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Algal Polysaccharides: Properties and Applications

Jae Kweon Park*

Department of Life Sciences, Gachon University, South Korea

***Corresponding author:** Park KJ, Department of Life Sciences, Gachon University, Seongnamdaero 1342, Seongnam-si, Gyeonggi-do 461-70, South Korea, Tel: +82-31-750-4763; Fax: +82-31-750-4763; E-mail: jkpark@gachon.ac.kr

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Commentary

Bioactive polymers mainly polysaccharides such as cellulose, chitin, amylose and beta-glucan are well discovered from various sources in nature. Amongst chitin, as the second most abundant polysaccharides after cellulose, is known as a highly insoluble polysaccharide consisting of β-4-linked N-acetyl-D-glucosamine, which has been identified as a structural component of crustaceans, crabs, shrimps, insects, and other arthropods, as well as a component of the cell walls of fungi [1] and some alga [2]. Although various bioactive functions are characterized well, less is known about the relationship between structure of biopolymers and their physiological/biological activities. Therefore, more efficient utilization of these raw materials is being required in various fields like in pharmaceutical, medical, agricultural and industrial applications. Since biopolymers are interesting in various applications described above, especially marine alga are of focusing as the plentiful sources for various bioactive compounds including proteins, poly-phenolic compounds, carotenoids and polysaccharides, which was identified as cell wall structural or intercellular components. Structural specificities, substitution patterns and polymerization degrees of polysaccharides are prerequisites of physical and functional properties in alga, even though other biopolymers such as proteoglycans, polymeric phenolics and proteins may participate in the synergic activities and the formation of algal cell wall. Great variability of cell wall polysaccharides in marine alga has been identified to be involved in the determination of the species or taxa, and developmental stages of life-cycle. In general, alga have been grouped into mainly Clorophyta (green algae), Rhodophyta (red algae) and Phaephyta (brown algae). These alga produce various bioactive compounds including sulphated polysaccharides as in complex composite cell walls consisting of cellulose, sulfated galactans, xylan or mannan fibrils. For instance, green algae of Ulvophyceae consists of sulphated (1→3)-β-D-galactans [3] and sulfated glucuronofucan containing both fucofuranose and fucopyranose residues were identified from the brown alga Chordaria flagelliformis [4]. As described above, it is very hard to identify their structural components in precise. In addition, more complex compounds which were highly branched sulphated hetero-polysaccharides of brown alga were assigned from many different origins. Eventually, both sulphated and carboxylated algal polysaccharides are known to exhibit biological activities such as anti-herpetic [5], anti-coagulant [5,6], anti-inflammatory [7], anti-tumor [8], anti-microbial [9], immune-modulatory [10], anti-viral activities [11] and etc. Among them, immuno-modulating and anti-coagulant activities seem to be the most potent biological activities for understanding the mechanism of action of algal polysaccharides [5,6,10,12]. Therefore, the geometry of glycosidic linkages to get better understanding for physical or chemical properties of algal polysaccharides is critically important. Besides marine algal cell wall polysaccharides, in recent, alpha-amylose like polysaccharide consisting of glucose mainly was identified from a photosynthetic microalgae Dunaliella tertiolecta [13], which was isolated as a biodiesel producer. It can be effectively converted into glucose by enzymatic or acidic hydrolysis, which recovered over 90% of glucose from the defatted cell wall. High potential production of algal biomass and efficient conversion to glucose may allow further exploration for industrial exploitation of bio-ethanol. It suggested that micro-algal defatted biomass can provide the significant commercial potential to increase net ethanol production as an alternative bio-resource replaceable of corn or edible starch. Therefore polysaccharide derived from the defatted biomass of D. tertiolecta and characterized as a homo-polysaccharide consisting of glucose is a promising candidate for industrial exploitation for ethanol production in aspect of bio-refinery [13]. According to many reports, polysaccharides obtained in homo- or hetero complexes from many different kinds of alga including photosynthetic microalga and other species have great potential for bioactive materials, bio-ethanol and medicinal applications, because of their biocompatibility with the human tissues, biodegradability and non-toxicity.

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References

1. Herth W, Kuppel A, Schnepf E (1977) Chitinous fibrils in the lorica of the flagellate chrysophyte Poteriochromonas stipitata (syn. Ochromonas malhamensis). J Cell Biol 73: 311-321.
2. Rahman MA, Halfar J (2014) First evidence of chitin in calcified coralline algae: new insights into the calcification process of Clathromorphum compactum. Sci Rep 4: 6162.
3. Lahaye M (1998) NMR spectroscopic characterisation of oligosaccharides from two Ulva rigida ulvan samples (Ulvales, Chlorophyta) degraded by a lyase. Carbohydr Res 314: 1-12.
4. Bilan MI, Vinogradova EV, Tsvetkova EA, Grachev AA, Shashkov AS, et al. (2008) A sulfated glucuronofucan containing both fucofuranose and fucopyranose residues from the brown alga Chordaria flagelliformis. Carbohydr Res 343: 2605-2612.
5. Kolender AA, Pujol CA, Damonte EB, Matulewicz MC, Cerezo AS (1997) The system of sulfated a-(1?3)-linked D-mannans from the red seaweed Nothogenia fastigiata: structures, antiherpetic and anticoagulant properties. Carbohydr Res. 304: 53-60.
6. Kim WJ, Koo YK, Jung MK, Moon HR, Kim SM, et al. (2010) Anticoagulating activities of low-molecular weight fuco-oligosaccharides prepared by enzymatic digestion of fucoidan from the sporophyll of Korean Undaria pinnatifida. Arch. Pharm. Res. 33: 125-131.
7. Kang SM, Kim KN, Lee SH, Ahn G, Cha SH, et al. (2010) Anti-inflammatory activity of polysaccharide purified from AMG-assistant extract of Ecklonia cava in LPS-stimulated RAW264.7 macrophages. Carbohydr. Polym 85: 80–85.

8. Koyanagi S, Tanigawa N, Nakagawa H, Soeda S, Shimeno H (2003) Oversulfation of fucoidan enhances its anti-angiogenic and antitumor activities. Biochem Pharmacol 65: 173-179.
9. Khan S, Tøndervik A, Sletta H, Klinkenberg G, Emanuel C, et al. (2012) Overcoming drug resistance with alginate oligosaccharides able to potentiate the action of selected antibiotics. Antimicrob. Agents Chemother 56: 5134-5141.
10. Karnjanapratum S, Tabarsa M, Cho M, You S (2012) Characterization and immunomodulatory activities of sulfated polysaccharides from Capsosiphon fulvescens. Int J Biol Macromol 51: 720-729.
11. Lee JB, Hayashi K, Hayashi T, Sankawa U, Maeda M (1999) Antiviral activities against HSV- HCMV, and HIV-1 of rhamnan sulfate from Monostroma latissimum. Planta Med 65: 439-441.
12. Jiang Z, Okimura T, Yamaguchi K, Oda T (2011) The potent activity of sulfated polysaccharide, ascophyllan, isolated from Ascophyllum nodosum to induce nitric oxide and cytokine production from mouse macrophage RAW264.7 cells: Comparison between ascophyllan and fucoidan. Nitric Oxide 25: 407-415.
13. Goo BG, Baek G, Choi DJ, Park YI, Synytsya A, et al. (2013) Characterization of a renewable extracellular polysaccharide from defatted microalgae Dunaliella tertiolecta. Bioresour. Technol 129: 343-350.