



Algae Activity as an Antioxidant Agent: Nutrition for the Skin

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Abstract: Skin health disorders have become increasingly prevalent in the face of global climate change. Algae product development is focused on enhancing protection against ultraviolet (UV) radiation by incorporating its antioxidant properties. This study aims to investigate the potential of algae as an antioxidant source. Qualitative identification of active compounds was conducted using specific reagent tests, while antioxidant activity was evaluated through the DPPH (2,2-Diphenyl-1-Picrylhydrazyl) assay. The antioxidant capacity was expressed as the IC₅₀ (Inhibitory Concentration) value. Phytochemical screening revealed the presence of terpenoids, triterpenoids, and saponins in the algae extract. The antioxidant assay demonstrated an IC₅₀ value of 84,83 ppm, indicating notable antioxidant activity. Further understanding of the mechanism by which algae act as antioxidant agents is essential. This research provides scientific evidence supporting the innovation of algae-based formulations for cosmetic applications.

Keywords: skin health, algae, antioxidant

1. INTRODUCTION

The skin is the largest immunological organ in the human body, playing a vital role in maintaining body functions, acting as a sensory interface barrier, aiding in thermoregulation, serving as a barrier against harmful exogenous agents, and generating responses to help fight infections (Merin KA, Merin Shaji 2022; Naharro-rodriguez et al. 2025). "However, in the current modern state, the skin does not only function as a physiological organ; it can also serve as an indicator of physical health status (beautiful skin) characterized by homogeneous pigmentation, a radiant glow, smooth and uniform texture, elasticity and firmness, adequate hydration, and the absence of visible inflammation or lesions (Valenzuela et al. 2025).

Oxidative stress and oxidative damage can exacerbate skin pigmentation and aging, leading to changes in skin tone uniformity, wrinkles, sagging, dryness, and roughness, resulting in chronic inflammation, mitochondrial dysfunction, lipid peroxidation, epigenetic changes, and microbiome disruption (Haykal et al. 2025). Therefore, compounds capable of neutralizing O₂ as antioxidants are needed to help resist, interrupt, and break the chain of free radical production and peoxidase formation. Natural antioxidants from plants work on the transforming growth factor-beta (TGF-β) and mitogen-activated protein kinase (MAPK) pathways; many applications in topical as well as consumable preparations already exist (Hussen et al. 2025).

Algae are natural ingredients originating from marine environments that contain several compounds such as polysaccharides, proteins, lipids, and polyphenols, which have potential as antioxidants (Frazzini et al. 2022). The results of

research by Rezayian et al. (2019) reported that algae have complex antioxidant defenses consisting of enzymatic and non-enzymatic components. Furthermore, a study by Mariya Jose and Muraleedhara Kurup (2016) reported that the brown algae *Sargassum swartzii* has a high carbohydrate content compared to *Ulva fasciata* and *Chaetomorpha antennina*, which possess strong antioxidant. Algae are natural ingredients from marine environments that contain many compounds and possess pharmacological activity; however, to date, there has not been much research on the antioxidant activity of algae originating from Lampung province concerning skin health. Therefore, this study aims to explore the antioxidant activity of algae for skin health."

2. MATERIALS AND METHODS

2.1 Equipment and Materials

The materials used in this research were algae, ethanol 96%, aquadestilata, methanol pro analysis (Merck), DPPH (Sigma-Aldrich). The equipment used in this research were a steering bar, measuring cup (Pyrex®), beaker (Pyrex®), volume pipettes, UV-Vis Spectrophotometer (Shimadzu 1900i & 2600 i), Ultrasound-Assisted Extraction (Ovan).

2.2 Sample Preparation

A 120 gram sample of algae was used. The sample was extracted using Ultrasonic Assisted Extraction (UAE). The solvent used was 96% ethanol



2.3 Qualitative Phytochemical Analysis

Qualitative examination of the compound content of the samples was carried out using several solution reagents. The identified compounds were directed towards the Phenolic, Flavonoid, Triterpenoid, Steroid, Tannin, Saponin, Coumarin, and Alkaloid groups. This screening analysis aims to predict the possible active compound groups responsible for antioxidant and anticancer actions (Shaikh and Patil 2020).

2.4 Antioxidant Test

The antioxidant activity of the extract was determined by the DPPH test, as previously described with some modifications. Briefly, 200 μ L of each extract (100-500 μ g/mL) was mixed with 3.8 mL of DPPH (Sigma-Aldrich) solution and incubated in the dark at room temperature for 1 hour. The absorbance of the mixture was then measured at 517 nm. Data from absorbance measurements were analyzed for the percentage of antioxidant activity. The IC_{50} value was determined by linear regression analysis from concentration data with free radical binding percentage (Baba and Malik 2015).

3. RESULTS

3.1 Phytochemical Test

Table 1. Phytochemical screening

Compound	Test Result
Terpenoid	+
Triterpenoid	+
Saponin	+
Flavonoid	-
Phenolic	-
Tannin	-

*'+ indicates that algae contain secondary metabolite compounds. '-' indicates that algae do not contain secondary metabolite compounds.

4. DISCUSSION

Marine algae are rich in bioactive substances that have been shown to provide benefits for the skin, particularly in treating rashes, pigmentation, aging, and cancer. This study shows that algae have very strong antioxidant activity (Figure 1). Interestingly, this antioxidant potential does not align with the results of the algae phytochemical screening test, which showed no qualitative polyphenols, tannins, or flavonoids (Table 1).

Based on evidence from previous studies, brown algae contribute most to cosmetics, including phlorotannins, which have several activities, such as anti-melanogenic and antioxidant. Several bioactive compounds from brown algae exhibit several cosmetic activities, including anti-

Chemical identification results showed that the algae only contained terpenoid, triterpenoid, and saponin compounds. They did not exhibit any phenolic, flavonoid, or tannin compounds. It is suspected that the active compounds contained in algae also influence its pharmacological activity.

3.2 Antioxidant test

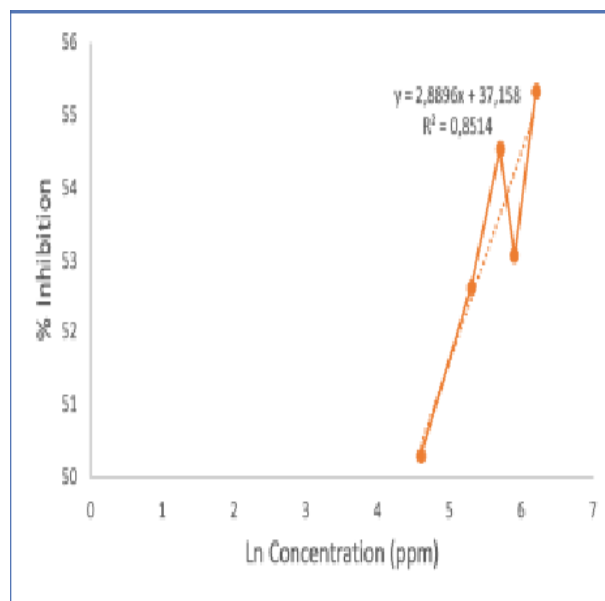


Figure 1. Free radical inhibition effect of algae. Each test was repeated 3 times. The resulting equation is $y = 2,8896x + 37,158$. IC_{50} is then calculated using the equation

Antioxidant activity test results showed that the algae had an IC_{50} of 84,83 ppm. Thus, algae has very strong potential as an antioxidant.

inflammatory and anti-aging. Similarly, fucoidan, a sulfated polysaccharide isolated from brown algae, contributes to anti-inflammatory, anti-melanogenic, and anticancer activities. Fucoxanthin, a carotenoid isolated from brown, red, green, and microalgae, exhibits anti-melanogenic, anti-aging, and antioxidant activities. Mycosporine-like amino acids (MAAs), commonly found in red and green seaweeds and microalgae, also contribute to antioxidant, anti-inflammatory, and anti-aging activities (Thiyagarasaiyar et al. 2020). In this study, the only phytochemical compounds detected were terpenoids, triterpenoids, and saponins (Table 1). It is suspected that the green algae in this study act as an antioxidant supported by the content of undetected microsporine-like amino acids or fucoidan.



Several secondary metabolites derived from algae are known for their benefits for the skin. The global trend toward products considered healthy, environmentally sustainable, and ecologically sourced is driving the cosmetics industry to fund research and development of new products containing compounds or extracts from natural sources. Algae are naturally exposed to oxidative stress and have developed several efficient protection systems against reactive oxygen species and free radicals, resulting in compounds that can act in cosmetics against the harmful effects of UV radiation, promoting a similar action of organic and inorganic filters currently used on the market.

In fact, there has been an increase in chlorophyll and carotenoid production from *C. vulgaris*, *Nostoc*, and *Spirulina* platensis when cultivated in areas with UV radiation. Furthermore, these compounds can help protect against oil oxidation in formulations, especially in emulsions containing a significant oily phase, due to their antioxidant properties (Ariede et al. 2017; Ferreira et al. 2021).

5. CONCLUSION

The algae in this study had a protective effect against UV rays as an antioxidant. Further research is needed to further examine other compounds involved in skin protection.

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