Novel Approaches for Decortication of Sorghum Grain and Improvement of Sorghum Flour Storage Stability

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Abstract

Sorghum (*Sorghum bicolor* L.) is a staple food crop primarily in Asia, Africa, and other semi-arid regions. Nevertheless, sorghum finds limited food applications majorly due to poor techno-functionality and sensory issues, partly attributable to abundant polysaccharides in the grain pericarp, necessitating decortication. Additionally, when the grains are milled to flour, rapid deterioration of crude fat occurs due to the action of lipase, causing instability and demanding efficient lipase inactivation for improved shelf life of flour. The present study investigates the efficacy of cell wall degrading enzymes for selective decortication of sorghum grain and intense pulse light (PL) treatment for improved flour storage stability.

An initial attempt was made to study the field-level decortication by varying the grain moisture content (MC) and polishing time (PT), proposing 12.7% MC and 11.2 min PT as optimal. An enzyme cocktail (xylanase, cellulase, pectinase) was then formulated employing a simplex-lattice mixture design, with a 4:1:1 proportion, to degrade the fibrous pericarp layers of sorghum grain. Optimisation of the enzyme decortication process suggested incubating the grains at 55 °C in an enzyme cocktail (pH 5) with a concentration of 118 mg/100 g dry matter for 7.1 h and subsequent polishing in a laboratory grain mill for 11 s resulted in 88.21% total yield, 71.68% head yield, and minimal brokens (12.48%). Improved colour, moderate physical properties, and superior retention of fibre, bioactives, resistant starch, and ash were observed in comparison to water soaking and hydrothermal pre-treatments.

Further, the intense PL treatment demonstrated a 55.5% reduction in lipase activity at a fluence of 30 J/cm^2, the IC_{50} value being 25.31 J/cm^2. The inactivation kinetics followed a fractional conversion model and flour obtained from 12 J/cm^2 treated (FDA-approved dose) polished grains displayed superior shelf-life properties during storage study. Additionally, cell cytotoxicity studies using Caco-2 cell line indicated acceptable toxicity levels (<5%) in both PL-treated and untreated samples. Notable changes were observed in the functional properties of flour, including an overall 5.9% increase in *in vitro* protein digestibility. Substantial shifts in spectral intensity and protein secondary structure were also discerned, accompanied by prominent alterations in starch properties.

Keywords: Sorghum, Enzyme polishing, Polysaccharides, Pulse light, Lipase activity