

IN VITRO ANTIBACTERIAL ACTIVITY OF MANGROVE PLANT KANDELIA CANDEL (L.) DRUCE (RHIZOPHORACEAE)

Jasna T. K.* Khaleel K. M. and Rajina M.

Department of Post Graduate Studies and Research in Botany, Sir Syed College,
Taliparamba, Kannur, Kerala, India, 670142.

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*Corresponding Author

Jasna T. K.

Department of Post
Graduate Studies and
Research in Botany, Sir
Syed College, Taliparamba,
Kannur, Kerala, India,
670142.

ABSTRACT

The present study investigated the antibacterial activity of leaves and bark of *Kandelia candel* using petroleum ether, chloroform, acetonitrile and water extract against bacteria such as *Escherichia coli*, (ATCC 25922) *Pseudomonas aeruginosa*, (ATCC 27853) *Streptococcus mutans* (MTCC 890) and *Staphylococcus aureus* (ATCC 25923). The *Kandelia candel* possessed higher antibacterial potency, with which the highest activity was recorded in bark extract. The water and acetonitrile leaf extract (20 mm) showed highest zone of inhibition against *E. coli* followed by water and acetonitrile bark extract (16mm). All the four extract of bark shows good zone of inhibition (16 mm-20 mm) against the pathogen *Pseudomonas aeruginosa*. Bark shows greater zone of inhibition than leaf extracts. Petroleum ether leaf

extract shows highest zone of inhibition (20 mm) against *Staphylococcus aureus* and water extract shows no inhibition.

KEYWORDS: Mangrove, *Kandelia Candel*, Soxhlet Extraction, Antibacterial Activity.

INTRODUCTION

The Rhizophoraceae family belongs to the red mangrove, contains about 16 genera and 120 species, which can be found in tropical and subtropical parts of the world. Mangrove plants have been used traditionally and extracts from mangrove species have proven inhibitory activity against human, animal and plant pathogens. Mangroves are rich sources of secondary metabolites like alkaloids, phenolics, steroids and terpenoids and have pharmacological and ecological importance (Bandaranayake, 1998; Bandaranayake, 2002). Mangroves are group of plants that grow in estuarine environment, are source of natural products like alkaloids,

flavonoids, glycosides, saponins, tannins, etc., and are known to exhibit antiviral, antibacterial and antifungal activities (Bhimbaet *al.*, 2010).

Mangroves are salt tolerant plants of tropical and sub-tropical intertidal regions of the world and they contain biologically active antimicrobial compounds. The leaf extract of *A.officinalis* shows antibacterial effects and this can be used for cancer treatment as to inhibiting cancer cell growth (ValentinBhimbaet *al.*,2010). Mangroves and mangrove associates are used as medicine to treat various human diseases. *Bruguiera cylindrica*, *Ceriops decandra*, *Lumnitzera racemosa*, *Rhizophora apiculata*, and *Rhizophora mucronata* used against malaria and the ethanolic extract of bark of *R. mucronata* exhibited high antiplasmodial activity (Sundaram Ravikumaret *al.*,2010)

MATERIALS AND METHODS

Plant materials

Leaves and bark of *Kandelia candel* were collected from Pazhyangadi of Kannur district.

Preparation of plant extracts

Fresh leaves and bark of plant were washed thoroughly in distilled water and dried under shade. Dried plant materials were then crushed into fine powder with the help of a mechanical grinder and stored in air tight containers at room temperature. Bark and leaf sample were then extracted sequentially with petroleum ether, chloroform, acetonitrile and water in a Soxhlet apparatus. The obtained extracts were concentrated to dryness by evaporating the solvents and are used for further investigation.

Test organisms

The bacterial strains used for the study are: *Escherichia coli* (ATCC 25922), *Pseudomonas aeruginosa*(ATCC 27853), *Streptococcus mutans*(MTCC 890) and *Staphylococcus aureus*(ATCC 25923).

Evaluation of antibacterial activity

The crude extracts dissolved in DMSO at different concentration were screened against bacterial strains. Antibacterial activities of the extracts were determined by using agar well diffusion method. Petriplates containing 20ml Muller Hinton Agar Medium were seeded with bacterial culture of *Escherichia coli*, *Pseudomonas aeruginosa*, *Streptococcus mutans* and *Staphylococcus aureus*(growth of culture adjusted according to McFards Standard, 0.5%).

Wells of approximately 10mm was bored using a well cutter and sample of 25, 50 and 100 µg concentrations were added. The plates were then incubated at 37°C in a biological incubator for 24 hours. The antibacterial activity was assayed by measuring the diameter of the inhibition zone formed around the well (NCCLS, 1993). Streptomycin was used as a positive control.

RESULTS AND DISCUSSION

The leaf and bark extract was tested for the antibacterial activity against bacteria including *Escherichia coli*, *Pseudomonas aeruginosa*, *Streptococcus mutans*, *Staphylococcus aureus*. The water and acetonitrile extract of leaves showed highest zone of inhibition (20 mm) against *E.coli* followed by water and acetonitrile extract of bark (16mm). All the four extract of bark shows good zone of inhibition (16 mm-20 mm) against the pathogen *Pseudomonas aeruginosa*. Bark shows highest antibacterial activity than leaf extracts. Petroleum ether extract of leaf shows highest zone of inhibition (20 mm) against *Staphylococcus aureus* and water extract shows no inhibition. This antibacterial activity might be due to the active components which are present in plant extracts. Extracts from mangrove plants are described to have diverse medicinal properties (Agoramoorthy *et al.*, 2007). Flavonoids are known to associate with strong antibacterial activities (Ernest K. *et al.*, 2009).

Table: 1. Antibacterial activity of the petroleum ether extract of leaf and bark of *Kandelia candel*.

Organism	Concentration in µg/ml	Zone of inhibition in mm			
		Streptomycin(10µg)	Leaf extract	Streptomycin(10µg)	Bark extract
<i>Escherichia coli</i>	25	28	Nil	28	Nil
	50		12		Nil
	100		15		Nil
<i>Pseudomonas aeruginosa</i>	25	30	Nil	30	10
	50		11		11
	100		17		16
<i>Streptococcus Mutans</i>	25	28	Nil	28	10
	50		10		10
	100		10		13
<i>Staphylococcus aureus</i>	25	30	10	27	Nil
	50		13		Nil
	100		20		10

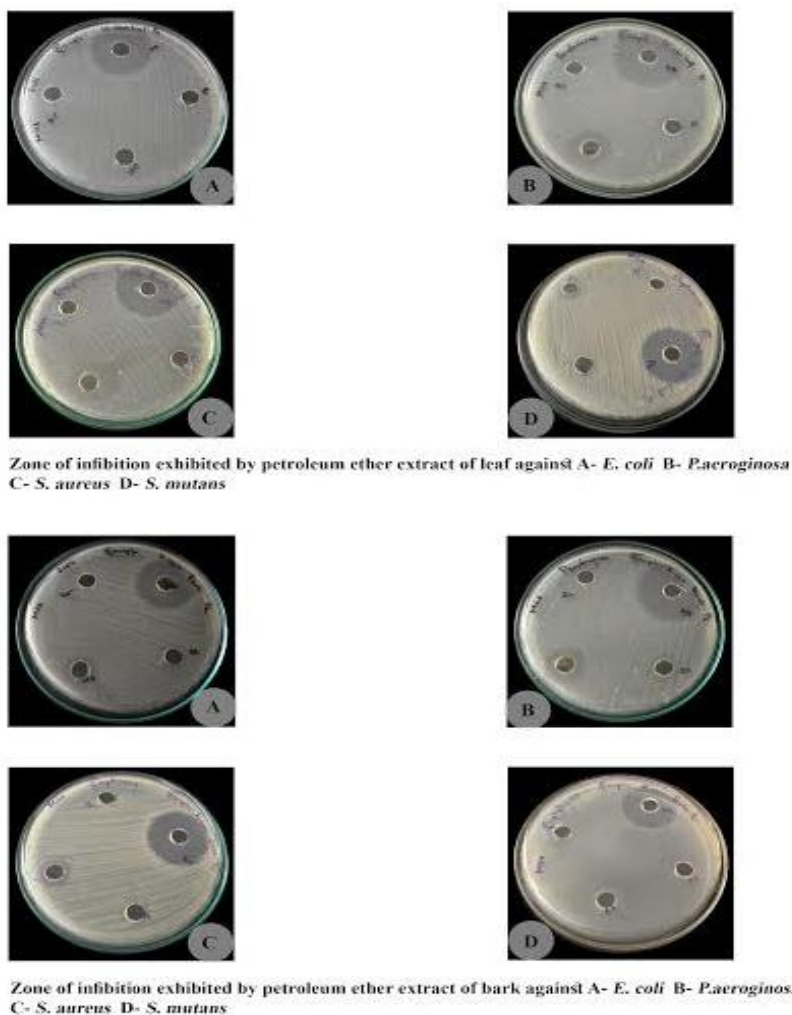


Figure: 1 Antibacterial activity of the petroleum ether extract of leaf and bark of *Kandelia candel*.

Table: 2. Antibacterial activity of the chloroform extract of leaf and bark of *Kandelia candel*.

Organism	Concentration in µg/ml	Zone of inhibition in mm			
		Streptomycin(10µg)	Leaf extract	Streptomycin(10µg)	Bark extract
<i>Escherichia coli</i>	25	28	Nil	28	Nil
	50		12		12
	100		15		15
<i>Pseudomonas aeroginosa</i>	25	30	Nil	30	Nil
	50		12		10
	100		18		16
<i>Streptococcus Mutans</i>	25	28	10	28	10
	50		10		12
	100		11		17
<i>Staphylococcus aureus</i>	25	27	Nil	27	10
	50		10		13
	100		16		17

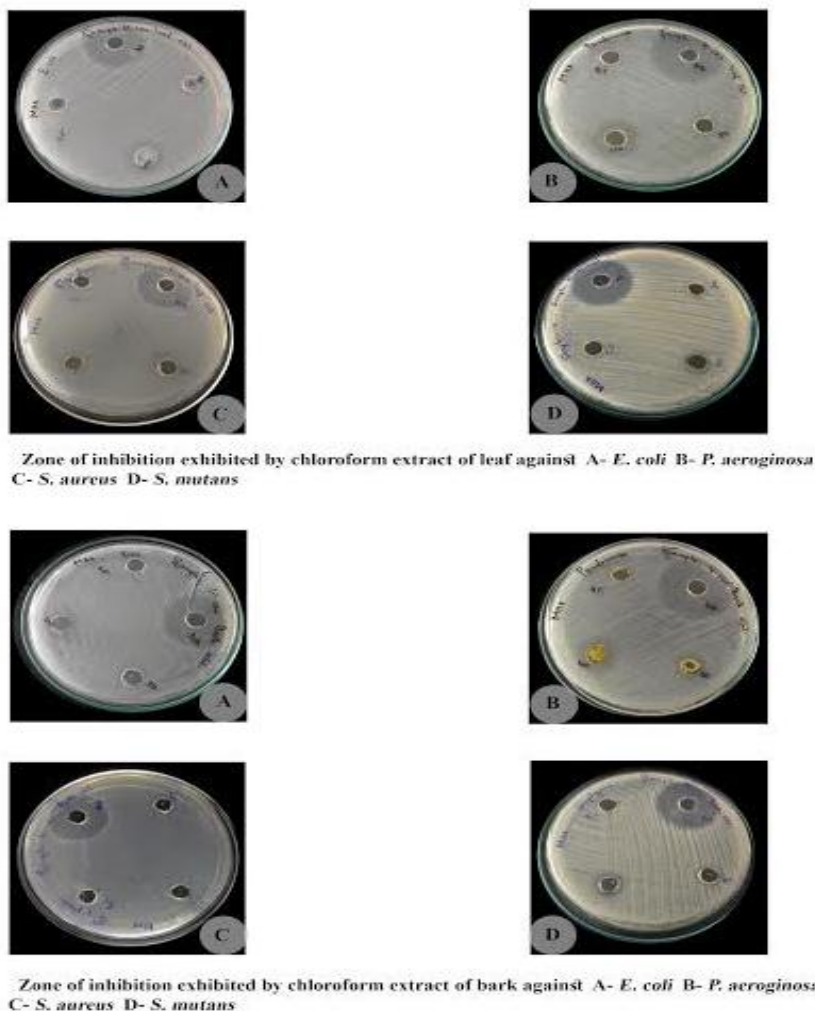


Figure: 2. Antibacterial activity of the chloroform extract of leaf and bark of *Kandelia candel*.

Table: 3. Antibacterial activity of the acetonitrile extract of leaf and bark of *Kandelia candel*.

Organism	Concentration in µg/ml	Zone of inhibition in mm			
		Streptomycin(10µg)	Leaf extract	Streptomycin(10µg)	Bark extract
<i>Escherichia coli</i>	25	28	Nil	28	11
	50		13		12
	100		20		15
<i>Pseudomonas aeruginosa</i>	25	30	Nil	30	Nil
	50		10		15
	100		15		19
<i>Streptococcus Mutans</i>	25	28	10	28	11
	50		10		13
	100		12		16
<i>Staphylococcus aureus</i>	25	28	10	28	11
	50		13		13
	100		16		16

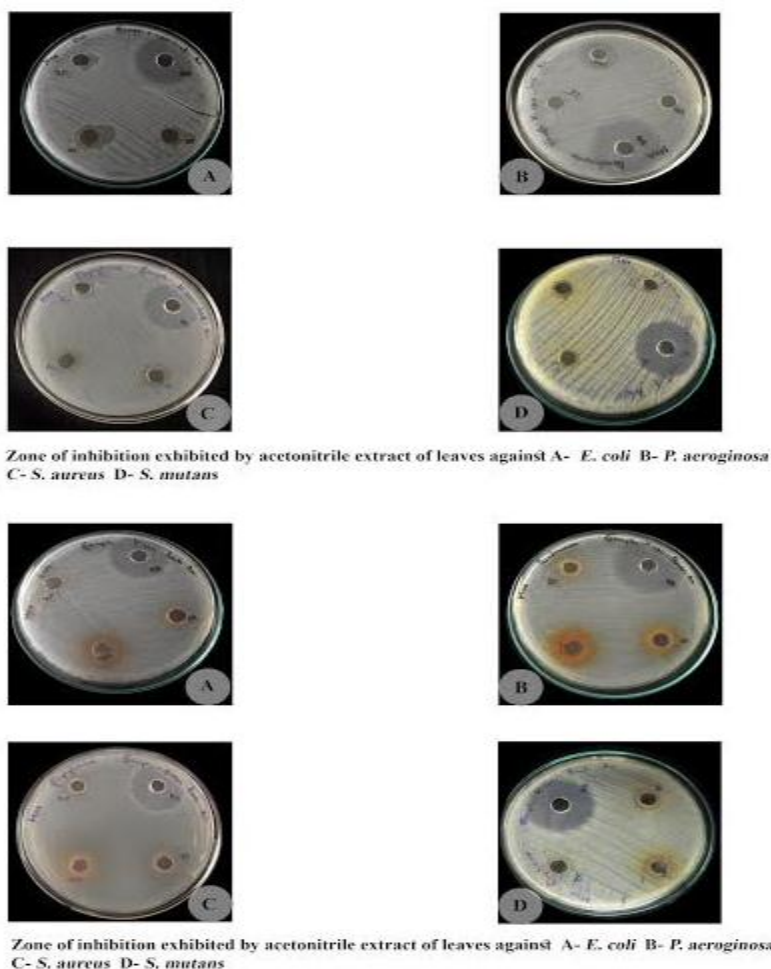
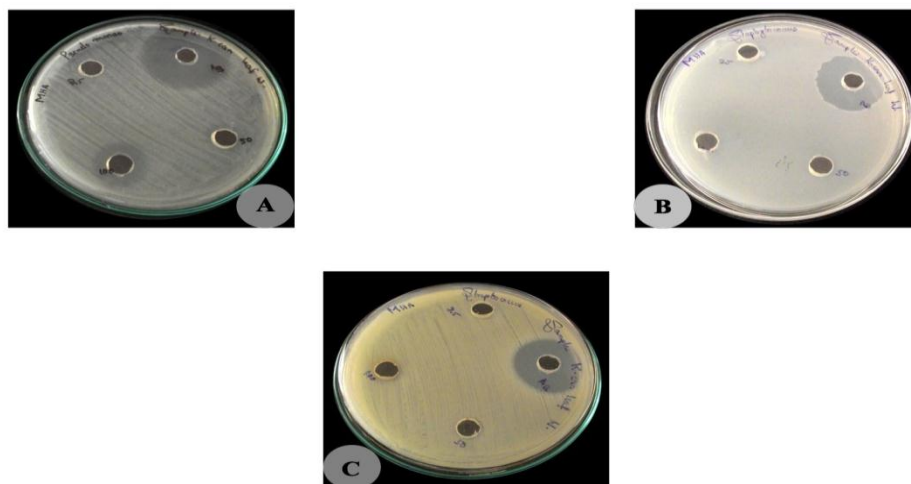


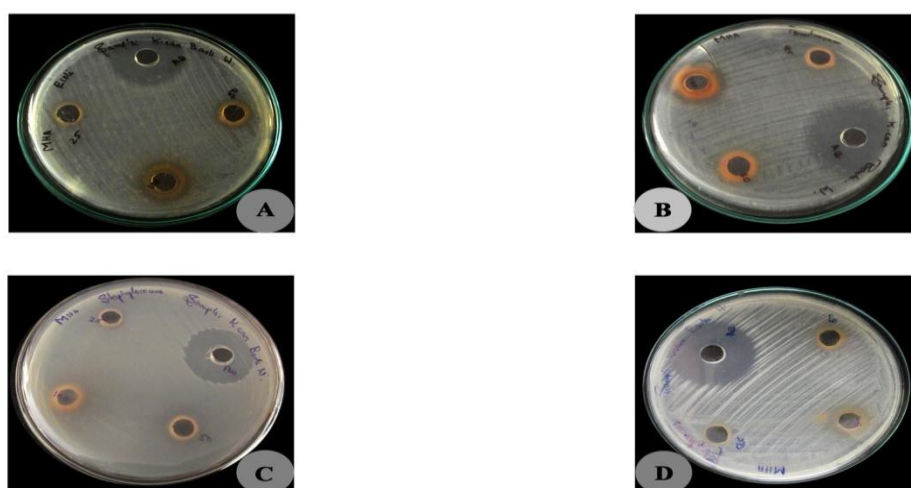
Figure: 3. Antibacterial activity of the acetonitrile extract of leaf and bark of *Kandelia candel*.

Table: 4. Antibacterial activity of the water extract of leaf and bark of *Kandelia candel*.

Organism	Concentration in µg/ml	Zone of inhibition in mm			
		Streptomycin(10µg)	Leaf extract	Streptomycin(10µg)	Bark extract
<i>Escherichia coli</i>	25	28	12	28	Nil
	50		15		13
	100		20		16
<i>Pseudomonas aeruginosa</i>	25	30	10	30	Nil
	50		12		16
	100		15		20
<i>Streptococcus Mutans</i>	25	28	Nil	28	10
	50		10		12
	100		10		16
<i>Staphylococcus aureus</i>	25	27	Nil	27	10
	50		Nil		16
	100		Nil		18



Zone of inhibition exhibited by water extract of leaves against A- *P. aeruginosa*
B- *S. aureus* C- *S. mutans*



Zone of inhibition exhibited by water extract of bark against A- *E. coli* B- *P. aeruginosa*
C- *S. aureus* D- *S. mutans*

Figure: 4. Antibacterial activity of the water extract of leaf and bark of *Kandelia candel*.

CONCLUSION

Based on the present results it is concluded that *Kandelia candel* had different level of antibacterial activity. The present studies have to develop better and safer chemotherapeutic agents from *Kandelia candel*. Further studies are needed to identify the pure compound and to establish the exact mechanism for antibacterial action of the plant extract.

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