UPGRADING LIGNIN ANTIOXIDANT PROPERTIES BY SELECTIVE DISSOCIATION OF WHEAT STRAW LIGNIN LINKAGES

Mohammadali Azadfar and Shulin Chen

Department of Biological Systems Engineering, Washington State University, Pullman, WA 99164-6120, USA

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ABSTRACT

Production of value-added products from lignin obtained after pretreatment of biomass requires advanced characterization and modification techniques to illustrate the lignin structure in detail and also to increase the lignin's usability. The lignin modification methods which have been proposed so far endeavor to decompose the natural structure of lignin for producing the value-added products. One of the attractive applications of raw lignin obtained after pretreatment is for use as an antioxidant. In order to preserve the intrinsic structure of lignin for producing antioxidant, the lignin linkages should be dissociated utilizing the ingenious methods. This project aims to modify the lignin structure employing the benefits of the effect of alkaline and acidic conditions on ester and ether lignin linkages without destruction of valuable original structure of wheat straw lignin.

The characterization of wheat straw lignin obtained from sequential ozone and soaking aqueous ammonium pretreatment revealed the presence of phenolic derived-compound with comparable antioxidant activity with other synthetic antioxidants. The characterization of lignin structure demonstrated that the good antioxidant activity of the lignin is due to the predominant presence of hydroxycinnamic acids and G-lignin derived-compounds such as ferulic acid and guaiacol during the alkaline pretreatment (S/G ratio of 0.35). Alkaline pretreatment (soaking aqueous ammonium in this project) of wheat straw is mainly responsible for breaking down of the ester linkages. The dissociation of ester linkages open this opportunity that the hydroxycinnamic acids derivatives can be appeared with

applied antioxidant properties including the presence of hydroxyl group, *ortho*-methoxy substitution on the phenolic ring, and low molecular mass (<1000 Mn).

Regarding the molecular mass of lignin's precursors and characterization of obtained lignin structure, it is possible to determine the number of linked lignin monomers (G, S, H lignin units). Consideration of the lignin macromolecule structure opens this opportunity to characterize the potential linkages among lignin monomers. The ether linkages have predominant capability to link the lignin's monomers in order to show the obtained lignin's molecular weight. Based on the selective destruction effect of acid on ether bonds, it has been proposed that by utilizing the acidic condition the majority of ether linkages in lignin structure will be dissociated. Thus, lignin-derived compounds with a substantial lower molecular weight and also containing new active functional groups will be obtained. The prepared lignin derivatives including aforementioned properties will be indicated excellent antioxidant activity.

Keywords: Lignin linkages; Selective dissociation; Characterization, Modification; Antioxidant