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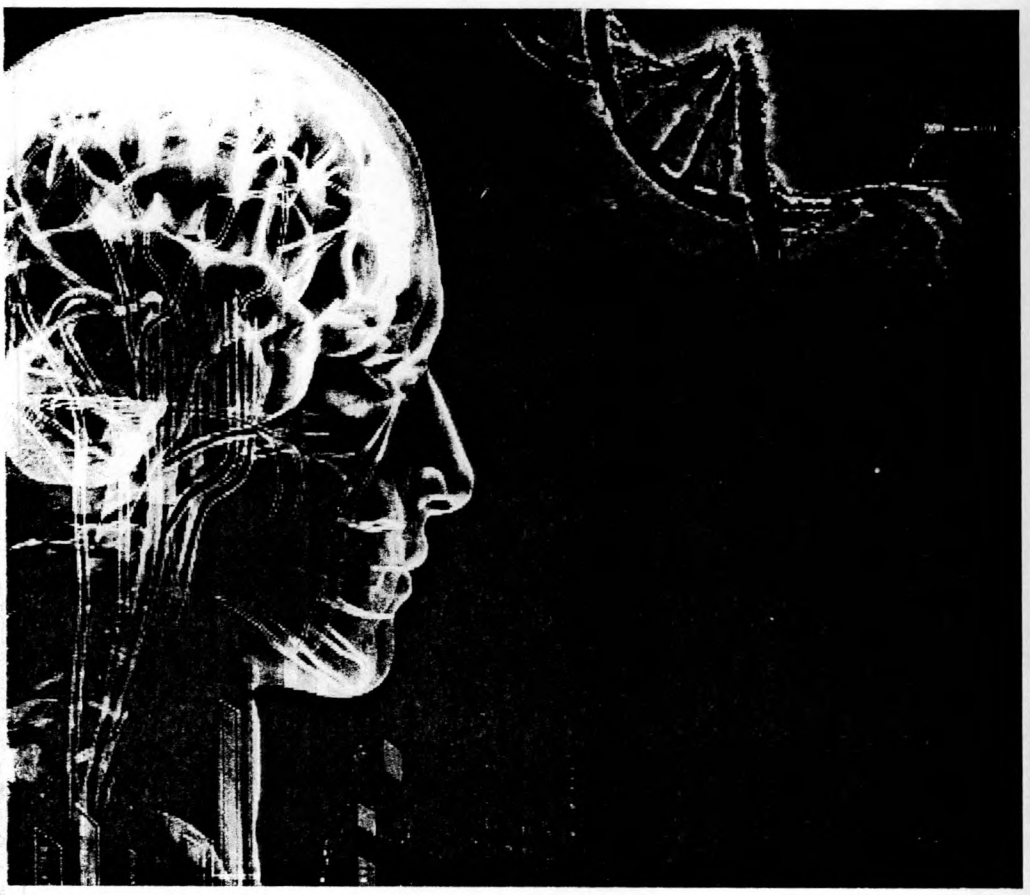

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Short communication

Phylum Echinodermata - A source for biologically active compounds: A Review

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Abstract

Phylum Echinodermata (Echinoderms) have more than 6500 living marine species. Different types of biologically active compounds are isolated from the echinoderm species. Echinoderms are rich in saponins and carotenoids. Pharmacological studies have established antitumor, antimicrobial, anticoagulant activities of biologically active compounds of Echinoderms.

Keywords: Echinoderms; Saponins; carotenoids; biologically active compounds

Introduction

According to the World Health Organization (WHO) estimates, 80% of the world population use animal and plant based medicines. Biologically active compounds extracted from animals and plants, are not only used in traditional medicine but also taken as raw materials for the preparation of modern medicines.[1] Based on variations in body symmetry, number of tissue layers, type of body cavity and pattern of development, animals are divided into various phylums such as Coelenterate, Platyhelminthes, Annelida, Echinodermata, Chordata etc. Echinoderms have well developed body plan.[2]

Various biologically active compounds are isolated from Echinoderms such as Saponins,[3] carotenoids,[4] glycolipids, venoms, porphyrins, naphthoquinone[5] and poly unsaturated fatty acids (PUFAs)[6] which have antimicrobial, antiviral, antitumor, anticoagulant and cytotoxic properties.[7]

The Phylum Echinodermata

Echinoderms have more than 6500 living species.[8] It includes marine animals such as sea cucumbers, sea stars, sea urchins, brittle stars and sand dollars. Every species in the phylum have three main structural characteristics. They all represent a calcium based endoskeleton (internal skeleton) which composed of plates of calcium carbonate (ossicles) together with connective tissue.[9] Some species of Echinoderms have spiny projections outward from these calcium carbonate plates. Second characteristic is water vascular system, a hydraulic system which helps in feeding, locomotion, gas exchange and excretion. Lastly, Echinoderms evolved with bilateral symmetry and adult echinoderms have pentameric symmetry.[9, 10] Phylum Echinodermata consists of five major classes; Ophiuroidea (brittle stars), Crinoidea (Sea lilies), Echinoidea (Sea urchins), Asteroidea (Starfishes) and Holothuroidea (Sea cucumbers).[11]

Taxonomic Summary

Kingdom - Animalia
Sub kingdom - Eumetazoa
Sub phylum - Deuterostomia
Phylum – Echinodermata

Biologically active compounds and their pharmacological properties Echinoderms provide a rich source of biologically active substances such as saponins,[12] glycolipids, carotenoids, venoms, porphyrins, naphthoquinones and others.[8] These compounds have already proven biological activities such as antibacterial, antifungal,

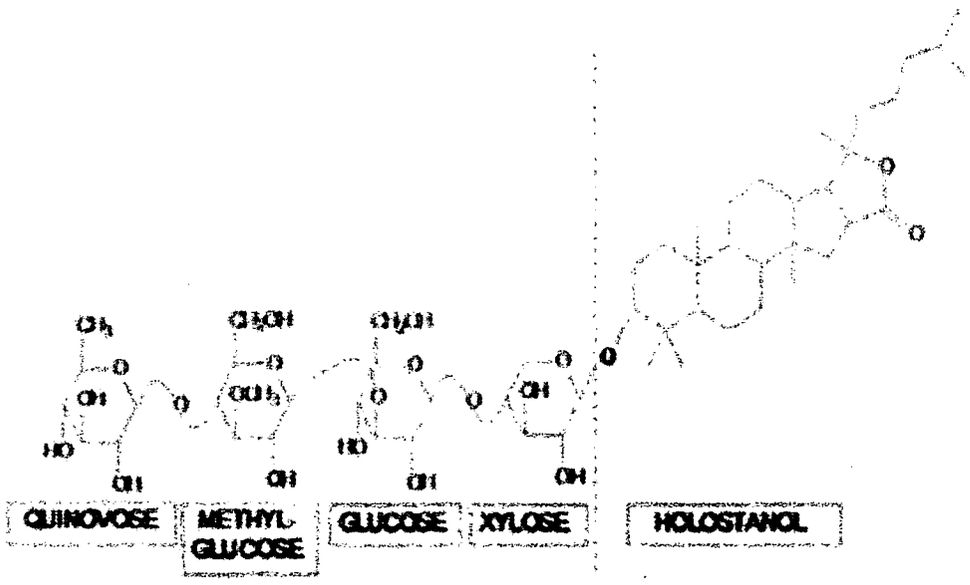

Figure 1- Structure of a hypothetical saponin with holostanolaglycone

antiviral, antitumor, anticoagulant, cytotoxic, hemolytic and even anti HIV agents.[6,7]

Saponins

Saponins have been considered for a long time as a plant metabolite. But today saponins are identified as the widely distributed compound in class Holothuroidea (Sea cucumbers) and Asteroidea (Star fish) of the phylum Echinodermata.[12] Chemically saponins are steroidal or triterpenoid compounds which have one or more sugar moieties. Hydrolysis of saponins yields sugar moiety and non-sugar moiety aglycone which is sapogenin.[13] Saponins isolated from class Holothuroidea are triterpene glycosides and, from class Asteroidea are steroid glycosides.[12,14] Holothuroidian triterpene glycosides (Figure 1) composed of an oligosaccharide chain and holostane-3b-ol based aglycone.[15] Oligosaccharide chain consists with 6 sugars units: xylose, glucose, 3-O-methylglucose and quinovose. Some holothuroidian saponins can be sulphated at the xylose.[15] Triterpene glycosides exhibits wide range of pharmacological effects: antifungal, antitumoral, hemolytic, cytostatic, antiinflammatory and immune modulatory effect.[4,15] Steroid glycosides exhibit hemolytic, antineoplastic, cytotoxic, antitumor, antibacterial, antiviral antifungal and anti-inflammatory activities.[16]

Triterpene glycoside: Fuscocineroide C isolated from sea cucumber *Holothuria fuscocinerea* showed cytotoxic nature against human cancer cells.[4]

Carotenoids

Carotenoids are distributed in the various body parts of echinoderms such as ovaries, eggs or liver of starfish, sex glands of sea cucumbers and sea urchins, skin and gonads of sea lilies.[17] Echinoderms do not synthesize carotenoids in the body. They partly modified by metabolic reactions or directly accumulated from food.[18] Major carotenoids present in the gonads of sea urchins and star fish are echinenone and astaxanthin (Figure 2(a)) which is an oxidative metabolite of β-carotene (Figure 2(b)) canthaxanthin (Figure 2(c)) and astaxanthin were found in the gonads of sea cucumbers as major components.[17]

Carotenoids act as antioxidants. Because of antioxidant properties, carotenoids inhibit the

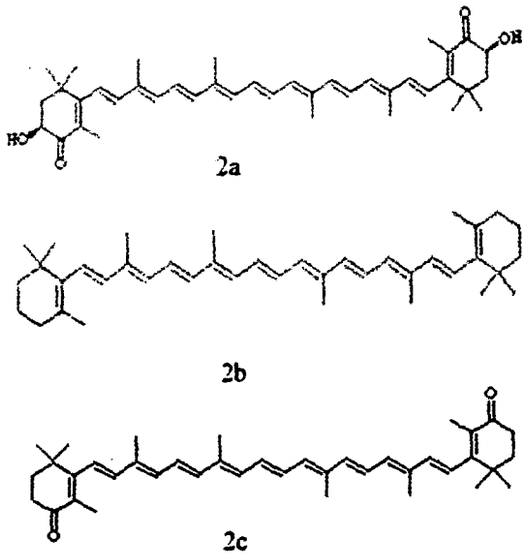

Figure 2: Molecular Structure of (a) Astaxanthin (b) β-carotene (c) Canthaxanthin

oxidation of low density lipoproteins and hence prevent from coronary vascular disease. Related to the antioxidant activity, carotenoids increase immune function, protection from sunburns and inhibit cancer development.[19]

Poly unsaturated fatty acids (PUFAs)

Poly unsaturated fatty acids are rich in male and female gonads of sea urchin species. PUFAs have preventive action from arrhythmias, cardiovascular diseases and cancers.[16]

Glycosaminoglycan

Glycosaminoglycan which contains side chain disaccharide units of sulphated fucosylation, isolated from the body wall of sea cucumbers.[20] The antithrombotic activity of a fucosylated chondroitin sulphate is more intense than antithrombotic doses of unfractioned heparin, low molecular weight heparin and mammalian dermatan sulphate.[21] Bioactive glycoside compounds which containing chondroitin sulphate from sea cucumber species *S. liouvillei*, have antiviral activity to inhibit human immuno deficiency virus (HIV) infection.[12]

Summary

Echinoderms yield smaller range of secondary metabolites than other marine invertebrates like sponges because echinoderms have ability to protect themselves from predators. The most specific compounds which isolated from phylum Echinodermata are saponins, carotinoids and sulfated glycosolated sterols. These compounds have various pharmacological properties such as antitumor, antibiotic, anti-inflammatory etc.

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