Efficacy of Bioactive Metabolites from Marine Bacteria against Selected Multi-Drug Resistant Gram Negative Bacteria

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INTRODUCTION

Antibiotics are secondary metabolites used for the treatment of bacterial infections. Despite the rich diversity in the marine environment, the exploration of marine-derived compounds for combating pathogens remains underdeveloped. The marine environment in Nigeria has not been adequately explored for the discovery of natural products, and thus has the potential of yielding microorganisms that can synthesise novel bioactive compounds. The study was designed to determine the efficacy of bioactive metabolites from marine bacteria against selected Multi-Drug Resistant (MDR) bacteria. .

METHODOLOGY

- Sea water and sea sediment samples were collected from Ibom Deep (n=6 each), Asasa West (n=5 each) and Udibe seaports (n=6 each) in Akwa Ibom State, Nigeria.

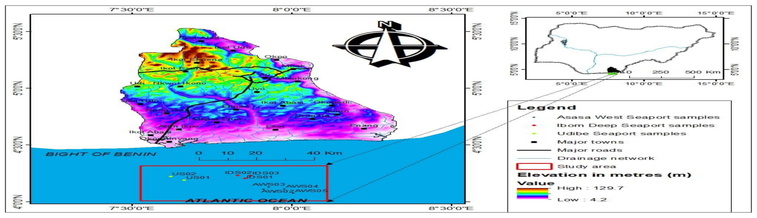

Figure 1: Map of study area and sampling points

- Isolation of bacteria was done using starch casein nitrate agar.
- Pure cultures of isolates were screened for antagonistic activities against eight Multi-Drug Resistant (MDR) Gram negative bacteria of clinical (*Enterobacter cloacae*, *Aceinetobacter baumannii*, *Escherichia coli* and *Klebsiella oxytoca*) and environmental (*Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *Salmonella enterica*) origin using cross streaking plating technique.
- The best bioactive metabolites-producing isolates were identified using standard biochemical tests and molecular methods.

RESULTS

- A total of 152 bacteria were isolated from the water (n=65) and sediment samples (n=87), out of which 72 (47.4%) exhibited antagonistic activities (5.00-39.00 mm) against the MDR bacteria. Bioactive extract from the marine bacteria (with code SSV 122) had the highest percent activity of 87.5% across all test bacteria.

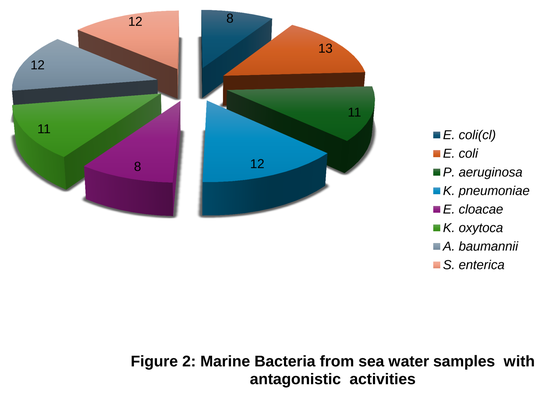

Figure 2: Marine Bacteria from sea water samples with antagonistic activities

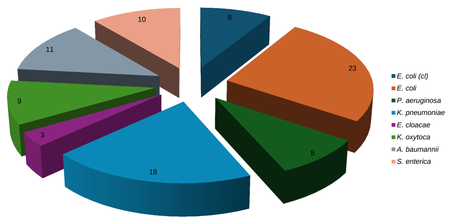

Figure 3: Isolates with antagonistic aactivities from sea sediment samples

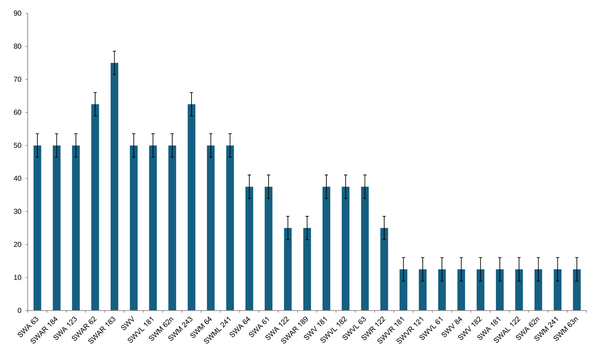

Figure 4: Percent activity of secondary metabolites from marine bacteria obtained from sea water

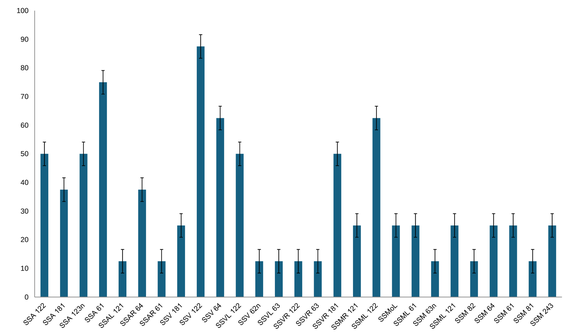

Figure 5: Percent activity of metabolites from marine bacteria obtained from sea sediment

- The Bacteria Susceptibility Index (BSI) for MDR isolates revealed that *Escherichia coli* obtained from environmental sample were more susceptible to the bioactive metabolites from the marine bacteria with the highest BSI value of 50% and the least BSI was observed for *E. cloacae* with BSI value of 15.3%.

- The results of molecular identification of marine bacteria are shown in Tables 1and 2. Twelve different organisms belonging to five different classes of microorganisms were identified and their genetic relatedness is shown in the phylogenetic tree in plate 1.

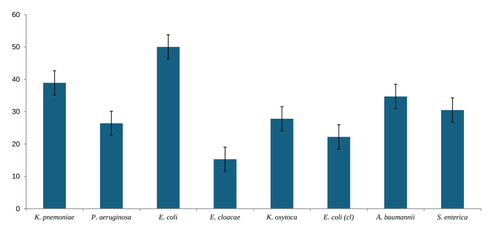

Figure 6: Bacteria Susceptibility Index of Multi-Drug Resistant Bacteria

Table 1: Molecular Identification of Gram-positive marine antibiotic-producing bacteria

Class	Isolate code	Organisms identified	Accession number
Actinomycetia	SWGIV	*Cellulosmicrobium marinum*	MW255641
	SSV 122	*Streptomyces griseus*	PP751404
	SSA 61	*Streptomyces albus*	PP751405
Bacilli	SWA61	*Lysinibacillus fusiformis*	OR673601
	SWM243	*Bacillus velezensis*	NR180225
	SSA181	*Bacillus haynesi*	PQ470048
	SSML 121	*Bacillus paralicheniformis*	PQ524685

Table 2: Molecular Identification of Gram-negative marine antibiotic-producing bacteria

Class	Isolate code	Organisms identified	Accession number
Gammaproteobacteria	SSGi	*Halomonas piezotolerans*	OR673606
	SSGiii	*Marinobacter nauticus*	NR074619
	SSML 62	*Marinospirillum perlucidum*	NR179171
Betaproteobacteria	SSV64	*Alcaligenes aquatilis*	NR104977
Flavobacteriia	SSM122	*Myroides odoratus*	OR673600

Plate 1: The Neighbour-Joining Phylogenetic Tree Based on Partial 16s rRNA Sequences of Marine Bacteria

CONCLUSIONS

- The bioactive metabolites from marine bacteria from Akwa Ibom State, Nigeria had antagonistic effects against the multi-drug resistant bacteria used in this study; thus have the potential for use in formulation of antimicrobials. This finding supports the claim that marine bacteria are rich sources of biologically active products.

REFERENCES

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- World Health Organisation. 2024. Bacterial Priority Pathogens List, 2024: bacterial pathogens of public health importance to guide research, development and strategies to prevent and control antimicrobial resistance. *Licence: CC BY-NC-SA 3.0 IGO. Cataloguing-in-Publication*