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The Effects of Stearic Acid and Cowpea Protein Isolate Addition on Ternary Complex Formation in Normal and High Amylose Maize Starch

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Abstract

Starch naturally occurs as granular structure in plants. It is also considered the second largest plant-based biomass after cellulose. Depending on the intended application, normal maize starch (NMS) has some limitations such as poor thermal stability, quick retrogradation, and low viscosity. Similarly, high amylose maize starch commercial utilization is limited due to the high gelatinisation temperature. Starch can be modified to change its properties for specific use. Naturally occurring fatty acids and proteins can modify rheological and other functional properties by forming ternary complexes. This study determines the interaction of stearic acid and cowpea protein isolate (CPI) with normal maize starch in the formation of amylose-lipid-protein as ternary complexes.

Normal maize starch suspensions treated with CPI and stearic acid at different concentrations were held at 91 ℃ for 30 minutes (short pasting) and 120 minutes (extended pasting). Stearic acid addition reduced pasting viscosity and final viscosity significantly ($P<0.05$) after the short pasting cycles. The addition of protein alone to NMS caused a high breakdown viscosity while the combination of protein and stearic acid produced a small plateau viscosity at the beginning of pasting and reduced final viscosity. For extended pasting cycle, NMS formed a sharp second peak with stearic acid. The addition of CPI to NMS alone prevented second peak formation, but the addition of protein and stearic acid increased second peak viscosity.

Stearic acid can form a coating around starch molecules thereby inhibiting water intake. The lower ability of starch molecules to absorb water inhibits swelling to explain the reduction in pasting viscosity. Stearic acid also interacts with amylose to form amylose lipid complexes. By entrapping the amylose needed for gel formation, junction zones formation is also prevented. CPI on exposure to heat released its hydrophobic side group and there is a possible phase separation to enhance retrogradation during pasting with starch alone. In combination, it seems like CPI with stearic acid produces ternary complexes with further enhancement in pasting viscosity.

Cowpea protein isolate combined with stearic acid is a cost-effective and environmentally friendly approach to starch modification. It can produce a low-viscosity starch with improved functional properties.