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Some Physical and Chemical Changes of Food Properties (Tamia, Potato Chips) after Frying Process

بعض التغيرات الفيزيائية والكيميائية التي تحدث في المادة الغذائية (رقائق البطاطس والطعمية) بعد التحمير

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Dedication

TO OUR FATHER

TO OUR MOTHER

TO OUR TEACHERS,

TO OUR FRIENDS

ACKNOWLEDGEMENTS

First of all, I would like to thank almighty God who gave me his blessings, good heath and support to accomplish this study.

Sincere thanks are given to my Supervisor: **Dr. Mahdi Abass Saad Shakak** for his kind support. Special thanks are due to T. Altigani Abdalla, and Mr. Algilly Omer Mohammed for help us. Finally, we thank our Dr. .

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ملخص الدراسة

الهدف من هذه الدراسة معرفة التغيرات الفيزيائية والكيميائية التي تحدث في المادة الغذائية بعد التحمير. أجريت الدراسة على مادتين غذائيتين هما الطعمية ورقائق البطاطس (الشيبس). كانت نتائج التحليل الكيميائي للطعمية 27.49%، 12.25% ، 22.08% و 11.6 مل مكافئ/ملجم لكل من الرطوبة والبروتين والدهن ورقم البيروكسيد على التوالي. أوضحت النتائج ارتفاع نسب الرطوبة والبروتين والدهن في الطعمية. وكانت نتائج التحليل الكيميائي لرقائق البطاطس (الشيبس) 21.90%، 11.05% و32.44 مل مكافئ/ملجم لكل من الرطوبة والدهن ورقم البيروكسيد على التوالي. وكانت نتائج التحليل الفيزيائي للزيت المستخلص من الطعمية 1.4، 0.92 و0.86 لكل من معامل الانكسار والكثافة واللون. كذلك كانت نتائج تحليل الزيت المستخلص من رقائق البطاطس (الشيبس) 1.00، 0.92 و1.36 لكل من معامل الانكسار والكثافة واللون على التوالي.

Abstract

The purpose of this study was to determine the physical and chemical changes that take place after frying of food stuff. The study was conducted on two kind of foods: *Tamia* and Potato chips. Results of chemical analysis were 27.49%, 12.25, 22.08 and 11.6 mq/mg for moisture, protein, fat and peroxide value, respectively. Results illustrated that moisture, protein and fat content were high in *Tamia*. Chemical results of potato chips were 21.90%, 11.05% and 32.44 mq/mg for moisture, fat and peroxide value, respectively. Physical analysis of oil extracted from *Tamia* were 1.4, 0.92 and 0.86 for refractive index (RI), density and color. Results of oil extracted from potato chips were 1.00, 0.92 and 1.36 for refractive index(RI), density and color.

CHAPTER ONE

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. (Radwan and anany, 2006).

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 filters (Paul and Mittal, 1996).

Oxidative alteration in the frying medium due to release of moisture from the food, atmospheric oxygen entering the oil, where as 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. (Stevenson and Eskin, 1984).

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 subsequently influencing its properties. This affects not only the flavor and aroma of the products, but also the texture, depending on the quantity of oil absorbed during frying. (Kita and Lisinska and Golubowska 2007).

The effect of pre-frying treatment on the final oil content of tortilla chips fried for 60 sec was studied. 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. (Moreira and Chen1997).

The objectives of this study:

1. To study Effect of frying process of the physical and chemical characteristics.
2. To study Effect of frying process on the nutritional value of food stuff (*Tamia*, Chips).

CHAPTER TWO

2. LITERATURE REVIEW

Food frying has long been used as a technique to prepare various foods both at home and in industrial food sectors. Since fried foods develop a much desired texture, flavor and appearance, they are consumed in large quantities all over the world. The popularity of fried food is due to the surface texture, crunchiness and flavor. Especially the fast food sector uses frying widely. (Russell 2001).

2.1 Types of fried food:

2.1.1 Potato chips:

Fried foods play a very important role in the diet of the Potato chips have been a popular salty snacks for 150 years and retail sales in many countries are about 6 billion/year, representing 33% of the total sales on the market. (Garayo and Moreira 2002). However, potato chips have an oil content that ranges from 35 to 45g/100g (wet basis), which is a major factor affecting consumer acceptance for oil-fried products today. (Dueik and Bouchon, 2011). Due to consumer health concerns, fat content of potato chips is an important parameter to be controlled during processing. (Dueik and Bouchon, 2011).

2.1.1.1 Potatoes components:

- It contains up to 80% of water.
- 20% solids.
- 85% starch.
- 2% protein.
- Fiber 2.2%
- carbohydrate19%

- Contains many of vitamins such as Niacin, Riboflavin and thiamine.
- Contains metal salts such as magnesium, calcium, iron, phosphorus, sodium and sulfur.

2.1.1.2 How to prepare:

- Put potatoes cut slices in hot water and add salt.
- Boil the potatoes well the slices color become red.

2.1.1.3 Benefits of Potatoes:

- Easy to digest.
- Protects against cancer because it contains essential nutrients for the body, such as minerals (calcium, phosphorus and copper) and vitamin c, and Allaktinat which destroys the cancer cells.
- It contains vitamin C.
- Skin Care: Vitamin-C and B-complex as well as minerals like potassium, magnesium, phosphorus and zinc are good for the skin.
- Maintaining Brain functioning and nervous system health.

2.1.1.4 Disadvantage of fried potatoes (chips):

- Increases cholesterol in the blood because it deposits in saturated fat and that are very harmful.
- Increase the irritation and inflammation of the stomach problems.
- Industrial materials could be deposited on the liver and kidney and that is harmful in the future.
- Increased Diabetes Risk.

2.1.1.5 Potato facts:

Like tomatoes, eggplants and peppers, potatoes are members of the nightshade family. They are not root vegetables; potatoes are actually the swollen part of the stem of the perennial Selenium tuber sum this part of the plant is called a tuber, which functions to provide food to the leafy part of the plant. The "eyes" of potatoes are buds, which will sprout into branches if left alone. (Aladdin 2010) – Alshuraa for Scientific Research Publish

2.1.2 Tamia:

It is traditionally Arab food also called falafel means pepper, these Fried vegetation fritters are often served along with hummus and tahini Sauce. *Tamia* is a great source of protein for people who have cut meat Out of their diet. It is relatively low in fat and has no cholesterol if you fry it in heart –healthy grape seed oil. It is delicious fast food that is much higher and better for heart than burgers and fries. *Tamia* made from check pea soaked in water, ground by specialized miller and thin, and its ingredients are check pea, water, salt and baking powder. (Wiki Books, Website 2007).

Tamia is made from types of legumes such as chickpeas and beans, which are crushed and mash well until become smooth and soft, then add a certain spices and Garlics. *Tamia* spread widely in different places from the world. Especially in the Arabic area and Middle East like the Levant, Egypt and Sudan and it is one of the local dishes.

2.1.2.1 Ingredients:

- Cup of beans chickpeas.
- Fresh fennel.
- Cloves of garlic.
- Onions.
- Baking powder (sodium bicarbonate).
- Spoon of salt.
- Hot pepper.

2.1.2.2 Method of Preparation *Tamia*:

- Soak the chickpeas with water and add the amount of sodium bicarbonate.
- Add salt, Shasta, pepper and garlic
- Heat oil over high temperature after the completion of the formation of tablets falafel and put them in the hot oil.

2.1.2.3 Benefits *Tamia*:

- It contains many minerals such as magnesium, calcium, and also contains fiber.

2.1.2.4 Disadvantages of *Tamia*:

- Deep Frying of *Tamia* causes high blood sugar because it contains saturated fat.
- Causes a clear flaw in the blood pressure and cholesterol rate

Aladdin 2010 (Syria -Hallab) – alshuaa for Scientific Research Publishing.

2.1.2.5 Frying Process:

In frying, the frying oil serves as a heat transfer medium and an ingredient of fried food .during this process, heat transfer from oil to food and cooking of food, meantime water vaporization from food into the oil and then to the of oil into the capillaries formed in food, air –oil mixing at the surfaces and similar phenomena occurred content of food surface nearly to3%, and oil enter into the spaces left by the evaporation water. A series of physical and chemical changes take place in frying oils used at around $175C^0$ or above. The factors that affect the oil and product quality during deep –fat frying are refreshing ratio of oil, frying time and temperature, heating type, composition of frying oil quality of startup oil, composition of fried food, fryer type, antioxidants and oxygen availability. During frying, some chemical reactions like oil hydrolysis, thermo-oxidation, dimer and polymer formation, mail lard reactions and others take place in the oil. The products of these reaction accumulate by time and lead to oil deterioration and reduce the frying oil quality and healthiness properties of fried foods**.** (Smitheal, 1985**)**.

have suggested ideal frying oil as having a maximum of 0,05-0,08% free acidity maximum of1,0 med/kg peroxide value, minimum of 200c of smoke point, maximum of 1.0% moisture with mild flavor and tast. to protect public health ,some regulation and guidelines to control frying operation and frying oil have been developed in different countries.

There are different regulation for fresh and used frying oil in European countries turkey, the first regulation for frying oil has issued by the ministry of Agriculture (Regulation no:2007) the control criteria for the solid and liquid oil used frying ". this notification emphasize especially tow parameters; total polar materials must be %25 and smoke point polar materials must be $170C^0$.Although the restaurant owners or cooks usually decide when to change frying oil by visual examination ,after this regulation it is obligatory to measure total polar material .

The times of this study have been to objectively evaluate some frying oil samples collected from fast food restaurants and to assess the attitudes and knowledge of the cooks operating frying in the restaurant by a survey. (Melton 1994). During frying, oil are degraded from thermal oxidation from volatile and non –volatile decomposition products (Melton *et al.*, 1994).

The chemical changes in frying oil also resulting changes in frying oil also resulting changes in the quality of fried food .the fatty acid composition of the frying oil is an important factor affecting fried food flavor and its stability; therefore, it should be low level of polyunsaturated fatty acid such as linoleic or linolinolenic acid and high level of oleic acid with moderate amounts of saturated fatty acid As a result, the quality of frying oil is important because of absorbed oil of fried products during deep frying. (kiatsrichart *et al* .,2003).

Fat or oil frying one of the most common and the oldest methods developed and used by man for the preparation of food .Recent consumer interest in "healthy eating "has raised awareness of the need limit the consumption of fat and fatty foods. (Brian and Lyon1990).

Frying processes are carried out at temperatures of between 140-200C^0, far higher than can be reached when boiling water, but lower when roasting food in a circulating hot air flow. The complex reaction taking place under frying process condition have been extensively studied for frying oils. Fats and oils used for the preparation of foods are exposed to elevated temperatures in the presence of changes these reaction are causing deterioration of the frying fat and oils, the degree of deterioration depends on the nature of the frying oils and many other circumstances as the fryer design, the kind of food that is fried and the frying method (deep-.fat frying or shallow-frying) etc**.** (Gertz *et al*. (2000).

2.2 Frying oil quality

The necessity of using a good quality frying medium becomes obvious when one considered that some of the fat is absorbed by every piece of food fried in it. The choice of frying fat depends on many factors such availability, price, frying performance, flavor and stability of product during storage. (Suleiman *et al*, 2006).

Edible oils use for food frying are subjected to the formation of compounds, such as enzyme inhibitors , vitamin destroyers, lipid oxidation products gastrointestinal irritants potential mutagens that are harmful to human health and can therefore become a chemical and physical hazard . For this reason, regulation have been drawn up in several countries to control the use of frying fats in restaurants and food processing establishments. (Soriano *et al* 2002).

The requirements for the oil in processing plant center on handling and resistance to breakdown at the frying temperatures during which the product undergoes textural changes and water is driven off. The finished product should be bland flavor and the shelf life should not be adversely affected. (Burdon 1989).

An ideal frying fat should be inexpensive, have long frying life and fatty acid profile that is low in saturated and trans fatty acid .It should also be resistant to gumming, rancidity and uniform in frying, as well as panfrying, is a very complicated procedure that is not only influenced by the quality of fat or oil being, but also by several other factors. (Gertz and Kochhar 2004).

2.3 Type of food that is fried:

The type of food being fried affects the frying life of the oil .food, when fried ,can introduce various components such as carbohydrates, phosphates, sulfur compounds, trace metals, to the oil and these will contribute to color formation and other changes that may be deleterious in frying medium by reacting with the oil or its breakdown products. (Kochhar 2004).

Moisture in foods creates a steam blanket over the fryer and reduces contact with air. (Choe and Min, 2007).

The higher the moisture content of the food is, the higher moisture transfer, and hence hydrolysis. (Stevenson *et al*, 1984).

Frying foods that contain high levels of egg solids can contribute to early foaming due to the leaching of lecithin into the frying fat.

2.4 The frying equipment design:

The frying oils should be handled with great care during storage and processing because any abuse will result in reduced product shelf life (Burdon1989).

The fast food industry is adopting various methods designed to maintain the quality and increase the useful life of frying oils. They include the use of active and passive filters, antioxidants, and the proper maintenance of frying equipment. (Paul and Mittal, 2001).

Sophisticated fryers with indirect heating systems, automatic filtration, balanced steam stacks, control oil flow, efficient controls and instrumentation that aim at keeping the oil in good condition. (Burdon, 1989).

The design features should eliminate known factors of heat degradation/oxidation in the oil, while maintaining an output of fried products of consistent quality. For instance, pro-oxidant catalyst copper or brass valve fittings must not be employed. (Kochhar 2004).

A fryer should ensure the required throughput of food for the minimum amount of fat volume, and it should have a heating element capable of rapidly returning the temperature of the fat. Alaso, the ratio of volume of fat to the volume of food is of great importance. The larger the surface area of the vat is, the larger the area of fat exposed to the air and the faster the rate of oxidation. (Mehta and swinburn2001).

Using fryers designed with a small surface to volume ratios will prevent aeration of the oil; air in the hot oil is the greatest contributor to oil breakdown. (Stevenson *et al*. 1984).

Cleanliness of the fryer is another factor to be controlling oil breakdown. (Stevenson et al (1984).

Deposits of gum or polymer around the fryer hood or utensils promote oxidation, and are difficult to remove if left for long periods. (Methta and swinburn, 2001).

Regular cleaning of the frying equipment should be carried out with special attention being paid to rinsing, to ensure that all the traces of soap and detergent are removed. (Stevenson *et al* 1984).

Water or detergent remaining after cleaning will cause of foaming and aeration. Failure to remove alkaline cleaning compounds is a prime cause of fat degradation because the compounds react with water and free fatty acids to from alkaline soaps**. (Blumenthal 1984).**

2.5 Turnover rate:

The turnover rate is probably the most important factor in maintaining oil quality. (Paul and Mittal, 1997). The rate of color darkening or any other change in the characteristic of the frying oil depends on the turnover rate which fresh oil is added to the kettle .The higher the rate of replacement, the lower the level of oil darkening. (Soriano *et al* 2002).

Also, the higher the turnover rate, the slower the Production of free fatty acids. (Kochha, 1999). Are commended daily turnover is15-25% of the fryer capacity? Proper turnover will keep the level of free fatty acid low. In large-scale commercial operations, in which frying is continuous, this turnover period can be as low. In law as12 hours, and fat degradation is minimal. (Stevenson *et al* 1984).

The frequent addition of fresh fat throughout the deep-frying process minimizes thermo-oxidative and hydrolytic changes in frying oils and extends the frying life of the oils. Various factors may account for this phenomenon, compounds formed during fringe, while the addition of unaltered fatty acids and antioxidant compounds from the fresh oil helps to maintain the initial composition of the frying oil. (Romero *et al* 1999).

In most fast food out lets the rate of turnover varies from3 to 5 days. The rate of turnover may be low, if the food being fried is less absorbent or if the frying process is not continuous. High turnover (fewer than 2days) means that fat never has to be discarded. When turnover replaced.

In such situation, smaller frying vats should be used and some fat should be removed each day to allow the addition of fresh makeup fat. (Mehta and Swinburne ,2001).

2.6 Frying temperature:

The frying temperature recommended for specific foods in different studies varies from16o to 200C^0, with the optimal frying temperature depending on the type of food, its size, the fat turnover, the size of the frying vats used. (Mehta and Swinburne 2001).

Higher temperatures, especially over 200C^0, accelerate oxidative and thermal alterations and increase the rate of formation of decomposition products. (Soriano *et al* 2002).

2.7 Heating time:

The intermittent heating and cooling of oil shows a greater rate of polar compound formation than that occurring during continuous frying. This is due to the increase in fatty acyl-peroxides as the oil cools and their de composition upon heating causing further damage to the fat. This is repeated with each heating and cooling cycle. (Clark and Serbia, 1991).

Therefore, intermittent heating is much more destructive than continuous heating. (Paul and Mittal ,1997).

CHAPTER THREE

3. MATERIALS AND METHODS

3.1 Materials:

Sample were collected from of Sudan university of science and technology college of Agriculture studies cafeteria.

3.2 Methods:

3.2.1 Proximate and mineral sample analysis:

The moisture, ash and crude fiber contents were analyzed according to standard methods described in **AOAC (1997).**

Nitrogen was assayed using Kjeldahl method and the nitrogen content was converted to protein by a multiplication factor of 6.25 **(AOAC, 1997)** Total Carbohydrates were determined by difference using a standard method of **AOAC (1997).** All the proximate analyses were carried out in triplicate and the results expressed as percentage of the sample analyzed.

The sample calorific values were estimated (in kcal/g) by method adopted from **Yusuf *et al.*, (2007).**

3.2.2 Chemical methods

3.2.2.1 Moisture content

The moisture content was determined according to the standard method of the Association of Official Analytical Chemists **(AOAC, 2003).**

Principle: The moisture content in a weighed sample is removed by heating the sample in an oven (under atmospheric pressure) at 105 $^{\circ}$C.

Then, the difference in weight before and after drying is calculated as a percentage from the initial weight+66.

Procedure: A sample of 2 g ±1 mg was weighed into a pre-dried and tarred dish. Then, the sample was placed into an oven (No.03-822, FN 400, and Turkey) at 105 ± 1 °C until a constant weight was obtained. After drying, the covered sample was transferred to desiccators and cooled to room temperature before reweighing. Triplicate results were obtained for each sample and the mean value was reported to two decimal points according to the following formula:

$$\text{Moisture content (\%)} = \frac{(Ws - Wd)}{\text{Sample weight (g)}} \times 100\%$$

Where:

Ws = weight of sample before drying.

Wd = weight of sample after drying.

3.2.2.2 Crude protein content

The protein content was determined in all samples by micro-Kjeldahlmethod using a copper sulphate-sodium sulphate catalyst according to the official method of the **AOAC (2003).**

Principle: The method consists of sample oxidation and conversion of its nitrogen to ammonia, which reacts with the excess amount of sulphuric acid forming ammonium sulphate. After that, the solution was made alkaline and the ammonia was distilled into a standard solution of boric acid (2%) to form the ammonia-boric acid complex which is titrated against a standard solution of HC1 (0.1N). The protein content is calculated by multiplying the total N % by 6.25 as a conversion factor for protein.

Procedure: A sample of two grams (2 gm) was accurately weighed and transferred together with, 4g NaSO4 of Kjeldahl catalysts (No. 0665, Scharlauchemie, Spain) and 25 m1 of concentrated sulphuric acid (No.0548111, HDWIC, India) into a Kjeldahl digestion flask. After that, the flask was placed into a Kjeldahl digestion unit (No.4071477, type KI 26, Gerhardt, Germany) for about 2 hours until a colourless digest was obtained and the flask was left to cool to room temperature.

The distillation of ammonia was carried out into 25m1 boric acid (2%) by using 20 ml sodium hydroxide solution (45%). Finally, the distillate was titrated with standard solution of HC1 (0.1N) in the presence of 2-3 drops of bromocreasol green and methyl red as an indicator until a brown reddish colour was observed.

$$\text{Crude Protein (\%)} = \frac{\text{(ml Hcl sample – ml Hcl blank) x N x 14.00 x (F)}}{\text{Sample weight (g) x 1000}} \times 100\%$$

Where:

N: normality of HCl.

F: protein conversion factor = 6.25

3.2.2.3 Fat content

Fat content was determined according to the official method of the **AOAC (2003).**

Principle:

The method determines the substances which-are soluble in petroleum ether (65-70 °C) and extractable under the specific conditions of Soxhlet extraction method. Then, the dried ether extract (fat content) is weighed and reported as a percentage based on the initial weight of the sample.

Procedure:

A sample of 5g ± l mg was weighed into an extraction thimble and covered with cotton that previously extracted with hexane (No.9-16-24/25-29-51, LOBA Chemed, and India). Then, the sample and a pre-dried and weighed extraction flask containing about 100 ml hexanes were attached to the extraction unit(Electro thermal, England) and the extraction process was conducted for 6 hrs. At the end of the extraction period, the flask was disconnected from the unit and the solvent was redistilled. Later, the flask with the remaining crude ether extract was put in an oven at 105 °C for 3 hrs , cooled to room temperature in a desiccators, reweighed and the dried extract was registered as fat content according to the following formula;

$$\text{Fat content (\%)} = \frac{(W2 - W1)}{W3} \times 100\ \%$$

Where;

W_2 =Weight of the flask and ether extract

W_1 =Weight of the empty flask

W_3=initial weight of the sample

3.2.2.4 Ash content

The ash content was determined according to the method described by the **AOAC (2003).**

Principle:

The inorganic materials which are varying in concentration and composition are customary determined as a residue after being ignited at a specified heat degree.

Procedure:

A sample of 5g ±1 mg was weighed into a pre-heated, cooled, weighed and tarred porcelain crucible and placed into a Muffle furnace (No.20. 301870, Carbolite, England) at 550 to 600 °C until a white gray ash was obtained. The crucible was transferred to a desiccator, allowed to cool to room temperature and weighed. After that, the ash content was calculated as a percentage based on the initial weight of the sample.

$$\text{Ash (\%)} = \frac{[(\text{Wt of crucible} + \text{Ash}) - (\text{Wt of empty crucible})]}{\text{Initial weight (Wt)}} \times 100\%$$

3.2.2.5 Peroxide Value Determination:

A known weight (2 g) of sample was weighed into clean dried boiling tube, 1 gram of potassium iodine (KI) powder was added to the oil and 20 cm3 of the solvent mixture (i.e., glacial acetic acid and chloroform in the ratio 2:1). Then the boiling tube was placed in boiling water bath so that the liquid mixture boils within 30 seconds and allowed to boil vigorously for not more than 30 seconds, the content after boiling was quickly poured into a flask containing 20 cm3 of 5 % potassium iodine (KI) solution and the tube was washed out twice with 25 cm3 of water. Then the mixture was titrated with 0.002 M sodium thiosulphate using fresh 1 % starch solution, a blank titration was carried out at the sample time, the peroxide value was calculated using the relationship below **(Akpan et al., 2005).**

$$\textit{Peroxide value} = \frac{T \times M \times 1000}{\textit{Weight of sample / (g)}}$$

Where

T = titre value of $Na_2S_2O_3$ = (Sample titer – Blank titer,)

M = Molarity of $Na_2S_2O_3$.

3.2.3 Physical characteristics

3.2.3.1 Refractive index (RI)

Velocity of light in vacuum to the velocity of light in the medium being Closely related to oxidation products and development of rancidity. It is Useful for identification purpose and for establishing purity, and also for Observing the progress of reactions, such as catalytic, hydrogenation and Oils decrease in most condition controlled or normal, with concomitant Causes slight difference in R I between crude and refined oils. Increasing in temperature of oil and fats causes the R I to decrease along with decrease

Increase of refractive index and conjugated unsaturation cause a higher due to specific gravity, molecular weight, increase in saturation and

3.2.3.2 Viscosity:

Defined the viscosity as the measure of resistance to flow. Viscosity is the measure of the internal fraction in the oil and is the important index of the study of oil and their intermolecular forces and its useful criterion for degradation or de ploymeraization such as that occur in initial stage of hydrolysis of fat and oil during storage (Joslyn, 1970).

The viscosity of an oil decrease with the rise of temperature and increase with saturated and large molecules such as long –chain fatty acids.

Prasad and Butt (1989) found that the viscosity to be influenced by change

In temperature and decreased exponentially with increase in temperature.

Russel (1972) studied various sunflower seeds oil and cottonseed oil heated at 182 ◌̊C and observed a small change in the viscosity of cottonseed oil

Compared to that of sunflower oil which increased after 60 hours of heating, such increase in viscosity was probably due to polymer formation

3.2.3.3 Colour:

Oils generally colored, as they contain in true or colloidal solution varying quantities of different lipodolube pigments originated from oleiferous tissues ,or artifacts caused by degradation ,most usually thermal,

during processing –treatments. Standards show that the colour of oil will be 10 creamy white to yellow. Colour is important quality factor, and in order to maintain a bright colour in the final product,chemical treatment and additives are often used in place of bleaching by heat to inactivate enzymes vegetables oils and fats is due to presence of the natural pigments or of their de composition and their a compounded substances e.g . Xanthophylls and in colour of oil was closely orrelated with increasing amount of carbonyls compounds. That, the determination of colour of oil was based on visual composition with standard by using Lovibond tinometer. Colour of crude oil of sunflower as 1.0 yellow tint and 1.0 red tint, or 2.0 yellow tint and 3.0 red tint.

CHAPTER FOUR

4. RESULTS AND DISCUSSIONS

Table (1) shows the physical properties of oil extracted from *tamia* and potato chips after frying. The oil extracted from *Tamia* was significantly different from that extracted from fried potato chips 1.4000 and 1.000 ,respectively.

The density of oil extracted from *tamia* was unsignificantly different from that extracted from potato chips 0.923 and 0.917 density.

The blue colour of oil extracted from *tamia* was unsignificantly different compared to that extracted from potato chips 0.16 and 0.15.

The red colour of oil extracted from *tamia* was unsignificantly different compared to that extracted from potato chips 0.86 and 1.36.

The yellow colour of oil extracted from *tamia* was significantly different compared to that extracted from potato chips 31.6 and 32.4.

Table 1. Physical composition of Tamia and Chips

Sample	Refractive index	Density	Colour		
			Blue colour	Red colour	Yellow colour
Sample *Tamia*	1.4000 0.2000±	0.9230 3.78±	0.16 0.0153±	0.86 0.0000±	31.6 0.0577±
Sample chips	1.0000 0.1518±	0.9170 5.25±	0.15 9.23±	1.36 0.0577±	32.4 0.0577±

Table (2) shows that there was a significant different between *Tamia* past and one was decrease moisture content de waxed from 77.327% to 27.49% .

It was assumed that this high percentage of water in the fried *Tamia* might be due to inadequate frying temperature which was the main cause of increase peroxide value oil increase peroxide value. There was significant increase in all other chemical characteristics protein, ash, carbohydrate, and fat 8.55% 12.25% ash 1. 6, 2.1%, 7.23%, 27.97%, and fat 1.132% to 22.083% peroxide value of fried *Tamia* was 11.6% mq/mg. which was not acceptable according to codex standard which should be less than 10mq/mg.

Results in table (2) shows that the moisture content, protein, ash , fat , crude fiber and peroxide value were (27.49% , 12.25% , 2.1, 22.08% , 8.11% , 11.6%) respectively were in agreement with (M. S., AL-zinc *et al*, 2001) in the moisture content 28.25% , and ash 1.20.% and peroxide value 11.18% and dis agreement in fat 19.66% and protein 13.71% .

Table 2. Chemical composition of *Tamia* paste fried *Tamia*

Sample	Moisture	Protein	Ash	Fat	Cured Fiber	Carbohydarates	Peroxiedde
Tamia past	77.327 1.1490±	8.5 0.3554±	1.6 0.0153±	1.132 0.1330±	4.21 0.3851±	7.23 0.421±	-
Tamia fried	27.49 1.6111±	12.25 1.6318±	2.1 0.0306±	22.083 1.3969±	8.11 0.2152±	27.97 1.721±	11.6 0.292±

Number in the same Colum bearing the same superscript are no significantly different ($p<0.05$).

Table (3) show that there was a significant different between *Tamia* past and fried are in all chemical composition characteristics for example moisture content de waxed from 69. 37% to 21. 903%.

It was assumed that this high percentage of water in the fried chips might be due to inadequate fry temperature which would affect oil increase peroxide value. There was significant increase in all other chemical characteristics protein, ash, carbohydrate, and fat 3. 5% 4. 37% ash 3. 4, 5. 6%, 12. 6%, 22. 23%, and fat 0. 2% to 11. 057% peroxide value of fried chips was 32. 4% mg/mg. which was not acceptable according to codex stander which should be less than 10mq/mg.

Table 3. Chemical composition of Potato and Fried Chips

sample no	Moisture	Protein	Ash	Fat	Fiber	Peroxied value
Potato	69.37 0.0600 ±	3.5 0.1790 ±	3.4 0.7937 ±	0.2 0.5771 ±	4.4933 0.5001 ±	31.2 0.179±
Chips	21.903 0.6574 ±	4.37 0.8451 ±	0.6 0.1000 ±	11.057 0.0000 ±	7.3133 0.6146 ±	32.437 0.1518 ±

C= Chips D= Potato

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

From the results obtained in this study it can be conclude that, the Tamia and Chips were contained high protein

Also it has been found to be very rich in carbohydrates, calcium, magnesium.

It was also Noticed that, Tamia and Chips were contented high percentage of Carbohydrates and magnesium.

5.2 Recommendation

According to the above mentioned conclusion we recommend:

- It is not recommend to use the products of the deep frying oils that contain a high peroxide and free redicals.
- Inspection and control should be carried out to check for oil stability and products.
- Also it was recommend for more studies in this field.

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