COMBINED APPROACHES TO IMPROVE THE MOISTURE RESISTANCE OF WHEAT GLUTEN MATERIALS

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ABSTRACT

The use of biopolymers, like wheat gluten, to make plastics is of interest in order to obtain a more sustainable environment. The interest in wheat gluten is partly due to its high gas barrier properties under drier conditions and its renewability. The drawback, however, as with most protein-based polymers, is its water/moisture sensitivity. The aim of this study was therefore to improve the "apparent" hydrophobicity of wheat gluten films by means of surface and matrix modifications while maintaining the gas barrier properties. The approach was to increase the surface roughness and/or to chemically modify or coat the polymer.

The surface roughness was increased by a combination of electrospinning of wheat gluten fibers onto the surface and plasma surface modification. The latter involved O2/Ar plasma etching with and without the presence of electrospun wheat gluten fibers . The hydrophobicity was improved by plasma polymerization of hexamethyldisiloxane (HMDSO) and other hydrophobic precursors. The plasma polymerization trials were performed both at reduced and atmospheric pressure conditions. The wheat gluten matrix water resistance was also improved by crosslinking it using He plasma and glutaraldehyde.

The surface modification resulted in significantly improved hydrophobic properties of the wheat gluten films. The initial water contact angle for glycerol-plasticized wheat gluten increased from 65 to 110-130 degrees, depending on the actual combinations of electrospinning and plasma modification conditions. The plasma coatings prepared at ambient conditions resulted in slightly lower contact angles compared to the plasma coating prepared at reduced pressure.