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Predictive modelling of microbial inactivation in beer pasteurisation

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Introduction

Beer pasteurisation is often described as a "necessary evil" (Rader, 1979). It is required for microbial inactivation, but affects the quality of the product. Optimisation of the pasteurisation kinetics is therefore essential. NIZO Premia is a modelling platform which allows the evaluation of process conditions on food products. For example, all different kinds of pasteurisation equipment designs can be modelled in detail and coupled to specific product characteristics, such as microbial inactivation kinetics.

In this study, microbial inactivation kinetics have been measured, and the pilot scale pasteuriser for beer of IFBM has been evaluated.

NIZO Premia modelling

For the IFBM pasteuriser, the number of pasteurisation units were calculated at varying temperatures. To do so, the exact dimensions were entered (such as number of tubes, diameters, lengths, temperatures) and coupled to microbial inactivation data.

NIZO MicroHeater and kinetics

The inactivation rates for two *Lactobacilli (L. brevis, L. lindneri)*, and three yeasts found in spoiled beer (S. cerevisiae) have been determined with the micro-pasteuriser (NIZO MicroHeater) at varying times and temperatures. The resulting data have been fitted to the Bigelow model, resulting in D values, indicating the time required to get a 1 log reduction at the reference temperature of 60 °C and a z value, indicating the temperature increase to get a tenfold reduction of the D value.

The information gathered in these preliminary experiments was extrapolated towards the IFBM pasteuriser.

Figure 1. Micro-Pasteuriser (NIZO MicroHeater)

Results

The inactivation measurements of the three yeasts and two *Lactobacilli* are shown in Figure 2. These results show that the D values for the yeasts and the *L. brevis* are less than 2 sec, indicating that a 6-log reduction at 60 °C for these strains is reached within 10.5 seconds. The *L. lindneri*, however, requires a treatment time of 136 seconds.

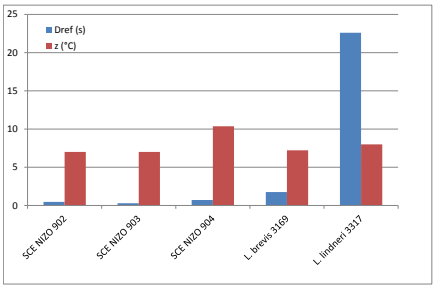

Figure 2. D and z values for three strains of *S. cerevisiae* and two *Lactobacilli*.

Applying these kinetics to the IFBM pasteuriser, running at 67 °C, as done regularly, shows that a more than required microbial reduction is obtained.

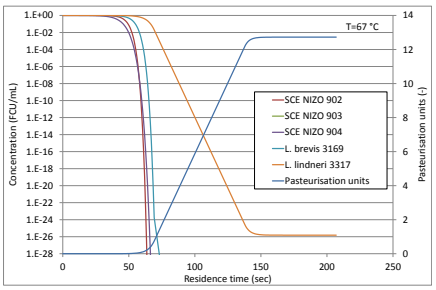

Figure 3. Microbial reduction in the IFBM pasteuriser.

In practice, a higher heat load could affect the product quality, such as the aroma and taste of the product. Calculations (Figure 4) show that the temperature of the IFBM pasteuriser could be reduced to 62 °C to inactivate the five studied micro-organisms.

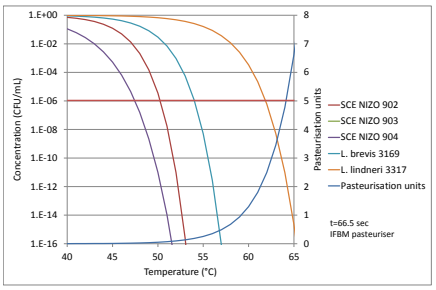

Figure 4. Effect of temperature on microbial inactivation in the IFBM pasteuriser.

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Conclusions

The combination of measuring the microbial inactivation and predictive modelling in NIZO Premia allows the optimisation of pasteurisers while retaining product quality.

The NIZO MicroHeater allows a fast and industrial representative measurement of microbial inactivation kinetics.

NIZO Premia, in addition, allows the extrapolation of the measurement results to all different kinds of heat exchanger equipment, such as tube and plate heat exchangers, but also of bottles and cans in tunnel pasteurisers.