Modelling of *Alicyclobacillus acidoterrestris* inactivation in apple juice using thermosonication technologies

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Alicyclobacillus acidoterrestris is a thermoacidophilic, non-pathogenic, spore-forming bacterium, which is responsible for quality degradation of fruit juices. *A. acidoterrestris* has become an important concern, and it has been suggested as a target microorganism for the design of thermal processes of fruit juices. In single strength juice and under specific conditions these microorganisms may find a favorable environment for germination and growth that can lead to product deterioration. Thermal pasteurization is efficient in reducing the number of viable microorganisms in foods. However, to reduce the negative impacts of high temperature processes, alternative non-thermal technologies as efficient as thermal pasteurization ones, but with minor impacts on the products quality features, are promising fields of investigation. Ultrasound is capable of inducing cavitation to inactivate microorganisms in foods. However, as a preservation method, application of ultrasound alone is not efficient enough to kill all microorganisms. Combining ultrasound with a heat treatment (thermosonication, TS) may decrease the time for a target microbial inactivation, depending on the ultrasound wave's amplitude, composition and volume of food to process and temperature selected. Mathematical modelling of the kinetics of thermosonicated juices would allow to understand the impact of the process and predict microbial survival in treated juices.

The objective was to study the influence of ultrasounds (35 kHz frequency, 120-480 W power levels) and combinations with thermal treatments (70, 80, 85, 90 and 95 ºC) on *A. acidoterrestris* spores inactivation in apple juices. Commercially available juices were artificially inoculated with the bacterium and the juices were then exposed to the treatments. A Weibull model was successfully fitted to *A. acidoterrestris* spores inactivation as function of thermosonication exposure times. Results showed that ultrasounds alone had no significant effect on spores' inactivation. However, when combined with temperature, a higher reduction of spores' loads was observed. As temperature increased, inactivation rates increased (from 0.005±0.0002 min^{-1} at TS-70°C to 0.124±0.0140 min^{-1} at TS-95°C). When compared to thermal treatments applied alone, thermosonication resulted in higher inactivation. For the highest temperature tested, thermosonicated samples had a reduction of 5 log-cycles after 20 minutes, while in thermal treated samples at 95 ºC for the same time, only 3 log-cycles reduction was observed.

Overall it can be concluded that thermosonication treatments have significant impacts on the loads of *A. acidoterrestris* in apple juices and the kinetic Weibull model applied will allow to design efficient conditions for target decontaminations.