# SUPERBUGS DO NOT DIE DURING WASTEWATER TREATMENT

**Potential for bacterial regrowth demonstrated in treated, reclaimed water**. In water-short areas reclaimed water must be used for agricultural or other approved uses, and its potential for bacterial regrowth in reclaimed water used for crop irrigation must be understood. ARS scientists in Phoenix, AZ, assessed the survival and regrowth potential of bacteria present in tertiary-treated effluent used for crop irrigation and surface water discharge as it passed through a model laboratory distribution system. Total bacteria increased 3 to 4 orders of magnitude, and that E. coli remained viable during the 11-day experiment. This research has established that although the reclaimed water met EPA standards for irrigation at the wastewater treatment plant, there is great potential for bacterial regrowth during transport that could place the water out of compliance at the point of intended use. The information will help prevent future problems of food contamination via wastewater irrigation.
http://www.ars.usda.gov/research/programs/programs.htm?np_code=108&docid=1271

An E. coli superbug that grows at 112.1 degrees Fahrenheit (fecal coliform) is used as an indicator for the safety of sewage sludge biosolids, reclaimed water and drinking water. EPA is very careful to state that the **treatment processes only inactivate pathogens.** On the other hand, the Water Environment Federation (WEF), the public relations arm of EPA, has claimed the treatment processes destroy pathogens. WEF states: **"These forms of treatment are designed to kill disease-causing microscopic organisms."**

Then, "In May 2006, University of Minnesota researchers published data showing that extremely high numbers of multi-drug resistant bacteria in effluent (treated water) at high levels are being released into the environment from highly efficient, award winning, sewage wastewater treatment plants."

And: in June 2006, WEF stated: "In a recent study of anaerobically digested solids from seven wastewater treatment facilities, counts of fecal coliform bacteria increased after dewatering at four of the facilities tested. Immediately after centrifugation, **fecal coliform counts increased from very low or nondetectable levels, often by as much as several orders of magnitude,** at the four facilities where increases were observed."

EPA and WEF acted surprised and they are going to study the problem -- sometimes in the future. But, EPA and the WEF have been knowingly **RECYCLING DEATH - DISEASE - CANCER THROUGH POLLUTANTS IN SEWAGE SLUDGE/BIOSOLIDS** for the past 35 years. EPA and WEF scientist have watched as our surface water, drinking water, farmland, crops and ground water (even lawns, gardens and school grounds) were contaminated with pathogens and the epidemics/pandemics raised their ugly heads so high the wastewater industry could no longer ignore the problems.

According to the New York Times, 2007, "The Journal of the American Medical Association, suggests that invasive infections with methicillin-resistant Staphylococcus aureus, or M.R.S.A., may be twice as common as previously thought, according to its lead author, Dr. R. Monina Klevens. If the mortality estimates are correct, the number of deaths associated with M.R.S.A. [19,000] each year would exceed those attributed to HIV/AIDS, Parkinson's disease, emphysema or homicide." That is simple guesswork by CDC who estimated "94,360 patients developed an invasive infection from the pathogen in 2005"

A Global Decline in Microbiological Safety of Water: A Call for Action (PDF)

The **U.S. Agency for Healthcare Research and Quality Documentation** surveyed community hospitals, defined as short-term, non-Federal, general and other hospitals, excluding hospital units of other institutions (e.g., prisons) and stated: "In **2005, there were about 368,600 hospital stays for infections with MRSA** (an antibiotic-resistant bacterium). Hospital stays for these infections more than tripled after 2000 and increased nearly tenfold after 1995. **The increase from 2004 to 2005 was 30 percent."**

Members of the American Academy of Microbiology sounded the alarm in 1996 raising concerns about bacterial degradation of our waters and the survival of superbugs in the environment. EPA and WEF can no longer deny that bacteria do not die during the treatment process.

**The American Academy of Microbiology states: "Many bacteria, including viable but non-culturable human pathogens, e.g., enterotoxic Escherichia coli, Vibrio cholerae, Salmonella spp., Shigella spp., and Campylobacter jejuni enter a survival or dormant stage in the natural environment."**

It would appear that EPA's experts have really led us into serious problems -- knowing that when released into the environment, bacteria go dormant and are viable but non-culturable. Isn't EPA/WEF sound science wonderful?

www.asm.org/Academy/index.asp?bid=2202


37
**Appendix 2**

**CHARACTERISTICS IMPORTANT FOR BACTERIAL SURVIVAL**

Many bacteria, including viable but non-culturable human pathogens, e.g., enterotoxic Escherichia coli, Vibrio cholerae, Salmonella spp., Shigella spp., and Campylobacter jejuni enter a survival or dormant stage in the natural environment.1,2,3

**These bacteria retain their pathogenic capabilities,** requiring that public health methods be revised to estimate public health risk from waterborne disease more accurately.4 Furthermore, injured and non-injured sewage bacteria discharged into freshwater and seawater are exposed to environmental stress.5,6

Sublethal exposure of enteric bacteria to stressors, including disinfectants, metals and UV, results either in a form of injury or viable but non-culturable state, that renders them unable to form colonies on selective media that are commonly used to determine water potability.7

Such stressed indicator bacteria can pass undetected from the treatment system into the distribution network and result in the underestimation of indicator and pathogenic bacterial populations in water.8,4

• Different species react differently to temperature changes; Salmonella spp. exhibited less mortality and stress than E. coli at low temperatures.9

Lower temperatures have also been studied as sewage is released into coastal marine water with the same result. 10,1

• Water with relatively high concentrations of organic material does not necessarily represent a rich nutritional environment for microorganisms. A large part of the organic material may be refractory, and only bacteria with minimal activity or those capable of rapid organic matter uptake during short periods of nutrient abundance can survive, i.e., reproduce rapidly.11

Survival mechanisms of Vibrio cholerae, E. coli and Shigella spp. related to organic matter concentration may require important physiological and structural transformations. 12,3

Their metabolism changes and surviving bacteria are no longer culturable but viable, i.e. they are alive and able to use exogenous material, but they no longer multiply.13,14

• Enteric bacteria are subject to osmotic shock when effluents are discharged in seawater, but cellular uptake of special molecules acting as osmoprotectors can prevent dehydration.15

The negative effect of visible light on enteric bacteria in aquatic ecosystems is a well known fact.16,17 It is assumed that light induces a state of dormancy in cells that are no longer culturable although cells stay morphologically intact.2,18

This negative effect is attributed to damage to different cell components, but there is still a lack of knowledge about the mechanisms of light's action. An indirect effect mediated by the formation of photoproducts has been suggested.19

So far, little is known about the possibility that plasmids of plasmid carrier E. coli strains codify resistance to environmental factors such as light and disinfectants. High concentrations of particles in water will prevent light

penetration and therefore reduce bacterial mortality.

In any case, depending upon bacteriological culturing methods will not provide accurate data on incidence and distribution of pathogens in water and water distribution systems.

REFERENCES

1 Xu, H-S, N Roberts, FL Singleton, RW Atwell, DJ Grimes and RR Colwell. 1982. Survival and viability of non-culturable Escherichia coli and Vibrio cholerae in the estuarine and marine environment. Microb. Ecol. 8:313-323.

2 Roszak, DB and RR Colwell. 1987. Survival strategies of bacteria in the natural environment. Microbiol. Rev. 51:365-379.

3 Hussein, et al. 1995.

4 Colwell, et al. 1995.

5 Pommepuy, M, JF Guillaud, E Dupray,

A Derrien, F Le Guyader and M Cormier. 1992. Enteric bacteria survival factors. Wat. Sci. Technol. 25(12):93-103.

6 Pommepuy, M, M Butin, A Derrien, M Gourmelon, M Cormier and RR Colwell. Maintenance of enteropathogenicity by viable but non cultivable E. coli in seawater. Appl. Environ. Microbiol. Submitted.

7 McFeters, GA. 1990. Enumeration, occurrence and significance of injured bacteria in drinking water. In McFeters, GA (ed.) Drinking Water Microbiology: Progress and Recent Developments, pp. 478-492. Springer, New York.

8 Bucklin, KE, GA McFeters and A Amirtharaja. 1991. Penetration of coliforms through municipal drinking water filters. Wat. Res. 25:1013-1017.

9 Rhodes, MW and H Kator. 1988. Survival of Escherichia coli and Salmonella spp. in estuarine environments. Appl. Environ. Microbiol. 54:2902-2907.

10 Smith, JJ, JP Howington and GA McFeters. 1994. Survival, physiological response and recovery of enteric bacteria exposed to a polar marine environment. Appl. Environ. Microbiol. 60:2977-2984.

11 Nedwell and Gray. 1987. In: Fletcher, Gray, Gones (eds.). Cambridge, 22, 55.

12 Munro, PM, MJ Gauthier and FM Laumond. 1987. Changes in Escherichia coli cells starved in seawater or grown in seawater-wastewater mixtures. Appl. Environ. Microbiol. 53:1476-1481.

13 Roszak, DB, DJ Grimes and RR Colwell. 1984. Viable but nonrecoverable stage of Salmonella enteritidis in aquatic systems. Can. J. Microbiol. 30:334-338.

14 Byrd, JJ, and Colwell, RR. 1993. FEMS Microbiol. Ecol. 12:9-14.

15 Kushner, DJ. 1993. Microbial life in extreme environments. In: Ford, T.E. (ed.) Aquatic Microbiology: an Ecological Approach, pp. 383-407. Blackwell, Oxford.

16 Barcina, I, J Arana, A Fernandez-Astorga, J Iriberri and L Egea. 1992. J. Appl. Bact. 73:229-236.

17 Arana, I, A Hue, J Iriberri, L Egea and I Barcina. 1992. J. Appl. Env. Microbiol. 58:3903-3907. 18 Davies, CM and LM Evison. 1991. J. Appl. Bacteriol. 70:265-274.

19 Curtiss, TP, DD Mara and SA Silva. 1992. Appl. Environ. Microbiol. 58:1335-1343.