Ozone vs. Electrolyzed Water (EW)

Salt, water, and electricity—Pure, safe substances used to produce Electrolyzed Water (Hypochlorous Acid). Certainly sounds innocent enough, PURE and SAFE; but then so does hydrogen, carbon and nitrogen, also pure substances necessary for life. But combined, they could become Hydrogen Cyanide, a most UNSAFE cocktail! And so it is with Hypochlorous Acid.

A U.S. Government study on Electrolyzed Water (Hypochlorous Acid) concluded: "Because the primary oxidant formed is chlorine, disinfection capabilities are similar, if not identical, to traditional chlorine solutions."[1] Pouring bleach into water produces the same effect, sharing all the disadvantages of chlorine.

Chlorine disinfection is slow, ineffective against many pathogens, and creates carcinogenic by-products when used on food, as discovered by a researcher at the US EPA in 1974[2]. Ozone, on the other hand, kills pathogens on contact, converts to regular oxygen, leaving no toxic residuals.

The oxidation potential of Ozone is 39% greater than that of Hypochlorous Acid, resulting in greatly reduced times required to kill pathogens. According to US EPA data presented below, Ozone is between 5 and 6 times faster at inactivating viruses than Hypochlorous Acid.[3] In this table, "CT" stands for Concentration times Time, and the ideal disinfectant would have the lowest concentration and take the least time, so the lower the CT value, the better.

Table 2-13. CT Values for Inactivation of Viruses

Disinfectant	Units	Inactivation		
		2-log	3-log	4-log
Chlorine[1]	mg · min/L	3	4	6
Chloramine[2]	mg · min/L	643	1,067	1,491
Chlorine Dioxide[3]	mg · min/L	4.2	12.8	25.1
Ozone	mg · min/L	0.5	0.8	1.0
UV	mW · s/cm^2	21	36	not available

CT values were obtained from AWWA, 1991.
[1] Values are based on a temperature of 10°C, pH range of 6 to 9, and a free chlorine residual of 0.2 to 0.5 mg/L.
[2] Values are based on a temperature of 10°C and a pH of 8.
[3] Values are based on a temperature of 10°C and a pH range of 6 to 9.

When considering pathogens such as Cryptosporidium, Norovirus, and Hepatitis A, one cannot depend upon Hypochlorous Acid for any safe level of disinfection. Ozone does the job much more effectively.

Hypochlorous Acid does kill bacteria, but much more slowly than Ozone. The following graph illustrates the slow kill rate of Bleach and EW Disinfectant used on Bacon contaminated with Listeria.[4] Note these data indicate EW is hardly more effective than water.

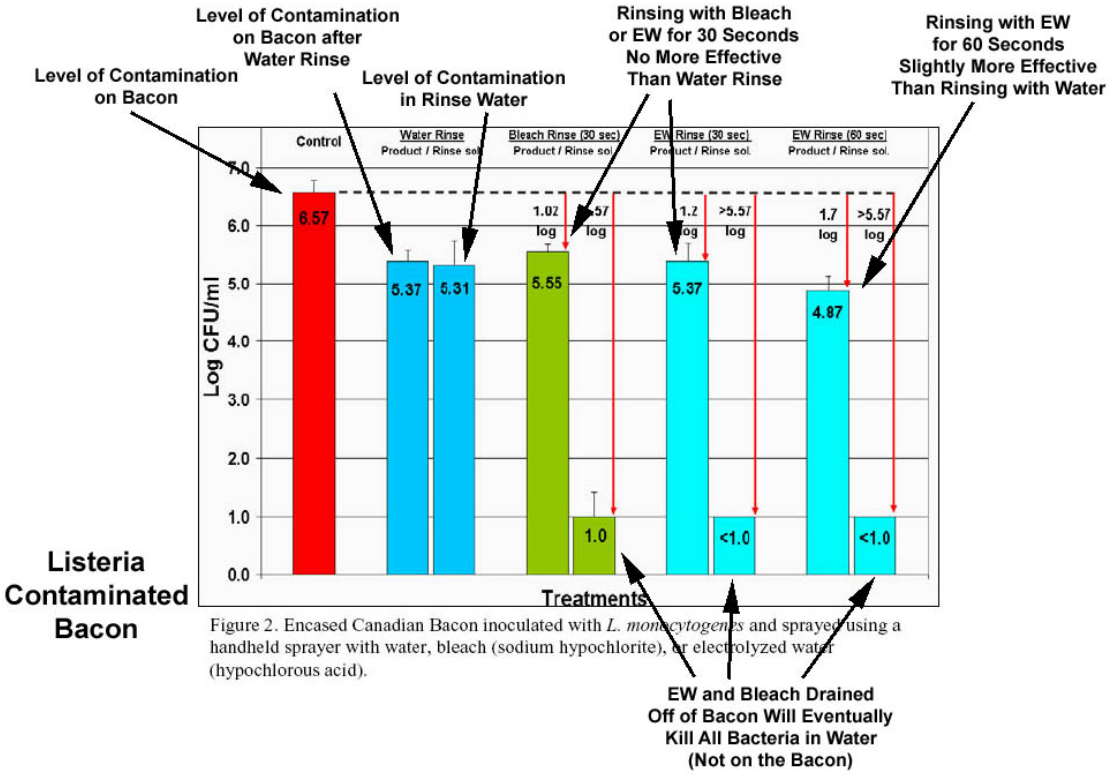

Figure 2. Encased Canadian Bacon inoculated with *L. monocytogenes* and sprayed using a handheld sprayer with water, bleach (sodium hypochlorite), or electrolyzed water (hypochlorous acid).

From a paper relating the efficacy of ozone against Listeria in a different test, "Overall, more than 4 log units of *L.monocytogenes* cells per ml was killed at time zero (instantaneously)."[5] In other words, in this test, Ozone killed over 99.99% of Listeria cells instantaneously.

Even though Electrolyzed Water is produced from pure, safe substances, it is ***not safe*** when used on food. It forms carcinogenic compounds which remain on the food we consume. It is not green technology, and it is no safer than regular chlorine disinfection.

Electrolyzed Water generators present a novel means of creating the same thing as bleach added to water. It is not green technology, and it is no safer than regular chlorine disinfection. Ozone, on the other hand, produces no harmful by-products and no residue, and can be used on organic products with no mention in the labeling. Ozone is not just ***Green***, it is ***Bright Green***, and is the fastest, most powerful, and safest disinfection agent available.

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1. Clarke, S. and Bettin, W. 2006. Electrochemically Generated Oxidant Disinfection in the Use of Individual Water Purification Devices. U.S. Army Center for Health Promotion and Preventive Medicine

2. Bellar, T.A., Lichtenberg, J.J., and Kroner, R.C. 1974. The Occurrence of Organohalides in Chlorinated Drinking Water. JAWWA 66(12), 703

3. Office of Water. 1999. Alternative Disinfectants and Oxidants Guidance Manual. U.S. EPA

4. Veasey, S.R. and Muriana, P.M. 2007. The Use of Hypochlorous Acid Generated by Electrolysis for the Treatment of Pathogens and Spoilage Microorganisms on Meat Products. Oklahoma Agricultural Experiment Station

5. Restaino, L., Frampton, E.W., Hemphill, J.B., and Palnikar, P. 1995. Efficacy of Ozonated Water against Various Food-Related Microorganisms. Applied and Environmental Microbiology. p. 3471-3475

Explanation of Graph Comparing Water, Bleach, and Electrolyzed Water

The graph comparing Electrolyzed Water (such as from Sterilox) and Bleach vs. Water requires some explanation.

The Red bar shows the contamination level of Listeria on the Bacon sample to be 3.7 million Colony Forming Units (CFUs) per milliliter.

The first Blue bar shows the contamination remaining on the bacon after rinsing with water for 30 seconds to be 230,000 CFUs. This amounts to approximately 1 Log reduction from the initial contamination level and this is generally what one expects from a water rinse. The second blue bar shows the amount of Listeria collected in the rinse water. This is not as important a number because food safety is determined by how many pathogens are left on the food after rinsing. For the remaining green and turquoise bars, the second bars also refer to the amount of Listeria remaining in the liquid collected after rinsing. The counts here are very low, because given enough time, chlorine will eventually kill most bacteria. Again, however, this is not important, as food safety is determined by bacteria remaining on the food.

The first Green bar shows the contamination left on the bacon after rinsing with Bleach (hypochlorous acid) for 30 seconds to be about 350,000 CFUs, which shows that the water rinse was more effective, although in food safety terms, this isn't much of a difference.

The first Turquoise bar shows the contamination left on the bacon after rinsing with Electrolyzed Water (the same chemical, hypochlorous acid, as found in bleach) for 30 seconds to be about 230,000 CFUs, exactly the same result obtained when using water for disinfection.

The next tall Turquoise bar shows the contamination left on the bacon after rinsing with Electrolyzed Water for 60 seconds to be about 74,000 CFUs. It is reasonable to imagine that doubling the contact time could result in an extra one half log or so of pathogen reduction. There was no test measuring the amount of Listeria remaining on the bacon after a 60 second water rinse, so we do not know how much more effective the water rinse might be had it been administered for twice the amount of time.

The bottom line from these results seems to be that a rinse of any hypochlorous acid product will likely be about as effective as rinsing with water, except that hypochlorous acid will always create carcinogenic residues which will remain on the food product.