

CHAPTER 1

INTRODUCTION

A freshwater green algae *Rhizoclonium* spp., *Cladophora* spp. and *Aegagropila* spp. are macroalgae found in Britain, India, China and Australia. Among other places, they are also found in northern and northeastern Thailand, and locally referred to as “Kai”. Kai are abundant during the dry season in the Nan River, Nan Province and the Mekong River, Chiang Rai Province, Thailand. Locals in the area traditionally consumed these algae as a health food [1].

Three genera of Kai; *Rhizoclonium* spp., *Cladophora* spp. and *Aegagropila* spp. are classified in Division Chlorophyta, Class Ulvophyceae, Order Cladophorales, Family Cladophoraceae [2]. This research focuses on *Rhizoclonium hieroglyphicum* (C.Agardh) Kützinger, the edible algae in the Nan River and the one richest in cell-wall polysaccharides. It exhibits maximum growth during the dry season (November-March), when the temperature and velocity of water are low [1]. Many edible algae have been shown to have important nutritional and health benefits. *Spirulina platensis*, a blue-green alga, is a famous food supplement found in soil, freshwater, brackish water and seawater. It has been proven to have a high nutritional value (containing protein and amino acids) and offers health benefits, including antioxidative and antimicrobial properties stemming from its polyunsaturated fatty acids, phycobiliprotein, phycocyanin and phenolics [3-5]. Many studies also exist on a wide variety of edible freshwater macroalgae, looking at a range of issues including diversity, ecology, nutritional value, toxicity, and pharmaceutical and medicinal

properties. For example, *Cladophora glomerata* and *Nostochopsis lobatus* exhibit anti-gastric ulcer, anti-inflammatory, analgesic and antioxidant activities, offering the potential to play an important role in pharmacological activities [6]. The location, morphology and biochemical contents of *R. hieroglyphicum* have been studied in Thailand [1], but its biological activities have yet to be investigated. Given *R. hieroglyphicum*'s traditional uses, it shows promise for potentially beneficial uses, and has been selected for further analysis here, particularly its potential antioxidative role.

One particularly interesting feature of *R. hieroglyphicum* is its polysaccharide richness. Polysaccharides are used as a natural polymer in various applications, including as thickening or gelling agents in food manufacturing and pharmaceutical production [7-9]. Moreover, they also play a very important role in cosmetic formulation as humectants and moisturizers. For many years, researchers have been interested in the uses of polysaccharides from algae. Most of this attention has been devoted to agars and carrageenans from red seaweeds; and alginates from brown seaweeds [10-14]. Some polysaccharides from seaweeds have been reported to possess many biological activities and have been used as natural bioactive compounds in food and pharmaceutical industries [10]. In addition, cosmetic ingredients such as alginic acid, which is used as a consistency agent and as a moisture retaining surface film, are produced from brown algae; and carrageenan, a gelling agent, is produced from red algae [7, 9, 15-16]. On the other hand, the properties of polysaccharides from freshwater algae such as *Cladophora* spp., *Nostochopsis* spp., *Spirogyra* spp., particularly, *R. hieroglyphicum* and their potential for health and cosmetic applications have not been widely investigated.

A large number of preparations are available; many of which are marketed as cosmetic and therapeutic moisturizers. Moisturizing creams containing natural substances are currently popular since these are likely to be effective, safe and friendly to human skin. Moisturizers are a group of cosmetic products designed for skin care and hygiene. Besides daily use as a skin care, moisturizers are also used for treatment of dry skin. Recently, one great benefit of moisturizers when used on normal skin has been found that moisturizers are able to decrease skin susceptibility to irritants [17]. In addition, moisturizers are used to restore normal barrier functions of the skin and increase skin's hydration by reducing its evaporation [18]. Skin which is fully moisturized will appear to be healthy and good-looking [19]. Skin moisturizing products typically contain ingredients such as groups of emollients, humectants and natural moisturizing factors (NMFs) [18]. Moisturization is accomplished by a combination of hydrating humectants, followed by the action of occlusive agents on the skin surfaces which are able to maintain the moisture in the stratum corneum [20].

Several studies have verified the antioxidant properties of polysaccharides from seaweeds [8, 10, 21]. The antioxidant activity of the polysaccharides depends on several structural parameters such as the molecular weight, type of sugar and glycosidic branching, the degree of sulfation (DS) and the sulfation position [21]. In contrast to seaweeds, the properties of polysaccharides from freshwater algae and their potential health and cosmetic applications have not been widely investigated. In particular, polysaccharides from *R. hieroglyphicum*, whether from Thailand or elsewhere, have yet to be investigated.

The aim of this research was to examine some of the biological activities of *R. hieroglyphicum* extracts, in particular its antioxidative and antimicrobial activities, as well as moisturizing effects on skin. The physical characteristics and chemical composition of its polysaccharides and the moisturizing effect of the aqueous extracts from *R. hieroglyphicum* and its efficacy in cosmetic products, compared with commercial skin moisturizers were also determined. The results from this study could provide fundamental data for developing potentially beneficial applications of polysaccharides from *R. hieroglyphicum* and probably be a new source of natural moisturizer for the prevention and treatment of dry skin.

The objectives of the study are as follows:

1. To study the extraction method for *R. Hieroglyphicum* for cosmetic application.
2. To investigate the physical characteristics, chemical composition and biological activities of *R. hieroglyphicum* extracts.
3. To develop cosmetic products containing the active ingredients from *R. hieroglyphicum* extract.