Is the Sea an Eldorado for Bioactive Substances?

Elisabetta Tosti*
Maria Costantini, Alessandra Gallo, Stazione Zoologica, Naples, Italy

Introduction

Since ancient times, the environment has been utilized as a source of compounds active against a series of diseases [1]. Higher plants for examples have been used for centuries to extract drugs exerting different effects. The most popular in the world is undoubtedly the salicylic acid, precursor of the aspirin, initially isolated from the willow tree.

Starting from the early 70’s, a peculiar attention has been paid to the marine environment as a new source for active substances. In fact since more than 70% of the earth surface is covered by the oceans and seas, where more than 300,000 species of animals and plants live and grow representing almost 80% of the total living organisms. Thanks to the large surface of the oceans, the organisms are subjected to a strong environmental pressure and have adapted to live in ranges of physical-chemical and nutritional variations. This situation has greatly increased the biodiversity of marine flora and fauna generating a great predation and space/nutrients competition.

For these reasons along the last 40 years, more than 10,000 bioactive compounds have been isolated from marine organisms, giving rise to more than 300 patents and the involvement of some of these metabolites in intense and advanced clinical experimentation [2,3].

Although the marine environment hosts about 34 of the known living phyla, secondary metabolites have been investigated and isolated from a small number of organisms. Marine microbes show a great potential for providing drugs either by themselves [4] or when they play a symbiotic role. In fact it has been very surprising that many substances attributed to marine invertebrates are just produced by their symbionts [5,6]. This is the case of some sponges whose bacterial hosts produce more bioactive substances than the sponges themselves.

The body of the sponges represents an ideal medium for the life of microbes due to the ability of sponges to filter large volumes of sea water retaining a large biomass of bacteria. This filtration capacity is so efficient and has allowed to isolate a large mass of metabolites exerting a wide variety of pharmacological actions including antibiotic, analgesic, anti-inflammatory, antifungal up to cytotoxic and anticancer activity [7,8].

Large marine algae are pabulum for many marine animals even if to self-defend from herbivores and fouling organisms they produce a lot of secondary metabolites such as terpenes, alkaloids and polyphenolics. Paradoxically the cytotoxicity exerted by terpenoids of some seaweeds, that ultimately kills the fishes [9], has been shown to be potently pharmacological agents affecting brain, renal and colon tumour cells and giving rise to encouraging preclinical drug development.

A remarkable source of metabolites is represented by the tunicates and in particular by the ascidians, in which simple molecules such as aminoacid derivatives and alkaloids have been isolated and tested. These molecules along with antifungal, antimarial and antibiotic activities have shown to be also potent cytotoxic and anticancer agents.

In the late ‘60, it was firstly described the anticancer activity of an extract from the caribbean ascidian Ecteinascidia turbinata and later on, the compound ET-743 was isolated and characterized as the molecule Trabectedin that entered phase II/III clinical trials on patients affected by sarcoma and breast cancer. Subsequently the experimentation in vivo clearly indicated that ET-743 induced a regression in breast, lung, ovaries cancers and melanoma [10,11]. Recently we showed that an extract from the ascidian Ciona intestinalis exerts an apoptotic activity [12] becoming a potential source of anticancer compound.

Conclusion

Because of an increase of drug-resistant infectious diseases and tumours cases, the discovery of new pharmaceutical agents appears to be an urgent need. From 40 years marine-derived natural products and their synthetic analogs are widely used as antitumor drugs originated from cytotoxic compounds. Although this is well accepted by the pharmacologists, the researchers evidenced the scientific paradox that the same toxicity is lethal for predators and competitors but become a therapy for animals and human.

Although it seems difficult to explain why marine microbes produce antiarthritic agents, an easier answer is possible for tumours. Anti-cancer medications act on the cell division that is underlined by an interplay between proliferation and programmed cell death (e.g. apoptosis). Actually anticancer therapies are based on cytotoxic agents widely used in the chemo and radiotherapy. However it is known that these have a great impact on the normal cells. In conclusion, a possible future for an effective tumour treatment may account on compounds acting on the photo-psychological apoptotic pathway. In this respect, sponges, tunicates and other marine organisms have already shown to provide antiapototic compounds making the sea a real gold-mine for new medications discovery and production.

References


*Corresponding author: Elisabetta Tosti, Animal Physiology and Evolution laboratory, Stazione Zoologica Anton Dohrn, Napoli, Italy, E-mail: tosti@szn.it

Received November 07, 2012; Accepted November 07, 2012; Published November 11, 2012


Copyright: © 2012 Tosti E. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.