

# Inactivation of *Salmonella* on Hatchery and Table Eggs Using a Gas-phase Hydroxyl Radical Process

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## INTRODUCTION

Within Ontario there are 2000 reported cases of human Salmonellosis each year, or 141 cases per 100,000 of the population<sup>1</sup>.

Eggs are a potential route for dissemination of *Salmonella* enteritidis, along with other pathogens, within the hatchery and grading stations<sup>2</sup>.

Current methods of egg disinfection remove visible soils but have negligible impact on pathogen levels due to the inability to access an egg's protective sites.

Gas-phase hydroxyl radical treatment based on the UV-C degradation of hydrogen peroxide and ozone as an alternative egg disinfection method.

## OBJECTIVES

Decontaminate eggs of *Salmonella* enteritidis with hydroxyl radical treatment without negatively impacting egg quality or embryo development.

Compare surface decontamination efficacy of standard egg washing with NaOH pre-rinse and NaClO post-rinse versus hydroxyl radical process.

## METHODS

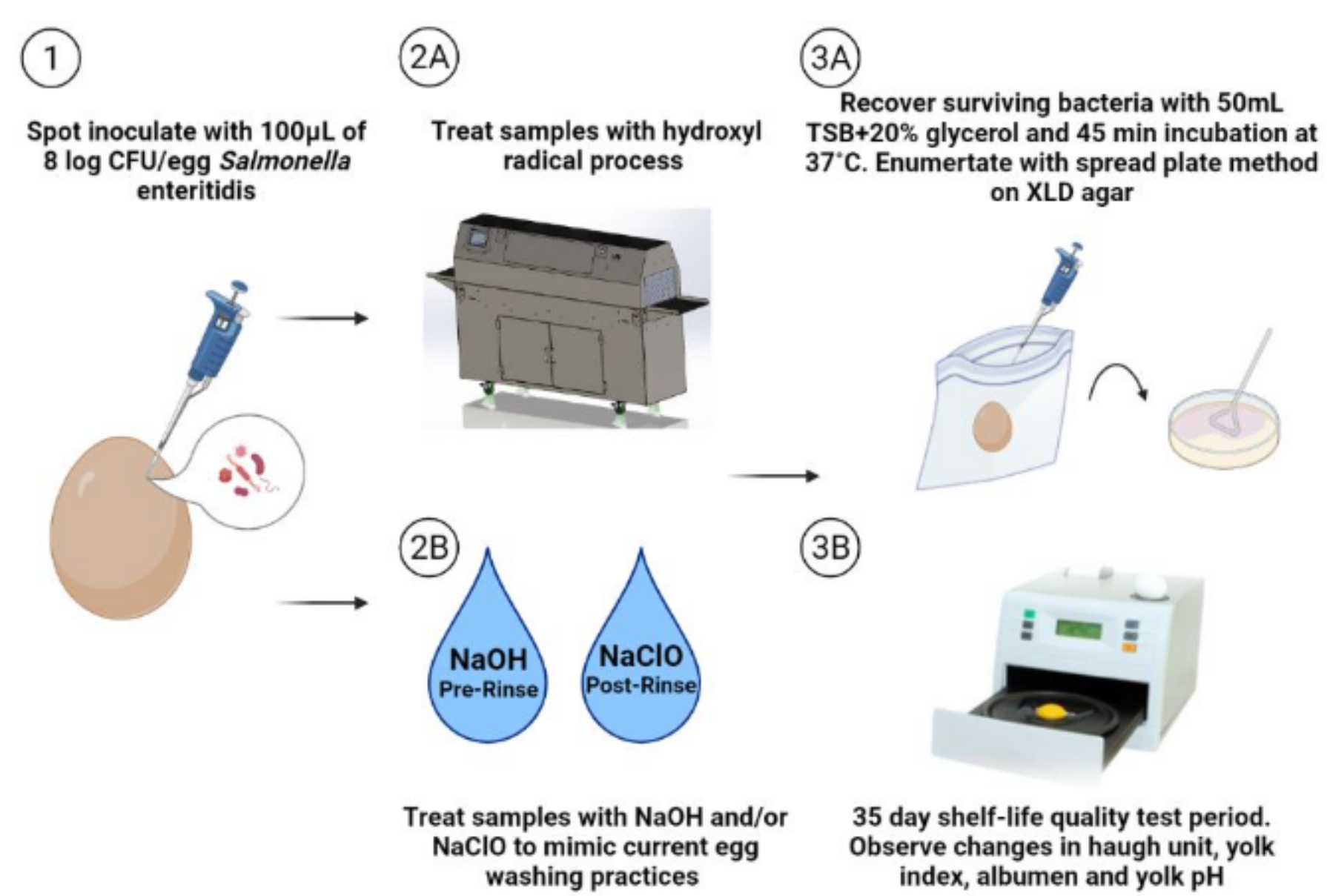


Figure 1: Methodology for disinfection of shelled egg by hydroxyl radical process or standard egg washing.

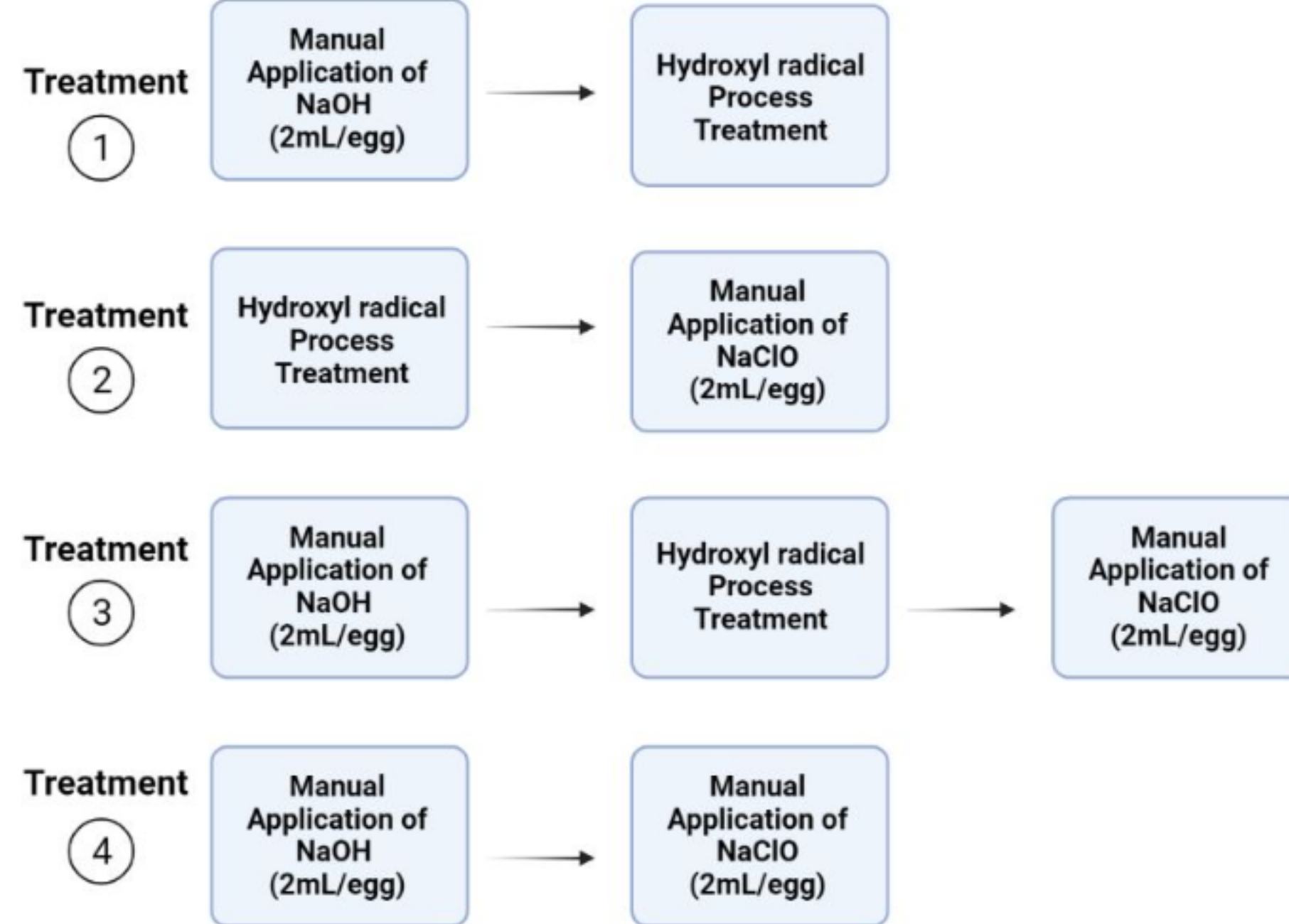


Figure 2: Procedure mimicking standard egg washing practices in industry. NaOH pH:10 at 40°C; NaClO pH: 6.5, 200ppm at 40°C.

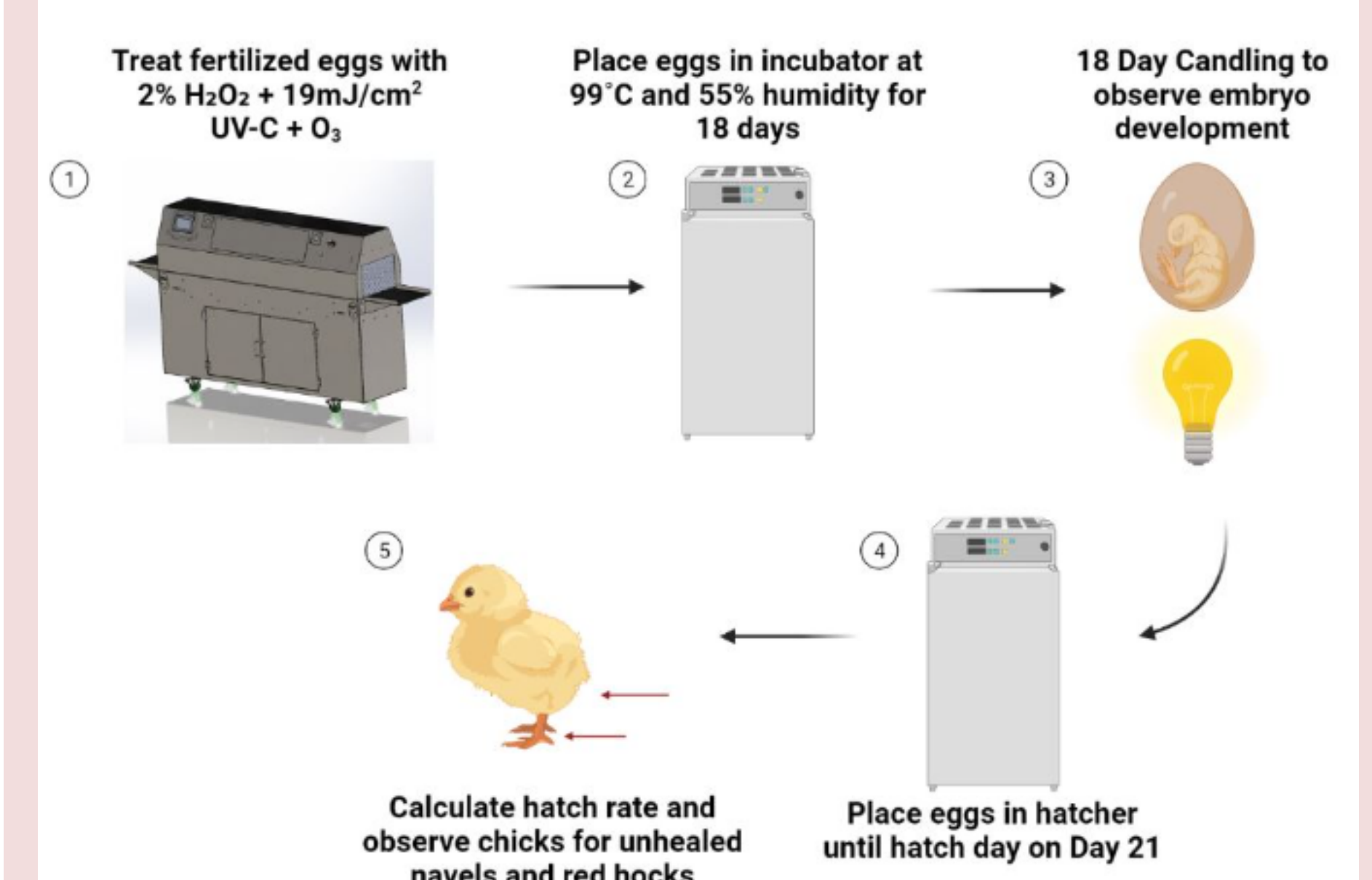


Figure 3: Methodology for hydroxyl radical treatment of hatchery eggs.

## RESULTS

5 second treatment of 2% H<sub>2</sub>O<sub>2</sub> + 19mJ/cm<sup>2</sup> UV-C + O<sub>3</sub> yields >5 log<sub>10</sub> CFU/egg reduction of *Salmonella* enteritidis.

Sodium hydroxide (NaOH) pre-rinse and hypochlorite (NaClO) post-rinse steps alone result in significant lower log count reduction of pathogen than treatments including a hydroxyl radical treatment step.

Pre-rinse and post-rinse steps have no impact on *Salmonella* disinfection efficacy of hydroxyl radical treatment.

Treatment demonstrated no negative impact on haugh unit, a comprehensive egg quality metric.

Treatment demonstrated no negative impact on embryo development, hatchability, or chick health.

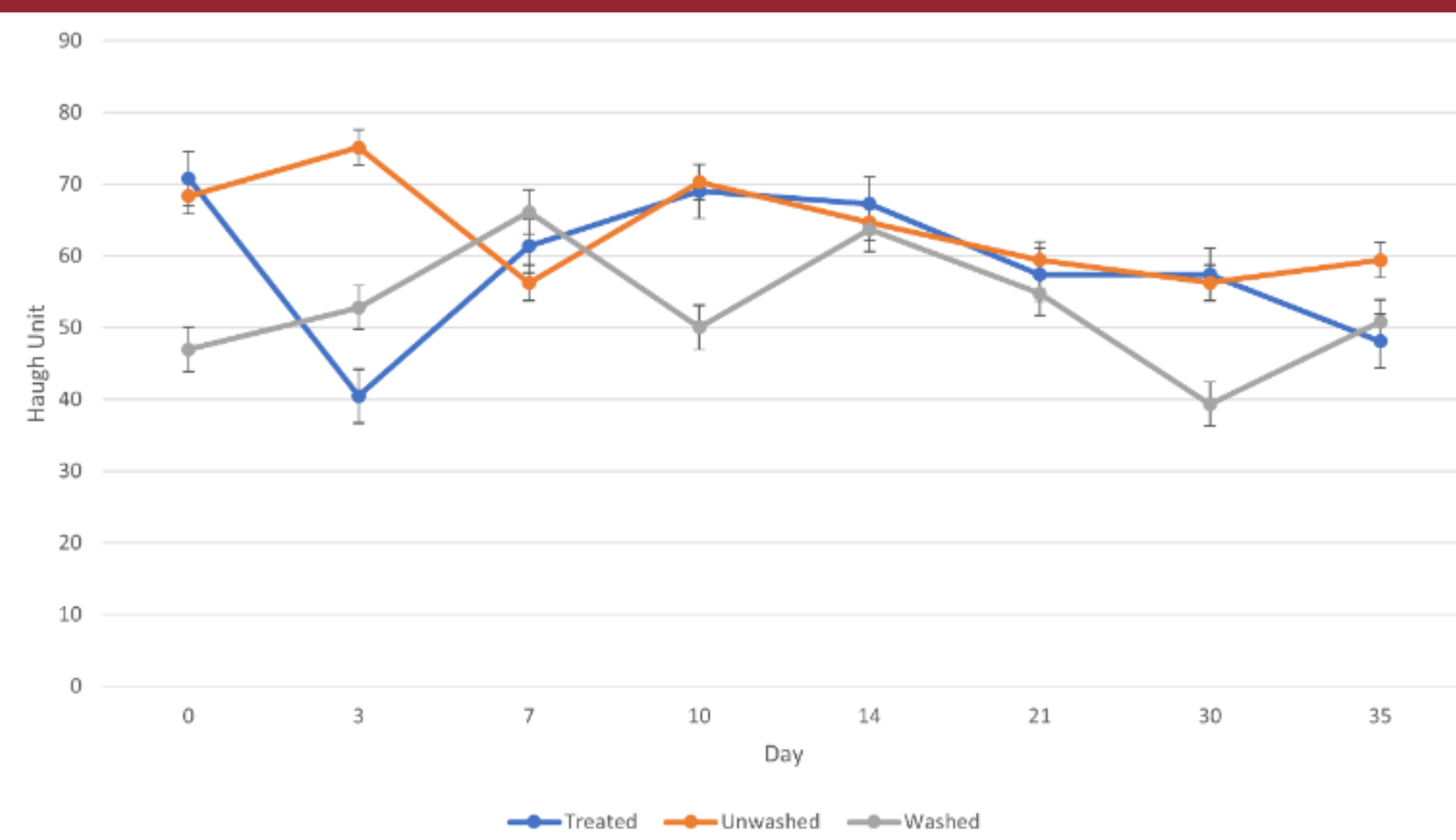


Figure 5: Determination of Haugh Unit over 35 day shelf life period. Three sample groups: treated, unwashed/ungraded, washed/graded; held at 21°C. HU=100\*log(h-1.7w<sup>0.37</sup>+7.6).

Group	# of Eggs	# of Undeveloped Embryos at 18 Day Candling	# Hatched: Failed to Hatch	Hatch Rate	# of Deformities Observed
Control (non-treated)	14	2	11:1	78%	1
Treated	16	3	12:1	75%	0

Table 1: Effects of hydroxyl radical process on hatchery eggs. 5s treatment of 2% H<sub>2</sub>O<sub>2</sub> + 19mJ/cm<sup>2</sup> UV-C + O<sub>3</sub>.

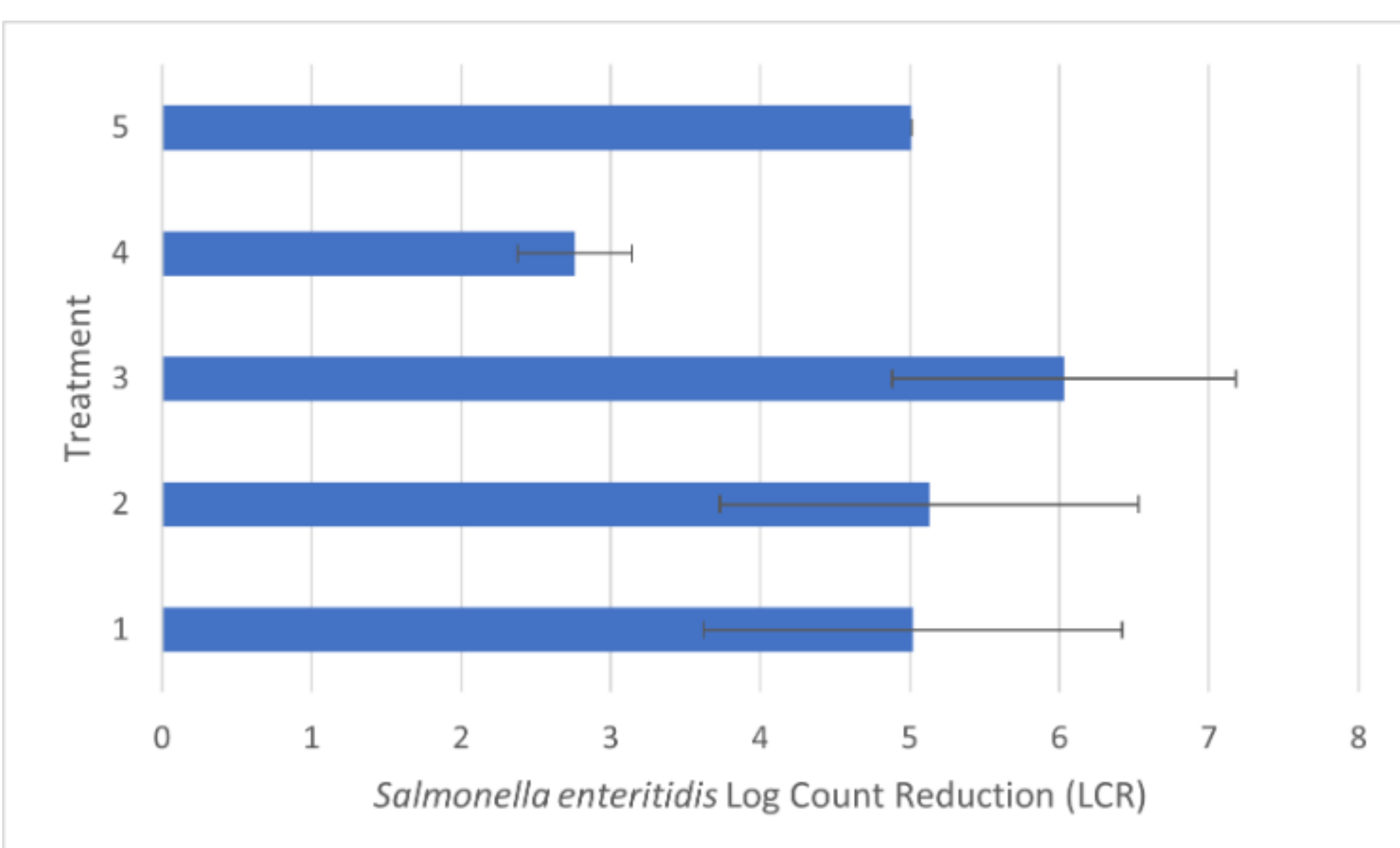


Figure 4: Efficacy of hydroxyl radical process versus standard egg washing for egg disinfection of *S. enteritidis*. Hydroxyl radical process is labeled as Treatment 5.



Figure 6: Clean Flow unit facilitating hydroxyl radical process treatment.

## CONCLUSION

Hydroxyl radicals demonstrate oxidation potential to enhance food safety of shelled eggs.

Hydroxyl radical treatment is a continuous, rapid, and effective treatment to inactivate *Salmonella* on both hatchery and table eggs.

Treatment offers a waterless and novel method for eggshell surface decontamination, improving the sustainability of the poultry and egg industry.

## REFERENCES

- Ontario Public Health (2019)
- Fei, X., He, X., Guo, R.X., Yin, C., Geng, H.P., Wu, K.Y., Yin, K.Q., Geng, S.Z., Pan, Z.M., Li, Q.C. and Jiao, X.A. (2017) Analysis of prevalence and CRISPR typing reveals persistent antimicrobial-resistant *Salmonella* infection across chicken breeder farm production stages. Food Control 77, 102-109.

## ACKNOWLEDGEMENTS

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