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Immunomodulatory Effects of a Brown Seaweed *Sargassum fusiforme*

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Abstract

Seaweed, particularly in Asian countries, has been used as food products and standard healing agents. *Sargassum fusiforme* (brown seaweed), as it is rich in dietary fibers and minerals such as calcium, iron, and magnesium, is commonly used in traditional cuisine. Due to its therapeutic benefits, in China, Korea, and Japan, as well as in the United Kingdom and North America, *S. fusiforme* remains common in diet.

Introduction

Seaweed has been used as food products and as traditional healing agents, especially in Asian countries. For a broad range of applications, there is currently an interest in growing the use of seaweed and in particular, in adding value to the extracted components. Seaweed, apart from its use as a food source, is also an excellent source of structurally diverse bioactive compounds with substantial medicinal and biomedical potential to produce functional materials such as nutraceuticals and cosmeceuticals.

Sargassum fusiforme is a macroalgal seaweed belonging to the order Fucales of the class Phaeophyceae. Because of its nutritional potential and its economic value in the pharmaceutical and manufacturing sectors, the global demand for *S. fusiforme* remains strong. Most studies on *S. fusiforme* have focused on polysaccharides; especially fucoidans is one of the most pharmacologically significant active compounds produced by *S. fusiforme*. Special interest is given to the specific characteristics of polysaccharides and bioactive low-molecule compounds in this species of seaweed, thus emphasizing the importance of further research in this area. *S. fusiforme* metabolites have been shown to have anti-tumor, antiviral, anti-aging, and anticoagulant effects. The medicinal and nutraceutical value of this seaweed must therefore be explored in order to raise public awareness and to allow effective use of this renewable natural resource.

Immunomodulatory Effects

Medical medicine focuses on the use of chemotherapeutic medications to treat malignant illnesses. These drugs however are immunosuppressive, i.e., the drugs weaken the immune responses of the patient even though the aim is to increase the likelihood of survival. Therefore, immunomodulators or other therapeutic options are required to help to mitigate these adverse effects of chemotherapy. In terms of strengthening the immune system following chemotherapy treatment, these alternatives can also accelerate recovery. In light of this a group of scientists began testing the effectiveness of *S. fusiforme* as an immunomodulator. Intrinsic and extrinsic substances that control or alter the scope, form, length or

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ability of the immune response are immunomodulators (Rasmussen and Arvin, 1982). A small portion of laminarin, alginic acid, fucoidan, and dietary fiber are primarily composed of *Sargassum fusiforme* polysaccharides (SFPSs). The maintenance of immune homeostasis can be impaired by diet. Chen *et al.,* (2012) have suggested that *S. fusiforme* can be an effective immune-potentiating supplement and can be used as an antidote to chemotherapy-induced immunosuppression, and can also be used in the food and pharmaceutical industries as an immunostimulant. This conclusion was confirmed by findings showing that SFPSs stimulated splenic lymphocyte proliferation and cellular factor secretion (IFN-γ, IL-2, and IL-6) in cyclophosphamide-treated immunocompromised mice. The spleen index was greatly increased by the SFPSs. The administration of SFPSs to immunocompromised mice (subjected to 200 mg/kg cyclophosphamide) showed immunomodulatory effects, in line with the previous report. Elevated spleen indices and substantially increased numbers of intraepithelial jejunal lymphocytes (IELs) and goblet cells confirmed this. In lubrication (secretion) and defense against pathogens which are in contact with the intestinal lumen, goblet cells play an important role. In response to a variety of pathological conditions that may affect the intestines, IELs, which are in close contact with enterocytes, are therefore triggered.

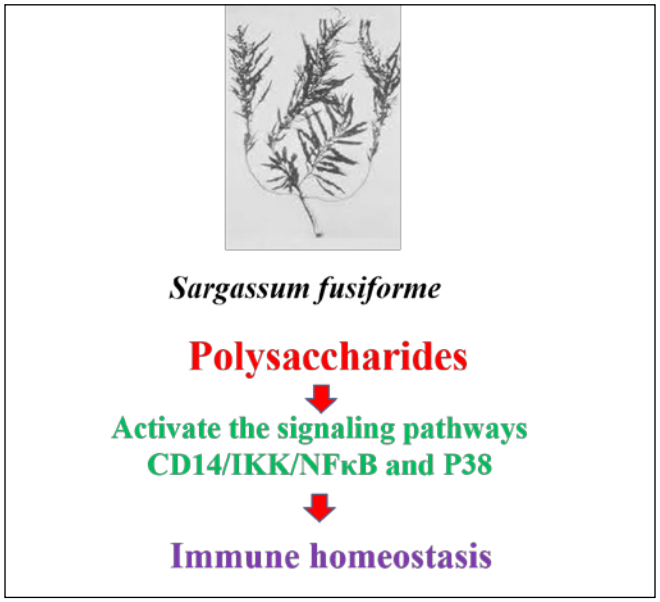

Figure 1: Immunomodulatory effects of Sargassum fusiforme

A novel fraction of SFPS, SFP-F2, was purified and characterized by Chen *et al.,* (2018) and showed that it exerted immune-enhancing effects by activating the signaling pathways CD14/IKK/NFκB and P38/NFκB in mice. Moreover, in RAW264.7 cells, SFP-F2 increased the production of cytokines including TNF-alpha, IL-1β, and IL-6. In fine-tuning the responses of different components of the immune system, these effects may play a vital role. Consequently, *S. fusiforme* contains promising agents for immunotherapy.

Conclusion

Growing current studies on marine algae as a potential drug reveals that a valuable bioactive resource is the use of natural seaweed products. While promising preclinical findings have shown extensive biological activities of its compounds, there are still limited applications in clinical practice.

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