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Editorial

How *Sargassum fusiforme* Polysaccharides Promote Health Condition

Peichao Chen[1]*, Ya Zhang[1,2] and Mingjiang Wu[1]

[1]*College of Life and Environmental Science, Wenzhou University, Wenzhou, Zhejiang, China*
[2]*Department of Natural Resources and Environmental Studies, University of Northern British Columbia, Prince George, BC, Canada*

***Corresponding Author**: Peichao Chen, College of Life and Environmental Science, Wenzhou University, Wenzhou, China.

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Sargassum fusiforme is a kind of nutrient-rich edible brown algae, which enjoys a good reputation as a "longevity promoting vegetable" in Eastern Asia. Although it is popularly served as side dish, *Sargassum fusiforme* also has been listed in Chinese Pharmacopoeia and used as medicinal ingredients. Polysaccharides, phlorotannins, meroterpenoids and etc. compounds in *Sargassum fusiforme* are the major contributors for its pharmacological properties. While the polysaccharides are the predominant ingredients, which account for 40 - 60% of the algae dry weight. Furthermore, the *Sargassum fusiforme* polysaccharides have been suggested anti-oxidation, anti-cancer, anti-aging, anti-clotting, etc., thus promoting health condition and lifespan extension [1]. However, the mechanisms remain largely unknown.

Sargassum fusiforme polysaccharides (SFPS) are mainly consisted of alginate, fucoidan and a few laminaran. Alginate is a linear, unbranched polymer, consisting of D-mannuronic acid and guluronic acid, which are linked by β- (1,4) glucosidic linkages in differential ratios [2]. Fucoidan is a class of water-soluble, naturally-occurring sulfated polysaccharides predominantly presenting in brown algae cells. In addition to Fucose, fucoidan also contains Galactose, Xylose, Glucose, Arabinose, Mannose, Alduronic acids and etc., which are mainly linked by α/β- (1, 2)/(1, 3) glucosidic linkages [3]. Laminaran is known as brown algae starch or kelp starch, which is β-(1, 3)-glucan with differential degrees of polymerization. Therefore, the complex composition of the mono saccharides and glucosidic linkages endows the SFPS with abundant and diverse structures, which are intensively associated with many biological activities [4].

The study on the biological activities of polysaccharides from *Sargassum fusiforme* mainly focused on anti-oxidation, anti-tumor, hypolipidemic and hypoglycemic effects, and also a small amount of work related to anti-fatigue, antivirus and etc.

In vitro experiments showed that SFPS directly exhibited good radicals scavenging ability via 2,2-diphenyl-1-picrylhydrazyl radical (DPPH) system and linoleic acid system tests. In addition, SFPS also prevented pancreatic β-cells from H_2O_2 induced oxidative damage, which was suggested relating to the PI3K/AKT pathway [5]. Therefore, it indicates that SFPS functions not only via its chemical property but also influencing cellular signaling transduction pathways. Further *in vivo* experiments demonstrated that the antioxidant activity of SFPS is related to anti-tumor, hypolipidemic and hypoglycemic, and plays an important role in restoring the immunocompetence of mice as well [5]. SFPS may enhance the expression of tumor suppressor gene p53, and activate Fas/FasL/Caspases signaling pathway [6], thus inhibiting tumor cell cycle and inducing apoptosis. It suggested that SFPS performed anti-tumor activity by enhancing animal's immune activity, which associated with NF-kB signaling pathway [7].

In the study of hypolipidemic blood glucose, SFPS significantly inhibited the blood lipid level in hyperlipidemic rats, which was related to the antioxidant capacity [8], as well as reducing the absorption of exogenous lipids. Hypoglycemic effect of SFPS may also be associated with antioxidant [9]. For SFPS can also reduce the blood sugar in diabetic rat through enhancing glucose tolerance and reducing the MDA content in rat [10].

Our recent studies suggested that SFPS functioned anti-aging, which was intensively linked to its antioxidant activity. It showed that SFPS prevented oxidative damage of CCl4 induced liver injury [11] or D-galactose induced aging in mice [12]. Furthermore, we demonstrated that dietary intake of SFPS can improve intestinal physiological status and gut microbial flora during aging [13]. Meanwhile, long-term administration of SFPS also up-regulated the antioxidant Nrf2/ARE signaling pathway. However, the precise mechanism remains obscure. It is presumed to associate with the metabolites of SFPS or that from the gut microbes.

In addition, the sulfated polysaccharide had certain inhibitory effect on liver cancer cells. Compared with the original polysaccharide fraction, the inhibitory effect on the cell growth was improved. Thus sulfated polysaccharides of *Sargassum fusiforme* have the ability to enhance antitumor activity [14]. In SFPS, the content of fucoidan is low and the content of alginate is high, so APTT activity is very low. This indicates that alginate has no anticoagulant activity because it contains no sulfate group and is composed of uronic acid. In addition, the uronic acid content of polysaccharide fragments is relatively high, while the anticoagulant activity is low, which shows that uronic acid content and anticoagulant activity is not directly related. Fucoidan did not significantly prolong the clotting time, indicating that fucoidan mainly achieved anticoagulant effect by inhibiting the intrinsic coagulation pathway [15]. Compared with heparin, SFPS has weaker anticoagulant activity and may be developed into a functional food for preventing thrombotic diseases.

In summary, *Sargassum fusiforme* is a kind of food and drug dual used algae, and the polysaccharides perform major contribution to its health promoting property. The SFPS exhibits robust antioxidant activity, which links to anti-tumor, anti-aging, immunomodulation, hypolipidemic and hypoglycemic, thus eventually promoting health condition. As antitumor drug sensitizer and functional food side effects, SFPS in the field of food or medicine has broad application prospects.

Conflict of Interest

The Authors declare no conflict of interest.

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