Electrolyzed Water:
Eco-innovative solution for the Farming, Agro Food and Water Industry
Electrolyzed Water (EW)

- EW is an **universal biocide** eliminating all kind of virus, bacteria, fungus, spores, algae, mold
- 100% **biodegradable and harmless** for Human and Environment
- Ecological and cost-effective alternative to traditional disinfection methods: **70-80 times more efficient than chlorination**/sodium hypochlorite (Culp/Wesner/Culp, 1986)
Electrolyzed Water (EW)

- **One of the most efficient biocide known today (OMS)**
  - Main active molecule: HOCl (Hypoclourous Acid)
  - Can be used in all stages of disinfection and cleaning
  - Fast acting (log8 reduction of E. Coli in 10sec)
  - Eliminate biofilm & legionella
  - Microorganisms do not create resistance (>10 years testing)

- **Non toxic** to humans, animals and environment
  - Can be safely dispose of in sewage systems in its pure form
  - Hypoallergenic, do not require special handling
  - No toxic by-products (chloramine, trihalomethane, etc.)

- Can be used in different forms: **liquid, ice, aerosol (fog)**

- **In-situ production** from water, salt (5g NaCl) and electricity (15W/L) using electrolysis principles
  - Eliminate handling and storage of dangerous chemicals
  - Production cost: <0.02€/L (in Western Europe)
  - Usage at small dosis: 0,1 - 5% for water disinfection
  - Excellent Return on Investment

*Salmonella enteritidis*

*Escherichia coli.*
EW - Characteristics

3 solutions can be produced out of the **unique and patented electrolysis cell** thanks to its permeable membrane and high quality rare materials of the Anode and Cathode:

- **Acidic Anolyte (A)**
  - Active Chlorine mg/l = 500 - 700 ppm // pH = 2,0 - 3,5
  - ORP (Reduction potential) = 1.000 – 1.200 mV
  - **Disinfectant, sterilizer, fast acting**
    Used whenever pH is unimportant (no danger of corrosion)

- **Catholyte (K)**
  - Active Chlorine mg/l = 0 ppm // pH = 11,0 - 13,0
  - ORP (Reduction potential) = -800 – -900 mV
  - **Alkaline solution, excellent washing liquid, plus it removes heavy metals from water through precipitation.**

- **Neutral Anolyte (ANK)**
  - Active Chlorine mg/l = 500 - 700 ppm // pH = 5,0 - 8,5
  - ORP (Reduction potential) = 700 – 900 mV
  - **Disinfectant, sterilizer**
    Used wherever pH is important (e.g. corrosion)
EW - Characteristics

Electrolyzed Water technology should not be confused with standard electrolysis which only produces sodium hypochlorite which is much less effective and more toxic:
EW: a natural phenomenon

EW is an example of **Biomimetics** science (imitation of the models, systems, and elements of nature for the purpose of solving complex human problems)

**EW mimics the human immune system**
- Produce the same acting agent (HOCL, Hypochlorous acid) than the white blood cells (Neutrophil) when the body comes under attack from invading pathogen

**EW replicate the solution formed at the surface of ocean when lightning occurs**

**EW is produced using **natural and renewable** elements: Water + Salt**
- Highly stable solution: less toxic by-products
- 100% Biodegradable (return to its original form of Water + Salt)
Microbiological efficiency of EW

<table>
<thead>
<tr>
<th>Laboratory Suspension Tests</th>
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<tbody>
<tr>
<td><strong>Sporicidal Activity</strong></td>
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<tr>
<td><em>B. subtilis var niger</em></td>
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<tr>
<td><strong>Bactericidal Activity</strong></td>
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<tr>
<td><em>E. coli 0157</em></td>
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<tr>
<td><strong>Helicobacter pylori</strong></td>
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<tr>
<td><strong>Pseudomonas aeruginosa</strong></td>
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<tr>
<td><strong>Enterococcus faecalis</strong></td>
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<tr>
<td><strong>Fungicidal Activity</strong></td>
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<tr>
<td><em>Aspergillus niger</em></td>
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<td><strong>Candida albicans</strong></td>
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<td><strong>Virucidal Activity</strong></td>
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<tr>
<td><em>Poliovirus Type 2</em></td>
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<tr>
<td><em>Duck Hepatitis B</em></td>
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<td><em>HIV 1</em></td>
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I Germicidal Activity

The germicidal activity of the Anolyte has been proven against the sensitivity of the *Escheria coli*, *auruginosa Pseudomonas*, *Salmonella* spp. and *Legionella pneumophila* serogroup1 stocks that are important pathogens.

Description of the study. The objective of this study is to confirm the germicidal activity of the Anolyte. For it part of one bottle of 20 litres of concentrated Anolyte that has a residual chlorine superior to 500 mg/L. Using water distilled previously sterilised a dilution of 1:1000 of the sample is made. From this form we obtain the sample that is going to be study object. Before coming to the study, one analyses pH (8), residual chlorine (0.7 mg/L) and the potential redox (825 mV) of the sample. Also an analysis of bacteria is made to 37 °C to make sure the total absence of growth before coming to the inoculation of microorganisms.

The results summary in the Table 1 and Table 2.

### Table 1. Germicidal effect of Neutral Anolyte Dilution 1:1000

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Concentration</th>
<th>1 min</th>
<th>5 min</th>
<th>10 min</th>
<th>30 min</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Escheria coli</em></td>
<td>1.5 x 10⁵</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Salmonella</em> spp.</td>
<td>1.3 x 10⁵</td>
<td>NEG</td>
<td>NEG</td>
<td>NEG</td>
<td>NEG</td>
</tr>
<tr>
<td><em>Bacteria</em> heterótrofas</td>
<td>&lt;1</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
</tbody>
</table>
Applications – Agriculture

1. Agriculture (crops):

Application of Electrolyzed Water:
- Soak seeds in 2 solutions: 50% Anolyte with water and 100% Catholyte
- Dose 0.1-1% Anolyte into irrigation system
- Crop pulverization with 30-50% Anolyte with water
- Dose 0.5-3% Anolyte for wastewater treatment

Benefits:
- Disinfect seeds, improve germination rate and yield
- Disinfect irrigation water
  - Increase crops health and growth, **improve yield/ha**
  - Final product is bigger and better quality
  - Reduce irrigation system maintenance (no need for shock treatment, the irrigation system stays in optimal condition)
- **Reduce water needs of the crops**
Applications – Agriculture

1. Agriculture (crops):

Benefits:

- Opportunity as tertiary treatment to reuse municipal sewage for irrigation (removes heavy metals and biological contamination)
- Disinfect grain and seeds for storage
- **Preserves fodder/silage**, reduce fermentation processes
- Reduce/replace phytosanitary treatments
- **Suppresses pathogens and fungi** on plants
- Helps in soil disinfection
- Reduce production costs and **increase farmers’ profits**
Scientific Publications - Agriculture

- Inactivation of Escherichia coli O157:H7, Salmonella enteritidis and Listeria monocytogenes on the surface of tomatoes by neutral electrolyzed water - Deza MA, Araujo M et Al. - Institute of Food Research and Analysis, University of Santiago de Compostela, Santiago de Compostela, Spain

- Reduction of Salmonella enterica on alfalfa seeds with acidic electrolyzed oxidizing water and enhanced uptake of acidic electrolyzed oxidizing water into seeds by gas exchange - Stan SD, Daeschel MA - Department of Food Science and Technology, Oregon State University, 100 Wiegand Hall, Corvallis, Oregon 97331-8575, USA.

- Effectiveness of electrolyzed acidic water in killing Escherichia coli O157:H7, Salmonella enteritidis, and Listeria monocytogenes on the surfaces of tomatoes - Bari ML, Sabina Y, Isobe S, Uemura T, Isshiki K - Food Hygiene Laboratory, National Food Research Institute Food Technology Division, Kannondai-2-1-12, Tsukuba, 305-8642, Japan

- Efficacy of acidic electrolyzed water ice for pathogen control on lettuce - Koseki S, Isobe S, Itoh K - Food Processing Laboratory, National Food Research Institute, 2-1-12 Kannondai, Tsukuba 305-8642, Japan

- Treatment of Escherichia coli O157:H7 inoculated alfalfa seeds and sprouts with electrolyzed oxidizing water - Sharma RR, Demirci A - Department of Agricultural and Biological Engineering, Pennsylvania State University, University Park, PA 16802, USA

- Effects of chlorine and pH on efficacy of electrolyzed water for inactivating Escherichia coli O157:H7 and Listeria monocytogenes - Park H, Hung YC, Chung D - Department of Food Science and Technology, College of Agricultural and Environmental Sciences, University of Georgia, Griffin, GA 30223 1797, USA.
Applications – Animal farming

2. Poultry farming:

Application of Electrolyzed Water:
- Dose 1-3% Anolyte into drinking water system
- Spray and fog batteries, pens, sheds, barns and stables with 30% Anolyte with Water
- Local application for general disinfection with 20% Anolyte with water

Benefits:
- **Increase yields:**
  - Shorter cycles, better indexes
- **Better eggs quality:**
  - More resistant, better quality of the shell
  - Bigger (5-6g/egg average increase). more homogeneous and less dirty eggs
  - Durability increase (eliminate Staphylococcus)
2. Poultry farming:

- **lower mortality rate** (at least 50%):
  - Animal are more resistant and healthier
  - **Reduction of antibiotics and drugs** use
  - Direct effect on digestion: better uptake of nutrients, reduction of feed consumption
  - Less digestive and respiratory diseases
  - Drier faeces
  - Most effective disinfectant in eliminating Avian Influenza Virus (H5N1)
  - Highly effective against salmonella, Coccidiosis, E. Coli, legionella, etc.
- Treat waste and remove odors
- **Excellent ROI: 1-1.5 year**
  - Reduction of variable costs (up to 3 times less)
  - Easy installation, low maintenance
  - Visible improvements in 1-2 weeks
4. Pig farming:

Application of Electrolyzed Water:
- Dose 1-3% Anolyte into feeding system
- Spray and fog barns and stables with 30% Anolyte with Water
- Local application directly on animals with 50-100% Anolyte

Benefits:
- Maternity
  - Less involuntary abortions and more deliveries
  - Better production of piglet
  - Higher vitality of piglets after separation
  - Better milk flow
Applications – Animal farming

4. Pig farming:

- **Lower mortality rate**
  - Better nutrient intake, reduccion of feed consumption
  - More weight of the animal, shorter cycles, higher indexes
  - Less digestives and respiratory diseases
  - Disolves enterotoxins
  - Animals are healthier, with higher vitality and resistance
  - **Reduction of antibiotics and drugs use**

- **Excellent ROI: < 1 year**
  - Reduction of variable costs (2-3 times less)
  - Easy installation, low maintenance
  - Visible improvements in 1-2 weeks
Applications – Animal farming

3. Dairy farming:

- General disinfection of the barn
- Surface cleaning and misting medium for aerobic and anaerobic bacteria
- **Fodder assimilation increase**
- Less involuntary abortions and more deliveries
- Promotion of general health as a drinking water additive, reduced mortality
- Pest control on the skin
- **Improve feed assimilation** of animals, reduce enteric fermentation
- **Shorter cycles, higher indexes**
- Aerobic and anaerobic bacteria control through misting
- Equipment cleaning without further additives
- Disease control and cure
- **Increase milk quality and quantity**
- **Reduction of antibiotic and drugs** use (at least 50%)
5. Fisheries and Shrimp farming

- Better survival rate at all phases of shrimp farming (hatcheries, etc.): from 20-30% up to 60-100%

- **Better yield**: from 2-3 tons per pond up to 5-7 tons
  - Shorter growth cycle: from 120-160 days to 70 days
  - Extra yield per year due to the shorter growth cycle

- Better feed conversion rate

- Better quality of the water, control of Ph of the water and algae growth
  - **Total abolition of the use of antibiotics**
  - Effective control of viral and bacterial diseases in the grow out phase of shrimp farming
  - Shrimps with healthy look and even in sizes as a result of all above listed improvements
Scientific Publications

- The effect of electrolyzed oxidative water applied using electrostatic spraying on pathogenic and indicator bacteria on the surface of eggs - Russell SM. - Department of Poultry Science, Poultry Science Bldg., The University of Georgia, Athens, Georgia

- Comparison of electrolyzed oxidizing water with various antimicrobial interventions to reduce Salmonella species on poultry - Fabrizio KA, Sharma RR et Al. - Department of Food Science, The Pennsylvania State University

- The Anti-microbial Activity of Electrolysed Oxidizing Water against Microorganisms relevant in Veterinary Medicine - Institute of Veterinary Bacteriology, Vetsuisse-Faculty University of Zurtich, Winterthurerstrasse, Zurich, Switzerland

- Modern methods ensuring sanitary-veterinary protection for animal farms, based on using of electrolyzed water - I. SURDU1, IOANA VĂTUIU et Al. - Microbian Biotechnological Center Bucharest

- Antimicrobial effect of electrolyzed water for inactivating Campylobacter jejuni during poultry washing - Park H, Hung YC et Al. - Department of Food Science and Technology College of Agricultural and Environmental Sciences, University of Georgia
Applications – Food Industry

6. Food processing:
- Disinfection of incoming and rinse water
- **Prolongs the shelf life** of vegetables, fruit and cut flowers
- Disinfection of all surfaces in the production process
- Equipment cleaning without further additives
- General disinfection, control of fungi growth in the premises
- **Clean-in-place** (CIP) cleaning and disinfection
- Disinfection of various produce before packaging

7. Beverage and breweries:
- Treatment of incoming water and brewing water
- Disinfection of all surfaces in the production process
- Bottle **cold washing and sterilizing**
- Filling plants, pumps, filters, reservoirs, water tanks, wells
- Rinsing of installations
- Disinfection of all installations, pipelines, working cloths etc.
- Pipeline protection, cooling installations, air cleaning systems
- **Water and energy savings up to 60%**
Decontamination of lettuce using acidic electrolyzed water - Koseki S, Yoshida K, Isobe S, Itoh K - Graduate School of Agricultural Science, Hokkaido University, Sapporo, Japan

Inactivation of Escherichia coli O157:H7, Salmonella enteritidis and Listeria monocytogenes on the surface of tomatoes by neutral electrolyzed water - Deza MA, Araujo M et Al. - Institute of Food Research and Analysis, University of Santiago de Compostela, Santiago de Compostela, Spain

Efficacy of acidic electrolyzed water for microbial decontamination of cucumbers and strawberries - Koseki S, Yoshida K, Isobe S, Itoh K - Food Processing Laboratory, National Food Research Institute, 2-1-12 Kannondai, Tsukuba 305-8642, Japan

Enhancing the bactericidal effect of electrolyzed water on Listeria monocytogenes biofilms formed on stainless steel - Ayebah B, Hung YC, Frank JF - Department of Food Science and Technology, University of Georgia, 1109 Experiment Street, Griffin, Georgia 30223, USA.

Efficacy of electrolyzed water in the prevention and removal of fecal material attachment and its microbicidal effectiveness during simulated industrial poultry processing - Kim C, Hung YC, Russell SM - Department of Food Science and Technology, College of Agricultural and Environmental Sciences, University of Georgia, Griffin, Georgia 30223-1797, USA.

Effects of chlorine and pH on efficacy of electrolyzed water for inactivating Escherichia coli O157:H7 and Listeria monocytogenes - Park H, Hung YC, Chung D - Department of Food Science and Technology, College of Agricultural and Environmental Sciences, University of Georgia, Griffin, GA 30223 1797, USA.
8. Potable Water and Wastewater Treatment:

- Approved for use as a disinfecting agent for drinking water and municipal effluent
- **Remove unpleasant smell and taste** associated with conventional chlorine based water treatment
- No formation of toxic by-product (chloramine, trihalomethane)
- **Eliminate biofilm and algae** of the water network (hypochlorite does not)
- Pipes does not need rinsing after disinfecting (EW is non toxic)
- Effective biocide at low dosage (av. 10 times lower than chlorination) **including Legionella**
- Neutralization and flocculates **heavy metals**
- Wide product range: can be apply for a small village up to several millions habitant city
- Lower maintenance and risk management costs
- On-site and on-demand production
9. Healthcare:

- **Cold sterilization** of medical instruments
- Cleans surfaces, including walls, furniture and floors
- Produces sterile water
- Used in the laundry, it disinfects linen
- **Disinfects air through misting**
- Eliminates/reduces chemical usage
- Highly effective for wound, burn care and skin infection
- **Microorganisms do not create resistance** (> 10 years testing)
- Technology used in 90% of Russian hospitals
- Limit the spread of infectious disease including M. tuberculosis, MRSA, E.coli, Norovirus, Avian Influenza, HIV, Polio Virus, Helicobacter pylori, and Legionella
Other Applications

10. Swimming pools
11. Industrial cleaning and disinfection
12. Cooling Towers
13. Water Systems
14. Ferry boats
15. Hotels
16. Oil and Gas industry
EW – available units

- A wide range of capacity to meet customer’s need: from 20 LPH to 4000 LPH
- Over 6,000 installations in more than 55 countries
Certifications

- Approved and regulated by the **ECHA** (European Chemical Agency) as:
  - Product-type 1: Human hygiene
  - Product-type 2: Disinfectants and algaecides not intended for direct application to humans or animals
  - Product-type 3: Veterinary hygiene
  - Product-type 4: Food and feed area
  - Product-type 5: Drinking water

- **CE** – European Conformity

- **NSF International** – Tested and approved quality NSF

- **ISO9001**

- Recognized by **WHO** (World Health Organization) as one of the most efficient biocide known today

- Regulated and approved in USA by **EPA** (Environment Protection Agency) and **FDA** (Food and Drug Agency)
Thank you for your attention and we hope this was a useful information to you

Feel free to contact us:

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