

THE TROUBLE WITH **TRICLOSAN**

HOW A PERVASIVE ANTIBACTERIAL CHEMICAL
IS POLLUTING OUR WORLD AND OUR BODIES

May 2012



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About ENVIRONMENTAL DEFENCE

ENVIRONMENTAL DEFENCE is Canada's most effective environmental action organization. We challenge, and inspire change in government, business and people to ensure a greener, healthier and prosperous life for all.

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ENVIRONMENTAL DEFENCE would like to thank the eight Canadians who volunteered to be tested for the amount of triclosan in their systems for the purpose of creating this report:

Alison Humphrey

Jamie Kennedy

Sook-Yin Lee

Henry Lickers

Katrina Onstad

Richard Parry

Tim Powers

John K. Samson

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EXECUTIVE SUMMARY

We're in the midst of an antibacterial craze. Not just for hand sanitizers anymore, consumers can get antibacterial toothpaste, kitchen utensils, smartphone cases, air filters, garbage bags, hair products, deodorant, toys and socks!

And as the number of antibacterial products grows, so does the presence of antibacterial chemical triclosan—along with fears from many scientists that this spread is contributing to antibiotic resistance, and a rise in “superbugs.” For this reason, the Canadian Medical Association and other organizations have recommended a ban on the household use of triclosan. On March 30, 2012, Health Canada and Environment Canada published a preliminary assessment of triclosan, officially commencing a 60 day comment period. In light of this comment period, ENVIRONMENTAL DEFENCE recommends a mandatory ban on triclosan in household products to protect the health of Canadians and the environment.

Triclosan is an antibacterial chemical that was first registered as a pesticide in 1969. For the first 20 years that it was available, it remained common in medical settings, but through the 1990s, adding triclosan to consumer products skyrocketed as marketers saw an opportunity to cash in by adding the label “antibacterial” to consumer products—despite no evidence that it actually helped.¹

But there is evidence that it harms. Triclosan is known to be toxic to fish, frogs and algae. When it reacts with other substances in water, or breaks down in sunlight, the chemical reactions create the human carcinogens chloroform, and dioxins, which are one of the most toxic groups of substances known.

All the more reason to be worried that triclosan has been found in the bodies of millions of people around the world—including Canadians.

We tested eight Canadian consumers of various ages, to show how exposure to triclosan in everyday products drives up the levels of it in our bodies. Our tests found triclosan in seven of our eight volunteers. These are the first publicly available data on triclosan levels in Canadian adults.

What do our results mean? With triclosan appearing in seven of our eight volunteers, it's clear that its use in consumer products is too widespread. Some of our participants make conscious efforts to avoid toxic products, and so were surprised to find it in their systems. The average amount of triclosan in our volunteers was found to be above the level at which triclosan is toxic to marine organisms, including certain species of algae, crustaceans and fish.²

All the same, as triclosan is put in more consumer products, Canadians are subject to chronic exposure to it. While further research is needed to investigate its impact on human health, we know it's toxic to wildlife. Triclosan also harms the health and development of aquatic species even at low concentrations, highlighting the threat posed by its presence in wastewater.



Commercial shaving creams have been found to contain triclosan.

RECOMMENDATIONS

1. ENVIRONMENTAL DEFENCE strongly recommends a ban on the household use of triclosan.

While the chemical may be useful in a medical context, the explosive proliferation of triclosan in consumer products has resulted in the contamination of waterways, and may contribute to the rise of antibacterial resistance. On March 30, 2012, Health Canada and Environment Canada published a preliminary assessment of triclosan, officially commencing a 60 day comment period. In light of this comment period, ENVIRONMENTAL DEFENCE supports the voluntary reductions on the use of triclosan in products, proposed by Health Canada and Environment Canada. However, to better protect human health, a stricter, mandatory ban on triclosan in household products is advisable.

2. Further testing is required to assess the effects that long-term chronic low-grade exposure to triclosan is having on human health.

Evidence shows that triclosan mimics hormones and affects cells that are important to immune function. More research is required to assess the impact that constant, daily exposure to triclosan has on humans.

*Some shampoos
contain triclosan.*



INTRODUCTION

The Trouble with Triclosan

Triclosan is an antibacterial chemical used in hundreds of products, from soap to makeup, even smartphone cases. The Canadian Medical Association has called for a ban from use in consumer products. These doctors are concerned that triclosan could contribute to antibiotic-resistant bacteria, also known as “superbugs”.

It’s also a known endocrine disruptor—interfering with the human body’s natural hormones. Many of these disruptors have been linked to thyroid problems and cancer. And triclosan contaminates the environment, washing down our drains to pollute rivers and lakes, where it bioaccumulates in aquatic species, decreasing algae populations,³ mimicking male hormones in fish (thereby altering sex ratios),⁴ and due to hormone-disrupting properties, affecting the development of frogs.⁵

ENVIRONMENTAL DEFENCE is concerned about the long term effect all this proliferation will have, considering how widespread it is in our products and in the environment. For this reason, triclosan is included in our list of the Toxic Ten chemicals consumers should avoid in personal care products. A pocket shopping guide to help people avoid the Toxic Ten is available at justbeautiful.ca

Triclosan Research in *Slow Death by Rubber Duck*

In his research for the best-selling book *Slow Death by Rubber Duck* (2009), co-authored with Bruce Lourie, ENVIRONMENTAL DEFENCE’S executive director Dr. Rick Smith exposed himself to personal care and cleaning products containing triclosan, in order to test the effect this would have on the level of triclosan in his body.

Before the experiment with triclosan, Dr. Smith had avoided products labelled “antibacterial” for several years. All the same, before starting the test, a urine test showed he had 2.47 nanograms per millilitre (ng/mL) of triclosan in his system.

“Why, given the fact that we’ve banished triclosan from our home for years, wasn’t my starting value zero? Likely because of the levels of triclosan that are now found in water and food that we all absorb day in and day out,” he wrote.

For the experiment, he bought products containing triclosan: Colgate Total Toothpaste, Clean & Clear foaming facial cleanser, Dial Complete hand soap, Gillette shave gel, Right Guard deodorant, Dettol pine fragrance shower soap; and the kitchen products Dawn Ultra concentrated dish liquid/antibacterial hand soap, and J Cloth (apple blossom scent with Microban). After using the products for just two days the level of triclosan in Dr. Smith’s urine rocketed from 2.47 ng/mL to 7,180 ng/mL—almost 3,000-fold: “The increase in triclosan in my body was simply stunning.”⁶

ENVIRONMENTAL DEFENCE investigates triclosan levels of Canadians

ENVIRONMENTAL DEFENCE tested eight Canadians to highlight how exposure through everyday products drives up the levels of triclosan in our bodies. We found triclosan in seven of them, demonstrating how widespread triclosan has become in our households. These results are the first publicly available data on triclosan levels in Canadian adults.

SECTION 1: WHAT OUR TESTING FOUND

Summary

ENVIRONMENTAL DEFENCE asked a diverse group of Canadians to volunteer to be tested for the presence of triclosan in their bodies. While one might expect medical professionals to have higher levels, due to its use in hospitals and clinics, triclosan has moved beyond the clinical environment for which it was originally intended, and is now in hundreds of consumer products.

Triclosan is now found in millions of people, as it is easily absorbed not only through the skin but also through the oral mucous membranes and GI tract.

Previous tests found triclosan in 75 per cent of Americans, in the breast milk of mothers in Sweden⁸ and in Australians, too.⁹ Our tests showed similar widespread detection in a diverse group: two musicians, an environmental scientist, a chef, a writer, a political strategist, a midwife, and an artist/broadcaster from Montreal, Cornwall, Ottawa, Toronto, Winnipeg and Vancouver.

What do our results mean? Finding triclosan in all but one subject underlines that its use in consumer products is too widespread and poses a risk to human and environmental health. The average amount of triclosan we found was 15.48 ng/mL; at this concentration or lower, it is toxic to marine organisms, including certain species of algae, crustaceans and fish.¹⁰

And while waste water treatment removes most triclosan, it still appears in waterways at concentrations high enough to harm marine organisms.¹¹ When it is in sludge used in agriculture, some plants, such as soybeans, absorb it from soil.¹²

Indeed, below the concentration level of 15.48 ng/mL (the average amount across our volunteers) triclosan can have a highly destructive impact on populations of blue green algae, green algae, and phytoplankton, all vital species to the aquatic food chain. At levels below those we found, triclosan also alters the thyroid function of *Xenopus leavis* frogs, as well as the hind limb development of bullfrog (*Rana castabeiana*) tadpoles, and produces deformities in fathead minnows.¹³

Recent research also shows the risk to human health. Natural Killer (NK) cells play an important role in the human immune system, particularly in destroying cancer cells. A 2010 study examined the effect triclosan has on the ability of NK cells at destroying human chronic myelogenous leukemia cells.

Their effectiveness at destroying the cells was shown to be impaired by exposure to as little as 289 ng/mL (an amount approximately 25 times less than that found in Dr. Smith's body in his 2009 test), functioning 30 per cent less effectively after being exposed for just six days. This also shows it's not only how much triclosan we're exposed to that counts, it's also for how long.¹⁴

Triclosan's hormone-mimicking properties also raise concerns for human health. The family of chemicals it belongs to, halogenated phenols, has been shown to disrupt the levels of thyroid hormones in humans. Deiodinase (DI) is an enzyme that plays a role in regulating hormone levels; DI activity is also critical to the development of brain, placenta and fetal tissues. A 2011 study in the journal *Toxicological sciences* found that triclosan inhibits DI activity.¹⁵

Given the effects on human health and wildlife, several of our participants were concerned and surprised to find triclosan in their systems, especially since they make a conscious effort to buy products labelled as non-toxic. And the upside? Not much, considering it's not been shown to have an added health benefit, and the long term effects of chronic low-grade exposure are unknown.



Triclosan can even be found in flip flops.

ALISON HUMPHREY

Midwife, Mother

Vancouver, BC

Triclosan level: **28.9 ng/mL**



Originally from Sudbury, Ontario, ALISON HUMPHREY is a midwife, and has practiced in both Toronto and Vancouver. She lives in Vancouver with her husband, a geneticist, and her two young children.

“I’m shocked it’s so high. I avoid buying antibacterial soaps with triclosan, but I did accidentally buy antibacterial soap a couple of months ago and wanted to use it up rather than throw it away. I’m amazed that that one product put my levels at almost double the average. I will be extra careful next time I buy soap.”



Garden hoses are one of the many household items to contain triclosan.

JAMIE KENNEDY

Chef, Jamie Kennedy Kitchens

Toronto, ON

Triclosan level: **3.16 ng/mL**



For over three decades, JAMIE KENNEDY has been instrumental in shaping the culinary landscape in Canada. He uses his role as chef to strengthen the vital links within our community of artisans, farmers, wineries and fellow chefs, while providing his audience with an educational and nourishing demonstration of the bounty and excellence possible right in our own backyard. Jamie has applied the slow food philosophy in every aspect of his acclaimed restaurants and his flourishing catering business.

In 2010, Jamie was honoured for his contributions with two major appointments; with Chef Michael Stadtländer, he was awarded for his leadership at the inaugural Governor General's Award in Celebration of the Nation's Table, and soon after he was appointed to the rank of Member of the Order of Canada.

"I'm happy with the result and not surprised (that it is relatively low), because I don't come into contact with the typical commercial toiletries. For instance, I use soap from the farmers market. I'm as concerned with what I put on my skin as what I put in my mouth."

SOOK-YIN LEE

Musician, actor, visual artist, filmmaker and Radio & TV broadcaster

Toronto, Ontario

Triclosan level: **4.12 ng/mL**



SOOK-YIN LEE is the host and co-producer of Gabriel-Award winning personal storytelling program DNTO on CBC Radio 1. Previously, she fronted the art-rock band, *Bob's Your Uncle*, before going on to be a Muchmusic VJ. She has acted in and created critically acclaimed films including *Shortbus*, in which she starred, *The Brazilian*, a chapter of Toronto Stories, and feature-film *The Year of the Carnivore* which she wrote and directed. Sook-Yin is now developing *Dorion is Dead*, a supernatural love story.

"I'm relieved I'm in the 'lower end of the average amount', but disturbed that I contain trace amounts of triclosan. So, now I want to know more about it!"



Some garbage bags have been found to contain triclosan.

HENRY LICKERS

Environmental Science Officer, Mohawk Council of Akwesasne

Cornwall, Ontario

Triclosan level: **Below detection limit**



HENRY LICKERS is a member of Seneca Nation, Turtle Clan, and is the Director of the Department of the Environment for the Mohawk Council of Akwesasne. For more than 25 years, Mr. Lickers has been instrumental in incorporating First Nations people and knowledge into environmental planning and decision making. In 2006, Mr. Lickers was honoured with a lifetime achievement award by the Mohawk Council of Akwesasne environment program for his 30 years of work with the Haudenosaunee Environmental Task Force. In 2008, Henry was awarded the Annual Sandford Fleming Medal by the Royal Canadian Institute for the Advancement of Science, for his “outstanding contributions to the public understanding of science”.

“Many years ago my wife and I decide to use as many “natural” or less manufactured health care products. We choose baking soda based toothpastes, and deodorant and shampoos that don’t highlight sense/smells/many hour protection, substituting these with simple and sometimes cheaper alternatives. We use salt and baking soda for mouth rinse mostly for teeth, and avoid processed foods. Although my test was negative, I am concerned about the amount of triclosan many Canadians are being exposed to.”

KATRINA ONSTAD

Journalist, novelist

Toronto, Ontario

Triclosan level: **21.9 ng/mL**



KATRINA ONSTAD'S second novel, *Everybody Has Everything*, will be published by McClelland and Stewart in May, 2012. Her first novel, *How Happy to Be*, was met with critical acclaim in 2006. Katrina is also a freelance writer whose work on culture appears in publications including The New York Times Magazine, The Guardian and Elle.

Katrina is a National Magazine Award winner for Arts Writing, and has been nominated several times, including as Best Columnist for her work in *Chatelaine*. Katrina's work in non-print media includes frequent appearances on CBC radio and television; TVO's *Saturday Night at the Movies* and *The Agenda*; hosting events for the Toronto International Film Festival Group; and co-hosting the national film review show *Reel to Real*.

Born and raised in Vancouver, B.C., Katrina has an English degree from McGill and a Master's from University of Toronto. She lives in Toronto with her family.

“It's alarming, and confusing, to see these levels, especially as we think of ourselves as conscientiously avoiding many chemical products in our home. Considering the links between triclosan and hormonal problems, as well as antibiotic resistance, I'm concerned for my family, and wondering when the government is going to take action.”

RICHARD REED PARRY

Musician, Artist

Montreal, Quebec

Triclosan level: **54.3 ng/ML**



RICHARD REED PARRY is a double bassist-multi-instrumentalist-composer-producer-musician-artist, who divides much of his time between his two bands: the Grammy award-winning *Arcade Fire* and Juno award-winning *Bell Orchestra*, in both of which he writes, plays, records and performs.

As a composer he has written music for *Kronos Quartet*, *Kitchener-Waterloo Symphony* and *Ymusic*, and collaborated with dance luminaries *LaLaLa Human Steps*. He has performed with musicians David Byrne, David Bowie and Neil Young. He has done production and occasional performances with The National, Little Scream, Islands and The Unicorns. He is currently doing a lot of different things, all at the same time. He lives in Montreal.

"This is terrifying. How do i get it out of me, now???"



Kitchen utensils, including pizza cutters, garlic presses, and ice cream scoops, contain triclosan, even though they are likely to be washed after each use.

TIM POWERS

Strategist

Ottawa Ontario

Triclosan level: **18.9 ng/mL**



TIM POWERS is vice president of *Summa Communications*, offering clients a wide range of experience and expertise in the fields of business, communications, and public policy. Originally from St. John's, he began his career as an assistant and advisor to the John C. Crosbie, then Minister of Fisheries and Oceans. Thereafter, he acted as advisor to the Minister of Indian Affairs and Northern Development.

He also served as the director of policy and research to the leader of the Progressive Conservative Party.

He has a Bachelor's degree from Memorial University of Newfoundland, a Master's from St. Mary's University, as well as the London School of Economics. Mr. Powers is also a media commentator, appearing frequently on CBC's *"Power and Politics"* and Ottawa radio station, CFRA.

"My results have certainly given me pause for thought. I want to learn more both about what it means and how I can lower my triclosan level."

JOHN K. SAMSON

Musician, Publisher

Winnipeg, Manitoba

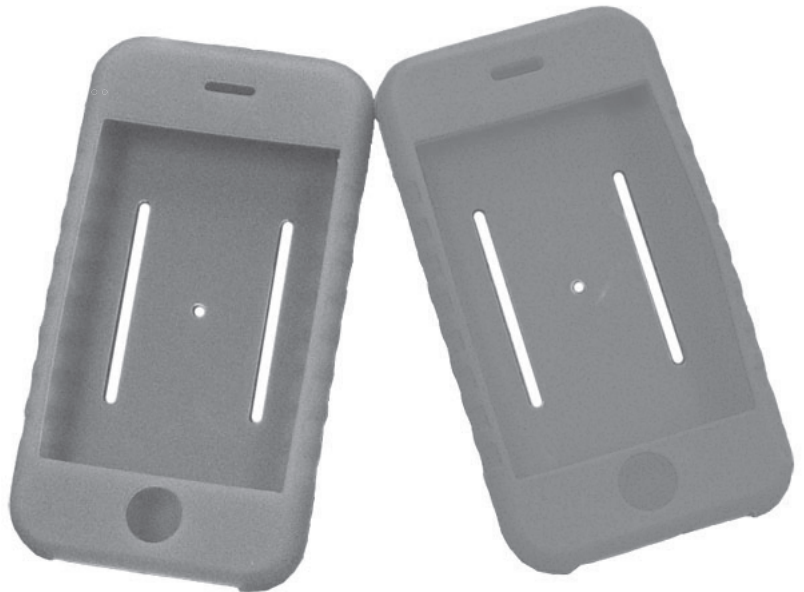
Triclosan level: **3.91 ng/mL**



JOHN K. SAMSON is singer-songwriter for critically lauded indie rock band *The Weakerthans*, as well as a solo artist, and founding member of ARP, a publishing collective established in Winnipeg in 1996. The Weakerthans were born out of the Winnipeg-punk-scene, and have released four albums including *Fallow*, *Left and Leaving*, *Reconstruction Site* and *Reunion Tour*. Samson's solo album *Provincial* was released in January via Epitaph-Anti Records. When not composing and performing, John has also championed the work of Canadian authors, participating as a judge in two CBC Canada Reads competitions, and, with ARP, participating in the publication of books with politically progressive themes.

"I am extremely concerned by the results of this study. It seems to me that government and industry must now finally take notice and take steps to protect us from this insidious chemical."

Many smart phone cases labelled "antibacterial" contain triclosan.



SECTION 2: WHAT DO THE RESULTS MEAN?

Our testing found triclosan in the urine of seven out of eight volunteers, none of whom is a medical professional. They were all exposed to triclosan just by going about their daily routine. Likely sources of exposure include personal care products such as shaving cream, moisturizers, and makeup, as well as hand washing stations and soap in public restrooms. Finding triclosan in almost all of the diverse people we tested shows how widespread it now is.

Our results are the first publicly available data on triclosan levels in Canadian adults. The U.S. Centers for Disease Control and Prevention conducted extensive tests on Americans, and found triclosan in 74.6 per cent of subjects.¹⁶ The U.S. results are disconcerting, given many products sold in both Canada and the U.S. use the same ingredients.

Triclosan is excreted by humans and washed down drains when bathing, entering sewage treatment systems with varying capacities to deal with it. As a result, it's found in waterways, and may also be in food grown with biosolids and irrigated with wastewater, as shown by studies on soybeans.¹⁷

SECTION 3: WHAT SHOULD BE DONE?

ENVIRONMENTAL DEFENCE congratulates Health Canada and Environment Canada for declaring triclosan to be toxic to the environment.¹⁸

In addition to this environmental toxicity, ENVIRONMENTAL DEFENCE is concerned about the relationship between triclosan and antimicrobial resistance. Furthermore, we are concerned about the human health impacts of chronic low-grade exposure, which have not been adequately studied, as well as the effect of triclosan's breakdown products, chloroform and dioxins.

ENVIRONMENTAL DEFENCE supports the government's proposed voluntary reductions; however, to protect human and environmental health, a stricter, a mandatory ban from use in household products is advisable.

Organizations calling for a ban on triclosan:

The Canadian Medical Association first called for a ban on the household use of triclosan in 2009;¹⁹ the American Medical Association has been advising consumers to avoid triclosan since 2000. Physicians for Social Responsibility petitioned the U.S. Environmental Protection Agency for a ban in 2011.²⁰

What other governments are doing about Triclosan

In Japan, the amount of triclosan permitted in cosmetics is restricted to 0.1 per cent.²¹ Australia classifies triclosan as “irritating to eyes, respiratory system and skin” and “toxic by inhalation.”²² The European Union classifies it as irritating to skin and eyes, and toxic to aquatic ecosystems. The current limit of triclosan in cosmetics in Europe is 0.3 per cent, the same as Canada.²³

In the E.U., the Scientific Committee on Consumer Safety (SCCS) recently studied the relationship between triclosan and anti-microbial resistant bacteria. The report concluded that, “SCCS can only recommend the prudent use of triclosan... conclusions from in vitro studies cannot be ignored, notably the role of triclosan (and other biocides) in triggering resistance...”²⁴

The U.S. Environmental Protection Agency and Food and Drug Administration are also studying triclosan. The FDA expects to publish its results in 2012.²⁵ The study is expected to reveal the endocrine-disrupting properties of triclosan.

WHAT CAN YOU DO?

1. Avoid purchasing products that are labelled antibacterial, or items that contain the following: **Amicor, Aquasept, Bactonix, Irgasan DP300, Microban, Monolith, Sanitized, Sapoderm, Ster-Zac, and Ultra-Fresh.** Always check product labels for triclosan and don't buy products that contain it.
2. Call on Health Canada to ban triclosan for household use. Sign the petition at action.environmentaldefence.ca/take-triclosan.
3. Visit justbeautiful.ca to download a pocket shopping guide listing triclosan, and other toxic chemicals to avoid in personal care products.



APPENDICES

APPENDIX 1: *THE STORY OF TRICLOSAN*

A brief history of Triclosan

Triclosan [5-chloro-2(2,4-dichlorophenoxy)phenol] was first registered as a pesticide in 1969.²⁶ It is a halogenated phenol, meaning it bears structural similarities to the thyroid hormones,²⁷ as well as PCBs (poly-chlorinated biphenyl), PBDEs (poly-brominated flame retardants), and bisphenol-A, a toxic chemical which has been banned from baby bottles in Canada and has been voluntarily removed from other products as well.²⁸ It is lipophilic, meaning it dissolves in fats. As a result, it can bio-accumulate in fatty tissues.

Triclosan destroys bacteria and some fungi by passing through the cell wall, then interfering with the synthesis of RNA and fatty acids, killing bacteria and preventing bacterial cells from multiplying. While it is not toxic to *C. Difficile* or *Pseudomonas aeruginosa*, it has been shown to be effective against *Staphylococci*, *Streptococci*, MRSA and other bacteria, making it useful in certain contexts.²⁹

In a medical setting, the antibacterial properties of triclosan help doctors, nurses, patients and families to keep hands free of infections that would be harmful to immune-depressed people. But consumers in North America, Europe and Australia have been eager to sanitize the home and work environment too, as if a germ-free world were not only possible but desirable. This has resulted in the proliferation of triclosan in consumer products, and many scientists fear the spread of it has contributed to antibiotic resistance, contributing to a rise in “superbugs” that are especially dangerous to people with depressed immune system function.

For the first 20 years that triclosan was available, it remained common in medical settings, but through the 1990s, its use as an additive in consumer products skyrocketed as marketers saw an opportunity in adding the label “antibacterial” to consumer products. By 2001, it was found in over 700 personal care products in North America.³⁰ As of 2007, Health Canada had registered over 1200 personal care products containing it as an ingredient;³¹ as of 2012, the amount had increased to 1600 products.³²

What is it in?

From its humble beginnings in the surgical setting, triclosan has come a long way. It is in the majority of products labelled “antibacterial”³³. Brand names of it include Aquasept, Irgasan DP300, Sapoderm and Ster-Zac.³⁴ Some fabrics and materials have it added, their name brands are Amicor, Bactonix, Microban, Monolith, Sanitized and Ultra-Fresh.³⁵

Some hand sanitizers are alcohol based, but if they are advertised as “antibacterial”, they are likely to contain triclosan. Many soaps and personal care products also contain triclosan, and in Canada it is

permitted at concentrations of 0.03 per cent in mouthwashes and 0.3 per cent in cosmetics.³⁶ Personal care products such as soap, makeup, shaving cream and other personal care products are subject to the Cosmetics Regulations in Canada, and restrictions and bans on ingredients are listed in the Cosmetics Hotlist.

Toothpaste is regulated by the Food and Drugs Act, and is not subject to the Cosmetics Hotlist. The Colgate-Palmolive Company includes triclosan in Colgate Total toothpaste to combat gingivitis. Triclosan is not necessary for dental health; the Canadian Dental Association approves of many types of toothpaste that do not contain the chemical.

Triclosan has been added to cosmetics and soaps, and is now also found in products as diverse as smartphone cases, clothes, footwear, socks, toys and even some toothbrushes. It is sometimes added to vinyl, plastics, polyethylene, polyurethane, adhesives, floor wax emulsions, caulking compounds, rubber and carpeting as a preservative, and has been used as an anti-microbial pesticide in fire hoses, ice-making equipment, and dye bath vats.³⁷

Concerns for antibiotic resistance

With cases of antibiotic resistant infections on the rise, hand sanitizing stations are a familiar sight in hospitals and clinics. But the U.S. Centres for Disease Control and Prevention (CDC) has compared products containing triclosan to regular soap and water, and has determined that products containing the antibacterial ingredient are no more effective at cleaning hands than traditional soap and water, even in a surgical setting.³⁸ A 2007 review of research comparing hand soaps without triclosan, to antiseptic hand soaps found “the effectiveness was similar to that of plain soap in the majority of studies.”³⁹

Adding triclosan to soaps and cleansers does not result in cleaner hands, but it may be promoting the growth and spread of antibiotic resistant bacteria. In a 2011 study of the bacteria *Stenotrophomonas maltophilia*, researchers found an “unambiguous link” between the presence of triclosan and increased antibiotic resistance. *S. maltophilia* is involved in several types of infections with a high mortality rate, including endocarditis, bacteremia and respiratory infections suffered by cystic fibrosis patients, and infections in people living with cancer.⁴⁰

Triclosan does not cause genetic mutations in bacteria, but rather, in destroying the more susceptible cells and allowing resistant bacteria to survive, it selects for the production of resistant strains of bacteria over generations. Triclosan kills off the susceptible bacteria within a population, but the remaining bacteria go on to grow a new generation that exposure to triclosan cannot destroy. This effect has been demonstrated in the laboratory setting on tests of *E. coli* and *P. aeruginosa*. Because triclosan operates via pathways similar to antibiotics, there is concern that triclosan resistant microbes will also be resistant to pharmaceuticals.⁴¹ Debate currently surrounds the question of whether the resistance to triclosan that has been demonstrated in the laboratory setting is a contributing factor to increasing rates of antibiotic resistance, but the evidence has been sufficient to warrant concern and calls for bans on the household use of triclosan from numerous organizations, including the Canadian Medical Association.⁴² The proven health benefits of triclosan are few, and questions about the safety of the chemical abound.

Triclosan and the Environment

Triclosan is a chemical that has become pervasive in aquatic ecosystems, and stored in fatty tissues of fish and wildlife. Triclosan can bioaccumulate; according to a literature review conducted by the Danish Environmental Protection Agency, the concentrations of triclosan in fish can be thousands of times higher than what is detected in the water column.⁴³ The U.S. Geological Survey conducted a study in 1999-2000 which found triclosan in 57 per cent of 139 waterways;⁴⁴ since the time the study was conducted, the use of triclosan in consumer products has increased. Triclosan has also been detected in wastewater in Europe and Asia.⁴⁵

When people use one of the more than 1,600 personal care products that contain triclosan, some of the chemical is absorbed through the skin, eventually processed by the body and excreted, and some is immediately washed down sinks and drains when we bathe or clean our hands.

When water containing triclosan and other chemicals from personal care products enters city water treatment systems, what happens next depends on the type of Waste Water Treatment Plant (WWTP) that is used to treat municipal sewage and drainage water. WWTP use a variety of techniques; aerobic water treatment is more effective at eliminating triclosan than anaerobic treatment. Effectiveness at triclosan removal in WWTP ranges from nearly total, to totally ineffective.⁴⁶

Considering the prevalence of triclosan in treated wastewater and biosolids, environmental scientists conducted a study on soybeans grown in a greenhouse, under conditions simulating the application of biosolids and wastewater irrigation. Triclosan was found to concentrate in the root of the plant, as well as in the bean.⁴⁷ Wastewater irrigation is a key component of agriculture in many areas, especially as water scarcity concerns are addressed. The long term effects of the human consumption of foods containing triclosan are unknown.

Once triclosan enters waterways, it has a destructive impact on the health of the ecosystem. Triclosan has been shown to be toxic to algae, fish, amphibians, and rats,⁴⁸ and questions about how it affects other species remain unanswered. Dr. Caren Helbing of the University of Victoria has conducted research on the effects of triclosan on anurans (frogs) and found that exposure to the chemical had an impact on metamorphosis and development.⁴⁹ Studies of wistar rats have demonstrated a relationship between triclosan exposure, and the onset of puberty.⁵⁰ The toxic effects of triclosan on fish range from developmental effects and behavioural change, to fry death.⁵¹

In addition to the effects of triclosan itself, its breakdown products include the human carcinogen chloroform, and dioxins, which are one of the most toxic groups of substances known. Chloroform is produced when triclosan reacts with the chlorine present in treated water. Dioxins are produced when triclosan reacts with sunlight.⁵² It has been argued that the amount of chloroform and dioxin produced by the breakdown of triclosan are not significant, but with potent carcinogens, it is advisable to reduce sources of environmental exposure where possible.

Triclosan and Human Health

ENDOCRINE DISRUPTION

In addition to the contamination of aquatic ecosystems, and the production of carcinogens, triclosan poses additional concerns for human health.

Endocrine disrupting chemicals are substances that interfere with the body's hormones. Triclosan is a known endocrine disruptor,⁵³ and mimics thyroxine, an important hormone for the regulation of the body's functions. Triclosan has also been shown to suppress the activity of mast cells, which are important to the functioning of the immune system.⁵⁴

The effects of triclosan's endocrine disrupting capabilities have been studied in rats, fish, and amphibians. Initial studies of triclosan's toxicity were based on a toxicology model that considers toxicity to be monotonic, meaning a higher dose is assumed to be more toxic, and research is aimed at assessing a safe dose, a threshold below which there will be no effect from exposure. But advances in the study of hormones have shown that chemicals like triclosan that mimic the body's own hormones pose a risk to health even at low doses.

The body's hormones, which regulate crucial biological functions such as cell growth, temperature regulation, puberty and reproduction, are part of the endocrine system. Insights into endocrine system function in recent decades have highlighted the extremely sensitive nature of the body's hormonal responses, challenging the traditional understanding that there is a threshold below which exposure to a chemical will not have an effect. Substances that have little effect at a moderate dose may have significant health effects at extremely low doses, in addition to a significant response at a high dose. A well-known example of this phenomenon in humans is the breast cancer treatment drug Tamoxifen, which at high doses is an anti-cancer therapeutic, but at low doses can promote the growth of cancer.⁵⁵ Dr. Tyrone Hayes has also drawn attention to this phenomenon in frogs exposed to the pesticide Atrazine, which has endocrine disrupting effects, impacting the sexual development of xenopus frogs, when administered at extremely low doses.⁵⁶

In light of advances in the study of hormone-mimicking chemicals and endocrine disruption, the argument that triclosan is safe in household products, at the low concentrations currently allowed, fails to take this into account. The established guidelines for use also fail to take into account that consumers are exposed to triclosan constantly, from numerous sources. Not only is the inclusion of triclosan in many of these products without proven benefit, triclosan's endocrine-disrupting properties mean that the constant low-level exposure could be impacting our hormonal systems.

TRICLOSAN AND CHEMICAL PROLIFERATION

The story of triclosan is one chapter in a larger tale of chemical proliferation. Since the Second World War, many chemical innovations have entered the marketplace, to the delight of consumers. From nylons to plastic containers, to pesticides, thousands of new chemicals entered the household of North Americans in just a few decades. According to Dr. Leonardo Trasande, a New York University associate professor of pediatrics, environmental medicine and health policy, “One thousand to three thousand new chemicals were introduced into our environment every year over the past 30 years.”⁵⁷

The health effects of many of these chemicals are simply unknown. But a lack of research should not reassure us that a substance is safe. In January 2012, the U.S. EPA issued a report on the collection of exposure data for chemicals in the marketplace. The report indicates the lack of information available about chemicals currently in commerce, “Of the roughly 100,000 chemicals that have at least limited toxicity information available, less than one-fifth also have exposure information—and for most of these the information is of limited utility (e.g., production volume).”⁵⁸ A chemical registry in the European Union suggests that approximately 143,000 substances are currently in global commerce, and research on the health and environmental effects of many of these substances is lacking.⁵⁹

When triclosan first went into production, there was a lack of scientific understanding of the endocrine-disrupting effects many chemicals such as pesticides and plastics have at varying concentrations. Because this area of research is relatively new, there is a lack of data for the impact triclosan and other chemicals have at low doses. An additional challenge to assessing the health impacts of chemicals is that there may be a lengthy latency period between exposure and observable health effects, as is often the case with cancer, for example, which can take several decades to develop. In addition, when chemicals are widespread in the environment, there may be a lack of an unexposed population against which to compare the health of those who have been living with chronic long term exposure to a given substance. Considering the number of chemicals in commerce, it is also difficult to isolate the effect of any single substance, as humans are now regularly exposed to thousands of chemicals with unknown additive, cumulative, and synergistic effects.

For this reason, ENVIRONMENTAL DEFENCE strongly supports programs such as Canada’s Chemicals Management Plan, which reviews the safety of chemicals currently in commerce. Under the auspices of the Chemicals Management Plan, BPA was banned from baby bottles, and phthalates were restricted from use in children’s toys. In the interests of protecting human and environmental health, ENVIRONMENTAL DEFENCE welcomes any regulatory action on triclosan and other toxic chemicals reviewed by the Chemicals Management Plan.

APPENDIX 2: RESEARCH METHODOLOGY

Materials and Methods

STUDY POPULATION: ENVIRONMENTAL DEFENCE asked eight Canadians from a diverse range of professions and cities, none of whom work in a medical setting, (where the application of triclosan-based sanitizers is a common aspect of personal hygiene) to volunteer to be tested for the presence of triclosan in their urine. Each participant provided a urine sample, which was sent to an accredited laboratory for testing.

EXPOSURE: ENVIRONMENTAL DEFENCE asked participants not to make any changes in their routine, but to continue to use the personal care products they use every day. The triclosan subjects were exposed to would have come from products, items, or other sources in the participant's environment.

CHEMICAL ANALYSIS AND QUALITY CONTROL: ENVIRONMENTAL DEFENCE asked AXYS Analytical Services Inc., an accredited laboratory in Sidney, British Columbia, to conduct analysis for triclosan. AXYS Analytical Services Inc. tests are performed in accordance with CALA accreditation. The lab is certified through CALA and meets all the requirements for ISO17025.

METHODOLOGY FOR LABORATORY ANALYSIS: Urine samples were spiked with β -glucuronidase enzyme (for deconjugation of possible glucuronidated forms of the target analytes) and isotopically labelled quantification standards. Samples were extracted and cleaned up using solid phase extraction (SPE) procedures. The method determined the total of the free and the glucuronidated forms of triclosan. Analyte concentrations were determined by LC/MS/MS and quantified using the isotope dilution quantification method. Typical reporting limits are 1 ng/mL on a 2 mL sample.

METHODOLOGY FOR DATA ANALYSIS: Raw data was received from AXYS Analytical Services Inc. and analyzed by ENVIRONMENTAL DEFENCE.

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