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THE ANTIMICROBIAL PROPERTIES OF MARINE-DERIVED COMPOUNDS

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Abstract
The Ocean covers more than 70% of the surface of the earth. The ocean ecosystem is vast and there is an immense potential to utilize the ocean creatures for their unconventional materials. Taking this by volume into consideration, it encompasses better than 95% of the biosphere. The ocean environment ranges from the nutrient zones to nutritionally sparse zones where scarcely a few species can survive. Many habitats of the ocean have found niches for the development of diverse kinds of life. The marine system is immensely complex, involving extreme pressure, salinity, temperature and biological habitat variations. The creatures' marine biota developed unique metabolic and physiological mechanisms that allow them to survive in harsh conditions and provide opportunities for the creation of new materials for use. But the research related to bacterial pathogens isolated from Mugil Cephalus is not being undertaken until now. Hence, the present study is hypothesised out to determine the alternative therapeutic agents from marine sources. The results were colour-based, green for live cells and red was dead cells. Dead cells were found mostly A concentration and this compound can be inhibiting cell wall synthesis.
Keywords: Antimicrobial, Properties, Marine, Derived Compounds.

1. INTRODUCTION

There are about 36,000 species of fish, or 40% of all vertebrates on Earth, and they are the first vertebrates with jaws. They are cold-blooded and have the ability to breathe through their gills. Known as the "Golden age of fishes," they spread during the Devonian era after evolving during the Ordovician era. Ichthyology is the study of fishes. In addition to being a natural supply of protein and omega-3 fatty acids, they are present in all bodies of water and are vitally important to human life. They also provide many nations with economic resources and other useful commodities [1]. The culturing and capture of the aquatic animals in saltwater contribute significantly to the fishery commodity that ends up in world markets. Around 140 metric tonnes of aquaculture and capture fisheries were produced worldwide in 2002 (FAO, 2002). The majority of fishermen in most nations find work in maritime fisheries[2]. The production of capture fisheries, which are dominated by demersal species, is dominated by the marine sector in every country[3]. The Philippines and Sri Lanka are the only two countries where pelagic species predominate in coastal fisheries landings. The two main categories of coastal fisheries are industrial or large-scale fisheries and small-scale fisheries. Small boats, both motorized and non-powered, with a variety of gears, including gillnets, trammel hook and line traps, small push nets, and seine nets, are the mainstays of small-scale fisheries. Large powered boats with a lot of storage and fishing capacity dominate the industrial fisheries. Trawlers govern large-scale fishing in Malaysia and Thailand, but boats control large-scale fishing in

India and the Philippines, which harms pelagic resources [12]. Furthermore, small-scale boats comprise more than 80% of the fishing fleet in Bangladesh, Indonesia, the Philippines, and Vietnam. Additionally, 95% in Bangladesh and 30% in the Philippines, Sri Lanka, and Vietnam are attributable to the small-scale industry. Due to the challenge of accurate monitoring, small-scale fisheries landings and their importance to food security have been undervalued in most countries. [10].

2. REVIEW OF LITERATURE

According to a review of the literature, heterocyclic chemistry started to emerge in the 1800s, coinciding with the growth of organic chemistry [4]. There was a massive surge in heterocycle research following World War II. About half of the more than six million chemicals listed in Chemical Abstracts are heterocycles. Heterocyclic chemistry is arguably the most complex and difficult area of organic chemistry, and heterocyclic molecules make up the largest and most varied family of organic substances. Heterocyclic chemistry encompasses a wide range of field-wide concerns that impact nearly every aspect of modern organic chemistry, medicinal chemistry, and biochemistry. In addition to offering a very high degree of structural variety, heterocyclic compounds have shown themselves to be very popular and profitable medications. Organic molecules classified as heterocyclic have at least one carbon atom plus at least one element other than carbon, such as nitrogen, oxygen, or sulfur, in a ring [5]. Non-carbon atoms, such as those other than carbon and hydrogen, are referred to as heteroatoms because they are typically assumed to replace carbon atoms in hetrocycles. A ring that solely has heteroatoms is referred to as a homocyclic compound, while heterocycles are the opposite of homocyclic compounds. Therefore, a heterocyclic compound is created when an atom of a matching element, such as oxygen, nitrogen, or sulfur, is added to an organic ring structure in place of a carbon atom[9]. These molecules might have non-aromatic rings or basic aromatic rings. In general, heterocyclic compounds have a stable ring structure that is difficult to hydrolyze or depolymerize. Ring strain causes increased reactivity in heterocycles with three ring atoms. One-heteroatom ones are often stable. Reactive intermediates are more likely to be found in those containing two heteroatoms [14].

3. MATERIALS AND METHODS

The Ocean encompasses over 70% of the earth‟s surface. The marine ecosystem is huge and there is a vast potential to utilize the ocean‟s organisms for their novel materials. By considering this by volume, it accounts for better than 95% of the biosphere. The marine ecosystem varies from nutrient-dense areas to nutritionally barren places where few organisms can live. All of the marine environments have developed niches for the living organisms to diversify[6]. Marine organisms have discovered their environment immensely complex, made up of extreme pressure, salinity, temperature, and biologic habitats gradients. Marine life has developed extraordinary metabolic and physiologic processes that not just guarantee survival in extreme environments but also offer a chance for new product production to be harnessed. However, the research works on bacterial pathogens isolated from Mugil cephalus are not undertaken till date. Hence, the present work is mooted out to search for the alternative medicines from the marine materials. Marine microorganisms offer very good chances for antibiotic discovery [13], but that perhaps is still to be achieved. Despite having a huge microbial diversity, cultures of the most diverse microbes in the lab are absent and seriously limit bio discovery research growth. When using the traditional microbiological technique of electroplating a sample onto selective media more than 30 years ago, it became evident that there were more bacteria in the surface ocean than were being cultivated[7]. The challenge for microbial ecologists has been to characterize the high bacterial density seen by epifluorescence microscopy, such as in a sample stained with DAPI. The application of molecular biology techniques in marine microbial ecology led to the most significant advancements, and these techniques have radically altered our comprehension of environmental bacteria. Drug discovery typically focuses on marine natural ingredients, which have produced a variety of beneficial medicinal compounds. Lead compounds with biomedical significance have been discovered in bacteria, fungus, and marine invertebrates. Only 13 molecules have made it into the clinical pipeline thus far, out of thousands of compounds that demonstrate a panel of biological functions that arrive every year. One of the four compounds approved for clinical use is exclusive to the European Union. The approved compounds include a cone snail peptide, a tunicate metabolite, and two nucleosides that are derived from sponge nucleosides. Marine microorganisms have gained more attention as a source of bioactive metabolites and hold great promise for expanding the range of marine natural products available in clinical settings. The purification of slower-growing macroorganisms typically makes it easier to achieve an economical and defendable supply of the active pharmaceutical ingredient (API) for compounds generated by microbial fermentation techniques. Two new reviews are published on bacterial-derived marine natural products: one on symbiotic bacteria and the other on marine microbes as therapeutic leads in general. Ascidian bryozoan symbionts, marine actinomycetes, and cyanobacteria are discussed separately in this volume.

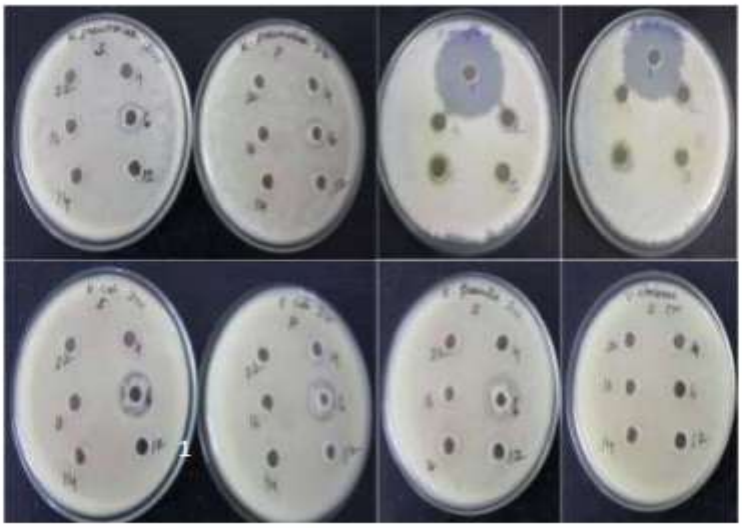
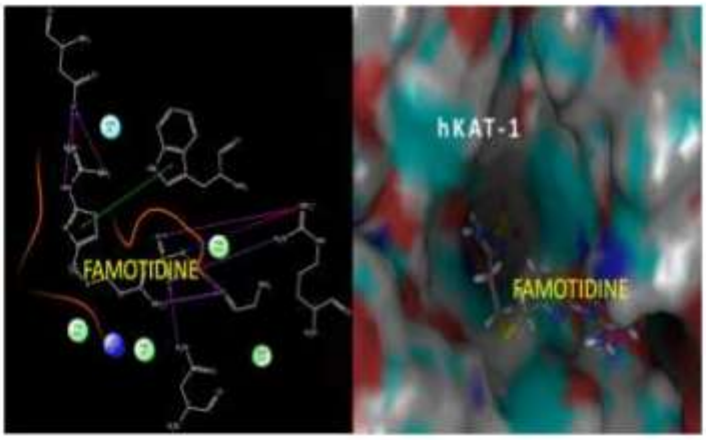


Figure 1: Diffusion method

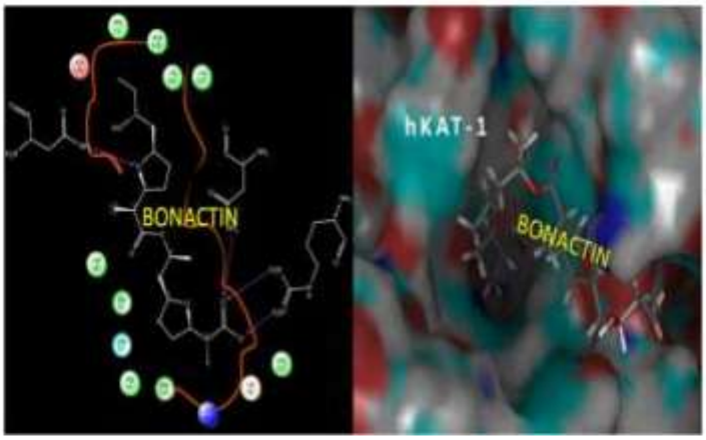
The discovery of marine natural products is establishing the relative status of marine invertebrates and their bacterial symbionts to real compound production in the invertebrates, despite the discipline's occasionally severe and contentious nature. The difficulty of conclusively attributing compound formation to either the host, the symbionts, or both is demonstrated by the fact that the subject has been debated for centuries. There is some circumstantial evidence that the distant compounds from the invertebrates may be bacterial in origin due to the striking structural similarity that has been observed between some invertebrate-derived compounds of taxonomically different groups and the bacterial analogues. However, this is not very strong because bacteria produce a wide variety of structural compounds. Since bioactive metabolites are only being created by one cell to have an effect elsewhere, the localization of certain chemicals in symbiotic or invertebrate cells is also insufficient evidence. The isolation of symbionts and the demonstration of chemical creation by microorganisms on pure philosophy on artificial media provide the strongest proof. There are very few examples of this being accomplished, and there are still difficulties in extending and modifying biosynthesis outside of the host. Molecular approaches have offered strong circumstantial evidence. It is noteworthy that around 50% of these substances have a clear or probable bacterial origin. This offers solid proof of the value of looking for microbial origins in order to find marine natural compounds. However, the fact that some compounds that were initially obtained from invertebrates were later discovered to be of bacterial origin does not mean that all or even the majority of compounds produced from invertebrates are of bacterial origin. Validating bacterial production and demonstrating the possibility for sustainable production may increase the likelihood that a particular lead will proceed to clinical trials. We believe that the relative significance of marine invertebrates and their microbial symbionts as bioactive chemical makers is still up for debate and should be decided case-by-case.

4. RESULT AND DISCUSSION

Combinatorial chemistry has been heavily engaged in by pharmaceutical companies as a means of creating new medications [15]. Due to this strategy's failure to produce the novel medications that were expected, the majority of big pharmaceutical companies have now introduced significantly fewer substances to the market or in development than they had originally planned. Research on everyday products, which have been so successful in the past, appears to be reversing course[8]. The most significant anticancer and anti-infective compounds are found in natural products, many of which have forced the market away from chemical modification. It is conceivable that during the 3.7 billion years that nature and natural harvest have been on Earth, bioactive chemicals have been improved during that lengthy evolutionary era[11]. Research on marine microbes for biodiscovery is supported by a few generalizations. The chemical diversity of natural products is far greater than that produced by synthetic chemistry, and novel organisms may produce compounds that can act as molecular scaffolds and have multipurpose binding properties. Therefore, it would appear that techniques involving the production of very large numbers of compounds (i.e., combinatorial chemistry) are unlikely to deliver new drugs and other chemicals (the technique has at least not lived up to expectations thus far). However, the fact that it takes a long time to separate and thoroughly describe active compounds from crude extracts and that it takes a great deal of work to obtain sufficient concentrations of active molecules are the two most important problems with natural product drug discovery. Most crucially, though, it's possible that too much emphasis was placed on organisms that are simple to cultivate, and that new bacteria are needed. Culture collection screening was the common biodiscovery technique prior to the development of metagenomics and clone libraries and their functional diffusion. It is an asset that the organisms can be cultured as strains, and that their metabolism and products be defined specifically. The methods are highly developed and the products utilized presently in microbial biotechnology are being produced by isolated strains.



(a)



(b)

Figure 2: Famotidine and Bonactin bind with target protein

The 16S sequences of every maritime province are available in sizable and growing databases thanks to developments in polymerase chain reaction (PCR) and innovative sequencing technologies. The groupings of bacteria in seawater are now better understood, and we have an aim-proven approximation of relative profusion despite the many biases of molecular approaches. Indeed, one type of marine bacterium is thought to be the most prevalent organism on Earth. It has been detected in practically every saltwater sample that has been studied and is thought to make up 25% of the isolated bacterial 16S rRNA genes.

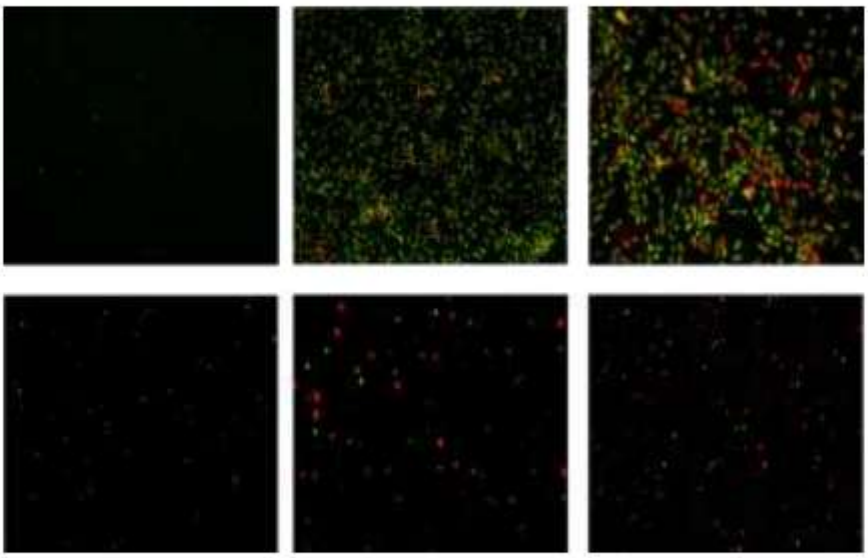


Figure: Confocal image analysis

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5. CONCLUSION

For naturally occurring bacterial strains, the increased concentration in the aquatic environment generates additional selecting pressures. Numerous antibiotic resistances in both pathogenic and healthy intestinal bacteria have most likely evolved as a result of improper antibiotic use. Antibiotic resistance can spread quickly among bacteria, and R-plasmid determinants can be transmitted in less than a minute. Excreta from humans or animals as well as sewage effluent discharge cause high antibiotic loads to quickly build up and remain in water sediments. The cell cycle duration for most bacterial organisms may be short, particularly in high temperatures which are prevalent in tropical regions. Most bacterial strains hence grow rapidly with cell cycle durations of 20–30 min. Because of their brief cell cycle, they are genetically more equipped to adapt to environmental changes and endure in unfavourable circumstances through mutations, where the adapted strains are quickly chosen. Antibiotic-resistant bacteria, multiple antibiotic resistance, pathogenic bacteria resistance, and the effectiveness of antibiotic treatments for resistant pathogen diseases in aquatic ecosystems have all dramatically increased globally as a result of human use of antibiotics. Particularly in immune-compromised hosts, infections brought on by resistant strains have a greater mortality rate than infections brought on by non-resistant strains.

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