

ANTI-PSEUDOMONAS ACTIVITY OF THE 70% ETHANOLIC EXTRACT FROM LEAVES AND TRUNK BARK OF *SPONDIAS MOMBIN* L. (ANACARDIACEAE) AGAINST MULTIDRUG-RESISTANT BACTERIA

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ABSTRACT

Like other members of the Anacardiaceae family, *Spondias mombin* is widely used in traditional medicine in Côte d'Ivoire and Congo where it is regarded as a true panacea to treat various conditions, including fever, spasms, hemorrhages, urinary retention, seizures, chickenpox, and candidiasis. This study aimed to evaluate the anti-*Pseudomonas* potential of 70% ethanolic extracts from the plant's leaves and bark against multidrug-resistant strains of *Pseudomonas aeruginosa*. Strain susceptibility was assessed using the agar diffusion method, while antibacterial parameters were quantified via broth microdilution. Finally, qualitative analysis using thin-layer chromatography (TLC) was performed on the extracts to identify their phytoconstituents. The results reveal a remarkable effect on bacterial growth, with inhibition zone diameters ranging from 19.33 ± 1.0 to 14.85 ± 0.9 mm for the leaves, and from 18.51 ± 1.6 to 15.00 ± 1.6 mm for the bark. The leaf extract demonstrated a bactericidal effect against 100% of the strains, compared to 62.5% for the bark extract. TLC analysis confirmed the presence of polyphenols, flavonoids, anthrones, sesquiterpene lactones,

tannins, coumarins, saponins, anthraquinones, and terpenes; these compounds appear to be more concentrated in the leaves. This study provides a scientific basis for the traditional uses of *Spondias mombin* and contributes to the fight against bacterial resistance, a major public health threat. He also highlights the urgent need for the rational and sustainable use of medicinal plants to safeguard plant biodiversity in Côte d'Ivoire.

KEYWORDS: *Spondias mombin*, anti-*Pseudomonas*, phytochemical characterization, Côte d'Ivoire.

1. INTRODUCTION

Microbial diseases have had the most severe impact on the health of the global population. Consequently, the discovery of anti-infective agents particularly antibiotics offered a genuine ray of hope for humanity. However, the excessive and often uncontrolled use of these compounds has triggered resistance in many pathogenic bacteria.^[1] Today, this resistance has made infectious diseases a leading cause of mortality; indeed, they account for one-third of global deaths and 43% of deaths in developing countries.^[2] Overall, bacterial infections alone are responsible for 70% of deaths caused by microorganisms.^[3] They pose a significant public health challenge while calling into question the very efficacy of the antibiotic arsenal currently available within global healthcare systems.^[4]

In Côte d'Ivoire, according to the^[5], the death rate linked to infectious diseases ranges from 50% to 60%. This situation shows no signs of improvement, given poor sanitary living conditions and crucially the industrial processing of perishable goods and their global transport, which create ideal conditions for the proliferation and spread of pathogenic bacteria.^[2] According to the European Centre for Disease Prevention and Control^[6], carbapenem-resistant *Pseudomonas aeruginosa* (CRPA) is among the multidrug-resistant bacteria most frequently implicated in cases worldwide over recent decades. No continent is immune to this phenomenon, as it occurs in both developed and developing countries.^[7] Numerous cases of multidrug-resistant bacteria have been reported in Côte d'Ivoire. According to^[8], the prevalence of imipenem-resistant bacterial strains rose from 1.9% in 2005 to 5.9% in 2009. The WHO has identified the emergence of bacterial antibiotic resistance combined with conditions ideal for the proliferation and spread of pathogenic bacteria as a threat to humanity and, consequently, an obstacle to the UN's Millennium Development Goal of eradicating poverty.^[9]

Faced with this therapeutic impasse, the search for new antibacterial compounds has become essential. The plant kingdom and medicinal plants in particular remains the primary source to explore in this quest.^[10] Among these, *Spondias mombin* L. (Anacardiaceae) holds a prominent position, justifying its widespread use in African pharmacopoeia. Indeed, the plant is considered a veritable panacea in the Congo; a leaf macerate is used to treat metrorrhagia in pregnant women, gonorrhea, anuria, chickenpox, and candidiasis, while the sap is instilled into the eyes to relieve headaches. A decoction of the same plant part, used in steam baths, serves to treat convulsive seizures and tetanus.^[11] According to this author, in Togo, the fruit pulp of *Spondias mombin* is used to prepare a sorghum porridge for therapeutic purposes, while in Côte d'Ivoire, the fresh leaves are used to treat fontanelle-related conditions.^[12]

The present study aims to evaluate the antibacterial activity of 70% ethanolic extracts from the leaves and trunk bark of *Spondias mombin* L. (Anacardiaceae) against multidrug-resistant *Pseudomonas* strains, and to perform a phytochemical characterization of the leaf extract in order to identify the major classes of chemical compounds present in the plant.

2. MATERIALS AND METHODS

2.1 Plant material

It consists of the leaves and trunk bark of *Spondias mombin*.

2.2 Laboratory equipment

Crude extracts were obtained using a rotary evaporator, a freeze-dryer, a vortex mixer, a magnetic stirrer, a densitometer, an oven, a fume hood, a refrigerator, an analytical balance, and automatic micropipettes (P200 and P1000). Phytochemical screening was performed using a UV lamp, a chromatography tank, a hot plate, and a digital camera.

Anti-*Pseudomonas* tests were conducted using various glassware and consumables: beakers (100 and 250 mL), graduated cylinders, funnels, test tubes, hemolysis tubes, Pasteur pipettes, sterile Petri dishes (90 mm diameter), jars, syringes (5 and 10 mL), and sterile glass pipettes (10 mL). This setup was supplemented with microfilters (0.22 and 0.45 µm), swabs, silica gel F254 plates, capillary tubes, suction bulbs, spatulas, forceps, Whatman® 3 mm filter paper, absorbent cotton, aluminum foil, latex gloves, and masking tape. The extraction solvents were sterile distilled water, hexane, and 70% (v/v) ethanol.

2.3 Bacterial strains

The bacterial material was obtained from the bacterial strain biobank of the Institut Pasteur of Côte d'Ivoire. It consists of eight (8) clinical strains including five with a resistant phenotype and three wild-type strains and one *Pseudomonas aeruginosa* reference strain (ATCC 27853) for quality control (Table 1).

Table 1: List of Bacterial Strains Studied.

Bacteria	Codes	Origins	Resistance phenotypes
Clinical strains			
<i>Pseudomonas aeruginosa</i>	891C	suppuration	PARC par déficit en porine D2
<i>Pseudomonas aeruginosa</i>	489C	Wound	PARC par déficit en porine D2
<i>Pseudomonas aeruginosa</i>	1060C	Probe tip	PARC par déficit en porine D2
<i>Pseudomonas aeruginosa</i>	1810C	Catheter aspiration	PARC par déficit en porine D2
<i>Pseudomonas aeruginosa</i>	1076C	Urine	PARC par déficit en porine D2
<i>Pseudomonas aeruginosa</i>	955Y	Pus	Savage
<i>Pseudomonas aeruginosa</i>	565C	Pus	Savage
<i>Pseudomonas aeruginosa</i>	1016C	Pus	Savage
Reference strain			
<i>Pseudomonas aeruginosa</i>	ATCC 27853		

PARC: *Pseudomonas aeruginosa* resistance to carbapenems ; **ATCC:** American Type Culture Collection.

2.4 Preparation of crude extracts

The samples were collected, dried, and ground into a plant powder, which underwent several extractions using a method described by^[13], adapted for this study. To defat the plant material, 25 g of each powder was macerated in 250 mL of hexane for 24 hours under magnetic stirring. The residues were dried on filter paper, weighed, and then placed in 250 mL of 70% (v/v) ethanol. After 24 hours of maceration with stirring, the filtrates were evaporated using a rotary evaporator (Rotavapor) at 40°C to remove the alcohol and then dried in a fume hood to obtain the 70% (v/v) ethanolic extracts for each plant part. These extracts were stored in sterilized glass jars in a refrigerator.

2.5 Preparation of the inoculum for solid medium tests

Using a Pasteur pipette fitted with a bulb, two isolated colonies from a 24-hour Petri dish culture on selective medium were collected and emulsified in 2 mL of 0.85% NaCl suspension. The optical density was adjusted to a 0.5 McFarland standard using a densitometer. A 10 µL volume was diluted in 10 mL of physiological saline (0.9% NaCl), thereby forming the bacterial inoculum, estimated at 10⁶ bacteria/mL.

2.6 Tests of microbial sensitivity to extracts

Prior to any biological evaluation, the sterility of the extracts was verified to ensure the absence of microbial contamination. Agar well diffusion and broth macrodilution methods were used to conduct the tests.^[14] Petri dishes containing Mueller-Hinton agar (MHA) were inoculated with the bacterial suspension using a swab. Fifty microliters of extract solution (prepared at 50 mg/mL) were dispensed into wells cut into the agar.^[15] The plates were incubated at 37°C for 24 hours. Following incubation, the diameter of the inhibition zone around each well was measured using a caliper (Figure 1). The efficacy of the extracts was assessed based on the criteria established by.^[16] According to these authors, a substance is considered ineffective if the inhibition zone diameter (IZD) is less than 8 mm, and effective if the IZD is between 9 and 14 mm. It is deemed highly effective when the IZD is between 15 and 19 mm, and extremely ...effective if it exceeds 20 mm.

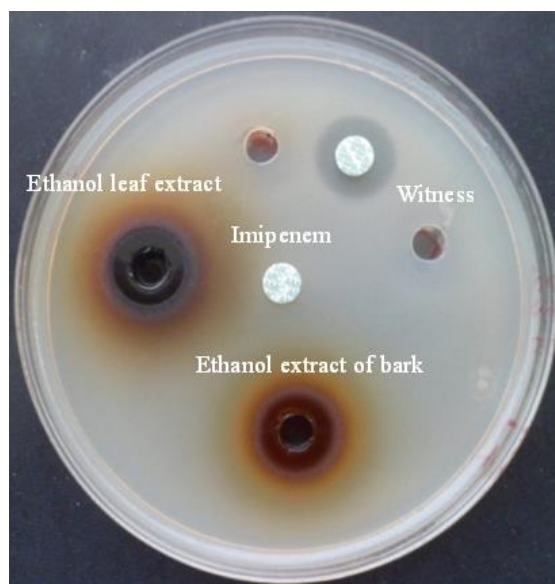


Figure 1: Antibacterial activity of 70% Ethanolic Extracts of *Spondias Mombin* Leaves and Trunk Bark, and of Antibiotics, against *P. Aeruginosa* 891C.

2.7 Preparation of the inoculum for liquid medium tests

Young 24-hour cultures were sampled and emulsified in a test tube containing 10 mL of sterile Mueller-Hinton broth. The mixture was incubated at 37°C for 3 hours. Following this incubation, a 0.3 mL suspension of this preculture was diluted in 10 mL of sterile Mueller-Hinton broth and then homogenized.

2.8 Preparation of the concentration range for MICs

A starting concentration of 50 mg/mL was prepared by dissolving 500 mg of extract in 10 mL of sterile distilled water. A twofold serial dilution method was used, involving successive dilutions with a common ratio of 2. This resulted in concentrations ranging from 50 mg/mL to 0.095 mg/mL.^[17]

2.9 Determination of antibacterial parameters

The anti-*Pseudomonas* parameters were determined using the liquid medium macro-dilution method, adapted from the protocol described by.^[11] In a series of 10 hemolysis tubes, 0.2 mL of each extract concentration was combined with 1.8 mL of bacterial inoculum. This procedure resulted in a 1:10 dilution of the initial solutions, yielding a final concentration range of 5 to 0.019 mg/mL. A growth control was prepared by substituting the extract with 0.2 mL of sterile distilled water, while a sterility control contained only 2 mL of sterile Mueller-Hinton broth. After incubation at 37°C for 24 hours, the Minimum Inhibitory Concentration (MIC) was defined as the lowest extract concentration at which no bacterial growth was visible to the naked eye. The Minimum Bactericidal Concentration (MBC) defined as the concentration resulting in a viable bacterial count less than or equal to 0.01% of the initial inoculum was determined by colony counting. Initially, serial dilutions (ranging from 10^{-1} to 10^{-4} of the starting inoculum) were streaked onto Mueller-Hinton agar (MHA) in 5 cm-long lines using a calibrated 2 μ L loop (set of plates A) and incubated at 37°C for 24 hours. After reading the MIC, the contents of all tubes showing no visible turbidity were streaked using the same method (set of plates B) and incubated under identical conditions. The MBC was established by comparing colony counts between plates A and B, thereby identifying the lowest extract concentration that reduced the initial bacterial load by 99.99%.

The MBC/MIC ratio was used to characterize the mode of action of the extracts.^[18] According to this author, if the MBC/MIC ratio is less than or equal to 2, the substance is considered bactericidal; conversely, if it is greater than 2, the substance is considered bacteriostatic.

2.10 Phytochemical screening

The detection of various chemical compounds in the extracts was carried out using thin-layer chromatography (TLC) following the method described by.^[11] This method enables the detection of several groups of secondary metabolites through specific color reactions, observed either in the visible range or at a specific wavelength.^[19] A 10 mg mass of extract

was dissolved in 1 mL of absolute methanol to obtain a 10 mg/mL solution. Ten microliters (10 μ L) equivalent to 100 μ g of this solution were spotted onto a silica gel F₂₅₄ plate (stationary phase) using a microcapillary tube. The chromatograms were developed in chambers pre-saturated with the eluent (mobile phase): CHCl₃-MeOH-H₂O (65:35:5 v/v/v), and then dried. The plates were examined before and after visualization, either in the visible range or under a UV lamp at 254 and 366 nm. The retention factors (R_f) of the observed spots were calculated using the following formula.

$$R_f = \frac{\text{Distance traveled by the compound}}{\text{Distance traveled by the compound solvent}}$$

2.10.1 Terpenoids and saponins

These compounds were detected using Godin's reagent. This is a versatile reagent that allows for the detection of several compounds. After heating the plate sprayed with Godin's reagent, terpenes appear violet and saponins appear blue. Potassium hydroxide reagent also allowed for the characterization of terpenes (violet) and saponins (blue) in the visible range after heating the chromatogram.^[20]

2.10.2 Alkaloids

Dragendorff's reagent allows for the detection of alkaloids. After spraying the chromatogram with this reagent, alkaloids were observed as orange spots in the visible range.

2.10.3 Polyphenols

Polyphenols were characterized using 10% Folin-Ciocalteu reagent. The chromatogram was sprayed with the 10% Folin-Ciocalteu reagent. After heating, blue spots observed in the visible range indicated the presence of polyphenols.^[21]

2.10.4 Flavonoids and sesquiterpene lactones

Flavonoids were detected by spraying the chromatogram with a 5% (w/v) ethanolic solution of aluminum chloride. The sprayed chromatogram was then gently heated before being observed in the visible range and under UV light at 366 nm. The presence of flavonoids is indicated by yellow spots. As for sesquiterpene lactones, they are indicated by fluorescence of various colors at 366 nm, which sometimes takes time to appear.^[22]

2.10.5 Coumarins

Coumarins were detected using 5% lead acetate. This reagent was sprayed onto the chromatogram. Observation under UV light at 366 nm revealed the coumarins, which appeared as blue or green spots.

2.10.6 Tannins

Tannins in the plant extracts were characterized using a ferric chloride solution. To do this, a 10% ferric chloride solution was sprayed onto the chromatogram, which was then observed under visible light. Spots of various colors (blue, green, black) indicated the presence of tannins.

2.10.7 Anthraquinones and anthrones

Anthraquinones and anthrones were detected using a 5% ethanolic potassium hydroxide solution. This solution was sprayed onto the chromatogram. Red spots observed under visible light and at 366 nm confirmed the presence of anthraquinones.^[23]

2.11 Statistical analysis of results

Analysis of variance (one-way ANOVA) followed by Tukey's test was used to compare MIC values among themselves and MBC values among themselves, and to determine whether the activities of the hydro-ethanolic extracts from *Spondias mombin* leaves and trunk bark were statistically influenced by bacterial phenotypes. Prior to this, equality of variances was verified using Bartlett's test. Results were expressed as means $\pm$ standard deviations. Probability values of $P < 0.05$ were considered statistically significant. Statistica 8 software was used to perform these statistical tests.

3. RESULTS

3.1 Antibacterial activity

The hydro-alcoholic extracts were active against all strains studied, with mean inhibition zone diameters ranging from 19.33 ± 1.0 to 14.85 ± 0.9 mm for the 70% ethanol leaf extract and from 18.51 ± 1.6 to 15.00 ± 1.6 mm for the trunk bark extract (Figure 2). The highest values for both extracts were obtained against the *P. aeruginosa* 1060C strain. This strain, isolated from the tip of a catheter used on a patient with urinary retention, is resistant to carbapenems due to a porin D2 deficiency.

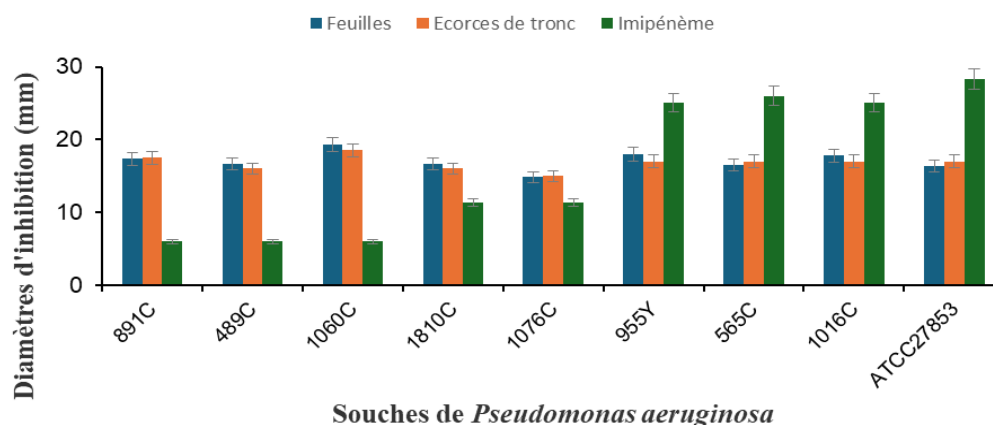


Figure 2: Activity of hydroethanolic extracts from *S. mombin* leaves and trunk bark (mean ± SD) against *P. aeruginosa* strains.

Regarding antibacterial parameters, turbidity caused by bacterial growth decreased in inverse proportion to the extract concentration in the experimental tubes. The experiment revealed that the 70% ethanolic leaf extract exhibited minimum inhibitory concentrations (MICs) ranging from 0.19 to 0.78 mg/mL, indicating a bactericidal effect against 100% of the bacteria. In contrast, MICs for the bark extract ranged from 0.19 to 1.56 mg/mL, indicating a bactericidal effect against 62.5% of the strains.

Minimum bactericidal concentrations (MBCs) ranged from 0.19 to 1.56 mg/mL for the leaf extract and from 0.39 to 1.56 mg/mL for the trunk bark extract (Table 2).

Table 2: MIC and MBC of *Spondias Mombin* Extracts against *Pseudomonas Aeruginosa* Strains.

Strain codes	70% ethanolic extract of the leaves				70% ethanolic extract of trunk bark			
	MIC (mg/mL)	MBC (mg/mL)	$\frac{MBC}{MIC}$	Power	MIC (mg/mL)	MBC (mg/mL)	$\frac{MBC}{MIC}$	Power
891C	0,39	0,39	1	Bcide	0,39	1,56	4	Btique
489C	0,78	0,78	1	Bcide	1,56	1,56	1	Bcide
1060C	0,19	0,39	2	Bcide	0,78	0,78	1	Bcide
1810C	0,78	1,56	2	Bcide	0,39	1,56	4	Btique
1076C	0,78	1,56	2	Bcide	0,78	1,56	2	Bcide
955Y	0,39	0,39	1	Bcide	0,78	1,56	2	Bcide
565C	0,19	0,19	1	Bcide	0,39	1,56	4	Btique
1016C	0,19	0,19	1	Bcide	0,78	1,56	2	Bcide
(ATCC 27853)	0,19	0,19	1	Bcide	0,19	0,39	2	Bcide

Btique : Bacteriostatic ; Bcide : Bactericidal.

3.2 Statistical analysis

The statistical analysis performed in this study allowed for the assessment and comparison of mean values ($\pm$ standard deviations) obtained for wild-type bacterial strains (*P. aeruginosa* 955Y, 565C, and 1016C) and resistant-phenotype bacteria treated with extracts from each organ. Analysis of variance showed that the differences observed in MIC and MBC values were not significant at the 0.05 level (Tables 3 and 4; $P > 0.05$).

Table 3: Comparison of Mean Values (mean $\pm$ SD of three trials) of MIC and MBC of the 70% Ethanolic Extract of *Spondias Mombin* Leaves according to Bacterial Strain Phenotypes.

Antibacterial parameters	Wild-type bacterial strains	Resistant bacterial strains	P-value
MIC (mg/ml)	0,256 $\pm$ 1,0	0,584 $\pm$ 0,3	P > 0,05
MBC (mg/ml)	0.256 $\pm$ 0,9	0,936 $\pm$ 0,5	P > 0,05

Table 4: Comparison of Mean Values (mean $\pm$ SD of three trials) of MIC and MBC for the 70% Ethanolic Extract of *Spondias Mombin* Stem Bark, according to Bacterial Strain Phenotypes.

Antibacterial parameters	Wild-type bacterial strains	Resistant bacterial strains	P-value
CMI (mg/ml)	0,651 $\pm$ 1,1	0,781 $\pm$ 0,4	P > 0,05
CMB (mg/ml)	1.56 $\pm$ 0,3	1,405 $\pm$ 1,2	P > 0,05

3.3 Phytochemical screening

The results of these tests revealed the presence of eight (8) groups of phytoconstituents. These compounds were detected using Godin's reagent, 10% Folin-Ciocalteu reagent, Dragendorff's reagent, 5% lead acetate, 10% ferric chloride, 5% aluminum chloride, and 5% potassium hydroxide, observed under visible light or UV light at 366 nm before and after visualization. The identified compounds include polyphenols, flavonoids, anthrones, sesquiterpene lactones, tannins, coumarins, saponins, and terpenes (Table 5).

Table 5: Phytochemicals Identified in 70% Ethanolic Extracts of *Spondias Mombin* Leaves and Trunk Bark.

Chemical compounds	70% ethanolic extract of the leaves	70% ethanolic extract of trunk bark
Saponins	+	+
Tannins	+	+
Coumarins	+	+
Alkaloids	--	--

Flavonoids	+	+
Terpenes	+	+
Sesquiterpene lactones	+	+
Polyphenols	+	+
Anthrones	+	+

+ : present ; - : Absent

4. DISCUSSION

The antibacterial activity of the 70% (v/v) ethanolic extract from the leaves and trunk bark of *Spondias mombin* was evaluated against the *in vitro* growth of eight clinical strains of *Pseudomonas aeruginosa*, comprising five resistant strains, three susceptible strains, and one reference strain. The tests revealed remarkable activity by all extracts against the bacteria in general, but particularly against the multidrug-resistant strain *P. aeruginosa* 1060C. Indeed, the largest mean inhibition diameters were observed with this strain: 19.33 ± 1.0 mm for the 70% ethanol leaf extract and 18.51 ± 1.6 mm for the trunk bark extract. Consequently, this strain proved to be the most susceptible to the action of the extracts. These results demonstrate remarkable activity, as according to^[24] criteria for the solid-medium diffusion method an extract is considered active if it produces an inhibition zone of at least 10 mm, a threshold easily surpassed by the various extracts. This high efficacy suggests that the active principles responsible for the biological activity are highly soluble in the ethanol-water mixture, or that there is a synergistic effect among the various compounds.^[25] Furthermore, these observations corroborate the work of^[26] on *Annona senegalensis*, which also found superior antibacterial performance in hydroalcoholic extracts. This consistency in results may be attributed to the shared use of cold maceration as the extraction method. Regarding antibacterial parameters (MIC and MBC), the lowest concentration at which the inhibitory action of the 70% (v/v) ethanolic extracts began to manifest was 0.19 mg/mL. This value confirms the efficacy of the extracts observed during susceptibility testing. Furthermore, the notable bactericidal activity of the leaf extract against 100% of the bacteria and that of the bark extract against 62.5% of the strains suggests that the identified secondary metabolites, which contribute to the chemical complexity of the extracts, may enable them to overcome the multidrug-resistance mechanisms of these bacteria. These results align with those of^[27], who demonstrated the antibacterial activity of *Spondias mombin* leaves and stem bark. This bactericidal potential of *Spondias mombin* could explain its use in African pharmacopoeia to treat dental caries and Buruli ulcer, a condition in which *P. aeruginosa* is known to act as a secondary infecting agent.^[28]

Overall, the mean inhibition diameters obtained for both the leaves and the trunk bark were quite similar. A one-way analysis of variance (ANOVA 1) was used to statistically evaluate and compare the mean values for the different plant parts across all selected bacterial strains. This analysis revealed that the differences observed between the extracts from the two plant parts were not statistically significant at the 5% level. In other words, while the values differ, they produce the same effects on the bacteria. This confirms a synergistic or complementary action among the various chemical constituents of the plant responsible for the observed anti-*Pseudomonas* activity. Phytochemical investigations revealed the presence of eight major groups of chemical compounds, including polyphenols, flavonoids, anthrones, sesquiterpene lactones, tannins, coumarins, saponins, and terpenes. These phytocompounds underlie the pharmacological effects observed with the use of this plant and, consequently, determine its therapeutic value. These results differ from those of^[29], who reported the presence of alkaloids in *Spondias mombin* leaves harvested in Brazil. This discrepancy may be attributed to the use of different detection methods: the authors employed test-tube characterization, whereas this study utilized thin-layer chromatography. Indeed, thin-layer chromatography is more precise and arguably more reliable than test-tube characterization, which is prone to false-positive results.^[30] Similarly, the findings of^[31] regarding the presence of alkaloids in this plant differ from the current results. This difference may stem from the plant part analyzed; those authors studied *Spondias mombin* fruit, whereas the present study utilized leaves and trunk bark. The flavonoids found in this plant species are secondary metabolites with significant antibacterial activity; being rich in phenolic groups, they can bind to specific proteins and enzymes, thereby disrupting enzymatic balance. Similarly, saponins are known for their anti-inflammatory, anti-edema, analgesic, and antibacterial effects,^[32] as are tannins both gallic and catecholic which are recognized for their antiseptic, bactericidal, and astringent properties.^[33] The presence of these chemical compounds, acting either synergistically or complementarily, would account for the traditional use of *Spondias mombin* in treating infectious diarrhea, superinfected boils,^[34] and other *Pseudomonas*-related conditions.

These results scientifically validate the traditional medicinal use of *Spondias mombin* by highlighting its phytochemical potential and its efficacy against antibiotic resistance. Furthermore, the combined action of these plant extracts and conventional antibiotics offers promising prospects for enhancing the effect of standard therapies and overcoming the defense mechanisms of multidrug-resistant strains.

5. CONCLUSION

The aim of this study was to evaluate the efficacy a crucial step in the development of phytomedicines of *Spondias mombin*, a medicinal plant commonly used in the Ivorian pharmacopoeia. The results confirmed remarkable antibacterial activity of 70% ethanolic extracts from the plant's leaves and trunk bark against various strains of *Pseudomonas aeruginosa*. Determination of MIC and MBC values revealed a bactericidal effect on the majority of bacterial strains, demonstrating the extracts' efficacy. Furthermore, the major classes of chemical compounds likely responsible for the plant's therapeutic potential were identified; these appear to act synergistically or complementarily. Consequently, further ethnopharmacological and safety studies on *Spondias mombin* are warranted, as it holds promise for the treatment of microbial infections.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration with all the authors mentioned. They participated in all stages of the manuscript's development, up to its final version. They have therefore read and approved the final manuscript.

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