Structural characteristic of molecular aggregation of xyloglucan and congo red

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Introduction

Xyloglucan exists in plant cell walls and plays a role of binding plant cells by the physical association with cellulose microfibriles on the walls. It also exists in some seeds of trees growing in the tropical zone. Tamarind seed xyloglucan, which is stored in seeds of *Tamarindus indica*, is used as food additives such as a gelling agent, a stabilizer, a starch modifier, etc, in Japan. Xyloglucan has a cellulose backbone with branched (1→6)-α-xylose or (1! 2)-β-galactoxylose as a side chain. Although cellulose is insoluble in water because the chains are crystallized with cooperative hydrogen bonds, but xyloglucan is a water-soluble by suppressing the cellulose-like chain aggregation due to steric hindrance of the side chains. Xyloglucan in solution can form gel or gel-like precipitation by addition of congo red. In this study the aggregation of xyloglucan chains with congo red molecules was observed by means of small angle X-ray scattering (SAXS).

Experimental

A xylogluncan sample was provided by Dainippon Pharmaceutical Co., Ltd. It was purified with an alcohol precipitation method before preparation of samples for measurement. SAXS experiments were carried out with SAXES optics installed at BL-10C in Photon Factory.

Results and Discussion

Very small amount of dye molecule, congo red, makes xyloglucan aqueous solutions form gel. For example,0.1% of congo red is enough to make gel for1% xyloglucan. Figure 1 shows the Kratky plots ($q^2I(q)$ vs q, where $I(q)$ is scattering intensity and q is the magnitude of scattering angle) for xyloglucan 2% aqueous solution without and with 0.5% congo red. The profile from xyloglucan solution state is characteristic of rod-like structure. This can be approximated with Gunier formula and evaluated with cross-sectional radius of gyration being 4.6Å from cross-sectional Guinier plots ($ln(qI(q))$ vs q^2). On the other hand the congo red addition system has characteristic maxima in Kratky plots suggesting the formation of molecular assembly. Figure 2 shows the thickness Guinier plots for SAXS from xyloglucan gel with congo red. If scattering body has the plate structure with very large surface, the linear region in its profile should be appeared. The well-defined linear profile was observed as shown in Fig.2, as evaluating the thickness radius of gyration, Rgt, = 4.2Å. This size is considered to correspond to the width of xyloglucan chain. This suggested that the ribbon-like structure of xyloglucan was stacked via congo red molecule by hydrogen bonding and van del Waals interaction, subsequently the chain assembly structure was constructed like plate-structure.

References

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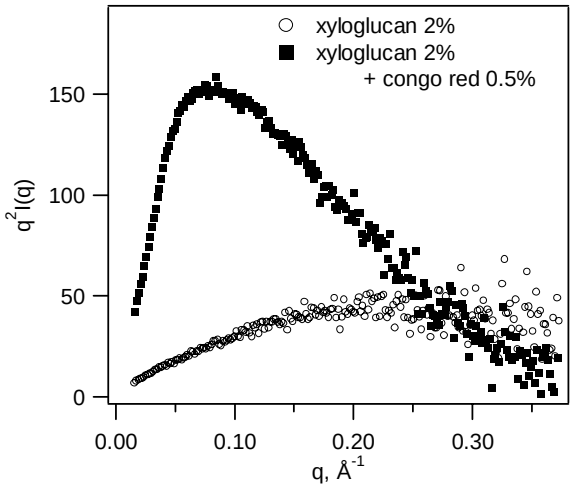

Figure 1. Kratky plots for SAXS from xyloglucan 2% aqueous solution without and with 0.5% congo red.

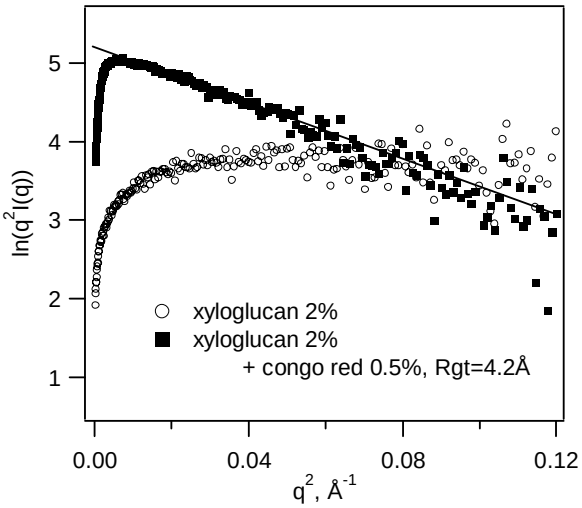

Figure 2. Thikness Guinier plots for SAXS from xyloglucan 2% aqueous solution without and with 0.5% congo red.

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