

## Guidelines for MAFMA Final Report

Final Reports due 3 months after completion of project  
(4-5 pages)

Project Title Efficacy of three commercial sanitizers against *L. monocytogenes*, *E. coli* O157:H7 and *Salmonella* on conveyor belts during normal operation

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**Please complete all questions below and attached form**

### 1. Objective Summary (1-2 sentence summary)

The specific objectives of this research were to assess the efficacy of three sanitizers - Vortexx, Octave and Whisper (manufactured by Ecolab, Inc., St. Paul, MN) against *L. monocytogenes*, *E. coli* O157:H7, and *Salmonella* on one interlocking high-density polyethylene belt (Intralox, Harahan, LA) and one solid ThermoDrive rubber belt (Mol Industries, Grand Rapids, MI) during discontinuous inoculation followed by continuous sanitizing, and continuous inoculation and sanitizing.

### 2. Objective Accomplishments

**Reduction of *L. monocytogenes* on conveyor belts during discontinuous inoculation.** When the Intralox belt was used, Vortex was significantly more effective ( $P < 0.05$ ) than XY-12, with no significant difference seen between XY-12, Octave and Whisper. Using Vortexx, *L. monocytogenes* populations decreased 5 logs after 20 minutes of continuous sanitizer spraying, with Whisper, Octave, and XY-12 reducing populations only 3-4 logs after 60 min. On the ThermoDrive belt, Vortexx was again the most effective ( $P < 0.05$ ) followed by Whisper and XY-12. Octave yielded significantly less reduction in numbers of *L. monocytogenes* compared to Whisper, Octave, and XY-12. A 5 log reduction was achieved after 5 minutes using Vortexx, whereas Whisper and XY-12 yielded 5 log reductions only after 20 minutes of spraying. *Listeria* populations decreased 5 logs after 60 minutes of continuous exposure to Octave. All four sanitizers were significantly more effective than water which decreased *Listeria* populations only 1.5 logs after 60 minutes of spraying. The ThermoDrive belt was significantly ( $P < 0.05$ ) easier to sanitize than the Intralox belt using Vortexx, Whisper or XY-12. However, no significant difference was seen between the two belts using Octave and water.

**Reduction of *Salmonella* on conveyor belts during discontinuous inoculation.** Using the Intralox belt, no significant differences in *Salmonella* reductions were seen between Vortexx, XY-12, and Whisper or between XY-12 Whisper and Octave. Vortexx was most effective in decreasing the populations of *Salmonella*. Significantly greater reductions in *Salmonella* were

demonstrated for the ThermoDrive compared to Intralox belt using Vortexx, Octave and Whisper. However, no differences were seen between XY-12 and water. Only Vortexx yielded a 5 log reduction for the ThermoDrive belt after 25 minutes of use with the remaining sanitizers yielding reductions of less than 5 logs after 60 minutes of use.

**Reduction of *E. coli* O157:H7 on conveyor belts during discontinuous inoculation.** No significant differences in reduction of *E. coli* O157:H7 were seen when Vortexx, Octave, Whisper and XY-12 were used on the Intralox belt. However, Vortexx yielded a significantly greater reduction of *E. coli* O157:H7 on the ThermoDrive belt followed by XY-12, Whisper and Octave. The ThermoDrive belt was significantly easier than the Intralox belt to sanitize with Vortexx, Whisper, and XY-12, while no differences were seen between Octave and water. Using the ThermoDrive belt, Vortexx, Whisper, and XY-12 yielded a 5 log reduction after 30, 45, and 45 minutes of spraying, respectively, while Octave and water failed to decrease the *E. coli* O157:H7 populations 5 logs on either belt.

**Reduction of *L. monocytogenes* on conveyor belts during continuous inoculation.** Continuous inoculation with the simultaneous application of sanitizer was only assessed using *L. monocytogenes* as the test pathogen. No significant difference in sanitizer efficacy was seen for either conveyor belt which is likely due to the short sanitizer contact time since a portion of the sanitizer transferred into the inoculation vat during each belt revolution. A significantly greater reduction in *Listeria* was achieved on ThermoDrive compared to Intralox belt using Vortexx and XY-12.

**Conclusions.** Using discontinuous inoculation, Vortexx decreased *L. monocytogenes*, *Salmonella*, and *E. coli* O157:H7 populations > 5 logs on the ThermoDrive belts after 5, 25 and 30 min, respectively. In contrast, *Listeria* populations decreased < 3 logs during 2 h of continuous inoculation with no significant difference seen between Vortexx, Octave and XY-12. Regardless of the inoculation method, significantly greater reductions were seen using the ThermoDrive belt. Therefore, Vortexx was the most effective sanitizer for these conveyor belts with the ThermoDrive belt being more easily sanitized.

### **3. Unexpected findings, if any**

When both conveyor belts were tested during continuous inoculation/sanitizing, a design flaw in our conveyor belt system led to sanitizer carryover into the inoculation vat which decreased the populations of *L. monocytogenes* being applied to the belt over time. Since the continuously lower inoculum being applied to both conveyor belts interfered with our ability to assess efficacy of the sanitizer spray, this phase of the study was discontinued for *E. coli* O157:H7 and *Salmonella*.

### **4. Practical impacts of research efforts. Include: implementation of accomplishments by industry partners (if any), identification of economic impacts, and any further pursuit by PI of research in area of this project whether MAFMA or not.**

Ecolab and Mol Industries are the beneficiaries of these findings. Based on our findings, Ecolab can now confirm the efficacy of their three most popular sanitizers - Vortexx, Octave and Whisper, for two popular conveyor belts – Intralox and ThermoDrive, when used under conditions that closely mimic those encountered in meat processing facilities. Hence, these

results are expected to enhance the marketability of these sanitizers as well as the ThermoDrive belt which was far easier to sanitizer compared to the Intralox belt.

Upon completion of this project, Dr. Zhinong Yan, who worked under my direction as an Assistant Research Professor, was recently hired by Mol Industries (the manufacturer of the ThermDrive belt) as their technical consultant in microbial food safety. As part of his duties, Dr. Yan is also in charge of the company's operations in China where the ThermoDrive belt is now being marketed. Very strong sales for the ThermoDrive belt are expected as a result of this MAFMA-funded project which clearly demonstrated superiority of the ThermoDrive compared to the Intralox belt in terms of sanitizing efficacy.

Future work with Mol Industries will likely include similar testing of new antimicrobial belting materials currently under development. In addition, I am currently in negotiations with Ecolab to assess the efficacy of several produce sanitizers during processing of leafy greens.

**5. If you are also making reports to other funding agencies in the course of this research work, please include a copy of that report.**

All of the information in this report has also been supplied to Ecolab.

6. a. If any publications resulted from the research, a copy must be included. Please note we were notified by the USDA/CSREES National Program Leader for the Midwest Advance Food Manufacturing Alliance (MAFMA) that all publications resulting from research that was funded by MAFMA must include the following wording **“The project was supported by the USDA Cooperative State Research, Education and Extension Service, special research grant number 200X-34328-xxxxx.**

**Publications.**

1. Yan, Z., M. Steele, L. Zhang, and E.T. Ryser. 2008. Efficacy of two commercial sanitizers and two conveyor belt systems against *Listeria monocytogenes* during normal operation. Abst. Ann. Mtg. Food Prot., Columbus, OH.

**Efficacy of Two Commercial Sanitizers and Two Conveyor Belting Systems against *Listeria monocytogenes* during Normal Operation**

Authors: Zhinong Yan, Matthew Steele, Lei Zhang, and Elliot T. Ryser

*Introduction:* The food industry has historically faced many concerns regarding adequate design, cleaning and sanitizing of conveyor belts with development of biofilms also hindering sanitizer efficacy.

*Purpose:* This study assessed the efficacy of two commercial sanitizers against *Listeria monocytogenes* (*Lm*) using a custom-built dual belt conveyor system designed for continuous/discontinuous inoculation and continuous spray sanitizing.

*Methods:* For conveyor belt inoculation, 15 liters of 10% turkey slurry containing a 6-strain *Lm* cocktail ( $10^7$  CFU/ml) was placed in a inoculation tray. An Intralox (interlocking) and ThermoDrive (smooth) belt were then simultaneously passed through the inoculation tray for 3.5 min (5 revolutions, followed by tray removal) or 2 h for discontinuous and continuous inoculation, respectively. After initially quantifying *Lm* on both belts, two organic acid sanitizers – Octave (2340 ppm) and Vortexx (2294 ppm), XY-12 (180 ppm, chorine) and water (control)

were continuously sprayed onto both belts (30 L/h) during 2 or 3 h of operation. At pre-determined intervals, two interlocking belt segments were removed and sonicated in neutralizing buffer for 10 min, whereas the ThermoDrive belt was sampled using 1-ply composite tissues. Appropriate dilutions were plated on Modified Oxford Agar overlaid with a non-selective medium to quantify *Lm*, with membrane filtration used when low populations were expected.

*Results:* Using discontinuous inoculation, Vortexx and Octave decreased *Lm* populations  $> 5$  and  $> 4$  logs ( $P < 0.05$ ) on the ThermoDrive and Intralox belts after 15 and 20 min respectively, while XY-12 and water were significantly less effective. In contrast, *Listeria* populations decreased  $< 3$  logs during 2 h continuous inoculation with no significant difference seen between Vortexx, Octave and XY-12. Regardless of the inoculation method, significantly greater reductions were seen using the ThermoDrive belt.

*Significance:* Both Vortexx and Octave were effective sanitizers for these conveyor belts with the ThermoDrive belt offering greater cleanability.

Manuscript in preparation for the *Journal of Food Protection*.

**b. If any patents (pending or granted) resulted from the research, please include the patent information.**

No patents are pending.