Model of fungal development in stored barley ecosystems as a prognostic auxiliary tool for postharvest preservation systems

Jolanta Wawrzyniak

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Abstract

Postharvest preservation and storage have a crucial impact on the technological quality and safety of grain. The important threat to stored grain quality and nutritional safety of cereal products is mould development and their toxic metabolites, mycotoxins. Models based on predictive microbiology, which are able to estimate the kinetics of fungal growth, and thus, the risks of mycotoxin accumulation in a mass of grain are promising prognostic tools that can be applied in postharvest management systems. The study developed a modelling approach to describe total fungal growth in barley ecosystems stored at different temperatures (T = 12–30 °C) and water activity in grain (a_w = 0.78–0.96). As the pattern of fungal growth curves was sigmoidal, the experimental data were modelled using the modified Gompertz equation, in which constant coefficients reflecting biological parameters of mould development (i.e. lag phase duration (τ_{lag}), maximum growth rate (μ_{max}) and the maximum increase in fungal population level (Δ_{max}log(CFU)) were expressed as functions of storage conditions, i.e. a_w and T. The criteria used to evaluate the overall model performance indicated its good precision (R^2 = 0.95; RMSE = 0.23) and high prediction accuracy (bias factor and accuracy factor B_f = 1.004, A_f = 1.035). The formulated model is able to estimate the extension of fungal contamination in a bulk of grain versus time by monitoring temperature and intergranular relative humidity that are readily measurable in practice parameters; therefore, it may be used as a prognostic support tool in modern postharvest management systems.