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Phytochemical Analysis of *Cocos nucifera L*

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ABSTRACT

The phytochemical screening of *Cocos nucifera* L was studied. The aim of the study was to determine the phytochemical constituents of the endosperm of *Cocos nucifera* L. The nuts of *Cocos nucifera* were collected from a coconut tree in the Botany Department of the University of Nigeria, Nsukka. The nuts were broken to release the solidified endosperm (kernel). The endosperm was cut, washed, dried and milled using a laboratory mill. The phytochemical analyses carried out on the milled kernel showed the presence of terpenoids, alkaloids, resins, glyco-sides and steroids. Flavonoids and acidic compounds were not detected. The macronutrient analyses, on the order hand showed the presence of carbohydrate, proteins, reducing sugar, fats and oil. Of the above macronutrients, oil is known to be the major constituent that is necessary for the medicinal uses of coconut, though the phytochemicals: alkaloids, steroids and terpenoids are known to have antioxidant properties. The nutritional and health implication of coconut consumption are also discussed.

Keywords: *Cocos nucifera*; Phytochemistry; Macronutrients; Antioxidants.

INTRODUCTION

Phytochemicals are plant or fruit derived chemical compounds that can be used as therapeutic agents. They reduce the risk of cancer due to dietary fibres, polyphenol antioxidants and anti-inflammatory effects[1]. The phytochemicals are produced via secondary metabolism in relatively small amounts[2].

In recent times quite a number of some plants i.e. palms, leaves, stems and roots of some plants have been used due to the presence of phytonutrients in them. Scientifically, research is being undertaken to bring to limelight, the therapeutic properties of the phytochemicals present in these plants and also use them as a yardstick in modern medicinal plant uses[3]. Some groups of phytochemicals, which appear to have significant health potentials, are carotenoids, flavonoids, phytoestrogens, non-digestible carbohydrate i.e. dietary fibre and prebiotics (Prior and Cao, 2000).

A typical example of this plant is a palm, coconut (*Cocos nucifera* linn). It belongs to the family *Areecaceae* (Palmae). Palmea is a vast family consisting of about 217 genera and about 2500 species. *Cocos nucifera* belongs to the order arecales and it is the sole species of the genus cocos belonging to the subfamily cocoideae, which includes 27 genera, and 600 species[5]. One of the primary natural products from dry coconut fruit is the coconut oil, which has been used from time immemorial as functional food and in pharmaceuticals. It is referred to as "miracle oil". The coconut is a functional food because it provides health benefits beyond its nutritional content[6].

Coconut oil consists of a mixture of triglycerides containing only short and medium chain saturated fatty acid (92%) and unsaturated fatty acid (8%)[7]. Approximately 50% of the fatty acid in coconut fat is lauric acid[8]. Lauric acid is a medium chain fatty acid that is broken down into monolaurin in the human body. Monolaurin is the active metabolite of lauric acid[9]. Other medium chain saturated fatty acids present are: caprylic acid (9%), capric acid (8%), caproic acid (5%) and myristic acid (20%) which make up the triglyceride molecule, and form antimicrobial properties of coconut oil. The long chain fatty acids include palmitic acid and stearic acid. The unsaturated fatty acid present includes: linoleic acid, linolenic acid (1-3%), arachidonic acid (0.2%) and eicosinoic acid (0.2%0)[10]. The fatty acid portion of the coconut oil is responsible for the antibacterial, antiprotozoal, antifungal and antiviral effect of the plant[11].

People from many diverse cultures, languages, religions and races scattered around the globe have revered the coconut as a valuable source of both food and medicine wherever the coconut palm grows, the people have learned of its importance as an effective medicine. In traditional medicine around the world, the coconut is used to treat a wide variety of health problems. According to Hartwell (1967-1971)[12], coconuts are used in folk remedies for tumors. It has been reported to be antihelmintic, antidotal, antiseptic, astringent, bactericidal, diuretic, purgative, vermifuge, stomachic and supportive[13]. In other places, it is known as a remedy for abscesses, asthma, bronchitis, cold, constipation, cough, earache, fever, flu, gingivitis, jaundice,

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nausea, rash, scabies, scurvy, sore throat, toothache, tuberculosis, tumors, typhoid and veneral diseases[14].

Indigenous people of tropical countries use young coconut juice in the treatment of stomach upsets, diarrhea and dysentery.The lauric acid content of coconut endows it with antimicrobial properties.As such,coconut is useful in the treatment of digestive tract infections[9].Coconut water relives the symptoms associated with Crohn's disease, an illness in which the intestines are infec ted[15],ulcerative colitis and stomach ulcers. In addition, coconut water is a source of quick energy, boosts energy and endurance. Coconut water is used in place of dextrose\glucose in medical emergencies. During World War II, young coconut water was used as an emergency room glucose supply in the absence of sterile glucose; it is also used as an antidote for poisons[16].It is used to expel intestinal parasites like tapeworms and Helicobacter pylori, which are responsible for indigestion and ulcer[11].

In the tropics, coconut oil is widely used in skin care to; moisturize the skin, relieve dryness, flaking and prevent stretch marks. It is used for wounds, bruises, burns, rashes, eczema, and dermatitis[7]. It supports the natural chemical balance of the skin and provides protection from the damaging effects of ultraviolet radiation from the sun. Coconut, due to its contents of caprylic acid, which is fungicidal, is used in the treatment of fungal skin infections such as athlete's foot, thrush, ringworm and candidiasis[11, 17, 18].

In modern medicine, coconut is used as an immune system boaster in infants[9]. It improves digestion and absorption of other nutrients such as; vitamins, minerals, amino acids. It prevents obesity, overweight problem by increasing metabolic rate, regulates thyroid function, boosts energy and fights fatigue[19, 20, 21]. Coconut is one of the few thyroid-activating substances that actually support the body's use of thyroid hormones, thus increasing metabolism[22]. Coconut is used in the treatment of mal-absorption of fat such as cystic fibrosis and enteritis[7]. It improves insulin secretion and enhances the utilization of blood glucose. This forms the basis for its use in the management of diabetes[23]. Coconut is effective in treating and preventing heart disease, chronic fatigue syndrome, osteoporosis, gall bladder disease, Crohn's disease, prostate enlargement and cancer because of its composition and high medium chain fatty acid content[11]. It is beneficial in disease conditions as hepatitis, SARS and AIDS caused by viruses[24]. It improves CD_4 and CD_8 counts in patients who are immuno-compromised. Research has shown that it reduces viral load in AIDS patients[25]. It also reduces inflammation and allergic reaction due to its anti-histaminic effect[26].

The coconut palm has a multitude of industrial uses. It provides raw materials for industries such as the wood, furniture and food industry. Its products includes: timber, food, fermented and unfermented drink, alcohol, vinegar, thatching material, splint fibres for making baskets, masts rope, hats, brushes and broom (Ohler, 1999). It produces utensils for household use such as cups, bowls; oils for food, illumination, soap and margarine production and ointment[16]. The residue after extraction is used in feeding domestic animals and as fertilizer. Nearly one third of the world's population depends on coconut to some degree for their food and their economy. Among these cultures, the coconut has a long and respected history[28].

Coconut is highly nutritious; rich in fibre, vitamins, and minerals. It is classified as a "functioned food: because it provides many health benefits beyond its nutritional content[16].

Phytochemicals act in numerous ways to assist the human body in combating disease and health problems. They combine with numerous vitamins to boost antioxidants activity of scavenging free radicals before they can cause damage within the body. These phytochmicals boost enzyme activity and increase the benefits of the various protective enzymes consumed with in the diet[2]. Non-nutrients (phytochemicals) often help to fight the malignant changes within the cells that have already been penetrated by carcinogens. The consumption of phytochemicals enhances reduction in the emergence of degenerating diseases following a typical western diet[4].

The aim of this study is to determine the phytochemical and macronutrient constituents of the endosperm of *Cocos nucifera* Linn and possibly relate the constituents to their medicinal/pharmacological uses.

MATERIALS AND METHODS

Plant Materials

The nuts of *Cocos nucifera* L. were collected from a coconut tree in the Botany Department in the University of Nigeria, Nsukka. The identification was made by the preliminary observation of the nut and morphological parts by Mr. A. Ozioko, a taxonomist of Bio-resources Development and Conservation Programme center, Nsukka (BDCP).

Preparation of Plant Material

Some nuts of coconut were collected from the Department of Botany, University of Nigeria, Nsukka. They were dehusked and the nuts broken to release the solidified endosperm (kernel). The endosperm was washed, grated and dried (sundrying and oven drying at 40^{o}C). The dried samples were milled using a laboratory mill.

Extraction of Plant Material

The plant was extracted using both polar and non-polar solvents.

Water Extraction (aqueous)

A small quantity of milled coconut was extracted in cold distilled water and used for the analysis.

N-hexane Extraction

Milled coconut (100g) was soaked in 500ml n-hexane for 24 hours and filtered. The filtrate was concentrated by heating in a water bath at 60^{o}C to evaporate the n-hexane giving a semi-solid extract. The extract was used for the analysis.

Phytochemical Analyses of *Cocos nucifera l.*

The phytochemical tests below were carried out on the semi-solid extract of *Cocos nucifera L* to determine the active constituents

according to the procedures and methods outlined in Trease and Evans[29] and Harborne[30]. These phytochemical tests were done to detect the presence of secondary metabolites, such as alkaloids, tannins, saponins, resins, flavonoids, steroid, glycosides and terpenoids in the plant under investigation.

Test for Alkaloids

A quantity (0.2g) of the sample was boiled with 5ml of 2% HCl on a steam bath. The mixture was filtered and 1ml portion of the filtrate was measured into four test tubes. Each of the 1ml filtrate was treated with 2 drops of the following reagents.

i. **Dragendorff's Reagent:** A red precipitate indicates the pres ence of alkaloids.
ii. **Mayer's Reagent:** A creamy-white colored precipitate indi cates the presence of alkaloids.
iii. **Wagner's Reagent:** A reddish-brown precipitate indicates the presence of alkaloids.
iv. **Picric Acid (1%):** A yellow precipitate indicates the prese nce of alkaloids.

Test for Flavonoids

A quantity (0.2g) each of the extracts was heated with 10ml of ethylacetate in boiling water for 3 minutes. The mixture was filtered differently and the filtrates used for the following tests:

i. **Ammonium Test:** A quantity (4ml) each of the filtrates was shaken with 1ml of dilute ammonia solution (1%). The layers were allowed to separate. A yellow coloration was observed at the ammonia layer, which indicates the presence of flavonoids.
ii. **Aluminum Chloride Test:** A quantity (4ml) each of the filtrates was shaken with 1ml of 1% aluminum chloride solution and observed for light yellow coloration. A yellow precipitate indicates the presence of flavonoids.

Test for Glycosides

Dilute sulphuric acid (5ml) was added to 0.1g each, of the extracts in a test tube and boiled for 15 minutes in a water bath. It was then cooled and neutralized with 20% potassium hydroxide solution. A mixture, 10ml of equal parts of Fehling's solution A and B was added and boiled for 5 minutes. A more dense red precipitate indicates the presence of glycoside.

Test for Steroids and Terpenoids

A quantity (9ml) of ethanol was added to 1g each of the extracts and refluxed for a few minute and filtered. Each of the filtrates was concentrated to 2.5ml in a boiling water bath. Distilled water, 5ml was added to each of the concentrated solution, each of the mixtures was allowed to stand for 1 hour and the waxy matter was filtered off. Each of the filtrates was extracted with 2.5ml of chloroform using a separating funnel. To 0.5ml each of the chloroform extracts in a test tube was carefully added 1ml of concentrated sulphuric acid to form a lower layer. A reddish-brown interface shows the presence of steroids.

To another 0.5ml each of the chloroform extract was evaporated to dryness on a water bath and heated with 3ml of concentrated sulphuric acid for 10 minutes on a water bath. A grey colour indicates the presence of terpenoids.

Test for Saponins

A quantity (0.1g) each of the extracts (aqueous and n-hexane) was boiled with 5ml of distilled water for 5 minutes. The mixture was filtered while still hot and the filtrates used for the following tests:

i. **Emulsion Test**
A quantity (1ml) each of the filtrates was added drops of olive oil. The mixture was added to another two drops of olive. The mixture was shaken and observed for the formation of emulsion.
ii. **Frothing Test**
A quantity (1ml) of the different filtrates was diluted with 4ml of distilled water. The mixture was shaken vigorously and then observed on standing for a stable froth.

Test for Tannins

A quantity (2g) each, of the extracts (n-hexane and water) was boiled with 5ml of 45% ethanol for 5 minutes. Each of the mixtures was cooled and filtered. The different filtrates were subjected to the following tests.

i. **Lead Sub-acetate Test**
To 1ml of the different filtrates was added 3 drops of lead sub-acetate solution. A cream gelatinous precipitate indicates the presence of tannins.
ii. **Ferric Chloride Test**
A quantity (1ml) each of the filtrates was diluted with distilled water and added 2 drops of ferric chloride. A transient greenish to black color indicates the presence of tannins.

Test for Acidic Compounds

A quantity **(**0.1g) each of the extracts was placed in a clear dry test tube and sufficient water added. These were warmed differently in a hot water bath and cooled. A piece of water-wetted litmus paper was dipped into the different filtrates and observed for color change. Acidic compounds turn blue litmus paper red.

Test for Resins

Two tests were carried out to detect the presence of resins in the plant under investigation.

i. **Precipitate Test**
A quantity (0.2g) each of the extracts was treated with 15ml of 96% ethanol. The alcoholic extract was then poured into 20ml of distilled water in a beaker. A precipitate occurring indicates the presence of resins.
ii. **Color Test**
A quantity (0.12g) each of the extracts was treated with chloroform and the extracts concentrated to dryness. The residues were re-dissolved in 3ml of acetone and 3ml of concentrated hydrochloric acid added. The mixtures were now heated differently in a water bath for 30 minutes. Pink color, which changes to magenta-red, indicates the presence of resins.

MACRONUTRIENT Analyses of *Cocos nucifera* L

The tests below were carried out to determine the presence of macronutrients in the endosperm of *Cocos nucifera* L.

Test for Proteins

A quantity (5ml) of distilled water was added to 0.1g each, of the extracts. This was left to stand for 3 hours and then filtered. To 2ml portion of the filtrate was added 0.1ml Millon's reagent. It was shaken and kept for observation. A yellow precipitate indicates the presence of proteins.

Burette Test

A quantity (2ml) each of these extracts was put in a test-tube and 5 drops of 1% hydrated copper sulphate was added. A quantity, 2ml of 40% sodium hydroxide was also added and the test-tube shaken vigorously to mix the contents. A purple coloration shows the presence of proteins (presence of two or more peptide bonds).

Test for Carbohydrate

A quantity of 0.1g each of the extracts was shaken vigorously with water and then filtered. To the aqueous filtrate was added few drops of Molisch reagent, followed by vigorous shaking again. Concentrated sulphuric acid, 1ml was carefully added to form a layer below the aqueous solution. A brown ring at the interface indicates the presence of carbohydrate.

Test for Reducing Sugar

A quantity of 0.1g each of the extracts was shaken vigorously with 5ml of distilled water and filtered. To each of the filtrates was added equal volumes of Fehling solutions A and B and shaken vigorously. A brick red precipitate indicates the presence of reducing sugars.

Test for Fats and Oil

A quantity of 0.1g each of the extracts was pressed between filter paper and the paper observed. A control was also prepared by placing 2 drops of olive oil on filter paper. Translucency of the filter paper indicates the presence of fats and oil.

RESULTS AND DISCUSSION

PHYTOCHEMICAL ANALYSES OF *Cocos nucifera* L

The results of the phytochemical analyses carried out on milled endosperm of *Cocos nucifera* are in two parts. The first and second parts are the results using polar solvent extract (water) and non-polar solvent extract (n- hexane) respectively. They both revealed the presence and the absence of some secondary plant metabolites. The results of the phytochemical analyses are shown in Tables 1 and 2 below:

Results using polar solvent extract

This shows the result of the phytochemical analysis carried out on the milled endosperm of *Cocos nucifera L*, using the polar solvent extract (water extract). It is shown in Table 1 below:

Results using non-polar solvent extract

This shows the result of the phytochemical analysis carried out on the milled endosperm of *Cocos nucifera L* using a non-polar solvent extract (n-hexane). It is shown in Table 2 below:

Results of the Macronutrient Analyses of *Cocos nucifera* L

The results presented in two parts reflect the analyses using both polar and non-polar solvent extracts of the milled endosperm of *Cocos nucifera L*. They both revealed the presence of

Table 1: Results of the Phytochemical Analyses on the milled endosperm of *Cocos nucifera* using Polar Solvent Extract (water)

Test	Observation	Inference	Intensity
1) Alkaloids			
i) Dragendorff's reagent	Brick red precipitate	Alkaloids Present	+++
ii) Mayer's reagent	Milky precipitate	,,	+++
iii) Wagner's reagent	Reddish brown precipitate	,,	+++
iv) Picric acid solution 1%	Yellow precipitate	,,	+++
2) Flavonoids			
i) Ammonium test	No color change	Flavonoids absent	-
ii) Aluminum chloride test	,,	,,	-
3) Glycosides	Presence of dense brick red precipitate	Glycosides present	++
4) Saponin			
i) Emulsion test	Emulsion formed	Presence of saponin	++
ii) Frothing test	Formation of stable froth	,,	++
5) Resin			
a) Precipitate test	Precipitate formed at the bottom of the test tub.	Presence of resins	+++
b) Color test	A light pink color which changed shortly was observed	,,	+++
6) Tannins			
a) Lead sub acetate test	Presence of cream gelatinous precipitate.	Tannins Present	+++
b) Ferric chloride test	A light green coloration which changed shortly to black was observed		+++
7) Steroids			
Conc. H_2 SO_4 test	A reddish brown Interface was observed	Steroids present	+
8) Terpenoids			
Conc. H_2SO_4 test	A Grey coloration was observed	Terpeniods Present	+
9) Acidic compounds	No change was observed on the blue litmus paper	Acidic compounds absent	-

some macronutrients, though in differing intensities. The results are shown in Tables 3 and 4 below:

Results using polar solvent extract

This shows the result of the macronutrient analysis carried out on the milled endosperm of *Cocos nucifera L,* using the polar solvent extract (water extract). It is shown in Table 3 below:

Results using non-polar solvent extract

This shows the result of the macronutrient analysis carried out on the milled endosperm of *Cocos nucifera L,* using a non-polar solvent extract (n-hexane). It is shown in Table 4 below:

The phytochemical analyses on the endosperm of *Cocos nucifera L* showed the presence of alkaloids, tannins and resins and in high concentration as indicated by the intensity of the coloured solution and precipitates formed on detection. Saponins and glycosides were present in moderate concentration. Terpenoids and steroids had the least concentration. The macronutrient analyses showed the presence of carbohydrate, fats and oils in high concentration while reducing sugar and proteins were present in moderate concentration. Each result of these analyses (phytochemical and macronutrient), presented in two parts showed the analyses using aqueous and n-hexane extracts. Some phytochemicals were present in smaller concentration in one of the extract while being present in higher concentration in the other extract. This can be attributed to their volatility as they may have evaporated during the concentration of n-hexane extract while heating in a water bath. Some macronutrients were also detected.

From this research, the presence of phenolic compounds such as terpenoids, steroids (phytosterols i.e. ß-sitosterol) though in very low concentration contributes to the antioxidant properties of coconut. It is known that coconut is a poor source of phytosterol. The phytosterols fight atherosclerosis and reduce the growth of cancer cells[31]. For many years now, it has been known that plant polyphenols (steroids, terpenoids, flavonoids etc) are antioxidants *in vitro*[32]. These antioxidants are compounds that reduce the formation of free radicals or react with and neutralize them thus potentially protecting the cell from oxidative damage[33]. The tannins and resins are employed as astringent both in gastro-intestinal tract and on skin abrasions. On the other hand, the macronutrients; proteins, carbohydrate and reducing sugar are involved in the energy giving and bodybuilding function of coconut[34].

The fats and oil constituent of coconut has many functions as the different types of fatty acids contained; all have different functions to perform. Coconut oil contains about 50% lauric acid[9]. The lauric acid is a medium chain fatty, which is abundant in coconut oil, and considered responsible for many of its health benefits. The lauric acid has the additional beneficial function of being converted into monolaurin in the human body. Monolaurin is the antifungal, antibacterial, antiprotozoal and antiviral monoglyceride formed from the metabolism of lauric acid[11]. It is used by the human body to destroy lipid-coated viruses such as; HIV, herpes, cytomegalovirus, influenza and various pathogenic bacteria including *Listeria monocytogens, Helicobacter pylori* and protozoa such as *Giardia lamblia*[9]. It lyses the plasma membrane lipid bilayer, solubilizing the lipids and phospholipids in the envelope of the virus and causing the distingration of the virus envelope. Another antimicrobial effect of monolaurin in viruses is due to the lauric acid interference with virus assembly and virus maturation[15]. This corroborates the use of coconut in the treatment of HIV, herpes, ulcer, influenza, Crohn's disease and ulcerative colitis. Coconut oil is anti- inflammatory and plays a role in alleviating and curing the inflammatory damage in the digestive tract that are characteristic of ulcerative colitis and Crohn's disease[35]. The medium chain fatty acid, caprylic acid kills fungi and yeast that cause candidiasis, ringworm, athlete's foot, and thrush rash. Lauric acid affects the virus *Helicobacter pylori*, which is implicated in indigestion and ulcers[36]. The oil is valued as an emollient and is used as an ingredient in the remedies of skin infection.

Although coconut oil is predominately a saturated fat, it does not have a negative effect on cholesterol. HDL is the "good cholesterol" that helps protect against heart disease. Another incredible fact about coconut oil is that even though it is a fat, it actually promotes weight loss. The reason is because of the healthy medium chain fatty acids it contains. These fatty acids do not circulate in the blood stream like other fats, but are sent directly to the liver where they are immediately converted into energy, just like carbohydrates. So the body uses the fat in coconut oil to produce energy rather than be stored as body fat[21]. Medium chain fatty acids found in coconut oil also speed up the body's metabolism, burning more calories and promoting weight loss[11]. Coconut oil also supplies energy to cells because it is easily absorbed without the need of pancreatic enzymes. It has been shown to improve insulin secretion and utilization of blood glucose due to the presence of capric and lauric acids[9]. Coconut oil in the diet also enhances insulin action thus its use in diabetes. Coconut oil enhances the body's ability to absorb important minerals such as calcium and magnesium, which is necessary for the development of bones, thus coconut oil is very useful to women who are prone to osteoporosis after middle age. Since coconut oil facilitates absorption of calcium by the body and calcium is an important element in the teeth, coconut oil helps in getting the teeth strong and hence prevents tooth decay. Brushing the teeth with coconut oil can prevent tooth decay by up to 80%[37]. Coconut oil helps to prevent premature aging and degenerative disease due to its antioxidant properties.

The presence of medium chain triglycerides and fatty acids help in preventing liver diseases as substances are easily converted into energy when they reach the liver, thus reducing work load on the liver and also preventing accumulation of fat. From literature review, it has being established that the proximate analysis of *Cocos nucifera* endosperm shows the presence of fiber, which aids in digestion and prevents constipation by softening hard stool[11].

In conclusion, the results obtained from the phytochemical analyses of the endosperm of *Cocos nucifera L* showed the presence of alkaloids, resins, steroids, terpenoids, and the absence of flavonoids

Table 2: Results of the Phytochemical Analyses on milled Endosperm of *Cocos nucifera* using a non-polar Solvent Extract (n-hexane)

Test	Observation	Inference	Intensity
1) Flavonoids			
Aluminium chloride test	No color change	Flavonoids absent	_
2) Alkaloids			
i) Picric acid test	Light yellow precipitate was observed.	Presence of alkaloids	+++
ii) Mayer's reagent	Presence of a milky precipitate.	,,	+++
iii) Dragendorff's reagent	Brick red precipitate was observed.	,,	+++
iv) Wagner's reagent	Reddish brown precipitate was observed.	,,	+++
3) Saponin			
i) Emulsion test	Emulsion formed	Saponin present	+++
ii) Frothing test	A stable froth was observed	,,	+++
4) Tannins			
i) Lead sub acetate test	A white gelatinous precipitate.	Tannins present	++
ii)Ferric chloride solution test	A green color that changed to red was observed.	,,	++
5) Glycosides	Dense red Precipitate	Glycosides present	++
6) Steroid			
i) Conc. H_2SO_4	Brownish red coloration at the interface	Steroids present	+
7) Acidic compounds	No change of blue litmus paper	Acid compound absent	-
8) Terpeniods			
i) Conc. H_2SO_4	Presence of a grey color	Terpeniod Present	+
9) Resins			
i) Precipitate test	Precipitate present	Resins present	+++
ii) Color test	A light color that changed shortly was observed	,,	+++

Table 3: Macronutrient Analyses on the Milled Endosperm of *Cocos nucifera* using Polar Solvent Extract (water)

Test	Observation	Inference	Intensity
1) Reducing sugar			
i) Fehlings' solutions A and B	Presence of a brick red precipitate	Reducing sugar present	++
2) Protein			
i) Millon's reagent	White precipitate formed	Presence of proteins	++
i) Burette's test	Purple coloration observed	,,	++
3) Carbohydrates			
i) Molisch test	A brown coloration was observed at the interface	Carbohydrate Present	+++
4) Fats and oil			
i) Translucency test	Translucency was observed on the filter paper compared to the control/ blank.	Fats and oil Present	+++

Table 4: Results of the Macronutrient Analyses on milled Endosperm of *Cocos nucifera* using a non-polar Solvent Extract (n-hexane)

Test	Observation	Inference	Intensity
1)Reducing sugar			
i) Fehlings' solution	Presence of a brick red precipitate	Reducing sugar Present	++
2) Protein			
i) Millon's reagent	White precipitate	Protein present	++
ii) Biuret's test	solution	Proteins present	++
3) Carbohydrate			
i) Molisch test	Presence of a brown ring at the interface	Carbohydrate present	+++
4) Fats and oil			
Translucency	observed	Fats and Oil present	+++

Key

– Absent
+ Present in low concentration
++ Present in moderate concentration
+++ Present in high concentration

and acidic compounds while the macronutrient analyses revealed the presence of proteins, carbohydrate, reducing sugar, fats and Oil. This study justifies the use of *Cocos nucifera L* in the treatment of many debilitating ailments like cancer, diabetes, ulcer, obesity, heart disease and infections due to micro-organisms[9]. However, the medicinal/ pharmacological usage of *Cocos nucifera* is as a result of the oil present in it and its non-nutrient (phytochemical) content which act as antioxidants against dangerous free radicals in the body system.

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