

Research Article

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Antimicrobial Effects of Cocos Nucifera Water on Some Bacteria Isolates

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Abstract

Plants have been used to treat illnesses for as long as people have existed. The plant *Cocos nucifera* belongs to the *Arecaceae* family, which includes palms. Considered by tradomedicinal experts to have the following therapeutic indications, it is one of the oldest medicinal plants used by humans. These include antimicrobial, antioxidant, leishmanicide, anthelmintic, anti-inflammatory, antinociceptive, antineoplastic, pro-inflammatory, and non-toxic properties. It can also be used to treat diabetes, prostatic hyperplasia, high blood pressure, and dehydration. The plant is native to Nigeria and is a drupe rather than a nut. Using the conventional approach, the fresh water content of the fruit extract from *Cocos nucifera* was evaluated against eight human pathogenic bacteria: *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Enterobacter*, *Escherichia coli*, *Proteus vulgaris*, *Serratia*, *Streptococcus* spp., and *Staphylococcus aureus*. When compared to ciprofloxacin and tetracycline, respectively, the fresh water extract from *Cocos nucifera* demonstrated strong antibacterial activity against the test isolates. *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Proteus vulgaris* were susceptible, while *Klebsiella* species, *Streptococcus pneumoniae*, *E. coli*, *Enterobacter*, and *Serratia* were resistant. Following four repetitions of the *Cocos nucifera* susceptibility test on each isolate, the mean zone of inhibition for *Pseudomonas aeruginosa*, *Proteus vulgaris*, and *Staphylococcus aureus* was 35 mm, 16 mm, and 15 mm, respectively; the minimum inhibitory concentrations (MICs) were 2.5 mg/ml, 5 mg/ml, and 5 mg/ml, respectively, while the minimum bactericidal concentrations (MBCs) were 5 mg/ml, 10 mg/ml, and 10 mg/ml, respectively. *Cocos nucifera* fruit water's bioactive content showed that the plant's antibacterial properties are caused by a variety of phytochemicals, including tannins, glycosides, flavonoids, phenols, eugenol, terpenes, steroids, and saponins. The inclusion of *Cocos nucifera* (coconut fruit and water) in the everyday diet of the family is advised in light of the aforementioned findings.

Keywords: antimicrobial; *cocos nucifera*; water; bacteria; isolates

Introduction

The majority of underdeveloped nations around the world are still plagued by infectious diseases. Microbial infections are responsible for around half of all deaths worldwide (Fongang et al., 2023). In addition to the plague of infectious diseases, drug-resistant bacteria have recently surfaced, decreasing the efficacy of antimicrobial treatments (Chukwu et al., 2022). In developed countries, outbreaks caused by resistant bacteria and the development of previously unidentified disease-causing microorganisms (microbes) provide serious public

health challenges, even with advancements in our understanding of biology and its management (Che et al., 2024). Infectious diseases are the leading cause of death globally. These figures in underdeveloped countries may not come as a surprise, but what is perhaps noteworthy is that infectious diseases, which were the fifth greatest cause of mortality in 1981, rose by 58% to become the third major cause of death in 1992 (Baik et al., 2022). According to estimates, 8% of deaths in the United States are thought to be caused by infectious diseases (Baik et al., 2022). It was formerly thought that infectious diseases would be

eradicated by the year 2000, therefore this is concerning. The rise is ascribed to an increase in HIV/AIDS and respiratory tract diseases. Growth in antibiotic resistance in nosocomial and community-acquired infections is another contributing cause (Baik et al., 2022).

The foundation of therapeutics has been the search for environmental solutions to human ailments (Georg et al., 2021). Since the beginning of time, people have used herbs and plant-based items as medicine to build resistance or immunity against illnesses including fever, joint discomfort, and colds. Numerous therapeutic plants that have been studied have scientific evidence on them (Osungunna, 2020). Still, not even a dozen medicinal plants have been found. African plants are a rich, unexplored source of natural goods, claims Al-Worafi (2020). Although few academics have documented the therapeutic efficacy of *Cocos nucifera* water, people have attested to its effectiveness in treating a variety of infections.

Water from the *Cocos nucifera* plant is a valuable multipurpose plant that has been shown by traditional medicine specialists to be effective against a number of infectious disorders. Along with other plants like *Moringa oleifera* and *Morinda lucida*, it is said to be utilized by traditional healers in several African nations to treat a variety of illnesses, including bacterial infections. Infusions, decoctions, and mixtures are made by directly extracting various parts of the plant, such as the fruits, leaves, stem, and roots, or by soaking them in hot water or alcohol (Tchamgoue et al., 2024). The use of *Cocos nucifera* water as antimicrobial agents will lower the cost of treating some infections due to its well-established therapeutic benefit, which has been the focus of scientific research. It doesn't have any harmful effects on the body.

Materials and Methods

The study was conducted in Ekpoma, the administrative headquarters of Esan West LGA, Edo State, Nigeria. The town, with a population of 127,718 (2006 census), is largely inhabited by civil servants, traders, farmers, and students, and hosts Ambrose Alli University. Ekpoma has two distinct seasons: a wet season (April-October, 150–250 cm

rainfall) and a dry season (November-March, average temperature $\sim 25^{\circ}\text{C}$), with rainfall and wells as the main water sources (Iyevhobu et al., 2025).

Ethical Permission: Ethical approval was obtained from the management (Ambrose Alli University, Ekpoma) and the informed consent of subjects was also acquired before collection of samples.

Source of *Cocos Nucifera* Water: The fresh *Cocos nucifera* fruit were purchased from the market located in Ekpoma.

Source of Bacteria Isolates and Identification of Test Organisms: The different test organisms were isolated from urine, sputum, and blood from some pupils attending primary schools in Ekpoma and were analyzed in the Department of Medical Laboratory science diagnostic/research laboratory located in College of Medical sciences Ekpoma, for a period of four months (March - July, 2025). The test organisms isolated for the study includes; *Staphylococcus aureus*, *Klebsiella pneumonia*, *Streptococcus* species, *Proteus Mirabilis*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Serratia*, *Citrobacter* and *Enterobacter*.

All isolates for this study were identified by their colonial appearance on the media which include Size, Shape, Elevation, Opacity, Edge, Colour, haemolysis and fermentation and odour.

Results

Table 1 shows that aqueous extracts of *Cocos nucifera* antibacterial activity Indices (AI) variable inhibition zone (IZ) to test bacteria isolates. The IZ of the extraction for the different test bacteria isolates shows that *Pseudomonas aeruginosa* had the highest IZ as 35 mm, followed by 16 mm for *Proteus vulgaris*, 15 mm for *Staphylococcus aureus*, 6 mm for *Klebsiella* spp, 6 mm for *Streptococcus pneumoniae*, 5 mm for *E. coli*, 5 mm for *Enterobacter*, and 5 mm for *Serratia*. ciprofloxacin (CPX-5 $\mu\text{g}/\text{ml}$ (broad spectrum antibiotics) and tetracycline [TTC-30 $\mu\text{g}/\text{ml}$ (narrow spectrum antibiotics)] were used as positive control, while sterile distilled water (DW) was used as negative control. CPX gave IZ for all the bacteria isolates ranging from 20-34mm while TTC gave IZ ranging from 18-40mm and DW gave IZ ranging from 0-2 mm to the test bacteria isolates.

Table 1: Mean of Zone of Inhibition of *Cocos nucifera* on Test Isolates [Mean zone of inhibition (mm)].

Organisms	Aqueous Coconut Extract (mm)	Controls (mm)			Susceptibility to Aqueous Coconut Extract
		Ciprofloxacin (5ug/ml)	Tetracycline (30ug/ml)	Sterile Distilled Water	
<i>P. aeruginosa</i>	35	30	24	0	+
<i>Proteus spp</i>	16	34	40	0	+
<i>Staphylococcus aureus</i>	15	25	30	0.5	+
<i>Streptococcus spp</i>	6	28	18	1	-
<i>Klebsiella spp.</i>	6	30	28	0	-
<i>Escherichia coli</i>	5	25	30	0	-
<i>Serratia spp</i>	5	23	25	1	-
<i>Enterobacter spp</i>	5	20	35	2	-

KEY: + - sensitive, — - resistance (where IZ greater than (>) 8 mm is sensitive while lesser than (<) 8 mm is resistance)

Table 2 shows that the various bacterial isolates sensitive to aqueous coconut water extract gave minimum inhibitory concentration (MIC) as 2.5

mg/ml for *Pseudomonas aeruginosa*, 5 mg/ml for *Staphylococcus aureus* and 5 mg/ml for *Proteus vulgaris* respectively.

Table 2: Minimum Inhibitory Concentration (MIC) of Activity of *Cocos nucifera* on Sensitive Bacterial Isolates.

Test Organisms	MIC (mg/ml)
<i>Pseudomonas aeruginosa</i>	2.5
<i>Staphylococcus aureus</i>	5
<i>Proteus vulgaris</i>	5

Table 3 shows that minimum bactericidal concentration (MBC) carried out in this study determined the smallest concentration of *Cocos nucifera* aqueous extraction that prevent growth of

the bacteria after overnight incubation gave the various MBC 5mg/ml for *Pseudomonas aeruginosa*, 10 mg/ml for *Staphylococcus aureus*, 10 mg/ml for *Proteus vulgaris* respectively.

Table 3: Minimum Bactericidal Concentration (MBC) of activity of *Cocos nucifera* on Sensitive Bacterial Isolates.

Test Organisms	MBC (mg/ml)
<i>Pseudomonas aeruginosa</i>	5
<i>Staphylococcus aureus</i>	10
<i>Proteus vulgaris</i>	10

Discussion

Antibiotics provide the main basis for the therapy of bacterial infection. However, the high genetic variability of bacterial enables them to rapidly evade the action of antibiotics by developing antibiotic resistance strains. Thus, there has been continuing search for new and more potent antibiotics (Yang, 2020). According to World Health report on infectious disease in 2000, overcoming antibiotic resistance is the major issue of WHO for the next millennium. Hence the last decade witnessed an increased in the investigation on plants as a source of human disease management and not many reports are available on the exploitation of plants for the management of human disease (Abdallah et al., 2023). This is mainly due to lack of information on the screening/evaluation of diverse plants for their

antibacterial potential. Therefore, in this pharmacological investigation of the aqueous fruit extract of *Cocos nucifera*, a plant widely acclaimed by tradomedical experts to have therapeutic potential, was evaluated for antibacterial potentials.

The antibacterial activity of *Cocos nucifera* fruit water was clearly active against some the test bacteria which include *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Proteus vulgaris* but *Klebsiella spp*, *Streptococcus pneumoniae*, *E. coli*, *Enterobacter*, and *Serratia* were resistant. This agrees with the findings of Haruna et al., (2021), and the antibacterial effects are attributed to the presence of the chemical substances as earlier revealed by (Haruna et al., 2021). *Pseudomonas aeruginosa*, *Proteus vulgaris* and *Staphylococcus aureus* gave mean zone of inhibition as 35 mm, 16 mm and 15 mm respectively; the minimum inhibitory concentrations (MICs) were 2.5

mg/ml, 5 mg/ml and 5 mg/ml respectively while the minimum bactericidal concentrations (MBCs) were 5 mg/ml, 10 mg/ml and 10 mg/ml after the susceptibility test of *Cocos nucifera* was repeated four times on each isolate.

The present evaluation of the invitro antibacterial activity of *Cocos nucifera* plant truly has antibacterial activity and hence can be seen as a source of useful drugs. The world has entered an era when health is increasingly managed with an eye to cost containment. Criteria to developing a cost-effective approach to the evaluation and management of clinical illness is the selective use of available diagnostic methods, therapies and preventive measures. The emergence of bacterial strains that are resistant to many commonly used antibacterial drugs means that treatment failures may become common. Appropriate antimicrobial therapy can shorten illness and reduce morbidity in some bacteria and parasitic infections and can be lifesaving in invasive infections. Being that this plant is effective against the test organism, it can be exploited for the treatment of infections caused by these organisms.

Conclusion

It is important that, this rich heritage and important source be used more effectively in implementing primary health care in many African countries, hoping to see in the future, plants derived antimicrobials replacing synthetically produced antibiotics used in both human and veterinary medicine.

Declarations

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Conflict of Interest

None to declare.

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Availability of Data and Materials

The authors declare consent for all available data present in this study.

Authors' Contributions

The entire study procedure was conducted with the involvement of all writers.

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