CHAPTER I

INTRODUCTION

The oceans occupy about 71% of the Earth's surface. The deepest part of the seafloor is almost 11,000 m from sea surface, and the average depth of the oceans is about 3800 m; the total volume of the marine environment about 1370 x 10^6 km^3. Marine and terrestrial environments provide different physical conditions for life. Sea water has a much higher density than air, and consequently there is a major difference in the way gravity effects organisms living in sea water and those living in air. Whereas terrestrial plants and animals generally require large proportions of skeletal materials (e.g. tree trunks, bones) to hold themselves erect or to move against the force gravity; marine species are buoyed up by water and do not store large amounts of energy in skeletal material. The majority of marine plants are microscopic, floating species. Many marine animals are invertebrates without massive skeletons (Lalli and Parsons, 1993).

Above properties provide the more complicated food chain in the marine environment than that in the terrestrial environment. The properties also result in an abundance of filter-feeding sessile organisms, such as sponges or ascidians, which become the excellent substrates for epibionts and symbionts. These communities are very rare in terrestrial ecosystem (Scheuer, 1990). Therefore, scientists pay more attention to marine organisms as new compounds and biomedical resources (Sato *et al.*, 1995)or study about marine natural product. Marine natural products, the secondary metabolites produced by organisms that live in the sea, have been received attention from chemists and pharmacologists during last two decades. When compared with land plants and animals, the use of marine organisms in flock medicine is very restricted, particularly outside Asia. There are several well-known marine products that have been used for many years, sush as cod and halibut liver oils, spermaceti, protamine sulphate and seaweed polysaccharides agar, carrageenan and algiric acid (Evan, 1996). Much use has been made of marine plants and animals for food but, probably because of their inaccessibility, serious consideration of these organisms as sources of biologically active compounds has been confirmed to the last 40 years.

The study of chemistry of marine organisms concentrates on biological and pharmaceutical properties (Faulkner, 1994), numberous novel compounds have been isolated from marine organisms and many of these substances have been demonstrated to possess interesting biological activities for example; treatment of human diseases and control agricultural pets (Evan, 1996). Pharmacological study of marine natural products had been with the early investigation of toxins, followed by studies of cytotoxic and antitumor activity (Attaway and Zaborsky, 1993).

Among the marine organisms, sponges are one of the most interesting animals in which organic chemists have paid attentions. Sponges are complex, sedentary, filter-feeding metazoans that maintain an almost protozoan independence for each of their constituent cells. They are relatively unselective particle feeder and exist by pumping a very large volume of water through their tissue at low pressure. The sponge body is organized around a system of pore, canals, and chambers, which conduct the water current though out the body. It is very difficult to characterize the sponge's diet definitely, but it is generally suspected that the upper size limit of particles inhaled is about 50 μm, that the wide range of smaller organisms such as bacteria, diatom, fungi, and dinoflagellate can be retained, some part of the sponge's nutrition could come from microscopically unresolvable organic carbon (e.g. sugar, amino acids, and their polymer) dissolved in sea water (Scheuer, 1983).

A varieties were of known and new compounds isolated from a marine sponges for example :

(i) A new sesterterpene tetronic acid, isopalinurin, has been isolated from an Australian marine sponge, *Dysidea* sp.. Isopalinulin was identified as the agent responsible for antibiotic and protein phosphatase inhibitory properties (Murry *et al.*, 1993).

(ii) Cavernosolide, a new sesterterpene, has been isolated from the Tyrrhenian sponge, *Fasciospongia cavernosa*. Cavernosolide showed potent activity

(LD_{50} = 0.37 μg/ml, in the *Artemia salina* bioassay and moderate toxicity (LD_{50} = 0.75 μg/ml) in fish (*Gambusia affinis*) lethality assay (Rosa *et al.*, 1997)

(iii) A highly cytotoxic macrocyclic lactone polyether has been isolated from a sponge, *Spongia* species and named spongistatin 1. Spongistatin 1 inhibited the glutamate-induced polymerization of purified tubulin (LC_{50} value of 3.6 μM versus 2.1 μm for dolastatin 10 and vinblastine and 5.2 μM for nalichondrin B) and it was a potent inhibitor of the binding of vinblastine and GTP to tubulin (Bai *et al.*, 1993).

(iv) A new imidazole alkaloid, (2E, 9Z)-pyronaamideine 9-(N-methylimine), was isolated from the yellow sponge, *Leucetta* sp. cf. *chagosensis* which is exhibited mild cytotoxicity toward A-549, MCF-7 and HT-29 human tumor cell lines (Plubrukarn *et al.*, 1997).

(v) A new triterpene, sodwanones M has been isolated from the sponge, *Axinella weltneri* from the Comoros Islands. This compound was found to be cytotoxic to P-338 murine leukemia cell at a concentration of 1 μg/ml (Rudi *et al.*, 1997).

(vi) An Eastern Indian Ocean sponge in the genus *Spongia* contains a structurally unprecedented macrocyclic lactone, spongistatin, with extremely potent activity against selected human cell types in the U.S. National Cancer Institute's primary screen. (Pettit, 1993).

(vii) A new tridecapeptide lactone named theonellapeptide Iid was isolated from the Okinawan marine sponge, *Theonella swinnoei.* Theonellapeptide Iid prevented fertilization of the sea urchin, *Hemicentrotus pulcherrimus* at the concentration of 25 μg/ml (Kobayashi *et al.*, 1994).

In Thailand, there are some species of marine sponge which were studied about chemical constituents for instance; a polyether and three diene-unsaturated steroids were isolated from *Biemma fortis* (Topent) (Thitithanaphuk, 1995). Two new karihinol type diterpenes, 1,5,6-tri-epi-kalihinol I and 10-epi-karihinal J and one known compound, kalihinol Y, were isolated from a Thai marine sponge *Acanthella cavernosa* Dendy (Deepralard, 1997).

A large number of chemical compounds were isolated from marine sponge and terpenes are the most abundant, nonsteroidal secondary metabolites isolated and characterized to date from marine sponges (Scheuer, 1978).

As discussed previously in this chapter, sponges are represented as the great reservoirs of metabolites from marine organisms. Although they are in the same genus or species, the sponges collected from different locations may contain different kinds of constituents because of different environments and communities. This project is aimed at isolation and characterization of compounds from a marine sponge *Ircinia* sp., which was collected from Palau Island by Skin diving and showed toxicity to brine shrimp (LD_{50} at 10 μg/ml) on preliminary bioactive determination. The main objectives of this research are as follows.

(i) to isolate and purify the chemical constituents from a marine sponge *Ircinia* sp.

(ii) to identify and elucidate the structure of chemical compounds from sponge, *Ircinia* sp.