

Comparative Study of the Fatty Acid Profiles of Vegetable Oil Brands Consumed in Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author OBA designed the study, wrote the protocol and managed the analyses of the study. Author OIM managed the literature searches and wrote the first draft of the manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

Aims: Since techniques employed in refining can reduce the fatty acid nutritional value of edible oil, the fatty acid profile of most widely consumed oil brands in Nigeria were comparatively analyzed.

Study Design: The fatty acid profile of oil samples were analyzed using gas chromatography.

Place and Duration of Study: Department of Biochemistry, Ekiti State University, Ado-Ekiti, Nigeria between June 2014 and July 2014.

Methodology: The fatty acid profile was determined as fatty acid methyl esters (FAMES) by gas chromatography equipped with flame ionization detector.

Results: Lahda Soya Oil, Grand Pure Soya Oil and Turkey Vegetable Oil presented the healthiest fatty acid profile with polyunsaturated fatty acids making up about 60% of their fatty acids. Power Vegetable Oil had 40% polyunsaturated fatty acid. Mamador Vegetable Oil, Oki Vegetable Oil and Laser Olive Oil had about 20% polyunsaturated fatty acid but as high as 50% monounsaturated fatty acid. Executive Chef Soya bean Oil and Gino Refined Palm Oil had the least healthy fatty acid profile with about 40% saturated fatty acid.

Conclusion: The fatty acid profiles of the branded oils were not exactly the same with that of the alleged raw material. The difference may be due to manufacturers' infidelity or the processing

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techniques employed. Executive Chef “Soya Bean” Oil presented the most obvious perturbation and the least healthy fatty acid profile while Lahda Soya Oil presented the healthiest fatty acid profile.

Keywords: Fatty acid; oil brand; Nigeria; cardiovascular disease; hypercholesterolemia.

1. INTRODUCTION

Edible oil is an essential nutrient and an important source of energy. Edible oils and fats are biological mixtures, usually of plant origin, consisting of esters derived from glycerol with chain of fatty acids [1]. The kind and proportion of the fatty acids in the triacylglycerol significantly influence both the physical and the chemical characteristics of oils and fats [2,3]. Fatty acids can be classified as saturated, mono-unsaturated (MUFA) and poly-unsaturated (PUFA) fatty acids. Furthermore, the unsaturated ones are classified into series known as omega, being ω -9 considered nonessential for humans, and the ω -3 and ω -6 as essential fatty acids, because the latter cannot be synthesized by mammals; therefore, they must be obtained from diet [4,5].

Elevated levels of serum total cholesterol, low density lipoprotein cholesterol (LDL-C), serum triglycerides (TG) and reduced levels of serum high density lipoprotein cholesterol (HDL-C) are risk factors for coronary heart disease (CHD) and are modulated by the content of fat in the diet. A high intake of saturated fatty acids and cholesterol in the diet may lead to hypercholesterolaemia, largely through an increase in LDL-C [6]. On the contrary, polyunsaturated fatty acids have a hypocholesterolaemic effect in human [7]. Furthermore, intake of linoleic and linolenic acids increases HDL and decreases LDL while high intake of oleic acid decreases LDL but does not affect HDL levels [8,9].

Although the World Health Organization [10] has confirmed that the consumption of palmitic acid increases risk of developing cardiovascular diseases, many Nigerian homes still prefers the use of unrefined palm oil for most of their cookings; usually because of the accustomed flavor. However, the use of refined and branded vegetable oils is increasing among Nigerian urban elites. As a result, Nigerian markets are becoming “flooded” with assorted refined vegetable oils brands from different parts of the world [11]. The Food and Agriculture Organization warned that techniques employed in refining can cause chemical changes to fatty

acids and thus decreases the nutritional value of edible oils [12]. This study comparatively examines the fatty acid profile of the major brands of refined vegetable oil consumed in Nigeria.

2. MATERIALS AND METHODS

All the oil brands were bought from Ado-Ekiti urban market. The manufacturers of the oil brands are presented in Table 1.

Table 1. Producer of the oil brands analyzed

Oil brands	Producers
Executive chef soya bean oil	JOF Industries Limited
Mamador vegetable oil	PZ Wilmar Limited
Oki vegetable oil	Oki Food Industries
Laser olive oil	Sun Mark Limited
Power vegetable oil	Dufil Prima Foods Plc
Gino refined palm oil	Watanmal Group
Turkey vegetable oil	Ngo Chew Hong Edible Oil PTE Ltd.
Grand pure soya oil	UAC of Nigeria Plc

2.1 Preparation of Fatty Acid Methyl Ester (FAME)

The fatty acid profile was determined as fatty acid methyl esters (FAMES) by gas chromatography equipped with flame ionization detector. 50 mg of the extracted fat content of the sample was saponified (esterified) for five (5) minutes at 95°C with 3.4ml of the 0.5 M KOH in dry methanol. The mixture was neutralized by using 0.7 M HCl. 3ml of the 14% boron trifluoride in methanol was added. The mixture was heated for 5 minutes at the temperature of 90°C to achieve complete methylation process. The fatty acid methyl esters were thrice extracted from the mixture with redistilled hexane. The content was concentrated to 1 ml for gas chromatography analysis and 1 μ l was injected into the injection port of gas chromatography.

Sample was introduced by split injection in split mode (ratio 20:1). The initial oven temperature

was at 60°C for 20 mins at 120 C/min and then second. Ramping at 150 C/min for 3 minute while the carrier gas used wa

3. RESULTS AND DISCUSSION

As shown in Table 2, all the oil brand presented lower percentage (w/w) saturated fatty acids compared to unsaturated fatty acids. Laser Olive oil presented the lowest and Gino refined palm oil, the highest percentages of saturated fatty acids. While the high saturated fatty acid content of Gino refined palm oil is in accordance with what is expected of palm oil [6,13], Executive Chef "Soya Bean" oil presented a saturated fatty acid composition much higher than the reports for Soya bean oil [6,14,15]. Since the 1950s, it has been commonly believed that consumption of foods containing low amounts of saturated fatty acids is potentially healthier for cardiovascular health than consuming fats with a high proportion of saturated fatty acids [16]. However, a 2010 meta-analysis of 21 studies [17] concluded that there is no significant proof for concluding that dietary saturated fat is associated with an increased risk of coronary heart Disease (CHD) or cardiovascular disease (CVD). Also, Chowdhury and co workers [18] in a systematic review and meta-analysis concluded that their findings do not support the reduction of the consumption of total saturated fatty acids as a cardiovascular guideline. Nevertheless, Willett and co-workers [19] warns that the conclusions from these studies are "seriously misleading" and concluded that the replacement of saturated fat with polyunsaturated fat or monounsaturated fat reduced risk of CVD. Furthermore, leading heart-health, medical, and governmental authorities, such as the World Health Organization [20], the American Dietetic Association [21], Dietitians of Canada [21], Health Canada [22], the US Department of Health and Human services [23], the UK Food Standards Agency [24], the Australian Department of Health and Aging [25], the Singapore Government Health Promotion Board [26], the Indian Government Citizens Health portal [27], the New Zealand Ministry of Health [28], the Food and Drugs Board of Ghana [29], the Republic of Guyana Ministry of Health [30], Hong Kong's Centre for Food safety [31], the British Dietetic Association [32], American Heart Association Nutrition Committee [33], the British Heart Foundation [34], the World Heart Federation [35], the British National Health Service [36], the United States Food and Drug Administration [37], the and the European Food

Safety Authority [38] advise that saturated fat is a risk factor for cardiovascular disease (CVD).

The saturated fatty acid composition of the oil brands are presented in Fig. 1. Palmitic acid, being the most common saturated fatty acid in plants, animal and micro-organism [39], presented the highest concentrations amongst other saturated fatty acids in all the oil brands. Executive Chef "Soya bean" oil presented a conspicuously high palmitic acid concentration, much higher than the reports for soybean oil [6,14,15]. Although palmitic acid has been found to comprise 21–30% (molar) of human adipose tissue fat [40], consumption of palmitic acid increases risk of developing cardiovascular diseases [10]. Furthermore, rats fed a diet of 20% palmitic acid and 80% carbohydrate for extended periods showed alterations in central nervous system control of insulin secretion and suppression of the body's natural appetite-suppressing signals from leptin and insulin [41].

As shown in Fig. 1, the most concentrated saturated fatty acid following palmitic acid in all the oil brands is stearic acid. This is consistent with the distribution of saturated fatty acid in nature [39]. Stearic acid, in epidemiologic and clinical studies, was found to be associated with lowered LDL cholesterol in comparison with other saturated fatty acids [42]. Also, an isotope labeling study in humans [43] concluded that the fraction of dietary stearic acid that oxidatively desaturates to oleic acid is 2.4 times higher than the fraction of palmitic acid analogously converted to palmitoleic acid. These findings may indicate that stearic acid is healthier than other saturated fatty acids. Comparing across the oil brand samples, it is noteworthy that Grand "Pure Soya" oil presented the highest and Executive Chef "Soya bean" oil presented the least stearic acid concentrations relative to their palmitic acid concentrations.

Other saturated fatty acids that were present but in much lower concentrations in all the oil brands were myristic, arachidic and behenic acids. All of which are less common saturated fatty acids in nature [39]. Margaric acid was present but in trace amount in Lahda Soya oil, Power Vegetable oil, Gino refined palm oil, Turkey vegetable oil and Grand pure soya oil while lauric acid was present in Power Vegetable oil, Gino refined palm oil, Turkey vegetable oil and Grand pure soya oil, also in a very low concentration. Although both Behenic and Lauric acids increase total serum cholesterol in human [44], most of

the increase due to Lauric acid is attributable to an increase in HDL. As a result, lauric acid has been characterized as having "a more favorable effect on total HDL cholesterol than any other fatty acid, either saturated or unsaturated" [45]. Nonetheless, Mensink and co workers [45] in their extensive meta-analysis on foods affecting the total/ LDL serum cholesterol ratio concluded that the net effects of lauric acid on CHD outcomes remain uncertain.

As presented in Fig. 2, all the oil brands but Lahda Soya oil, Power Vegetable oil, Turkey vegetable oil and Grand pure soya oil have the mono unsaturated fatty acid; oleic acid as the most concentrated fatty acid. Monounsaturated fat consumption has been associated with decreased LDL [46]. Oleic acid may hinder the progression of adrenoleukodystrophy [47] and may be responsible for the hypotensive effects of olive oil [48]. As expected of olive oil [49], Laser

Olive Oil presented the highest percentage of Oleic acid; having 64% of its fatty acid content made up of oleic acid.

Another monounsaturated fatty acid that is present but in a very small amount in all the all brands is palmitoleic acid which has been discovered to improve cell sensitivity to insulin and blocks fat accumulation in the liver as well as inhibits the destruction of insulin-secreting pancreatic beta cells [50,51]. Furthermore, research has indicated that palmitoleic acid could have a role as a signaling molecule affecting body weight [52], a finding consistent with previous observations that palmitoleic acid, among other fatty acids available in the diet, may be used by enzymes affecting fat oxidation [53]. As a consequence, oil types manufactured with high palmitoleic acid content may have a role in addressing obesity.

Table 2. The content of SFA, MUFA, PUFA (% w/w) of vegetable oil brands consumed in Nigeria

	SFA (%)	MUFA (%)	PUFA (%)
Executive chef soya bean oil	40.55	41.26	18.19
Mamador vegetable oil	26.86	50.41	22.73
Oki vegetable oil	15.71	59.82	24.48
Laser olive oil	8.95	64.59	26.43
Lahda soya oil	15.87	23.11	61.01
Power vegetable oil	30.23	29.40	40.36
Gino refined palm oil	46.51	40.92	13.03
Turkey vegetable oil	20.10	21.35	58.54
Grand pure soya oil	21.09	16.06	62.87

SFA – saturated fatty acid, MUFA – mono unsaturated fatty acid, PUFA – poly unsaturated fatty acid

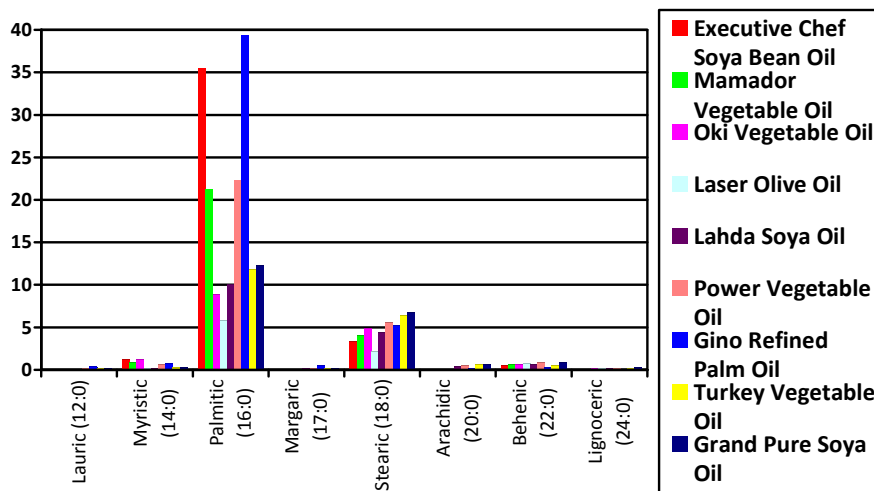


Fig. 1. Saturated fatty acid composition of vegetable oil brands consumed in Nigeria (%w/w)

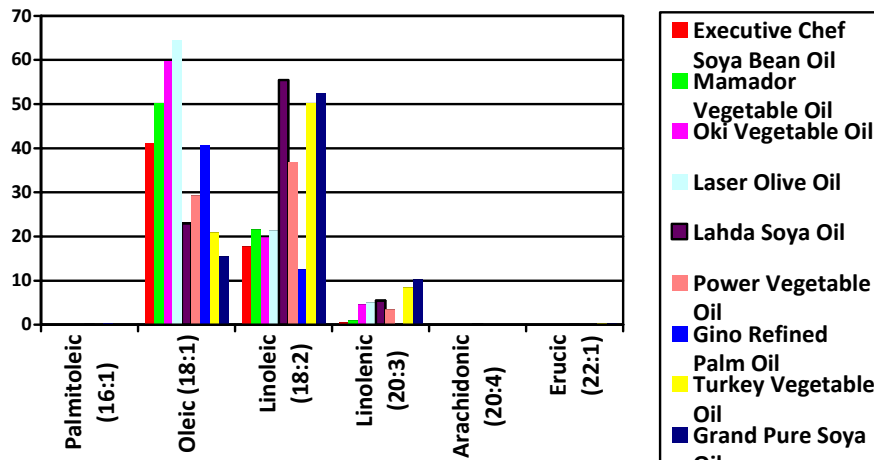


Fig. 2. Unsaturated fatty acid composition of vegetable oil brands consumed in Nigeria (%w/w)

The polyunsaturated Omega-6 fatty acid; linoleic acid is present in a significantly high amount in all the oil brands. Polyunsaturated fatty acids have been greatly appreciated for reducing the risks of CHD and CVD [19,54]. Linoleic acid is an essential fatty acid that must be consumed for proper health. A diet deficient in linoleic acid caused mild skin scaling, hair loss [55] and poor wound healing in rats [56]. Lahda soya oil however presented the highest and Executive Chef Soya bean oil, the lowest linoleic acid concentrations.

All the oil brands but Executive Soya bean oil and Mamador Vegetable oil contained a considerably high amount of the omega-3 fatty acid, linolenic acid. There is some evidence the linolenic acid consumption might have a preventative effect against cardiovascular diseases [57]. Executive Chef Soya bean oil and Mamador Vegetable oil also contained linoleic acid but at a very low concentration. Although at a very low concentration, arachidonic acid was present in all the brands but Gino refined palm oil and Turkey vegetable oil.

4. CONCLUSION

The result showed differences between the fatty acid profile of some of the branded oils and the alleged raw materials. These perturbations may not necessarily be due to manufacturers' infidelity but may be due to the processing techniques employed. Comparing in terms of the risk of CVD, Lahda Soya oil presented the healthiest fatty acid profile, followed closely by Turkey, then Laser Olive oil and Oki vegetable

oil. Executive Chef Soya oil however presented the least healthy fatty acid profile.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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