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Role of Protein on the Properties of Bambara Groundnut Flours Obtained from Infrared, Microwave and Combined Heat-Treated Seeds

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Abstract

Introduction: Heat treatment of Bambara groundnut seeds using infrared and microwave, alone and in combination, led to a reduction in paste viscosities of resulting flours. Structural changes in heat-treated Bambara seeds will impact the functionality of their flours. Heat treatment caused protein denaturation and starch pre-gelatinisation. Microscopy images showed that protein surrounded/adhered to the starch forming aggregates. It was postulated that encapsulation of starch by protein matrix led to low paste viscosities of flours by forming a hydrophobic barrier. The current study was conducted to determine further the role of protein in low paste viscosity of flours from heat-treated Bambara groundnut seeds.

Methodology: Bambara flour (30 g) from pre-conditioned, heat-treated [infrared and microwave alone and in combination at (130 °C) for 5 or 10 min] and untreated seeds were dispersed in Tris-HCl (pH 8) buffer solution with and without an enzyme, then incubated at 40 °C for 1 hour, followed by centrifugation. The obtained pellet was lyophilised and then gently ground into flour. The flours [before and after enzyme hydrolysis] were analysed for light, and confocal microscopy, pasting, thermal properties, SDS-PAGE and FTIR were done.

Results and Discussion: Light and CLSM micrographs confirmed the removal of protein from Bambara flours. Aggregated structures were disintegrated, and previously clustered starch was liberated. There was no significant decrease in flour onset and peak transition temperatures; however, gelatinisation enthalpy significantly decreased. Flour paste viscosities increased by 1.4 times after protein removal. SDS-PAGE showed an increase in band intensities for the protein of flours that were heat treated with microwave and the combined heat treatment. Heat treatment caused changes in the secondary structure of the protein, which led to a reduction in α-helix with an increase in β-sheet. These changes may be attributed to the rearrangement and formation of new hydrogen and disulphide bonds due to protein denaturation.

Conclusions: This study provides evidence of the role of denatured protein in low paste viscosities of flours from heat-treated Bambara seeds. Conformational changes in Bambara protein caused by heat treatment reinforced the protein matrix around the starch forming aggregated structures.

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