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MEASUREMENT OF *TRANS FATTY ACIDS IN* READY TO EAT CHICKEN MEAT

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ABSTRACT

High intake of TFA leads to more health problems as heart disease, breast cancer and diabetes. So we worked in this study for measurement of *trans fatty acid*s (TFA) of ninety ready to eat chicken meat samples from restaurants of Luxor city, and effect of different material of fried on TFA to help people and tourists for determined awareness of TFA in these restaurants and material of fried. In this study found mean of TFA and elaidic acid in chicken burger samples (1.813 mg\100 gm, ± 0.151 mg\100 gm, and 1.450 mg\100 gm, respectively). In fried chicken samples (0.159 mg\100 gm, ± 0.024 mg\100 gm, and 0.127 mg\100 gm, respectively), and in chicken shawirma samples (4.016 mg \100 gm, ± 0.583 mg\100 gm, and 3.212 mg\100 gm, respectively). In this study also an experiment to what happens of TFA in ready to eat chicken meat when used of vegetable oil, butter, or margarine was carried out. It was found TFA of chicken burger, fried chicken and chicken shawirma with use of oil (0.343 mg\100 gm, 0.065 mg\100 gm, and 1.622 mg\100 gm, respectively). TFA of chicken burger, fried chicken and chicken shawirma use of butter (1.836 mg\100 gm, 12.855, and 0.446 mg\100 gm, respectively). TFA of chicken burger, fried chicken, Chicken shawirma which use of margarine (3.278 mg\100 gm, 4.139 mg\100 gm, and 3.22 mg\100 gm, respectively). In conclusion: throughout the samples analysis in our study, chicken shawirma samples from restaurants showed the highest content of *trans fatty acid*s and elaidic acid. The TFA formation was found to be varied with the food ingredient and with the material used for frying.

Keywords: *Trans fatty acid*; ready to eat; chicken meat

INTRODUCTION

*Trans fatty acid*s are dangerous fats produced by heating liquid vegetable oils in the presence of hydrogen. Fast foods contain up to 50% *trans fatty acid*s. *Trans fatty acid*s have been increase LDL cholesterol and lower HDL cholesterol, which may increase the risk for heart disease (Mozaffarian *et al.*, 2006). *Trans fatty acid*s in food are derived from three main sources, including (1) hydrogenation of oils and fats, which used in industrial process (2) biotransformation by bacteria in

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the stomach of a ruminant animal, resulting in the natural presence of TFA in milk, milk products, and meat from these animals and (3) heat treatments such as commercial deep frying and cooking at high temperatures (Hénon *et al.,* 1999). *Trans fatty acid*s formed industrially during the partial hydrogenation of commercial liquid vegetable oils to semi-solid fats are found in margarine and frying fats. Intake of *trans fatty acid*s is associated with metabolic and inflammatory risk factors and diseases. It was recommends that *trans fatty acid*s intake be limited to less than 1% of total energy intake (WHO, 2008). According to FDA about 5.6 g of *trans fatty acid*s was consumed per day. Consumption of *trans fatty acid*s has shown to increase the risk of coronary heart disease (FDA, 2003). Amount of *trans fatty acid*s in a serving of food is 0.5 g or more according to FDA (Dhaka *et al.,* 2011). Commercial frying oil contain significant amount of *trans fatty acid*s there for fried fast food items as french fries and fried chicken contain significant amount of *trans fatty acid*s (Enig *et al.,* 1990). The major *trans fatty acid*s is C18:1tran-9 elaidic acid (Wanders *et al.,* 2010). High intake *trans fatty acid*s increases the risk of coronary heart disease, diabetes mellitus, myocardial infraction and risk of pregnancy induced hypertension (Grundy, 2002; Clifton *et al.,* 2004; YLi-Jama *et al.,* 2002). Association between the adipose concentration of *trans fatty acid*s and breast cancer there is the risk of breast cancer increase with increase in *trans fatty acid*s level in blood serum of women (Kim *et al.,* 2006). *Trans fatty acid*s has also been implicated in systemic inflammation, endothelial dysfunction, adiposity, and insulin resistance (Micha and Mozzaffarian, 2008).

*Trans fatty acid***s** cause more health problems so aimed of this study to determination of *trans fatty acid*s in ready *to* eat chicken meat in Luxor city restaurants. Besides, the present study was designed to keep track of a real-life path to what happens in *trans fatty acid*s in ready to eat chicken meat when frying on oil, butter, or margarine.

MATERIALS AND METHOD

1. Collection of restaurant samples:

A total of 90 random samples of ready to eat chicken meat including chicken burger, fried chicken and chicken shawirma (30 of each product) were collected from different restaurants in Luxor city. Each sample was kept in a separate sterile plastic bag and put in an ice box. The samples were well labeled and transferred to chemistry unite of animal health research institute, Egypt, Dokki, Giza under complete aseptic condition without undue delay for measurement of *trans fatty acids*

2. Experimental for measurement *trans fatty acids* in ready to eat chicken meat prepared at home and used of oil, butter, or margarine:

Nine Nine samples from chicken burger, fried chicken and chicken shawirma (3 of each product) were prepared for cooking. Apiece of chicken burger (1) was fried in vegetable oil, a piece of chicken burger (2) was fried in butter and a piece of chicken burger (3) was fried in margarine. A piece of fried chicken (4) in vegetable oil, a piece of fried chicken (5) in butter and a piece of fried chicken (6) in margarine, and a piece of chicken shawirma (7) in vegetable oil, a piece of chicken shawirma (8) in butter, and a piece of chicken shawirma (9) in margarine, until complete cooking. Each sample was kept in a separate sterile plastic bag, put in an ice box, well labeled, prepared to be transferred to chemistry unite of animal health research institute, Egypt, Dokki, Giza under complete aseptic conditions without undue delay for determination of *trans fatty acids*

3. Analysis of *Trans Fatty Acids* According to (Jayasena *et al.*, 2013):

3.1 Sample Preparation and Fat Extraction (Jayasena *et al.*, 2013):

Samples were grinded then add Glycrel Tritridecanoate at concentration of 200µg/ml by adding 20ml of the stock solution (1mg/ml Dichloromethane). Then solvent of the glyceryl tritridecanoate (dichloromethane) was evaporated by applying nitrogen flow without any heat. Afterward, accurately 40 ml of chloroform, 20ml of methane and 12ml of deionized water into the spiked sample were added after that filtration

3.2 Preparation of methyl esters and derivatization of the extraction (Jayasena *et al.*, 2013):

Before the derivatization, 1ml of the chloroform extraction transferred to a screw cap test tube and evaporated by nitrogen flow without any heat using a Reacti-Vap Evaporator to remove the chloroform from the extract. The evaporated 1ml was treated with 7ml of derivatizing solution (Boron trifloridemethanol GC derivatization grade (~10% ~1.3M) after tightly closed till disappearing of fat globules and saponification was carried out at approximately 70ºC in Driblock DB-3H (Tecam) before GC/FID analysis. After the test tube was cooled, 1ml of water and 1ml of hexane was added to the solution then was shaken very well to force the esters into the hexane layer. The hexane layer was transferred into another test tube which contained a pinch of sodium sulphate as a water scavenger to remove any residual water. The dried hexane transferred into labeled GC vial for analysis.

3.3 Gas Chromatography analysis (Jayasena *et al.*, 2013):

The quantification of the whole profile of the fatty acids include *trans fatty acids* levels in samples was performed using a GC/FID (Gas chromatography/Flame ignition detector) Agilent (7890B) equipped with a capillary column SP-2560 (Fused silica) Supelco (length 100m x I.D. 0.25mm x D.F. 0.25 mm) (Beliefonte, PA). Gas chromatography found in chemistry unites of animal health research institute, Egypt, Dokki, Giza.

3.4 Statistical analysis

Results from three repetitions of frying were collected and were analyzed by SAS system (Statistical Analysis System). Data were analyzed by single factor analysis of variance (ANOVA).

RESULT

Table 1: Incidence of *total trans fatty acids* and elaidic acid content in restaurants samples.

	chicken burger	fried chicken	chicken shawirma
Mean	1.813 mg\100gm	0.159 mg\100gm	4.016 mg\100gm
SE	0.151 mg\100gm	0.024 mg\100gm	0.583 mg\100gm
Elaidic acid	1.450 mg\100gm	0.127 mg\100gm	3.212 mg\100gm

High *trans fatty acid*s in chicken shawirma samples
High eliadic acid in chicken shawirma samples

Table 2: Effect of frying process on content of *trans fatty acids* by use of oil, butter, or margarine in cooking of home prepared chicken burger, fried chicken, and chicken shawirma.

Samples	TFA in vegetable oil	TFA in butter	TFA in margarine
chicken burger (1,2,3)	0.343 mg\100gm	1.836 mg\100gm	3.278 mg\100gm
fried chicken (4,5,6)	0.065 mg\100gm	12.855 mg\100gm	4.139 mg\100gm
chicken shawirma (7,8,9)	1.622 mg\100gm	0.446 mg\100gm	3.22 mg\100gm

High *trans fatty acid*s in all of samples which use margarine in cooking
High *trans fatty acid*s in fried chicken samples (5) which use butter in cooking

DISCUSSION

The limit intake *from trans fatty acids* not let than 1 % (approximately 2 g/day) of total energy according to WHO (Yamada *et al.*, 2010). High consumption of *trans fatty acids* may increase the risk of heart attack (EFSA, 2004). *Trans fatty acid*s intake was positively associated with the incidence of diabetes with a risk of up to 39 mg\100 gm (Meyer *et al.*, 2001). So we worked this study for determination of TFA in restaurants of Luxor city and effect of using different material of fried on TFA to help people and tourist for now awareness of TFA in theses restaurant and material of fried.

In our study in table 1 mean of TFA 1.813 mg\100 gm in chicken burger this limit high little than WHO limit (not let than 1 %) and similar to (Akmar e*t al.*, 2013), who detected TFA in chicken burger 1.97 mg\100 gm, and lower than (Church, 2008), who detected TFA in chicken burger ≤ 2 mg\100 gm,. Elaidic acid in chicken burger was 1.450 mg\100 gm, that indicated TFA from ingredients such as hydrogenated oils and some products of animal origin had a higher ratio of elaidic acid as expected (FSAI, 2008). In our study fried chicken have TFA 0.159 mg\100 gm, these result similar to (Lee *et al.*, 2010) who detected TFA 0.14 mg\100 gm, in fried chicken but lower than (Fu *et al.*, 2008) who detected TFA 8.81 mg\100 gm, in fried chicken. Elaidic acid in fried chicken 0.127 mg\100 gm, that consider in range of WHO and lower than (Ahmed *et al.*, 2020) who detected elaidic in fried chicken 0.1987 mg\100 gm, and higher than (Akmar *et al.*, 2013) who detected elaidic acid in fried chicken < 0.001 mg\100 gm,

In cooking used of corn oil for frying chicken meat at a temperature of 170°C for 4 minutes did not induce the formation of *trans fatty acids* in the meat (Yang *et al.*, 2014). In current study chicken shawirma have TFA 4.016 mg\100 gm, this result more than WHO limit (not let than 1 %) that indicated the part of chicken contained skin which high in TFA and ingredients in shawirma as vegetables high in TFA. Formation of varied amounts of TFAs increase according to frying temperature, ingredients and the oil used (Liu *et al*., 2007). Some liquid vegetable oils such as canola and soybean, contain small amounts of TFA which can be formed during the commercial refinement of these oils (Ratnayake *and* Zehaluk, 2005). The continuous using of frying oil might produce certain harmful toxic compounds to human health such as oxidized fatty acids, *trans fatty acids* (Ganbi, 2011).

In table 2 in these results use of margarine in cooking lead to increase of TFA more than the limit of WHO in chicken burger, fried chicken and chicken shawirma (3.278 mg\100 gm, 4.139 mg\100 gm, and 3.22 mg\100 gm,). These results lower than (Yamada *et al.*, 2010) who detected TFA content for margarine 5.8 mg\100 gm and these results also lower than (Ratnayake and Zehaluk, 2005) who detected TFA content for margarine that used in ready to eat chicken meat (14.7 mg\100 gm, –21.0 mg\100 gm), and similar to (Wood *et al.*, 1993) who detected TFA content for margarine that used in ready to eat chicken meat (3.4 mg\100 gm,). High intake of TFA lead to more health problems, in this result due to fried chicken carry high TFA in subcutaneous fat and deep frying lead to increase of TFA so its result is more them. Chicken fats are mostly unsaturated and found in skin so during frying, these give TFA (Goburdhun *et al*., 2000). In present result use of butter in cooking not increases TFA more than the limit of WHO (not let than 1 %), in chicken burger and chicken shawirma (1.836 mg\100 gm, and 0.446 mg\100 gm, respectively). These results were lower than (Wood *et al.*, 1993) who detected TFA (5.3 mg\100 gm), in butter. However in fried chicken TFA (12.855 mg\100 gm,) was more than normal limit of

WHO and dangerous. The high result because chicken fats in skin or thigh are mostly unsaturated and during frying, these will melt and seep out into the frying medium, where rapidly oxidized to give more TFA (Goburdhun *et al*., 2000). Deep frying of chicken despite responsible for good flavor and color, however generates many of hazardous compounds, such as TFA which are formed in food during frying in high temperatures (Choe and Min, 2007). Frying chicken thigh did not result in the formation of *trans fatty acids* in the meat but TFA appeared in the skin of the meat fried because of the absorption of the oil. The maximum *trans fatty acid* content was obtained after 15 minutes of frying (Liuet *et al*., 2008). *Trans fatty acids* can be formed when vegetable oils are converted to solid fats such as margarine and other fats by an industrial process called hydrogenation. Foods in which the hydrogenated oils are used as ingredients may contain industrial *trans fatty acids* which found in small amounts during the refining of liquid vegetable oils (Mehta and Swinburn, 2001). Heat treatments such as commercial deep frying and cooking at high temperatures lead to increase TFA in restaurant food (Hénon e*t al.*, 1999). In our study use of oil in cooking lead to not increase of TFA according to the limit of WHO (not let than 1 %) in chicken burger, fried chicken and chicken shawirma (0.343 mg\100 gm, 0.065 mg\100 gm, and 1.622 mg\100 gm, respectively). These results similar to (Asgary *et al.*, 2009) who detected TFA 0.9 mg\100 gm, on foods French fries and fried chicken

CONCLUSION

Chicken shawirma samples from restaurants showed the highest content of *trans fatty acid*s and eliadic acid which may attributed to ingredients in shawirma as vegetables high in TFA. Formation of varied amounts of TFA increase according to frying temperature, ingredients and the oil used. Fried chicken with use of butter and margarine show highest TFA, and highest value with use of butter, which may related to the increase of fat in the skin and thigh of piece of chicken used. The high variability of TFA content in samples could related to several factors as the lipid composition of the food, differences in cooking methods, fast food preparation and ingredient content, deep frying, food surface area for fat absorption, high temperature use in cooking and major of them type of vegetable oil used for food preparation. It is possible to minimize *trans fatty acids* during the hydrogenation by increasing the pressure, catalyst concentration and agitation. All these technologies were oil formulation, so must be lead to decrease TFA in food to avoid health problems

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قياس الدهون المتحولة فى لحوم الدواجن الجاهزة للاستهلاك

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يؤدي تناول كميات كبيرة من الدهون المتحولة في لحوم الدواجن الجاهزة للاستهلاك إلى مشكلات صحية مثل أمراض القلب وسرطان الثدي والسكري , لذلك قمنا بعمل دراسة لتجمع ٩٠ عينة عشوائية من لحوم الدواجن الجاهزة للاستهلاك لقياس الدهون المتحولة في مطاعم مدينة الأقصر لمساعدة الناس والسائحين في معرفة خطر الدهون المتحولة في هذه المطاعم ، وكذلك تم دراسة استخدام مواد مختلفه في القلي علي تكوين الدهون المتحولة. اظهرت الدراسة ان متوسط الدهون المتحولة وحمض الإيليديك في عينات بيرجر الدجاج ١,٨١٣ مج / ١٠٠جم ± ٠,١٥١ و١,٤٥٠ مج / ١٠٠جم، و في عينات الدجاج المقلي ٠,١٥٩ مج / ١٠٠جم ± ٠,٠٢٤ و٠,٠١٢٧مج / ١٠٠جم في عينات شاورما الدجاج ٤,٠١٦ مج / ١٠٠جم ± ٠,٥٨٣ و ٣,٢١٢ مج / ١٠٠جم .

في هذه الدراسة تم عمل تجربة لما يحدث للدهون المتحولة في لحوم الدجاج الجاهزة للأكل عند استخدام زيت نباتي، سمن طبيعي او سمن مهدرج. تم العثور على الدهون المتحولة من بيرجر الدجاج والدجاج المقلي وشاورما الدجاج باستخدام زيت نباتي علي التوالي ٠,٣٤٣ مج / ١٠٠جم و ٠,٠٦٥ مج / ١٠٠جم و ١,٦٢٢ مج / ١٠٠جم ، الدهون المتحولة من بيرجر الدجاج والدجاج المقلي وشاورما الدجاج باستخدام سمن طبيعي علي التوالي ١,٨٣٦ مج / ١٠٠جم ١٢,٨٥٥ مج / ١٠٠جم و ٠,٤٤٦ مج / ١٠٠جم ، و الدهون المتحولة من بيرجر الدجاج و الدجاج مقلي و شاورما الدجاج باستخدام سمن مهدرج علي التوالي ٣,٢٧٨ مج / ١٠٠جم و ٤,١٣٩ مج / ١٠٠جم و ٣,٢٢ مج / ١٠٠جم. خلصت الدراسة إلي ان عينات شاورما الدجاج من مطاعم مدينة الاقصر وجد بها المحتوي الأعلى من الدهون المتحولة وحمض الإيليديك ، وخلصت الدراسة ايضا ان تكوين الدهون المتحولة يختلف باختلاف المادة الغذائية وكذلك باختلاف المادة المستخدمة لعملية القلي