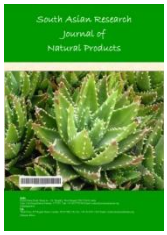

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Analysis for Quality and Cholesterol Composition of Handcrafted Coconut, Soybean and Corn Oils

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Handcrafted coconut, soybean and corn oils were analyzed for quality and cholesterol composition using standard methods. The observed moisture composition of the oils exceeded the 0.2% threshold for maintenance of quality shelf life. Corn oil displayed the highest degree of unsaturation followed by soybean oil. Coconut oil was below the specified standard for edible oil. The vitamin C content of the handcrafted oils followed the order corn oil (0.20 µg/100g) > soybean oil (0.10 µg/100g) > coconut oil (0.07 µg/100g). The observed cholesterol level of corn oil (7.5 mmol/dL) was the highest against the cholesterol of soybean oil (6.5 mmol/dL) and then followed by coconut oil (3.6 mmol/dL), which was the least in cholesterol content. The oil samples possessed those quality parameters that could project them as edible from of vegetable oils. However, effort should be made to lower cholesterol and moisture contents of the handcrafted oils. High cholesterol has been implicated against healthy living in humans while low moisture is known to promote the shelf life or delay spoilage of vegetable oils. This study has analyzed the quality and cholesterol composition of handcrafted coconut, soybean and corn oils.

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Keywords: Coconut oil; cholesterol composition; vegetable oil; vitamins; quality parameters.

1. 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 oil, 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 soybean 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 may*s is another plant which produces seeds that give another oil that is highly valued. *Z. mays* belong to a genus of flowering plants Zea [15]. 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. It is easily affordable when compared to other vegetable oils.

Coconut, soybean or corn oils are prone to deteriorate 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 analysed the quality and cholesterol composition handcrafted coconut, soybean and corn oils.

This study has analyzed the quality and cholesterol composition of handcrafted coconut, soybean and corn oils.

2. MATERIALS AND METHODS

2.1 Procurement of the Oils

The coconut, soybean and corn oils used were purchased from the local producer in Owerri, Imo State, Nigeria. They were properly identified, and transported to the Department of Biochemistry Imo State University for further studies. Care was

properly taken to avoid exposing them to contamination.

2.2 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

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 desiccator for 20 minutes. The difference was estimated as follows

% 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/L potassium hydroxide using 1 mL phenolphthalein as indicator. The titration continued until a faint pink color persists for 20-30 seconds. Acid value was estimated as follows

Acid value =

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

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 mgin 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 bythe 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 oil 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 color 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. Blank was also prepared and it contained 2.0 mL of chloroform, 3.0 mL glacial acetic acid and 3.0 mL of color reagent. The absorbance of the standard and

sample were taken at 560 nm after cooling for 30 minutes at room temperature. Cholesterol content was estimated as follows

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

3. RESULTS AND DISCUSSION

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 bears no unit, but 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 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 were 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. Soybean oil was the highest while coconut oil was the least of the three oil samples. Both soybean and corn oil samples have acid values that are higher than the permissible level of 0.6 mg KOH/g oil [27]. Acid value sometimes conforms to edibility of the oil [27-28]. The acid values of soybean and corn oil in the present study were 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 soybean 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 soybean oil failed to confirm to their standards as reported by Codex Alimentarius [27], but the iodine value for corn oil conformed to the standard as reported by Codex Alimentarius [26]. Peroxide value measures oxygen used to monitor the development of rancidity [8, 22-27]. It has an inverse relationship with moisture content and shelf-life of oil sample. Corn oil had 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 with peroxide value of 17.16 (mill equivalents oxygen/kg oil). The implication is that corn oil could be the highest in terms of shelf-life while soybean could be the first to go rancid.

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 the 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 then coconut oil (0.35 µg/100g). The vitamin E of soybean and corn oil samples fall short of the 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.

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 of the analyzed oil samples were relatively low compared to the standard. However, corn oil (7.5 mmol/dL) had the highest cholesterol content, followed by soybean oil (6.5 mmol/dL) and then coconut oil with 3.6 mmol/dL cholesterol content. Okpuzor et al. [30] reported higher cholesterol in some brands of vegetable oils. The observed cholesterol content of the samples were lower than their individual range as reported by Codex Alimentarius [27].

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/ goil)	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
Peroxide 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 determinations

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 deviation of triplicate determinations

Table 3. Cholesterol of 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 and % cholesterol contents were taken as mean of triplicate determinations

4. CONCLUSION

The handcrafted oil samples possessed some quality parameters that could project them as edible vegetable oils. However, care should be taken in handling them because of high moisture content to avoid their spoilage. Again, efforts should be made to fortify them with vitamin A and further lower their cholesterol contents. This study has analyzed some selected vegetable oils for quality and cholesterol composition.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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