BL-6A/2015G139

Structural Characterization of Association of Seaweed Polysaccharide and Protein in Aqueous Solutions by Small Angle X-ray Scattering

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1 Introduction

Polysaccharides in seaweeds are almost polyelectrolyte as carrageenan and alginate, which have sulfate groups and carboxyl groups. They are used as food additives or gelling agent, because their aqueous solutions show high viscosity or gel state at various conditions. These behaviors are related with the solution structure of polysaccharide and their assembly structure at molecular level or nano-scale.

Recently, the sulfated polysaccharide as fucoidan, reveals various physiological activities, as antiviral, antitumor, and so on. In order to understand the physiological activity mechanism, it is very important to elucidate the structure of association between protein and electrolyte polysaccharide.

In this study, structural characterization of association of marine polysaccharide and protein is examined by small angle X-ray scattering (SAXS) [1].

2 Experiment

The sulfated polysaccharide sample (named UL-1) was extracted from green seaweed *Ulva Lactuca*, collected at central coasts of Vietnam. The chemical composition of UL-1 was analyzed as mainly consisting of rhamnose, uronic acid and sulfate groups. Lysozyme was used as the protein sample.

SAXS experiments were carried out at BL-6A experimental station in Photon Factory, Tsukuba, Japan. The X-ray beam from synchrotron radiation was used. An incident X-ray beam was monochromatized to λ = 0.15 nm and focused to the position of the detector with a bent focusing mirror. The scattered X-ray was detected by PILATUS positioned at a distance of about 1 meter from the sample holder. The solutions were injected in a flat cell of 0.3 cm path-length made of glass with quartz windows (20 μm thick).

3 Results and Discussion

Figure 1 shows the Kratky plots ($q^2I(q)$ vs q, where $I(q)$ is scattering intensity and q is the magnitude of scattering defined by $(4\pi/\lambda)\sin(\theta)$ with λ the wavelength of incident beam, 2θ scattering angle) for 0.5% sulfated polysaccharide (UL-1), 0.25 %lysozyme, and their mixture in 0.5M NaCl. The clear peak in scattering from lysozyme can be found in 1 nm^{-1} of q, due to the particular shape of protein. The profile of UL-1 has the upturn in smaller angle region and reflects chain structure in other region. The scattering from mixture indicates strong upturn for high degree of aggregation. This means that the anionic polysaccharide interacts and associates with cationic protein. Figure 1 also shows the linear sum of scattering from UL-1 and lysozyme, and the difference from scattering data of mixture sample proves the interaction of polysaccharide and protein.

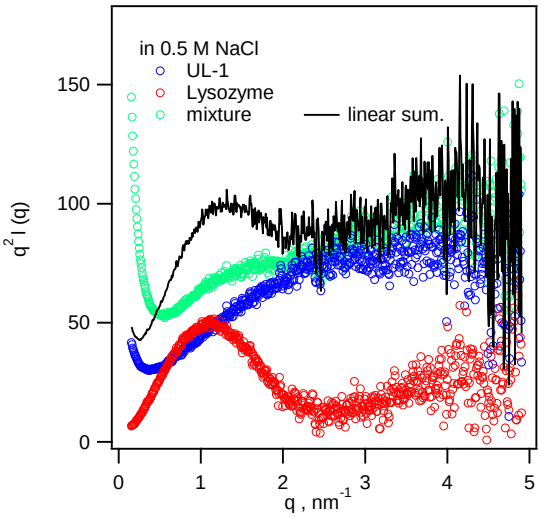

Fig. 1: Kratky plots for SAXS from 0.5% sulfated polysaccharide (UL-1), 0.25% lysozyme, and their mixture in 0.5M NaCl.

References

[1] Thuy Thi Thu Thanh, Van Thi Thanh Tran, Yoshiaki Yuguchi, Thuy Thi Thanh Tran, Ly Minh Bui and Tai Tien Nguyen, *Marine Drugs*, **11**, 2431-2443 (2013)

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