

## Effect of extraction temperature on the yield and physicochemical properties of cashew nut oil

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### Abstract

*Effect of Extraction temperature on the yield and Physicochemical Properties of Cashew nut oil were investigated using standard analytical methods. The oil was extracted using solvent extraction method at two different temperatures; the physicochemical properties and the oil yield were determined. The physical properties of the extracted oil at two temperatures 55°C and 65°C are as follows: specific gravity 0.93 and 0.9; refractive index 1.39 and 1.40; viscosity 6.93 and 6.57; smoke point 183.33 and 187.00 respectively. The chemical properties of the extracted oil at the two temperatures of 55°C and 65°C are as follows: Saponification value of 156.61 and 199.62; acid value of 12.53 and 14.40; iodine value (mg iodine/100g) of 55.23 and 52.36; peroxide value of 8.55 and 7.59 and free fatty acid (mg KOH/g) of 6.26 and 7.20 respectively. The oil yield for the extraction temperatures of 55°C and 65°C were 41.52% and 50.33% respectively. The result shows that oil yield increases with increase in extraction temperature; the refractive index and specific gravity were not significantly different.*

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### Introduction

Cashew tree (*Anacardium Occidentale*) originates from Brazil and the Lower Amazons. It has been introduced and is now a valuable cash crop in the Americas, the West Indies, Madagascar, India and Malaysia (Frankel, 1991). Cashew trees are mostly found in coastal areas but are now widely distributed throughout the tropics, particularly in many parts of Africa and Asia. Cashew tree will tolerate a wide range of condition including drought and poor soil, but cannot withstand cold frost.

Cashew nut is a high value edible nut which yields two "Oils" one of these found, between the seed coat (or pericarp) and the nuts, called the cashew nut shell Liquid (CNSL). It is not a triglyceride and contains a high proportion of phenolic compound. It is used in the industries as raw material for brake lining compounds, as a water proofing agent, a preservative in the manufacturing of paints and plastics. It is toxic and corrosive to the skin (Akinhanmi *et. al.*, 2008).

The Cashew nut oil and cashew nut shell liquid (CNSL) are very important. The extraction process has various effects on the quality and the quantity of the oil. There are various processes of extraction which include using stone wheels; the dehulled nuts are usually ground into a paste, which is then pressed to produce the oil (Afaf and Robert, 2009). Solvent or supercritical fluid extraction (SFE) can also extract the oil from the nut paste (Afaf and Robert, 2009). Manual extraction is conducted by applying gentle pressure (so that the temperature does

not exceed 30°C), producing a low yield of oil which is usually expensive (Afaf and Robert, 2009). Manually extracted oils have superior nutty flavor and fresh taste, and are often used in salad dressings and in the cooking of specialty dishes (Afaf and Robert, 2009).

### Materials and Methods

Cashew nuts used for this Study were obtained from Karshi market, Abuja. The seeds were cleaned, dried and milled. The soxhlet apparatus was set up. One hundred (100g) of the crushed sample was used for each temperature. The samples was placed in a filter paper and properly wrapped and inserted into the assembled soxhlet apparatus. The weight of the filter paper and sample was recorded. The solvent N-hexane of (2000ml) was measured using a measuring cylinder and then poured into a (500ml) round bottom flask which is the lower part of the soxhlet apparatus. This was then heated in a heating mantle at 55° C and 65° C for 6 hours. As the solvent boiled, it evaporated into the reflux condenser and this hot solvent was cooled by the surrounding water which flowed continually through soxhlet arrangement. The cooled solvent then condenses back into the portion of soxhlet containing the folded sample. This facilitates the extraction of oil from the samples. The oil that dropped into the round bottom flask was a combination of oil and solvent.

Extraction on each sample was replicated three times and the oil was recovered by the oil recovery method. The oil obtained was

heated at a temperature higher than the boiling point of the solvent until the solvent finally evaporated leaving behind the extracted oil. The procedure was carried out for all samples. The average oil yield on each sample was obtained. The percentage oil yield was calculated as follows;

% oil yield =

$$\frac{\text{Weight before extraction} - \text{weight of sample after extraction}}{\text{weight of sample before extraction}} \times 100$$

## Results

Results obtained from the experiment are presented in Tables 1 and 2 respectively.

Table 1: Physical Properties of Cashew Nut oil

Extraction Temperature (°C)	Oil-yield (%)	Specific Gravity	Refractive Index	Viscosity (mm <sup>2</sup> /s)	Smoke point (°C)
55	41.52±0.35 <sup>b</sup>	0.93±0.001 <sup>a</sup>	1.39±0.01 <sup>a</sup>	6.93±0.10 <sup>a</sup>	183.33±1.38 <sup>a</sup>
65	50.33±0.35 <sup>a</sup>	0.93±0.001 <sup>a</sup>	1.40±0.01 <sup>a</sup>	6.57±0.10 <sup>a</sup>	187.00±1.38 <sup>a</sup>

Mean ± standard error on the same column with different subscript is significantly different (p≤0.05)

Table 2: Chemical Properties of Cashew Nut oil

Extraction Temperature (°C)	Saponification Value (mg/g)	Peroxide Value (m/mol/kg)	Free Fatty Acid (mg/KOH/g)	Acid Value (mg/KOH/g)	Iodine Value (g/100g)
55	156.61±21.93 <sup>a</sup>	8.55±0.30 <sup>a</sup>	6.26±0.22 <sup>b</sup>	12.53±0.44 <sup>b</sup>	55.23±0.45 <sup>a</sup>
65	199.62±21.93 <sup>a</sup>	7.59±0.30 <sup>a</sup>	7.20±0.22 <sup>a</sup>	14.40±0.44 <sup>a</sup>	52.36±0.45 <sup>b</sup>

Mean ± standard error on the same column with different subscript is significantly different (p≤0.05)

## Discussion

### Physical Properties

Oil yield for cashew nut at extraction temperature of 55°C and 65°C were 41.52% and 50.33%. This result shows a significant difference as observed on the table. Oil yield is higher at 65°C and lower at 55°C, the oil yield is higher as the extraction temperature increases. The oil yield is similar to 40-49% reported by Ryan *et. al.*, 2006. Specific gravity for extraction temperature of 55°C and 65°C, were 0.93 and 0.93 which shows that there was no difference in the specific gravity of cashew oils extracted at 55°C and 65°C and it is less dense than water as reported by (Akinhanmi *et. al.*, (2008).

Refractive index for cashew nut oil extracted at 55°C and 65°C were 1.39 and 1.40 respectively. This result shows that there was no significant difference in the refractive index. Viscosity for cashew nut oil at extraction temperature of 55°C and 65°C are 6.93 and 6.57 respectively. Values were not significantly different as can be seen from the table. Smoke point for cashew nut oil at extraction temperature of 55°C and 65°C are 183.33°C and 187.00°C respectively and is in close relation with other cooking oils, coconut oil 177°C, olive oil (extra virgin)191°C, palm oil 235°C and groundnut oil 160°C.

### Chemical Properties

Saponification value for cashew oil at extraction temperature of 55°C and 65°C are 156.61mgKOH/g and 199.62mg/KOH/g respectively. The result shows that there was a significant difference in the two values. These values however differ from the saponification value of cashew nut oil of 137mg/KOH/g by Akinhanmi *et. al.*, (2008). This was lower than the values for some common oils like palm oil, 196-205mgKOH/g, groundnut oil 188-96mgKOH/g, corn oil 187-196mgKOH/g as reported by Cocks and Van Reed (1996), coconut oil 253mgKOH/g and palm kernel oil, 247mgKOH/g (Pearson, 1976). However this saponification value is within the same range of some edible oils reported by Eromosele *et. al* (1994). The low saponification value is an indication that the oil may not be suitable for soap making (Akinhanmi *et. al.*, 2008).

Peroxide value for cashew nut oil at extraction temperature of 55°C and 65°C are 8.55meq/kg and 7.59meq/kg respectively. This result shows that peroxide value decreases with increase in extraction temperature. The peroxide value does not differ significantly from the value of 7.73meq/kg by Abitogun and Borokini (2009). Peroxide value is a useful indicator

of the extent of oxidation of lipids, fats, and oil (Saadet *et al.*, 2012).

The free fatty acid value for the cashew nut oil at extraction temperature of 55°C and 65°C are 6.26 and 7.20 respectively. This result shows that the higher the extraction temperature the higher the free fatty acid value. The values however differ from the value of 4.52 by Abitogun and Borokini (2009). This might be due to environmental fat factors. The free fatty acid and acid value are confirmation of identity and edibility of the oil (Benerdini, 1973). The acid value for the cashew oil at extraction temperature of 55°C and 65°C are 12.53mgKOH/g and 14.40mgKOH/g respectively which is in line with 10.7mgKOH/g gotten from previous work by Akinhanmi *et al.*, (2008). This result shows that with increase in extraction temperature the acid value also increases.

The iodine value for the cashew oil at extraction temperature of 55°C and 65°C are 55.23mg/100g and 52.36mg/100g respectively. This result shows that with increase in extraction temperature, the iodine value decreases. The values are higher than the values of 41.3mg /100g by Akinhanmi *et al.*, (2008) and 37mg/100 by Abitogun and Borokini (2009). Oils are classified into drying, semi drying and non-drying according to their iodine values. Since the iodine value of cashew Nut oil is lower than 100 it could only be classified as a non-drying oil Akinhanmi *et al.*, (2008). The iodine value or iodine number of Oil is the measure of iodine in grams consumed by 100grams of the oil.

### Conclusions

From the results obtained from the experiments, the following conclusion can be deduced; The extraction temperatures of 55°C and 65°C had various effects on the oil yield and the physicochemical properties of the oil. The oil yield at 55°C and 65°C were 41.52% and 50.33% respectively showing a higher yield for a higher extraction temperature, the specific gravity for extraction temperature 55°C and 65°C were 0.93 and 0.93 showing no difference, the refractive index for extraction temperature 55°C and 65°C were 1.39 and 1.40. The viscosity for extraction temperature 55°C and 65°C were 6.93 and 6.57 which shows little difference, the saponification value for

the extraction temperature 55°C and 65°C were 156.61 and 199.62 which showed significant difference. The higher the extraction temperature the higher the yield, however solvent extracted oil is not safe for consumption because of possible contamination from the solvent.

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