"MODERN METHODS ENSSURING SANITARY-VETERINARY PROTECTION FOR ANIMAL FARMS, BASED ON USING OF ELECTROLYZED WATER"

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ABSTRACT

The bacteriological parameters of water stand as indices for the status of digestive microflora in poultry and for faecal contamination. The term refers at total coliformes, termophilic coliformes (especially E. coli), and streptococci. A great variety of studies and reports regarding infectious diseases evidenced water as an important pathogenic carrier, like ***Staphylococcus, Streptococcus, E. coli, Cryptosporidium, Giardia Lamblia, Listeria and Legionella*** *– bacteria that causes the so-called legionary disease. Bacterial contaminants can be found inside biofilms formed around living premises and water distribution systems. Biofilms are microorganisms layers, contained in a matrix formed at water contact on different surfaces.*
Studies based on electrochemical activated substances developed a clean substance, known as hypocloric acid (HOCl). The technical designation for HOCl in solution is neutral electrolyzed water (ANK). ANK has become the most important disinfecting solution for pathogens carried in water and in the distribution systems. Three samples of electrolyzed water were obtained using the Envirolyte EL 400 instrument, showing the subsequent characteristics: Sample 1 – Neutral Anolite ANK, pH=7,3; ORP (redox potential)=796,4 mV; Active Chlorine 400 mg/l. Sample 2 – Neutral Anolite ANK, pH=7,8; ORP (redox potential)=743 mV; Active Chlorine 500 mg/l. Sample 3 Catholite, pH=11,2-11,3; ORP (redox potential)= - 865 mV. Microbiological content was determined in the first stage for all three electrolyzed water samples, as follows: Total number of germs / ml and Total Coliformes / 100 ml. In the second stage, the activity of the electrolyzed water was determined over Total number of germs / ml and Total Coliformes / 100 ml, over a water sample with : Total number of germs / ml = 2,0 x 10^3 ; Total Coliformes / 100 ml= 16. Electrolyzed water had the following effects: sample 1 significantly reduced Total number of germs from 2000 / ml to 100 / ml; sample 2 reduced even more Total number of germs from 2000 / ml to 40 / ml. Both samples of electrolyzed water showed a bactericidal effect over Total Coliformes. All these results obtained in the preliminary experiments, suggest the idea that electrolyzed water could be useful in controlling microorganisms from: water, forages, poultry premises, eggshells, etc.

Key words: electrolyzed water, Neutral Anolite ANK, bactericidal effect, electrochemically activated substances

INTRODUCTION

Unipolar (anode or cathode) ElectroChemical Activation (ECA) for a diluted saline solution resides on applying a high voltage continuous current (104-106 V/cm) to the electrodes. ECA leads to obtaining activated solutions, rather than concentrated chemical substances. Those are slightly mineralized, meta-stable status activated solutions for a determined period, e.g. relaxing time. Activated solutions must be used right after they were obtained, undiluted.
The principle of ECA is shown in figure 1:

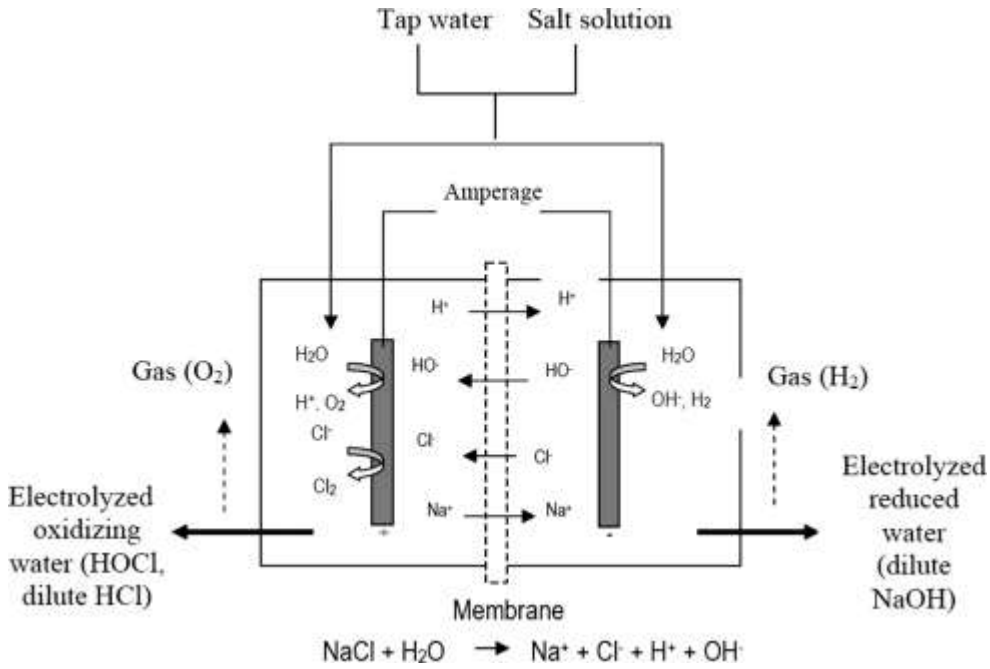

Fig. 1. Description of ElectroChemical Activation (ECA)

ECA reactions and processes can be described as follows: negatively charged ions Cl^-, OH^- in the diluted salt solution move to the anode to give up electrons and become O_2, Cl_2, ClO^-, HClO, HCl, while positively charged ions such as H^+, Na^+ move to the cathode to take up electrons and become H_2 and NaOH.
As a result, two types of water are produced simultaneously:

- electrolyzed oxidant (EO) water / Anolite (A), with low pH (2.3–2.7), high oxidation–reduction potential (ORP) >1000 mV (1150 +- 50 mV), high dissolved oxygen and contains free chlorine (concentration depends on the EO water machine setting): 50-600 mg/l is produced from anode side.
- electrolyzed reduced (ER) water, with high pH (9-12), low ORP (−800 to −900 mV), high dissolved hydrogen is produced from the cathode side.

Anolite and catholite are clear / transparent liquids; for catholite, a small sediment can be observed. Reducing solution (catholite) shows the same structural changes for more

than 10 hours, as being an electron donor. Anolite (anodic solution) shows oxidative characteristics, as an electron acceptor.

Factors influencing the characteristics of electrochemically activated solutions:

1. Basic groups at cathode (catholite) and acidic groups at anode (anolite). Their concentration is proportional with the mineralization degree for water and with the electric potential applied to the electrodes on ECA.
2. Meta-stable, super-active compounds, with large capacity of oxidation (anolite) and reduction (catholite). These are gradually passing to a stable status, because of a spontaneous, structural (chemical and energetic) conversion. They are supposed to support the oxidative and reducing character for both solution obtained at electrodes.
3. "Gas-liquid" interface, created by the gaseous micro-bubbles resulted from electrolysis and stabilized by electrical uncompensated charges. This interface represents an electrical and chemical active component in the activated solution.

MATERIALS AND METHODS

Three samples of electrolyzed water have been obtained using the Envirolyte EL 400 instrument, showing the subsequent characteristics:

Sample 1 – Neutral Anolite ANK

- pH=7,3;
- ORP (redox potential)=796,4mV;
- Active Chlorine = 400mg/l.

Sample 2 – Neutral Anolite ANK

- pH=7,8;
- ORP (redox potential)=743mV;
- Active Chlorine = 500mg/l.

Sample 3 – Catholite

- pH=11,2-11,3;
- ORP (redox potential) = - 865mV.

pH and ORP measurements have been performed with YSI Professional Plus instrument.

Active Chlorine measurements have been performed accordingly to the Envirolyte procedure, as follows:

Method: *Iodine titration*
Protocol:
Anolite Solution: 10 ml
H_2SO_4 1N: 50 ml

KI: few crystals

Titration with $Na_2S_2O_3$ x 5 H_2O solution 0.1 N

Calculus of active chlorine, as concentration

Table nr. 1

Volume solution $Na_2S_2O_3$ x 5 H_2O for titration (ml)	**Active chlorine concentration (mg/l)**
0,58	200
0,85	300
1,40	500
2,00	700
2,10	750
2,25	800
2,40	850
2,50	900
3,00	1065
3,50	1240
4,00	1420

Microbiological test have been performed in 2 stages:

A. Microbiological content was determined in the first stage for all three electrolyzed water samples, as follows: Total number of germs / ml and Total Coliformes / 100 ml.

Results are given in the Table nr.2:

Table nr. 2

Sample	Total number of germs / ml	Total Coliformes / 100 ml
1	absent	absent
2	absent	absent
3	$1,0 \times 10^2$	16

B. In the second stage, the activity of the electrolyzed water was determined for Total number of germs / ml and Total Coliformes / 100 ml, over a water sample with :

- Total number of germs / ml= $2,0 \times 10^3$;
- Total Coliformes / 100 ml= 16

In order to determine the effect of electrolyzed water towards the microbiological content, normal water (high content of microorganisms) was treated with electrolyzed water on different concentrations:

1. Witness (normal water) + electrolyzed water 1 % (sample 1; ANK - active chlorine 400 mg/l), time of contact 15';
2. Witness (normal water) + electrolyzed water 2 % (sample 2; ANK - active chlorine 500 mg/l), time of contact 15';
3. Witness (normal water) + electrolyzed water 3 % (sample 3; catholite), time of contact 15';

After 15' of contact, the solutions have been transferred on double concentrate Lauryl sulphate in order to determine Total Coliformes, and on nutritional Agar to determine mesofilic aerobic Bacteria.

The samples have been incubated for 48 h, at 37^0C.

RESULTS AND DISCUTIONS

Table nr. 3

	Total number of germs / ml	**Total Coliformes / 100 ml**
	Time	**Time**
	15 '	**15 '**
Witness sample (well water)	$2,0 \times 10^3$	16
Sample 1 (witness + ANK) **1%**	100	absent
Sample 2 (witness + ANK) **2%**	40	absent
Sample 3 (witness + Catholite) **3%**	$2,0 \times 10^3$	16

CONCLUSIONS

Electrolyzed water had the following effects:

1. **sample 1** significantly reduced *Total number of germs* from 2000 / ml to 100 / ml;
2. **sample 2** reduced even more *Total number of germs* from 2000 / ml to 40 / ml.

Both samples of electrolyzed water showed a bactericidal effect over Total Coliformes on the witness sample.

All these results obtained in the preliminary experiments, suggest the idea that electrolyzed water could be useful in controlling microorganisms from: water, forages, poultry premises, eggshells, etc.

Sodium hypochlorite is less and less used as a micro-biocide for water, due to the safety issues regarding the environment and to the general impact.

The technological process regarding synthesis of the electrochemical activated solutions (anolite, catholite, neutral anolite) specific for the zootechnical field, belongs to the category of complexity 0-1: "Synthesis of electrochemically activated sterilizing, detergent and disinfecting solutions of A, K, ANK types, with the rate of mineralization from 2.5 to 5 g/l and technologies of their practical use".

In poultry farms, electrolyzed water can be used for:

1. Disinfecting the poultry yard with anolite solution. A simple washing of the surfaces can be made or a sprayer can be used. Studies have shown that the second idea is more efficiently, especially in case of large surfaces. Medium can be kept aseptically for 8-10 days. There is no need to relocate the poultry, because the solution is not toxic. pH for the anolite solution has to be around 2 units. The procedure has to be regularly repeated.
2. Fresh eggs treatment. It is advisable to wash or to immerse them into anolite water for 2 minutes, then to let them dry. The anolite destroys Staphylococcus located on eggs surface, thus prolonging their conservation time. pH for the solution has to be sited between 2.5 and 3.5.
3. Treatment for intestinal troubles (diarrhea) in poultry. Anolite solution - pH=4.5 can be used for drinking, food preparation or as a spraying solution for poultry (chicken, ducks, gees) manifesting this kind of troubles. Reestablishing can be seen in several hours to one day maximum.

4. Growth and metabolic development. Neutral anolite (ANK) solution of low concentration: 1.5 % - 2.5 %, pH=7.5-8.5, ORP 700 – 900 mV and active chlorine 500 – 700 mg/l can be used as drinking water and to spray the poultry, or the less developed ones. Studies performed indicated that for a correct use of ANK, the mortality is reduced with 40 %, poultry becoming thus more resistant to various diseases. In order to reduce the pathogenic content in forages, a spraying with ANK solution can be also done.

Due to its physical and chemical properties, the electrolyzed water shows similarly characteristics to liquids from living organisms (blood, lymph, intercellular liquids). Electrolyzed water used in farm animals as disinfecting / sterilizing or biological active substance shows the below mentioned advantages:

- the requirements for materials and disinfection equipments are reduced.
- the production costs are dropping.
- the zootechnic productivity increases.

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