

# Ozone Fresh Eggs



*Salmonella enterica* serovar Enteritidis (Salmonella) is a food-borne pathogen with considerable economic impact on the food industry. Transmission of Salmonella by fresh egg results in 700,000 cases of salmonellosis, and \$1.1 billion loss annually in the U.S. (Frenzen et al., 1999). Current decontamination procedures that eliminate Salmonella Enteritidis inside shell eggs are limited; these include lengthy heating or gamma radiation treatment. Despite their effectiveness these technologies adversely affect egg quality.

Ozone (O<sub>3</sub>) is a powerful antimicrobial agent suitable for food applications and FDA approved is use in food. When combined with thermal treatment, ozone technology may be used to eliminate Salmonella inside shell eggs in a relatively short time without reducing quality (Rodriguez-Romo, 2004).

Control of Salmonella in shell eggs by gamma irradiation (Tellez et al., 1995) and heating (Hou et al., 1996) is currently permitted. Irradiation of shell eggs with <sup>60</sup>Co effectively eliminates Salmonella but drastically reduces egg quality (Tellez et al., 1995). Heating of shell eggs has been commercially introduced to eliminate Salmonella (USDA, 1997). Although effective, this procedure is lengthy and the extensive heating results in protein denaturation and reduced egg functionality (Hou et al., 1996; Schuman et al., 1997).

The U.S. Egg Safety Action Plan requires outbreaks of Salmonellosis from shell eggs be eliminated by 2010. Ozone (O<sub>3</sub>) is a strong antimicrobial agent extensively studied for applications in the food industry (Kim et al., 2003). Ozone spontaneously decomposes to nontoxic oxygen. It has been tested for eliminating pathogens from poultry facilities and products such as hatcheries, hatching eggs, poultry-processing chiller water, and poultry carcasses (Dave, 1999, Kim et al., 2003). The FDA approved the use of ozone as an antimicrobial agent in food (CFR, 2001). Research suggests that combining ozone with other treatments, such as heat, could have a synergy in microbial inactivation (Novak and Yuan, 2003).

Research in Yousef's laboratory indicates that heating Salmonella contaminated shell eggs (10<sup>6</sup>-7 CFU/g egg) at 57 C for 25 min, followed by treatment with gaseous O<sub>3</sub> at 10 psig (applied after ~ 10 in Hg vac.) for 40 min, resulted in at least a 6.4 log microbial reduction inside shell eggs in 65 min (Rodriguez-Romo, 2004). The treatment decreased substantially the egg's microbial load but a resistant sub population survived. When heated eggs were immediately subjected to vacuum, then to pressurized ozone, the remaining Salmonella was eliminated. The preheating facilitated ozone diffusion into the egg and increased ozone efficacy against the pathogen. Treatments had minimal impact on egg quality. These findings can now be validated at conditions that mimic processing environment.

Iowa and Ohio are the first and second largest egg producers in the U.S., respectively. Innovation that allows production of Salmonella-free eggs directly benefit the food industry in these states.

Although the incidence of Salmonella in market eggs is believed to be low ( 1/10,000), the new safe-egg technology should improve public health and practically eradicate the pathogen from egg products. Ozone decreases wastewater's chemical oxygen demand (COD). Consequently, the proposed ozone-based treatment should have a positive environmental impact. Members of EggTech LLC will implement the technology in four egg-producing plants in Ohio.