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Rheological Characterization of Polysaccharide Extracted from Camelina Meal as a New Source of Thickening Agent

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Abstract : Camelina sativa (L.) Crantz is an oilseed crop currently used for the production of biofuels. However, the low price of diesel and gasoline has made camelina an unprofitable crop for farmers, leading to declining camelina production in the US. Hence, the ability to utilize camelina byproduct (defatted meal) after oil extraction would be a pivotal factor for promoting the economic value of the plant. Camelina defatted meal is rich in proteins and polysaccharides. The great diversity in the polysaccharide structural features provides a unique opportunity for use in food formulations as thickeners, gelling agents, emulsifiers, and stabilizers. There is currently a great degree of interest in the study of novel plant polysaccharides, as they can be derived from readily accessible sources and have potential application in a wide range of food formulations. However, there are no published studies on the polysaccharide extracted from camelina meal, and its potential industrial applications remain largely underexploited. Rheological properties are a key functional feature of polysaccharides and are highly dependent on the material composition and molecular structure. Therefore, the objective of this study was to evaluate the rheological properties of the polysaccharide extracted from camelina meal at different conditions to obtain insight on the molecular characteristics of the polysaccharide. Flow and dynamic mechanical behaviors were determined under different temperatures (5-50°C) and concentrations (1-6% w/v). Additionally, the zeta potential of the polysaccharide dispersion was measured at different pHs (2-11) and a biopolymer concentration of 0.05% (w/v). Shear rate sweep data revealed that the camelina polysaccharide displayed shear thinning (pseudoplastic) behavior, which is typical of polymer systems. The polysaccharide dispersion (1% w/v) showed no significant changes in viscosity with temperature, which makes it a promising ingredient in products requiring texture stability over a range of temperatures. However, the viscosity increased significantly with increased concentration, indicating that camelina polysaccharide can be used in food products at different concentrations to produce a range of textures. Dynamic mechanical spectra showed similar trends. The temperature had little effect on viscoelastic moduli. However, moduli were strongly affected by concentration: samples exhibited concentrated solution behavior at low concentrations (1-2% w/v) and weak gel behavior at higher concentrations (4-6% w/v). These rheological properties can be used for designing and modeling of liquid and semisolid products. Zeta potential affects the intensity of molecular interactions and molecular conformation and can alter solubility, stability, and eventually, the functionality of the materials as their environment changes. In this study, the zeta potential value significantly decreased from 0.0 to -62.5 as pH increased from 2 to 11, indicating that pH may affect the functional properties of the polysaccharide. The results obtained in the current study showed that camelina polysaccharide has significant potential for application in various food systems and can be introduced as a novel anionic thickening agent with unique properties.

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