

# 2004 MAFMA Final Report

Project Title     **Validation of Ozone-based Combination Treatment for Eradicating *Salmonella enteric* serovar Enteritidis in Shell Eggs**

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Award Date       **September 2004**

## 1. Objective Summary

An ozone-processing system was designed, assembled, and set up in a biosafety level-2 pilot plant. The prototype consisted of a high-yield ozone generator, and a stainless-steel vessel (300 liter) equipped with egg-holding trays, air-circulation fan, gas inlet/outlet ports, vacuum pump, and ozone monitor. Shell eggs internally contaminated with *Salmonella* Enteritidis ( $\sim 10^7$  CFU/g egg), using a standardized inoculation protocol, were heated in water (57-59° C) for  $\sim 25$  min, transferred to the processing vessel, placed under vacuum (10 in Hg), and subsequently treated with ozone gas (10-12% wt/wt O<sub>3</sub> in O<sub>2</sub>;  $\sim 15$  lb/in<sup>2</sup> – gauge) for  $\sim 40$  min.

## 2. Objective Accomplishments

Processing contaminated eggs in the prototype equipment significantly decreased internal *Salmonella* population ( $p < 0.05$ ), when compared to the heat-treated control. For example, heating eggs at 57°C for 25 min followed by vacuum application (10 in Hg), and ozone ( $\sim 10\%$  wt/wt O<sub>3</sub> in O<sub>2</sub>; 10 lb/in<sup>2</sup> – gauge) for 40 min, synergistically inactivated *Salmonella* Enteritidis by  $\sim 7$  log. Selected efficacious combination treatments were found to minimally affect the quality of egg contents.

In conclusion, processes relying on sequential application of heat and ozone, in properly designed pilot-scale equipment, can effectively eliminate *Salmonella* in shell eggs. This newly developed system may be considered for future industrial application.

## 3. Unexpected findings, if any

The project proceeded with minor problems. Equipment failures have caused several delays. Modifications of the setup were done several times to maximize the outcome.

## 4. Practical Impacts of research efforts

Egg Tech, Ltd. is a start-up company that was established to fund the early stages of this research and to assist with technology transfer. This company is now actively involved in producing the first egg sanitizer, based on our ozone technology. We expect that by the end of the year, the company will commission an ozone-based egg sanitizer in an Ohio production facility. The company recently secured

funding (\$100K) through Rural Development Value Added Grant Program, to market the *Salmonella*-free egg, which will be produced using OSU ozone technology.

**5. Publications resulting from this research**

L. A. Rodriguez-Romo, M. Vurma, and A. E. Yousef. 2007. Development of ozone-based technology to eradicate *Salmonella* Enteritidis within shell eggs. Annual meeting of International Association of Food Protection, Orlando, FL. (P1-13).

6. Patents resulting from this research

A. E. Yousef and L. A. Rodriguez-Romo. Ozone-based decontamination of shell eggs.