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Letter to the Editor

Seaweeds: Some Pharmaco-Immunological Effects

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TO THE EDITOR

Seaweed is a sea plant that is found in every sea or ocean and may belong to one of several groups of multicellular seaweeds such as the red, the green, and the brown seaweeds. Seaweeds are consumed by people living in coastal areas, particularly in East Asia including Japan, China, Korea, Taiwan, and Thailand and are rarely eaten by people in the western countries. Seaweeds, as an important source of trace minerals, have been frequently used as an herbal medicine to suppress inflammation and also used for the treatment of various diseases such as allergy, cancer, ulcers, arthritis, and hypotension (1-5). Therefore, extracts of seaweeds, especially the brown seaweeds, could be utilized as a good natural source of a possible food supplement and is consumed as an anti-inflammatory agent in the pharmaceutical industry to treat some immunologic disorders and allergic diseases (1). Several studies from various countries indicate an increasing prevalence of allergic diseases and asthma in the last decades (6,7). Also, studies have demonstrated a relationship between dietary factors and allergic diseases, particularly with high fatty acid foods, fruits, and antioxidants (1,8-10). Hyaluronidase, an enzyme which cleaves hyaluronic acid in the extracellular matrix of connective tissue, is also known to be involved in allergic inflammation (11). Antiallergic agents may have a strong inhibitory effect on the activation of hyaluronidase (12). A wide variety of seaweeds, specially the brown ones, with polyphenol and phlorotannin contents were assessed for their antihyaluronidase activity, as antiallergic agents (12,13). However, the inhibitory effect on hyaluronidase may be related to the high molecular weight of phlorotannin, since the higher the molecular weight of phlorotanin, the higher its inhibitory effect on the sulphation of compounds present in the crude extract of seaweeds (12,14). Another study investigated the effect of alginic acid, a naturally occurring hydrophilic colloidal polysaccharide obtained from a different species of brown seaweeds (Phaeophyceae), on the mast cell-mediated

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anaphylactic and inflammatory reactions (15). The results depicted that alginic acid oligosaccharide suppresses Th2 development and IgE secretion by inducing interleukin (IL)-12 secretion (16). Furthermore the results of an epidemiological study showed that higher dietary ingestion of seaweed may diminish the prevalence of allergic rhinitis in Japanese female young adults (1). Indeed, the dietary fiber in the seaweed, fucoidan, modulates the function of immune cells including macrophages, natural killer (NK) cells, lymphocytes and neutrophils (17,18). Therefore, fucoidan upon inhibition of class switching in B lymphocytes, blocks IgE production and its might clarify its beneficial effect in the treatment of allergic diseases and a reduction in the prevalence of allergic rhinitis in this group (19).

Likewise, anti-tumor activity of seaweed extracts may eventually emerge as a treatment for cancer. β-glucan purified from seaweeds is a recognized biologic ingredient with immunostimulantory activity against cancer (20,21). The anti-tumor effect of β-glucan has been used successfully in Japan as early as forty years ago (22,23). The anticancer mechanisms of β-glucan may include induction of humoral immunity, complement and antibodies. For example, it has been shown that the majority of malignant cells in breast cancer are naturally targeted with C3 for cytotoxicity by NK cells bearing CR3 receptors that have been primed with β-glucan (24). Also, a double-blind study on fifteen healthy postmenopausal Japanese women showed an inverse correlation between consumption of seaweed powder (10 capsules) and serum estradiol. Indeed, seaweed upon modulation of colonic bacteria alters estrogen and phytoestrogen metabolism. On the other hand, seaweed as a prebiotic agent has protective effects in phytoestrogen and estrogen metabolism (25). Another natural compound from seaweeds is fucoidan, with anti-angiogenic and anti-tumoral activities, that may enhance tumor hypoxia by inducing endothelial cell apoptosis (26). In this regard, a recent study has demonstrated the ability of fucoidans in inhibiting the vascular endothelial growth factor (VEGF) induced angiogenesis and tumor neovascularization *in vivo* (27). In this case, fucoidan from Saccharina latissima is considered as a promising candidate for novel anti-tumor therapies (28). Moreover, active sulfated homo-heterofucans derived from a brown seaweed through induction of HeLa cell apoptosis have shown antitumor effects (29).

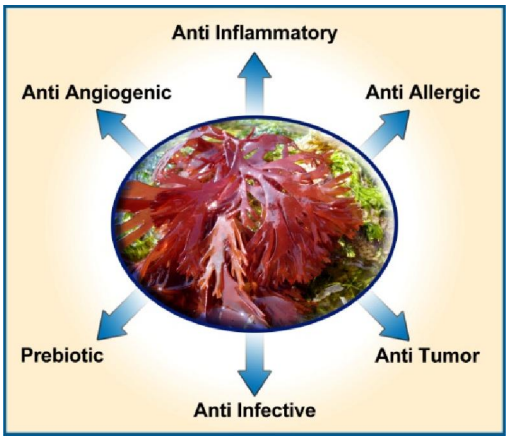

Figure 1. Some Immunopharmacologic Properties of Seaweeds.

Porphyra dentate has anti-inflammatory effects through suppression of nitric oxide (NO) production, repression of inducible nitric oxide synthase (iNOS) transcription and nuclear factor κ-light-chain-enhancer of activated B cells (NF-κB), and enhancing the activation of lipopolysacharide-stimulated macrophages (30). The extracted compounds of seaweeds may function as competitive inhibitors of cyclooxygenase and/or lipoxygenase in an inflammatory reaction, leading to decreased production of prostaglandins and leukotrienes (31). Overall, these data indicate that the compounds present in seaweeds could be used as safe remedies for subsiding inflammatory symptoms. Researchers are looking for drugs with maximum effects and minimal side effects. Therefore, drugs of natural origin, such as seaweeds, seem to be very effective and useful. In summary, several compounds present in seaweed extracts have been indicated to have antiallergic, antitumour, anti-inflammatory and antiinfective properties (Figure 1). This may suggest a promising future in developing natural drugs.

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