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EVALUATION OF ELECTROLYZED WATER AS AN ANTIMICROBIAL IN FOOD SAFETY

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Abstract: Food safety is based on a series of measures that facilitate the implementation of a system for the protection of consumer health; Therefore, by controlling the potential and significant hazards in the different stages of the agri-food chain, it is possible to guarantee the trade of reliable foods. For this reason, electrolyzed water was used, which is based on an electrochemical technology, where acid electrolyzed water is obtained by electrolysis at the anode and reduced electrolyzed water at the cathode, the objective of this work is to evaluate the use of hypochlorous acid, an active compound obtained by electrolysis of water, as an antimicrobial to reduce contamination in food, for this purpose the parameters of the two types of water generated were standardized, the effectiveness of hypochlorous acid was analyzed for Salmonella sp microorganisms, using the techniques of horizontal method ISO 6579: 2017, for the microorganisms, the results show a microbiological inhibition halo of 2 cm in the application of the sensidisc impregnated with acid electrolyzed water pH 3.4 (A) and 1 cm in the sensidisc impregnated with sodium hypochlorite pH5 (B), demonstrating that there is no significant difference between the use of this antimicrobial that could be applied to food, as an environmentally friendly disinfectant and reduce food losses and waste.
Keywords: Hypochlorous acid, electrolyzed water, antimicrobial

INTRODUCTION

*Salmonella*it is a Gram negative bacillus, facultative aerobic, catalase positive, oxidase negative, facultative anaerobes, lactose fermenters, not sporulated, it has peritrichous flagella with the exception of S. gallinarum and S. pullorum, which are immobile and specifically affect birds; its metabolism is fermentative and oxidative; ferment glucose with production of hydrogen sulfide (H2S) and gas, except S. Typhi (Pedraza et al.,2014). Salmonella spp, is the etiological agent of salmonellosis, being the main pathogen involved in foodborne diseases and in turn is associated with acute diarrheal disease, which is one of the most important causes of morbidity and mortality reflected mainly in infants. children and the elderly. Salmonellosis is distributed worldwide, which makes it one of the main public health problems, in addition to generating a high negative impact on the poultry industry since, when this disease occurs in a shed, it is best to slaughter these animals (Torres, 2020), this bacterium causes gastroenteritis due to the ingestion of contaminated food, including chicken eggs for human consumption, with control in foods of animal origin being a priority, this zoonosis is one of the biggest health problems in the world. (Suarez, 2000).

Hypochlorous acid, is the active compound of oxidizing or acid electrolyzed water (AEA) is a new environmentally friendly technology (Buck et al., 2003). When the electrodes are electrically charged the anode attracts electrons from the water and the cathode. Then water with low concentration of electrons at the anode and water with high concentration of electrons at the cathode are obtained. The first is known as "electrolyzed oxidizing" water (AEA), it has a high degree of electronic activity due to the increase in its oxidation capacity and, in search of electrical balance, it has the property of taking electrons from those organisms with which it is in contact. contact (Kohno, 1996).

Antimicrobial substances are used for the destruction of microorganisms that can cause diseases, however, not all microorganisms can be destroyed by this process, for this sterilization is used. Antimicrobials and disinfectants are classified by their mechanism of action, such as alteration of the cell wall, alteration of the cytoplasmic membrane and

alteration of nucleic acids (OIRSA, 2021). They can also be classified into three categories according to their antimicrobial potential, high, intermediate and low level.

High-level ones can inactivate the vegetative forms of microorganisms, bacteria, fungi, viruses and some spores, but they do not manage to eliminate all bacterial endospores, they may require a contact time between 20 min and up to 10 hours, some are 2% glutaraldehyde, peracetic acid, hydrogen peroxide 6-8% (OIRSA, 2021).

Intermediate level ones inactivate vegetative bacteria, fungi and some viruses, but not bacterial or fungal spores, they require a contact time of 10 minutes, for example 70 and 90% ethyl alcohol, chlorinated and phenolic (OIRSA, 2021).

Low-level ones cannot destroy endospores, mycobacteria, fungi and/or non-lipid viruses, they only affect the vegetative forms of non-acid-resistant bacteria, the minimum contact time is 10 minutes, for example quaternary ammonium (Rodríguez, 2006; OIRSA, 2021).

MATERIALS AND METHODS

Sample. Electrolyzed water pH 3.4 ORP 578mV, 10ppm (A), electrolyzed water pH 11, ORP-863mV, 10ppm (B),sodium hypochloritepH 5, 10 ppm (C), control Distilled water (D),

Antimicrobial standardization. The concentration of water is standardized

electrolyzed water to be used that would be more effective in the elimination of Salmonella spp, for this purpose, 2 different concentrations obtained from the electrolyzed water product equipment will be measured for 10 days, with their respective variables, parts per million (mg/L) of active residual chlorine that will be measured with Merck colorimetric strips, and with the DPD reagent, the pH will be measured with the Peachimeter and the oxidation reduction potential (ORP) that will be measured with the voltmeter, in a water generation time of twenty (20) minutes.

Preparation of sensidisks. An antibiogram study is carried out, with three concentrations of antimicrobials called A, B and C impregnated in the sterile filter paper sensidiscs with a control sample D.

Microbiological analysis. Salmonella Enteritis ATCC 13067 and Salmonella typhymurium ATCC 14028 are obtained and inoculated into 225 mL of brain heart infusion (BHI) broth, incubated at 35 ^{o}C for 150 rpm for 24 h. The remaining culture will be washed 3 times by centrifugation and re-suspension in saline. In this suspension, the absorbance is adjusted with the 0.5 McFarland standard. For 10 $^{-8}$ microorganisms/ml, in saline solution, according to the McFarland scale (McFarland, 1970), this suspension is sown by swabbing in the entire Hektoen culture medium, later the sensidiscs impregnated with the study solutions are added, bring to incubate at 35+-2 ^{o}C for 24-48 H. This was done in triplicate; After this time, the inhibition halos were measured to verify the inhibitory effect.

RESULTS AND DISCUSSION

Standardized antimicrobial. To check the effectiveness of hypochlorous acid, the active compound is first standardized using ZHENGYI TECHNOLOGY CO brand equipment.

LIMITED, from Asia; for which 10 samples were taken for 10 consecutive days for a total of 100 measurements, which were averaged, obtaining as best options the concentrations of electrolyzed water with pH 3.4 with 578mV Oxide Reduction Potential (ORP); and pH 11 with- 863 ORP.

Microbiological inhibition. The microbiological results for the inhibition of Salmonella, was presented with a 2 cm halo in the antimicrobial solution A, in second place for a 1 cm inhibition halo in

solution C, in solutions B and D no halo was observed. inhibition figure 1. Allowing to demonstrate that the antimicrobial solution with electrolyzed water pH 3.4 has an inhibitory effect against the Salmonella sp microorganism as corroborated by Zang et al, 2019 in their study of the efficacy of electrolyzed water as an antimicrobial for salmonella in eggs, likewise Bialka et al 2004, obtained a reduction in the salmonella population between >0.6 to >2, 6 log cfu/mg using alkaline electrolyzed water followed by acidic electrolyzed water; however, it is observed that there is no significant difference between the antimicrobial acid electrolyzed water and sodium hypochlorite. Also Veasey & Muriana,2016, in their study, evaluation of hypochlorous acid generated in electrolysis for sanitizing meat and surfaces did not show recovery of viable cells from tests with E. coli O157:H7, Salmonella Enteritidis or L. monocytogenes, generating a >6 log reduction of these pathogens.

Solutions	pH	ORP (mv)	CHLORINE (mg/L)
Electrolyzed Water	1.5	3600	100
	eleven	-863	10
	4.3	566	7
	4.1	997	7
	3.4	578	10
	2	750	fifty
	9	-299	10
	7	160	5
	8.5	-87	10
	10.7	-830	10

Table 1. Standardization of hypochlorous acid. The data are averages in the pH of the sampling of 100 data generated from the electrolyzed water equipment.

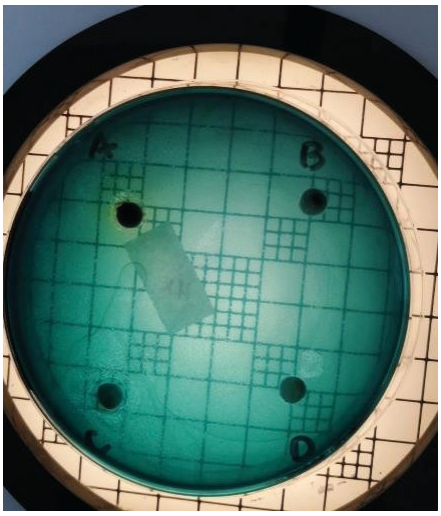

Figure 1. Effect of the antimicrobial on the inhibition of Salmonella, by inhibition halos.

CONCLUSIONS

This study determined the inhibition of Salmonella using acid electrolyzed water and sodium hypochlorite, where a greater inhibitory effect was demonstrated with electrolyzed water at pH 3.4 compared to sodium hypochlorite at pH 5, which could be used in the food as a safe and environmentally friendly antimicrobial.

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CONFLICT OF INTERESTS

The authors declared that there is not any conflict of interest.

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