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Research Article

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Fatty Acid Composition, Physico-Chemical and Antibacterial Activity of Oil Extracted from Monkey Cola (*Cola parchycarpa*)

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Abstract *Cola parchycarpa* (monkey cola) has been one of the underutilized Tropical plant in Tropical African sub regions. It is among some of the valuable fruit species whose potentials have not been fully realized. In recent times, work has been carried out on the proximate and phytochemical properties of the cola but no result on the activities or potency of the oil. The values obtained from the physical properties of the oil from *Cola parchycarpa* were: Refractive Index (1.5550±0.01), Specific gravity (0.9127±0.01), Viscosity (47.8236±0.02), Oil yield (11.5000±0.02) and the colour is deep yellow respectively. The chemical properties were Acid value (mg/g) (102.1020±0.01), free fatty acid (28.7928±0.01), Saponification value (mg/g) (152.5920±0.02), Iodine value (mg/g) (61.4196±0.01) and Peroxide value (mmol/kg) (46.4196±0.02) respectively. The Fatty acid composition of oil from the sample revealed Palmitic Acid (C16:0) (32.5410) as the highest saturated fatty acid present, Stearic Acid (C18:0) (2.6871), Myristic Acid (C14:0) (1.1902), Arachidic Acid (C20:0) (1.6281) had value greater than one while other saturated fatty acids present were less than one. Polyunsaturated fatty acid present were Linoleic Acid (C18:2) (17.1689), Linolenic Acid (C18:3) (2.0694) and Arachidonic acid (C20:4) (0.3722) respectively. The highest monounsaturated present were Oleic Acid (C18:1) (42.4471) while other values for monounsaturated present like Palmitoleic Acid (C16:1) and Erucic Acid (C22:1) were less than one. The antibacterial activity revealed that the oil from *Cola parchycarpa* was susceptible to *Escherichia* Coli (2.00 ± 0.01), *Staphylococcus aureus* (5.00 ± 0.02) (*Klebsiella pneumonia* (2.00± 0.01) and *Pseudomonas Spp* (1.00± 0.01) and resistant to *Proteus*. Though the cola is of low yield, but the oil had great health benefits and good industrial and pharmaceutical applications.

Keywords antibacterial activity, fatty acid, Monkey cola, physico-chemical, oil

Introduction

Tropical African sub regions are home to many valuable fruit species whose potentials have not been fully realized [1]. A good number of these fruit species are not yet domesticated. Anya [2] reported that the southeast Nigeria holds rich species diversity of the Cola group, and had been regarded as the primary centre of early domestication for the monkey kola species. *Cola parchycarpa K. Schum* (Malvaceae) is a perennial tree commonly described as monkey kola [3]. Monkey kola is a popular nomenclature for the lesser known members of the *Cola* species that yield edible tasty fruits [4]. They are a close relative to the familiar West African kola nuts (*C. nitida* and *C. acuminata*), cultivated for their masticatory and stimulating nuts. In southern Nigeria and the Cameron, the fruit pulp is eaten by humans as well as some wild primate animals especially monkeys, baboons and other species

[5]. Substantial quantities of produce (mainly the fruits, herbal medicine and lumber) of these species are still been gathered from forest reserves, community woodlands, and home gardens for direct consumption as well as for local markets by humans [1].

The regular cylindrical caulescent follicles of *C. Parchycarpa* consist of one to eight nuts which correspond to the fruit length. The follicles are beaked and ribbed with rough and light brown epicarp; seeds (greenish or reddish brown) are obliquely ovate with two flat rough surfaces. The whitish aril (waxy mesocarp) consist the sweet edible portion of the follicle as described by Naphohla Prints [6].

The identification, characterization, evaluation and domestication of various neglected and underutilized species (NUS) have been marked as necessary steps toward the conservation and preventing sustained exploitation as well as extinction of Tropical African rich plant genetic diversity [7]. African native fruits can make much greater contribution to nutrition, health and economic development of the nations within the continent and beyond, given renewed scientific and institutional support [8-9].

Proximate, anti-nutrients, mineral elements analyses and antioxidant activity of *C. lepidota*, *C. Parchycarpa* and *C. lateritia* fruits' pulp have been reported by Ogbu *et al.*, [10]. Research has shown that juice and jam can be developed from the pulp of the monkey kola [9]. Fabunmi and Arotupin [11] suggested from their findings that the husk and white shell of slimy kola nut (*C. verticillata*) could serve as a blend in animal feed. *In vivo* studies also revealed that about 50% of kola nut husk meal could replace maize diets of rabbits.

Several valuable fruit species in Africa are not yet domesticated. However, substantial economic produce are obtained from their wild or gardens, farms and forest reserves. Dearth of scientific research inputs on these indigenous plants have led to concepts such as neglected and underutilized species. As part of the systematic analysis of the poorly studied fruit plants for their oil potentials, this study was carried out to evaluate its pharmaceutical and industrial values due to paucity or no report on the oil extracted from this nut. This research aims at extraction of the oil from *Cola parchycarpa* (monkey cola) nut; determine the fatty acid composition, physico-chemical composisition and the antibacterial activity of the oil respectively. The results obtained will be compared with some convectional oil used in pharmaceutical and industrial processes.

Collection and identification of plant material: *Cola parchycarpa* (monkey cola) was harvested from the farm of local farmers in the suburb villages in Owo town, Owo local government area, in Ondo state, Nigeria. It was identified in the department of Agricultural Technology department, Rufus Giwa Polytechnic, Owo, Ondo State.

Preparation of seed samples: The samples were manually removed from the pod (regular cylindrical caulescent follicles) from different point source in the site and kept inside clean buckets. It was sorted to remove the dirt and immature ones. The mesocarp was removed before sundried for two weeks and the samples were reduced to fine powder with the aid of a mechanical grinder to pass through 40 mesh sieves to increase the surface area for proper analysis. The milled powder samples were collected and stored in glass jars, tightly covered and kept for analysis

Characterization of the Extracted Oil from *Cola parchycarpa* (monkey cola)

In evaluating the quality of the extracted oil, the percentage yield, refractive index, viscosity, specific gravity, saponification values, acid value, iodine value, free fatty acid value, peroxide value of the oil were determined using AOAC [12].

Fatty Acid Methyl Ester Analysis: 50mg of the extracted fat content of the sample was saponified (esterified) for five (5) minutes at 95 ºC with 3.4 ml of the 0.5m KOH in dry methanol the mixture was neutralized by using 0.7 M HCl 3ml of the 14% boron triflouride in methanol was added. The mixture was heated for 5 minutes at the temperature of 90 ºC to achieve complete methylation process. The fatty acid methyl esters were thrice extracted from the mixture with redistilled n-hexane. The content was concentrated to 1ml for gas chromatography analysis and 1µ was injected into the injection port of GC.

Antibacterial Activity

Source of Microorganisms

Proteus, E. coli, Staphylococcus aureus, Pseudomonas Spp and Klebsiella pneumonia were collected from department of microbiology, Federal Medical Centre Owo, Ondo state of Nigeria.

Antibacterial Test

The oil was tested for its antibacterial properties using the agar – well technique [13]. The assay for antibacterial activities was carried out with *Proteus, E. coli, Staphylococcus aureus, Pseudomonas Spp and Klebsiella pneumonia*. Triplicate plates of media for each organism were inoculated with the appropriate suspension of bacteria. Agar well was aseptically made in the media with a sterile 6.0mm diameter cork borer. The different concentrations of the test solutions of extracts were dispensed (0.5ml) aseptically into the wells. The plates were kept in sterilized inoculation chambers for two hours to facilitate diffusion of solutions. The plates were then inoculated at 37 ^{o}C for 24 hours for the bacteria. The diameters of the zones of inhibitions of bacteria growth were measured in the plates and the mean value and standard error for each organism was recorded.

Results and Discussion

Results: The tables1-4 below revealed the results of the physico-chemical, fatty acid composition and antibacterial activity of oil extracted from *Cola parchycarpa*

Table 1: Physical Parameters of Oil From monkey cola (*Colaparchycarpa*)

Parameters	Values
Refractive Index	1.555±0.01
Specific Gravity	0.9127±0.01
Viscosity (30°C)(Pas/sec)	47.8236±0.02
Colour (Unit)	Deep yellow
Oil Yield (%)	11.500 ±0.02

±SDV of triplicate results

Table 2: Chemical Parameters of Oil from monkey cola (*Cola parchycarpa*)

Parameters	Values
Acid Value (mg/g)	102.1020±0.01
Free Fatty Acid (% oleic	28.7928±0.01
Saponification Value (mg/g)	152.5920±0.02
Iodine Value (mg/g)	61.4196±0.01
Peroxide Value (mmol/kg)	46.4196±0.02

± SDV of triplicate results

Table 3: Fatty acid composition of oil from monkey cola (*Cola parchycarpa*)

Parameter (%)	Values
Lauric Acid (C12:0)	0.3482
Myristic Acid (C14:0)	1.1902
Palmitic Acid (C16:0)	32.5410
Palmitoleic Acid (C16:1)	0.0496
Margaric Acid (C17:1)	0.0496
Stearic Acid (C18:0)	2.6871
Oleic Acid (C18:1)	42.4471
Linoleic Acid (C18:2)	17.1689
Linolenic Acid (C18:3)	2.0694
Arachidic Acid (C20:0)	1.6281
Arachidonic acid (C20:4)	0.3722
Erucic Acid (C22:1)	0.0159
Behenic Acid (C22:1)	0.0281
Lignoceric acid (C24:0)	0.0607

Note: C: 0= Number of Carbon atoms and level of saturation or unsaturation

Table 4: Antibacterial Activity of Oil from monkey cola (*Cola parchycarpa*)

Sample	Organisms	Zone of Inhibition (mm)
Neem Seed Oil	*Proteus*	No zone
	Escherichia Coli	2.00 ± 0.02
	Staphylococcus aureus	5.00 ± 0.02
	Pseudomonas Spp	1.00± 0.01
	Klebsiella pneumonia	2.00± 0.01

± SDV of triplicate results

Discussion

The results obtained in table1 indicated physical parameters of oil from *Cola parchycarpa* (monkey cola). The values obtained were: Refractive Index (1.5550±0.01), Specific gravity (0.9127±0.01), Viscosity (47.8236±0.02), Oil yield (11.5000±0.02) and the colour was deep yellow respectively.The refractive index indicated that the oil is more thick compared with most drying oils whose refractive indices were between 1.48 and 1.49 [14]. The high viscosity and the low refractive index of the oil indicated that the oil can flow easily and had low density. The low percentage yield indicated that the oil is not economical industrially when compared with other convectional oil used in industrial application except the pharmaceutical values are considered.

The chemical properties of Oil from monkey cola (*Cola parchycarpa*) as indicated in table 2 were Acid value (mg/g) (102.1020±0.01), Free fatty acid (28.7928±0.01), Saponification value (mg/g) (152.5920±0.02), Iodine value (mg/g) (61.4196±0.01) and Peroxide value (mmol/kg) (46.4196±0.02) respectively. The acid value was very higher than that of fluted pumpkin (3.5 mg/KOH/g) [15]. The high acid value of the oil indicated that it is not a good source as edible oil except in a little proportion for curative purposes. The saponification value was lower than values obtained for standard values for convectional vegetable oil ranging from 188–196mg KOH/g [16]. The peroxide value (46.4196±0.02) Peroxide value depends on a number of factors such as the state of oxidation (quality of oxygen consumed), the method of extraction used and the type of fatty acids present in the oil. Iodine value gives the level of saturation in oil sample. The higher the iodine value, the more unsaturated the oil. The value obtained for monkey cola oil (61.4196±0.01) was is extremely lower to those of unsaturated fatty acid-rich oils such as peanut (86.0 – 107.0), cottonseed (100.0 – 123.0), sesame (104.0 – 120.0), sunflower (118.0 – 141.0) but higher than that of soybean oil (24.0 – 29.0) [17].

Table 3 revealed the Fatty acid composition of oil from monkey cola (*Cola parchycarpa*). The sample revealed Palmitic Acid (C16:0) (32.5410) as the highest saturated fatty acid present, Stearic Acid (C18:0) (2.6871), Myristic Acid (C14:0) (1.1902), Arachidic Acid (C20:0)(1.6281) had value greater than one (>1) while other saturated fatty acids present were less than one(<1). Polyunsaturated fatty acid present were Linoleic Acid was 17.1689. The higher value in lenolenic acid (17.1689) increased the off-flavour and oxidation of some harmful product as reported by Warner and Gupta [18] and the lower values obtained for Linolenic Acid (C18:3) (2.0694) and Arachidonic acid (C20:4) (0.3722) respectively. The highest monounsaturated present were Oleic Acid (C18:1) (42.4471) while other values for monounsaturated present like Palmitoleic Acid (C16:1) and Erucic Acid (C22:1) were less than one.

Table 4 revealed the antibacterial activity of the oil from *Cola parchycarpa*. These values indicated that the oil was susceptible to *Escherichia* Coli (2.00 ± 0.01), *Staphylococcus aureus* (5.00 ± 0.02), *Klebsiella pneumonia* (2.00± 0.01) and *Pseudomonas Spp* (1.00± 0.01) and resistant to *Proteus*. Though the cola is of low yield, but the oil had great health benefits and good industrial and pharmaceutical applications.

Conclusion

Though the level of unsaturated fatty acids were higher than the saturated fatty acids, The results obtained from the physico-chemical characteristics indicated that the low yield and high acid value of the oil suggested that the oil is not a good source as edible oil. The oil is good for curative purposes due to its susceptibility to tested bacteria except *Proteus*.

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