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Assessment of Some Quality Identities of Crude and Processed Oils Extracted From Snake Tomato (*Trichosanthes Cucumerina*) Seeds.

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Abstract

Analysis of crude and processed oil extracted from Snake tomato (*Trichosanthes cucumerina)* seeds were carried out to establish the effect of processing on identity and quality characteristics of the oils. The crude oil was subjected to refining processes: Degumming, Neutralization and bleaching. There was no remarkable difference in the specific gravity, refractive index and moisture content of the crude and processed oils. However, there exists slight increase in Smoke point (^{0}C): (82.00±0.01 - 87.00±0.33), Flash point (^{0}C): (236.00±1.01 - 245.00±1.30), Fire point (^{0}C): (285.00±2.41 - 296.00±1.58) and Iodine value (g/100g): (83.26±2.01 - 89.30±2.50) of the oil samples. The qualities of the oils improved by showing gradual decrease in Colour (Lovibond unit): (10.00 - 4.00), Free fatty acid (% Linolenic): (1.21±0.01 - 0.64±0.01), Acid value (mgKOH/g): (2.43±0.04 - 1.26±0.21), Peroxide value (meq peroxide/Kg) :(2.08±0.10 - 0.61±0.01), Saponification value (mgKOH/g Oil): (281.27±2.18 - 277.98±1.90) and increase in the values of Linoleic acid (38.10 – 41.98%), Oleic acid (35.74 – 37.50%), Palmitic (11.68 – 12.80%) and Stearic acid(3.79 – 4.66%) as the crude oil was processed to bleached oil. The oil's high proportion of unsaturated fatty acids, high iodine value, and low free fatty acid content are all attributes that qualify the oil to be safe for consumption. The oil's quality will be further enhanced if it is processed to the deodorization.

Keywords: *Trichosanthes cucumerina* seed oil, Extraction, Degumming, Neutralisation, Physicochemical, Fatty acid.

1.0 Introduction

Edible fats and oils are biological mixture of plants, animals and marine origin that are made up of mixtures of fatty acids esterified with glycerol (Eqbql *et al.*, 2011). The type and quantity of fatty acids on the triacylglycerol have a significant impact on both the physical and chemical properties of oils and fats (Sandhya *et al*., 2010). Over 90% of the world's production of oils and fats from plant, animal, and marine sources is consumed directly as food or as an ingredient in food items (Stevenson *et al.*, 2007). In addition to being a concentrated source of energy, fats and oils also serve as a vehicle for the vitamins A, D, E, and K as well as sources of essential fatty acids which are precursors to the hormones required to maintain the functioning of many body systems (Stevenson *et al*., 2007). As tenderizing agents, ingredients that improve dough aeration, and shortening agents, fats and oils are useful in the processing and preparation of food. They also serve as a heating medium in preparation of foods (Katragadda *et al*., 2010).

Physical and chemical properties of fats and oils extracted from different sources differ from one another because they (fats and oils) contain varying quantity of different mixed esters. Some of these esters are solid, some liquids, some volatile, some saturated and some unsaturated substances. The physical and chemical properties of an oil or fat is therefore influenced to some extent by each ester in accordance with the amount of that ester present in the fat or oil. These differences are the foundation of tests for their identification (Jacobs, 1999). Qualitative identification of an extracted vegetable oil is obtained from its chemical composition and this is a very important area in the selective application guide in the commercialization and utility of oil products (Salunkhe *et al.,* 1992). Characteristic qualities are those that depend on the nature of the oil and are used to characterize oil, regardless of location or sources of origin. Quality, purity and other characteristics of oils are revealed from their physicochemical parameters properties. Such properties or parameters include the iodine value, saponification value as well as the properties that vary with location which include peroxide value, free fatty acid value, acid value and density (Abitogun and Oshodi, 2010).

Oils and fats are found in fish (10-20%), fruit pulp (30-58%), animal tissues (60-90%), and oil seeds (18-70%) (Arawande and Alademeyin, 2018; Gunstone and Norris, 1983). The method used to extract the oils from the vegetable source (i.e. whether it is virgin oil or cold pressed oil), both of which are acquired without changing the nature of the oil, also affects the quality of vegetable oils, which is a measure of their identity and edibility. Gums, phospholipids, pigments, colour bodies, tocopherols, and free fatty acids are a few naturally occurring substances found in crude fats and oils (Chow, 2008). Processing methods such as centrifuging, settling, filtering, and washing with water may be used to clean the fat or oil (Chabiri *et al.*, 2009). Crude oils, according to Lists and Erickson (1980) also contain impurities and substances created or added during processing, such as soaps, hydroperoxides and their breakdown products, hydrogenation catalysts, bleaching clay, moisture, and trace metals. The majority of these compounds are responsible for the development of undesirable odours, flavours and colours in the oil; therefore most steps of processing are carried out to remove these unwanted contaminants (Chow, 2008).

Snake gourd plant (*Trichosanthes cucumerina*) is one of the several underutilized crops that are very useful to the local people in western and central African sub-region (Abukutsa- Onyago, 2003; Idowu *et al*., 2019; FAO, 1998). *Trichosanthes L*. is the largest genus in the Cucurbitaceae family, comprising 91 species (Huang *et al*., 2007; Huang *et al*., 1998; Huang *et al.,* 1997). Although the wild variety of the species, *Trichosanthes cucumerina* var. cucumerina, is native to southern and eastern Asia, Australia, and the islands of the western Pacific, the snake gourd was first domesticated in India. In recent years, several sections of Africa, Madagascar, and other tropical and subtropical countries have started to plant snake gourds (*Trichosanthes cucumerina var. anguina* (L)) as a vegetable. Around the world, snake gourd is known by several names. It is known as a snake tomato in Nigeria, a pathakaya in India, a pakupis in the Philippines, and a baup ngu in Thailand (ECHO, 2006). The plant thrives in the tropical lowlands' humid climate. Snake tomatoes are typically tendril-climbing annuals that produce fruit 2-4 months after planting. It produces long, slender, cylindrical fruits that resemble snakes. Unripe fruit has a green appearance, but when it ripens, it turns orange-red. In India and other nations throughout the world, snake gourd is one of the vegetables with the highest economic value. The plant is mostly produced for the immature fruit, which can be

cooked and served as a vegetable, in India and certain other regions of the world (ECHO, 2006).

Only the ripe pulp is believed to be edible in the eastern section of Nigeria. The pulp, which is quite reddish in colour, can be utilized to enhance the visual appeal of cuisine since it can be mixed to make a stew sauce that mimics tomatoes in flavor and function (Enwere,1998). The fruit's great nutritional value causes it to typically be eaten as a vegetable. The plant has large concentrations of minerals, vitamins A and E, proteins, lipids, fibre, and carbs. The plant's abundance of functional elements, in addition to its basic nutrients including flavonoids, carotenoids, phenolic acids, soluble and insoluble dietary fibres, and necessary minerals, make it pharmacologically and therapeutically active (Sandhya *et a*l., 2010; Yusuf *et al*., 2007). When the seeds are dried, they are used as an alternative medication for the treatment of diarrhoea and anthelmintics. According to reports, the seed contains antibacterial properties (Yusuf *et al.,* 2007), making it a possible pesticide.

Because there have been little to no understanding of new uses for *Trichosanthes cucumerina* seeds**,** a significant amount of these oil-rich seeds are thrown away every harvest season in south-western Nigeria after the red pulp has been consumed in cooking soup (Adesina and Amoo, 2013).The proximate composition and nutritional value of the seeds and oil have recently been the subject of a small number of research, however data on the physicochemical characteristics and fatty acid composition of processed seed oil are scant or non-existent. In order to determine the impacts of these treatments on the parameters, this work aims to evaluate the physicochemical properties and fatty acid content of crude, degummed, neutralized, and bleached *Trichosanthes cucumerina* seed oil.

2.0 Materials and Methods

2.1 Sampling and Preparation of Samples

The ripe matured *Trichosanthes cucumerina* (Snake tomato) fruits were plugged from the *T. cucumerina* plant at a farm in Emure-Ile, Owo local Government Area, Ondo State, Nigeria. The harvested fruits were thoroughly washed with cleaned water in the Laboratory and longitudinally cut open to remove the seeds. The seeds were manually deshelled, air-dried, milled to powdery form and kept in an air-tight bottle.

2.2 Oil Extraction

The powdered *Trichosanthes cucumerina* seeds were then subjected to soxhlet extraction using hexane as solvent. 55 g of the powdered sample was inserted into the thimble and placed in the inner tube of the Soxhlet extracting apparatus. In this process, n-hexane (B.P 65 ^{o}C) was employed to completely extract the oil content. The solvent was removed, leaving a clear light-yellow oil termed ‘crude oil’ (Bligh and Dyer, 2009). Several extractions were employed until enough oil required for the analysis was obtained and stored in an air-tight bottle for further analysis.

2.3 Refining Process

The crude oil extracted from *Trichosanthes cucumerina* (Snake tomato) seeds was then subjected to degumming, neutralization and bleaching processes.

2.4 Degumming Process

About 400 cm^3 of the extracted oil was heated to temperature of 70 ^{o}C followed by addition of 0.80 cm^3 of 50 % phosphoric acid and the mixture was then vigorously stirred for 10 minutes. Thereafter 10 $cm^3$of water heated to 80 ^{o}C was added and whole mixture agitated for another 10 min. The agitation was stopped and the mixture was allowed to stand undisturbed for 1 h. The mixture was then separated into two layers i.e. oil and gum. The gum was drained off while the oil obtained was termed as degummed

oil (Arawande and Alademeyin, 2018; Salunkhe *et al*., 1992). The degummed oil was further subjected to alkali neutralisation.

2.5 Neutralization Process

About 200 cm^3 of degummed oil sample was heated to temperature of 70 ^oC with constant stirring in a beaker. 3.3 cm^3 of 3.59 M (20 Baume) sodium hydroxide solution was added to the oil with vigorous stirring and the temperature rose to 90 ^oC. Thereafter, 10 $cm^3$of saturated solution of sodium chloride (an electrolyte) was added and the resulting mixture was stirred vigorously at 90 ^oC for 30 min. The mixture was left undisturbed in a separating funnel for 6 h and it was later separated into two layers, the lower layer (soap stock) was then heated to 90 ^oC and washed with water heated to 95 ^oC. The washing was done six consecutive times to remove any excess caustic soda and water soluble gum remaining in the oil (Arawande and Alademeyin, 2018; Salunkhe *et al.*, 1992). The resulting neutral oil was then dried in a hot air oven, and later cooled in a desiccator. The dried oil was further bleached. Bleaching process 100 cm^3neutralized oil was heated to 75 ^oC with constant

2.6 Bleaching Process

About 100cm^3 of the neutralized oil was heated to 75 ^oC with constant agitation. Then 1.00 g of the bleaching earth was added and the mixture was heated to 110 ^oC with constant stirring for 45 minutes (Arawande and Alademeyin, 2018; Salunkhe *et al*.,1992). The mixture was then filtered and the resulting oil termed bleached oil

2.7 Physicochemical Determination of the Oil Samples

The crude, degummed, neutralized and bleached oils were analysed for physicochemical properties. The moisture content and specific gravity were determined according to AOAC, 2012 while the refractive index was measured using Abbey Refractometer coupled with thermometer (ASTM, 1985). The colour was determined using Lovibond Tintometer (Model 520). The colour of crude oil was determined in half ½ inch cell while that of degummed, neutralized and bleached oils were determined in 1 inch cell. The colour was calculated based on the expression (5R+Y) −B, where R stands for red pigment, Y for yellow pigment and B for blue pigment (Abitogun and Oshodi, 2010; Bernadini, 1973). The flash and fire points were measured using GallenKamp Automatic Pensky-Martens flash point and fire point tester with thermometer while the smoke point was determined using Cleveland Open Cup apparatus (AOAC, 2012). The temperature at which turbidity is first detectable was also measured using Palm Test turbidity tube (ASTM, 1985). The free fatty acid, acid value, saponification value, peroxide value and iodine value were determined using methods described by AOAC, 2012.

2.8 Fatty Acid Identification

The oil samples were converted to Fatty acid methyl esters (FAMEs) using the method described by Arawande and Alademeyin (2018); Oshodi (1996) and Hall (1982). The fatty acid methyl esters were analyzed using an HP 6890 gas chromatograph fitted with flame ionization detector and powered with HP chemstation Rev.09.01 [206] software. The career gas was helium at pressure of 19 psi. The FAMEs sample (1.5 µL) was injected and the separation was carried out on an HP capillary column (HP-INNowax; cross-linked PEG); 30.0 m length, 0.32 mm i.d., and 0.50 µm film thickness. The oven temperature was held initially at 60 ^oC for 2 min, increased from 180 ^oC at 12 ^oC/min to 320 ^oC at 14 ^oC/min and then maintained at 320 ^oC for 5.0 min. The temperature of the injection port and the detector were set at 250 ^oC and 300 ^oC respectively. The peaks were identified by comparison with standard fatty acid methyl esters

(Arawande and Alademeyin, 2018; ASTM, 1985).

2.9 Statistical Analysis

Statistical significance tests were performed using SPSS (v.20, IBM SPSS Statistics, US) at $p < 0.05$ by means of one-way analysis of variance (ANOVA) followed by LSD post hoc multiple comparisons.

3.0 Results and Discussion

Table 1 shows physicochemical properties of crude, degummed, neutralized and bleached oils obtained from *Trichosanthes cucumerina* (Snake tomato or Snake gourd) seeds. The oil yield content of *Trichosanthes cucumerina* seed was found to be 49.60% and the crude oil was light yellow with clear opacity. The percentage oil yield lies within the range of values (44.6 – 57.2%) reported by Atugwu *et al*., 2022) but lower compared with 71% reported for snake gourd seed oil (Etuk *et al*., 2022). The high percentage oil content of the seed (49.60%) not only categorize it among oil seeds but indicate that the oil could be economically refined for edible purposes or used for industrial purposes. Lovibond tintometer was used to measure the colour of the extracted crude oil, degummed oil, neutralized oil and bleached oil respectively and their colour in 1 inch cell was found to be 10.00, 6.00, 4.50 and 4.00 units. The phosphoric acid used for degumming and bleaching earth used in the bleaching process were responsible for the progressive decrease (improve) in colour of the oils from crude to bleached oil (Abitogun and Oshodi. 2010; Bernadini, 1973). The absence of moisture in the oil samples is a strong indicator that the seed can be stored and suitably preserved for a long time without deterioration.

Table 1: Physicochemical properties of Crude, degummed, neutralized and bleached oil extracted from *Trichosanthes cucumerina* (Snake tomato) seeds.

PARAMETERS	Crude Oil	Degummed Oil	Neutralised Oil	Bleached Oil
Refractive Index (at 25^0C)	$1.481^a \pm 0.01$	$1.480^a \pm 0.01$	$1.481^a \pm 0.01$	$1.481^a \pm 0.01$
Specific gravity (at 25^0C)	$0.920^a \pm 0.01$	$0.921^a \pm 0.01$	$0.921^a \pm 0.01$	$0.921^a \pm 0.01$
Moisture content (%)	0.00±0.00	0.00 ±0.00	0.00 ± 0.00	0.00 ± 0.00
Colour (Lovibond unit)	10.00	6.00	4.50	4.00
Smoke point (^{0}C)	$82.00^d \pm 0.01$	$83.00^c \pm 0.02$	$84.00^b \pm 0.01$	$87.00^a \pm 0.33$
Flash point (^{0}C)	$236.00^d \pm 1.01$	$239.00^c \pm 1.12$	$241.00^b \pm 1.28$	$245.00^a \pm 1.30$
Fire point (^{0}C)	$285.00^d \pm 2.41$	$289.00^c \pm 1.80$	$292.00^b \pm 2.40$	$296.00^a \pm 1.58$
Free fatty acid (% Linolenic)	$1.21^a \pm 0.01$	$0.90^b \pm 0.03$	$0.52^d \pm 0.02$	$0.64^c \pm 0.01$
Acid value (mg KOH/g)	$2.43^a \pm 0.04$	$1.82^b \pm 0.01$	$1.04^d \pm 0.03$	$1.26^c \pm 0.21$
Iodine value(g/100g)	$83.26^c \pm 2.01$	$85.20^b \pm 3.45$	$86.20^b \pm 2.01$	$89.30^a \pm 2.50$
Peroxide value (meq perioxide/kg)	$2.08^a \pm 0.10$	$1.23^b \pm 0.11$	$0.85^c \pm 0.15$	$0.61^d \pm 0.01$
Saponification value (mg KOH/g Oil)	$281.27^a \pm 2.18$	$280.20^a \pm 1.10$	$279.68^b \pm 2.10$	$277.98^c \pm 1.90$
YIELD (%)		49.60%		

Mean ± standard deviation of triplicate determination. Mean values bearing different superscripts in the same row differ significantly ($p \leq 0.05$).

The Refractive index and specific gravity are physical measures of adulteration of vegetable oils since different oils have characteristics density and refractive index. There was no remarkable difference in the values of both refractive indices (1.480-1.482) and specific gravity (0.920-0.921) of the oil samples. The refractive indices of the oil samples compared favourably with 1.4835 reported by Akintayo and Bayer (2002) for crude plukenetia conophora seed oil but higher compared with 1.43 and 1.46 reported for *Irvigna gabonesis* and *Citrullus colocynthis* seeds oils by Igwenyi (2014). The specific gravities of the oil samples compared

favourably with (0.904 ± 0.001) reported for fluted pumpkin seed oil by Chibor *et al.,* 2018 but higher compared with 0.62 reported by Arawande and Akinnusotu (2018) for castor seed oil.

The smoke point (^{0}c) for crude, degummed, neutralized and bleached oils were determined to be 82.00 ± 83.000 ± ,84.000 ± and 87.000 ± , respectively, flash point (^{0}c) for crude, degummed, neutralized and bleached oils were 236.00 ± , 239.00 ± , 241.00 ± and 245 ± respectively while the fire points (^{0}C) for crude, degummed, neutralized and bleached oils were determined to be 285.00 ± , 289.00 ± , 292.00 ± and 296.00 ± respectively. The progressive increase in values of smoke, flash and fire point from crude oil to bleached oil is remarkably observed and this might be as a result of efficiently removal of impurities such as volatile organic material and the residual extraction solvent during the oil processing (Nielsen, 2002; Abitogun and Oshodi, 2010; Erickson *et al*., 1980). The smoke point of the crude oil (82.00±) is lower compared with 213.5^{0}C reported for crude groundnut oil (Bello *et al.,* 2011) and 206.00 ± 2.10 reported *Sesamum indicum* seed oil by Arawande and Alademeyin (2018). It is noted that oil samples containing low free fatty acid produce high smoke ,flash and fire point (FAO/WHO, 1993) and this categorises the oil samples among oils with combustion characteristics (Giwa, 2010) as well as their uses in stir-fry cooking (Bello *et al.*, 2011; Akintayo and Bayer, 2002).

Among the characteristics required for identification and edibility of vegetable oil is free fatty acid and it can stimulate hydrolytic deterioration of oils to form off-flavor components. The free fatty acid (%Linoleic) of crude, degummed, neutralised and bleached oils are 1.20, 0.69, 5.20 and 0.64. These values are relatively low compared with 5.6 ± 0.1 reported for *Plukenetia conophora* by Akintayo and Bayer (2002) but higher than maximum allowable value of 0.3% for refined vegetable oil (NIS, 1992; CODEX, 1999). Acid value (mg kOH/g) of the samples are 2.43 (Crude oil), 1.82 (Degummed oil), 1.04 (Neutralized oil) and 1.26 (Crude oil) respectively. It was observed that free fatty acid (FFA) and Acid value of the oil samples decreased from crude oil to neutralized oil but slightly increased in bleached oil. This observation is due to the effective use of caustic alkali in neutralizing the oil samples which led to reduction in the free fatty acid (FFA), acid values and other impurities while the increase in FFA and acid values of bleached oil is as a result of acidic nature of bleaching earth used for colour removal **(**Abitogun and Oshodi. 2010; Salunkhe *et al*., 1992; Bernadini, 1973). The following processing stage i.e deodorization will reduce the acidity. Acid values of the oil samples were lower compared with 3.48 (mgKOH/ g) reported for seed oil of *Telfairia occidentalis* Hook, F. (Bello *et al*., 2011) and the minimum accepted value (4.0%) for vegetable oil as recommended by the CODEX Alimentarius commission for oil seeds (Bello *et al.,* 2011;Abayeh *et al*., 1998). Furthermore, acid value of 0.00 to 3.00 mg KOH/g oil is recommended to find application in coking (Bello *et al*., 2011; Oderinde *et al*., 2009).

Iodine value is the number of gram of iodine that combines with 100g of lipids, which shows the degree of unsaturation of the fat or oil (Ononogbu, 2002; Omeje *et al.,* 2019) and reflect the susceptibility of oil to oxidation. The higher the iodine value, the greater the degree of unsaturation and the greater the liquidity of the oil (Jacobs, 1999). The iodine values (g/100g) of the crude, degummed, neutralized and bleached oils are 83.00, 85.00, 86.20 and 89.30 respectively. The iodine values of the oil samples compare favourably with 84.00 ± 0.01g/100g (Etuk *et al.,* 2022) but higher compare with 34.27g/100g reported for Snake Tomato seed oil (Adesina and Amoo, 2013) and 29.00± 0.16g/100g and 35.00mg/100g reported for African star apple (Omeje *et al*., 2019; Adebayo *et al*., 2012). Since iodine values of the samples are less than 100.00g/100g, the samples could be

classified as non- drying oil (Igwenyi, 2014). Non-drying oils are not volatile at room temperature and does not pose any danger of inflammability.

Saponification value is the number of milligram of potassium hydroxide required to neutralize the fatty acid liberated on complete hydrolysis of saponification of 1g of the oil. It is inversely proportional to the molecular weight of the oil (Amira *et al*., 2014). The saponification values of the samples under investigation: Crude oil (281.27), degummed oil (280.20), neutralized oil (279.68) and bleached oil (277.98) are very close to 280. 50mgKOH/g and 257.50mgKOH/g reported for palm kernel oil and coconut oil by Amira *et al.* (2014) but are higher compared with 184.93 $\pm$ 3.17 mg ssKOH/g reported for *Trichosanthes cucumerina* seed oil (Etuk *et al*., 2022) and lower than 317.27 mg KOH/g reported by Adesina and Amoo (2013). The oil samples have relative high saponification value, which points to applications in the soap and cosmetics industries.

Peroxide value is an index of rancidity. It is a useful indicator of oil quality since it shows how stable the oil is and how much fat is degrading. The oils under study were found to have peroxide values of 2.08, 1.23, 0.85 and 0.710 for crude, degummed, neutralized and bleached oil respectively. The peroxide value of the crude oil (2.08) is favourably compared with 2.03 $\pm$ 0.06 reported by Etuk *et al*. (2022) while the values for degummed oil, neutralized oil and bleached oil are lower compared with 2.03 $\pm$ 0.06 reported by Etuk *et al*. (2022). However, the peroxide values of the samples are lower than the maximum limit of 10.0 mg KOH/g set by the CODEX Alimentarius commission for vegetable oils (Abayeh *et al.,* 1998).

The iodine value indicates that the oil contains a few unsaturated bonds and is non-drying (Oil with iodine value less than 115), hence little affected by deterioration and oxidative rancidity (Igwenyi, 2014). This is further confirmed by its lower peroxide value which indicates that there are anti-oxidants present in the oil. Relative low iodine value of the oils suggests that it has a few unsaturated bonds, is non-drying, and is hence less susceptible to oxidative rancidity and deterioration. This is further supported by its low peroxide value, which shows the presence of antioxidants.

Table 2 shows the fatty acid composition of crude, degummed, neutralized and bleached oil, obtained from *Trichosanthes cucumerina* seeds. The fatty acid detected in the crude, degummed, neutralized and bleached oil samples are lauric, palmitic, stearic, arachidic, palmitoleic, oleic, erucic, linoleic and linolenic acids.

The individual amount (%) of fatty acids in the crude oil is lauric (90.358), palmitic (11.680), stearic (3.785), palmitoleic (0.300), oleic (35.740), linoleic (3.100) and linolenic (0.280). The content (%) of the fatty acid in degummed oil are lauric (0.456), palmitic (11.95), stearic (4.135), palmitoleic (0.381) oleic (36.800), linoleic (39.700) and linolenic (0.300) respectively. Furthermore, the following fatty acids are present in the neutralized oil, lauric (0.568), palmitic (12.20). Stearic (4.345), arachidic (0.020), palmitoleic (0.40), oleic (36 980), erucic (0.240), linoleic (40.80) and linolenic (0.340) respectively. Moreover, the amount of individual fatty acids present in bleached oil are lauric (0.685), palmitic (12.870), stearic (4.660), arachidic (0.070), palmitoleic (0.450), oleic (38.20), erucic (0.24), linoleic (41.980) and Linolenic (0.380) respectively.

It is observed that the amount (%) of fatty acids in the oil samples increased as the processing progressed from one stage to another. This establish the fact that more of the fatty acids are detected with the removal of impurities in each stage of processing. Also, linoleic acid was observed to have the highest value followed by Oleic acid while arachidic and erucic were absent in crude and degummed oil samples but are

detected in trace amounts in neutralized and bleached oil samples. The oil is suggested to be edible when completely refined owing to its high level of unsaturated fatty acid in conjunction with its low free fatty acid and acid values (Abitogun and Oshodi, 2010; Messink and Katan, 1993). *Tranchosanthes cucumerina* seed oil may not congeal at room temperature due to the large concentration of unsaturated fatty acids in the oil, which supports this claim.

Table 2: Fatty acid composition of Crude, degummed, neutralized and bleached oil extracted from *Trichosanthes cucumerina* (Snake tomato) seeds.

PARAMETERS	NO OF CARBON	CRUDE OIL(%)	DEGUMMED OIL(%)	NEUTRALIZED OIL(%)	BLEACHED OIL(%)
SATURATED FATTY ACID (%)					
Lauric	12:0	0.36	0.46	0.57	0.69
Palmitic	16:0	11.68	11.95	12.20	12.80
Stearic	18:0	3.79	4.13	4.35	4.66
Arachidic	20:0	N.D	N.D	0.02	0.02
TOTAL SATURATED FATTY ACIDS (%)		15.83	16.24	17.14	18.17
MONO-UNSATURATED FATTY ACIDS (%)					
Palmitoleic	16:1	0.30	0.38	0.40	0.45
Oleic	18:1	35.74	36.80	36.98	37.50
Erucic	22:1	N.D	N.D	0.24	0.24
TOTAL MONO-UNSATURATED FATTY ACIDS (%)		36.04	37.18	37.62	38.19
POLY-UNSATURATED FATTY ACID (%)					
Linoleic	18:2	38.10	39.70	40.80	41.98
Linolenic	18:3	0.28	0.30	0.34	0.38
TOTAL POLY-UNSATURATED FATTY ACIDS (%)		38.38	40.00	41.14	42.36
TOTAL FATTY ACID DETECTED (%)		90.25	93.42	95.90	98.72

ND: Not Detected

The total amount (%) of saturated fatty acids found in the crude, degummed, neutralized and bleaching oils are 16.823, 17.691, 18.323 and 19.165 respectively with palmitic acid having the highest value of 12.80% in the bleached oil. This result is consistent with the fact that palmitic acid is the most abundant saturated fatty acid in plant lipids (Camilo *et al.*, 2016; Jorge *et al*., 2012). It possess high caloric power and thus the consumption of products with high content of this acid provides a feeling of fullness due to its high satiety capacity. Moreover, total amount (%) of Monounsaturated fatty acids found in crude, degummed, neutralized and bleached oil samples are 36.040, 37.481, 37.681 and 38.350, while the values (%) of polyunsaturated fatty acid present in these oil samples are 37.30, 38.92, 40.040 and 41.270% respectively. There exists an observable progressive increase in the saturated, monounsaturated and polyunsaturated fatty acids as well as the total fatty acid composition of *Trichosanthes cucumerina* seed oil during processing (refining) from crude oil to bleached oil. This may be due to the effectiveness of the oil processing method in the removal of impurities during refining processes.

In monounsaturated fat, oleic acid (Omega-9) was obtained in high amounts (35.74% - 38.2%), which is vital in the construction of membranes, being present in the epidermis (outermost skin layer), with the function of protection and barrier against dehydration and also in the formation of hormones (Camilo *et al.*, 2016). In the food industry, oleic acid is the most used in various processes because it provides better quality products (Almeida *et al.*, 2008; Camilo *et al*., 2016). Foods that contain high percentage of

unsaturated fats could lowers blood levels of harmful cholesterol and aids in the absorption of vitamins A, D, E, and K. (fat soluble vitamins) in the body (Camilo *et al*., 2016). Among monounsaturated (MUFAs) and polyunsaturated acids (PUFAs), only oleic acid [(18:1 n-9) (Omega-9)] (35.74% - 38.2%) and linoleic acid [(LA, 18:2 n-6) (omega-6 fatty acid)] (38.10 % – 41.98%) were found in significant higher amount. El-Adawy and Taha (2001) reported that a vegetable oil's ability to prevent the production of bad cholesterol is positively correlated with the level of linoleic acid relative to oleic acid. Also, the quantity and composition of unsaturated fatty acids present in edible vegetable oils determines their quality and digestion (El-Adawy and Taha, 2001). Therefore, the oil samples could be considered among vegetable oils of high nutritional value because of its higher ratio of linoleic acid (omega-6 fatty acid) to oleic acid (Omega-9) content.

All the fatty acids required by the human body can be synthesised, with the exception of Alpha-linolenic acid (ALA) (omega-3 fatty acid) and linoleic acid (LA) omega-6 fatty acid. These two fatty acids are known as essential fatty acid and can only be obtained from diet. They are required for proper growth and development and they also serve as building blocks for the synthesis of other fatty acids (for example, LA is converted to arachidonic acid (AA)). (Lunn and Theobald, 2006). Essential fatty acids have capacity to react with oxygen and this is enhanced by absorption of sunlight radiation which makes them extremely active chemically (Frančáková *et al*., 2015).

Essential fatty acids (EFA) have gained attention recently as functional foods and nutraceuticals. Due to their strong antiatherogenic, antithrombotic, anti-inflammatory, antiarrhythmitic, and hypolipidemic effects, numerous studies have shown their important roles in a variety of biochemical pathways that result in cardioprotective impact (Orsavova *et al*., 2015).

4.0 Conclusion

The result of the research work showed that the qualities of oil extracted from *Trichosanthes cucumerina* seeds improves as it is processed from crude to bleached oils. The physicochemical properties and fatty acid composition of the oil suggest it for consumption rather than industrial application. Processing of the oil increase its iodine value, smoke point, flash point, fire point, saturated, unsaturated and total fatty acid composition while FFA, acid value (%), peroxide value and saponification value decreases. If the oil is further processed to the deodorisation stage, it will be of high quality and could supply essential fatty acid needed in the body when consumed. Further processing of the oil to deodorization stage is recommended and the deodorized oil obtained should be assessed for physicochemical properties and fatty acid composition.

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