



Review or Mini-review

Potential anti-inflammatory natural products from marine algae

I.P. Shanura Fernando^a, Jae-Woon Nah^b, You-Jin Jeon^{a,*}^a Department of Marine Life Science, Jeju National University, Jeju, 690-756, Republic of Korea^b Department of High Polymer Engineering, Suncheon National University, Jungang-ro, 13, Suncheon, Jeollanam-do, Republic of Korea

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ABSTRACT

Inflammatory diseases have become one of the leading causes of health issue throughout the world, having a considerable influence on healthcare costs. With the emerging developments in natural product, synthetic and combinatorial chemistry, a notable success has been achieved in discovering natural products and their synthetic structural analogs with anti-inflammatory activity. However, many of these therapeutics have indicated detrimental side effects upon prolonged usage. Marine algae have been identified as an underexplored reservoir of unique anti-inflammatory compounds. These include polyphenols, sulfated polysaccharides, terpenes, fatty acids, proteins and several other bioactives. Consumption of these marine algae could provide defense against the pathophysiology of many chronic inflammatory diseases. With further investigation, algal anti-inflammatory phytochemicals have the potential to be used as therapeutics or in the synthesis of structural analogs with profound anti-inflammatory activity with reduced side effects. The current review summarizes the latest knowledge about the potential anti-inflammatory compounds discovered from marine algae.

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Contents

1. Introduction.....	22
2. Marine algae, a source of bioactive secondary metabolites.....	23
3. Algal phenolic compounds possessing anti-inflammatory activity.....	24
4. Algal polysaccharides with anti-inflammatory activity.....	25
5. Fatty acids and lipid derivatives.....	25
6. Algal alkaloids possessing anti-inflammatory properties.....	26
7. Terpenoids: sterols and carotenoids from marine algae with anti-inflammatory activity.....	27
8. Algal proteins and peptides possessing anti-inflammatory properties.....	27
9. Other secondary metabolites.....	28
10. Conclusion.....	28
Conflict of interest.....	29
Acknowledgements.....	29
References.....	29

1. Introduction

Inflammation is a part of the non-specific protective response of the body to harmful stimuli that include damage to tissues, pathogens, specific disease conditions and harmful chemicals (Ferrero-Miliani et al., 2007). The teleological purpose of inflammation is to counteract the tissues against aforementioned conditions

by clearing the dead cells and cause of inflammation and to stimulate the tissue repair mechanisms (Zitvogel et al., 2010). Inflammation can be classified into two phases as acute and chronic. The acute phase is associated with accumulation of fluids, elevated blood flow, increased vascular permeability and increase of the number of leukocytes and inflammatory mediators, whereas the chronic inflammation is associated with progression of specific humoral and cellular immune responses (Feghali and Wright, 1997). Inflammation is mainly mediated by a complex system of soluble factors that can be categorized into several groups based on their source and/or chemical composition; (1) inflammatory

* Corresponding author.

E-mail address: youjin2014@gmail.com (Y.-J. Jeon).

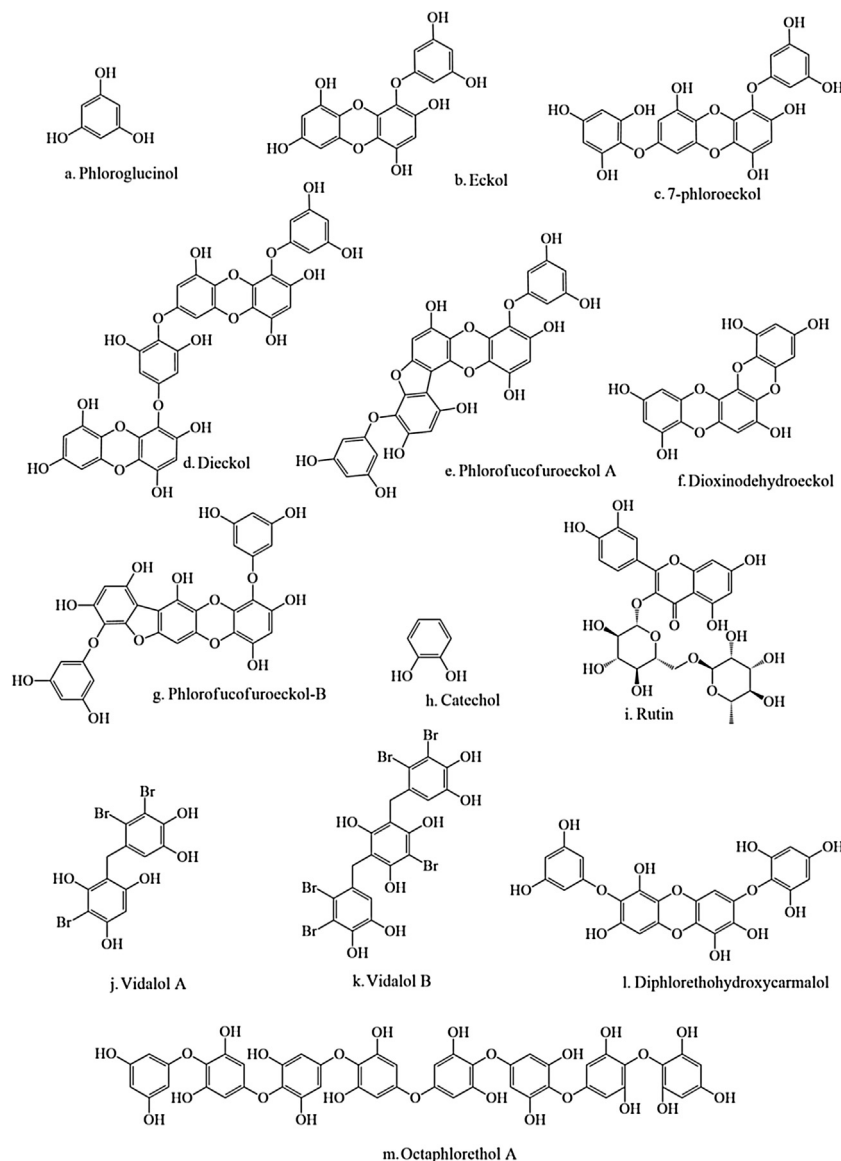


Fig. 1. Structures of anti-inflammatory active phenolic compounds isolated from marine algae.

lipid metabolites that includes platelet activating factor and various types of arachidonic acid derivatives such as eicosanoids, prostaglandins, leukotrienes and lipoxins that generate from phospholipids; (2) plasma protein systems related with kinin, the complement and the clotting/fibrinolysis systems that include, thrombin, fibrinopeptides, plasmin and several other proteins; (3) nitric oxide synthesized in vascular endothelia and macrophages which induce vasodilatation and act as a cytotoxic agent on pathogenic microorganisms and neoplastic cells; (4) proinflammatory cytokines such as interleukins, tumor necrosis factor alpha (TNF- α) and beta (TNF- β), chemokines, colony-stimulating factor 2 and 3 (Feghali and Wright, 1997; Larsen and Henson, 1983; Lawrence et al., 2002). Most of these regulatory proteins and other inflammatory mediators are produced in activated cells, such as macrophages, fibroblasts, mast cells neutrophils, eosinophils, monocytes, lymphocytes and endothelial cells (Martin and Leibovich, 2005). Clearly, the inflammatory response is crucial to counteract infection. Nevertheless, these effects of inflammation, specially chronic conditions could ultimately cause detrimental health issues, including multiple sclerosis, cancer, inflammatory arthritis, atherosclerosis, coronary artery diseases, obesity,

dermatitis, migraines, interstitial cystitis, irritable bowel syndrome, insulin resistance and an array of other disease conditions (Coussens and Werb, 2002; Hansson, 2005; Theoharides and Cochrane, 2004; Xu et al., 2003). Thereby anti-inflammatory compounds play a pivotal role in the treatment of inflammatory diseases. Anti-inflammatory natural products and food products have long been used in folk medicine against inflammatory symptoms (Yuan et al., 2006). Significant advances have been made in the recent decade in discovering new anti-inflammatory agents (Levin and Laufer, 2012). Similar to most therapeutic agents, anti-inflammatory drugs also cause complications and serious side effects (Bjarnason et al., 1993; Hoppmann et al., 1991; Vo et al., 2012). Therefore, the discovery of novel anti-inflammatory drugs from marine algae could bring a new insight to the field of biomedical research and industry.

2. Marine algae, a source of bioactive secondary metabolites

Ocean, the enormous ecosystem which covers more than 70% of the earth's surface, houses to a vast variety of marine organ-

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