OPEN ACCESS Journal of Applied Sciences

ISSN 1812-5654
DOI: 10.3923/jas.2019.

Short Communication
Comparative Study on Some Chemical Properties of the Oil and Copra of Two Coconut Species

[1]Ebhohon Shirley, [1]Obike Chiemeziem, [1]Nwuke Chinedu, [2]Nweje-Anyalowu Paul, [3]Eze-Steven Emeka, [1]Anumiri Chibuike, [1,2]Ejiofor Emmanuel and [1]Omeh Ndukaku

[1]Department of Biochemistry, College of Natural Sciences, Michael Okpara University of Agriculture, Umudike, Umuahia, Abia State, Nigeria
[2]Department of Biochemistry, Faculty of Science, Clifford University, Owerrinta, Abia State, Nigeria
[3]Department of Biochemistry, Enugu State University of Science and Technology, Enugu, Enugu State, Nigeria

Abstract

Background and Objective: Plant based oils play critical roles in human and animal nutrition, therefore making the search of plant oils with nutritional potentials unending. The study compared the chemical properties of two coconut species and characterized the fatty acid present in their oils. **Materials and Methods:** Oil extraction from dried coconut copra was obtained using soxhlet extractor and n-hexane as solvent. Phytochemical screening, proximate analysis of copra and physiochemical analysis of oil and all assays were carried out using standard protocol. The fatty acid composition of the oil was evaluated using gas chromatographic techniques. **Results:** Results showed that the copra of both species is rich in fat, carbohydrate and has high energy value. Phytochemical screening showed that phenols and saponins are more in tall, while alkaloids more in the short. Saponification value and free fatty acids values were high in the short. Fatty acid profiling showed the presence of caprylic (7.51, 6.17), capric (4.97, 4.71), lauric (50.37, 52.63), myristic (17.94, 19.65), palmitic (5.87, 8.96) and stearic (3.41, 7.82) acid in both oils (tall and short), respectively. **Conclusion:** From the findings of the study, it can be concluded that the coconut oil has nutritional potential and contains medium chain fatty acids, although more fatty acids were present in the tall specie.

Key words: Lauric acid, coconut oil, fatty acids, copra, phytochemical screening

Citation: Ebhohon Shirley, Obike Chiemeziem, Nwuke Chinedu, Nweje-Anyalowu Paul, Eze-Steven Emeka, Anumiri Chibuike, Ejiofor Emmanuel and Omeh Ndukaku, 2019. Comparative study on some chemical properties of the oil and copra of two coconut species. J. Applied Sci., 19:.

Corresponding Author: Ejiofor Emmanuel, Department of Biochemistry, College of Natural Sciences, Michael Okpara University of Agriculture, Umudike, Umuahia, Abia State, Nigeria Tel: (+234) 70 36250103

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Oils obtained from plants play important roles in biological system. They serve as precursors for many biological molecules such as; hormones, serve as energy sources, provide body insulation and are required for proper membrane development and functioning. Oils extracted from plants have been reported to have medicinal and nutritional properties. This however; has led to the unending search of plant based oils[1].

The coconut tree is one of the widely cultivated trees in the world because of the many products and by-products that can be obtained during harvest and processing. It belongs to the family Arecaceae and widely grown in the tropics[2]. The coconut tree exists in two varieties which include tall and short varieties[2]. In terms of distribution, 95% are the tall specie while around 5% are the short or dwarf specie. Major products obtained from the coconut tree include the coconut oil, copra, coconut oil cake, coconut, coconut milk, coconut flavour (widely used in food industries) and coconut proteins[3]. A review is critically summarized the medicinal properties of coconut plant and products which include antidote effect, antioxidant effects, electrolyte balance, cardioprotective effects, antibacterial effect, hypolipidemic effect, antiviral and anti-cancer effects[4].

The coconut oil is derived from the dried kernel or meat of coconut, also known as copra[5]. Chemically, coconut oil is majorly made up of lauric acid (47.5%), a low molecular weight saturated fatty acid known to be a better alternative to other saturated fats[6].

The coconut oil is rich in medium chain fatty acids, exhibits good digestibility, which promote its use nutritionally and has antioxidant activities[7]. The oil has been reported to have hepatoprotective properties[8] and effective to combat metabolic syndromes[9]. The copra obtained from the coconut is used as flavour sources, food or as condiments[10]. Generally, there is enormous knowledge about the tall coconut species especially on it fatty acids, phytochemical, proximate analysis of the copra, but little or less is known about the short specie of this plant. This however, has led to the present study, which tries to compare the nutritive profile of the copras and fatty acids profile of the oils obtained from both species.

MATERIALS AND METHODS

Location and time of study: The study was conducted in the Biochemistry Department, College of Natural Sciences, Michael Okpara University of Agriculture, Umudike, Umuahia Abia State, in the year 2018. Study lasted for 3 months (June-August).

Materials

Plant material sampling: The two-matured species of coconut were obtained from Ndoro Market, Ikwuano Local Government Area of Abia state, Nigeria. The coconuts were identified by Dr. Garuba Omosun of the Department of Plant Science and Biotechnology, College of Natural Sciences, Michael Okpara University of Agriculture, Umudike as *Cocos nucifera* (West Coast Tall and Chowghat Orange Dwarf).

Oil extraction: Coconut oil was extracted using soxhlet extractor in accordance with the method described already[11].

Proximate analysis: Proximate analysis (dry matter, moisture content, ash content, carbohydrates, energy value, crude protein and crude fibre) were determined by the method described by AOAC[12].

Phytochemical analysis: Phytochemicals quantified in the copra which includes saponins, tannins, alkaloids, flavonoids and phenol were carried out by the method described in previous study[13].

Chemical analysis: Saponification, free fatty acids and peroxide values were determined by using the method of AOAC[12]. The pH of the oils was determined by using a pH meter.

Fatty acid profiling of the oils: Fatty acid (FA) composition of the oils was determined as their corresponding methyl esters. Preparation of fatty acid methyl esters (FAMEs) done. Briefly, 0.2 g of test oil was dissolved in 10 mL of 0.2 mol L^{-1} H_2SO_4 prepared in 100 mL of methanol. Esterification was performed by refluxing for 30 min at 100°C in tightly sealed pyrex tubes. After cooling at room temperature, 10 mL of petroleum ether was added followed by 10 mL of deionized water, mixed gently and allowed to settle until the upper petroleum ether layer became clear. The distinct upper layer of methyl esters in petroleum ether were separated carefully in a capped vial and used for analysis. About 2 µL of the petroleum ether aliquots were injected into the chromatographic column of the gas chromatograph (GC) (Chemito 8610 HT India) and peaks were recorded for their respective retention times and areas by the data processor unit of the GC. Identification of each individual fatty acid ester was achieved by comparison with authentic reference standards (Merck, Fluka). The nitrogen carrier gas flow rate was 3 mb, hydrogen and air were 1mb, temperature of the oven was 190°C and injector 200°C. The recorder was a Chemito 5000 data processor.

Statistical analysis: Data obtained was statistically analysed by using student t- test at 95% confidence level using SPSS Ver. 22.

RESULTS

The results for proximate composition of the two-coconut species are presented in Table 1 . Result showed a significant ($p<0.05$) increase in dry matter, fat, energy value and crude fibre in the tall specie when compared to the short specie. Result for moisture content, ash and crude protein was significantly ($p<0.05$) higher in the short specie when compared to the tall specie. Result for carbohydrate showed no significant difference for both species.

Table 1: Showing composition (%) of proximate function of short and tall coconut species

Parameters (%)	Short	Tall
Dry matter	90.30±0.10*	93.09±0.17
Moisture content	9.61±0.02	7.01±0.01*
Ash	1.87±0.02	1.04±0.00*
Carbohydrate	28.28±1.51	26.28±0.31
Energy value	535.86±0.07*	568.19±1.18
Crude protein	12.65±0.00	10.87±0.01*
Crude Fibre	6.42±0.00*	8.15±0.30
Crude Fat	41.50±0.01	46.60±0.01*

Values reported as mean±SD of triplicate determinations, *significant difference

Table 2: Some phytochemical composition of short and tall coconut species

Parameters	Short	Tall
Saponins	0.05±0.01	0.06±0.00
Tannins	0.03±0.00	0.05±0.00
Alkaloids	0.13±0.05	0.08±0.00*
Flavonoids	0.24±0.02	0.26±0.01
Phenols	0.51±0.04*	0.65±0.00

Values reported as mean±SD of triplicate determinations, *significant difference

Results for phytochemical analysis are presented in Table 2. Phenols were significant ($p<0.05$) lower in the short specie when compared to the tall specie. Result for alkaloid was significantly ($p<0.05$) higher in the short specie when compared to the tall specie. Tannins, saponins and flavonoids showed no significant difference for both species.

Results for physicochemical parameters of oils are presented in Table 3. Peroxide value showed no significant difference. However, saponification value was significantly ($p<0.05$) higher in short than tall specie. Free fatty acid value was significantly ($p<0.05$) higher in short when compared to tall. Statistically, pH was significantly ($p<0.05$) lower in the short specie when compared to the tall specie, both oils were slightly acidic.

Table 3: Some chemical parameters of short and tall coconut species oil

Parameters	Short	Tall
Saponification value	271.33±1.15*	266.66±1.15
Free fatty acid	0.14±0.01	0.09±0.01*
Peroxide value	0.47±0.01	0.47±0.01
pH	4.20±0.01*	4.25±0.00

Values reported as mean±SD of triplicate determinations, *significant difference

Table 4: Composition (%) of fatty acids of short and tall coconut species oil

Fatty acid (%)	Short	Tall
Caprylic	6.17	7.51
Capric	4.71	4.97
Lauric	52.63	50.37
Myristic	19.65	17.94
Palmitic	8.96	5.87
Myristoleic	NP	0.61
Stearic	7.82	3.41
Palmitoleic	NP	0.56
Oleic	NP	8.71

NP: Not present

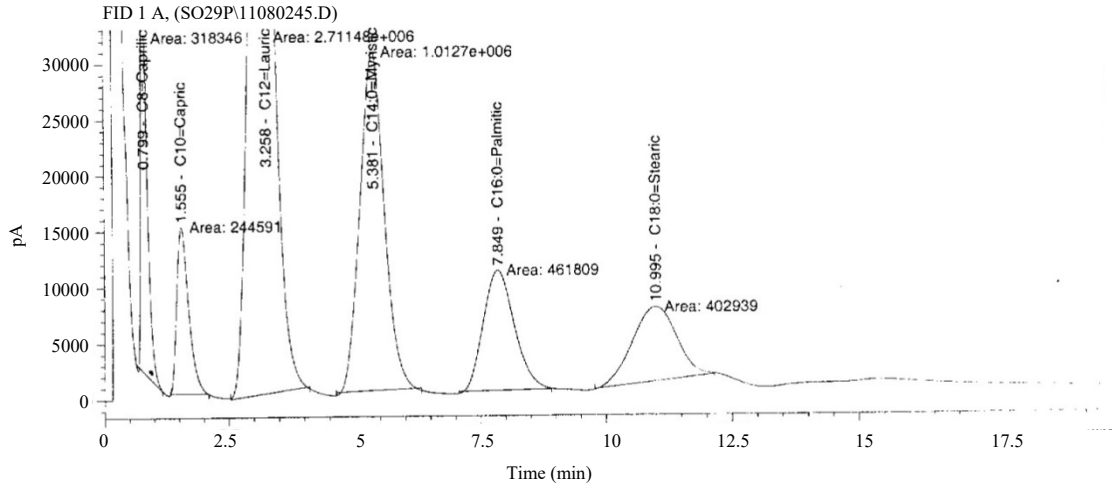

Fig. 1: Chromatogram of fatty acids present in the short specie oil

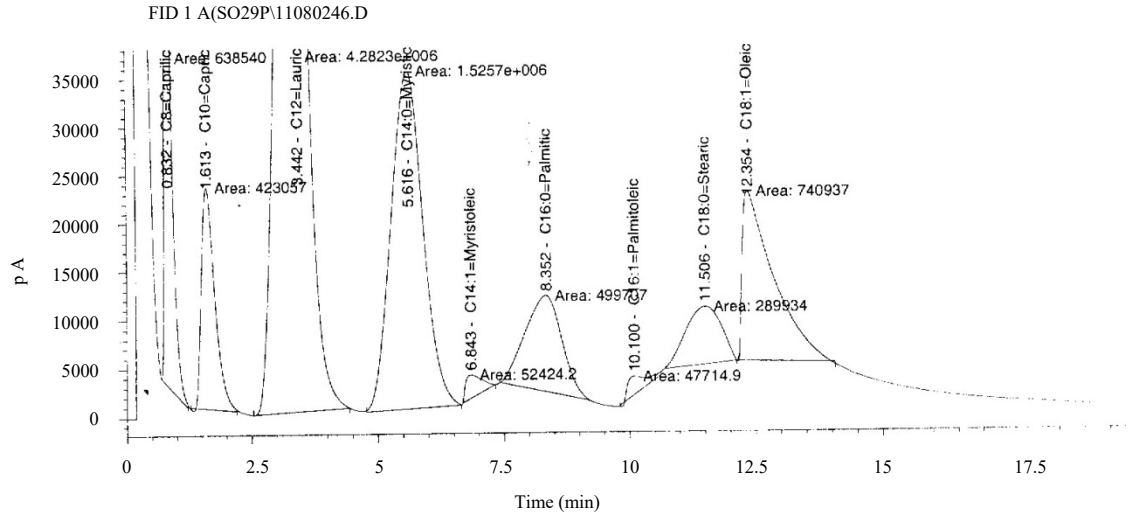

Fig. 2: Chromatogram of fatty acids present in tall specie oil

Results for fatty acid composition are presented in Table 4. Caprylic, capric, lauric, myristic, palmitic, stearic were present in both species. Myristoleic, palmitoleic and oleic acid were present in the tall specie and not in the short species.

The fatty acids present in the oil obtained from the short specie oil as shown by the chromatogram include caprylic, capric, lauric, myristic, palmitic and stearic fatty acid (Fig. 1). The highest concentration of fatty acid was that of lauric fatty acid, while capric fatty acid occurred least in the oil.

The fatty acids present in the oil obtained from the tall specie oil as shown by the chromatogram include caprylic, capric, lauric, myristic, palmitic, stearic, myristoleic, palmitoleic and oleic fatty acid (Fig. 2). The highest concentration of fatty acid was that of lauric fatty acid, while capric fatty acid occurred least in the oil.

DISCUSSION

Results for proximate composition showed that crude fibre, fat, dry matter and energy value were significantly ($p<0.05$) higher in the tall specie. However, moisture content, ash content, carbohydrates, crude protein were significantly ($p<0.05$) higher in short specie. This result corresponded with the findings for the tall species except for carbohydrate and oil value[11]. The decreased oil value in this study when compared to study can be attributed to different planting factors such as; weather, soil type and composition, location etc[11]. Furthermore, the proximate analysis of the copra indicated that the coconut species are good sources of energy. The low moisture content of the copra (9.61+0.02, 7.01+0.01) for short and tall, respectively, suggested the ability of the copra to withstand spoilage[14]. The high crude fibre content of the copra promoted the ability of the copra to play a role in digestion. The high crude fat content suggested that the plant serves as an oil bearing plant[15].

Results for quantification of phytocompounds presented in the copra showed that flavonoid was the highest phytocompound present in the copra in both species and this agreed with earlier report[16]. The presence of flavonoids and phenols in the copra were responsible for it antioxidant ability[17]. The results for phytochemical screening of the copra obtained from both species corresponded with the result already published[11]. Phytochemicals found in this plant are useful secondary metabolites that have therapeutic effects[16].

Physicochemical parameters of the oil showed that the oils were light yellow in colour and possessed roasted coconut smell. Saponification value of the short specie oil (271.33+1.15) was significantly ($p<0.05$) higher compared to tall specie (266.66+1.15) and this agreed with the previous findings[18]. High saponification value in the oil obtained from the short specie indicated that there is a greater percentage of short chain acids present in the oil. The pH value of both oils were slightly acidic. The peroxide value in the both oils from this study disagreed with the previous findings for coconut oil. Peroxide value is used to determine the extent of peroxidation in oil samples. The peroxide value obtained in this study showed that the oil samples of both species from the studied region were free from autoxidation and of high quality. Results for free fatty acids agreed with the findings of Ghosh *et al.*[11] for oil sample obtained from tall species.

The fatty acid profile of the studied oils showed 6 common fatty acids which are caprylic, capric, lauric, myristic, stearic and palmitic fatty acids having similar concentration in both oil. However, palmitoleic, oleic and myristoleic were also present in the oil obtained from the tall specie. The highest fatty acid in both oil samples was lauric fatty acid (52.63 and 50.37%) followed by myristic fatty acid (19.65 and 17.94%) respectively, for short and tall specie. This agreed with findings of a researcher who reported lauric and myristic fatty acids to be the two most prominent fatty acids in coconut oil[11]. This confirmed that coconut oil is a good source of medium chain fatty acids. The value obtained from lauric acid in this study disagreed with the findings of other authors who have worked on coconut oil from Nigeria. It was reported that the value of lauric acid in coconut[19] oil from Nigeria as 41%. This can be attributed to farming methods, location and soil properties as they are known to affect plant product and output. Lauric acid which is the major fatty acid present in the coconut oils and other fatty acids detected in this study has been reported to be beneficial health wise[20,21]. The research has demonstrated that coconut oil is rich in medium chain fatty acids and contains some unsaturated fats that are essential for life. The oils obtained from the two species may be useful in diet formulations considering it low acidic content and stability.

CONCLUSION

It can be concluded from this study that coconut oil obtained from both species are rich in medium chain fatty acids. Also, the proximate analysis showed that the copra can serve as a good source of food. Little differences existed between both species as shown by results obtained from this study, specifically the fatty acid profiling. The oil which contains (Saturated fats) may have significant application in baking industries.

SIGNIFICANCE STATEMENT

This study discovered the coconut oil contain medium chain fatty acids majorly. However, the tall species contain more fatty acids compared to the short specie. Also, the presence of some unsaturated fats in the oil is beneficial to humans and presence of saturated fats can be useful in baking and food industries. Proximate analysis of the copra enhanced the use of the copra as food source. This study will help the researchers in plant and food science to uncover that some fatty acids exist in the oils obtained from different coconut species. Thus, it is certain that specie difference can affect the type and quantity of plant produce.

REFERENCES

1. Kyari, M.Z., 2008. Extraction and characterization of seed oils. Int. Agrophys., 22: 139-142.
2. Mannekote, J.K. and S.V. Kailas, 2011. Experimental investigation of coconut and palm oils as lubricants in four-stroke engine. Tribol. Online, 6: 76-82.
3. Onifade, A.K. and Y.A. Jeff-Agboola, 2003. Effect of fungal infection on proximate nutrient composition of coconut (*Cocos nucifera* Linn) fruit. Food Agric. Environ., 1: 141-142.
4. DebMandal, M. and S. Mandal, 2011. Coconut (*Cocos nucifera* L.: Arecaceae): In health promotion and disease prevention. Asian Pac. J. Trop. Med., 4: 241-247.
5. Nevin, K.G. and T. Rajamohan, 2004. Beneficial effects of virgin coconut oil on lipid parameters and *in vitro* LDL oxidation. Clin. Biochem., 37: 830-835.
6. Feranil, A.B., P.L. Duazo, C.W. Kuzawa and L.S. Adair, 2011. Coconut oil is associated with a beneficial lipid profile in pre-menopausal women in the Philippines. Asian Pac. J. Clin. Nutr., 20: 190-195.
7. Che Man, Y.B. and M.A. Marina, 2006. Medium Chain Triacyclglycerols. In: Nutraceutical and Specialty Lipids and Their Co-Products, Shahidi, F. (Ed.)., Taylor and Francis Group, Boca Raton, pp: 27-56.
8. Zakaria, Z.A., M.S. Rofiee, M.N. Somchit, A. Zuraini and M.R. Sulaiman *et al*., 2011. Hepatoprotective activity of dried-and fermented-processed virgin coconut oil. Evidence-Based Complement. Altern. Med., Vol. 2011. 10.1155/2011/142739.
9. Nagao, K. and T. Yanagita, 2010. Medium-chain fatty acids: Functional lipids for the prevention and treatment of the metabolic syndrome. Pharmacol. Res., 61: 208-212.
10. Göhl, B., 1981. Oil-Bearing Seeds and Oil Cakes. In: Tropical Feeds: Feed Information Summaries and Nutritive Values, Göhl, B. (Ed.)., Food and Agricultural Organization of the United Nations, Rome, Italy, pp: 349-391.
11. Ghosh, P.K., P. Blatta charjee, S. Mitra and M. Poddar-Sarkar, 2014. Physicochemical and phytochemical analyses of copra and oil of *Cocos nucifera* L. (West Coast Tall variety). Int. J. Food Sci., Vol. 2014. 10.1155/2014/310852.
12. AOAC., 1990. Official Methods of Analysis. 15th Edn., Association of Official Analytical Chemists, Washington, DC., USA., Pages: 684.
13. Edeoga, H.O., D.E. Okwu and B.O. Mbaebie, 2005. Phytochemical constituents of some Nigerian medicinal plants. Afr. J. Biotechnol., 4: 685-688.
14. Ejikeme, P.M., L.N. Obasi and A.C.C. Egbuonu, 2010. Physicochemical and toxicological studies on *Afzelia africana* seed and oil. Afr. J. Biotechnol., 9: 1959-1963.
15. Shankar, P., S. Ahuja and A. Tracchio, 2014. Coconut oil: A review. Agro Food Ind. Hi Tech., 24: 62-64.

16. Lima, E.B.C., C.N.S. Sousa, L.N. Meneses, N.C. Ximenes and M.A. Santos, Jr. *et al*., 2015. *Cocos nucifera* (L.) (Arecaceae): A phytochemical and pharmacological review. Brazil. J. Med. Biol. Res., 48: 953-964.
17. Santos, J.L., V.S. Bispo, A.B. Filho, I.F. Pinto and L.S. Dantas, 2013. Evaluation of chemical constituents and antioxidant activity of coconut water (*Cocus nucifera* L.) and caffeic acid in cell culture. An. Acad. Bras. Cienc., 85: 1235-1247.
18. Ghani, N.A.A., A.A. Channip, P.C.H. Hwa, F. Ja'afar, H.M. Yasin and A. Usman, 2018. Physicochemical properties, antioxidant capacities and metal contents of virgin coconut oil produced by wet and dry processes. Food Sci. Nutr., 6: 1298-1306.
19. Odenigbo, U.M. and C.A.O. Otisi, 2011. Fatty acids and phytochemical contents of different coconut seed flesh in Nigeria. Int. J. Plant Physiol. Biochem., 3: 176-182.
20. Guerzoni, M.E., R. Lanciotti, L. Vannini, F. Galgano, F. Favati, F. Gardini and G. Suzzi, 2001. Variability of the lipolytic activity in *Yarrowia lipolytica* and its dependence on environmental conditions. Int. J. Food Microbiol., 69: 79-89.
21. Page, K.A., A. Williamson, N. Yu, E.C. McNay, J. Dzuira, R.J. McCrimmon and R.S. Sherwin, 2009. Medium-chain fatty acids improve cognitive function in intensively treated type 1 diabetic patients and support *in vitro* synaptic transmission during acute hypoglycemia. Diabetes, 58: 1237-1244.