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Failure of Ionised Water Produced by Activeion Ionator to Kill Potential Harmful Bacteria

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Abstract

Objectives: The increasing global problem with spread of rather robust and resistant microbes, triggers the need of good hygienic routines concerning food, water and the environment.

Methods: A newly developed surface disinfection system; Activeion Ionator, convert tap water into activated water, which is intended to be used instead of chemical surface disinfectants. Electric charged water passed through an ion exchange membrane activates nano -bubbles that "breaks down dirt, lifts it from the surface, and enables is to be easily wiped away." In this study, the Activeion Ionator system was tried with ordinary tap water from the dealer's office. The water was sprayed through the electric charged system onto plates of agar media. After drying in air the plates were placed in incubation for 4 days at 37°C. This procedure was done repeatedly with different sources of tap water, and after disinfection of the system with 70% alcohol.

Results: A rich growth of one single species identified as most comparable with *Acidovorax delafieldii* in the Maldi-TOF system, was observed on all agar media sprayed with electric charged tap water. Eleven days later on, the study was repeated, using the same spray flask system and tap water from the hospital department. A rich growth of three types of Gram-negative bacteria, most comparable with *Acidovorax delafieldii, Acidovorax temperans* and *Brevundimonas aurantica,* was found in activated tap water taken from our department. After disinfection of the spray system with 70% alcohol and rinsing afterwards with tap water from our department, there was no growth at all on agar media sprayed with activated tap water.

Conclusion: Ionised water produced by the Activeion Ionator system does not kill tough, aquatic bacteria that may contaminate the system. The use of this system may increase the risk of spreading resistant, potential harmful bacteria to the surfaces and into the air. The control of different disinfection equipments for sale is important.

Introduction

There is a need for safe cleaning without the use of chemicals in households, restaurants, schools, day-care centres, nursing homes and hospitals. The regular use of chemical cleaners may be high [1]. Nearly all cleaning chemical labels contains human health warning and may be associated with allergic reactions and asthma. The Work-Related Asthma Prevention Program in California found that nearly 10% of all work-related asthma cases in California are caused by exposure to chemical cleaning products [1]. Many workplaces, like schools, hospitals, and restaurants are places where everyone, including children, can be affected by chemical cleaning products [1].

In the present study a new Activeion ionator EXP™ clame to clean as well or better than traditional cleaning chemicals and to kill 99.9% of harmful bacteria and virus, including the pandemic 2009 H1N1 influenza A virus, " in addition to protect 100% of your employees, customers and guests" [2]. This system is free of chemicals, and is used as a disinfectant in "food-processing plants and four-star restaurants" [2].

Activeion ionator EXP™ was presented by the Norwegian vendor to the Department of Hospital infections, Oslo University Hospital-Ulleval, Oslo. Since it was recommended for use in schools, day-care, nursing homes, cafeterias, food courts, restaurants, offices and so on, it was decided to test the system for ability to kill microbes.

Materials and Methods

Surface disinfection system

Activeion Ionator (Activeion, Europe GmbH Rutistrasse 3 CH-54 Baden, www.activeion.com) convert tap water into activated water that is sprayed by a kind of a spray flask on surfaces [2]. It is intended to be used instead of chemical surface disinfectants. A water cell applies an electric charge to tap water, which results in charged water that passes through an ion exchange membrane and is further changed to an "oxygen-rich mixture of positively and negatively charged nano-bubbles" [2]. The bubbles "breaks down dirt, lifts it from the surface, and enables is to be easily wiped away" [2].

How the system works

The Activeion Ionator spray flask is filled with tap water 5 Litre and sealed with a self-vented high-impact cap that holds the water. By a trigger system a 12V diaphragm pump starts a flow of water and the tap water is converted by a patented, blended-stream water electrolysis technology. As long as the reservoir in the flask is lit green, the water is activated [2]. The decontamination is done by spraying ionised water on surfaces for 6 seconds and thereafter wiping the surface. The vendor participated in the study.

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Growth studies from ionised water

The vendor prepared the system as usual with tap water from his office. Ten plates with agar media (five plates of Lactose –brom-thymol -blue agar media and five plates of Trypticase soy agar media, produced by the Department of Medical Microbiology, Oslo University Hospital-Ulleval) were sprayed with activated water form the Activeion Ionator. After drying in the air, the plates were placed in incubation for 4 days at 37°C.

Eleven days later, the vendor was asked to come back to our department for a new control of the system. This time tap water from our department was used to spray via the system on 1 new plates of agar media (five of each media) before incubation in the same manner as before.

The complete Activeion Ionator system was then rinsed with 70% alcohol, emptied and thereafter rinsed with tap water to get rid of alcohol rests. Thereafter it was filled up with a new portion of tap water from our department. This was sprayed on 1 new agar media.

Bacterial identification was done by Maldi-TOF (Bruker Daltonics, GmbH).

Results

In the first study, there was a rich growth of one single species most compatible with *Acidovorax delafieldii* in the Maldi-TOF on all agar media sprayed with Ionator- activated tap water from the office of the dealer (Table 1). In the second study 11 days later on, there was a rich growth of three species, most compatible to *Acidovorax delafieldii, Acidovorax temperans* and *Brevundimonas aurantica* in the Maldi-TOF system, in activated tap water from our department (Figure 1 and 2). In the third study, after disinfection of the inner parts of the Activeion Ionator with 70% alcohol, and rinsing afterwards with tap water from our department, there was no growth at all on agar media sprayed with activated tap water from our hospital department. (Figure 1 and 2). Thus the *Acidovorax delafieldii* survived the ionisation system in the bottle and in the spraying system for at least 11 days. All three species were killed by 70% alcohol. When the spraying system was tried again, there were no bacteria growing from the activated tap water. The vendor was informed by personal and written information, concerning the results, and decided not to distribute this system.

Discussion

The Activeion Ionator system is already in use in day-care centres, cleaning bureau, health institutions in the community and training centres many places in the world [2]. It is tried for cleaning performance for: general purpose cleaning, cleaning of glass, chrome, mirrors, stainless steel, grease cleaning and carpet stain cleaning (Toxic Use Reduction Institute (TURI), Surface Solutions Laboratory, University of Massachusetts Lowell, USA). In addition, it is laboratory certified by the United States. Environmental Protection Agency (EPA) has performed the testing and confirmed its efficacy [2].

According to Activeion (Europe) GmbH, the ionator EXP™ "is an outstanding cleaner" by using ionisation to convert tap water into a powerful cleaner that is tested and confirmed to kill directly 99.9% of

Study	Source of water	Growth of bacteria from isonisate tap water
1	Tap water from office outside the hospital	Rich growth of *Acidovorax delafieldii*
2	Tap water from the hospital department	Rich growth of *Acidovorax delafieldii*
		Rich growth of *Acidovorax temperans*
		Rich growth of *Brevundimonas aurantica*
3	Rinsed with 70% alcohol and tap water	
	from the hospital – and thereafter new tap water	No growth

Table 1: The effect of Ionisator on tap water; growth after ionisate treatment.

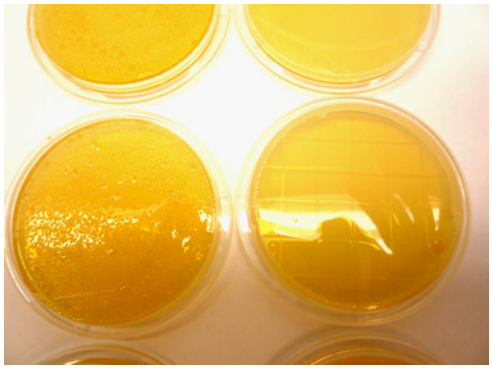

Figure 1: A rich growth of three types of Gram- negative bacteria identified as; *Acidovorax delafieldii, Acidovorax temperans* and *Brevundimonas aurantica* directly in the spray from activated tap water from the Ionator (left). Untreated control plates without growth (right).

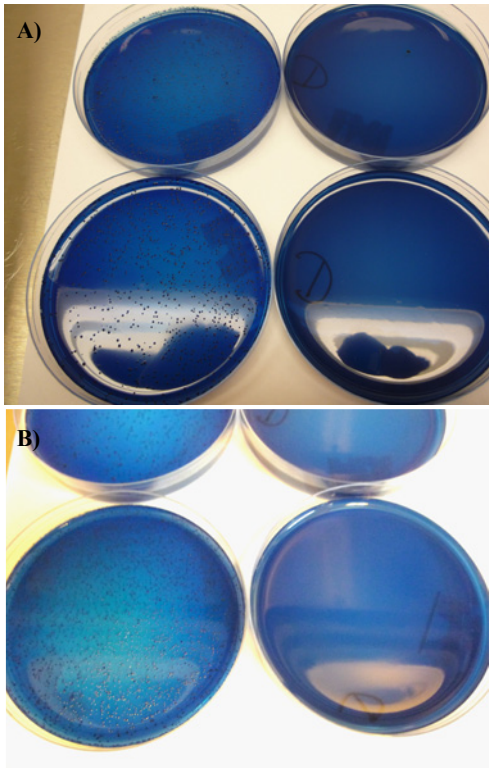

Figure 2: Growth of three species identified as *Acidovorax delafieldii, Acidovorax temperans* and *Brevundimonas aurantica* directly in the spray from activated tap water from the Ionator seen in the left column. In the right column; no growth after disinfection of the system with 70% alcohol, washed with tap water and then sprayed with tap water from the hospital.

harmful bacteria like *Escherichia coli*, methicillin resistant (MRSA) and sensitive *Staphylococcus aureus, Listeria, Salmonella* and *Pseudomona* [2]. A water cell applies an electric charge to tap water, which results in charged water changed by a process to an "oxygen-rich mixture of positively and negatively charged nano-bubbles" [2].

The finding of a rich growth of three types of Gram- negative bacteria; *Acidovorax delafieldii, Acidovorax temperans* and *Brevundimonas aurantica* directly in the spray from activated tap water from the Activeion Ionator was not in accordance with the information from the producer. It is well known that bacteria may vary in sensitivity to different types of decontamination, and Gram negative rods, enterococci and other microbes may be very resistant to various disinfection methods [3-8].

In this setting, two *Acidovorax* species and one *Brevudimonas* species contaminated the Activeion ionator system and was not disinfected by the ionisation process. *Acidovorax* species, earlier assigned to the genus *Pseudomonas,* belongs to the beta subdivision of the class *Proteobacteria,* family *Comamonadaceae* and [9,10], Several subtypes are associated with worldwide serious pathogens on corn, watermelons and vegetables, and may be found in activated sludge wastewater systems, environment, tap water, soil, non-chlorinated water, and even from commercial bottled waters [11]. *Acidovorax* species has also been detected in clinical samples like blood, Central Venous Catheters (CVC), pus from orthopaedic operations, joints, cerebrospinal fluid, nasopharynx, and dialysis equipment [1,9,12-15].

Acidovorax delafieldii (formerly *Pseudomonas delafieldii*) is closely related to *Comamonas acidovorans* (*acidovorans* complex) [1,9,16]. It is detected in soil and wastewater treatment plants, degrade biodegradable plastic and other organic contaminants, and survive under harsh environmental conditions [16,17]. It is found in clinical samples from wound, CVC, bone and joint, orthopaedic -associated infections, blood and dialysis equipment [3].

Acidovorax temperans has the ability to form biofilms and flocs and is found in all sludge and wastewater treatment systems, and in clinical samples from hospitals [9,18].

Brevundimonas aurantica belongs to the alpha subdivision of the class *Proteobacteria,* family *Caulobacteraceae,* and have a special dimorph structure; dividing into one bacteria with flagellae and one without [19]. The *Brevundimonas* bacteria are typical aquatic and is isolated from soil, wastewater, and even from clinical samples [19].

In the present study, the Activeion Ionator sprayed a rather large dose of Gram-negative bacteria from its water reservoir, repeatedly. Thus, the system did not disinfect all bacteria in the reservoir or via the spray system. The aquatic, biofilm-producing bacteria contaminants detected in the system may be of importance concerning clinical infections in children, patients with reduced immunity, or in the elderly, if sprayed on surfaces and as aerosols in the environment. By using ordinary soap and water instead of this ionised water system, most bacteria and biological materials, soil and fomities are removed and new microbes are not added, if the mop, soap and water is clean [20].

The increasing global problem with spread of rather robust and resistant bacteria triggers the need of hygienic routines especially associated with patients, children and the elderly and their use of different medical equipments [21]. Also the environment should be cleaned in a manner that does not add new microbes to the surroundings. The control of different disinfection equipments in important.

Conclusion

Ionised water produced by the Activeion Ionator system, does not kill tough, aquatic bacteria that may contaminate the system. The system may transfer resistant and potential harmful bacteria to the surroundings and to the air. The control of such systems is important.

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