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THE POTENTIAL OF MARINE COMPOUNDS IN ANTICANCER THERAPY

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Abstract
Marine habitat has shown to be a fascinating source of chemicals with unique and exotic chemical properties that can be used to improve the efficiency and selectivity of therapies through molecular modelling and chemical synthesis of new medications. New anticancer medications must be developed immediately because cancer is a growing public health concern, even with advancements in biomedical technology and research. More than 60% of commercially available anticancer drugs are produced from natural biomimicry, and algae are now one of the primary sources of novel marine-derived chemicals, such as cytotoxic and antitumor substances. In both in vitro and in vivo settings, these compounds showed the capacity to modify certain inhibitory effects against a variety of important cellular events, such as angiogenesis, invasion, migration, and apoptosis pathways, indicating their potential as anticancer medications. With particular attention to the alga as a source of cytotoxic chemicals, the current review addresses the bioactive algal compounds with anticancer activity, from their place of origin to their possible uses.
Keywords: Marine environment, bioactive molecules, biomimetic inspired

1. INTRODUCTION

The oceanic environment is an extremely unique resource for the discovery of novel anticancer medications because of its unfathomable chemical and biological diversity. There are currently 1,31,000 land-based natural products and about 22,000 marine natural products. Natural products emerge as the high yield source of lead with potential chemotherapeutic or chemopreventive agents of current day cancer research.1 Most drugs have been isolated from nature and researchers are still exploiting rain forest organisms in tropics for maybe useful medicinal leads[1]. Historic times show that human beings are well aware of the hazardous nature of sea animals for at least 4000 years. In the 19th century and early 20th century, cod liver oil was used as a food additive. But not until the mid-20th century did researchers begin to examine the oceans rationally for pharmaceuticals. Up to now, more than 10,000 bioactive compounds have been characterized from marine origin, and scores of new chemicals continue to be discovered every year. Plants are the most abundant source of natural goods in the terrestrial ecosystem. However, invertebrates like sponges, mollusks, bryozoans, tunicates, etc. hold this status in the marine ecosystem[2]. In addition to producing the most marine natural products at the moment, they also exhibit the most chemical diversity of natural products, including polyketides, terpenes, peptides, and alkaloids. Significantly, out of 13 natural products (or analogues thereof) currently undergoing human clinical trials as potential drug candidates, twelve are derivatives of marine invertebrates.

Marine organisms like gorgonian, sponge microbe symbiotic relationship, actinomycetes and soft coral, as well as sponges, have been explored for anticancer leads. Out of the marine invertebrates, Porifera or sponges remain the richest phylum as far as new pharmacological compounds are concerned. With over 15,000 species, marine sponges, or phylum porifera, are the most archaic multicellular creatures[3]. Sponge species are essentially filter feeders because the majority of them depend on the water that constantly passes through their porous bodies to filter organic particles and bacteria. Some, on the other hand, have also been shown to be carnivores that mostly eat small crustaceans, while others generate food and oxygen through endosymbionts[13]. Sponges and/or their symbionts produce a diverse range of secondary metabolites to fend off predators and compete for space with other sessile marine invertebrates. Sponge is known to be the most diverse source of marine natural chemicals of biological importance[10]. Breast cancer in women is a global public health concern. In both industrialized and developing nations, breast cancer is the most prevalent cancer among women. Breast cancer in women accounts for one out of every ten new malignancies diagnosed globally each year[5]. The most prevalent cancer in women and the second most common cancer globally is breast cancer.

2. REVIEW OF LITERATURE

This chapter unveils the major impact of marine sponge in research. It offers information on Spirastrella pachyspira taxonomy, distribution and bioactive compounds. The marine ecosystem which could never be found in terrestrial natural products. The oceanic environment is vastly complex, with extreme pressure, salinity, temperature, and biological habitats variations[11]. Of all the marine organism groups, the most numerous and diverse ones with soft bodies and sedentary lifestyles are the sponges. Marine sponges and other sessile invertebrates typically lack morphological characteristics; instead, they have evolved to acquire chemical defences against predators and the larval colonization of other sessile animals. Indeed, among marine organisms, marine sponges are among the most abundant suppliers of intriguing compounds[15]. As a homeostatic mechanism to keep the number of cells in tissues in balance, apoptosis is a physiological aspect of growth and aging. Apoptosis can also happen as a defence mechanism in immunological responses or when sickness or poisons cause damage to cells. Not every cell will die in response to the same stimulus, even though a wide variety of circumstances and stimuli can cause apoptosis in both physiological and pathological senses[6].

Certain hormones, including corticosteroids, can cause thymocytes to undergo apoptosis, even when they have no effect on or even stimulate other cells [4]. The intricate and sophisticated mechanisms of apoptosis involve a series of molecular reactions that are dependent on energy. According to current research, there are two main apoptotic pathways: the intrinsic, or mitochondrial, pathway and the extrinsic, or death receptor, system[7]. However, it is now understood that molecules in one channel can influence molecules in the other, and that the two pathways are interconnected. Perforin has a crucial role in another mode of T-cell-mediated cytotoxicity. Introduction: Cell Killing 9. Apoptosis can be triggered by either Granzyme B or Granzyme A via the perforin/granzyme pathway[14]. The intrinsic, extrinsic, and granzyme B pathways all combine to form the execution route. This pathway is initiated by the cleavage of caspase-3 and results in DNA breakage, disruption of nuclear and cytoskeletal proteins, protein crosslinking, creation of apoptotic bodies, synthesis of phagocytic cell receptor ligands, and finally phagocytosis by phagocytic cells[8]. A novel, caspase-independent process of cell death is initiated when single-stranded DNA is damaged by the Granzyme A pathway. The increasing demand for non-cytotoxic anticancer medicines has piqued the attention of the cancer research community in new apoptosis-inducing pharmacological leads that could eventually be transformed into potent targeted anticancer therapies[9].

2.1. Aim and objective

Hexane, chloroform, ethyl acetate, and ethanol will be used in order to extract Spirituelle pachyspira. SK-BR-3 cancer cell lines were used to examine the extracts' cytotoxic activity using the in vitro MTT assay and their antioxidant activity using the DPPH and nitric oxide radical scavenging techniques[12]. To perform the acute toxicity study according to OECD guidelines for the lead extract. To study anticancer activity of promising extract on SK-BR-3 induced breast cancer in xenograft model. Purification of active principle from the promising extract using column chromatography and characterization using various spectral studies such as IR, HNMR, CNMR and mass spectroscopy. In order to study the expression of anti and proapoptotic genes like Bax, Bcl2 and for the potential extract and isolated compound onSKBR-3 cell line.

3. MATERIALS AND METHODS

The thawed sponge was kept in ethanol and was sent to Zoological Survey of India for identification. A small piece of the sponge was cut and carried in a boiling test tube to which dilute nitric acid was added and the solution was brought to boil. The test tube was set aside after boiling for the spicules to settle down. The spicules were observed under a high-quality electron microscope with a Nikon camera. The sponge was determined by the type of spicules. The spicules indicated the occurrence of Tylo style that was straight with a well-developed rounded or globular head and various types of spirasters. After being polarity, such as methanol, hexane, chloroform, and

ethyl acetate. The extraction process continued until all of the ingredients had been used up. Whatman filter paper was utilized to filter the extract, and a vacuum rotary evaporator was employed for concentration. Dry concentrated extract was obtained and yield was calculated. The extracts were kept in desiccator for further investigations.

65% of people worldwide obtained their initial medical treatment, primarily from plant-based traditional remedies, according to World Health Organization estimates from 1985; in the developed world, this percentage was lower. Because of their special chemical characteristics, NPs have been used as scaffolds to create new compounds with great potential for use in medicine and industry. These compounds are also more specific and effective in terms of target locations because they co-evolved with biological processes. These fascinating materials are the result of interactions between live organisms and their environments, which promote the development of complex.

In contrast with life on land, the marine life lacks a documented history of conventional medical use. However, over the past half-century, the marine environment has been accessible to scientists thanks to developments in contemporary engineering and technology, including remotely operated vehicles (ROVs), manned submersible ships, and scuba diving techniques. These small-scale environments become more complicated and competitive when multiple species coexist there. Referred to as "secondary metabolites" in general, these chemical defenses are members of various chemical compound classes that have demonstrated significant therapeutic potential. As a result, marine life has been a great source of NPs, some of which have structural characteristics that are different from those of their terrestrial counterparts. Despite significant obstacles, several marine chemicals managed to reach the market and are already used in medicines, offering a helpful model for further translational research.

Therefore, medications that target a single main pathway in a cancer may not be sufficient to completely "switch off" a signature activity. Then, it's possible that some cancer cells will be able to survive by maintaining their baseline activity, which will allow their offspring to adapt to the drug's selective stress. The adaptation can be achieved through stromal microenvironment remodeling, epigenetic reprogramming, or genetic changes. Restitution of the functional ability, reconstituted tumor development, and ultimately clinical recurrence are all possible outcomes of these processes. However, there are other ways that tumor cell line drug resistance might spread, including drug efflux, drug action interference. Chemotherapy is one of the most crucial cancer treatments currently available, along with radiation therapy, hormone therapy and immunotherapy, surgery, and supplementary care. However, in certain instances, medication resistance limits its efficacy, requiring the identification of the best combinations for therapeutic strategies that guarantee the tumor's successful removal.

4. RESULT

The seas play a crucial part in the dynamics of the planet and cover a vast portion of its surface. The operation of the earth system depends heavily on their chemistry, physics, and biology, which serve as an interface between the various natural systems. Their immense significance is further expressed through oceans' vast majority of the diversity of the Earth. An up-to-date analysis estimated the number of eukaryotic species to be 8.9 million, 2.2 million of which are marine life, and implied that approximately 86% of the species on the planet, and 91% in the ocean, remain undescribed. The fact that there is a vast array of forms of life within the oceans is linked to the incredibly demanding, competitive and combative environment that encourages particular and intricate interactions, inter-species and intra-species.

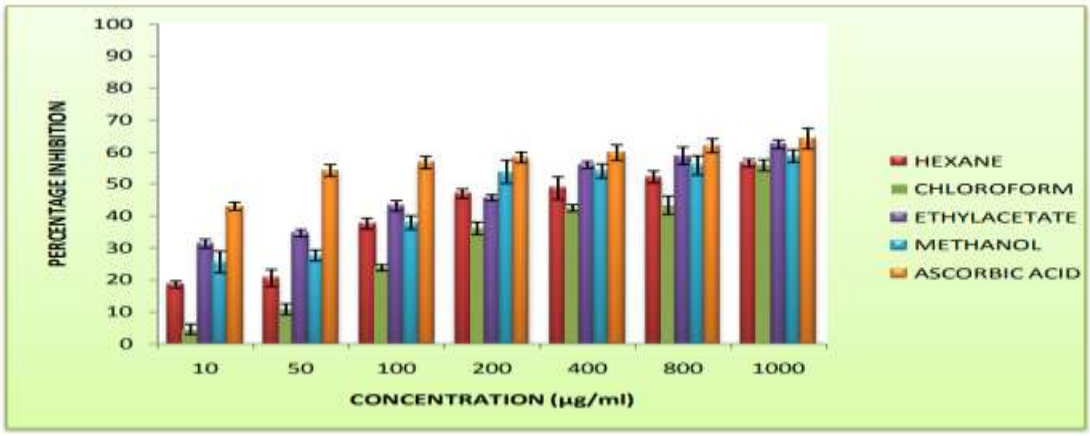

Figure 1: Nitric oxide radical scavenging activity

Throughout the period of evolution, numerous species have a common environment and set up well-balanced relations among them. Within these communities a number of organisms persist and exist in close relation to other species, both macros. Chemical signals mediate many of these complex interactions, which are essential to the marine ecosystem's organizational structure. Many marine organisms that lack certain senses, including eyesight and hearing, rely heavily on these chemical signals, which make up a large portion of the language of the water.

However, even animals that can see and hear rely on these signals. These signals have an effect on ecological function, community organization, and population structure.

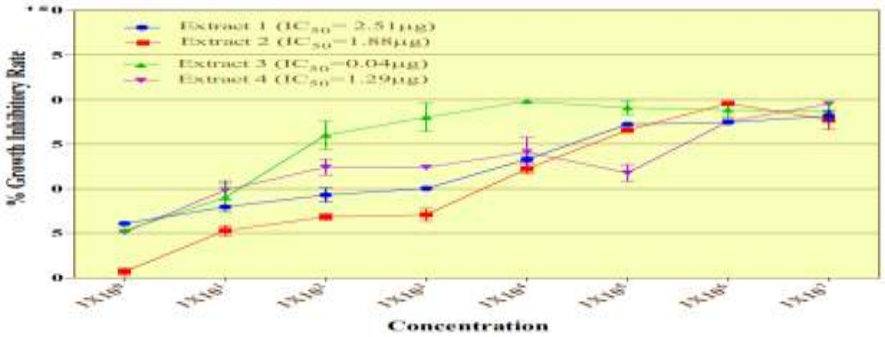

Figure 2: Cytotoxic potential of Spirastrella pachyspira

Among sea creatures, algae provide a prime example where chemical signals are central to ecological processes. They are committed to growth and survival under highly challenging conditions, which endows them with competitive benefits over other sea organisms including over competitors and predators. Such evidence was recently witnessed in coral reefs, which are precipitously declining all over the world, and tend to be substituted by algae. Algae have been found in some research to directly injure corals or opportunistic colonize, preventing recruitment of corals by releasing some chemical cues that deter the recruits.

5. CONCLUSION

In recent decades, marine creatures have emerged as a fascinating source of unidentified and previously existing substances with enormous potential for long-term economic and human advantages. With their distinct and strong effects on a variety of illnesses, including cancer, the majority of the chemicals showed great promise for therapeutic use. The pipeline has indicated that they will soon be used as a storehouse of anticancer medications. Many chemicals generated or sourced from ocean animals are in clinical studies with potential oncologic treatments, and six out of nine presently marketed medications of ocean origin are used to treat cancer. In contrast to isolated compounds with anticancer action, there are very few molecules on the market or undergoing clinical trials. The main causes of this are excessive toxicity, low efficacy of the active chemicals, environmental regulations, and pharmaceutical corporations' inadequate investment. The attrition of "candidates" during clinical or preclinical trials due to issues with organism harvesting and the isolation and purification procedure, which yields minute numbers, is another restriction in discovery and commercialization.

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