



SYNTHESIS OF GALACTOMANNAN DIALDEHYDE DERIVATIVES AND INVESTIGATION OF THEIR PHYSICAL AND CHEMICAL PROPERTIES

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<https://doi.org/10.5281/zenodo.17337447>

Galactomannan is a polysaccharide mainly composed of D-mannose and D-galactose, linked by α -1,4 and δ -1,6 glycosidic bonds. These connections define the structure of the polysaccharide and influence its physicochemical properties. The structure can vary, with different branching from galactose residues affecting its overall characteristics. Dialdehyde derivatives of galactomannan are novel compounds formed through oxidation or chemical modification. These derivatives enhance the polymer's rigidity, solubility, and mechanical strength. They can also react with primary amino groups, forming imino (azomethine) bonds and Schiff bases, which are significant in various applications. This study explores the production of low molecular weight galactomannan dialdehyde derivatives, their reaction conditions, and their physicochemical properties.

In this study, we developed and characterized dialdehyde derivatives through the periodate oxidation of low molecular weight galactomannan, obtained by depolymerizing guar galactomannan at a concentration of 20 mg/ml in distilled water. A freshly prepared 0.2 N sodium periodate (NaIO_4) solution was added, maintaining a galactomannan to sodium periodate molar ratio of 1:0.1-1.0. The reactions took place in the dark at 40°C for 1 to 24 hours. To stop the reaction, 0.5 ml of ethylene glycol was added. The resulting product was precipitated with 96% (v/v) ethanol (1:5 ratio), washed four times with 70% (v/v) ethanol to remove impurities, dialyzed in the dark, filtered, and lyophilized to obtain the final product. The structures of the galactomannan dialdehyde derivatives were analyzed using IR and ^{13}C NMR spectroscopy.

In the IR spectroscopy studies, the dialdehyde derivatives of galactomannan exhibited absorbance characteristic of N-H and O-H stretching vibrations in the range of 3200-3600 cm^{-1} . Signals related to H-C-H ($-\text{CH}_2-$) and C=O (aldehyde) stretching vibrations were observed at 2820-2950 cm^{-1} and 1732 cm^{-1} , respectively. Absorbances in the 1300-1400 cm^{-1} region correspond to the deformational vibrations of C-H bonds, while those at 1060 cm^{-1} are attributed to the valence vibrations of C-O-C bonds in the glucopyranose ring. Absorbances at 894 cm^{-1} are characteristic of the β -(ManC1-O-ManC4) glycosidic bonds between mannose residues in the polymer chain. Additionally, absorbances corresponding to the Man(C6)-O-Gal(C1) glycosidic bonds between mannose and galactose residues were identified at 870 cm^{-1} . In the ^{13}C NMR spectrum, signals with high intensity corresponding to the hemiacetal and gem-diol forms of polysaccharides were identified in the ranges of 87-98 ppm. Specifically, in the range of 80.10-80.17 ppm, high-intensity signals correspond to the carbon atoms ManC2 and ManC3 in the hemiacetal and gem-diol forms,



respectively. This indicates that the periodate oxidation in galactomannans primarily occurs at the carbon atoms ManC2 and ManC3.

This study developed low molecular weight galactomannan dialdehyde derivatives and thoroughly investigated their properties. The obtained galactomannan dialdehydes were analyzed using IR and ^{13}C NMR spectroscopy techniques. The IR spectroscopy results indicated that the C=O (aldehyde) stretching was observed at 1732 cm^{-1} . The ^{13}C NMR spectrum confirmed the unique characteristics of the galactomannan structure, showing that the periodate oxidation occurred at the ManC2 and ManC3 carbon atoms. The resulting dialdehyde derivatives play a crucial role in enhancing the polymer's rigidity, solubility, and mechanical strength, creating new opportunities for their use in various industrial and biological applications.