Study on UV Absorption Materials Derived from Red Algae 
*Gloiopepeltis fucatas* and *Mazzaella* sp. in Russia

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Abstract

We investigated ultraviolet (UV) absorption materials from Russian seaweeds. First, the UV absorptivities of five seaweeds *Gloiopepeltis fucatas*, *Mazzaella* sp., *Mastocarpus pacificus*, *Laminaria cichorioides*, *Saccharina japonica* were evaluated by a UV spectrometer. Of these seaweeds, *Gloiopepeltis fucatas* and *Mazzaella* sp. showed high levels of UV absorption. Column chromatography of active 50% aqueous ethanol extracts from *Gloiopepeltis fucatas* and *Mazzaella* sp. resulted in the purification of two known compounds. Spectroscopic techniques identified their structures as shinorine and palythine. These materials exhibited UV absorptive capabilities at wavelengths of 333 and 320 nm, respectively. These results suggest that *Gloiopepeltis fucatas* and *Mazzaella* sp. may be useful as natural cosmeceutical sources.

Key words: *Gloiopepeltis fucatas*, *Mazzaella* sp., Russian seaweeds, Shinorine, Palythine

Introduction

*Gloiopepeltis fucatas* red algae belonging to the family Endocladaceae, have been traditionally consumed as medicines and food thickeners in China and Japan (Schachat and Glicksman, 1959). Various beneficial effects have been reported, such as anti-inflammatory and anti-tumor activities (Niu et al., 2003; Bae and Choi, 2007). *Mazzaella* sp. belong to the family Gigartinaceae and are distributed in the north and west Pacific, around Pacific South America, Gough Island and off South Africa (Hommersand et al., 1993). They are well known as sources of carrageenan which is used as a food additive.

Ultraviolet (UV) radiation is one of the most harmful exogenous agents and affects numerous biological functions in all sun-exposed living organisms. Organisms are exposed to solar radiation, including harmful UV-B (280-320 nm) and UV-A (315-400 nm) radiation, in their natural habitats. Repetitive exposure to sun causes premature skin aging (Marrot and Meunier, 2008) and skin cancer (Afaq et al., 2005; de Gruijl and Ananthaswamy, 2010). In response to intense solar radiation, organisms have evolved certain mechanisms, such as avoidance, repair, and protection by synthesizing or accumulating photoprotective compounds, such as mycosporine-like amino acids (MAAs).

In the present study, we investigated the UV absorption power of Russian seaweeds and isolated UV-absorbing constituents from them.

Received 18 October 2012; Revised 8 November 2012; Accepted 12 November 2012

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pISSN: 2234-1749  eISSN: 2234-1757

http://dx.doi.org/10.5657/FAS.2012.0361

http://e-fas.org
Results and Discussion

UV radiation is either reflected or absorbed by sunscreens. Different structural molecules have unique absorption wavelengths. An absorption spectrum will show a number of absorption bands that correspond to structural groups within the molecules.

In the present study, we examined the UV absorption properties of five Russian seaweeds within the range of 240 to 720 nm. Among the seaweeds, Gloiopeltis fucatas and Mazzaella sp. had the highest absorption peaks between 280 and 360 nm, while the other species did not show any absorption peaks (Fig. 1). We also measured the UV absorption activities of 0%, 50% and 100% aqueous ethanol extracts of Gloiopeltis fucatas and Mazzaella sp. to identify active UV-absorbing materials. Among these, 50% aqueous ethanol extracts from Gloiopeltis fucatas and Mazzaella sp. had high absorption peaks between 280 and 360 nm. These extracts were purified via column chromatography and two compounds were isolated. Their structures were identified as shinorine and palythine through comparisons with spectral data and the literature.

Materials and Methods

Samples

Five species of seaweed were collected at Sacchalin, Russia, from February to July 2011 (Table 1) by the TINRO-center, and stored frozen at -20°C.

Extraction

The seaweeds samples were extracted in 10 volumes of 0%, 50%, and 100% aqueous ethanol using a sonicator. The extracts were evaporated using a rotary evaporator.

Isolates derived from Gloiopeltis fucatas and Mazzaella sp. in Russia

The 50% aqueous ethanol extracts from Gloiopeltis fucatas (0.5 g) and Mazzaella sp. (0.5 g) were subjected to column chromatography over silica gel (silica gel 60, 0.063-0.200 mm; Merck, Darmstadt, Germany) and eluted with 80% aqueous acetonitrile, to yield four subfractions (G 1-4) and five subfractions (M 1-5) based on thin layer chromatography analysis, respectively. Then, separations of fractions G 3 (0.35 g) and M 4 (0.35 g) were carried out on a Dionex P690 HPLC system equipped with a UV detector (Dionex UVD 170U; Thermo Scientific, San Jose, CA, USA). High-performance liquid chromatography conditions were as follows: guard column, C18 (i.d. 4.6 × 7.5 mm, 5 µm; Alttech, Woodridge, IL, USA); column, Intersil ODS-3V (i.d. 4.6 × 150 mm, 5 µm; GL Science Inc., Tokyo, Japan); flow rate, 0.7 mL/min; detection wavelengths, 320 and 333 nm. An eluent solvent was followed by 50% acetonitrile (in 0.2% acetic acid) within 30 min. The structures were analyzed from spectral data using nuclear magnetic resonance and electrospray ionization mass spectrometry.

Measurements of UV absorption spectra

UV absorption spectra of seaweed extracts were evaluated using an Optizen 2120UV spectrophotometer (Mecasys, Daejeon, Korea) for wavelengths of 240 to 720 nm at a concentration of 1 mg/mL (Oyamada et al., 2008).

Table 1. The yield of five Russian seaweeds (%)

<table>
<thead>
<tr>
<th>Phylum</th>
<th>Classification</th>
<th>Yield (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phaeophyta</td>
<td>Gloiopeltis fucatas</td>
<td>10.32</td>
</tr>
<tr>
<td></td>
<td>Mazzaella sp.</td>
<td>11.77</td>
</tr>
<tr>
<td></td>
<td>Mastocarpus pacificus</td>
<td>8.23</td>
</tr>
<tr>
<td>Phaeophyta</td>
<td>Laminaria cichoroides</td>
<td>5.23</td>
</tr>
<tr>
<td></td>
<td>Saccharina japonica</td>
<td>7.35</td>
</tr>
</tbody>
</table>

The yield was expressed as percentage and calculated with the 50% aqueous ethanol extract weight per dry sample weight.
Lee et al. (2012) UV Absorption Materials from Russian Seaweeds

References


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Acknowledgments

This research was funded by a grant from the National Fisheries Research and Development Institute, Korea (RP-2012-FS-031).

![Fig. 3. Ultraviolet spectrum of the compound 1 and 2 isolated from *Gloiope-
peltis fucata* and *Mazzaella* sp.](image-url)