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Medicinal Applications of Seaweeds: A Promising Future for Marine Bioactives

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SUMMARY

Seaweeds, or marine macroalgae, have long been used for medicinal purposes in both Asian and European traditions. Ancient Roman uses seaweeds as treatments for burns and wounds, while traditional Chinese and Japanese medicine includes seaweed-based remedies for a variety of ailments. In recent decades, interest in seaweeds has grown globally due to their potential as sources of novel bioactive compounds with therapeutic effects not found in terrestrial plants (Bernard & Tonk, 2019). This article explores the medicinal properties of seaweeds, highlighting research into their role in preventing chronic diseases, infections, and neurodegenerative disorders, as well as their application in bone and metabolic health.

INTRODUCTION

Cardiovascular diseases remain the leading global cause of mortality, responsible for approximately 30% of all deaths (World Health Organization, 2023). Dietary interventions are a crucial aspect of CVD prevention, and seaweeds offer high levels of dietary fiber and other heart-healthy compounds. Animal studies have demonstrated that seaweeds such as *Ulva, Porphyra tenera, and Laminaria digitata* positively affect lipid profiles and cholesterol levels. Fucoxanthin, a carotenoid found in brown seaweeds, has been shown to lower blood pressure and reduce risk factors for stroke. Furthermore, human studies involving alginate a polysaccharide derived from brown algae such as *Saccharina latissimi* have indicated reduced glucose and cholesterol absorption, suggesting potential in managing and preventing CVD (Bernard & Tonk, 2019).

Seaweeds are also rich in omega-3 polyunsaturated fatty acids, offering a vegan alternative to fish. These fatty acids are linked to improved cardiovascular health, reduced triglyceride levels, and better blood pressure regulation.

Figure 1 : Image of *Polyphyra tenera which is used to cure cardiovascular diseases.*

Figure 2 : Image of *Laminaria digitata* which is used to cure cardiovascular diseases.

Type 2 Diabetes

Type 2 diabetes, a metabolic disorder resulting from insulin resistance, can be mitigated through the intake of seaweed-derived fibers. Compounds such as alginate (brown seaweeds), agar, and carrageenan (red seaweeds) have demonstrated beneficial effects on blood glucose, lipid profiles, and body mass index (BMI). Seaweed extracts from species *like Fucus and Ascophyllum nodosum* help moderate insulin spikes following high-carbohydrate meals, suggesting a potential role in dietary management of diabetes (Bernard & Tonk, 2019).

Obesity

As one of the most serious public health challenges globally, obesity can be addressed with dietary fibers that promote satiety. Seaweed fibers have been shown to reduce caloric intake and support weight loss. Clinical trials have confirmed that *A. nodosum*-enriched bread significantly reduced energy consumption. Additionally, a 12-week trial involving alginate supplementation resulted in measurable weight loss and fat mass reduction in overweight individuals (Bernard & Tonk, 2019).

Antimicrobial and Antiviral Properties

Antibiotic resistance is a growing global health crisis, necessitating the discovery of new antimicrobial agents. Seaweeds contain numerous bioactive compounds with potent antimicrobial effects, particularly against bacteria. In vitro studies have identified species such as *Ulva, Saccharina, and Chondrus crispus* as effective against bacterial growth. Although most studies have not yet advanced to clinical trials, the findings suggest a promising role for seaweeds in future antibiotic development (Bernard & Tonk, 2019).

Seaweeds also exhibit antiviral properties. In vitro and animal studies have shown that certain seaweed compounds can act against enveloped viruses like herpes simplex virus types 1 and 2, as well as HIV. Carrageenan, traditionally used to treat colds and coughs, has shown efficacy against the human rhinovirus in laboratory tests (Bernard & Tonk, 2019).

Cancer Prevention and Therapeutic Potential

Epidemiological data reveal lower cancer incidence in populations with high seaweed consumption, suggesting a protective effect. Laboratory studies support these observations, showing that seaweed extracts have anti-tumor activity. The brown seaweed *Undaria pinnatifida* has demonstrated activity against breast cancer cells in vitro. Similarly, the red seaweed *Porphyra* has been linked to reduced breast cancer risk in postmenopausal women (Bernard & Tonk, 2019).

While the specific active compounds remain under investigation, some polysaccharides and carotenoids are believed to play a role. These compounds could potentially be developed into novel cancer-preventive or therapeutic agents with further research and clinical validation.

Figure 3: Image of *Undaria pinnatifida which is used for cancer prevention.*

Bone Health and Osteoporosis Prevention

Osteoporosis is characterized by weakened bones and an increased risk of fractures. Adequate calcium intake is essential for bone health, and some seaweeds offer calcium content two to three times higher than milk. *Ascophyllum nodosum, Laminaria digitata, and Ulva* are notable for their high calcium levels, making them

valuable in osteoporosis prevention strategies, especially for individuals with lactose intolerance or those on plant-based diets (Bernard & Tonk, 2019).

Figure 4 : Image of *Ascophyllum nodosum which is used for* Bone Health and Oteoporosis prevention.

Neurological Benefits and Alzheimer's Disease

Seaweeds may have neuroprotective properties, especially in the context of Alzheimer's disease (AD). AD is characterized by the accumulation of amyloid-beta (Aβ) plaques in the brain. Seaweed extracts have shown the ability to inhibit Aβ formation in vitro. Genera such *as Saccharina, Alaria, and Chondrus* have demonstrated promise in laboratory settings. Moreover, in vivo animal studies suggest that seaweed-derived compounds may also aid in treating other neurological conditions like epilepsy, Parkinson's disease, and depression (Bernard & Tonk, 2019).

Figure 5 : Image of *Saccharina species* which is used to cure Alzheimers disease

Anthelmintic Activity: Seaweeds as Vermifuges

Seaweeds may also help eliminate parasitic worms. Red seaweed species like *Palmaria palmata* contain kainic acid, a compound that paralyzes intestinal parasites such as *Ascaris*. Once immobilized, these worms are naturally expelled from the body through peristalsis and defecation. This traditional use illustrates another avenue where seaweeds could serve as a natural therapeutic (Bernard & Tonk, 2019).

CONCLUSION

Although preclinical studies on the medicinal potential of seaweeds are promising, human clinical trials are still limited in both quantity and methodological rigor. A major gap in current research is the identification and characterization of specific active compounds responsible for the observed effects. Another concern is the potential accumulation of heavy metals and toxins in seaweed biomass from polluted waters, which may limit their safe use.

Nonetheless, the broad spectrum of biological activities exhibited by seaweed compounds underscores their potential as novel therapeutic agents. As seaweed industries, particularly in Europe and Asia, continue to grow, health-promoting applications of marine macroalgae could provide new high-value markets. Rigorous clinical validation and stringent quality controls are essential for realizing their full medicinal potential.

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