Journal for the Agriculture, Biotechnology and Education, 4(3), 59-65, December 2024
e-ISSN: 2754-7825
jabedu.com

Young Wise Publishing
youngwisepub.com

Research Article

Study the efficacy of Bello Zon chlorine dioxide on control of pathogenic bacteria in Lactating Sows

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Article Info

Received: 23 October 2024
Accepted: 26 December 2024
Online: 30 December 2024

Keywords
Bello Zon chlorine dioxide
Pathogenic bacteria
Lactating Sows
Perception

Abstract

This research aims to study and compare the efficiency of controlling germs on surfaces between Bello Zon Chlorine dioxide and Glutaraldehyde, towards reducing the amount of pathogenic bacteria in sows. The population in the study is hybrid sows between the Landrace and LargeWhite breeds, 10 sows with similar basic factors (farrowing date, parity, number of piglets). The sample group is divided into 2 groups, a control group of 5 mothers which using antibiotics. Glutaraldehyde spray after basic cleaning. The trial group of 5 mothers which using Bello Zon Chlorine dioxide 10 ppm, spray after cleaning, replacing the current product. Dara collection: Boot swab and breast swab 4 times at the following durations: 10 minutes, 30 minutes, 60 minutes, and 480 minutes, respectively. Analyze the decrease in bacterial load over time. Using the experimental plan of analysis of variance with repeated measures (Repeated Measures ANOVA), the differences between the experimental groups were analyzed with a T-test using the R-studio program, with the significance level of the hypothesis test set at the 0.05 level. The result found that the efficiency of using chlorine dioxide for surface disinfection is not different from using the control group of disinfectants Both can be used interchangeably, even more effective at controlling infection than the control group of disinfectants in a period at 480 minutes in the Enterobacteriaceae [Boot swab] and TPC [Boot swab] groups due to increased contamination in the feces of sows and piglets

To cite this article

Chukiatsiri, K., Thippaya, K., Injana, W., and Raksasiri, B.V. (2024). Study the efficacy of Bello Zon chlorine dioxide on control of pathogenic bacteria in Lactating Sows. *Journal for the Agriculture, Biotechnology and Education, 4*(3), 59-65. DOI: https://doi.org/10.5281/zenodo.14617507

Introduction

In recent years, chlorine dioxide has become a common technique on farms due to its remarkable capacity to destroy germs so well that it may be used as an alternative to hydrogen peroxide or chlorine (Chhetri et al., 2017; Meireles *et al*., 2016). Whether it's the broad-spectrum action that effectively inhibits bacteria, fungi, yeast, viruses, and microorganisms, the oxidation ability that is 2.5 times greater than chlorine but less corrosive, or the capacity to remove biofilm that chlorine is unable too. (Thai Bio Oxzine Co., Ltd.). Animal farms, slaughterhouses, animal feed factories, and facilities that process animal products all need and benefit from disinfectant products (Limeneh *et al*., 2022). Pathogenic microorganisms including bacteria, fungus, and yeast that create contamination in buildings (Prussin & Marr, 2015), sheds (Chinivasagam et al., 2009), and various equipment factories (Szulc *et al*., 2017) during the

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production process are eliminated, prevented, and controlled by properly employing disinfection solutions *(Achinas et al.*, 2019). As a result, the cattle industry is free of harmful microbes, producing consumer-safe livestock products *(Li et al*., 2019). Livestock disinfectant products fall under the category of hazardous materials. (Ministry of Industry's Announcement on the List of Hazardous Substances B.E. 2556) which has numerous groups that vary depending on the chemical group's characteristics and application. Farmers, disinfectant users, and pertinent officials will benefit from examining the outcomes of applying various disinfection product groups (Keïta *et al*., 2016). This will enable them to select the most appropriate disinfectant product (Keïta *et al*., 2016) and ensure that the hazardous substance products used on livestock are effective (Kim *et al*., 2020). Every category of disinfection agents has unique characteristics and applications (Yemiş & Harmancı, 2020). The following seven product groupings were chosen for this study: This study selected 7 product groups as follows: Acid (Srisukontharat, 2015); Alcohol (Mahaphrom, 2014); Aldehyde (Srisukontharat, 2015, Harintranon *et al*., 2013); Iodophor (Srisukontharat, 2015); Chlorine (Mahaphrom, 2014); Oxidant (Srisukontharat, 2015); QUAT (Harintranon *et al*., 2013). The use of acids to denaturize proteins and alter the cytoplasm's pH, which can interfere with cellular processes, was the main focus of this investigation. At pH values between 3 and 6, acids are bacteriostatic and can kill germs. Mineral acids, such as HCl and H2SO4, can be employed as disinfectants at pH values below 3. The benefits include the fact that they leave no residues and do not break down into toxic compounds (Rutala *et al*, 2008). The drawback is that certain surfaces have the potential to corrode (Srisukontharat, 2015 and Palakul, 1993). By testing and comparing the effectiveness of disinfectants with the original disinfectants used by farmers, the experiment was carried out to control pathogenic bacteria in lactating sows.

Aim of Study

Specifically, this study aimed to determine whether Bello Zon Chlorine Distiller is effective in lowering the quantity of harmful bacteria in the broodstock and to assess how well Bello Zon Chlorine Dioxide disinfectant works in comparison to the original disinfectant.

Method

In order to compare the effectiveness of surface pathogen management between Bello Zon Chlorine Dioxide and Glutaraldehyde in lowering the quantity of pathogenic bacteria in sow pens, the study technique was carried out in four study procedure were follows:

Ten sows were used in the experiment, which was carried out on seven-day postpartum sows. Two groups, each consisting of five sows, were employed in the experiment: the experimental group used Bello Zon Chlorine Dioxide while the control group used Glutaraldehyde.

Each pen was separated into two areas: the floor of the enclosure, where samples were taken with boot swabs, and the sow's udder area, where samples were taken using cotton swabs at three sites, each measuring five square centimeters. Clean water was used to cleanse the sow's udder area and the pen floor before to the experiment. Following that, every area was swabbed and kept in Biosafe peptone water. The recommended concentration of the disinfectant was then sprayed. After spraying for five, ten, fifteen, and thirty minutes, gather the swab samples at the same location. The quantity of bacteria will be determined using the samples that were gathered.

The gathered samples will be diluted ten times in order to determine the amount of E. coli, the bacteria that cause gastrointestinal disorders (Coliform count), and the total number of bacteria using the Total Plate Count method. Each group, place, and time period will have its own record of the counting results.

Use the analysis of variance with repeated measures (Repeated Measures ANOVA) to compare the number of bacteria that declined with time. By setting the significance level of the hypothesis test at 0.05, the T-test will be used to examine the differences between the experimental groups using the R-studio software.

Results

Testing of Bello Zon Chlorine Distiller is effective in lowering the quantity of harmful bacteria in the broodstock

Table 1. Enterobacteriaceae Boot swab

Enterobacteriaceae		
Time	Treatment	
	Control	Chlorine dioxide
Before	0±0.00a	0±0.00a
10	98.54±0.99a	97.87±1.00a
30	98.54±0.55a	99.33±1.02a
60	98.69±0.48a	98.24±0.16a
480	-122.70±112.18Bb	-37.47±66.84Ab

*Different uppercase letters in column indicate a statistical difference (p<0.05) **Different lowercase letters in row indicate a statistical difference (p<0.05)

According to Table 1, Boot swab for Enterobacteriaceae Bello Zon Chlorine dioxide had the same germ killing effectiveness as the control group at 10 minutes (98.54±0.99a, 97.87±1.00a), 30 minutes (98.54±0.55a, 99.33±1.02a), and 60 minutes (98.69±0.48a, 98.24±0.16a), according to the results of the Boot Swab technique sample collection. At 480 minutes, however, Bello Zon Chlorine dioxide was shown to be substantially more effective at controlling germs than the Control group (-122.70±112.18Bb,-37.47±66.84Ab) (0.05).

Table 2. Enterobacteriaceae Breast Swab

Enterobacteriaceae		
Time	Treatment	
	Control	Chlorine dioxide
Before	0±0.00a	0±0.00a
10	97.65±1.24a	98.19±0.59a
30	98.72±0.52a	97.91±0.99a
60	95.19±2.58a	89.61±7.19a
480	39.13±18.32b	51.71±16.48b

*Different uppercase letters in column indicate a statistical difference (p<0.05) **Different lowercase letters in row indicate a statistical difference (p<0.05)

According to Table 2, The Enterobacteriaceae Samples taken from the sows' breasts revealed that Bello Zon Chlorine Distillate was just as effective in disinfecting as the control group.

Table 3. E-coli (EMB: Eosin Methylene Blue Agar) Boot swab

E-coli (EMB: Eosin Methylene Blue Agar)		
Time	Treatment	
	Control	Chlorine dioxide
Before	0±0.00a	0±0.00a
10	76.27±10.75a	79.07±7.90a
30	79.21±10.83a	90.43±6.09a
60	51.34±27.79Ba	93.55±1.75Aa
480	20.28±24.27b	49.09±17.51b

*Different uppercase letters in column indicate a statistical difference (p<0.05) **Different lowercase letters in row indicate a statistical difference (p<0.05)

According to Table 3, Boot swab for E. Coli (EMB: Eosin Methylene Blue Agar) Bello Zon Chlorine dioxide had the same sterilization efficiency as the control group at 10 minutes (76. 27±10. 75a,79. 07±7. 90a), 30 minutes (79. 21±10. 83a,90. 43±6. 09a), and 480 minutes (20.28±24.27b,49.09±17.51b), according to the results of the bootstrap sample collection method. However, it was discovered that Bello Zon Chlorine dioxide had a good sterilizing efficacy at 60 minutes (51.34±27.79Ba, 93.55±1.75Aa), which was substantially greater than the control group (0.05).

Table 4. E-coli (EMB: Eosin Methylene Blue Agar) Breast swab

E-coli (EMB: Eosin Methylene Blue Agar)		
Time	**Treatment**	
	Control	**Chlorine dioxide**
Before	0±0.00a	0±0.00a
10	87.2±3.23a	99.20±0.24a
30	88.83±3.86a	99.41±0.20a
60	86.10±3.06a	97.48±2.12a
480	30.60±9.52b	38.31±13.64b

*Different uppercase letters in column indicate a statistical difference (p<0.05)**Different lowercase letters in row indicate a statistical difference (p<0.05)

According to Table 4, The disinfection effectiveness of Bello Zon Chlorine Dioxide and E. Coli (EMB: Eosin Methylene Blue Agar) breast swabs obtained from the breast region of sows is equal to that of the control group disinfectant.

Table 5. Total viable count (TPC) Boot Swab

Total viable count (TPC)		
Time	**Treatment**	
	Control	**Chlorine dioxide**
Before	0±0.00a	0±0.00a
10	95.92 ±1.54a	95.00±3.75a
30	96.30±1.32a	95.20±2.91a
60	84.61±12.14a	94.71±2.67a
480	-77.17±66.59Bb	32.27±15.57Ab

*Different uppercase letters in column indicate a statistical difference (p<0.05) **Different lowercase letters in row indicate a statistical difference (p<0.05)

According to Table 5, Boot Swab total viable count (TPC) Bello Zon Chlorine dioxide was shown to have the same sterilization efficiency as the control group at 10 minutes (95.92±1. 54a, 95. 00±3. 75a), 30 minutes (84.61±12. 14a,94.71±2. 67a), and 60 minutes (84.61±12.14a,94.71±2.67a), respectively, based on the bootstrap technique of sample collection. At 480 minutes, however, Bello Zon Chlorine dioxide was found to be considerably more effective at killing bacteria than the control group (-77.17±66.59Bb, 32.27±15.57Ab) (0.05).

Table 6. Total viable count (TPC) Breast Swab

Total viable count (TPC)		
Time	**Treatment**	
	Control	**Chlorine dioxide**
Before	0±0.00a	0±0.00a
10	97.90±1.25a	97.69±0.97a
30	97.77±1.50a	99.15±0.22a
60	97.16±2.16a	97.35±1.71a
480	31.50±18.94Bb	75.21±11.84Ab

*Different uppercase letters in column indicate a statistical difference (p<0.05) **Different lowercase letters in row indicate a statistical difference (p<0.05)

According to Table 6, Breast swab total viable count (TPC) Bello Zon Chlorine dioxide was found to be as effective in killing germs as the control group at 10 minutes (97. 90±1. 25a,97.69±0. 97a), 30 minutes (97. 77±1. 50a,99. 15±0. 22a), and 60 minutes (97.16±2.16a,97.35±1.71a) based on the samples collected around the sow's mammary glands. At 480 minutes, however, it was discovered that Bello Zon Chlorine dioxide substantially outperformed the control group (0.05) in terms of germ killing (31.50±18.94Bb, 75.21±11.84Ab).

Discussions

The study compares the efficacy of glutaraldehyde and Bello Zon Chlorine Dioxide in surface pathogen control in reducing the number of harmful bacteria in sow pens. Prior studies have shown that chlorine dioxide can be effective in controlling pathogens in agricultural environments (Moody *et al.*, 2019). Ten postpartum sows were used in the

experiment, split into two groups: an experimental group and a control group. The floor and the sow's udder area were treated with Bello Zon Chlorine Dioxide, similar to procedures in other studies targeting microbial reductions in livestock settings (Llonch *et al*., 2024). Boot swabs were used to gather samples, a method commonly used in environmental pathogen detection (Mateus-Vargas *et al*., 2022). To quantify bacterial load, the Total Plate Count method was applied, alongside specific tests for bacteria causing gastrointestinal diseases (Coliform Count) and E. coli. This testing aligns with standard microbial analysis protocols for assessing sanitation effectiveness (Hu *et al.*, 2021). Samples were diluted ten times, and data was collected by group, location, and time period to observe bacterial decline over time. At 480 minutes, Bello Zon Chlorine Dioxide showed superior containment of pathogens, aligning with prior findings on its prolonged bactericidal effects (Gómez-López *et al*., 2009). Bello Zon Chlorine Dioxide's efficacy was statistically significant ($p < 0.05$) in the control group, matching similar disinfectants in reducing Enterobacteriaceae counts in livestock environments (Davies & Wales, 2019). For E. coli (EMB: Eosin Methylene Blue Agar) at 60 minutes and 480 minutes, no significant differences were observed between Bello Zon Chlorine Dioxide and the control disinfectant, which aligns with findings by Yemiş and Harmancı (2020) on E. coli resistance in certain sanitation regimens. However, in the Total Viable Count (TPC) boot swab analysis, Bello Zon Chlorine Dioxide demonstrated higher disinfection efficiency than the control group disinfectant. These results reflect findings from recent studies emphasizing chlorine dioxide's effectiveness in reducing microbial load across different environmental surfaces *(Byun et al.*, 2021).

References

Harintranon, T., Kothammarit, K., Srina, C. & Koeylao, S. (2013). *Study on shelf life and bactericidal efficiency of glutaraldehyde and alkylbenzyldimethylammonium chloride.* Bureau of Animal Product Standards Development and Certification, Department of Livestock Development. P. 3.

Mahaphrom, P. (2024). *Antiseptic and Disinfectant. Faculty of Animal Science and Technology,* Maejo University. Retrieved from: http://www.as2.mju.ac.th/E-Book/t_panupong/Antiseptic_and_disinfectants.pdf.

Palakul, B. (1993). *Efficiency of chlorine dioxide in reducing the amount of Salmonella typhimurium in shrimp before freezing process.* Kasetsart University, Graduate School.

Srisukontharat, W. (2015). *Antimicrobial agents used in households or public health. Food and Drug Administration*, Thailand. P. 13-40.

Thai Bio Oxzine Co., Ltd. (2024). *Chlorine dioxide on farms.* Retrieved from: https://www.visittbo.com/farm-disinfection-th.html.

Achinas, S., Charalampogiannis, N., & Euverink, G. J. W. (2019). *A brief recap of microbial adhesion and biofilms*. *Applied sciences*, *9*(14), 2801.

Byun, K.-H., Han, S. H., Yoon, J.-w., Park, S. H., & Ha, S.-D. (2021). Efficacy of chlorine-based disinfectants (sodium hypochlorite and chlorine dioxide) on Salmonella Enteritidis planktonic cells, biofilms on food contact surfaces and chicken skin. *Food Control*, *123*, 107838.

Chhetri, R. K., Baun, A., & Andersen, H. R. (2017). Algal toxicity of the alternative disinfectants performic acid (PFA), peracetic acid (PAA), chlorine dioxide (ClO2) and their by-products hydrogen peroxide (H2O2) and chlorite (ClO2−). *International Journal of Hygiene and Environmental Health*, *220*(3), 570-574.

Chinivasagam, H., Tran, T., Maddock, L., Gale, A., & Blackall, P. (2009). Mechanically ventilated broiler sheds: a possible source of aerosolized Salmonella, Campylobacter, and Escherichia coli. *Applied and environmental microbiology*, *75*(23), 7417-7425.

Davies, R., & Wales, A. (2019). Antimicrobial resistance on farms: a review including biosecurity and the potential role of disinfectants in resistance selection. *Comprehensive reviews in food science and food safety*, *18*(3), 753-774.

Gómez-López, V. M., Rajkovic, A., Ragaert, P., Smigic, N., & Devlieghere, F. (2009). Chlorine dioxide for minimally processed produce preservation: a review. *Trends in Food Science & Technology*, *20*(1), 17-26.

Hu, D., Cheng, T.-Y., Morris, P., Zimmerman, J., & Wang, C. (2021). Active regional surveillance for early detection of exotic/emerging pathogens of swine: A comparison of statistical methods for farm selection. *Preventive Veterinary Medicine*, *187*, 105233.

Keïta, A., Huneau-Salaün, A., Guillot, A., Galliot, P., Tavares, M., & Puterflam, J. (2016). A multi-pronged approach to the search for an alternative to formaldehyde as an egg disinfectant without affecting worker health, hatching, or broiler production parameters. *Poultry Science*, *95*(7), 1609-1616.

Kim, S., Chung, H., Lee, H., Myung, D., Choi, K., Kim, S., Htet, S. L., Jeong, W., & Choe, N. (2020). Evaluation of the disinfectant concentration used on livestock facilities in Korea during dual outbreak of foot and mouth disease and high pathogenic avian influenza. *Journal of veterinary science*, *21*(3).

Li, S., Zhilyaev, S., Gallagher, D., Subbiah, J., & Dvorak, B. (2019). Sustainability of safe foods: Joint environmental, economic and microbial load reduction assessment of antimicrobial systems in US beef processing. *Science of the Total Environment*, *691*, 252-262.

Limeneh, D. Y., Tesfaye, T., Ayele, M., Husien, N. M., Ferede, E., Haile, A., Mengie, W., Abuhay, A., Gelebo, G. G., & Gibril, M. (2022). A comprehensive review on utilization of slaughterhouse by-product: Current status and prospect. *Sustainability*, *14*(11), 6469.

Llonch, L., Verdú, M., Martí, S., Riera, J., Cucurull, J., & Devant, M. (2024). Chlorine dioxide may be an alternative to acidification and chlorination for drinking water chemical disinfection in dairy beef bulls. *animal*, *18*(9), 101244.

Mateus-Vargas, R. H., Butenholz, K., Volkmann, N., Sürie, C., Kemper, N., & Schulz, J. (2022). Boot swabs to evaluate cleaning and disinfection success in Poultry Barns. *Agriculture*, *12*(1), 57.

Meireles, A., Giaouris, E., & Simões, M. (2016). Alternative disinfection methods to chlorine for use in the fresh-cut industry. *Food research international*, *82*, 71-85.

Moody, L. V., Miyamoto, Y., Ang, J., Richter, P. J., & Eckmann, L. (2019). Evaluation of peroxides and chlorine oxides as disinfectants for chemical sterilization of gnotobiotic rodent isolators. *Journal of the American Association for Laboratory Animal Science*, *58*(5), 558-568.

Prussin, A. J., & Marr, L. C. (2015). Sources of airborne microorganisms in the built environment. *Microbiome*, *3*, 1-10.

Szulc, J., Otlewska, A., Okrasa, M., Majchrzycka, K., Sulyok, M., & Gutarowska, B. (2017). Microbiological contamination at workplaces in a combined heat and power (CHP) station processing plant biomass. *International Journal of Environmental Research and Public Health*, *14*(1), 99.

Yemiş, F., & Harmancı, N. Y. (2020). Classification, Uses and Environmental Implications of Disinfectants. *Pakistan Journal of Analytical & Environmental Chemistry*, *21*(2).