Title Diffusion coefficient relationships during drying of soya bean cultivars

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Abstract

A drying kinetics equation, the diffusive analytical solution for short times previously developed for wheat, was utilised to explore its applicability for a larger grain as soya bean, in order to determine diffusion coefficients and their dependence with temperature. Thin-layer drying of cv. Nidera A6381 was measured for air temperatures between 19 and 75 °C. The diffusive solution accurately described the experimental drying curves thus allowing the calculation of the diffusion coefficients, which varied from $1{\cdot}78\times10^{-11}$ $m^2\ s^{-1}$ at 19 °C to $7{\cdot}28\times10^{-11}$ $m^2\ s^{-1}$ at 75 °C. The temperature dependence was evaluated first by the Arrhenius equation, to find activation energies of 16·6 kJ mol^{-1} below 50 °C, and of 28·8 kJ mol^{-1} above that threshold. The relationship between diffusion coefficient and temperature was also accurately predicted above 50 °C by the Williams–Landel–Ferry (WLF) model.

Drying curves were also recorded for cultivar Nidera A5409 in its conventional and genetically modified variants. Soya beans were dried from moisture contents of 0·15 and 0·30 dec., d.b., at 25 and 70 °C, and the activation energy was found to be 27 kJ mol^{-1}. The Arrhenius pre-exponential factor increased linearly with the initial moisture content, unlike the activation energy, which remained substantially constant. Reliable correlations between the diffusion coefficients and temperature are required to confidently simulate energy expenditure in dryers.