution of potassium hydroxide. The fatty acid methyl esters was identified by G.C. capillary column according to the methods of IOOC [(16)]. In 5 ml screw-top test weight approximately o.1 gm of the oil of sample. Add 2 ml of hexane, and shake. Add 0.2 ml. of 2N methanolic potassium hydroxide solution, put on the cap fitted with a PTFE-Joint, tighter the cap, and shake vigorously for 30 seconds. Leave to stratify until the upper solution becomes clear. Decant the upper layer containing the methyl esters. The hexane solution is suitable for injection into the gas chromatogragh. It is advisable to keep the solution in the refrigerator until gas chromatographic analysis. Storage of the solution for more than 12 hours is not recommended.

Identification of fatty acid methyl ester by GLC:

Agilent 6890 series GC apparatus provided with a DB-23 column (60mxo.32mm.x0.25µm). Fatty acid results after the previous procedures steps were transformed into methyl esters and directly injected into the GC. Carrier gas was N_2 with flow rate of 2.2 ml/min., splitting ratio of 1:80.The injector temperature was 270ºC.the temperature setting were as follow: 130ºC to 210° C at 3ºC/min. and held time 10 min. at 210ºC.

RESULTS AND DISCUSSION

Physical and chemical characteristics of blended oil:

The physical and chemical characteristics of blended oil (sunflower oil: soyabean oil 75:25 w/w) are shown in Table (1). From the data in this table, it could be noticed that ,the refractive index, colour, viscosity, free fatty acids and peroxide value were 1.4732,2.5(R), 12.9 (Cp), 0.08% and 4.6 mequ/kg. oil, respectively, also from the results in the same table ,the predominate unsaturated fatty acid of blended oil was lenoleic acid (62.68%), followed by oleic (25.02%), but it was contain lower amount of lenolenic acid (1.19%).On the other hand, the major saturated fatty acid was palmitic acid (7.19%), followed by stearic acid (3.77%). Regarding to the data in Table (1), it could be observed that, the commercial blended oil contain, 0.05% trans oleic acid (eliadic acid).

Table (1) Physical and chemical characteristics of commercial blended oil:

Physical and chemical characteristics	Blended oil (sun flower oil: soya bean oil)75%:25%
• Refractive index at 25^0C	1.4732
• Color red unit	2.5
• Viscosity (cp)	12.9
• Free fatty acid (%)	0.08
• Peroxide value (mequ/kg oil)	4.6
• Fatty acid composition (%):	
C16:0	7.19
C16:1	0.09
C18:0	3.77
C18:1	25.02
(C18:1 trans)	0.05
C18:2	62.68
C18:3	1.19

Physical and chemical properties of frying oil:

The changes in physical and chemical properties of frying oils during frying the different type of food material such as , fresh foods (potato, falafel (tamaya), fish, meat, and chicken) and semi- fried foods (chicken bites koki (nuggets), shish pan koki and farm frites potato) for 20,40 and 60 min at 180^0 C are shown in Tables 2,3,4,5 and 6. From these Tables, it could be noticed that, the refractive index, color, viscosity, free fatty acids and peroxide value of frying oil under study were affected according to the type of fried food material. Refractive index (RI) levels increased in case of frying all fresh food, but RI levels decreased in all frying oils of semi fried food may be due to the semi fried food contains a higher saturated fat (palmitic acid), which release from them into the frying medium and mixing with frying oil caused decrease in refractive index (RI) compared with control oil and frying oils of fresh food. The results in Table (3), show an increase in color Red unit of all frying oil with increased frying time, but it is clear from the results in this table, that more increase in color red take place for frying oil of fresh fish than that of other food material, followed by frying oils of fresh chicken and meat slices (poftake). The darking of oil could be observed during process of due to several reasons ,the darkening of oil colour upon heating, the colour of pigments during frying undergo oxidation and diffuse from the food into the oil [17,18]. The coloured degradation products formed by the interaction of food components with oil may contribute to the darkening of the oil [19].

Table (2): Effect of type of food on the refractive index of blended oil during frying process

Type of foods	Frying time (min)		
• **Fresh foods:**	20	40	60
-potato fingers.	1.4737	1.4740	1.473
-falafel	1.4740	1.4742	1.4746
-fish slices	1.4738	1.4739	1.4740
-meat slices	1.4734	1.4738	1.4743
-chicken pieces	1. 4732	1.4734	1.4722
• **Semi- fried food:**			
-chicken bites Koki (nuggets)	1.4724	1.4720	1.4717
-shish pan Koki	1.4720	1.4719	1.4719
-Farm frites potato	1.4725	1.4721	1.4720

Table (3): Effect of type of food on the color red unit of blended oil during frying process

Type of food	Frying time (min)		
• **Fresh foods:**	**20**	**40**	**60**
-potato fingers	3.0	3.1	4.7
-falafel	3.0	3.8	4.2
-fish slices	5.0	9.0	13.9
-meat slices	4.9	5.9	8.2
-Chicken pieces	4.8	6.2	8.5
• **Semi- fried foods:**			
-chicken bites Koki (nuggets)	4.6	4.9	5.9
-shish pane Koki	4.1	4.9	5.7
-farm frites potato	3.2	3.6	3.9

The other reasons that could lead to colour change may be the presence of suspended charred particles [20] and polymerization reactions at high temperature [21]. The results in table (4) regarding the influence of type of food material on viscosity of frying oil, the values of viscosity of all frying oils were increased compared to control oil, the increase in viscosity during frying was due to formation of higher molecular weight substances by polymerization, also, the results in Table (4) showed that higher viscosity for frying oils of all semi-fried food than all frying oils of fresh food. This due to release saturated oil from the frying oil of semi-fried food into the frying medium, mixed with them, caused increased in viscosity compared with the frying of fresh food oils. The higher increase in acidity of frying oils of all semi-fried food compared with frying oils of all fresh food materials, Table (5) could be attributed to the moisture that migrated from these products to the frying oil medium higher than the acidity of the frying oil of fresh food. The results in Tables (5) and (6) showed a higher increase in oxidation parameter (FFA and PV) with increased of frying times, it was clear from the obtained results that, the FFA and PV of frying oils produced from frying all semi-fried food were higher than produced from frying all fresh food, due to the hydrolysis of triglycerides by infusion of moisture from these foods into oil caused a higher oxidation compared with other frying oils.

Table (4): Effect of type of food on the viscosity (cp) centipoises of blended oil at 25^0 C during frying process.

Type of food	Frying time (min)		
• **Fresh foods:**	20	40	60
-potato fingers	15.2	15.9	17.2
-falafel	15.9	16.9	18.4
-fish slices	16.0	17.0	18.3
-meat slices	13.9	14.4	15.5
-chicken pieces	16.1	18.0	19.9
• **Semi- fried foods:**			
-chicken bites Koki (nuggets)	16.3	17.4	19.9
-shish pane Koki	16.2	18.9	20.8
-Farm frites potato	16.4	18.9	21.4

Table (5): Effect of type of food on the free fatty acids (%) of blended oil during frying process

Type of food	Frying time (min)		
• **Fresh food:**	**20**	**40**	**60**
-potato fingers	0.19	0.20	0.28
-falafel	0.21	0.27	0.31
-fish slices	0.21	0.28	0.32
-meat slices	0.22	0.26	0.31
-chicken pieces	0.25	0.27	0.32
• **Semi fried food:**			
-chicken bites Koki (nuggets)	0.35	0.57	0.66
-shish pane Koki	0.24	0.26	0.37
-Farm frites potato	0.28	0.36	0.42

Table (6): Effect of type of food on the peroxide value (mequ./kg. oil) of blended oil during frying process:

Type of food	Frying time (min)		
• **Fresh food:**	20	40	60
-potato fingers	4.9	5.3	5.6
-falafel	13.93	20.68	26.97
-fish slices	11.93	17.76	23.17
-meat slices	5.47	6.89	7.33
Chicken pieces	5.26	11.48	13.38
• **Semi- fried food:**			
-chicken bites Koki (nuggets)	19.83	37.36	46.83
-shish pane Koki	24.63	29.24	46.16
-Farm frites potato	19.75	23.89	27.78

Effect of type of food on oil uptake and oil content during frying:

Frying of food tends to result in uptake of frying fat which is undesirable for both the manufacturer and the consumer. The basic physical effect of frying is water replacement by oil formulation changes and different additives, as where as various treatment may alter the water-holding capacity and consequently affect fat uptake [22]. The effect of the type of food material on the oil uptake and oil content during frying process is shown in Table (7). It is clear that all semi-fried food samples absorbed substantially less oil were post frying compared to fresh food, 3.8, 4.08 and 4.99% for chicken bites Koki (nuggets), farm frites potatoes and Shish pane Koki, respectively. This may be due to the surface coating of these products (semi-fried food materials)which comprises of carbohydrates, protein and other components are expected to modified by gelatinization and denaturation of these components, there by forming barriers to moisture loss and fat absorption during frying process (Ngadi *et al.,* 2009). Among all fresh food material the oil absorption was the highest in falafel (24.02%). On the other hand, fresh potato restricted less oil absorption (15.89%), this may be due to lost less water evaporated during frying process, whereas, the lower of loss moisture the less of oil uptake, while fresh fish, meat and chicken slices absorbed intermediate oil (19.45, 16.23 and 20.74 %, respectively) during frying. Generally, the variation of oil uptake in different type of food may be due to the permeability of the outer layer of the product, also depends on the strength of the structure of food to water vapour escape. A stronger and more elastic network can result in a less permeable outer layer that may act as an effective barrier against oil absorption [(23)]

Table (7): Effect of type of food on the oil content and oil uptake (%) during frying process

Type of food	Oil content in fried food	Oil content in raw food	Oil uptake in fried food
• **Fresh food:**			
-potato fingers	17.86	1.97	15.89
-falafel	25.88	1.86	24.02
-fish slices	32.15	12.70	19.45
-meat slices	19.58	3.33	16.23
-chicken pieces	29.04	8.30	20.74
• **Semi- fried food:**			
-chicken bites Koki (nuggets)	31.55	27.75	3.80
-shish pane Koki	44.85	39.86	4.99
-Farm frites potato	19.99	15.91	4.08

Fatty acid composition of oils extracted from semi- fried food materials:

The fatty acids composition of oils extracted from nuggets (chicken bites koki), shish pane koki and farm frites potato are shown in Table (8). The results showed that, these oils were rich in palmitic acid (44.08, 32.27 & 29.53%, respectively), and oleic acid (39.03, 36.22 & 35.27%, respectively), followed by lenoleic acid were (9.31, 23.05 and 24.87 %, respectively), but these oils were contained a little amount from lenolenic acid (1.05, 1.55 and 1.72%, respectively). Also, these results indicated these oils contained a considerable percent from the trans fatty acid (eliadic acid) were 0.41 %, 0.40 % and 0.50%, respectively, that were increased the formation of it during frying these products . For that reason we must not be prolonged the frying periods of these products (semi-fried food) during frying process.

Table (8): Fatty acids composition (%) of oils extracted from the semi- fried products

Fatty acid composition (%)	Semi- fried products		
	Nuggets	Shish pane Koki	Farm frites potato
$C_{14:0}$	1.10	0.8	0.46
$C_{16:0}$	44.08	32.27	29.53
$C_{16:1}$	0.19	0.59	2.15
$C_{18:0}$	4.83	4.89	5.5
$C_{18:1}$	39.03	36.22	35.27
$C_{18:1\ (Trans\ eliadic\ acid)}$	0.41	0.40	0.50
$C_{18:2}$	9.31	23.05	24.87
$C_{18:3}$	1.05	1.55	1.72

Effect of type of food on the formation of trans fatty acid in frying oil during frying process:

The frying process left large gaps in the total fatty acid composition by percent weight, which was due to oxidation, polymerization, cyclization and other side reactions that would have taken place during the period of frying. Table (9) gives the changes in the fatty acids composition of the blended oil as a result of frying different types of food such as fresh foods (potato finger, falafel, meat slices, fish and chicken pieces) and semi-fried foods (nuggets (chicken bites koki), shish pane koki and farm frites potato). From these results, it was apparent increase in saturated fatty acid and monounsaturated fatty acid content and decrease in polyunsaturated fatty acid content. Palmitic acid ($c_{16:0}$) recorded a higher increased in frying oils of all semi-fried foods compared with frying oils of all fresh foods. These due to the oil extracted from these foods contains a higher percent from palmitic acid which were 44.08, 32.27 and 29. 53% in products in nuggets, shish pane koki and farm frites potato, respectively as shown in previous data in Table (8), that migrated from these products to frying blended oil. On the contrary, lenoleic acid ($C_{18:2}$) was appeared more decreased in frying oil of all semi-fried food, fresh meat slices and chicken pieces than frying oils of fresh potato finger, falafel and fish. The considerable reduction of lenoleic acid as a results of oil oxidation during frying. However, the fatty acid modification that occurred during repeated frying were not only related to thermoxidative alteration but also to interaction between the fry oil and fat of the food product to be fried, thus the increased in lenolenic acid ($C_{18:3}$) concentration observed after frying fresh meat slices, chicken pieces and semi-fried food (nuggets, shish pane koki and farm frites potato) is not easy to explain, but it could be due to the migration of this fatty acid from food products to fry blended oil in a degree exceed of its thermal oxidation. Additionally, coating ingredients of all semi-fried food which included vegetable oil (hydrogenated soy oil) in its formation could have accelerated for additional amounts of lenolenic acid in the fry blender oil. This finding agreed with previously published results [24] .On the other hand, the percent of trans fatty acid (eliadic acid) increased with increasing frying time in all frying oils of all products compared to control oil (blended oil), while the rate of formation of eliadic acid was more in frying oils of semi-fried foods. This related to the coating ingredients of these products including hydrogenated soya oil, which its role considered as a source of trans fatty acid, that migrated from these products to the blended oil which used in frying. Generally, the formation of eliadic acid of frying oils under investigated was increased in order to frying, farm frites potato> nuggets koki > shish pane koki> meat slices> chicken pieces > fish > falafel > potato finger.

Table (9): Effect of type of food on the formation of trans fatty acids (%) in blended oil during frying

Type of food	Frying time	Fatty acid composition (%)						
		C16:0	C16:1	C18:0	C18:1	Trans C18:1	C18:2	C18:3
.freshfood:	20 min							
-potato fingers		7.38	0.46	3.80	25.99	0.088	61.98	0.24
-falafel		10.68	0.03	0.03	25.98	0.05	62.45	0.53
-fish slices		7.19	0.93	3.53	25.08	0.24	62.46	0.57
-meat slices		10.10	0.30	4.73	25.94	0.28	53.25	4.62
-chicken pieces		8.05	0.43	3.64	25.4	0.09	61.69	0.39
.semi fried food:								
-nuggets		14.08	0.23	4.33	26.46	0.36	50.70	3.82
-shish pane Koki		14.03	0.80	4.34	27.09	0.27	49.78	3.51
-farm frites potato		9.31	0.75	4.28	29.95	1.16	50.84	3.69
fresh food	60 min							
-potato fingers		8.70	0.39	4.07	27.24	0.096	59.28	0.18
-falafel		7.81	0.89	3.70	25.66	0.12	61.38	0.19
-fish slices		7.99	0.27	3.83	25.29	0.30	62.21	0.36
-meat slices		10.93	0.21	3.94	27.33	0.40	52.68	4.51
-chicken pieces		14.85	0.52	4.85	27.02	0.36	46.79	5.15
.semi fried								
-nuggets		16.99	1.04	4.38	28.69	0.49	45.12	3.38
-shish pane Koki		17.19	0.12	4.92	29.30	0.41	44.72	3.05
-farm frites potato		16.30	0.13	4.68	27.29	1.34	47.22	3.05

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تأثير نوع المادة الغذائية على تكوين الأحماض الدهنية الترانس وخواص الزيت أثناء عملية التحمير

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أجريت هذه الدراسة لمعرفة التغيرات التي تحدث في الخواص الطبيعية و الكيمائية لزيت خليط عباد الشمس وفول الصويا بنسبة 75-25% علي التوالي وذلك بقلى مواد غذائية مختلفة سواء كانت طازجة مثل البطاطس والطعمية والسمك واللحوم والدجاج او نصف جاهزة مثل دجاج بيتس كوكى (ناجتس) وشيش بانية كوكي وبطاطس فارم فريتس علي فترات زمنية مختلفة 20 و 40 و60 دقيقة على درجة حرارة 180م^0 +_5م^0 . وأيضا تمت دراسة تأثير نوع المادة الغذائية على كمية الزيت الممتص وعلى تكوين المشابهات الهندسية للأحماض الدهنية (ترانس) للزيت اثناء عملية التحمير. و قد أظهرت النتائج ما يلى:

حدثت زيادة لكل من اللون و اللزوجة والحموضة ورقم البيروكسيد لزيت التحمير موضع الدراسة اثناء تحمير كل من المواد الغذائية الطازجة أو النصف جاهزة ولكن كانت الزيادة كبيرة فى حالة قلى المواد النصف جاهزة , بينما نقص معامل الانكسار فى حالة قلى المواد النصف جاهزة مقارنة بزيت الكنترول وزيت القلي للمواد الغذائية الطازجة .

كما أوضحت النتائج وجود اختلاف واضح بين كميات الزيوت الممتصة وذلك بإختلاف نوع المادة الغذائية المستخدمة فى التحمير؛من بين هذه المواد البطاطس الطازجة فقد وجد أنها امتصت اقل كمية زيت أثناء عملية التحمير مقارنة بالمواد الغذائية الطازجة.

بينما المواد الغذائية النصف جاهزة كلها فكان محتواها من الدهن عالي لذلك عند تحميرها امتصت اقل كمية من الزيت مقارنة بالمواد الطازجة.

كما تشير النتائج الى نسبة تكوين حمض الاليادك في زيت القلى بعد 20و 60 ق. أثناء تحمير الوجبات النصف جاهزة كانت اكبر من نسبة تكوينها في حالة قلي المواد الغذائية الطازجة.

كما لوحظ أيضا من النتائج أن نسبة تكوين حمض الألياديك (ترانس) كان في زيت قلي البطاطس الطازجة منخفض عن زيت قلي باقي المواد الغذائية الطازجة إضافة إلى أن خصائص زيت القلى للبطاطس الطازجة كانت الأفضل مقارنة بزيت القلى لباقى المواد الغذائية.