

Electric and Dielectric Behavior of Purified Galactomannan Films [†]

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Abstract: This work aimed to extract, purify, and to characterize galactomannan from *Adenanthera pavonina* L. by Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), and impedance spectroscopy (IS). Galactomannans (Gal) are polysaccharides, commonly found in the seed endosperm of the Fabaceae family, presenting a chemical structure formed by mannose and galactose, with units connected by glycosidic bonds of D-mannopyranose $\beta(1\rightarrow4)$ and by D-galactopyranose $\alpha(1\rightarrow6)$. Due to their physical-chemical properties and biocompatibility, this biopolymer can be integrated into a vast range of biomedical devices, for example, as biosensors. Galactomannan was extracted from seeds of *Adenanthera pavonina* L., precipitated in ethyl alcohol, dehydrated, pulverized, and hermetically stored. Galactomannan films purified at 100% were prepared at a concentration of 5% and characterized by FTIR, XRD, and IS. In FTIR, characteristic monosaccharides of Gal were identified as β -D-manopyranose at 814 cm^{-1} and α -D-galactopyranose at 871 cm^{-1} . From the diffractogram of purified Gal. (GP100), two diffraction peaks are observed at 5.8° and 20° , since the natural interaction of polysaccharides with water, intermediated by ethanol, causes changes related to crystalline-amorphous transitions. IS measurements in the frequency range between 10 Hz and 1 MHz, at room temperature, revealed the existence of a non-Debye relaxation phenomenon, observed using the electrical modulus function formalism (M^*) and impedance formalism (Z^*), ascribed to the short-range movement of charge carriers. For the purified and crude galactomannan films, we observed that the electrical resistivity is very high, reaching a magnitude of $10^9\ \Omega\cdot\text{mm}$, at the low-frequency region, decreasing to $10^8\ \Omega\cdot\text{mm}$ for frequencies higher than 10 kHz. Because of this high impedance characteristic and biocompatibility, purified galactomannan can be easily used as an insulating substrate in biosensors.

Keywords: polysaccharides; galactomannan; impedance spectroscopy.

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Conflicts of Interest

The authors declare no conflict of interest.