



## Antibacterial Properties of Different Husk Extracts of *Cocos nucifera* (Linn) in South Western Nigeria

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### Authors' contributions

This work was carried out in collaboration among all authors. Author BAE designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AOA and ORO managed the analysis of the study and the literature searches. All authors read and approved the final manuscript.

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### ABSTRACT

**Aim:** The husk of coconut is part of drupe which have enormous benefit to humanity. However, what constitute the antimicrobial activity has not been fully investigated, and this is the basis for the study.

**Materials and Methods:** The husk of coconut collected from local growers subjected to extraction process. The antimicrobial activity was investigated against bacterial strains; *Staphylococcus aureus*, *Escherichia coli*, *Proteus mirabilis*, *Salmonella typhi*, *Enterococcus faecalis*, *Klebsiella aerogene*, *Pseudomonas aeruginosa*, *Streptococcus pneumoniae* by agar well diffusion method using n-hexane, ethanol and distilled water as solvents.

**Results:** Aqueous extracts of coconut showed inhibitory effect against the different tested bacteria organisms with variable zone of inhibition range 7 to 22 mm.

**Conclusion:** The aqueous extracts of coconut exhibited the presence of highly effective bioactive ingredients in these extracts. This can be identified, assay and characterize to be used as synthetic drug which would be available for treatment of bacterial infection.

Keywords: *Cocos nucifera*; extracts; husk; antibacterial activity.

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## 1. INTRODUCTION

*Cocos nucifera* (C-nucifera) Linn is an important fruit tree in the world providing food for millions of people especially in the tropical and sub-tropical regions and with its many uses [1]. *Cocos nucifera* is called Kwakwa in Hausa, Agbon in Yoruba, Aki in Igbo and famously known as coconut in English [2]. Coconut is composed of an external epicarp, a mesocarp, an internal endocarp, embryo and endosperm [3].

*Cocos nucifera* belongs to the order *Arecales* and it is the sole species of the genus *Cocos* belonging to the family *Arecaceae*, a subfamily *Cocoideae*, which includes 27 genera and six hundred species [4-5]. *Cocos nucifera* L. is a plant commonly found along the South Western Nigeria is found throughout the tropics. There are mainly two distinct groups of coconut i.e. tall and the dwarf. The tall varieties grow slow and bear fruits 6 to 10 years after planting. The dwarf varieties are fast growing and bear early i.e. takes 4 to 5 years [6].

The fruit is a fibrous drupe. It consists of fibrous mesocarp (husk), the hard endocarp (shell) the white endosperm (kernel) and a large cavity filled with liquid water [7]. In modern medicine coconut is used as an immune system booster in infants [8].

Coconut is effective in treating heart disease, chronic disease fatigue syndrome,, gall bladder disease Crohn's disease prostate enlargement and cancer because of its composition and high medium-chain fatty acid content [9].

## 2. MATERIALS AND METHODS

### 2.1 Collection of Coconut Fibre

Coconut husk is collected from local coconut growers at Akungba, and Akure main market. The husk was identified and confirmed by Mr. A.A. Ibitoye in the department of Crop and Pest management of the Federal University of Technology Akure.

### 2.2 Extraction of Husk

The husk fibres are washed with distilled water to remove dirt, cut into smaller pieces and air-dried for 21 days. The dried husk fiber was then blended using household electric blender. For the preparation of water extract 250grams of the

plant powder was soaked in distilled water 750 ml. After complete extraction (72 hours) in shaker. The filtrate was concentrated to and was preserved at 4°C till further analysis. The cold water extract was lyophilized. The percentage yield of each extracting solvent was calculated to know the solvent with the highest yield according to the method of [10].

$$\text{Percentage Yield} = \frac{\text{Mass of extract} \times 100}{\text{Total mass of fibre}}$$

### 2.3 Collection of Test Organism

The test organisms (*Staphylococcus aureus*, *Escherichia Coli*, *Pseudomonas aeruginosa*, *Proteus mirabilis*, *Enterococcus faecalis*, *Salmonella typhi*, *Streptococcus pneumonia* and *Klebsiella aerogenes* were collected from the Microbiology Department of the University College Hospital (UCH) Ibadan and the Federal Medical Center Owo, Ondo state. Their identity was confirmed using biochemical and morphological characteristics before storing in slants and kept in the refrigerator.

### 2.4 Standardization of Test Organism and Anti-bacterial Assay

The test organisms were individually grown in Nutrient broth at 37°C for 18 hours in separate conical flasks. The cell were then harvested and standardized from the stock culture using the method of [11-12]. The absorbance was measured using a spectrophotometer (Unico 1100 RS series) 1 ml of the harvested cell was pour plated, two wells were bored using diameter 4 mm of sterilized cork borer and 0.4ml of the liquor was introduced into one well while the same volume of sterile distilled water was added to the other well to serve as control. The same process was used for the slurry. The plates were carefully incubated at 37°C for 24 hours in an incubator and the diameter of zones of inhibition measured. Standard antibiotics were used the test organisms for the control assay, according to [13].

### 2.5 Statistical Analysis

The data gathered were processed using descriptive one way analysis variance. SPSS version 23. The Duncan multiple range test was used as a follow up test.

### 3. RESULTS

Table 1 shows the standardized colony forming unit of each of the organism used for the antibacterial assay of the extracts and the standard antibiotic discs in this research work.

Table 2 shows the mean values and standard deviation of the diameter of zone of inhibition of the different extracts on the test organisms. Comparison of the extracts with standard antibiotics showed that the extracts was highly effective in n- hexane and ethanol extract and less effective in distilled water extracts. The highest zone of inhibition of the extracts was observed in *Escherichia coli*, (B) *Staphylococcus aureus* (G) and *Klebsiella aerogenes* (C) respectively. Other bacterial strains; *Proteus mirabilis*, (D) *Pseudomonas aeruginosa*, (E) *Salmonella typhi*, (F) *Enterococcus faecalis* (A) and *Streptococcus pneumoniae* (H) showed resistance to the studied extracts.

Table 3 shows the value obtained for the standard antibiotics used. Most of the organisms were sensitive to Rocephin (RTX), Augmentin (AX), Ciprofloxacin (CIP) Gentamycin (GN), Nalidixic acid (NA) and Nitrofurantoin (N). They are resistant to Streptomycin(S), Ampicillin (AM) and Tetracycline (TE).

### 4. DISCUSSION

In this study, different extracts of *Cocos nucifera* used indicated growth inhibitory effect on

majority of the tests organisms. *Pseudomonas aeruginosa*, *Salmonella typhi* and *Streptococcus pneumoniae* shows least inhibitory effect. This connotes that husk of *Cocos nucifera* contains bioactive components that had greater activity than that of the antibiotics in inhibiting growth of test organisms [14] collaborate with the report that *Cocos nucifera* endosperm shows potent antibacterial activity against *Staphylococcus aureus*, *Escherichia coli*, but not *Pseudomonas aeruginosa* as reported which was least inhibitory in this study. Equally [15-17] supported this study.

The highest inhibitory effect exhibited by *Escherichia coli*, *Staphylococcus aureus* and *Klebsiella aerogenes*, is an evidence that the extracts of this organism can be a substitute to the synthetic antibiotics, in the treatment of these infection caused by the bacterial organisms. The extract with the least growth inhibitory effect was distilled water extracts while the most susceptible organism among the test organism is *Escherichia coli*.

The results obtained in this work show that husk of *Cocos nucifera* have antibacterial properties as reported by [15-16] which could be as a result of the presence of alkanoids, phenols, flavonoids this is because these phytochemicals have been reported as antimicrobial agents. These properties must therefore be harnessed for novel drug as antimicrobial agents that would be useful for treating bacterial infection.

**Table 1. Standardized colony forming unit per ml of each organism suspension used**

Organism	Dilution Powder	Cfu/ml	Spectrophotometric reading	Standard cfu/ml
<i>Enterococcus faecalis</i>	10 <sup>6</sup>	13	0.052	1.3 X 10 <sup>7</sup>
<i>Escherichia coli</i>	10 <sup>6</sup>	26	0.042	2.6 X 10 <sup>7</sup>
<i>Klebsiella aerogene</i>	10 <sup>6</sup>	16	0.050	1.6 X 10 <sup>7</sup>
<i>Proteus mirabilis</i>	10 <sup>6</sup>	18	0.049	1.8 X 10 <sup>7</sup>
<i>Pseudomonas aeruginosa</i>	10 <sup>6</sup>	20	0.047	2.0 X 10 <sup>7</sup>
<i>Salmonella typhi</i>	10 <sup>6</sup>	15	0.051	1.5 X 10 <sup>7</sup>
<i>Staphylococcus aureus</i>	10 <sup>6</sup>	24	0.045	2.4 X 10 <sup>7</sup>
<i>Streptococcus pneumoniae</i>	10 <sup>6</sup>	19	0.048	1.9 X 10 <sup>7</sup>

**Table 2. Mean values and standard deviation of the diameter of zone of inhibition of the different extracts on the test organisms**

Solvent	Organisms							
	A	B	C	D	E	F	G	H
N-hexane	8.50±0.50 <sup>c</sup>	21.00±1.00 <sup>c</sup>	16.00±1.00 <sup>d</sup>	7.50±0.50 <sup>d</sup>	7.50±0.50 <sup>d</sup>	5.50±0.50 <sup>d</sup>	18.00±1.00 <sup>c</sup>	8.50±0.50 <sup>d</sup>
Ethanol	5.50±0.50 <sup>b</sup>	12.50±0.50 <sup>b</sup>	7.50±0.50 <sup>a</sup>	6.00±1.00 <sup>d</sup>	0.00±0.00 <sup>a</sup>	0.00±0.00 <sup>a</sup>	11.50±0.50 <sup>b</sup>	0.00±0.00 <sup>a</sup>
Distilled water	0.00±0.00 <sup>a</sup>	7.50±0.50 <sup>a</sup>	4.50±0.50 <sup>a</sup>	0.00±0.00 <sup>a</sup>	0.00±0.00 <sup>a</sup>	0.00±0.00 <sup>a</sup>	5.50±0.50 <sup>a</sup>	0.00±0.00 <sup>a</sup>

Data are presented as Mean±S.E (n=3). Values with the same superscript letter(s) along the same column are not significantly different (P<0.05)

**Table 3. The value obtained for the standard antibiotics used**

Antibiotics	Organisms							
	<i>E. faecalis</i>	<i>E. coli</i>	Kleb	<i>P. mirabilis</i>	Pseudo	<i>S. typhi</i>	<i>S. aureus</i>	Strep
CIP	21.00±1.00 <sup>d</sup>	30.50±0.50 <sup>d</sup>	26.00±1.00 <sup>e</sup>	22.00±1.00 <sup>c</sup>	16.00±1.00 <sup>c</sup>	18.00±1.00 <sup>d</sup>	25.50±0.50 <sup>e</sup>	17.50±0.50 <sup>et</sup>
TET	4.50±0.50 <sup>a</sup>	6.50±0.50 <sup>a</sup>	4.50±0.50 <sup>b</sup>	0.00±0.00 <sup>a</sup>	0.00±0.00 <sup>a</sup>	0.00±0.00 <sup>a</sup>	0.00±0.00 <sup>a</sup>	0.00±0.00 <sup>a</sup>
AX	17.00±1.00 <sup>c</sup>	31.50±0.50 <sup>d</sup>	28.50±0.50 <sup>ef</sup>	25.00±1.00 <sup>d</sup>	20.00±1.00 <sup>d</sup>	19.00±1.00 <sup>d</sup>	25.50±0.50 <sup>e</sup>	18.50±0.50 <sup>f</sup>
RTX	20.50±1.50 <sup>d</sup>	32.50±1.50 <sup>d</sup>	29.00±1.00 <sup>f</sup>	29.50±1.50 <sup>e</sup>	26.00±1.00 <sup>e</sup>	28.00±1.00 <sup>e</sup>	30.00±1.00 <sup>f</sup>	31.50±0.50 <sup>g</sup>
AM	4.50±0.50 <sup>a</sup>	5.50±0.50 <sup>a</sup>	4.50±0.50 <sup>b</sup>	0.00±0.00 <sup>a</sup>	0.00±0.00 <sup>a</sup>	0.00±0.00 <sup>a</sup>	3.50±0.50 <sup>b</sup>	4.50±0.50 <sup>c</sup>
GN	13.00±1.00 <sup>b</sup>	23.00±1.00 <sup>c</sup>	21.50±1.50 <sup>d</sup>	16.50±0.50 <sup>d</sup>	14.50±0.50 <sup>c</sup>	18.50±0.50 <sup>d</sup>	18.00±1.00 <sup>d</sup>	12.50±0.50 <sup>d</sup>
N	16.50±0.50 <sup>c</sup>	20.50±0.50 <sup>b</sup>	17.00±1.00 <sup>c</sup>	17.50±0.50 <sup>b</sup>	10.50±0.50 <sup>b</sup>	8.50±0.50 <sup>b</sup>	14.50±0.50 <sup>c</sup>	11.50±0.50 <sup>d</sup>
S	4.50±0.50 <sup>a</sup>	6.00±0.00 <sup>a</sup>	0.00±0.00 <sup>a</sup>	0.00±0.00 <sup>a</sup>	0.00±0.00 <sup>a</sup>	2.00±0.00 <sup>a</sup>	4.00±0.00 <sup>b</sup>	2.00±0.00 <sup>b</sup>
NA	11.50±0.50 <sup>b</sup>	21.50±0.50 <sup>bc</sup>	18.50±0.50 <sup>c</sup>	17.50±1.50 <sup>d</sup>	11.50±0.50 <sup>b</sup>	11.00±1.00 <sup>c</sup>	18.50±0.50 <sup>d</sup>	16.50±0.50 <sup>e</sup>

Data are presented as Mean±S.E (n=3). Values with the same superscript letter(s) along the same column are not significantly different (P<0.05)4

## 5. CONCLUSION

The study evaluated antibacterial activity of the husks of *Cocos nucifera* and reveal that it contains constituents inherent in the extract which are capable of their use medicinally as folk medicine notably in the treatment of infections caused by the bacteria .Opening up a new path for the isolation, identification and characteristic bioactive compound of the extract in order to explore therapeutic effect of the *Cocos nucifera* to combat diseases is the target to unravel in the next approach.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Chan E, Elevitoh CR. Species profile for pacific island agroforestry (Online); 2010. Accessed on November 03 2010.
2. Luis-Zarate VH, Rodriguez-Hernandez MC, Alatrisme-Mondragon F, Chazaro-Ruiz LF, Rangel-Mendez JR. Coconut endocarp and mesocarp as both biosolvents of dissolved hydrocarbon in fuel spills and as a power source when exhausted. J Environ Manag. 2018;211:103-111.
3. Ogeyemhe BE, Amaechi RA, Ekpruke CD, Airiagbonbu BO, Odigie EB. Comparative Benefits of *Cocos nucifera* L. Husk, Milk and Shell Extracts on Body Weight Changes and Haematological Indices in Male Rats. Trop J. Nat. Prod. Res. 2020; 4(7):455-462. DOI.org/10.26538/tjnpr/v4i8.22
4. Evans WC. Trease and Evans pharmacognosy 15<sup>th</sup> Edition. Elsevier Science Limited, New York. 2002;156-200.
5. Lima EBC, Sousa CNS, Meneses LN, Ximenes NC, Santo MA, Vanconcelos GS. *Cocos nucifera* L (*Arecaceae*): A phytochemical and pharmacological review Bra J Med Bio Res. 2015;48(11):953-954.
6. National multi –commodity Exchange of India; 2007.
7. Rasool H. Medicinal plants pharmaceutical Act. 2012;e193.
8. Enig MG. Coconut: In support of good health in the 21<sup>st</sup> century; 2004. Accessed on December 27, 2010.
9. Fife B. The healing miracle of coconut oil. Picadilly books limited, health wise publication Colorado Springs company. 2000;1-46.
10. Ogundare AO. Phytochemical and antimicrobial properties of *Vermonia amigdolina* Del and *Vermonia tenoreama* sensu Eyles. Ph. D Thesis, FUTA, Nigeria. 2006;211.
11. Fawole MA, Oso BA. Laboratory Manual of microbiology spectrum books; 2004.
12. Olutiola FO, Famurewa O, Sontaga HG. Introduction to microbiology 2<sup>nd</sup> edition Heideiberg. Nigeria. 2000;257.
13. Prescott LM, Harley JP, Klein DA. General microbiology 7<sup>th</sup> Edition McGraw Hill New York .United State of America; 2008.
14. Singla RK, Jagani H. Investigation of Antimicrobial effect of Dry distilled extract of *Cocos nucifera* Linn Endocarp Webmed Control pharmaceutical sciences. 2012; 3(8)
15. Marjorie C. Plant products as antimicrobial agents. Clinical microbial Rev. 1996;12. 564–582.
16. Yadav RNS, Agarwala Chemical analysis of some medicinal plants J. Phytol. 2011; 3(12):10-14.
17. Njoku OV, Obi C. Phytochemical constituents of some selected medicinal plants. Afr. J. Pure App. Chem. 2009; 3(11):228-233.

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