Bioresource Technology 244 (2017) 1407–1415

Contents lists available at ScienceDirect

Bioresource Technology

journal homepage: www.elsevier.com/locate/biortech

Review

Potential biomedical applications of marine algae

Hui-Min David Wang [a,b], Xiao-Chun Li [c], Duu-Jong Lee [d,e], Jo-Shu Chang [f,g,*]

[a] Graduate Institute of Biomedical Engineering, National Chung Hsing University, Taichung 402, Taiwan
[b] Center for Stem Cell Research, Kaohsiung Medical University, Kaohsiung 807, Taiwan
[c] School of Pharmacy, China Pharmaceutical University, Nanjing 211198, China
[d] Department of Chemical Engineering, National Taiwan University, Taipei 10617, Taiwan
[e] Department of Chemical Engineering, National Taiwan University of Science and Technology, Taipei 10607, Taiwan
[f] Department of Chemical Engineering, National Cheng Kung University, Tainan 701, Taiwan
[g] Research Center for Energy Technology and Strategy, National Cheng Kung University, Tainan 701, Taiwan

HIGHLIGHTS

- Marine macroalgae derived compounds are potential therapeutic agents in dermatology.
- Seaweed extracts has been shown to protect skin from photo-damage.
- Antibacterial compounds derived from macroalgae can fight acne and chronic wounds.
- Anti-tumor activity of macroalgae extracts can be exploited to treat melanoma.
- Skin whitening and anti-pigmentation properties of seaweed extracts are also discussed.

ARTICLE INFO

Article history:
Received 13 April 2017
Received in revised form 29 May 2017
Accepted 30 May 2017
Available online 3 June 2017

Keywords:
Algae
Dermatology
Acne
UV
Skin whitening
Melanoma

ABSTRACT

Functional components extracted from algal biomass are widely used as dietary and health supplements with a variety of applications in food science and technology. In contrast, the applications of algae in dermal-related products have received much less attention, despite that algae also possess high potential for the uses in anti-infection, anti-aging, skin-whitening, and skin tumor treatments. This review, therefore, focuses on integrating studies on algae pertinent to human skin care, health and therapy. The active compounds in algae related t
o human skin treatments are mentioned and the possible mechanisms involved are described. The main purpose of this review is to identify serviceable algae functions in skin treatments to facilitate practical applications in this high-potential area.

© 2017 Elsevier Ltd. All rights reserved.

Contents

1. Introduction . . . 1408
1.1. Marine algae . . . 1408
1.2. Polysaccharides . . . 1408
1.3. Lipids, fatty acids and sterols . . . 1408
1.4. Phenolic compounds . . . 1408
1.5. Pigments . . . 1409
1.6. Human skin . . . 1409
2. Algae against acne vulgaris . . . 1409
3. Algae protects skin from UV radiation injury . . . 1410
4. Algae reduces skin pigmentation . . . 1411
5. Algae for melanoma treatments . . . 1412

* Corresponding author at: Department of Chemical Engineering, National Cheng Kung University, No. 1, University Road, East District, Tainan City 701, Taiwan.
E-mail address: changjs@mail.ncku.edu.tw (J.-S. Chang).

http://dx.doi.org/10.1016/j.biortech.2017.05.198
0960-8524/© 2017 Elsevier Ltd. All rights reserved.

6. Other bioactivities from algae with functions for skin health treatment . . . 1412
7. Future protect and challenges . . . 1413
8. Conclusions. . . . 1413
Acknowledgement . . . 1413
References . . . 1414

1. Introduction

1.1. Marine algae

Marine algae, also known as macroalgae or seaweed, are photosynthetic eukaryotic organisms that can be found in coastal areas with tenacious vitality. There are three main macroalgae taxa according to their morphological pigmentations: *Rhodophyta* (red algae), *Chlorophyta* (green algae), and *Phaeophyceae* (brown algae) (Yu et al., 2014). Environmental factors, such as temperature, salinity, sunlight, pH, physiological status and CO_2 supply could influence the chemical composition of marine algae (Trivedi et al., 2015; He et al., 2013a,b). Macroalgae can survive in harsh environmental conditions because of different adaptation strategies. Macroalgae's physiology changes due to the necessary mechanisms of adaption, and as a result, macroalgae produces different secondary metabolites so as to conquer different environments. Macroalgae can even endure extremely high light intensity or very low light intensity in diverse habitats, for example, dessert and arctic region (Pallela et al., 2010). To survive in such various diverse and extreme environments, macroalgae produce a variety of natural bioactive compounds and metabolites, such as polysaccharides, polyunsaturated fatty acids, and phlorotannins (Cheng et al., 2010; Hultberg et al., 2013). Since macroalgae are one of the most commonly studied and used marine resources (Show et al., 2015; Chew et al., 2017), bioactivities of the constituent components of marine algae have been widely investigated. The bioactive compounds such as polyphenols exhibit anticancer, antidiabetic, antioxidant, and anti-inflammatory activities (Fernando et al., 2016). Polysaccharides often show significant antioxidant and immunomodulatory activities. Due to the increasing needs for natural and environmental friendly products, especially in nutraceutical and cosmetics industries, much effort has been made on evaluating the potential of applying bioactive compounds derived from macroalgae on functional foods, cosmeceuticals, and pharmaceuticals. In particular, there are more potential applications of bioactive compounds from macroalgae on dermatology conditions or diseases such as acne, skin aging, pigmentation and melanoma. Thus, this review is aimed to provide detailed information on how the bioactive compounds derived from macroalgae can be applied to treat the commonly found skin diseases.

1.2. Polysaccharides

Polysaccharides are usually the major component of red, green, and brown algae (Goo et al., 2013; Kurniawati et al., 2014). Various polysaccharides constitute the main composition of the cell walls of algae. The main polysaccharides in algae include agar, alginates, galactans, carrageenans, laminarans, fucoidan and ulvans. Thus, polysaccharides play the role of structural support as well as storage function in algae. In general, algal macromolecules are formed with various monosaccharides linked by glucosidic bonds, and some also have linear backbones containing repeating disaccharide units (Pérez et al., 2016). Alginate, laminarinan, and fucoidan are usually found in brown algae. Alginates are anionic with molecular weight range from 500 to 1000 kDa, they are made up of α-l-guluronic acid (G) and β-D-mannuronic acid (M) (Vera et al., 2011). Laminarinans and fucoidans are the main water-soluble polysaccharides of brown algae, while laminarinans are the most abundant polysaccharides stored in brown algae. Carrageenan and agar are found in red algae. Carrageenans are the major components of red algae cell walls, and they are linear polysaccharides chains with sulphate half-esters attached to the sugar unit. According to the degree of molecular sulphation, carrageenans are divided into three forms: kappa, lambda, and iota (Vera et al., 2011). Agars are the mixture of linear polysaccharide agarose as well as a heterogeneous mixture of smaller molecules called agaropectin (Williams and Phillips, 2000; Kumar et al., 2013). Ulvan and cellulose are usually from green algae. Ulvan is a kind of water-soluble polysaccharides isolated from green algae, with an average molecular weight ranging from 89 to 8200 kDa (Alves et al., 2013).

1.3. Lipids, fatty acids and sterols

Algae lipids consist of glycolipids, phospholipids and non-polar glycerolipids (neutral lipids) (Ansari et al., 2015; López Barreiro et al., 2014; Nakanishi et al., 2014; Soh et al., 2014). Phospholipids are characterized by the presence of a phosphate group at sn-3 position. The main phospholipids derived from algae include phosphatidylglycerol (PG), phosphatidylcholine (PC), phosphatidylethanolamine (PE), phosphatidylserine (PS), phosphatidylinositol (PI) and phoshatidic acid (PA) (Kumari et al., 2013).

Fatty acids (FA) are carboxylic acids with long aliphatic chains which may be straight or branched, saturated or unsaturated (Mohan et al., 2015). The carbon number of natural FAs is usually even (C4–C28), however, odd chain FAs also exist in algae. According to the number of double bonds, FAs are divided into monounsaturated fatty acids (MUFAs, with one double bond) and polyunsaturated fatty acids (PUFAs, with more than 2 double bonds) (Grama et al., 2014). Oxylipins are the oxygenated products derived from PUFAs which exhibit innate immunity in response to environmental stress such as wound, metal toxicity and pathogenic bacteria (Fontana et al., 2007; Ritter et al., 2008).

Sterols are the important structural components of cell membranes which can regulate membrane permeability and fluidity. The basic structure of sterol is composed of four rings (A, B, C, D) and with a hydroxyl group at C3, two methyl groups at C18 and C19, and a side chain at C17. The common sterols found in algae are fucosterol, cholesterol, isofucosterol, and clionasterol (Kumari et al., 2013).

1.4. Phenolic compounds

Phenolic compounds are the secondary metabolites of algae which not directly take part in physiological process such as photosynthesis, reproduction and cell division. They are biosynthesized through the shikimic acid and acetate–malonate pathways (Fernando et al., 2016). Phenolic compounds are characterized by aromatic ring with hydroxyl groups. Aromatic ring with one or two hydroxyl groups are defined as simple phenols, such as benzoic acids and hydroxycinnamic, and their derivates also have been

Download English Version:

https://daneshyari.com/en/article/4996981

Download Persian Version:

https://daneshyari.com/article/4996981

Daneshyari.com