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Physicochemical properties of porphyran from *Porphyra yezoensis*

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Introduction

Red seaweeds contain considerable amounts of polysaccharides often having peculiar structures. The major soluble polysaccharide in *Porphyra* species is porphyran, which usually has a linear backbone composed of alternating 3-*O*-linked β-D-galactopyranose and 4-*O*-linked α-L-galactopyranose(or 3,6 anhydro-L-galacto pyranose) residues. But the substituting patterns are very complex. They differ in the level and pattern of sulfation, methoxyl and pyruvic acid contents, and the configuration of the 4-*O*-linked residues. Although *Porphyra yezoensis* has been used as food materials in Korea, there is few information concerning its chemical and rheological properties. This paper describes viscosity of porphyran solution and ^{13}C-NMR chemical assignment for porphyran fractions(<3,000 dalton) obtained by β-agarase hydrolysis. These data could be useful to obtain basic data for the utilization of porphyran as soluble dietary fiber materials.

Materials and methods

Algal specimens were collected at buan in Korea. The harvested fronds of *Porphyra yezoensis* were cleaned with sea water. This was followed by drying in an oven at 45℃ for 48hrs. Porphyran was extracted in a crude form with hot-water extraction and purified with cetylpyridinium chloride precipitation and fractional precipitation of ethanol. Porphyran was treated with sodium borohydride and then with 1M NaOH at 80℃ for 6hrs according to the method of alkali treatment. For analysis sugar composition, porphyran was hydrolyzed with TFA, the hydrolyzed sugar were reduced with $NaBH_4$ and the extract was identified by gas chromatography. The amount of total sugar was measured by phenol-sulfuric methods. The amount of 3,6-anhydrogalactose was measured by the resorcinol test, according to Yaphe and Arsenault(1965). The sulfate amount of sulfate was determined by the turbidimeric method(Dodgson et al, 1962). For the structure analysis, porphyran was hydrolyzed with β-agarase and fractionated with ultrafilteration and ion chromatography. The smaller molecular weight fraction(<3,000) was disolved with D_2O and its ^{13}C-NMR spectra was recorded on Bruker AMX spectrometer at 125 MHz at room temperature. The chemical shift(ppm) was measured in relation internal DMSO and converted to external tetramethylsilane(TMS). Infrared spectra were recorded with a FT-IR 300, Jasco. Viscosity measurement were performed

with HAKKE RV 20 viscometer shear stress at various shear rates(0~2,000 1/s).

Results

Porphyran was extracted in a crude form with hot-water extraction and purified with cetylpyridium chloride precipitation and fractional precipitation of ethanol(61-70%). The porpyran content was 6.8% of the algal dry weight and the average molecular weight was 5.5 x 10^5 daltons. ^{13}C-NMR spectra of β-amylase degraded porphyran fractions and infrared spectra of alkali modified porphyran suggested that the polysaccharide contained and agar-type backbone of alternating 3-linked β-D- and 4-linked α-L-galactophyranosyl units. The L-residues were present as the 3,6-anhydro L-galactose and as its precusor L-galactose 6-sulfate. The presence of 6-O-methyl D-galactose as a minor sugar also was detected. The porphyran consisted of DL-galactose, 3,6-anhydro L-galactose, 6-O-methyl D-galactose and ester sulfate in the molar ratio of 1.00: 0.32: 0.07: 0.53. The 1% porphyran solution showed non-Newtonian behavior and apparent viscosity at 1,5000 shear rate (1/s) was 26mPa.s. Alkali desulfation increased 3,6-anhydro galactose content and produced high gel strength agar.

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