Hungarian University of Agricultural and Life Sciences Institute of Food Science and Technology

MSc in Food Safety and Quality Engineering

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Title of thesis: Thermal tolerance of foodborne pathogenic bacteria in fruit puree matrix

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The principal causes of foodborne infections, including *Listeria monocytogenes* and *Salmonella enterica*, constitute a major public health concern worldwide. Fruit purees and smoothies can contain these bacteria, which can lead to outbreaks that disproportionately harm vulnerable people. 4,005 foodborne disease outbreaks were documented in the European Union alone in 2021, resulting in approximately 32,000 illnesses, 31 fatalities, and 2,495 hospital admissions. The most typical organism connected to these outbreaks was *Salmonella*. Fruit juices that have not been pasteurized could also be contaminated because germs like *Salmonella* and *Listeria* can survive in acidic environments and cause a variety of illnesses. To stop the spread of dangerous bacteria, proper handling and processing procedures should be used like heat treatment.

Because heat resistance impacts the amount of heat needed to inactivate bacteria like *Listeria monocytogenes* and *Salmonella enterica* in food products, it is crucial to ascertain their thermal tolerance. Heat treatment aims to kill bacteria's vegetative cells, particularly those of dangerous strains like *Salmonella enterica* and *Listeria monocytogenes*. To prevent or reduce their growth, this knowledge can be used to set up suitable processing and storage settings.

The goal of this study was to find out how well *Listeria monocytogenes* and *Salmonella enterica* tolerate heat in various fruit-based matrices such as strawberry puree, smoothies, and distilled water. The development of efficient thermal processing techniques for the food sector will be aided by the research's determination of the D-values of these bacteria in these matrices.

In the experiment, mixed cultures of *Salmonella* Hartford and *Listeria monocytogenes* were heated in various matrices, and the injured and viable cells were counted using the thin agar layer (TAL) technique. Three replications were carried out for each time period to achieve the results through a succession of dilutions and inoculations.

Generally, the injured cell count increased with increasing duration of heat treatment. The proportion of injured cells in relation to the total microbial count at that time point increased

gradually, i.e., as the heat treatment time progressed, the proportion of damaged cells in the population increased more and more. The injured cells that were able to recover and grow on TSA agar suggested that under the right conditions, some cells may be able to recover from heat stress and may represent a potential source of contamination compromising the safety of the products.

Results showed that in sterile distilled water, longer durations of heat treatment were found to be more effective in reducing the viability of both bacteria. However, some cells were able to survive the heat treatment, highlighting the need for proper food safety measures. The D-values for both bacteria were found to decrease with increasing temperatures.

In smoothie, longer exposure times and higher temperatures led to greater reductions in cell numbers and a higher proportion of injured cells. The D-values of both bacteria were found to decrease with increasing temperatures, highlighting the importance of considering the inoculation medium when investigating bacterial resistance to environmental stressors in smoothies.

In strawberry puree, there was no growth of both bacteria even after the lowest heat treatment of 2.5 minutes. This is attributed to the low pH value of the strawberry puree, which inhibits the growth of both bacteria, in addition to the heat treatment. Overall, these findings suggest that both *Salmonella enterica* and *Listeria monocytogenes* are sensitive to heat treatment, and exposure to high temperatures can lead to a significant reduction in cell counts.

Additionally, the inoculation medium plays a crucial role in determining the D-values of bacteria, highlighting the need to consider the specific food matrix when investigating bacterial resistance to environmental stressors. This thesis contributes to the advancement of knowledge on food safety measures and can be used to inform the development of effective food safety protocols.