

Article

The Negative Health Effects of Chlorine

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Introduction

Federal regulations require chlorine treatment of the water supplied to urban and suburban areas of America and much of Canada from surface sources such as lakes, reservoirs and rivers, constituting about 75 percent of water consumed. Water from underground sources generally is not chlorinated unless it is supplemented by surface water. My hometown, Lacey, Washington, and some surrounding communities that are supplied water by Lacey, are fortunate to be among that group; I'd like to see that continue.

Chlorination is inferior water treatment on at least two counts. (1) Although it has greatly lowered infectious waterborne diseases in the U.S.A. and Canada, chlorination fails against a variety of water problems including parasites and can seriously harm people who use the water. (2) Its cost is unnecessarily high. As of 1996, Andover, Massachusetts' new ozone treatment costs \$83 per million gallons of purified water, only two-thirds as much as the old treatment process. The town saves \$64,000 annually in chemicals costs alone,¹ and uses less electricity.

Chemical Background

Highly reactive chlorine is one of the industrial waste products profitably disposed of using people as garbage cans,⁸ then on into the environment. Chlorine oxidizes lipid contaminants in the water. It thus creates free radicals,² (highly reactive atomic or sub-atomic particles lacking an electron) and oxysterols (formed when lipid and oxygen molecules combine).^{9,10}

To function we require moderate numbers of both free radicals and oxysterols. The immune system employs free radicals to kill cells that its cellular immune mechanism can't handle. A second mechanism using free radicals initiates programmed cell suicide known as apoptosis.¹¹ And moderate quantities of oxysterols, like cholesterol itself, serve a protective function.¹² But excess free radicals and excess oxysterols damage arteries and initiate cancer, among many other kinds of harm.

Chlorine in water destroys protective acidophilus, which nourishes and coöperates with the 3 to 3.5 pounds¹³ of immunity-strengthening "friendly" organisms lining the colon, where about 60 percent of our immune cells operate.¹⁴ And chlorine combines with organic impurities in the water to make trihalomethanes (THMs), or chloramines.

Among the THMs that result from chlorine combining with organic compounds in water are carcinogenic chloroform and carbon tetrachloride. It is the combination of chlorine and organic materials already in the water that produces cancer-causing byproducts. The more organic matter in the water, the greater is the accumulation of THMs.²⁰

In a study of more than 5,000 pregnant women in the Fontana, Walnut Creek and Santa Clara areas of California, researchers from the state health department found that women who drank more than five glasses a day of tap water containing over 75 parts per billion (ppb) of THMs had a 9.5 percent risk of spontaneous abortion, i.e. miscarriage. Women less exposed to the contaminants showed 5.7 percent risk; no comparison was given for women who in-gested no THMs.²¹

Industrial chemist J.P. Bercz, showed in 1992 that chlorinated water alters and destroys unsaturated essential fatty acids (EFAs),¹⁵ the building blocks of human brains and central nervous systems.¹⁶ The compound hypochlorite, created when chlorine mixes with water, generates excess free radicals; these oxidize EFAs, turning them rancid.

Most Western diets already contain very little of critically needed omega-3 EFAs. These are found in fish oil, flaxseed oil and also in moderate quantity in extra-virgin olive oil. These EFAs, except in olive oil, go rancid quickly. And so, to extend their products' shelf life food processors remove all health-promoting EFAs, as well as destroying or discarding most needed micronutrients.

Processors substitute either saturated fats or partially hydrogenated trans fats. Found in all packaged foods that have long lists of hard-to-pronounce chemical names on the side, trans fatty acids consumed in large quantity can cause heart attacks and many other degenerative diseases.¹⁷⁻¹⁹

Possible Artery Damage

When chlorinated water is run through a hose or carried in a pail followed by milk as in a dairy, "very tenacious, yellowish deposits chemically similar to arterial plaque" form; with unchlorinated water this doesn't happen.²

CBS' "Sixty Minutes" show July 11, 1992, displayed two laboratory rats, both of them eating standard rat chow and drinking chlorinated water. One rat was also on pasteurized, homogenized milk. When the animals were sacrificed, the arteries of the milk-drinking rats were found to be clogged.

Dairy buckets, hoses and rats' arteries resist the arterial-wall damage known as atherosclerosis. But what can chlorinated water and cow milk, particularly homogenized milk, do to the far more susceptible arteries of humans? Those of young chickens are about as susceptible to such damage as human arteries. As a first approximation, J.M. Price, MD, gave cockerels (roosters less than a year old) only chlorinated water (without milk). They developed arterial plaques; and the stronger the concentration of chlorine, the faster and worse the damage. Cockerels on unchlorinated water developed no such damage.²

The residents of the small town of Roseto, Pennsylvania, had no heart attacks despite a diet rich in saturated animal fats and milk—until they moved away from Roseto's mountain spring water and drank chlorinated water. After that, consuming the same diet, they had heart attacks.² The Roseto example is dramatic enough but the needed detailed comparisons and follow-up have never been done.

How closely does the incidence of heart attacks match the areas where, and times when water is chlorinated? Chlorination spread throughout America in the second and third decades of this century, about 20 years before the increase of heart attacks. Light chlorination yielded slow growth of plaques in Price's cockerels, therefore, chlorination of people's drinking water at the usual low concentration might have been expected to take at least 10-20 years to produce clinical manifestations of atherosclerosis.

A physician team led by William F. Enos autopsied 300 GIs who had died in battle in the Korean War. These men, who had passed induction examination as healthy, averaged 22.1 years of age. To their shock and amazement, in 77 percent of the 300 the pathologists found “gross evidence of arteriosclerosis in the coronary arteries.” In several, one or more heart arteries were partly or completely occluded.³ Although Enos didn’t try to explain his grisly discovery, he assumed arterial clogging had developed gradually. Seeming to support that assumption, almost 20 years later pathologists discovered early arterial damage in 96 percent of nearly 200 consecutive babies who had died from various causes in their first month outside the womb. Two of those babies’ coronary arteries were blocked, causing infantile heart attacks.⁴ Identified as crib deaths, these were related to functionally deficient vitamin B6.⁵

But did arterial damage in fact develop slowly? The water that the American soldiers had to drink in Korea was so heavily chlorinated that many could hardly tolerate it. In Vietnam, too, autopsies of American soldiers found heart artery damage.⁶ Again, water supplied to them had been heavily chlorinated.² Did much of the soldiers’ arterial damage develop not gradually but quickly as in Dr. Price’s cockerels? The truth—slow or rapid development of clogging—may never be known. Interestingly, from 1950 to 1965 while heart attacks increased, on a population level arterial lesions did not increase;⁷ the major growth was in clotting.

Relation to Melanoma and Cancers

Studies in Belgium have related development of deadly malignant melanoma to consumption of chlorinated water.²⁸ Drinking and swimming in chlorinated water can cause melanoma.^{29,30,31} Sodium hypochlorite, used in chlorination of water for swimming pools, is mutagenic in the Ames test and other mutagenicity tests.^{32,33} Redheads and blonds are disproportionately melanoma-prone; their skin contains a relative excess of pheomelanins³⁴ compared to darker people.³⁵ Franz Rampen of the Netherlands reports worldwide pollution of rivers and oceans and chlorination of swimming pool water have led to an increase in melanoma.^{36,37}

Long-term risks of consuming chlorinated water include excessive free radical formation, which accelerates aging, increases vulnerability to genetic mutation and cancer development, hinders cholesterol metabolism, and promotes hardening of arteries.

Excess free radicals created by chlorinated water also generate dangerous toxins in the body. These have been directly linked to liver malfunction, weakening of the immune system and pre-arteriosclerotic changes in arteries. Excessive free radicals have been linked also to alterations of cellular DNA.⁴² Chlorine also destroys antioxidant vitamin E,² which is needed to counteract excess oxysterols/free radicals for cardiac and anti-cancer protection.

A study in the late 1970s found that chlorinated water appears to increase the risk of gastrointestinal cancer over a person’s lifetime by 50 to 100 percent. This study analyzed thousands of cancer deaths in North Carolina, Illinois, Wisconsin and Louisiana. Risk of such cancers results from use of water containing chlorine at or below the Environmental Protection Agency standard and “is going to make the E.P.A. standard look ridiculous,” stated Robert Harris, lead scientist in the study.⁴³

A later meta-analysis⁴⁴ found chlorinated water is associated each year in America with about 4,200 cases of bladder cancer and 6,500 cases of rectal cancer. Chlorine is estimated to account for nine percent of bladder cancer cases and 18 percent of rectal cancers.⁴⁵ Those cancers develop because the bladder and rectum store waste products for periods of time. (Keeping the bowels moving regularly lowers such risk.) Chlorinated water is associated, too, with higher total risk of combined cancers.⁴⁶

Further Risks of Chlorinated Water

Chlorine in swimming pools reacts with organic matter such as sweat, urine, blood, feces, and mucus and skin cells to form more chloramines. Chloroform risk can be 70 to 240 times higher in the air over indoor pools than over outdoor pools.²² Canadian researchers found that after an hour of swimming in a chlorinated pool, chloroform concentrations in the swimmers' blood ranged from 100 to 1,093 ppb.²³ If the pool smells very much of chlorine, don't go near it.

Taking a warm shower or lounging in a tub filled with hot chlorinated water, one inhales chloroform. Researchers recorded increases in chloroform concentration in bathers' lungs of about 2.7 ppb after a 10-minute shower. Worse, warm water causes the skin to act like a sponge; and so one will absorb and inhale more chlorine in a ten-minute shower than by drinking eight glasses of the same water. This irritates the eyes, the sinuses, throat, skin and lungs, dries the hair and scalp, worsening dandruff. It can also weaken immunity.

A window from the shower room open to the outdoors would release chloroform from the shower room air, but to prevent its absorption through the skin requires a showerhead that removes chlorine.

Dishwashers pollute indoor air with chlorinated organics created from dishwasher detergents and volatilized in the air for us to breathe. They vent five to seven liters of air into the house air every minute of operation. The chlorine reacts with food scraps.²⁴ Ceramic disks, used instead of detergents, totally avoid the problem and are said to be about 75% less costly than detergent.^{25,26,27}

Chlorine in treated water can also cause allergic symptoms ranging from skin dryness and rashes to intestinal symptoms to arthritis, and headaches.⁴⁷

Recent research has found a new hazard in chlorinated water: a byproduct called MX. A research team from the National Public Health Institute in Finland discovered that, by causing genetic mutations, MX initiates cancer in laboratory animals.^{48,49} Also, DCA (dichloroacetic acid) in chlorinated water alters cholesterol metabolism, changing HDL to LDL cholesterol⁵⁰—and causes liver cancer in laboratory animals.⁵¹

Plants do not thrive as well on chlorinated as on unchlorinated water; wild animals do not develop atherosclerosis until they drink chlorinated water in American zoos. Although their food, selected by people, isn't the same as what they caught, plucked or dug up in the wilds, evidence indicates chlorinated water, with its thousands of other chemicals, is the worst culprit in zoo animals' arterial clogging.

Substitute Water Treatments

Hydrogen peroxide (H₂O₂) destroys infectious organisms and impurities in water 4,000 times better than chlorine.⁵⁶ "A 35-percent technical grade H₂O₂ will promote bacterial growth to break down sewage and enhance the dissolved oxygen level in discharge water entering lakes and streams."⁵⁷ Ozone (O₃) treatment is equally effective. Worldwide, 1,100 cities treat their drinking water with ozone; many have done so since as early as 1901.⁵⁸ Los Angeles treats its drinking water with H₂O₂, and then adds chlorine.⁵⁹ Some chlorine may likewise be added after ozonation to prevent re-infestation; about one-third as much suffices.

To generate ozone, dry air or oxygen is passed through a high-voltage electrical field. Ozone drinking-water treatment in Andover, Massachusetts successfully controlled the effects of algae blooms and eliminated water quality problems. Potential THM formation was reduced by an average of 75 percent.⁶⁰

H₂O₂ and O₃ are relatively inexpensive; moreover, the only byproducts are pure oxygen and hydrogen, so no one can reap a big immediate profit on their disposal. (Hydrogen is a potential major energy source for electricity generation and for zero-emission vehicles.⁶¹) France and Germany, wiser and less controlled by the chemical industry, now chlorinate water only in emergencies.⁶²

Other Water Pollution Problems

EPA tests have shown that in the water we drink, over 2,100 organic and inorganic chemicals including pesticides, heavy metals, radon,⁶³ radioactive particles⁶⁴ and parasitic organisms⁶⁵ including cryptosporidium^{66,67} have been identified; 156 of them are pure carcinogens. (In 1993, cryptosporidium killed more than 100 and infected over 400,000.) Of those, 26 are tumor promoting: they can make an existing tumor grow. Exposure to cryptosporidium in people with lowered gastrointestinal immune function could lead to chronic GI infection.⁶⁸ Other examples include recurring cases of Legionnaire's disease, a pneumonia caused by *Legionella pneumophila*, which may lurk in hot water supplies.⁶⁹

A public notice recently issued in Washington, D.C. warned that a high level of bacteria in the (chlorinated, fluoridated city system) water made it unsafe for dialysis patients, AIDS patients, organ transplant patients, the elderly and infants. Water contamination is often worst in small communities that can't afford proper treatment; the EPA has not released this information.⁷⁰

Testimony to hearings of the House Committee on Government Reform and Oversight revealed *Pfiesteria* outbreaks among people drinking chlorinated water. The organism, which kills fish, sickens some people; they get sick from drinking the water, not from eating infected seafood. The EPA's Robert Perciasepe said, in written testimony, "Any new public health policy on this issue needs to consider reduction of nitrogen and phosphorus pollution in our waters."^{71,72} A bill passed by the U.S. House of Representatives would require managers of municipal water systems to tell customers what contaminants have been found in local drinking water.⁷³ But government laboratories test only for bacterial content and a few of the major inorganic toxins such as lead and arsenic. So, for a complete water test one must consult a private laboratory.

The EPA called 129 contaminants found in water supplies "dangerous" singly, let alone in combination. Pesticides and other toxic wastes run off farmlands and pastures or are dumped by factories, pollute rivers and seep into underground aquifers. Aptly called "biocides" by Russell Jaffe, MD, PhD, pesticides are designed to end life; few have been shown to be safe. The EPA depends on producers of pesticides to test their safety: the wolf guards the hen house. It should be no surprise that the tests take a long time and many have been fraudulent.

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Further, one poison is tested at a time; synergistic effects of combinations, potentially far worse, are ignored.⁷⁸ Besides, many of the so-called "inert" substances in pesticide combinations are more toxic than the "active;" one of the "inerts" is DDT, supposedly prohibited for American farm use since 1973.⁷⁹

The American Society of Microbiology reported that water in the U.S.A. is filled with microbes, such as viruses and bacteria, which pose a growing threat to public health. The document states that water pollution control efforts have focused on protecting water against chemical pollution, but they neglect serious problems from wastewater, sewer overflows, septic tanks, and the risks associated with microbial pollutants. The report recommended creation of a task force to coordinate federal agency activities on environmental and public health issues.⁸⁰ Isn't all that bad enough without the deliberate addition of the further toxicity of chlorine?

References

1. City improves water quality with ozone system (Andover, Massachusetts). *Amer City & County*, 1996; 111; 12: 38.
 2. Price JM: *Coronaries/Cholesterol/Chlorine*, NY: Pyramid, 1969.
 3. Enos WF, et al: Coronary disease among United States soldiers killed in action in Korea. *JAMA*, 1953; 152: 1090-1093.
 1. Jaffe D, et al: Coronary arteries in newborn children: Intimal variations in longitudinal sections and their relationships to clinical and experimental data. *Acta Paediat Scand Supp.*
 2. 219: 1-27.
 4. Suzman MM: Nutritional and metabolic factors in the development of coronary artery disease in early life: The possible role of dietary protein and pyridoxine. *Unpub. Abstr.*, 1984.
 5. McNamara, JJ et al: Coronary artery disease in combat casualties in Vietnam. *JAMA*, 1971; 216: 1185-1187.
 6. Nieper H: Mineral transporters, *New Dynamics of Preventive Medicine*, 1974.
 7. Others are mercury in dental amalgams, fluoride and other chemical wastes disposed of into the atmosphere and into drinking water.
 8. Janney P: *Health dowsing in the 1990s* (audio

Journal of Orthomolecular Medicine Vol. 15, No. 2, 2000

tape), Sylvia, NC: Goodkind of Sound, 1992.
10. Taylor CB et al: Spontaneously occurring angiotoxic derivatives of cholesterol. *Am J Clin Nutr*, 1979;32:40-57.
 11. Taylor EW: Interview on Bland JS, *Funct Med Update*, 1997; May.
 12. Smith LL: Another cholesterol hypothesis: Cholesterol as antioxidant. *Free Rad Biol Med*, 1991; 11: 47-61.
 1. Bland JS: *Funct Med Update*, 1999.
 2. Dash SK: *Lecture to National Health Federation*, 1993.
 3. Bercz JP: Toxicology of drinking water disinfection byproducts from nutrients. Rate studies of destruction of polyunsaturated fatty acids in vitro by chlorine-based disinfectants. *Chem Res Toxicol*, 1992; 5: 418-425.

4. Howell E: Enzyme Nutrition: The Food Enzyme Concept. Wayne, NJ: Avery Publ Group, 1985.
5. Bercz JP: Op. Cit.
6. Budwig J: *Flax Oil as A True Aid Against Arthritis, Heart Infarction, Cancer and Other Diseases*. Vancouver, BC: Apple Publ., 1993.
7. Rogers SA: Tired or Toxic? Syracuse, NY: Pres-tige Publ., 1990.
8. Waller K et al: Trihalomethanes in drinking water and spontaneous abortion. *Epidemiol*, 1998; 9; 2: 134-140.
9. Herwart BL et al. Outbreaks of waterborne disease in the U.S.: 1989-190. *JAWWA*, 1992Apr:29.
10. *J Exposure Analysis and Environ Epidemiol*, 1994; 4;4: 491-502.
11. Levesque B: in Environmental Health Perspectives 1994;Dec. *Sci News*, 1995;147:5.
12. *Sci News*, 1999;July 10;156:22.
13. Craun G: Surface water supplies and health *JAWWA*, 1988; Feb:40.
14. Mercola J: Health news you can use. July 1999:6.

www.mercola.com

1. Herbert HJ: Bacterial threat to water supply reported growing. *Orange County Register*, 1996; July 11.
2. Douglass WC: *Second Opinion*, 1994;Feb.
3. Protta G: Recent advances in the chemistry of melanogenesis in mammals. *J Invest Dermatol*, 1980; 75: 122-127.
4. Rampen FH, Nelewans RT, Kerbeek ALM: Is water pollution a cause of cutaneous melanoma? *Epidemiol*, 1992;3;3:263-265.
5. Murray F: *The Murray report*. Let's Live 1997;Oct:16.
6. Meier JR: Genotoxic activity of organic chemicals in drinking water. *Mutat Res*, 1988; 196; 211-245.
7. Kurakawa Y, Takayama S et al: Long-term in vivo carcinogenicity tests of potassium

bromate, sodium hypochlorite, and sodium chlorite conducted in Japan. *Environ Cellular Perspect*, 1996; 69: 221-25.

1. The prefix pheo- means dusky, gray, or dun.
2. Cesarini JR: Photo-induced events in the human melanocytic system: Photoaggression and photoprotection. *Pigment Cell Res*, 1988;1:223-233.
3. Rampen FH et al: *Epidemiology*, 1992;3;3:263-265.

37. Murray F: The Murray report. *Let's Live*, 1997; Oct: 16.

1. Beral V et al: Malignant melanoma and exposure to fluorescent lighting at work. *Lancet*, 1982; Aug 7: 290-293.
2. Kustov VI et al: Epidemiology of malignant melanoma. *Vopr Onkol*, 1987; 33: 35-39 [Engl abstract).
3. Ott JN: *Light, Radiation and You*. Greenwich, CT: Devin-Adair Publishers, 1990.

41 Garland FC et al: Occupational sunlight exposure and melanoma in the U.S. Navy. *Arch Environ Health*, 1990;45:261-267.

1. Bercz JP: Op. cit.
2. Harris R: Speech to Miami chapter of Sierra Club, 1980. *NY Times*, 1980;Oct 17.
3. A study of many epidemiological–statistical population–surveys, some of whose results conflicted.
4. *Am J Public Health* 1997;87:1168-1176.

5. Morris RD et al: Chlorination, chlorination byproducts and cancer: A meta-analysis. *Amer J Pub Health*, 1992; 82: 955-963.

47. Douglass WC: Letters. *Second Opinion*, 1998; June:8.

1. *J Natl Canc Inst*, 1997; 89: 832-833, 848-856.
2. Whitaker JM: *Health and Healing*, 1997; Aug (Suppl.)
3. Douglass WC: *Second Opinion*, 1994; Dec.
4. *What Doctors Don't Tell You*, 1997; Oct; special supplement.
5. Williams DG: *Alternatives for the Health Conscious Individual*. 1997; August.
6. Bland JS: *Prev Med Update*, 1994; Nov.
7. Williams DG: *Alternatives for the Health Conscious Individual*. 1997; August.
8. Hattersley JG: The case against fluoridation. *J Orthomol Med*, 1999; 14: 185-197.
9. McCabe E: *Oxygen Therapies*. Morrisville, NY: Energy Publications, 1990.

57. Walters C: *The last word*. Acres USA 1999; Aug: 46.

1. McCabe E: Op. cit.
2. *Los Angeles Dept of Water and Power*, 1992.
3. Ann Hatcher, senior analyst with the NEES Companies, Westborough, Mass. *Amer City & County*, 1996; 111; 12: 38.
4. The third age of fuel. *The Economist*, 1997; Oct

25: 16.

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1. Hans Raible: Stuttgart, Germany. *Personal communication*, 1993.
2. See Addendum.
3. Null GH et al: What physicians should know about the biological effects of ingested fission products. *Townsend Ltr Doc*, 1993; Aug: 812-815.
4. Bland JS: *Prev Med Update*, 1993; Mar.
5. McAnulty JM et al: A community-wide outbreak of cryptosporidiosis associated with swimming at a wave pool. *JAMA*, 1994; 272: 1597-1600.

67. Rose JB: Environmental ecology of crypto-sporidium and public health implications. *Annu Rev Public Health*, 1997; 18: 135-161.

1. Bland JS: *Funct Med Update*, 1997; Oct.
2. Whitaker JM: Don't drink tap water. *Health &*

Healing, 1998; Apr: 4-7. 70. Glum GL: Essiac: Nature's cure for cancer. *Wild-*

fire, 1991; 6: 48-55.

71. Mlot C: Feds tackle toxic cell. *Sci News*, 1997; 152: 213.

72. Excess phosphorus—also put into soft drinks to prevent their acidity from dissolving the teeth—drains calcium out of the skeleton promoting osteoporosis and hip fractures.

73. *Amer City & County*, 1996;111;12:38.

74. Rogers SA: *Northeast Center for Environmental Medicine Health Letter*, 1994; Summer.

75. Janney P: Op. cit.76. Willix.77. Treacy K: *Personal communication*, 1994.78. Rogers SA: Tired or Toxic?79. Rogers SA: *Depression: Cured at Last! Sarasota*,

FL: SK Publ, 1996. 80. Bugs in our water. *Acres USA*, 1999;Sept:5.