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ANTIBACTERIAL ACTIVITY OF *Khaya senegalensis* METHANOLIC CRUDE EXTRACT AGAINST SOME ISOLATED BACTERIA FROM COMPUTER KEYBOARD

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ABSTRACT

Medicinal plants, often referred to as medicinal herbs, have been integral to traditional medicine practices since prehistoric times. These plants synthesize numerous chemical compounds that serve various functions, including defense against herbivores and pathogens. One prominent example of a medicinal plant is *Khaya senegalensis*, a tree native to Africa and belonging to the Meliaceae family, widely used by local communities to treat diarrhea, dysentery, and wound infections. This research study investigates the antibacterial activity of *Khaya senegalensis* methanolic crude stem bark extract against bacteria isolated from computer keyboards. The study was conducted at Kebbi State University of Science and Technology, Aliero (KSUSTA). Phytochemical screening of the extract revealed the presence of glycosides, saponins, alkaloids, and steroids. Bacterial isolates were identified as *Staphylococcus aureus* and *Escherichia coli* through Gram staining and biochemical testing. Antibacterial activity was evaluated via the agar well diffusion method and showed concentration-dependent inhibition against both organisms. The minimum inhibitory concentration (MIC) was determined to be 25 mg/ml for *E. coli* and 50 mg/ml for *S. aureus*. In contrast, the minimum bactericidal concentration (MBC) was 100 mg/ml for *S. aureus* and 50 mg/ml for *E. coli*, demonstrating significant bactericidal activity.

Keywords: Antibacterial activity, *Khaya senegalensis,* Methanolic extract, Minimum bactericidal concentration, Phytochemical analysis.

INTRODUCTION

Medicinal plants, often referred to as medicinal herbs, have been integral to traditional medicine practices since prehistoric times, synthesizing diverse chemical compounds that serve defense mechanisms against herbivores and pathogens (Gershenzon & Ullah, 2022). Documented usage dates back to ancient civilizations, including Sumerian clay tablets from 3000 BC, the Egyptian Ebers Papyrus from 1550 BC, and Dioscorides' De materia medica compiled in 60 AD, which collectively laid the groundwork for modern pharmacopoeias (Tapsell *et al*., 2016). A prominent modern subject of ethnobotanical interest is *Khaya senegalensis* (Meliaceae), commonly known as African mahogany. This indigenous African tree produces distinct fruits that transition from grey to black upon ripening and is regionally recognized in Nigeria as 'Madaci' (Hausa), 'Dalehi-Kahi' (Fulani), 'Oganwon' (Yoruba), and 'Ono' (Igbo). Local communities frequently utilize its bark and leaves to treat diarrhea, dysentery, and wound infections, therapeutic properties attributed to an abundance of specific bioactive compounds such as alkaloids, tannins, flavonoids, and phenolic compounds (Ibrahim *et al.*, 2014).

Concurrently, the proliferation of computer keyboards as essential data-entry tools in modern businesses, educational institutions, and healthcare settings has introduced a unique public health challenge (Johnson *et al.,* 2020). Despite their utility, keyboards are frequently overlooked reservoirs for microbial pathogens, which are continuously deposited via skin cell shedding, food or drink spills, and frequent contact with unwashed hands (Brady *et al.*, 2016). Common bacterial species identified on keyboard surfaces include both Gram-positive and Gram-negative organisms, notably *Staphylococcus aureus*, *Escherichia coli, Bacillus spp*., and *Enterococcus faecalis* (Adesoji *et al*., 2018). In high-traffic environments, particularly healthcare facilities, shared computer workstations facilitate dangerous cross-contamination networks where healthcare personnel can inadvertently vector pathogens between compromised patients and electronic interfaces, accelerating the transmission of healthcare-associated infections (HAIs) (Brady *et al*., 2016; Jones & Bhalla, 2019).

Despite the clear public health threat posed by keyboard-mediated contamination, a critical gap remains in the implementation of sustainable infection control protocols. Conventional hygiene measures rely heavily on synthetic, alcohol-based disinfectants, which suffer from poor compliance due to time constraints, can degrade hardware materials, and risk driving localized antimicrobial resistance (Brady *et al.,* 2016; WHO, 2020). Consequently, there is an urgent need to explore alternative, eco-friendly antimicrobial agents derived from natural sources that align with the principles of green chemistry and sustainable development (Anyanwu *et al*., 2020). Given that extracts from various parts of *K. senegalensis* have historically exhibited robust antibacterial efficacy against a wide spectrum of clinical pathogens (Akinpelu & Odeyemi, 2019), evaluating this plant as a natural surface sanitizer offers a promising, biogenic approach to mitigating microbial colonization on shared electronics.

This study aimed to evaluate the antibacterial activity of *Khaya senegalensis* against computer keyboard contaminants. Specifically, the study sought to isolate and biochemically identify the prevalent bacterial strains colonizing shared computer keyboards, evaluate the in vitro antibacterial activity of the *K. senegalensis* methanolic crude extract against these specific isolates, and determine the Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) of the crude extract.

It was hypothesized that the *K. senegalensis* extract would display significant, concentration-dependent antibacterial and bactericidal efficacy against the isolated strains, yielding MIC and MBC values

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comparable to conventional agents. However, baseline variations in bacterial density across different keyboard surfaces and fluctuating ambient environmental conditions (such as temperature and humidity) could introduce slight variability into the generalizability of the outcomes.

Computer keyboards serve as major fomites for diverse microorganisms due to continuous contact with human fingers, posing cross-contamination risks when pathogens transfer to users' hands (Jao *et al.,* 2018). While synthetic chemical disinfectants are traditionally utilized to maintain hardware hygiene, growing concerns exist regarding their long-term environmental persistence and potential to accelerate adaptive bacterial resistance (McDonnell & Russell, 2019). The global escalation of antibiotic-resistant bacteria, intensified by the misuse of conventional antimicrobials, underscores an urgent public health need to explore alternative antibacterial strategies (WHO, 2021). Natural plant products, such as extracts from *Khaya senegalensis,* present a viable alternative because their complex, multi-targeted mechanisms of action differ from conventional mono-substance antibiotics, thereby reducing the probability of resistance development (Nascimento *et al.,* 2021).

Khaya senegalensis (African mahogany) is an evergreen tree within the Meliaceae family native to the dry savannas and woodlands of sub-Saharan Africa, where it plays a critical structural role by providing canopy habitat and foraging resources for native wildlife (Ibrahim *et al*., 2018; Orwa *et al.,* 2019). Economically, the tree yields high-quality timber for woodworking industries (Ibrahim *et al*., 2018), while its polysaccharide gum exudate (Senegal gum arabic) serves as a stabilizing, thickening, and emulsifying agent in the pharmaceutical and food industries (Hostettmann *et al*., 2020). Ethnobotanically, *K. senegalensis* possesses a rich history in traditional African medicine; aqueous bark decoctions are prepared to treat malaria, wounds, diarrhea, and dysentery, while crude leaf extracts are used for their analgesic and anti-inflammatory properties (Igoli *et al.,* 2015; Kuete *et al*., 2017).

Figure 1: *Khaya senegalensis* Tree

Recent in vitro investigations confirm that *K. senegalensis* extracts exhibit broad-spectrum antimicrobial properties against prominent clinical pathogens, including *Staphylococcus aureus, Escherichia coli,* and *Pseudomonas aeruginosa* (Eloff *et al*., 2019; Noudjou *et al*., 2020). These properties are driven by an abundance of secondary metabolites, including alkaloids, tannins, and phenolic compounds (Kuete *et al*., 2017). These bioactive compounds systematically disrupt bacterial homeostasis through three core pathways:

- Cell Membrane Disruption: Hydrophobic components damage the bacterial cell envelope, causing the loss of membrane structural integrity, intracellular leakage and eventual cell lysis (Cowan, 2019).

- Enzyme Inactivation: Specific polyphenols bind to functional bacterial enzymes, halting essential replication, metabolic respiration, and energy production cascades (Nascimento *et al.,* 2021).

- Protein Synthesis Inhibition: Particular alkaloid groups pass through the cell envelope and bind to ribosomal subunits, effectively disrupting active translation processes required for bacterial growth and survival (Neu, 2016).

Given that *S. aureus, E. coli*, and *Klebsiella pneumoniae* have been identified as the predominant bacterial contaminants colonizing shared computer peripherals (Jao *et al*., 2018), evaluating the efficacy of targeted *K. senegalensis* extracts against these specific surface isolates provides a practical framework for biogenic hygiene solutions. Recent procedural optimizations have focused on polar organic solvents like methanol to maximize the extraction yield of potent bioactive fractions from the bark (Noudjou *et al*., 2020). Furthermore, emerging material processing techniques, such as microencapsulation, are being explored to entrap these volatile compounds within microscopic spheres, enhancing their chemical stability and allowing for controlled release (Souza *et al.,* 2021).

MATERIALS AND METHODS

Study Area

Kebbi State University of Science and Technology, Aliero (KSUSTA), founded in 2006, is a prominent institution of higher learning in northwestern Nigeria. As the 79th university in the nation, KSUSTA is dedicated to advancing education and research in science and technology, providing a vital contribution to regional development.

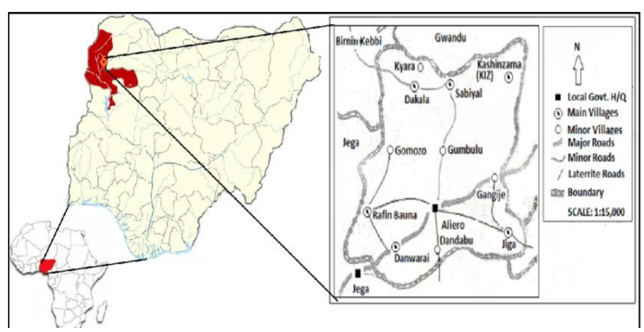

Figure 2: Map of Aleiro local government, Kebbi State

MATERIALS

Fresh dried plant material(Stem bark), Laboratory Evaporator, Homogenizers, Water Baths, Heating Mantles, weighing Balances and Scales, Phytochemical Reagents, test tubes, culture media, conical flasks, distilled water, hot plate, autoclave, cotton wool, sterile syringes, glass slides, measuring cylinder.

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Sample Collection

Collection of Stem Bark: Stem Bark of *Khaya senegalensis* (mahogany) was collected from three distinct locations within Aliero Local Government Area. Identification of the plant was facilitated by residents and verified by a botanist from the Department of Biological Sciences at KSUSTA. The collected materials were dried in the shade, ground into powder, and stored in labeled containers in preparation for extraction.

Sample Collection: Samples were collected from ten computer keyboards at KSUSTA. Each keyboard was swabbed with sterile cotton, and the swabs were placed in sterile containers to prevent contamination.

Extraction and Preparation of Plant Materials
The maceration method was employed for the extraction of bioactive compounds, utilizing 70% methanol and water as solvents. This method follows the protocol outlined by Okwu (2017).

Sample Processing
Phytochemical screening was conducted using qualitative chemical tests to assess the presence of carbohydrates, flavonoids, glycosides, saponins, tannins, alkaloids, and steroids in the plant extracts (Fadimu *et al*., 2019). The procedures for these tests are as follows:

Test for Flavonoids
To the alcoholic solution of the extracts, magnesium powder and a few drops of concentrated hydrochloric acid (HCl) were added. The development of orange or pink coloration indicated a positive result (Ita *et al*., 2020).

Test for Glycosides
To 50 mg of the methanolic extract, 2 mL of chloroform was added, followed by the gradual addition of concentrated sulfuric acid (H_2SO_4). The formation of a brown ring at the interface indicated a positive result (Ita *et al*., 2020).

Test for Saponins
A test tube containing 0.5 g of the powdered extract was shaken vigorously with 5 mL of distilled water. The presence of persistent froth lasting at least 15 minutes indicated the presence of saponins (Ita *et al*., 2020).

Test for Tannins
A few drops of 5% w/v ferric chloride ($FeCl_3$) solution were added to the extract. The appearance of a dark blue color signified a positive result (Ita *et al*., 2020).

Test for Alkaloids
An aliquot of the acidified extract was tested with Wagner's reagent. The formation of a reddish-brown precipitate indicated the presence of alkaloids (Ita *et al*., 2020).

Test for Steroids
One mL of concentrated sulfuric acid was added to one mL of the test extract. A red coloration indicated the presence of steroidal glycosides (Ita *et al*., 2020).

Preparation of Different Concentrations of Plant Extracts
A stock solution of 200 mg/mL was prepared by dissolving approximately 2.0g of the plant extract in 10 mL of distilled water. Serial dilutions were performed to obtain concentrations of 100, 50, 25, and 12.5 mg/mL.

Media Preparation
Mueller-Hinton Agar (MHA) was prepared according to the manufacturer's instructions and autoclaved at 121°C for 15 minutes. After cooling, the medium was poured into sterile Petri dishes to solidify.

Confirmation of the test isolates
Collected samples were cultured on nutrient agar and incubated at 37°C for 24 hours. Distinct colonies were subcultured onto fresh agar plates for isolation of pure bacterial strains.

Gram Staining
Gram staining was performed on isolated bacteria to distinguish between Gram-positive and Gram-negative organisms. Smears were prepared and examined under a microscope to classify the bacterial morphology and cell wall characteristics.

Biochemical Tests
A series of biochemical tests were conducted to classify the bacterial isolates further:

Catalase Test: A drop of hydrogen peroxide was added to bacterial colonies; bubbling indicated a positive catalase reaction.

Coagulase Test: Bacteria were mixed with plasma on a slide; clumping indicated a positive coagulase result.

Oxidase Test: A few colonies were rubbed onto oxidase reagent paper; a color change to purple indicated a positive result.

Urease Test: Bacteria were inoculated into urea broth; a pink color change indicated urease production.

Citrate Test: Isolates were inoculated onto Simmons citrate agar; a blue color change indicated a positive citrate result.

Preparation of Standardized Bacterial Suspension
Bacterial suspensions were standardized to match a 0.5 McFarland standard, ensuring consistent inoculum density for susceptibility testing.

Susceptibility Test of the Plant Extracts
The agar well diffusion technique was employed to evaluate the antibacterial activity of the plant extracts. A 20 mL Mueller-Hinton agar plate was prepared. A 1 mL aliquot of each standardized test organism suspension was spread evenly across the agar plates. Uniform wells were created using a sterile cork borer (4 mm diameter), with the center well serving as the control. Each well was filled with 0.5 mL of the plant extracts, with ciprofloxacin (100 mg/mL) used as the positive control. The plates were allowed to stand for 30 minutes at room temperature for proper diffusion before incubation at 37°C for 24 hours. The inhibition zones were measured using a transparent ruler to the nearest millimeter (Cheesebrough, 2020).

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Determination of Minimum Inhibitory Concentration (MIC) of Plant Extracts
The broth dilution method was utilized to determine the MIC. A stock solution of 200 mg/mL was prepared for the plant extract. One mL of nutrient broth was dispensed into multiple test tubes and autoclaved. The extract was serially diluted to achieve concentrations of 200, 100, 50, 25, 12.5, 6.25, 3.125, 1.562, and 0.781 mg/mL. A 0.1 mL inoculum was added to each test tube, with control tubes containing only nutrient broth serving as negative controls and those containing both nutrient broth and test organisms as positive controls. After a 24-hour incubation at 37°C, the growth was assessed. The lowest concentration showing no turbidity was designated as the MIC (Andrews, 2021).

Determination of Minimum Bactericidal Concentration (MBC) of the Plant Extracts
Following the determination of MIC, the MBC was assessed by plating the test tubes with no turbidity on sterile nutrient agar plates and incubating at 37°C for 24 hours. The absence of growth after 48 hours was considered indicative of the MBC (Andrews, 2021).

Data Analysis
The data obtained were statistically analyzed using Analysis of Variance (ANOVA), employing Duncan's Multiple Range Test (DMRT) to separate the means.

RESULTS

Phytochemical constituents of *Khaya senegalensis* Methanolic Crude Extract
The phytochemical analysis of the *Khaya senegalensis* extract revealed the presence of various bioactive compounds. Notably, glycosides, saponins, alkaloids, and steroids were detected, while flavonoids and tannins were absent. The specific phytochemical findings are outlined in Table 1 below:
This composition suggests that the *Khaya senegalensis* extract contains compounds with potential antimicrobial properties, particularly through the action of alkaloids and Saponins

Table 1: Phytochemical constituents of *Khaya senegalensis* Methanolic Crude Extract

Phytochemical	Result
Flavonoids	-
Glycosides	+
Saponins	+
Tannins	-
Alkaloids	+
Steroids	+

Keys: + = detected - = not detected

Table 2: Bacterial Colony Count from Computer Keyboard Samples

Sample	Number of Colonies	CFU/g per mm²
S1	26	2.6×10^2
S2	405	40.5×10^3
S3	TNTC	TNTC
S4	70	7.0×10^3
S5	155	15.5×10^3
S6	TNTC	TNTC
S7	29	2.9×10^2
S8	TNTC	TNTC
S9	TNTC	TNTC
S10	233	23.3×10^4

Key: TNTC = Too numerous to count, CFU/g = colony-forming unit

Samples from ten keyboards yielded various colony-forming units (cfu/g), indicating significant bacterial presence.
These results highlight a high bacterial load on some keyboards, with TNTC (too numerous to count) colonies suggesting heavy contamination on samples S3, S6, S8, and S9.

Morphological and Biochemical Characteristics of Bacteria Isolated
Through morphological and biochemical tests, the bacterial species identified were *Staphylococcus aureus* and *Escherichia coli*. Table 3 below presents the characteristics and biochemical responses of the isolated bacteria.

Table 3: Morphological and Biochemical Characteristics of Bacteria Isolated

Sample	Gram Reaction	Cell Shape	Cat	Coa	Oxi	Ure	Cit	Identified Organism
S1	+ve	Cocci	+	+	-	+	+	*Staphylococcus aureus*
S2	+ve	Cocci	+	+	-	+	+	*Staphylococcus aureus*
S4	-ve	Rod	+	-	-	-	+	*Escherichia coli*
S5	+ve	Cocci	+	+	-	+	+	*Staphylococcus aureus*
S6	-ve	Rod	+	-	-	-	+	*Escherichia coli*
S10	-ve	Rod	+	-	-	-	+	*Escherichia coli*

Key: +ve = Positive, -ve = Negative, Cat = Catalase test , Coa = Coagulase test , Oxi = Oxidase test, Urease test, Citrate test

Table 4 Antibacterial activity pattern of *Khaya senegalensis* methanolic crude extract against *Escherichia coli* and *Staphylococcus aureus*

Extract concentration in mg/ml	*Staphylococcus aureus*	*Escherichia coli*
12.5	11	10
25	13	14
50	16	15
100	18	17
Control drug: ciprofloxacin 100mg/ml	22	20

Minimum Inhibitory Concentration (MIC) of *Khaya senegalensis* Extract
The MIC test was conducted to find the lowest concentration of extract that inhibits visible bacterial growth. Results show that:
The minimum inhibitory concentration of *Escherichia coli* is 25mg/ml
The minimum inhibitory concentration of *Staphylococcus aureus* is 50mg/ml
These MIC values show that the *Khaya senegalensis* extract effectively inhibits bacterial growth at relatively low concentrations; the results were expressed in Table 5

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Minimum Bactericidal Concentration (MBC) of *Khaya senegalensis* Extract

The MBC was determined by identifying the lowest concentration at which no bacterial growth occurred after plating MIC samples. The MBC results show that:-

Staphylococcus aureus has its minimum bactericidal concentration at 50mg/ml

Escherichia coli has its minimum bactericidal concentration at 25mg/ml.

At 100 mg/ml, the *Khaya senegalensis* extract demonstrated bactericidal effects on both *E. coli* and *S. aureus*, showing its potential as a natural antimicrobial agent.

The results indicated that *Khaya senegalensis* methanolic extract contains effective phytochemicals with antibacterial properties against *E. coli* and *S. aureus*. The extract's effectiveness, though slightly less than ciprofloxacin, suggests its potential as a natural alternative for managing bacterial contamination on computer keyboards. These findings highlight the promise of *Khaya senegalensis* in developing eco-friendly antimicrobial solutions for public health applications.

Table 5: Minimum Inhibitory Concentration (MIC) of *Khaya senegalensis* Extract

Extract Con. (mg/ml)	200 mg/ml	100 mg/ml	50 mg/ml	25 mg/ml	12.5 mg/ml	6.25 mg/ml	3.12 mg/ml	1.56 mg/ml	0.78 mg/ml
S. aureus	-	-	-	+	+	+	+	+	+
E. coli	-	-	-	-	+	+	+	+	+

Keys: - = No turbidity
+ = Turbid

Table 6: Minimum Bactericidal Concentration (MBC) of *Khaya senegalensis* Extract

Test Organism	Extract concentration mg/ml.			
	200mg/ml	100mg/ml	50mg/ml	25mg/ml
Staphylococcus aureus	-	-	+	
Escherichia coli	-	-	-	+

Keys: + = growth present
- = growth absent

Statistical Analysis of Data using Analysis of Variance (ANOVA), employing Duncan's Multiple Range Test (DMRT).

The antibacterial activity of *Khaya senegalensis* methanolic crude extract revealed a dose-dependent increase in activity against *E. coli* and *S. aureus*. A significant ($p<0.05$) decrease in antibacterial activity against *E. coli* was observed at 12. 5 and 25 mg/ml. At the same time, S. aureus was also observed at 12.5 and 25 mg/ml as compared to the control drug ciprofloxacin. The activity of *Khaya senegalensis* methanolic crude extract against *E. coli and S. aureus revealed no significant difference (>0.05) at 100mg/ml* compared to the control drug (ciprofloxacin).

Table 7: Statistical Analysis of Data using Analysis of Variance (ANOVA), employing Duncan's Multiple Range Test (DMRT).

Extract concentration (mg/ml)	Zone of inhibition (mm) *Escherichia coli*	Zone of inhibition (mm) *Staphylococcus aureus*
12.5	10.67 ± 0.33^a	9.33 ± 0.33^a
25	13.50 ± 0.29^b	13.50 ± 0.29^b
50	16.50 ± 0.29^c	15.33 ± 0.17^c
100	19.16 ± 0.44^d	17.67 ± 0.33^d
Control drug: ciprofloxacin 100mg/ml	21.00 ± 0.58^e	18.33 ± 0.33^d

Values are presented as mean + SEM (n=3). Values with the same superscript down the column are not significantly different (p>0.05), analyzed using one-way ANOVA, followed by Duncan multiple comparison test with SPSS.

DISCUSSION

The increasing prevalence of antibiotic-resistant bacteria has necessitated the exploration of alternative antimicrobial agents. In this context, plant extracts have garnered significant attention due to their rich phytochemical composition and potential antibacterial properties. *Khaya senegalensis*, a tree indigenous to Africa, has been traditionally used for various medicinal purposes. Recent studies have begun to explore its antibacterial efficacy, particularly against common pathogens found on frequently touched surfaces such as keyboards.

The findings from this study highlight the promising antibacterial potential of *Khaya senegalensis* methanolic extract against *Staphylococcus aureus* and *Escherichia coli*, two pathogens commonly associated with nosocomial infections. Phytochemical analyses reveal the presence of several bioactive compounds, including glycosides, saponins, alkaloids, and steroids. These constituents are known for their antimicrobial properties, as documented in various studies (Nwodo *et al*., 2018; Adeleke *et al*., 2020).

The observed high bacterial load on keyboard samples is alarming, emphasizing the importance of hygiene protocols for frequently touched surfaces. The significant presence of *S. aureus* and *E. coli* on keyboards correlates with existing literature that discusses the contamination risks linked to shared technology (Odeyemi *et al*., 2021). This underlines the necessity for effective disinfection methods to mitigate the risk of transmission of these pathogens.
Phytochemicals are non-nutritive plant chemicals that have protective or disease-preventive properties. *Khaya senegalensis* is rich in these compounds, which play a crucial role in its antibacterial activity. For instance, saponins are known to disrupt bacterial membranes, leading to cell lysis (Adeleke *et al*., 2020). Alkaloids have also been documented to inhibit bacterial growth by interfering with vital cellular processes (Nwodo *et al*., 2018). The synergistic effect of these compounds may contribute significantly to the extract's overall antibacterial activity.

The methanolic extract of *Khaya senegalensis* demonstrated inhibition zones comparable to those of ciprofloxacin at a concentration of 100 mg/ml. This finding is significant as it suggests that the extract could serve as a viable alternative or complement to conventional antibiotics, which are increasingly facing issues of resistance and environmental concerns (Ezzat *et al*., 2020). The emergence of multidrug-resistant strains necessitates the exploration of natural alternatives that may have a different mode of action.

Determining the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) of *Khaya senegalensis* is critical for understanding its potential therapeutic application. The study found that the extract exhibited bacteriostatic effects at concentrations as low as 25 mg/ml for *E. coli* and 50 mg/ml for *S. aureus*. In comparison, bactericidal effects were noted at 100 mg/ml for *S. aureus* and 50 mg/ml for *E. coli*. These concentrations indicated that *Khaya senegalensis* could be an effective antimicrobial agent, particularly in settings where cost-effective solutions are needed (Ogundare *et al*., 2021).

The significant bacterial contamination of keyboards underscores a pressing public health concern, particularly in environments where hygiene is paramount, such as hospitals, schools, and workplaces. The findings advocate for regular disinfection of these surfaces and suggest that *Khaya senegalensis* extract could be integrated into cleaning protocols. Its natural origin and antimicrobial properties offer a promising alternative to synthetic disinfectants, which may pose risks of toxicity and environmental harm.

Conclusion

This study demonstrates that *Khaya senegalensis* methanolic extract effectively combats *Staphylococcus aureus* and *Escherichia coli*, common bacteria found on computer keyboards. Driven by its bioactive phytochemicals, the extract serves as a promising, eco-friendly alternative for public hygiene, performing nearly as well as the antibiotic ciprofloxacin. Incorporating this natural extract into sanitizing products offers a sustainable, innovative solution to reduce bacterial spread on shared surfaces while highlighting the relevance of traditional medicinal plants in modern public health.

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Disclosure Statement

Conflict of Interest: The authors declare that there are no conflicts of interest associated with this research.

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Compliance with Ethical Standards

This article does not contain any studies involving human or animal subjects.

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