# Antimicrobial activity of electrolyzed water in washing treatment of fresh vegetables

Soedarini, Inneke Hantoro, Budi Widianarko
*Soegijapranata Catholic University*
*Faculty of Agricultural Technology*
*Jl. Pawiyatan Luhur IV no. 1*
*Bendan Dhuwur, Semarang*
*Indonesia*
*e-mail: bernadeta@unika.ac.id*

**Abstract**

Washing is used to clean up dirt from surface of foodstuffs, such as fresh-served vegetables. In this research, Electrolyzed Acid Water (EAW) and Electrolyzed Reduced Water (ERW) were applied in washing treatments of white cabbage and *kemangi (Ocimum basilicum)*. The objective of the research was to evaluate the antibacterial activity of EAW (pH 4.0) and ERW (pH 8.8), in term of reduction of the bacterial contamination levels found in the samples. The samples (white cabbage and *Ocimum basilicum*) were collected from traditional market in Jatingaleh, Semarang – Indonesia. Tap water and Chlorine 100 mg/L were used as negative and positive controls, respectively. Each 500 mL washing solutions were poured into a 800 mL glass bowl and then 25 g of vegetable samples were soaked in the washing agents for 3, 4 and 5 minutes. During treatment, glass bowl was placed on a horizontal shaker. The result showed that EAW had stronger antibacterial activity than ERW. After 4 minutes of treatment, EAW gradually reduced the level of bacterial contaminations until reaching the safety level. There was no significant difference between washing treatment of 4 minutes and 5 minutes in term of bacterial contamination levels. Further, in general EAW was as effective as the positive control (Chlorine 100 mg/L).

Keywords: washing treatment, electrolyzed water, antibacterial activity, bacterial contamination, fresh vegetables.

## Introduction

Washing is an important and even critical stages in food processing because it can affect the quality and safety of food, especially for industries that produce fresh products or products that are minimally processed. In general, the washing of food intended to eliminate physical contaminants (dust, soil and dirt) and chemical (pesticide residues), or microorganisms that can degrade the quality and safety of foodstuffs (Zagory, 1999).

In practice, the food industry requires large amounts of water for washing fresh food products such as seafood, fruits, vegetables, meat, etc. In addition to washing the food, the food industry also need water for washing machinery and equipment either direct contact or indirect contact with foodstuffs, packaging materials washing and sanitary facilities meet the needs of workers. Thus the water used in the washing process must be available in sufficient quantities, derived from appropriate sources (free of contaminants), and meets the sanitary standards (Clute, 2009).

Washing of food to industrial scale, it requires lots of water if you want to completely eliminate impurities including to reduce the number of microorganisms. The use of water

in large quantities is assumed if the industry does not use a disinfectant. Improper washing process and the quality of the water that is not worth it can cause a risk of contamination of foodstuffs which degrade the quality and food safety is concerned (Gil et al., 2009).

Electrolyzed water is produced via electrolysis process. Through this process, minerals or cations in the water will move to negative pole, while the anions will move to the positive poles. So as the final result, we can collect Electrolyzed Acidic Water in one container and Electrolyzed Reduced Water in another. Electrolyzed Water, either acid with low pH or alkaline with high pH, have high potential of oxidation-reduction and therefore they are easy to penetrate the cell walls of microorganisms or inactivate the growth of microorganisms (Kim et al., 2001). Electrolyzed water is commonly used in Japan as a non-toxic, oxidized, antimicrobial solution that is capable of killing many pathogens in less than a minute.

**Research Objective**

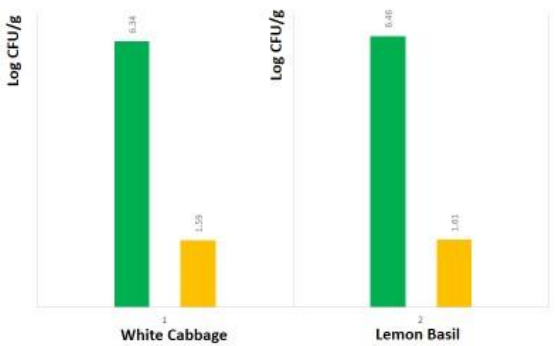
To evaluate the effectiveness of electrolyzed water in reduction of microbial contaminants in fresh vegetables (white cabbage and lemon basil) by washing treatment. The analyses was done through conventional and molecular approaches.

**Material and Method**

In our experiment, we used two commodities, white cabbage and lemon basil. As for washing, we use two types of Electrolyzed water, the acidic and the reduced water. At the preliminary experiment we examined the duration of washing that gives the optimum reduction of microorganism levels. Here we found that 4 minutes is the optimum duration of washing, where the proportion between commodity and the water is 1 in 20. In our experiment, we make sure that the microbial we isolated were really from the commodity and the water only not from other sources. At the moment, the microbial analysis based on DNA molecular is not completely done yet.


**Results**

| Vegetable samples | Microbial density reduction (log CFU/g) after washing in EAW for 5 minutes | Microbial density reduction (log CFU/g) after washing in ERW for 5 minutes |
|---|---|---|
| White cabbage | 6.34 ± 0.49 → 1.59 ± 0.23 | 6.34 ± 0.49 → 2.26 ± 0.61 |
| Lemon basil | 6.46 ± 0.14 → 1.46 ± 0.50 | 6.46 ± 0.14 → 2.31 ± 0.87 |




**Discussion**

Washing effectiveness in removing dirt and microorganisms depend on several factors, one of which is the characteristics of foodstuffs. White cabbage has different characteristic compare to lemon basil, especially in term of their surface. Otherwise the data of our research showed that the reduction level of microorganisms after washing treatment using electrolyzed waters were comparable. Further, Electrolyzed Acidic Water (EAW) showed higher antibacterial activities than Electrolyzed Reduced Water (ERW).

Antibacterial activity might have something to do with the degree of acidity (pH). Several research had proven that washing food by using water with a degree of acidity (pH) produced different different effectiveness. Neutral water has pH 6-7, while the range of acid water is from pH 2.4 to 3, and alkaline water is in the pH 9 -11(Okull & Laborde,

2004; Loi- Braden et al., 2005; Rahman et al., 2010). Although acid condition has strong relationship with antibacterial activity, still there are several genus of bacteria able to deal with the low pH.

The sanitizing characteristics might relate to the high oxidation of the water. The oxidative ions can damage bacterial cell walls, allowing infiltration by water. The microbe reaches capacity, causing an osmotic, or hydration, overload. The acidic fluid and water floods the cell more rapidly than the cell can expel it, literally causing the cell to burst (Powitz, 2010).

**Conclusion**

- Electrolyzed Acidic Water (EAW) is significantly more effective than Electrolyzed Reduced Water (ERW) in term of its antimicrobial activity.
- EAW was able to reduce the microbial density in white cabbage and lemon basil, with the reduction of 4.75 and 5.00 log CFU/g respectively.
- The recommended washing time is at least 4 minutes.

**Fakultas Teknologi Pertanian**
**Program Studi Teknologi Pangan**
Jl. Pawiyatan Luhur IV/1 Bendan Duwur Semarang 50234
Telp. (024) 8441555 ,8505003(hunting) Fax.(024) 8415429 - 8445265
e-mail:unika@unika.ac.id http://www.unika.ac.id

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