Physico-Chemical Properties and Level of Some Selected Metals in Oil of Pawpaw (Carica papaya L.) Seeds

Williams, O.D, Oladipo, G.O, Oduleye, O.S, Ogunyinka, O.O & Laniyan, A.B.
Department of Science Laboratory Technology
D.S. Adegbenro ICT Polytechnic
Itori, Ogun State, Nigeria
E-mail: walewilliams2005@yahoo.com
Phone: +2347039007215.

ABSTRACT

Oil was extracted from the seeds of pawpaw using the Soxhlet Extraction Method. The physico-chemical properties and level of some essential metals of the crude oil were determined using standard methods. The result of physico-chemical studies showed the percentage oil yield was 31.5% (w/w), saponification value (43.3 $mgKOH.g^{-1}$), acid value (0.55 $mgKOH.g^{-1}$), peroxide value (0.20 $meqkg^{-1}$), iodine value (70.54 $g100g^{-1}$), and free fatty acid (2.73%). The level of essential metals of the oil after wet digestion are: Calcium (68.42 $mgkg^{-1}$), Magnesium (1153.7 $mgkg^{-1}$), Phosphorous (5244.2 $mgkg^{-1}$), Potassium (1701.2 $mgkg^{-1}$), and Sodium (535.5 $mgkg^{-1}$). The data obtained for the analytical indexes are in agreement with those of other edible oils. Therefore, the potential utilization of pawpaw seed oil for edible oil production as well as dietary component may seem favourable.

Keywords: Carica papaya, Physico-chemical properties, Essential metals, Edible oil

iSTEAMS Proceedings Reference Format
Williams, O.D, Oladipo, G.O, Oduleye, O.S, Ogunyinka, O.O & Laniyan, A.B. (2019): Physico-Chemical Properties and Level of Some Selected Metals in Oil of Pawpaw (Carica papaya L.) Seeds. Proceedings of the 17th iSTEAMS Multidisciplinary Research Conference, D.S. Adegbenro ICT Polytechnic, Itori-Ewekoro, Ogun State, Nigeria, 21st – 23rd July, 2019. Pp 295-300. www.isteams.net - DOI Affix - https://doi.org/ 10.22624/AIMS/iSTEAMS-2019/V17N1P29

1. BACKGROUND

Edible oils had made an important contribution to the diet of people in many countries of the world serving as a good source of protein, lipid, and fatty acids for human nutrition including repair of worn out tissues and new cells formation as well as a useful source of energy (Atasie et al., 2009). They provide characteristic flavours and textures to foods as integral diet components (Odoemelam, 2005) and can also serve as a source of oleochemicals (Morrison et al., 1995). Oleochemicals are completely biodegradable (Kifli and Ahmad, 1986) and so could replace a number of petrochemicals. The human body uses oils and fats in the diet for three purposes, such as being an energy source, being a structural component, and making powerful biological regulators (Bereket and Alamayehu, 2016). The words oils, fats, and lipids are all used to refer to fat; oils are usually used to refer to fats that are liquids at room temperature, while fats are usually used to refer to that which are solid at normal temperature. Lipids are used to refer to both liquids and solids fats (Anthea et al., 1993).

Papaya (Carica papaya L.) is native of tropical America but has now spread all over the tropical world. The fruit is usually cylindrical, large (weighing 0.5-2.0 kg), and fleshy. The flesh is yellow-orange, soft, and juicy. The central cavity contains large quantities of seeds that comprise about 15% of the wet weight of the fruit (Desai and Wagh, 1995).The fleshy part of papaya is widely consumed as fruit, but the seeds are generally discarded. However, in order to make a more efficient use of the seeds and prevent environmental pollution, it is worth investigating the seeds as source of oil.

Thus, this research study is aimed at investigating the physical, chemical, and essential minerals of papaya seed oil with the objective of evaluating the nutritive and industrial suitability.

2. MATERIALS AND METHODS

Sample Collection

Ripe pawpaw fruits were obtained from a local farm in Afowowa Sogaade Village, Itori, Ogun State Nigeria. The seeds were manually removed from the fruits, lightly washed with distilled water, and dried at room temperature for approximately two weeks. They were subsequently ground into fine powder, packed in black polyethylene bag and stored at room temperature until use.

Chemicals and Reagents

All chemicals and reagents used were of analytical grade. Distilled water was used for preparation and dilutions of standard solutions.

Oil Extraction

Oil extraction was carried out by Soxhlet method according to Pearson's (1981). 5gram of the powdered sample was weighed into the thimble which was then placed into the soxhlet extractor. 100ml of petroleum ether was added into the flask and allowed to extract for 6hrs. The flask was then disconnected and put in the hot oven at 80-100^{0}C to evaporate the ether. After drying, it was cooled in a desiccator and weighed.

Calculation:

$$\% \text{ Oil or Fat} = \frac{\text{Wt. of flask + Oil} - \text{Wt. of dry flask}}{\text{Wt. of Sample}} \times 100$$

Chemical Analysis

Determination of Saponification Value

The saponification value was determined according to the titrimetric method of Pearson (1981). 2g of the sample was added to the 25ml of ethanolic potassium hydroxide in 500ml round bottom flask. The flask with its content was refluxed for 30 minutes. 1ml of phenolphthalein indicator was added and the hot solution was allowed to cool and later titrated against the 0.5N hydrochloric acid. A blank titration was carried out using the same procedure. The value was estimated by the formula:

$$\text{Saponification value} = \frac{56.1 \times N \times (b - a)}{W},$$

Where: N = molarity of hydrochloric acid, b = blank titre value, a = is sample titre value, W = weight of oil sample (2g), 56.1 = Equivalent weight of potassium hydroxide.

Determination of Peroxide Value

Peroxide value was evaluated according to AOAC (2006). 2g of the oil sample was weighed into the 200ml conical flask containing 20ml of petroleum ether and heated for 30 seconds in a water bath. 20ml of 50% aqueous solution of potassium iodide and 25ml of distilled water were added. The resulting mixture was titrated with 0.002N sodium thiosulphate solution using starch indicator. A blank was prepared along the oil sample.

The peroxide value of the sample was estimated on the basis of the equation below.

$$\text{Peroxide value} = \frac{2 \times (V_2 - V_1)\ \text{mEq/kg}}{\text{Weight of oil sample (g)}}$$

Where: V_2 = Blank titre value, V_1 = Sample titre value

Determination of Acid Value

Acid value was determined by the titrimetric method of Perason (1970). 5g of the oil sample was weighed into a 250 ml conical flask. 75 ml of hot neutralized alcohol was measured into the flask. The content in the flask was boiled on a water bath, after which 5 drops of phenolphthalein indicator was added into the content of the flask. The mixture was then titrated with 0.1M potassium hydroxide using a burette until a pink colour was observed, indicating the end point.

$$\text{Acid value} = \frac{56.1 \times N \times (V_1 - V_2)}{W}$$

Where V_1 = Sample titre value, V_2 = Blank titre value, N = Normality of potassium hydroxide, 56.1 = Equivalent weight of potassium hydroxide, W = Weight of sample (g).

Determination of Free fatty acid

Free fatty acid was estimated using the formula:
Free Fatty Acid (%) = Acid Value/ 2 x 100

Determination of Iodine Value

Iodine value was determined according to the titrimetric method of Pearson (1970). 0.2g of the sample was transferred into a flask containing 10ml carbon tetrachloride. 25ml of Hanus solution was added into the flask containing the sample (Hanus solution consists of iodine bromide). Blank was prepared. The mixture was stored in a dark place for 30 minutes at temperature of 25°C after which 15ml of 10% potassium iodide solution was added along with 100ml of distilled water. The resulting mixture was titrated with 0.1M sodium thiosulphate solution using 2ml of 1% starch indicator. The titration was continued until the blue colour just disappeared, indicating the end point. The iodine value was calculated on the basis of the following equation:

$$\text{Iodine value (g/100g)} = \frac{(V_2 - V_1) \times 1.269 \times 100}{\text{Weight of sample (g)}}$$

Where, V_2 = titre value for blank, V_1 = titre value for sample.

Mineral Analysis

The mineral content namely: Calcium, Magnesium, Sodium and Potassium of the oil sample were determined by Atomic Absorption Spectrometry according to the method of the AOAC, (2000. 1.0 g of oil sample was first digested with 20 ml of acid mixture (650 ml Conc. HNO_3, 80 ml Perchloric acid, 20 ml H_2SO_4) by weighing the sample into a digestion flask followed by addition of the 20 ml acid mixture. The digestion flask containing the sample and the digestion acid mixture was heated until a clear digest was obtained. The digest was later diluted with distilled water to 500 ml mark. After obtaining the digest, aliquots of the clear digest were used for atomic absorption spectrophotometry using filters that matched the different elements.

The concentration of Calcium, Magnesium, Sodium and Potassium were determined with their calibration curves prepared with their standard solutions. The percentage values were later calculated by multiplying the concentrations by 100.

Phosphorus content was determined by Molybdate Method AOAC, (2000). 0.5 ml of the mineral digest and 9.5 ml of 10 % trichloroacetic acid were put into a test tube. This was followed by agitation for 5 min. and then filtered through a filter paper. About 5 ml of the filtrate was then measured into a cuvet. Also, 5 ml of trichloroacetic acid and 5 ml of the working standard were also measured into two cuvets which served as a blank and standard, respectively. About 0.5 ml of molybdate reagent was then added to each test tube and mixed. Similarly, 0.2 ml of sulphuric acid reagent was added and the contents were stoppered, mixed and allowed to stand for 10 min. The absorbance of the test sample and standard were read in a Spectrophotometer at 660 nm with the blank set at zero. The % Phosphorus (P) was then calculated as follows:

Absorbance of test sample x Conc. of Standard (5 mg/dl) x100 Absorbance of Standard.

Table 1: Results of physico-chemical properties of papaya oil extract

Parameters	Values
Oil yield (%)	31.51±0.03
Colour	Golden yellow
Odour	Agreeable
State (at room temp.)	Liquid
Saponification value (mgKOH.g^{-1})	43.3±0.03
Peroxide value (mEq/kg)	0.20±0.02
Acid value (mgKOH.g^{-1})	0.55±0.01
Iodine value (g100g^{-1})	70.54±0.06
Free fatty acid (%)	2.73±0.02

Values are mean± standard deviations of triplicate determinations

Table 2: Concentration of the selected essential minerals in the analysed papaya seed oil

Parameters	Values (mg/kg)
Ca	68.42±0.02
Mg	1153.7±0.04
P	5244.2±0.01
K	1701.2±0.03
Na	535.5±0.01

Values are mean± standard deviations of triplicate determinations.

3. RESULTS AND DISCUSSIONS

Edible oils now constitute a major component of our daily diet and its growth in the market is now considered on the basis of functionality, economy, and acceptability (Anyasor et al., 2009). Some selected results for the physico-chemical parameters of papaya seed oil as shown in Tale 1 are as follows: Saponification value 43.3 mgKOH.g^{-1}, peroxide value 0.20 mEq.kg^{-1}, acid value 0.55 mgKOH.g^{-1}, iodine value 70.54 g100g^{-1} and free fatty acid 2.73%. Saponification value is a measure of the average molecular weight of all the fatty acids present. The low saponification value indicates that the oil will not be too good for soap making. Detection of peroxide gives the initial evidence of instability and rancidity in unsaturated fats and oils. The low peroxide value is an indication that the oil is stable and will not too susceptible to rancidity (Nzikou et al., 2007). Acid value determination is often used as a general indication of the condition and edibility of the oil. The permissible level of acid value for all edible oils should be below 0.6mgKOH/g (measured in potassium hydroxide per gram) from FAO/WHO recommendation. The acid value was found to be within the acceptable limits. Iodine value is used to determine the degree of unsaturation in fatty acids. The fairly low iodine value indicates that the oil may not be too good for cooking (Bello, 2011). Free fatty acid (FFA) concentration of the oil was within the acceptable limits for edible oils (Balley, 1982). This is also recommended by the Codex Alimentarius (Codex Alimentarius Commission, 1993).
The results obtained from the investigated essential metals in the analyzed papaya oil samples, were acceptable to human consumption at nutritional and toxic levels.

4. CONCLUSION

The investigation of the papaya seed oil revealed that the oil had a relatively high yield, low acid value, low free fatty acids, low peroxide value and rich in essential metals which are in agreement with most conventional edible oils. Therefore, the potential utilization of the oil of papaya seeds for edible oil production as well as dietary component seems favourable. The utilization the seeds in this way may also be a good avenue of controlling the indiscriminate disposal in the environment.

Competing Interests
The authors declare that there are no competing interests regarding the publication of this paper.

Acknowledgment
The authors are grateful to the Management of D.S Adegbenro ICT Polytechnic, Itori, Ogun State, Nigeria, for providing their support to publish out this research work.

REFERENCES

1. Anthea, A. ,Hopkins J., McLaughlin C.W. 1993. Human Health and Biology, Prentice Hall, Englewood Cliffs, NJ, USA.
2. Anyasor, G.N., Ogunwenmo K.O., Oyelana O.A., Ajayi D. and Dgana J. 2009. Chemical Analyses of Groundnut (Arachis hypogaea) Oil. Pakistan Journal of Nutrition 8 (3): 269 – 272.
3. A.O.A.C, Official Method 920.160-Saponfication Number o fOils and Fats/IUPAC 2.202 I.S.I Hand Book of Food Analysis (Part XIII1984),A.O.A.C,17thedition,2000.
4. A.O.A.C, Official Method 965.33 Peroxide value in oils and fats/Pearson's composition and analysis of food,17th edition, pp. 641,2000.
5. Atasie, V.N., Akinhanmi, T.F. and Ojiodu, C.C. 2009. Proximate Analysis and Physico-chemical properties of groundnut (Arachis hypogea L). Pakistan Journal of Nutrition 8(2): 194-197.
6. Balley, A.E. 1982. Industrial Oil and Fat Product. 3rd Edn., John Wiley-Interscience Publishers, USA., pp:22-28.
7. Bello, I. 2011. Physico-chemical properties of some commercial groundnut oil products sold in Sokoto metropolis, northwest Nigeria
8. Bereket, T. and Alamayehu, A. 2016. Physico-chemical Characteristics and level of some selected metals in edible oils. Journal of Advances in Chemistry, Vol 2016, Article ID 3480329, 7 pages.
9. Claudia, M.D.S., Celeste, M.P.A., Juliana, M.F., Estela, R.Q. and Marcelle, M.M. (2014). Chemical characterization of the flour of peel and seed from two papaya cultivars. Food Science Technology (Campinas), 34:2.
10. Codex Alimentarius Commission. 1993. Graisses et huiles vegetales, division 11. Version Abregee FAO/WHO Codwx Stan. 20-1981, 23-1981.
11. Krishna, K. and Paridhavi, M. (2008). Review on nutritional, medicinal and pharmacological properties of papaya (Carica papaya Linn.). Natural Product Radiance, 7: 364-373.
12. Kifli, H. and S. Ahmad, (1986). Palm Oil Developments, 5: 14.
13. Morrison, W.H., Hamilton, R.J. and Kalu, C. 1995. Sunflowerseed Oil. In: R.J. Hamilton, (ed), Developments in Oils and Fats. Blackie Academic and Professional, Glasgow, pp: 132-152.
14. Nzikou, J.M., Mvoula-Tsieri L., Matos E. and Desobry S. 2007. Solanum nigrum L. seeds as an alternative source of edible lipids and nutriment in Congo Brazzaville. Journal of Applied Science 7 1107-1115.
15. Odoemelam, S.A. 2000. Chemical composition and functional properties of conophor nut (Tetracarpidium conophorum) flour. International Journal Food Science Technology, 38: 729-734.
16. Odoemelam, S. A. 2005. Functional properties of raw and heat processed jackfruit (Artocarpu heterophyllus) flour. Pakistan Journal Nutrition, 4(6): 366-370.
17. Oyoyede, O. I. 2005. Chemical profile of unripe pulp of Carica papaya. Pakistan Journal of Nutrition, 4(6): 379-381.
18. Pearson, D. 1970. The Chemical Analysis of Food, (6th ed.). J.A. Chrchill, London, pp: 510-515.
19. Pearson, D. 1981. The Chemical Analysis of Food, (8th ed.). J.A. Chrchill, London, pp: 535.
20. Shadi, S., Hamed, M., Chin, P. T. and Hasanah, M.G. 2013.Ultrasound-Assisted Extraction (UAE) and Solvent Extraction of Papaya Seed Oil: Yield, Fatty Acid Composition and Triacylglycerol Profile. Molecules, 18: 12474-12487.