2002 MAFMA Final Report

Project title:	**Mechanisms and control of tailing during pressure death of *Listeria monocytogenes*.**
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1. Use of phenolic compounds for sensitizing *Listeria monocytogenes* to high-pressure processing

Three *Listeria monocytogenes* strains (Scott A, OSY-8578, and OSY-328) that differ considerably in barotolerance were grown to stationary phase and suspended individually in phosphate buffer (pH 7.0). Twelve phenolic compounds, including commercially-used food additives, were screened for the ability to sensitize *L. monocytogenes* to high-pressure processing (HPP). Each *L. monocytogenes* strain was exposed to each of the 12 phenolic compounds (100 ppm each) for 60 min; this was followed by a pressure treatment at 400 MPa for 5 min. Six phenolic compounds increased the efficacy of HPP against *L. monocytogenes* but *tert*-butylhydroquinone (TBHQ) was the most effective. The additives alone at 100 ppm were not lethal for *L. monocytogenes*. Subsequently, the three *L. monocytogenes* strains were exposed to TBHQ before or after pressure treatments at 400 or 500 MPa for 5 min. When TBHQ was added after the pressure treatment, the combined treatment was more lethal than was pressure alone. However, the lethality attributable to TBHQ was greater when the additive was applied before rather than after pressure treatment. The inactivation kinetics of the *L. monocytogenes* strains at 300, 500, and 700 MPa, in the presence or absence of TBHQ, were investigated. All survivor plots showed non-linear inactivation kinetics, but tailing behavior was most pronounced when HPP was used alone. Combinations of TBHQ and HPP eliminated tailing behavior when survivors were monitored by direct plating or an enrichment procedure. Pressure and phenolic additives are apparently a potent bactericidal combination against *L. monocytogenes*.

2. Inactivation of barotolerant *Listeria monocytogenes* in sausage by combination of high-pressure processing and food-grade additives

This study aims to enhance the efficacy of high-pressure processing (HPP) against barotolerant *Listeria monocytogenes* using food-grade additives. Three strains of *L. monocytogenes* (Scott-A, OSY-8578, and OSY-328) were compared for their sensitivities to high-pressure processing (HPP), nisin, *tert*-butylhydroxyquinone (TBHQ), and their combination. Inactivation of these strains was evaluated in 0.2 M sodium phosphate buffer (pH 7.0) and commercially-sterile sausage. A cell suspension of *L. monocytogenes* in buffer (10^9 CFU/ml) was treated with TBHQ at 100 ppm, nisin at 100 IU/ml, HPP at 400 MPa for 5 min, and combinations of these agents. Populations of the three strains decreased 3.9, 2.7, and 1.3 log with HPP alone, and 6.4, 5.2, and 1.9 log with HPP/TBHQ combination, for Scott-A, OSY-8578, and OSY-328, respectively. Commercially-sterile sausage was inoculated with the three *L. monocytogenes* strains (10^6-10^7 CFU/g) and treated with selected combinations of TBHQ (100-300 ppm), nisin (100 and 200 ppm), and HPP (600 MPa, 28°C, 5 min). Samples were enriched to detect the viability of the pathogen after the treatments. Most of the samples treated with nisin, TBHQ, or their combination were positive for *L. monocytogenes*. High-pressure treatment alone caused a modest decrease in the number of positive samples. *Listeria monocytogenes* was not detected in any of the inoculated commercial sausage samples after treatment with HPP/TBHQ or HPP/TBHQ/nisin combination. These results suggest that addition of TBHQ or TBHQ+nisin to sausage, followed by in-package pressurization, is a promising method to produce *Listeria*-free ready-to-eat products.

Publications:

Vurma, M., Chung, Y-K., Shellhammer, T.H., Turek, E.J., and Yousef, A.E. 2005. Use of phenolic compounds to sensitize *Listeria monocytogenes* to high pressure processing. Int. J. Food. Microbiol. (Accepted)

Chung, Y-K., Vurma, M., Turek, E.J., Chism, G.W., and Yousef, A.E. 2005. Inactivation of barotolerant *Listeria monocytogenes* in sausage by combination of high-pressure processing and food-grade additives. J. Food. Prot. 68: 744-750.