

Temperature and water activity dependence of α -galactosides degradation in cowpea bean during steeping process

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Pulses top the list of sustainable crops due to their high balance between nutritional quality and negative environmental impacts on greenhouse gas production, land and energy use. Among the different varieties of pulses, cowpea beans are a popular ingredient in traditional dishes from West Africa and Latin America, requiring a hydro-thermal pre-treatment before cooking or frying. For a transition towards more sustainable food systems, it is of particular interest to reduce the compounds with negative effects (e.g. α -galactosides and phytates) of cowpea beans during the hydro-thermal treatment, notably the steeping process. For that, the kinetics of α -galactosides degradation of cowpea beans were investigated under different process conditions (temperature and water activity). To assume isothermal conditions, experimental data were obtained from samples of cowpea powder at different water activities (0.7, 0.8, 0.9 and 1.0) placed in polyethylene pouches and treated under combinations of intermediary temperatures (45, 50, 55 and 60 °C) and treatment times (5 min $\leq t \leq 16$ h). The α -galactosidase activity was quantified by measuring the liberation of p-nitrophenol from p-nitrophenyl- α -D-galactopyranoside for cowpea beans treated under different conditions. A first-order kinetic model was fitted to the activity data at $a_w = 1.0$ ($k_{ref} = 0.05$ min at 55 °C and $E_a = 265$ kJ/mol); whereas, the enzymatic inactivation kinetics at other water activities (0.7, 0.8 and 0.9) were better described by the first-order kinetic model with a thermo-resistant fraction, suggesting the importance of water availability to α -galactosides degradation reactions. Predicted inactivation curves showed a negative log-linear dependence between thermal inactivation rate and water activity, as well as the temperature dependence of thermal inactivation rate, following the Arrhenius law. These results drive insight into the importance of water activity on the degradation of α -galactosides, resulting in implications for the representation of the diffusion-reaction phenomena inside the pulses during the steeping process.