



## Effect of Roasting On Some Physicochemical and Antimicrobial Properties of Cashew Nut (*Anacardium Occidentale*) Oil

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### ABSTRACT

Oil was extracted from raw and roasted cashew seeds (*Anacardium occidentale*) and subsequently analysed for physicochemical properties, fatty acid contents and antimicrobial activities against some microorganisms. The physicochemical properties with significant differences between oil from raw and roasted samples, respectively, include saponification value ( $201.96 \pm 0.00$  and  $171.10 \pm 0.00$  mg/g), iodine value ( $43.15 \pm 0.01$  and  $36.17 \pm 0.00$  mgKOH/g) and peroxide value ( $0.92 \pm 0.00$  and  $0.60 \pm 0.00$  mg/g). Unsaturated fatty acids dominate essential fatty acids and they constitute seventy percent of the total fatty acid present in the sample. Levels of fatty acids were not significantly different in both oils. The antimicrobial test revealed that the oil has antimicrobial activity against the growth of *E.coli*, *B.subtilis*, *B.cereus*, *C.albican*, *P. aeruginosa*, *P. syringe* and *X.anthropodes*. There was, however, no zone of inhibition in *E.coli* and *P. aeruginosa* for the oil from roasted seeds.

**Keywords:** *Cashew, Raw, Roasted, Oil, Physicochemical, Antimicrobial*

### 1. INTRODUCTION

Cashew is a tree in the family anacardiaceae. Its English name derives from the Portuguese name for the fruit of the cashew tree caju which in turn derives from the indigenous Tupi name, acaju originally native to Northeast Brazil; it is now widely grown in tropical climates for its cashew seeds and apples. The name *anacardium* refers to the shape of the fruits, which look like an inverted heart (ana means “upwards” and *cardium* means “heart”) In the Tupian languages acaju means “nut” that produces itself. (Achal, 2002).

Cashew consist of two parts, the cashew apples and cashew nut. Cashew nut is a high value edible nut. While the cashew nut oil is edible, another liquid, which is gummy in nature, found in the seed coat (or pericarp) called cashew nut shell liquid (CNSL) contains a high proportion of phenolic compound which is corrosive to the skin. The cashew apple is very sour and astringent until fully ripe, when it becomes edible. This can be made into various products such as juice, jam, syrup and beverages. (Winterhalter *et al* 1991)

Cashew is an excellent food source, the nut yields oil used in flavorings and cooking foods. The tree produces a sap or gum sometimes used in bookbinding and often in corporate into a varnish used to protect woodwork from insect damage. The cashew nut shell produces oil used in the manufacture of brake linings and is sometimes applied to metals as an anti-corrosive agent. The shell oil is also used for water proofing. Natives in South America used cashew nut shell oil in the treatment of scurry, sores, and ringworm. The oil is found to have potent antibacterial properties. Not many plants can claim to provide so many benefits. (Winterhalter and Dekker (1991).

Cashew provides essential fatty acids, B vitamins, fiber, protein, carbohydrate, potassium, iron and zinc. Like other nuts, cashews are high in saturated fat, however eaten in

small quantities cashew are a highly nutrients food consumption. (Achal, 2002).

Nuts and seeds are rich in unsaturated fat and other nutrients that may reduce inflammation. Frequent nut consumption is associated with lower risk of cardiovascular disease and diabetes. (Akash *et al*; 2009)

Unprocessed cashew nut oil is neutral and good for human health because it is rich in unsaturated fatty acids, (Abitogun and Borokini, 2009; Achal, 2002), however, cashew nut is usually consumed in the roasted form and it becomes quite important to determine the impact of roasting on its oil since literature information on this is scarce. The aim of this work therefore was to determine the fatty acid profile as well as the antimicrobial activities of the oil and the effects, if any, of roasting on these components/properties.

### 2. MATERIALS AND METHODS

#### 2.1 Materials

The cashew nuts were collected from Ada in Osun State, Nigeria and identified at Crop Soil and Pest Management laboratory of Federal University of Technology, Akure, Nigeria. The samples were air dried and the seeds were removed from the nut manually. Some of the seeds were roasted at a temperature of 92°C until it became brown while the remaining samples were analysed in the raw form. Both were ground into powder, stored in an air tight container and kept in the refrigerator at 4°C prior to analysis.

#### 2.2 Crude Fat Determination

Determination of crude fat by soxhlet extraction system. A previously dried filter paper was weighed as  $w_1$ . 3g of the sample was added into the filter paper weighed as  $w_2$ . This was tighten very well with white tread and transferred into a

thimble. A round bottom flask was filled with n-hexane, up to about  $\frac{2}{3}$  of 500ml flask. The soxhlet extractor was then fitted up with a reflux condenser and the heat source of the extractor was adjusted so that the solvent boils gently, and it was left to siphon for 8hrs, after paper were removed. The filter paper and defatted sample was dried in an oven at 105°C for about 30 minutes. The sample was allowed to cool down in desiccators and weighed as  $W_3$ . The percentage fat content was calculated as:

$$i. e \% \text{ fat content} = \frac{w_2 - w_3}{w_2 - w_1} \times 100$$

### 2.3 Determination of saponification value

2g of oil sample was weighed into a 250ml conical flask and to this was added 25ml of alcoholic potassium hydroxide solution. The flask with its content was heated on a boiling water bath for 30 minutes with occasional shaking. 1ml of phenolphthalein indicator was added to the solution and titrated while hot with 0.5M hydrochloric acid (aml). A blank titration was carried out which contained all the reagents without sample (bml).

$$\text{Saponification value} = \frac{(b - a)ml \times M \times 56}{\text{Weight of sample}}$$

Where  $a$  = titer value

$b$  = blank titer value

$M$  = molarity of acid used (A.O.A.C. 1990)

### 2.4 Determination of peroxide value

This analysis was carried out in the dark 1g of oil sample was weighed into a clean, dry boiling tube and 20ml solvent mixture (acetic acid + diethyl ether) were added into the tube boiled for 60 seconds. The content was poured into the titration flask containing 20ml of 5% potassium iodide. The contents were therefore titrated with 0.002M sodium thiosulphate using starch indicator and a milky color mark the end point. A blank was also carried out. (A.O.A.C, 1990).

$$\text{Peroxide value} = \frac{(v_1 - v_2)ml \times M \times 1000}{\text{Weight of sample}}$$

Where  $v_1$  = titre value for the blank

$v_2$  = titre value for the sample

$M$  = Morality of sodium thiosulphate.

### 2.5 Determination of iodine value

About 0.2g of oil sample was accurately weighed on small aluminium foil and this was dropped into a dry 250ml conical flask, 10ml of carbon tetrachloride ( $\text{CCl}_4$ ) was added with dry measuring cylinder and the flask was shaken to dissolve the oil. An aliquot of 20ml of Wij's solution was pipette into the flask in a fume cupboard and stoppered with moistened

cotton wool dipped in potassium iodide (KI) solution. The flask was allowed to stand for 30 minutes in the dark. A blank was prepared which contained all the reagents without the sample. The iodine liberated was back titrated with 0.1M sodium thiosulphate using starch solution as indicator. The blue black coloration disappeared to colourless and the titre value was recorded. The blank titration was equally carried out.

$$\text{Iodine value} = \frac{(b - a) \times 12.69 \times M}{\text{Weight of sample}}$$

$a$  = Titre value of the sample

$b$  = Titre value of the blank

$M$  = Molarity of  $\text{Na}_2\text{S}_2\text{O}_6$  i.e. 0.1M

12.69 = Molecular weight of Iodine.( A.O.A.C.1990)

### 2.6 Determination of acid value

About 5g of oil sample was weighed into conical flask. 25ml of 95% {v/v} alcohol was added and 1ml of phenolphthalein indicator. The solution was titrated with 0.1M potassium hydroxide until the colour changed to pink.( A.O.A.C, 1990).

$$\text{Acid value} = \frac{V \times M \times 56}{\text{Weight of sample}}$$

Where  $V$  = Titre value

$M$  = morality of potassium hydroxide used.

### 2.7 Determination of Free Fatty Acid (FFA)

1g of oil was dissolved in 20ml of petroleum ether inside 250ml conical flask and this was titrated with 0.1M sodium hydroxide (NaOH) using phenolphthalein as indicator; the colour changed to pink. Result obtained for free fatty acid was expressed as the acid degree value (ADV) (sometimes as percentage of oleic acid). Since the ADV is defined as the number of milliliter of 1M bases required to titrate 100g of fat. The titration figure (expressed as milliliter of 0.1M alkali) is 0.282. It is calculated thus:

$$\frac{0.282 \times \text{titre value}}{\text{Weight of sample}}$$

Where 0.282 is the oleic acid value.

The acid value can also use to determine the free fatty acid (A.O.A.C.1990)

Free fatty acid (FFA) x 2 = Acid value

### 2.8 Determination of Unsaponifiable matter

1ml of KOH solution was added to the titrated (neutralized) liquid in the sample flask from the earlier saponification

value analysis in order to make it alkaline again. This alkalized solution was then transferred to a separating funnel and washed once with distilled water. It was then extracted 3 times with 100ml distilled water and filtered. The residue was then oven-dried to a constant weight at 80°C for about 3 hrs.

$$\% \text{ Unsaponification matter} = \frac{w_f \times 100}{w_i}$$

Where,  $w_f$  = weight of washed, oven – dried residue (A.O.A.C.1990)

$w_i$  = weight of oil taken for the determination of saponification value.

## 2.9 Determination of specific gravity

This is the ratio of the weight of the oil sample in gram to that of equal volume of water at a specific temperature. It is also known as the relative density determination of oil or fat and it is usually measured at 20°C when the fat is liquid, but when the fat is not liquid at that temperature, it is measured at 40°C or 60°C. The oil sample was melted. A dried specific gravity bottle was weighed ( $W_1$ ), filled with distilled water to the brine and weighed ( $W_2$ ). The specific gravity bottle was emptied, dried, and filled with the oil to the brine and weighed ( $W_3$ )

$$\text{Specific gravity} = \frac{w_3 - w_1}{w_2 - w_1}$$

Where  $w_1$  = weight of specific gravity bottle

$w_2$  = weight of specific gravity bottle + water

$w_3$  = weight of density bottle + oil

## 2.10 Determination of refractive index

The refractive index of the oil sample was determined on an acetone cleaned surface called Abbey refractometer. The prism of the refractometer was wiped with tissue paper, moistened with ethanol to remove dirt, oil or greases. A drop of the oil sample was placed on the surface of the prism and clamped, the telescope was viewed and the control knob adjusted so that the coincidence of the dark part was indicated in the cross wire. The refractive index was read directly from the calibrated scale observed through the telescope. The prism was cleaned after this and the values obtained for both samples were recorded respectively (AOAC, 1990).

## 2.11 Determination of Viscosity

The oil of the sample was filled into the upper glass bulb of a jackets viscometer, whose temperature was maintained at 40°C, to the upper calibration mark with the aid of syringe and needle. The device was stoppered with a rubber bung at the near lower bulb to prevent the flow until the upper bulb was filled to the mark. After noting the temperature, the rubber bung was removed and a stopwatch was started simultaneously. The time, in seconds, required for the volume of liquid between the upper and lower calibration marks to

drain from the upper bulb into the lower bulb was measured. The time elapsed was used in conjunction with the formula (as shown below) supplied by the manufacturer of the viscometer bulb to determine the viscosity in centipoises.

$$\text{Viscosity} = \frac{\text{flow time (min)} \times \text{oil relative density} \times 1.002}{17.186}$$

## 2.12 Fatty acid analysis

Fatty acid composition of raw and roasted cashew seeds respectively was determined using their methyl esters on a gas chromatograph (Hewlett Packard 6890 powdered with HP chemstation Rev.A 09.01 [1206] with 30m long HP-IN Nowax (cross-linked PEG) type column, while a flame ionization detector was used as detector while nitrogen was used as the carrier gas. The injection and detection temperature were 250°C α 350°C respectively. The inside diameter of the column was 0.2mm and film thickness was 0.5 μm.

## 2.13 Inhibitory test (using the agar diffusion method)

The microorganisms of choice used for the investigation are *E. coli*, *P. syringae*, *Xanthomonas*, *P. aeruginosa*, *B. subtilis*, *B. cereus* and *C. albican*.

The isolates were separately cultured over each nutrient agar (NA) plates. Sterile cup borer of 8mm diameter was used to make wells on the solidified agar into which about 0.05ml of each of the oil were aseptically introduced. The plates were incubated at 37°C for 24hrs. Zones of inhibition around the wells were measured by the use of vernier calipers. Results were quoted as the radii (mm) of the zones of inhibition around that well. Controls plates were also set up using standard antibiotics (streptomycin sulphate). Olurinola, (1996).

## 3. Results and discussions

The physicochemical properties of the cashew seed oil are presented on Table 4.1. The yellowish in colour oil had specific gravity ( $\text{g}/\text{dm}^3$ ) of  $0.87 \pm 0.00$  for raw and  $0.86 \pm 0.00$  for the roasted with refractive index of ( $1.46 \pm 0.00$  and  $1.46 \pm 0.00$ ) respectively for raw and roasted samples, these values are very similar to the specific gravity (0.692) and refractive index (1.458) reported for cashew nut by Akinhanmi *et al* (2008).

**Table 4.1: Physicochemical Parameter of the Extracted Oil for both Raw and Roasted Cashew Seeds.**

Parameter	Raw	Roasted
Refractive index (32°C)	1.46±0.00	1.46±0.00
Specific gravity (g/dm <sup>3</sup> )	0.86±0.01	0.87±0.01
Viscosity (pal/sec)	50.28±0.00	48.12±0.01
Acid value (mg/g)	1.68±0.00	1.29±0.00
Free fatty acid (mg/g)	0.84±0.00	0.65±0.00
Saponification value (mg/g)	201.96±0.00	171.10±0.00
Unsaponifiable matter(mg/g)	1.64±0.01	1.42±0.00
Iodine value (mgKOH/g)	43.15±0.01	36.17±0.00
Peroxide value (mg/g)	0.92±0.00	0.60±0.00

The refractive index obtained for both raw and roasted respectively is in close agreement with (1.449) reported for groundnut oil by Atasi *et al*; (2009). And for cashewnut in an earlier study (Amoo, 2005).

The acid values obtained in this research were 1.68± 0.00 and 1.29 ± 0.00 for raw and roasted respectively. These values are much lower than 10.7 reported for raw cashew by Akinhanmi, (2008). The reason for this is not clear, however, a good observation is the relative reduction in acid value as a result of roasting.

Roasting also significantly lowered the saponification values from 201.96 ± 0.00 mg KOH/g to 171.10 ± 0.00 mg KOH. Aremu *et al*; (2006) obtained a value of 168.3 for raw cashew nut and Akinhanmi, (2008) obtained 137mg KOH/g. These results were lower than the result obtained in this study. The 243.2 ± 0.02 reported for cashew nut by Amoo, (2005) is higher than that reported in this research. These variations may be due to the sample source.

The low saponification value and acid value also indicates that it may not be suitable for soap making but very good nutritionally. The iodine value was also reduced by roasting, from 43.15 ± 0.00 mg/g to 36.17 ± 0.00 mg/g. The iodine value reported for raw cashew seed oil was, however, is in close agreement with values of 44.4 mg/g and 41.3 mg/g reported for cashew oil by Aremu *et al*; (2007) and Akinhanmi, (2008).

The fatty acid composition of raw and roasted cashew seed oil is presented in Table 4.2. The caprylic acid, lauric acid, myristic acid, arachidonic acid and lignoceric acid were not detected in both raw and roasted cashew seed, while magaric acid and behenic have the values of (0.06 ± 0.00 and 0.07 ± 0.00) and (0.11 ± 0.005 and 0.11 ± 0.00) for raw and roasted cashew seed respectively. Linoleic acid has the highest value of 57.95 ± 0.00 in the raw and 58.12 ± 0.00 in the roasted for the fatty acid. Unsaturated fatty acid constitutes about seventy percent of the total fatty acids present in the cashew seed oil. This is also indicated by iodine value of (43.15 ± 0.00 mg/g and 36.17 ± 0.00 mg/g) for raw and roasted respectively.

**Table 4.2: Fatty Acid Composition (% Total Fatty Acid) For both Raw and Roasted Cashew Seeds**

Fatty acid	Raw	Roasted
Palmitic acid	15.10±0.01	14.40±0.00
Palmitolic acid	0.19±0.01	0.21±0.01
Margaric acid	0.06±0.00	0.07±0.00
Stearic acid	12.89±0.01	10.19±0.01
Oleic acid	13.06±0.01	16.41±0.01
Linoleic acid	57.95±0.01	58.12±0.01
Linolenic acid	0.46±0.01	0.33±0.00
Arachidic acid	0.17±0.00	0.16±0.01
Arachidonicacid	0.00±0.00	0.00±0.00
Behenic acid	0.11±0.01	0.11±0.00
Erucic acid	0.00±0.00	0.00±0.00
Lignoceric acid	0.00±0.00	0.00±0.00

Table 4.3 shows the inhibitory effect of microorganisms on both roasted and raw cashew seed oil. From the results, it could be seen that there is higher zone of inhibition (no growth) in the raw cashew nut seed oil meaning that the oil sample had higher antimicrobial activity on the all tested microorganisms. In the case of roasted oil, there is no zone of inhibition in some tested organisms like E.coli and Xanthomomas, this may be due to the effect of heat which might have reduced the potency of some of the antimicrobial components of the oil from roasted seeds.

**Table 4.3 Inhibitory Effects Of Extracted Oil On Some Selected Micro-Organisms After 24hrs Incubation In (Mm)**

Microorganism	Raw	Roasted	(streptomycinsulphate) as standard
<i>B.subtilis</i>	4.80±0.4 3	1.85±0.0 3	8.90±0.3
<i>E. coli</i>	1.51±0.0 1	0.00±0.0 0	12.02±0.18
<i>C.albican</i>	3.56±0.1 3	2.22±0.2 0	7.15±0.12
<i>B. cereus</i>	3.50±0.0 2	1.21±0.0 1	11.03±0.20
<i>P.aeruginosa</i>	2.52±0.0 1	3.13±0.1 1	14.05±0.13
<i>P. syringine</i>	3.54±0.2 2	1.92±0.0 7	8.99±0.23
<i>X.oximopoides</i>	2.57±0.0 1	0.00±0.0 0	14.00±0.22

This result is in agreement with the result reported for Huracrepitans oil by Muhammed *et al*; (2013) and Agedah *et al*; (2010). Results of the antimicrobial activities of cashew nut oil indicate that the oil may be good for use as a preservative.

#### 4. CONCLUSION

Roasting did not have any significant effect on the fatty acid component of the oil, however a high content of Linoleic acid in both the raw and roasted seeds reveals that it would be very useful nutritionally, especially in the world of today where diets with high quantities of unsaturated fats are promoted to

reduce the increasing incidence of diet related ailments. In addition low saponification and acid values which were further reduced with roasting give more credit to the nutritional values of consuming roasted peanuts. Cashew nut oil had moderate antimicrobial activities, which were more pronounced in oil extracted from raw seeds than in the one from roasted seeds and suggests that the oil may be of good use as a preservative.

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