ESTIMATION OF FREE FATTY ACID AND CHOLESTEROL CONTENTS OF SELECTED EDIBLE OILS IN NIGERIA

Ezeike Amarachi Keziah
e-mail: amarachukas@gmail.com Tel: 08026217952
Department of Science Laboratory Technology,
School of Applied Sciences, Federal Polytechnic Oko

Abstract

Central to every economy is the human resource who must be healthy to be able to contribute to the economy. Oils have always been an integral part of human diet and health is determined largely by diet. In the present study, an attempt has been made to find out the free fatty acid and cholesterol contents of some commercial edible oils in Nigerian market. The free fatty acid and cholesterol contents were determined in five different samples namely: Emperor oil, Golden Penny oil, Kings oil, Power oil and Turkey oil. The free fatty acid and cholesterol determinations were done using the standard method of the Jacobs and the Official method of the Association of Analytical Chemists respectively. The results showed that for Emperor, Golden Penny, Kings, Power and Turkey oils, the free fatty acid content are: 0.308ml/L, 0.033 ml/L, 0.280 ml/L, 0.896 ml/L and 0.336 ml/L respectively. For the cholesterol content, the selected Emperor, Golden Penny, Kings, Power and Turkey oils are: 108.61mmol/L, 105.57 mmol/L, 97.04 mmol/L, 98.53 mmol/L and 106.94 mmol/L respectively. This result is important bearing in mind the implication of cholesterol in the diet of developing nations whose population must stay alive and healthy to be able to bring life to their economies.

Keywords: Free fatty acids, Cholesterol, Edible Oils, Economy.

Introduction

Oils have always been an integral part of human diet being essential for health. Industrially, they play an important role in the development of different areas of chemical products, pharmaceuticals, cosmetics, paints and most importantly food (Atlande *et al.*, 2010). Oils are naturally occurring esters of long straight-chain carboxylic acids. Edible oils are constituted of triacyglycerol molecules, mainly formed by unsaturated (oleic, linolenic acids etc.) and saturated fatty acids (myristic, palmitic, stearic acids etc.) esterified to glycerol units (Mcmurry, 2007). They can be formed from a single fatty acid that could be esterified up to three times into glycerol backbone or at least by three different ones.

Free Fatty Acids (FFA) are produced by the hydrolysis of oils and fats. The level of free fatty acids depends on time, temperature and moisture content because the oil and fat are exposed to various environment such as storage, processing, heating or frying (Gilbertson, 1998). Since free fatty acids are less stable than neutral oils, they are more

prone to oxidation and to turning rancid. Thus free fatty acid is a key feature linked with the quality and commercial value of oils and fats (Gallic, 2006).

A fatty acid is a carboxylic acid with a long aliphatic tail (chain) which is either saturated or unsaturated. Most naturally occurring fatty acids have a chain of an even number of carbon atoms from 12 to 28; fatty acids are usually derived from triglycerides or phospholipids. When they are not attached to other molecules, they are known as "free" fatty acids. Fatty acids are important sources of fuel because when metabolized they yield large quantities of ATP. The predominant fatty acids present in vegetable oils and fats are saturated and unsaturated compounds with straight aliphatic chain. An even number of carbon atoms with a single carboxyl group is the most common. A number of other minor fatty acids may be present in same vegetable sources including a small amount of branched chain, cyclic and odd number straight chain acids. An important feature common to most plant oils and fats is the high percentage of unsaturated fatty acids in the triglycerols. In general, the higher the degree of unsaturation of a vegetable oil fatty acid, the more susceptible they are to oxidative deterioration (Bradley and Min, 1992).

Cholesterol is the most common steroid in animals and the precursor for all other animal steroids, Cholesterol is a waxy substance made by animal liver and also supplied in diet through animal products such as meats, poultry, fish and dairy products. It is needed in the body to insulate nerves, make cell membranes and produce certain steroids hormones and for the biosynthesis of bile and bile acid salts. Bile is the major excretion route of cholesterol from the body, predominantly as unesterified cholesterol. In the adult human approximately 400 mg of cholesterol per day is converted to bile acid and only approximately 50mg are converted to hormones. Sterols also play an important role in embryonic development and an important lipid in some membranes. However, the body makes enough cholesterol, so that any dietary cholesterol may not be needed (Ma, 2006).

Cholesterol plays a major role in human heart health. Cholesterol can be both good and bad. High Density Lipoprotein (HDL) is "good" cholesterol and Low Density Lipoprotein is "bad" cholesterol. LDL-Cholesterol is considered bad because it is responsible for allowing fatty plaques to develop in the lumen of arteries, leading to their narrowing. If this narrowing develops in coronary arteries (supplying blood to the heart), the person can develop Coronary Heart Disease (CAD) and this can lead to heart attack (Mishra and Manchanda, 2012). HDL-cholesterol is desirable as it is a means of transporting cholesterol from parts of the body where there is much of it to the liver where it can be disposed of. High cholesterol in serum is a leading risk factor for human cardiovascular disease such as coronary heart disease and stroke (number one killer disease in developing economies). Excess cholesterol in the blood stream can form plaque (a thick hard deposit) in artery walls. The cholesterol or plaque build-up causes arteries to become thicker, harder and less flexible, slowing down and sometimes blocking blood flow to the heart. When blood flow is restricted, angina (chest pain) can result. A heart attack will result when blood flow to the heart is

severely impaired and a clot stops blood flow to the heart completely. When there is too much LDL cholesterol in the blood, it is deposited inside the blood vessels, where it can be build up to hard deposit and causes atherosclerosis, the disease process that underlies the heart attack (Ma, 2006).

Consuming cholesterol in our diet increases the level of Low Density Lipoproteins (LDL) cholesterol which has been positively associated with cardiovascular disease (CVD) risk. There are so many different varieties of vegetable oil brands in our markets and all of them claim to be cholesterol free. Most finding have led to worldwide recommendations to decrease the consumption of saturated fat to decrease the risk of CVD (Hoenselaar, 2012). Industrial processing especially catalytic hydrogenation of vegetable oils affects their fatty acid composition (Gur and Harwood, 1991). Processing increases saturated fatty acid components of oils and saturated fatty acid rich diets have been found to increase the level of cholesterol (Senanayake and Shahidi, 2002). Due to increasing awareness on the quality and health implications of high cholesterol in the diet, this study was undertaken to estimate the free fatty acids and cholesterol content of five selected vegetable oil in Nigeria

Materials and Methods

Collection of Sample

Samples of 5 brands of edible oil namely Emperor, Golden penny, Kings, Power and Turkey oil were purchased from Eke Ekwulobia and Eke Oko markets in Anambra State. The label on each container was no cholesterol.

Determination of Cholesterol Content

The cholesterol content was determined using the method described by AOAC (AOAC, Association of Official Analytical Chemists, 2002). One gram of oil sample was weighed into 50 ml round bottomed flask and one gram of sea sand was also added before the mixture was heated for 25 minutes with 10 ml of a freshly prepared methanolic potassium hydroxide solution under a reflux condenser while stirring (magnetic stirrer). The supernatant solution was transferred into a 25ml volumetric flask with a pipette and the residue boiled twice with portions of 6 ml isopropanol each under a reflux condenser for 5 mins. The solution in the volumetric flask was collected, allowed to cool, diluted to the mark with isopropanol and mixed properly. The turbid solution was filtered through a fluted filter. The clear solution was used for the assay. The cholesterol content of the oil sample was calculated using the equation;

Cholesterol Content of Sample Solution g/L $= \frac{100 \times 25 \times D}{w \times 200}$

Where w=weight of sample used in g

D=specific gravity of sample

Determination of Free Fatty Acids

The free fatty acids were determined using the titrimetric method of Jacob (1999). Five milliliter of the oil sample was weighed and dissolve in 50 ml of fat solvent. The solution was titrated with 0.1m KOH using phenolphthalein (1ml) as an indicator until a faint pink colour which persists for 30 seconds at the end point was observed. The number of milliners of KOH required was

Noted and calculated from the formula below;

$$\textbf{Acid value} = \frac{\textbf{Vol. of 0.1m KOH} \times \textbf{5.61}}{\textbf{weight of the sample in g}}$$

Note 5.61 = mg of KOH contained in 1ml of a 0.1M solution.

Statistical Analysis.

All the data generated from the analytical determinations were analyzed and the descriptive statistics presented as mean ± standard deviation of the two determinations. Standard deviation were done using Microsoft excel package, (windows version 2013).

Results

The results of the fatty acids and cholesterol content of the five samples used for this study are presented in Table 1 and 2. Kings oil brand has the lowest fatty acid and cholesterol content. For Emperor, Golden penny and Turkey oil, their fatty acid contents were relatively similar while power oil has the highest fatty acid content. For the cholesterol estimation, Turkey oil has the highest cholesterol content.

Table 1: Free Fatty Acid Composition of Selected Oil Samples

Samples	Trade Name of Oil sample	Free Fatty Acid (ml/L)
A	Emperor	0.308±0.2
B	Golden penny	0.336±0.1
C	Kings	0.280±0.03
D	Power	0.896±0.01
E	Turkey	0.336±0.03

Table 2: Cholesterol Content of Oil Samples

Sample	Trade Name of Oil sample	Cholesterol content (mMol/L)
A	Emperor	108.606±0.04
B	Golden penny	105.570±0.01
C	Kings	97.037±0.1
D	Power oil	98.534±0.2
E	Turkey	106.922±0.03

Discussion

The public has been fed a great deal of misinformation about the relative virtues of saturated fats versus polyunsaturated oils. Politically correct dietary gurus tell us that the polyunsaturated oil are good for us and that the saturated fats cause cancer and heart disease. The result is that fundamental changes are beginning to occur in the diet of developing nations. Most of the fatty acids in

our diet were either saturated or monounsaturated, primarily from butter, lard, tallows, coconut oil and palm oil. Today, most of the fats in the diet are polyunsaturated from oil derived from soy as well as corn, safflower and canola (Daniewski *et. al.*, 2003).

Excess consumption of polyunsaturated oils have been shown to contribute to a large number of disease conditions including increased cancer and heart disease; immune system dysfynction, damage to liver, reproductive organ and lungs; digestive disorders, depressed learning ability; impaired growth and weight gain (Lewton *et al.*, 2000).

One reason the polyunsaturates cause so many health problems is that they tend to become oxidized or rancid when subjected to heat, oxygen and moisture as in cooking and processing. Rancid oils are characterized by free radicals that is single atoms or clusters with an unpaired electron in an outer orbit. These compounds are extremely reactive chemically. They have been characterized as "mauuders" in the body for they attack cell membranes and red blood cells and cause damage in DNA/RNA strands thus triggering mutations in tissues, blood vessels and skin. Free radicals damage to the skin causes wrinkles and premature aging; free radical damage to tissues and organs sets the stage for tumors; free radical damage in the blood vessels initiates the buildup of plaque. Is it any wonder that tests and studies have repeatedly shown a high correlation between cancer and heart disease with the consumption of polyunsaturated (Przybylski and Mcdonald, 1995).

Our finding from this study supports previous works by Shukla *et al.*, (2002) which shared that cholesterol is present in vegetable oils although in small proportion. From this study, Kings Oil was detected to have the lowest cholesterol content of 97.04 mmol/L, closely followed by Power oil (98.53 mmol/L) while Golden penny and Turkey had similar cholesterol content of 105.57 mmol/l and 106.922 mmol/L respectively. Emperor had the highest cholesterol content of 108.61mmol/L. These results may contradict the label claimed by these producers that these oils are cholesterol free.

What is important in oil consumption is not the amount of fat but the type of fat. Linchtenstein *et al.*, (1999) showed that consumption of products low in trans-fatty acids has beneficial effects on serum lipoprotein, cholesterol has been known as the "oily killer".

Since the early mid-sixties, especially since seveids work has shown that it is the main cause of artherosclerotic lesions which are the major causes of coronary heart disesase (Anthony, 2000; Hayden and Tyagi, 2005; Jaquish, 2007). Moreover, the nutritional value of processed oil is lowered by processing methods (Vegalopes *et al.*, 2006). Also trans fatty acids are formed during hydrogenation of oils and this is done to improve oxidative stability and functionality of oils (King and White, 1999). Apart from processing techniques, variability may reflect the different growing season of the oil seeds plant source. Some plant characteristics are affected by seasons of harvest.

The finding of the present study showed that all the oil sample brands used in the study contain cholesterol and free fatty acid value

within the World Health (WHO) standard limit (less than 200 mmol/L) and free fatty acid value limit of 4-10 ml/L. it is however important and pertinent that oil producers and marketers should label their products correctly no matter how minute and then leave consumers to make up their minds on which brand satisfies their culinary needs.

Conclusion

This study has been able to show that free fatty acid and cholesterols are present in the selected edible oils sold in Nigerian markets; although the concentrations present are small and within acceptable standard limits.

Recommendation

In view of the health implication of cholesterol in our diets; the following are recommended;

- Companies producing and marketing edible oils should indicate the amount of cholesterol present in their products.
- Further research is needed to determine the type of cholesterol present in these oils.

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