Title- Process standardization and quality characterization of sorghum for the development of low-gluten bread

ABSTRACT

The present study investigated the effects of optimization of microwave roasting and germination process for the development of low-gluten bread. Microwave roasting(300W, 450W and 600W for 5, 10 and 15 min) and germination (1-5 days) of sorghum (HJ-513) was perform and its effect on physical, thermal, functional, pasting and antioxidant properties of sorghum have been analysed. The results demonstrate a significant ($p<0.05$) reduction in sorghum bulk density upon microwave roasting of sorghum grain (778 to 546 kg/m^3). Control sample showed highest protein content (13.73±0.66%) and the reduction was observed in roasted samples. Fat content increased continuously with the increase in roasting power and time and varied in the range of 3.42±0.80-5.82±1.21% whereas, an overall reduction occurred in fiber (13.99±9.74±1.66 %) and ash content (4.33±1.19-2.02±0.15). The carbohydrate content varied in the range of 64.46±0.37-71.45±2.57% and was mainly dependent on the changes associated with protein, fiber, ash and fat content. Roasting increased the total colour change and browning index from 14.8 to 48.2 and 17.9 to 64.8, respectively, but decreased the lightness 'L*' from 83.1 to 50.6. Onset temperature, peak temperature, and end temperature for the amylose-lipid complex decreased by 21.00%, 19.01%, and 17.03%, respectively. Similarly, peak viscosity, pasting viscosity, breakdown viscosity and setback from the trough decreased from 2295 to 35.42, from 26.15 to 16.67, from 984.8 to 8.38 and from 2013 to 17.97, respectively. Non-significant variations in starch gelatinization and functional properties were observed. However, roasting had significant effects on total phenolic content, total flavonoid content and antioxidant properties of sorghum flour

changing the corresponding values from 2.64 to 4.67mg GAE/100 g, from 3.89 to 2.73mg QE/100 g and from 92.50 to 83.95% DPPH, respectively.

The effect of microwave roasting parameters on acrylamide content in sorghum grain was determined using High Pressure Liquid Chromatography (HPLC)-photo diode array (PDA) detector coupled with C-18 column. Samples roasted at 300 W and 450 W did not possess acrylamide whereas 600W (15 min) favoured formation of 2740.19 µg/kg of acrylamide, levels far exceeding the defined European Union (EU) limits. The microwave roasting parameters have been optimized using partial least square method and optimum roasting condition i.e. 450 W and 10 min was found to be best for the development of various functional and healthy bakery products. Germination reduced the protein content by 24.70-44.00% with an increase in germination time while the effect on fat, ash, carbohydrate, and fiber content remained insignificant ($p<0.05$). Bulk density reduced from 760.99-644.69kg/m^3 whereas WAC and OAC enhanced by 14.01% and 25.97% respectively, demonstrating its increased potential use for bakery and confectionery products. The total color change in flour upon germination increased from 3.61-6.25. Germination significantly ($p<0.05$) affected pasting properties whereas a variable trend was observed for glass transition temperature. TPC increased with increase in germination time up to 3 days and further increase in germination time reduced the TPC whereas the opposite trend was observed for TFC and DPPH. Partial least square optimization concluded that the sorghum germination of Day 3 showed improved functional and quality attributes.

Control, and processed (optimized germinated and roasted) sorghum flour has been used for the partial replacement (10-40%) of refined wheat flour (RWF) for the development of low-gluten bread. Properties of flour/batter/dough (particle size, XRD, pasting, dynamic rheology, farinograph) and bread (physical, textural, digestibility, microbiological and sensory) were evaluated. Prominent variations adhered with sorghum processing, but decreasing pattern occurred for flour-water absorption, dough stability times, storage modulus, peak/final/breakdown viscosities, bread- moisture content, specific volume, porosity and

lightness. Flour' pasting temperature, dough development time, bread- bulk density, hardness, gumminess and bitterness increased. Composite flours mainly had weak nature. Baking loss decremented for 10-30% CS and GS incorporation but incremented with RS. Composite breads had higher *in-vitro* protein and starch digestibility (CS>GS>RS) than RWF. Three days storage life with acceptable quality scores obtained for breads with CS and GS up to 20% and RS to 30%.

Keywords: Microwave roasting; Germination; Physio-functional properties; Thermo-pasting properties; Antioxidant analysis; Low-gluten bread; Digestibility; Shelf-life