Analysis for quality and cholesterol composition of handcrafted coconut, soybean and cornselected vegetable oils

ABSTRACT

Analysis for quality and cholesterol composition of selected vegetable oils was carried out with coconut, soybean and corn oils extracted with low technology. The oils contained higher moisture than 0.2% reported to be a threshold for maintenance for quality shelf life. Corn oil displayed the highest degree of unsaturation, followed by soyabean oil. Coconut was below the specified standard for edible oil. Vitamins C and E were observed at different levels in the oil samples. Vitamin C was highest in corn oil (0.20 µg/100g), followed by soybean oil (0.10 µg/100g) and finally coconut oil with the least (0.07 µg/100g). Vitamin E was found at the highest level in corn oil (1.45 µg/100g), followed by soybean (1.05 µg/100g), and the coconut oil (0.35 µg/100g). Corn oil (7.5 mmol/dL) had the highest cholesterol level, followed by soybean oil (6.5 mmol/dL) and then coconut oil with 3.6 mmol./dL cholesterol level. The oil samples possessed those quality parameters than could project them as edible vegetable oil. Care should be taken in handling them because of their high moisture content to avoid their spoilage. Effort should be made to fortify them with vitamin A and further lower their cholesterol. This study has analysed some selected vegetable oils for quality and cholesterol composition.

Keywords: coconut oil, cholesterol composition, vegetable oil, vitamins, quality parameters.

INTRODUCTION

Oils have been part of human existence from creation [1-2]. There are edible or non edible oils [2]. Edible oils contribute unsaturated fats and vitamins in the diets of humans as well as animals [2-3]. They are used domestically for cooking and in food manufacturing industries. Edible oils are among the vegetable oils used by humans as food and as supplements [4]. Edible vegetable oils are mostly triglycerides extracted from plants or parts of plants [5-6]. Apart from unsaturated fatty acids and vitamin E, phospholipids, free fatty acids, phytosterols, waxes, and some antioxidants are among the compounds or groups that can be found in edible vegetable oils [7]. According to Negash *et al.* [8], edible vegetable oils of plant origin include sunflower oil, palm oil, soybean oil, canola oil, olive, and palm kernel oil. Edible vegetable oils are obtained from kernels, seeds, fruits and flowers of plants with either crude or refine methods [4, 9-10]. Oil which is unsaturated fat at room temperature performs important functions in the biological system [9]. Oil and fats are involved in membrane maintenance, serves as energy source to the body, conserves the body temperature, insulates the body and as well offer protections to the organs [9-10].

Cocos nucifera palm tree produces a fruit known as coconut. It is among the species of Arecaceae, the palm family but found within the Cocos family. The tree has been grown in most tropical regions for years. Coconut contains meat, juice, milk and oil. The demand for coconut has been on the increase in recent years due to its culinary uses, flavor, and health potential [11]. The coconut juice is interchangeable known as coconut water. Coconut fruit composed of fibrous

mesocarp of husk, encasing a large seed or inner stone. The endosperm or the coconut meat surrounds a central cavity, which is the hollow nature and filled with fluid. The hollow center is filled with a flavored liquid which is slightly thicker than water [12]. Coconut oil is incredibly becoming popular due to its health benefits. It has been associated with protection of the skin against UV rays and increasing high density lipoproteins (HDL) [11-12]. Coconut oil is derived from the wick, milk or meat of the coconut fruit, which is edible. The oil is a clear thin liquid with coconut aroma that turns whitish on solidification [12]. Coconut oil is made obtained by either pressing the dried or fresh coconut meat. The oil from the fresh meat is sometimes addressed as virgin oil while the one from the dried meat is known as refined coconut oil [12]. *Glycine max* is another plant that produces seeds of valuable importance in vegetable oil production. The popular soybean oil is a product of seeds of *G. max*. Soybean oil is a known vegetable oil that is extracted from soyabean seeds. It is among the most widely consumed cooking oils [13-14]. Industrially, dried form of the oil is processed as soy ink used in printing and in paints [14]. The oil is used in roasting, baking, and frying. It has a high smoking point and cannot easily break down or gets oxidized [15]. *Zea mays* is another plants which produces seeds that give another oil that is highly valued. *Z. mays* belong to a genus of flowering plants Zea [156. It yields seeds which can be pressed to produce oil addressed as corn oil. Corn oil is extracted from the germ of the corn. The oil has a high smoking point and is used for cooking. Corn oil is an important ingredient in the production of some margarine and is easily affordable when compared to other vegetable oils.

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Coconut, soybean or corn oils are prone to deteriorates with time or when handled improperly [2]. They can go rancid and lose their nutritional values or even lose their flavors upon extraction process and during storage [2 10]. The presence of microorganisms, air, antioxidants, and exposure to sunlight could accelerate their rancidity or deterioration [2, 10, 17]. Parameters such as degree of saturation, purity, free fatty acid formation, ability to form primary oxidation products, and cholesterol level are among the quality indices of edible oils.

This study therefore assessed the quality and cholesterol composition of edible vegetable oils such as coconut oil, soybean oil and corn oils.

MATERIALS AND METHODS

Procurement of the oils

The coconut, soyabean and corn oils used were purchased from the local producer. They were identified, and transported to the Department of Biochemistry Imo State University where they were used for further studies. Care was properly taken to avoid exposing them to contamination.

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Analysis for quality

The quality parameters considered in the present study were specific gravity, moisture content, acid value, iodine value, and peroxide value.

Determination of specific gravity: The method as described by Amadi *et al*. [17] was used for specific gravity. The specific gravity bottle method was employed. A clean and dry density bottle

of capacity 50 mL was weighed with its stopper. It was filled with distilled water and stoppered. The excess water was wiped with a cloth, and then reweighed. The bottle was emptied and dried. It was filled with the oil sample and reweighed. Specific gravity was calculated as follows

$$\text{Specific gravity} = \frac{\text{Weight of volume of the sample (g)}}{\text{Weight of an equal distilled volume of water (g)}}$$

Determination of moisture: The method as described by Amadi *et al*. [17] was used for moisture determination. Twelve grams of oil sample was weighed in a crucible and dried for 60 minutes to a constant weight using an oven (at the temperature of 105°C). It was then cooled in a desiccators for 20 minutes. The difference was estimated as follows

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$$\%\ \text{moisture content} = \frac{\text{Weight of loss in dry (g)} \times 100}{\text{Weight of oil sample (g)}}$$

Determination of acid value: The method as described by Amadi *et al*. [17] for acid value determination. Ten grams of the oil was weighed and dissolved in 50 mL fat solvent. The dissolved oil was titrated with 0.1 mol/Llitre potassium hydroxide using 1 mL phenolphthalein as indicator. The titration continued until a faint pink colour persists for 20-30 seconds. Acid value was estimated as follows

$$\text{Acid value} = \frac{V \times \text{Normality} \times \text{Molar weight of KOH (56.1g/mol).}}{\text{Weight of oil sample in grams}}$$

Note: V = volume of standard KOH solution in mL; and N = normality of standard KOH solution.

Determination of iodine value: The method of Yasuda [18], as described by Amadi *et al.* [17] was used. Five milliliter (5 mL) of pyridine dibromide solution was added to 5.0 mL of aliquot of lipid solution prepared with 5 mg in a 50 mL glass stoppered Erlenmyer flask and mixed thoroughly. The mixture was left at room temperature in the dark for 15 minutes. 0.5 mL of potassium iodide was solution, 0.5 mL of water and three drops of starch were added to the mixture and it was titrated to liberate the iodine with standard 0.02 N thiosulphate solution. A blank consisting of 5 mL of chloroform alone was used simultaneously. Iodine value was calculated as follows

$$\text{Iodine value} = \frac{(a-b)}{c} \times \frac{127}{5}$$

Note: a= blank titre, b=sample titre; and c-weight of lipid (g)

Peroxide value: The method of Paquot *et al.* [19], as described by Negash *et al*. [8] was used for the determination of peroxide value. Ten mL of oil sample was dissolved in acetic-acid/chloroform (3: 2 ratios) solvents. This solution was further reacted with 0.5 mL of 15% potassium iodide (KI). The liberated iodine was titrated with 0.1 N sodium-thiosulphate using

0.5 mL starch as indicator. Blank titration was performed. The peroxide value was calculated as follows:

Peroxide value = (B-S) × W × N

Note: S = volume of sodium-thiosulphate consumed by the oil sample, B = volume of sodium-thiosulphate used for blank, W = weight of oil sample, N = the normality of sodium-thiosulphate.

Determination of vitamin content of the sample: Vitamins A, C and E investigated in the oil samples were using the methods as describe by Amadi *et al*. [2].

Determination of cholesterol: The method as described by Ojiako and Akubugwo [20] was used for determination of cholesterol. A standard cholesterol dissolved in chloroform using the ration 1:10 was made up to 0.1 mL with the oil sample. The mixture was evaporated to dryness at the temperature of 50 °C. 3.0 mL each of glacial acetic acid and colour reagent which comprises of solution of ferric chloride/glacial/sulphuric acid was added to the sample and standard. They were shaken vigorously to dissolve the oil. Balack was also prepared and it contained 2.0 mL of chloroform, 3.0 mL glacial acetic acid and 3.0 mL of colour reagent. The absorbance of the standard and sample were taken at 560 nm after cooling for 30 mins at room temperature. Cholesterol content was estimated as follows

$$\text{Cholesterol mg/100 mL} = \frac{\text{Absorbance of oil sample}}{\text{Absorbance of standard cholesterol}} \times \text{Concentration of standard cholesterol}$$

RESULTS AND DISCUSSION

Table 1: Quality parameters of the oil samples.

Parameters	Coconut oil	Soybean oil	Corn oil
Specific gravity	0.82±0.03	0.71±0.06	0.75±0.02
Moisture content (%)	0.38±0.01	0.28±0.00	0.32±0.07
Acid value (mg KOH/g oil)	0.15±0.00	2.42±0.08	1.20±0.23
Iodine value (gram I_2/ 100 g oil)	31.02±2.11	90.45±1.06	120.80±1.54
Peroxidase value (mill equivalents oxygen/kg oil)	15.43±0.08	17.16±1.00	13.89±1.02

Values presented as mean and standard deviations of triplicate determination.

Quality parameters with regards to oil samples are those physical and chemical parameters that indicate their status at a glance. The parameters as presented in Table 1. It showed that specific gravity of the oil samples are 0.83, 0.71 and 0.75 for coconut, soybean and corn oil, respectively. The values are lower than the 1.16 of international standard for edible oil as presented by Chopra and Kanwar [21]. Specific gravity which has not unit, shares a relationship with water [22]. It increases as water content of oil increases. This relationship could be the reason why coconut oil with the highest value of specific gravity had the highest moisture content of 0.38%, followed by

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corn oil with moisture content of 0.32% and then soybean with moisture content of 0.28%. Moisture in oil favors the presence of microbial growth which could bring about rancidity [8, 23-26]. Certain fungal species survive and reproduce within when the moisture content is higher than 0.2%. Invariably, the studied samples could host the survival and reproduction of such species due to their moisture contents. Again, it has been reported that oils made with low technology contain more moisture than the ones made with refined technology [24-26]. This could be the reason why the moisture content of the studied oil samples in this study are higher than the moisture content of Avena oil (0.11%), Hayat oil (0.18%), Jersey oil (0.004%) and Chief oil (0.08%) as reported by Negash *et al.*[8]. Acid value for the oil samples ranged from 0.15 to 2.22 mg KOH/g oil. Soyabean oil was the highest while coconut oil was the least of the three oil samples. Both soyabean and corn oil samples have acid values that are higher than the permissible level of 0.6 mg KOH/g [27]. Acid value sometimes conforms to edibility of the oil [27-28]. The acid values of soyabean and corn oil in the present study are higher than those of Avena oil (1.0 mg KOH/g oil), Hayat oil (1.0 mg KOH/g oil), Jersey oil (0.9 mg KOH/g oil) and Chief oil (1.0 mg KOH/g oil) as reported by Negash *et al.*[8]. Iodine value measures unsaturated acid present and indicates the non-drying qualities of oil [22]. The higher the value, the more unsaturated a sample of oil becomes. Corn oil displayed the highest degree of unsaturation, followed by soyabean oil. However, only coconut was below the specified standard for edible oil. Both corn and soybean oil samples were within the specified standard (80 – 106 /100g.) by FAO/WHO [29]. The iodine values for coconut oil and soyabean oil failed to confirm to their standard as reported by Codex Alimentarius [27], but the iodine value for maize conformed to the standard as reported by Codex Alimentarius [26]. Peroxide value measures oxygen used to monitor the development of rancidity [8, 22-27]8. It has an inverse relationship with moisture content and shelf-life oil sample. Corn oil has the lowest peroxide value of 13.89 (mill equivalents oxygen/kg oil), followed by coconut oil with peroxide value of 15.43 (mill equivalents oxygen/kg oil) and then soybean oil. The implication is that corn oil could be the highest shelf-life while soybean could be the first to go rancid.

Table 2.: Vitamin composition of the oil samples.

Vitamins	Coconut oil	Soybean oil	Corn oil
Vitamin A (mg.100g)	0.00	0.00	0.04
Vitamin C (µg/100g)	0.07	0.10	0.20
Vitamin E(µg/100g)	0.35	1.05	1.45

Values are presented as value and standard deviations of triplicate determination.

Vitamin composition of the oil samples as present in Table 2 revealed the presence of vitamins A in corn oil while vitamins C and E were observed at different levels in the oil samples. Vitamin C was highest in corn oil (0.20 µg/100g), followed by soybean oil (0.10 µg/100g) and finally coconut oil with least (0.07 µg/100g). In that same order, vitamin E was found at the highest level in corn oil (1.45 µg/100g), followed by soybean (1.05 µg/100g), and the coconut oil (0.35 µg/100g). The vitamin E levels of soybean and corn oil samples fall short of their range as reported by Codex Alimentarius [27]. Amadi *et al.* [2] reported the presence of vitamins A, C and E in
"Akwu Ojukwu" oil- and oil- from bean seed.

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Table 3.~~:~~ Level of cholesterol in the oil samples.

Samples	Wavelength (nm)	Average reading	Cholesterol content (mmol/dL)	% cholesterol content
Coconut oil	570	18.60	3.6	20.7
Soybean oil	570	0.35	6.5	37.6
Corn oil	570	0.39	7.5	42.1
Standard	570	0.27	15.7	--

Average reading, cholesterol content w~~ere~~as taken as mean of triplicate determinations.

According to Okpuzor *et al*. [30], cholesterol has been associated with atherosclerotic lesions which are the major causes of coronary heart disease. Oils are meant to have zero or low cholesterol because of its health effects at increased level in the body. Cholesterol found in relatively low compared to the standard. However, corn oil (7.5 mmol/dL) had the highest cholesterol level, followed by soybean oil (6.5 mmol/dL) and then coconut oil with 3.6 mmol~~-~~/dL cholesterol level. Okpuzor *et al*. [30] reported higher level of cholesterol in some different brands of vegetable oils. The observed cholesterol levels of the samples were lower than their individual range as reported by Codex Alimentarius [27].

CONCLUSION

The oil samples studied though refined with low technology, still possessed those quality parameters than could project them as edible vegetable oil. Care should be taken in handling them because of their high moisture content to avoid their spoilage. Again, efforts should be made to fortify them with vitamin A and further lower their cholesterol. This study has analysed some selected vegetable oils for quality and cholesterol composition.

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