World Journal of Research and Review (WJRR)
ISSN:2455-3956, Volume-6, Issue-2, February 2018 Pages 06-08

Analysis of The Physicochemical Properties of Carica Papaya, Citrus Paradisi and Croton Zambesicus Seed Oils and Their Applications

Akpe Michael Akomaye, Oyo-Ita Inyang E. , Dosunmu Miranda I

Abstract— **Oil was extracted from three Nigerian local plant seeds namely: Carica papaya, Citrus paradise and Croton zambesicus using n-hexane and their physicochemical properties determined. The result of the analysis showed thgeir percentage oil yield to be C. papaya (22.00), C. paradisi (28.00) and C. Zambesicus (27.00). The three seed oils were liquid at room temperature and their odour non-offensive. The specific gravities were 0.92 for C. papaya and C. Zambesicus, and 0.93 for C. paradise. The flash point in oC were C. papaya (148.00), C. paradise (256.00) and C. Zambesicus (242.00). The acid values were 4.20, 3.93 and 2.43 for C. papaya, C. paradisi and C. Zmbesicus respectively. The peroxide values were: C. papaya (1.66), C. paradisi (19.74) and C. Zambesicus (9.26). The saponification values were: C. papaya (234.22), C. paradise. (204.77) and C. Zambesicus (210.66). The iodine values were: C. papya (25.38), C. paradisi (16.12) and C. Zambesicus (52.03). These results suggest that the three seeds may be viable sources of oil based on their % yield. The studied properties of the oils in most cases compete favourable with Elais guinensis seed oil (PKO) which is presently used for many domestic and industrial purposes in Nigeria especially for the production of paints, cosmetics, soap, lubricants and varnishes.**

Index Terms— **Analysis, Physicochemical properties, papaya/paradisi/zambesicus, Seed oils.**

I. INTRODUCTION

Vegetable oils from plants like oil palm tree, groundnut, olive, beniseed (*Sesame*), Soya beans, coconut, castorseed, linseed etc. plays an important role in our diet as a source of fat and oil, a major class of food required for energy and warmth in the body[1].Some of these oils are used for cooking or are prepared and eaten in form of margarine while others are used for the production of commodities like soaps, cosmetics, paints and vanishes, lubricants and plastics [1] Also, some vegetable oils are now used as substitutes for petrol or diesel as fuel in automobiles in the form of biodiesel or bioethanol [2]. According to [3],sesame seed oil can be used to treat health problems like chronic constipation in elders and round worms in children, dysmenorrheal (painful menstruation in women) and amenorrhea, asthmatic symptoms, coughs and hiccoughs, and insufficient flow of breast milk in nursing mothers (by the oral intake of the oil up to two tea spoons at a time). Thus, the importance of vegetable oil to man cannot be over emphasized. However, it has been observed that the oil crops or plants mentioned above are a small percentage of the several hundred of plants in nature that have not been discovered. Even those discovered as oil seed crops, are underutilized because their oil properties have not been properly studied to ascertain their suitability for the production of many useful or valuable commodities. Therefore, this study is aimed at determining the physiochemical properties of oils extracted from *Carica papaya* (Pawpaw), *Citrus paradisi* (grape) and *Croton zambesicus* (thunder plant) which are seeds found locally in Obudu Local Government Area of Cross River State and in many other parts of Nigeria, with a view to ascertain their potentials as sources of vegetable oil for domestic and industrial uses. And also, to compare their properties with the established potentials of palm kernel oil from *Elaeis guinensis* (palm tree) nut oil.

Akpe Michael Akomaye, Department Of Pure And Appled Chemistry, Unversity Of Calabar, P.M.B 1115, Calabar Corss River State, Nigeria
Oyo-Ita Inyang E., Department Of Pure And Appled Chemistry, Unversity Of Calabar, P.M.B 1115, Calabar Corss River State, Nigeria
Dosunmu Miranda I, Department Of Pure And Appled Chemistry, Unversity Of Calabar, P.M.B 1115, Calabar Corss River State, Nigeria

II. MATERIALS AND METHODS

Sample Collection and Preparation**:** Viable and healthy seeds of *Carica papaya, Citrus paradisi* and *Croton zambesicus* were collected form bushes in Obudu town in Cross River State of Nigeria between January and March. They samples were taken to the Department of Botany, University of Calabar, Cross River State for identification of botanical names and labeling. They were now taken to the laboratory in Chemistry Department, University of Calabar where they were shelled or dehauled (where applicable), sun dried, wrapped in polyethene bags and kept in a dedicator and used within two months. The seed samples were ground or crushed into a paste using a manual grinding machine. 100g of the Paste of each sample was transferred into the thimble of a Soxhlet apparatus (extractor) and extracted using normal hexane as the extracting solvent. At the end of extraction for six hours, the extracting solvent was evaporated off leaving the oil samples for analysis. The percentage yield of the oil extract of each sample was calculated thus:

$$\% \text{ yield} = \frac{\text{weight of oil extract} \times 100\%}{\text{Weight of sample}}$$

Sample Analysis: The specific gravity of the oils was determined according to the method of [4] thus: 50ml pycometer bottle was washed with detergent and water, rinsed and dried. The bottle was filled with water (distilled water) and weighed. After drying the bottle of water, it was filled with the oil sample and weighed. The specific gravity was calculated thus:

$$\text{Specific gravity} = \frac{\text{weight of 50ml of oil}}{\text{Weight of 50ml of water}}$$

The flash point of oil samples was determined using the method of [4] thus: 10ml volume of the oil was poured into an evaporating dish placed on a kerosene stove. The thermometer was suspended at the centre of the dish ensuring that the bulb dips inside the oil without touching the bottom of the dish. The temperature of the oil was gradually raised using the stove. Immediately the oil began to give off a thin bluish smoke continuously (i.e smoke point) a flame was applied using a match-stick. The temperature at which the oil started flashing when the flame is applied without supporting combustion was noted as the flash point of the oil.

The acid value was determined using the method of [5] as reported by according to [4] thus: 1g of the oil was dissolved in a mixture obtained by mixing 25ml diethyl ether and 25ml ethanol, and titrated with 0.1M NaOH using phenolphthalein as indicator, shaking to a pink colour endpoint which persisted for about 15 seconds. The % free fatty acids were calculated using the acids values.

Acid value = Titre volume (ml) X 56. 1 XM / Weight of oil sample

Where M is the molarity of NaOH (0.1). Acid value is expressed in milliequivalent per kilogramme (mEqkg-1)

% free fatty acid = Acid Value / 2

The saponification value was determined using the method of [5] as described by [4] thus: 1 gram of the oil was weighed into a round bottom flask and 24ml of alcoholic potassium hydroxide solution was added. A reflux condenser was attached to the flask and heated on a sandbath for 1 hour shaking frequently. One ml of phenolphthalein (1%) solution was added and titrated while hot with 0.5M HCl to a colourless end point. A blank titration was also carried out the volume at end point recorded. The saponification value was calculated thus.

Saponification value = (Y-X) x 56.1m / Wegt. (g) of sample

Where X = volume (ml) of test solution titration
Y = volume (ml) of blank titration
M = Molarity of HCl (0.5)

The peroxide value was determined using the method of [5] as described by [6] thus: 1 ml of potassium iodide (KI) was added to 20ml of a solution of ml of (2:1) volumes of glacial acetic acid and chloroform. The result out solution was added to 1g of the oil sample in a clean dry conical flask. The mixture was left in a dark for about 2 minutes and 30ml of distilled water was added and titrated with 0.02M sodium thiosulphate solution using 5ml starch as indicator. A blank titration was also carried out. The peroxide value was calculated thus:

Peroxide value = (100M (Va-Vb). meqkg^{-1})/W
Where W = weight of oil sample
Va = volume in ml of thiosulphate used in test solution
Vb = volume in ml of thiosulphate used in blank solution
M = molarity of sodium thiosulphate (0.02).

The iodine value was determined using Wij's method as described by [4] thus: 0.5g of the oil samples were poured into a beaker and 10ml of carbon tetrachloride was added, 20 ml of Wij's solution was added and a stopper previously moisten with potassium iodide was inserted and allowed to stand in the dark for 30 minutes. 15ml of potassium iodide solution (10%) was added and titrated with 0.1M thiosulphate solution using starch as indicator. Ablank titration was also carried out. The iodine value was calculated thus:

Iodine value = (b-a) x 12.69M) / Wgt. (g) of sample

Where a = volume in ml of test titration
b = volume in ml of blank titration
M = molarity of thiosulphate (0.1)

RESULTS: These are presented in tables below.

Table 1a: Physical properties of Carica Papaya, citrus paradisi and croton zambesicus seed oils.

Seed oil	%Yield	Specific gravity	Flash point in °C	State at 25 °C (Room Temperature	Colour	Odour
Carica papaya	22.00± 0.1	0.92±0.01	148.00±2.00	Liquid	Yellow	Non-offensive
Citrus paradisi	28.0±.00	0.93±0.01	256.00±2.00	Liquid	Light brown	Non-offensive
Croton zambesicus	27.00±2.05	0.92±0.01	242.00±2.50	Liquid	Pale yellow	Non-offensive

(Values reported in mean ± SD format with N=3)

Table1b: Physical properties of Elaeis guinensis

Seed oil	% Yield	Specific aparity	State at 25°C(Room temp.)	Colour	Odour
Elaeis (PKO) guinensis	28.00±2.10	0.88±0.01	Semi-solid	Milky white	Non-offensive

Source: [6]

Table 2a: Chemical Properties of Carica Papaya, citrus Paradisi and croton zambesicus seed oils.

Seed oil	Acid Value in mEqKg -1	% Free Fatty Acid	Peroxide Value	Saponification Value	Iodine Value
Carica papaya	4.20.15	2. 10±0.03	1.66±0.02	234:22±3.50	25.38±1. 05
Citrus paradi si	3.93±0.11	1.97±0.13	17.74±0.41	204.77±3.10	16.12±2. 02
Croto n zambes icus	2.43±0.05	1.22±0.02	9.26±0.21	210.66±2.35	52.03±2. 02

(Values reported in mean ± SD format with N=3)

Table 2b: Chemical properties of Elaeis guineasis

Seed oil	Acid value mEgKg^{-1}	Free falty Acid	Peroxide value	Saponification Value	Iodine value
Elaeis guinensi s (PKO)	14.04±0.22	7.02±0.11	7.06±0.01	246.60±4.20	18.30±1.10

Source: [6]

III. DISCUSSION

The physical properties of seed oils are shown in Table 1a: all values are reported in the form mean + SD, with N = 3. The result of the analysis (Table 1) showed the mean% yield of the extracted oils

to be 22.00% for Carica papaya, 28.00% for Citrus paradisi and 27.00% for Croton zambesicus. The results show that oil yield followed by C. zambesicus while C. papaya has the least % oil yield. The results also reveal that the values of the % yield for C. paradise and C. zambesicus compete favourably with that of palm kernel oil (Elaeis guinensis), 28% reported by [6]in table 1b. The result shows that the three seed plants could be used as good sources of vegetable oil.

The flash point of Carica papaya oil is 148.00%, Citrus paradise (256.00) and Croton zambesicus (242.00). It is the temperature at which volatiles evolving from the heated oil will flash, but not supports combustion. It measures the thermal stability of the oil [4]. The result of analysis shows that the flash point of the oil from the samples is highest in Citrus paradisi (256) followed by Croton zambesicus (242) while Carica papaya oil has the least value of 148. Since the flash point of the oil is a measure of the thermal stability of the oil in question [4]. The result of the analysis reveal that C. paradisi has the highest thermal stability followed by C. zambesicus while C. papaya has the least stability following the trend; C. Paradisi > C. Zambesicus > C. Paradisi. The result also reveals that C. zambesicus and C. Paradisi are better frying oils compare to C. papaya oil due to their flash point values.

The specific gravity of oils were 0.92 for Carica papaya and Croton zambesicus and 0.93 from Citrus paradisi, all higher than 0.88 reported for Elaeis guinensis [6] All the oil samples are non-offensive in their odour. Carica papaya oil is yellow in colour, Citrus paradisi is lightbrown and Croton zambesicus is pale yellow. This makes the oils attractive and appealing.

The chemical properties of the studied seed oils are shown in table 2. It indicates that acid value of Carica papaya is 4.20, C. paradisi is 3.93 and C. zambesicus is 2.43. Also, the % free fatty acid is 2.10 for Carica papaya, 1.97 for C. paradisi and 1.22 for C. zambesicus. All the oils have acid values less than PKO with a value of 14.04 [6]. Acid value is an indicator for edibility of oil and suitability for use in the Paint industry. All the oils are edible going by their free fatty acid value of less than 3[7]. Carica papaya and C. paradisi compete favourably with sesame, soyabean, sunflower and rapeseed oils with acid value of 4 as reported by [8].

The peroxide value is used as an indicator for the deterioration oils. Fresh oils have values less than 10 meqkg-1 and rancid oils have values between 20 to 40 [4].The values for C. papaya is 1.66, C. paradise 17.74 and C. zambesicus is 9.26. Therefore, C. papaya and C. Zambesicus are fresh oils. C. paradisi is not very fresh going by its value of 17.74. Fresh C. papaya is less than 2.12 reported for PKO by Akubugwo and [6]while C. paradisi and C. zambesicus are higher. It is also an indicator for longer or shorter shelve-life during storage lower values indicates longer shelf life and vice versa.

The saponification value is an indication that they oils have potentials for use in the industry when the values are high [9]. The values were 234.22 for Carica papaya, 204.77 for C. paradisi and 210.66 for C. zampbesicus. These high values shows that all the oils studied have potential for industrial use. Carica papaya competes favourably with PKO with a value of 246.60 as reported by [6]. The saponification value of C. papaya is higher than 154.70 reported by [10]. in Malaysia. This difference could be due to climate difference or variety difference.

Iodine value of the oils were: 25.38 for C. papaya, 16.12 for C. paradisi and 52.o3 for C. zambesicus. These values classify the oils as non drying oils. This non-drying character qualifies them for use in the paint industry [11]. It is also a parameter for assessing the ability of oil to go rancid [12]

Thus, storage procedure of these oils should ensure protection from oxidative deterioration as they contain appreciable level of unsaturated bonds by their iodine values. However, the oils compete favourabley with PKO which is also a non drying oil with iodine value of 18.30 as reported by [6]. One can therefore recommend them for soap paint or cosmetics production among other uses.

IV. CONCLUSION

Based on the percentage yield of the extractable oil, the three seeds can be classified as high yielding. Most of the physiochemical properties of the seed oils studied compete favourably with palm kernel oil (PKO) and conventional seed oils like groundnut oil, soya bean, sunflower, rapeseed etc. Their colours are bright and attractive and their odours are non-offensive. The seed oils therefore have potential for development and use for domestic and industrial purposes.

REFERENCES

[1] Unilever Limited (1968). Vegetable oil and fats. A Unilever educational booklet; Revised ordinary series, 2:1-5

[2] Ekpa, O. D (2008): Entrepreneurial Chemistry: A Chemist's approach to wealth creation in a depressed Economy. 43rd Inaugural lecture University of Calabar, Calabar.

[3] Ihesie, G. (2008). Medicinal Uses of Sesame oil. Saturday Vanguard, November, 29, 44-45.

[4] Onwuka, G.A. (2005). Food Analysis and instrumentation; Theory and practice. Napthali Prints, Lagos, Nigeria.

[5] AOAC (1984). Official Methods of Analysis: 4th ed. Association of Official analytical chemists; V.A. Arlington.

[6] Akubuguo, I. E and Ugbogu, A.E (2007). Physiochemical studies on oils from five selected Nigerian plant seeds. Pakistan Journal of Nutrituon 6(1): 75-78.

[7] Eckey, E.W (1954). Vegetable fats and oils; Reinhold: New York

[8] Pearson, D. (1976). The Chemical Analysis of food. Churchill, Livingstone. Puangsri, T., Abdulkarim, S.M. and Ghazali, H. M. (2004). Properties of Carica papaya. (Papaya) seed oil following extractions. Using solvent and aqueous Enzymatic methods. Journal of food lipids. http://www. Interscience Wiley. Com/journal/118663914/abstract.

[9] Amoo, I. a Eleyinmi, A.F., Oilelaboye, N. A and Akoja, S.S. (2004). Characteristics of Oil extract from gourd (Cucurbita Maxima) Seed; food, Agriculture and Environment; 2:38-39

[10] Puangsri, T., Abdulkarim, S.M. and Ghazali, H. M. (2004). Properties of Carica Papaya L. (Papaya) seed oil following extractions. Using solvent and aqueous Enzymatic methods. Journal of food lipids. http://www. Interscience Wiley. Com/journal/118663914/abstract.

[11] Dosunmu, M.J. and Ochuo, C. (1995). Physiochemical properties and fatty acid composition of lipids extracted from some Nigeria fruits and seeds. Global J. Pure and applied Sci; 1:45-47.

[12] Eka, O. U (1980). Proximate Composition of Bush Mango tree and some properties of Dika fat. Nig. J. Nutri. Sci. 1:33-36