UDC 615.28:511.13+546.711

The study of bactericidal effectiveness of neutral anolyte in combination with potassium permanganate

Aliev AA[2],
Shapiev BI[1],
Shapieva KB[1],
Atalaev MM[1],
Ismailov IM[1],
Kanbulatova ZS[3].

[1]Dagestan State Medical University, Makhachkala, Russia;
[2]Dagestan State Agrarian University, Makhachkala, Russia;
[3]The Republican center for gifted children Lyceum №9, Makhachkala, Russia

Objective. Study of the combined use of electrochemically activated solution of sodium chloride with potassium permanganate and develop modes of disinfection of various objects and objects of medical and veterinary purposes.
Materials and methods. There was conducted research by conventional methods in semi-production conditions by separated and combined use of electrochemically active-neutral anolyte (ca. 0.1 mg / l) with potassium permanganate.As a test microorganism was used a suspension of cultures of strains (E. coli, strain 1257, golden streptococcus, strain 209p), the test object (coarse calico) was without protein protection.
Results. Neutral anolyte with chlorine activity of 0.1 mg / ml in combination with potassium permanganate in various dilutions (1: 2000; 1: 2500; 1: 3000 and 1: 4000) disinfects all the binding objects at various exposures.Neutral anolyte with chlorine activity 0.1 mg / ml without manganic acid potassium combination showed a disinfecting effect quoad E. Coli in exposures of 15 and 20 minutes, and - St. Aureus This effect appears at a 20-minute exposure.Potassium permanganate in dilution with distilled water at a dilution of 1: 4000 did not show any bactericidal activity against the above-mentioned sanitary-indicative microorganisms.
Cunclusion. The results of the study allow recommendingelectrochemically active-neutral anolyte in combination with potassium permanganate for implementation into medical and veterinary practice in order to disinfect and deodorize the premises of hospitals, clinics, and also objects of veterinary supervision.

Keywords:
salicylic turpentine-chlorine-lime suspension, ECA - neutral anolyte, disinfection, disinsection and desaccharization of premises

For correspondence: Bammatgerey I. Shamiev **-** Ph.D. (Chemistry), Research Institute of Ecological Medicine, Dagestan State Medical University, Russian Federation
For citation: Aliev AA, Shapiev BI, Shapieva KB, Atalaev MM, Ismailov IM, Kanbulatova ZS. The Bactericidal efficiency of neutral anolyte in combination with the permanganate ka-ly. Environmental medicine 2018;1(1): 74-79. DOI: 10.34662/EM.2018.1.1.74-79
Translated from Ecologichtskaya Medicina. 2018. vol. 1, N. 1(1), pp.81-86.
Translated by Kakvaeva S.B.

In modern conditions of rapid development of industrial and agricultural production, one of the most important technical, ecological, biological, ecological, toxicological and social problems is environmental pollution: soil, air, natural water bodies, rivers, seas and oceans with chemicals, heavy metals, toxic gases , pathogenic microorganisms as a result of the activities of large state-owned agricultural enterprises.

Private industrial production facilities and farm animal and water and poultry farms also contribute to this problem. In addition to waste from various industries, the environment is poisoned by herbicides, pesticides, insecticides and other toxic chemicals, whose properties are subject to a number of stringent requirements.

In modern practical disinfectology, it is argued that ideal (and therefore promising)

chemical agents, along with high disinfectant activity and some other properties, should have long shelf life, but at the same time ready to use without prior activation or mixing with other components, and should also be different environmental safety, minimum toxic effects on humans and ease of disposal of the treated solution. Long-term storage of a chemical agent is feasible with high chemical stability of the active substances, however, the disposal of a stable substance after use requires equivalent costs of other substances or energy.Thus, the combination of stability requirements with ease of disposal is impossible in principle. As for the requirement to exclude pre-activation before using the "ideal" chemical agent, it should be noted that the whole variety of trade marks of chemical disinfectants is built on the use of only a few classes of chemical compounds known to many dozens of years. The appearance of a new class of compounds that meet this requirement is unlikely. The general trend in the development of chemical disinfectants in recent years is not the creation of new disinfectants, but the search for ways to activate already known disinfectants, including chemical additives [7].

Thus, the activation of chemical disinfectants is aimed at the development of modes in which the minimum concentration of active ingredients provides a high disinfecting effect, and the corrosive or destructive activity in relation to the materials of the premises and facilities, as well as the toxic effect on humans become minimal. The exposure time, concentration, temperature and conditions of application of active substances are the most important requirements for the disinfection process and are the main parameters of any practical method [3, 4, 12].

It is known that the achievements of electrochemistry are widely used in various fields of the national economy. So, at present, industrial production of chlorine, sodium hypochlorite, hydrogen, caustic soda is carried out using electrolysis of concentrated solutions of common salt; Electrochemical conditioning of water (desalination, softening, cleaning) is significantly superior to all other methods in terms of speed, quality and economy.

The search for rational ways of practical realization of the potential of electrochemical processes led the young Soviet researcher V.M. Bahira (1987) to the discovery of electrochemically activated liquids, including water. Currently, the electrochemically activated-solutions of electrolytes (salts) are officially allowed by the Ministry of Health of the Russian Federation (1994) for use as sterilizing, disinfecting and detergents. As applied to the practice of veterinary sanitation, animal husbandry and poultry farming, studies of electrochemically activated water and chloride solutions almost simultaneously (1982-1983) were initiated at All-Russian research Institute of veterinary sanitation, hygiene and ecology and All-Russian research and technological Institute of poultry. The studies were carried out in close contact with chemists and engineers of Kazan national research technological University and ALL-RUSSIAN RESEARCH AND TESTING INSTITUTE OF MEDICAL EQUIPMENT. In subsequent years, a number of other research institutes (Izhevsk State Agricultural Academy, institutes of the meat and dairy industry) joined this problem.

An alternative to well-known and widely used disinfectants, both domestic and foreign, are electrochemically activated solutions of sodium chloride. The preparation of electrochemically activated solutions of various concentrations in "STEL"devices is based on the use of electrochemical activation of a low-concentration aqueous solution of sodium chloride in flow-through electrochemical modules by acting on a solution of an electric field of high intensity for a certain period. The electrochemical solutions synthesized upon activation — anolyte and catholyte — are characterized by pronounced oxidizing and reducing properties. In addition to these solutions, the neutral anolyte ANK is also synthesized.

This is a solution of a new type, which has a unique biocidal effect and combines simultaneously detergent, disinfecting and sterilizing properties [7]. The solutions obtained in the "STEL" installations destroy the causative agents of both bacterial and fungal etiology (Staphylococcus aureus, Pseudomonas pneumonia and intestinal pathogens, hepatitis B viruses, poliomyelitis, HIV, adenoviruses, tuberculosis pathogens, salmonellosis, dermatitis, and myocarditis. According to the results of the research, in its effectiveness, electrochemically activated solution of sodium chloride significantly exceed such known disinfectants as chloramine, sodium hypochlorite, etc. [3-5]

One of the main features of electrochemically activated solutions as highly effective disinfectants is their environmental harmlessness to the environment, thanks to the ability for spontaneous destruction without the formation of toxic chemical compounds [4, 5, 11].

In addition to the listed environmental, economic indicators of the use of electrochemically activated solutions of sodium chloride also indicate the prospects of this technology. Economic calculations have shown that the cost of 1 liter of ANK working solution, taking into account the period of depreciation of "STEL", is no more than 30 kopecks (in prices of 2000).

Installations "STEL" with virtually any performance (from 20 to 100 l / h) allow to obtain three types of solutions: alkaline catholyte (detergent), acid anolyte (disinfectant) and neutral anolyte ANK (detergent-disinfectant). Studies have shown that anolytes with certain physicochemical parameters have bactericidal, sporicidal and virucidal effects. Thus, ANK anolyte with pH 8, ORP +1000 mV and concentration of active chlorine 0.03-0.095% inactivates Escherichia coli, Golden Streptococcus, Pseudomonas bacillus, etc. in a bacterial suspension (in vitro) in 5-10 minutes, and on surfaces (de-Revo, metal, glass) - for 1.5-2.5 hours. When choosing methods and methods of disinfecting treatment of industrial premises, farm animals and birds, social effect is equally important. The ANK neutral anolyte is completely harmless to working personnel, animals, and the environment, since after exposure the object is disinfected, the anolite spontaneously collapses without the formation of toxic compounds and does not require neutralization [1, 2, 13-17].

Purpose: to study the issue of combined use of electrochemically activated sodium chloride solution with different physicochemical properties with known disinfectants and on this basis to develop effective means, modes and technology of disinfection of various objects and medical and veterinary objects destination**.**

Materials and methods

In the course of the work, studies were carried out by standard methods in semi-production conditions by the separate and combined use of electrochemical activated-neutral anolyte (ca. 0.1 mg / l) with manganese-oxidized potassium.

Suspension cultures of cultures of strains were used as test microorganisms (chick sticks, strain 1257, streptococcusaureus,strain 209p); the test was the calico without protein protection. Test - an object was contacted with 2 min. suspension of test cultures (E. coli, golden streptococcus). A suspension of microorganisms (E.Coli; St. Aureus) was prepared, after drying, they were immersed in electrochemical activated solutions of a neutral anolyte (ca. 0.1 mg / l) in combination with potassium permanganate in various dilutions - 1: 2000; 1: 3000; 1: 4000 and 1: 5000.

Results and its discussion

The results of the studies showed a high bactericidal efficiency of electrochemically activated solution of sodium chloride -neutral anolyte in combination with potassium permanganate at various dilutions of the solution and disinfection of the coarse test objects contaminated with 2 billion. suspension of test cultures (*E. coli, St. aureus*).

Table. The bactericidal efficacy of a neutral anolyte in combination with manganese-potassium in the disinfection of biazovyh test objects, kontamirovnnyh 2 billion. weigh test-cultures (E. coli, Staphylococcus aureus) at various dilutions and exposures

Object of research (suspension of microorganisms)	**Control (growth of colonies of microorganisms before treatment)**	**The growth of colonies of microorganisms after processing at various dilutions and exposures**											
		1:2000				1:2500				1:3500			
		5	10	15	20	5	10	15	20	5	10	15	20
E. coli	10000	-	-	-	-	-	-	-	-	-	-	-	-
St. aureus	10000	-	-	-	-	-	-	-	-	-	-	-	-

(Table continuation)

Object of research (suspension of microorganisms)	**Control (growth of colonies of microorganisms before treatment**	**The growth of colonies of microorganisms after processing at various dilutions and exposures**											
		1:4000				ECA - neutral anolyte (c.a.x.0,1mg / ml) without potassium permanganate				Potassium permanganate diluted with distilled water 1: 4000			
		5	10	15	20	5	10	15	20	5	10	15	20
E. coli	10000	-	-	-	-	+	+	-	-	+	+	+	+
St. aureus	10000	+	-	-	-	+	+	+	-	+	+	+	+

These tables show that a neutral anolyte with chlorine activity of 0.1 mg / ml in combination with potassium permanganate in various dilutions (respectively 1: 2000; 1: 2500; 1: 3000 and 1: 4000) at various exposures disinfects the binding objects completely, i.e. disinfection efficiency 100%. Neutral anolyte with chlorine activity 0.1 mg / ml without combination with potassium permanganate showed a disinfecting effect on E. Coli at 15 and 20 minutes, and for St. aureus this effect manifested itself after a 20-minute exposure. Potassium permanganate in dilution with distilled water in a ratio of 1: 4000 did not show any bactericidal activity against the above-mentioned sanitary-indicative microorganisms.

Conclusion

Thus, we found that a neutral anolyte with chlorine activity of 0.1 mg / ml in combination with potassium permanganate at a dilution of 1: 1000; 1: 2500; 1: 3500 and 1: 4000, by-test test objects without protein protection completely disinfect, i.e. disinfection efficiency is achieved 100%.

The obtained research results allow us to recommend electrochemical activated-neutral anolyte in combination with potassium permanganate for introduction into medical and veterinary practice for the purpose of disinfection and deodorization of hospitals, outpatient clinics, and objects of veterinary supervision.

Financing and Conflict of Interest Information

The authors declare the absence of overt and potential conflicts of interest related to the publication of this article.

The search and analytical work on the preparation of the manuscript was carried out on the personal funds of the authors.

Participation of the authors: the concept and design of the research - Aliev A.A., Shapiev B.I .; collection and processing of materials - Aliyev A.A .; analysis of the data, writing the text, editing the text - Shapieva KB, Babaeva DP, Kanbulatova Z.Sh.

References

1. Bagamaev BM, Dorofeev VI. Effek-tivnost primeneniya elektroximicheski aktivirovannojvody prikozhnyxzabo-levaniyaxovecz [Efficiency of using electrochemically activated water in skin diseases of sheep]. *Trudy Kubansko gogosudarstvennogo agrarnogo universiteta* 2008;(14):170-173. (In Russ.).

2. Bagamaev BM, Simonov AN, Sklyarov SP, Taranuxa NI, Povetkin SN, Morozov VYu. Primenenie elektroximicheski aktivirovannoj (exa) vody pri der-matitax parazitarnoj etiologii u ovecz [The use of electrochemically activated (echo) water for dermatitis of parasitic etiology in sheep]. *VestnikAPKStavropolya* 2013;1(9): 123-125. (In Russ.).

3. Baxir VM. Mediko-texnicheskie sistemy i texnologii dlya sinteza elektroximicheski aktivirovannyxrastvorov [Medical-technical systems and technologies for the synthesis of electrochemically activated solutions]. M.: VNIIIMT, 1998. (In Russ.).

4. Baxir VM. Elektroximicheskaya aktivaciya i texnicheskie elektroximicheskie sistemy na osnove protochnyx elektro-ximicheskix modulnyx elementovPEM. Elektroximicheskaya aktivaciya. [Electrochemical activation and technical electrochemical systems based on PEM flow-through electrochemical modules. Electrochemical activation]. *Tezisydokladov i kratkie soobshheniya.* M., 1998. (In Russ.).

5. Buyanov VV, Nikolskaya VP, Kanishhev VVidr. *Sredstva dezinfekciidlya likvidacii posledstvij biologicheskogo zarazheniya pri razlichnyx temperaturax okruzhayushhej sredy* [Disinfection means for eliminating the consequences of biological contamination at various ambient temperatures]. Chernogolovka: Redakcionno-izdatelskij otdelI PXF. RAN. 2003, 277 s. (In Russ.).

6. Veterinarnaya sanitariya: Uchebnoe poso-bie [Veterinary Sanitation: Tutorial]. SPb.:Lan, 2011. 368 s. (In Russ.).

7. Vanner AA, Zakomyrdin AA. Vlazhnaya dezinfekciya poverxnostej pomeshhenij anolitomANK. [Wet disinfection of indoor surfaces by the anolyte ANK]. *Tretij mezhdunarodnyj simpozium. «Elektroximicheskaya aktivaciya v medicine, selskom xozyajstve, promyshlennosti». Moskva, 28-29 oktyab-rya 001 g. Doklady i kratkie soobshheniya.* Moskva: VNIIIMT, 2001. (In Russ.).

8. .Gorbunov VA, Titov LP, Ermakova TS. *Mnogocentrovoe issledovanie antibiotikorezistentnosti nozokomialnyx shtammov Pseudomonasaeruginosav RespublikeBelarus* [Multi-center study of the antibiotic resistance of nosocomial strains of Pseudomonas aeruginosa in the Republic of Belarus]. Minsk. Zdravooxranenie 2007;(1):28-29. (In Russ.).

9. Zakomyrdin AA, Vanner NE, Skvorczov FF, Bochenin YuI i dr. «O primenenii elektroximich-

eski aktivirovannyx ras-tvorov v veterinarii i zhivotnovod-stve» [«On the use of electrochemically activated solutions in veterinary medicine and animal breeding"]. *Vtoroj mezhdunarodnyj simpozi-um. Elektroximicheskaya aktivaciya. Tezi-sy dokladov i kratkie soobshheniya.* M., 1999. (In Russ.).
10. ZiborovaEA. Primenenie nejtralnogo anolita v komplekse veterinarno-sanitarnyx profilaktich-eskix meropri-yatij protiv kishechnyx infekcij novo-rozhdennyx telyat. [The use of neutral anolyte in the complex of veterinary and sanitary preventive measures against gut infections of newborn calves]. *Tretij mezhdunarod-nyj simpozium. «Elektroximicheskaya aktivaciya v medicine, selskom xozyaistve, promyshlennosti». Moskva, 28-29 oktyabrya 2001 g. Doklady i kratkie soobshheniya.* M.: VNIIIMT, 2001. (In Russ.).
11. Kavruk, Ziborova EA. Effektivnost primeneniya nejtralnogo anolita pri smetannoj kishechnoj infekcii novo-rozhdennyx telyat [The effectiveness of the use of a neutral anolyte when sour cream intestinal infection of newborn calves]. *Tretii mezhdunarod-nyi simpozium. «Elektroximicheskaya aktivaciya v medicine, selskom xozyaj-stve, promyshlennosti». Moskva, 28-29 oktyabrya 2001 g. Doklady i kratkie soobshheniya.* M.: VNIIIMT, 2001. (In Russ.).
12. Kudrya MI. Obezzarazhivayushhie svojstva novogo dezinfektanta dezyum [Disinfecting properties of new disinfectant disum]. *Veterinariya* 2011;(10):20-23. (In Russ.).
13. Kuzneczova LS. O mexanizme dejstviya poliguanidinovyx dezinfektantov [On the mechanism of action of poly-guanidine disinfectants]. *Myasnaya industriya* 2001;(4):52. (In Russ.).
14. Marasinskaya EI. «Vozmozhnosti i rezultativnost primeneniya elektroxi-micheski aktivirovannyx rastvorov v veterinarnoj praktike ["Possibilities and results of the use of electrochemically activated solutions in veterinary practice]. *Vtoroj mezhdunarodnyj simpozium. Elektroximicheskaya aktivaciya. Tezisy dokladov i kratkie soobshheniya.* Moskva, 1999. (In Russ.).
15. Novye materialy vmedicine [New materials in medicine]. *Materialy Vserossijskoj nauchno-prakticheskoj konferencii, aprel 2001 g. Izdvo Saratovskogo medicinskogo universiteta.* Saratov. 2001. (In Russ.).
16. Primenenie EXA- rastvorov dlya pro-filaktiki zabolevanij i lecheniya zhivotnyx [The use of ECA solutions for the prevention of diseases and treatment of animals]. *MinisterstvoSelskogo xozyaj-stva i Prodovolstviya Saratovsko joblasti Associaciya "Agrarnoeobrazova-nieinauka" GUNIIselskojgigieny MZRFOOO "Burservis".* Saratov, 2003. 5 s. (In Russ.).
17. Reybrouck G. The testing of disinfectants // Intern. *Biodeterioration and Biodegradation*. 1998; 41:269 -272.

Information about authors

Abdulgamid A. Aliev – Doctor of Biological Sciences, Dagestan State Agrarian University named after M.M. Dzhambulatov, Russian Federation;
Bammatgerey I. Shapiev – Candidate of Chemical Sciences, Associate Professor of Research Institute of Ecological Medicine, Dagestan State Medical University, Russian Federation;
Shamiyeva Kamilla Bammathereevna – neurologist of the Student Polyclinic of Makhachkala;
Murtuz M. Atalaev – Professor of the Surgical Dentistry and Maxillofacial Surgery with the improvement of doctorsDepartment, Deputy Dean of the Faculty of Stomatology Faculty, Dagestan State Medical University, Russian Federation;
Ismail A. Ismailov - Ph.D., Associate Professor of the General and Biological ChemistryDepartment, Dagestan State Medical University, Russian Federation;
Zumrud S. Kanbulatova – Biology Teacher of Lyceum No. 9 of the Republican Center for Gifted Children.