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Total Phytosterol Levels and Quality Attributes of some Vegetable Oil Brands Available in Onitsha Metropolis, Anambra State, Nigeria.

Obi Chioma Doris
Food Technology Department, Federal Polytechnic Oko, Anambra State, Nigeria.
Corresponding author email: chioma.obi70@yahoo.com

Abstract
This study assessed the phytosterol levels and quality attributes of some vegetable oil brands sold within Onitsha metropolis using standard methods. The results showed that all the vegetable oils studied contained significant levels of phytosterol. The total phytosterol levels were 43.27, 35.58, 13.75, and 32.92 mg /ml for ideal vegetable oil (IVO), power vegetable oil (PVO), turkey vegetable oil (TVO), kings vegetable oil (KVO) and grand vegetable oil (GVO) respectively. Phytosterols have been reported to have certain health benefits which include lowering of plasma cholesterol, thus preventing coronary heart disease, prevention of cancer, etc. The results also showed that there were significant variations in the values of the quality attributes (specific gravity 0.77-0.79, density 1.46-1.51 g/cm^3, acid values 2.23-6.23 mg/g, free fatty acids 0.23-1.67mg/g, iodine values 7.33-13.63 mgI/g and peroxide values 0.70-1.00 mg/g).These variations could have been due to processing and storage conditions or even adulterations indicating that some of the oils were not of good quality.

Keywords: Phytosterol, quality attributes, vegetable oil, adulteration

1.0 Introduction

Phytosterol or plant sterols are a large group of naturally occurring compounds which are exclusively plant and vegetable constituents, that resemble cholesterol both in structure and biological function hence they are also called the plant version of cholesterol. (Kawamura, 2008). They however differ from cholesterol in the presence of a methyl or ethyl group on the side chain which enables them to be absorbed minimally or not at all by the intestines. Phytosterols are cholesterol-like molecules found in all plant foods with the highest concentrations occurring in vegetable oils, but also in nuts legumes and cereals. They are absorbed only in small amounts but inhibit the absorption of intestinal cholesterol, a key step in bad cholesterol (LDL) elimination. According to Trauten and Demonty (2007), Phytosterol are structural components of the cell membrane where they regulate membrane associated metabolic processes. They are products of the Isoprenoid biosynthesis pathway, the synthesis of Phytosterol involves more than 30 enzyme catalyzed reactions all taking place in plant cell membranes. The term, phytosterol refers to more than 200 different compounds which are found in various plants and marine sources and also to plant sterols and It also refers to their saturated counterparts, the plant stanols which are less abundant in nature but are more resistant to oxidation. The most biologically relevant Phytosterol are sitosterol, campesterol, stigmasterol, brassicasterol, sitostanol and campestanol (Moreau, Whitaker & Hicks, 2002).

Commercially, Phytosterol are isolated from vegetable oils such as soybean, rapeseed (canola) oil, sunflower oil or corn oil etc (Kawamura, 2008). Appreciable amounts of Phytosterol are found in the lipid rich and fiber rich fractions of all plant foods particularly vegetable oils and oil products such as spreads and margarine. Other foods which contribute to the daily intake of plant sterols are cereals-grains, cereal-based products, nuts, avocados, legumes, vegetables and fruits, but the highest concentration of sterols are found in vegetable oils. Also while humans can make cholesterol or obtain it from the diet, they are unable to make any kind of Phytosterol, thus they only get them from dietary sources (Anna Jones and Shenzolenberg, 2011). The dietary intake of plant sterols ranges from 150 to 400 mg/day (Pironen, Toivo, Puypponen-Pimia and Lampia, 2003). Phytosterols compete with cholesterol absorption and uptake in the small intestine thereby reducing the supply of cholesterol in the blood stream (Anna Jones and Shen, 2011). Studies have shown that consuming 1-3 g of phytosterol each day can lower low density lipoprotein (LDL) cholesterol by 6 to 10 percent which may reduce the risk of coronary heart disease, hence they are sometimes added to some premium brands of margarine and spreads and marketed as health foods or functional foods, since current literature suggests that phytosterol are safe when added to the diet (Rafia, 2013). Phytosterols have also been reported to have cancer protection benefits (due totheir high antioxidant levels), skin protection benefits (Wasserman, 2011) as well as playing a role in changing the immune system (Awad and Fink, 2013).

Vegetable oil, a generic term used to describe cooking oils derived from plants or vegetable sources, are actually triglycerides extracted from plants which constitute a significant part of the human diet and also improve the flavor and palatability of foods (FAO, 2009). Recently there is an increased demand for vegetable oils worldwide due to population growth, rising standards of living as well as consumer preference arising partly from health concerns. (Suleiman, Ikpeme, and Ene-Obong, 2014).The quality of any vegetable oil is indicated by physicochemical properties such as acid value, free fatty acid value, peroxide value, iodine value etc. but these properties can be altered by heat, light or moisture, thereby by reducing their stability (WHO, 1985).

The cholesterol content of most vegetable oils is advertised on their labels, forcing many to erroneously believe that they contain cholesterol. Contrary to some schools of thought, cholesterol is actually absent in plant foods. Instead, phytosterol which are similar to cholesterol in structure are present (Trauwein and Demonty, 2007), hence, deceiving some researchers to believe that cholesterol is present in plants (Shukia, Dutta, and Artz, 2002 ; Okpuzo, Okochi, Ogbunugafor, Ogbonnia, Fagbayi, and Obidiegwu, 2009). This may largely be due to the fact that the same methods of identification can be used to identify both cholesterol and Phytosterol, mainly because Phytosterol resemble cholesterol both in structure and biological function (Trauwein and Demonty, 2007)

Local and foreign vegetable oil manufacturers label their products to be cholesterol free to advertise their products when in reality, these products contained no cholesterol originally but contain phytosterol which are actually beneficial to health. The awareness and demand for functional foods is increasing. The rate of adulteration of food products such as vegetable oils is also on the increase, especially due to the recent economic recession. Much work has been erroneously done on the cholesterol levels of vegetable oils, but little or no research has been made on their Phytosterol levels. This research therefore investigates the total Phytosterol levels and quality attributes of some vegetable oil brands within Onitsha metropolis in Anambra state, Nigeria.

2.0 Materials and Methods

2.1 Sample Collection

Five vegetable oil brands were purchased from various markets in Onitsha metropolis, Nigeria, namely Ideal vegetable oil (IVO), Power vegetable oil (PVO), Turkey vegetable oil (TVO), Grand vegetable oil (GVO) and Kings vegetable oil (KVO).

2.2 Quality Attribute Determinations

The quality attributes of the vegetable oils namely acid value, iodine value, free fatty acids, density, specific gravity and peroxide values were determined using standard methods (AOAC, 2000), while their color and physical states were assessed with the eyes.

2.3 Total Phytosterol determination

The phytosterol levels of the samples were determined using the Lieberman Burchard Reagent method as described by Sabir, Hayat, and Gardezi (2003) which is a colorimetric method in which the samples were treated with chloroform, acetic anhydride and concentrated sulphuric acid to produce a green color which was then measured using a spectrophotometer set at zero with blank (SF) at 640mm on SP 650UV/V.

2.4 Statistical Analysis

The experiment was designed based on a one way experimental design and the data obtained from the study were subjected to analysis of variance and means were separated by Duncan's multiple range test using IBM SPSS version 17.0 statistical significance was accepted at ($p<0.05$).

3.0. Results and Discussion

The phytosterol levels of the vegetable oil brands are presented in Table 1. The phytosterol contents of the samples ranged from 13.57 mg/100ml in KVO oil to 43.27 in the IVO oil. Significant difference ($p< 0.05$) existed between sample IVO and PVO, also between KVO and GVO but there was however no significant differences between TVO and KVO and between PVO and GVO. This variability could have been due to different processing techniques, growing season differences, season of harvest, the sensitivity of the method used as well as the type of raw material used (Okpuzo *et al.,* (2009). However, significant amounts of phytosterol were present in all the vegetable oils studied especially IVO, PVO and GVO. This has good health benefits for consumers of these oils since it has been reported that these phytosterol lower the blood cholesterol (LDL) thereby reducing the risk of coronary heart disease, reduce the chances of stroke by reducing bad cholesterol supply in the bloodstream). Cancer could also be prevented due to their high antioxidant levels (Rafia, 2013). Awad, Williams, and Fink (2003) also reported the role of phytosterol in changing the immune system as well as skin protection benefits. Anna Jones and Shenzolenberg, 2011 reported that consuming 1-2 g of phytosterol daily can lower low density lipoproteins (LDL) by 6-10 percent.

Table 1: Total phytosterol levels of the vegetable oil samples

Vegetable oil sample	Total Phytosterols, mg/g
IVO	$43.27^{a}\pm0.00$
PVO	$35.58^{b}\pm3.98$
TVO	$13.75^{c} \pm 0.02$
KVO	$13.57^{c} \pm 0.02$
GVO	$32.92^{b}\pm0.00$

Values are means of triplicate determinations ± S.D. Means followed by the same superscript in the same column are not significantly different. ($P < 0.05$).

Key: IVO = Ideal vegetable oil, PVO = Power vegetable oil, TVO = Turkey vegetable oil, KVO = Kings vegetable oil, GVO = Grand vegetable oil

The results of the quality attributes of the vegetable oils are presented in Table 2, their specific gravities ranged from 0.77 to 0.79 for KVO and IVO respectively. The specific gravity of oils is of diagnostic value in the consideration of the quality or purity of oil and it increases with increasing unsaturation of fatty acids. Significant differences existed between the oil samples except for between PVO, TVO and GVO with sample IVO being significantly higher than others indicating higher purity. Their densities which are higher in solid states and affected by the degree of unsaturation and average molecular weight (1.46 to 1.51 g/cm^3) varied significantly with sample IVO having the highest gain indicating the highest tendency to solidify. This may be due to higher levels of saturated fats.The acid values of the vegetable oils which ranged from 2.23 – 6.23 mg/g measures the amount of free fatty acids (Onimaiwo and Akubo, 2012) hence the degree of hydrolysis of the fats was considerably higher compared to other attributes especially for TVO and IVO indicating a level of hydrolysis. These results are higher than that reported by Okpuzo *et al.,* (2009) and also higher than the standard of 0.5 to 1.55 mg/g reported by Pearson, (1981), showing that these oils will easily go rancid especially the TVO sample. This may have been due to longer storage time or exposure to light, heat and moisture or even adulteration (WHO, 1985).

Table 2: Quality attributes of the vegetable oil samples.

Oil samples	Physical state	Color	Specific gravity	Density g/cm^3	Acid value (mg/g)	Free fatty acid (mg/g)	Iodine value (mg/g)	Peroxide value (mg/100g)
IVO	Liquid	Golden yellow	$0.79^{a}\pm0.00$	$1.51^{a}\pm0.00$	$5.97^{a}\pm0.15$	$1.43^{ab}\pm0.15$	$13.63^{a}\pm0.55$	$0.92^{b}\pm0.01$
PVO	Liquid	Golden yellow	$0.78^{b}\pm0.00$	$1.46^{c}\pm0.04$	$3.10^{b}\pm0.10$	$1.43^{ab}\pm0.15$	$13.18^{b}\pm0.02$	$0.70^{c}\pm0.02$
TVO	Liquid	Golden yellow	$0.78^{b}\pm0.00$	$1.49^{ab}\pm0.01$	$6.23^{a}\pm0.15$	$0.23^{b}\pm0.15$	$9.61^{d}\pm0.02$	$0.94^{b}\pm0.02$
KVO	Liquid	Golden yellow	$0.77^{c}\pm0.00$	$1.48^{bc}\pm0.00$	$2.23^{c}\pm0.15$	$1.67^{a}\pm1.52$	$7.33^{e}\pm0.03$	$1.00^{a}\pm0.02$
GVO	Liquid	Golden yellow	$0.78^{b}\pm0.00$	$1.50^{a}\pm0.01$	$3.37^{b}\pm0.21$	$1.36^{ab}\pm0.32$	$11.91^{c}\pm0.02$	$0.70^{c}\pm0.02$

Values are means of triplicate determinations ± S.D Means having the same superscripts along columns are not significantly different ($p < 0.05$)

The iodine values of vegetable oils which expresses the degree of carbon unsaturation of a fat or oil and is a measure of the stability and resistance to oxidation, ranged from 7.33 to 13.63 mgI/g and was lower than that reported by Ebuchi, Umeh, and Oletu (2006) but compared favorably with that of Okpuzo *et al.,* (2009). The values of iodine also differed significantly from each other in all the samples except for sample KVO and GVO. The free fatty acid values which is the percentage by weight of a specified fatty acid or acid value divided by two (ranged from 0.23 to 1.67) differed significantly between sample TVO and KVO but not between IVO, PVO and GVO with sample KVO having the shorter shelf life and supports the findings of Otunola, Adebayo, Adebayo and Olufemi (2009). Their peroxide values which are commonly used to know the amount of peroxide/oxygen per 1kg of fat ranged from 0.70 to 0.90, varying significantly also from each other except for between TVO and IVO where no significant difference existed. KVO oil showed the highest peroxide value indicating a higher level of rancidity. These differences in quality attributes could probably be attributed to the processing and storage conditions of the oil or to adulteration. The physical states of all the oils studied were liquid while their colors were all golden yellow which may have been due to added colors during processing.

4.0 Conclusion

This study has provided information on the total phytosterol levels and quality attributes of some vegetables oils brands, sold in Onitsha metropolis. The phytosterol levels of the oils were quite appreciable considering the fact that consuming 2-3 g of phytosterol a day can lower low density lipoprotein (LDL or bad cholesterol) from dietary sources as well as cholesterol from bile that would normally be absorbed and reused. This then helps to decrease absorbed cholesterol by removing more LDL from circulation which in effect reduces the risk of coronary heart diseases and stroke. A daily dose of 2-3 g of phytosterol has been shown to reduce LDL- cholesterol levels by 5-15 %. Hence phytosterol rich foods such as vegetable oils should be encouraged in the diet. Findings from this study have also shown that the quality of any vegetable oil is indicated by values such as acid, free fatty acid, iodine and peroxide values. Also, exposure to light, heat and water during storage or sales as well as processing methods and adulteration can alter some of these quality indicators. Regulatory bodies like National agency for food, drug, administration and control should therefore ensure that good manufacturing practices are carried out during the processing of these oils. Manufacturer and retailers should also ensure the storage of these oils under proper/suitable conditions to retain their qualities until it gets to the consumer. This research has also observed that instead of cholesterol, phytosterols which are cholesterol-like compounds are present in vegetable oils and are actually beneficial to health especially by reducing bad cholesterol (LDL) unlike cholesterol, which though plays a vital role in proper functioning of the body, is associated with coronary heart disease when LDL (low density cholesterol) is in high levels.

References

Anna Jones, B. S. & Shenzolenberg, S. (2011), Phytosterols, nutrition and health info.sheet for health professionals. UK cooperative extension center for health and nutrition. Research Department of Nutrition, University of California. Davis.

AOAC, (2000). Official methods of analysis of the association of official analytical chemists. AOAC International, 17th ed., Honowi, W. (ed.), Vols1 and 2,45,12-20.

Awad, A. & Fink, C. (2013). Phytosterols as anticancer dietary components: evidence and mechanism of action. *Journal of Nutrition*, 1(2), 4-5.

Awad, A. B., Williams, H. & Fink C. S. (2003). Effect of phytosterol on cholesterol metabolism and MAP kinase in MDA-MB-231 human breast cancer cells. *J.Nutr.Biochem*., 14(2),111-9.

Ebuchi, O. A. T., Umeh, R. A. & Oletu, F. U. (2006). Physicochemical and fatty acid composition of two common edible vegetable oils in Nigeria. *Nigerian Food Journal*, 24 (1), 17-24.

Food and Agricultural Organization. (2009). *Vegetable oil production and composition.* Monthly Bulletin, 9 (1), August, St Rome.

Kawamura, V. (2008). *Phytosterols, phytostanols and technical assessment.* CTA *Forbes Medi-Tech. In.,* U.K. 1-5

Moreau, R. A, Whitaker, B. D. & Hicks, K. B, (2002). Phytosterol, phytostanols and their conjugates in foods: Structural diversity, quantitative analysis and health promoting uses. *Prog. Lipid. Res,* 41, 457-500.

Okpuzo, J, Okochi, V. I., Ogbunugafor, A. A., Ogbonnia, S., Fagbayi, T. & Obidiegwu, C. (2009). Estimation of cholesterol level in different brands of vegetable oils. *Pakistan Journal of Nutrition,* 8(1), 57-62.

Onimaiwo, A. I. and Akubor I. P. (2012). Food chemistry: *Integrated approach with biochemical background* 1st ed., *Ambik press ltd,* 54-96.

Otunola, G. A., Adebayo, G. B., Adebayo, G. B. & Olu femi, G. O. (2009). Evaluation of some physico-chemical parameters of selected brands of vegetable oils sold in Ilorin Metropolis. *Int. Journal of Physical Sciences,* 4(5), 327-329.

Pearson, D. (1981). *Chemical analysis of foods,* 7th ed., Church Hill Living Stone, 448-496.

Pironen, V., Toivo, J., Puypponen-Pimia, R. & Lampia. M. (2003). Phytosterols in vegetables, fruits and berries. *J. Sci. food Agric,* 83, 330-27.

Rafia, B. (2013). Phytosterols in human nutrition. *International Journal of scientific Research and Reviews,* 2(2), 1-10.

Sabir, S. M., Hayat, I. & Gardezi, S.D.A. (2003). Estimation of sterols in edible fats and oils, *Pak.J. nutr.,* 2C3), 178-181.

Schwartz, L. B. (2011). Systematic anaphylaxis food allergy and insect sting allergy. In: Goldman L, Schafer Al (eds.), Cecil medicine, 24th ed., Philadelphia: Pasaunder Elsevier, 257.

Shukia, V. K. S., Dutta, P. C. & Artz, W. E. (2002). Camelina oil and its unusual cholesterol content. *J. Am. Oil. Chem. Soc.,* 79, 965-969.

Suleiman, J., Ikpeme, C. & Ene-Obong, H. N. (2014). An assessment of oil processing methods and technology in Taraba State, *Nigerian Journal of Nutritional Sciences,* 35 (1), 79-82.

Trauwein, E. A. & Demonty, I. (2007). Phytosterols: Natural compounds with established and emerging health benefits. Unilever Food And Health Research Institute Dossier, 259-265.

Wasserman, S. I. (2011). Approach to the person with allergic or immunologic disease In: Goldman L. and Schafer Al (eds). Cecil Medicine, 24th ed., Philadephia, Saunders Elsevier, 267.

World Health Organization (1985). *Energy and protein requirement.* WHO, Geneva, Technical Report Series, 74.