

Pharmaceuticals and Endocrine Active Chemicals in Minnesota Lakes



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Contributors/acknowledgements

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Glossary of terms

mg/L = milligrams per liter, or parts per million (ppm)

µg/L = micrograms per liter, or parts per billion (ppb)

ng/L = nanograms per liter, or parts per trillion (ppt)

EAC Endocrine active chemical

PPCPs Pharmaceuticals and personal care products

hands” routine. This ensured that the person responsible for taking the surface water sample was in contact only with the sampling bottle and minimized the risk for cross-contamination of the sample. Bottles were re-sealed in the plastic bags, chilled, and shipped overnight to the laboratory (Axys Analytical Laboratory, Vancouver, BC) for chemical analysis. Water samples were extracted at the lab within seven days of sample collection. Analysis of 125 chemicals included 97 pharmaceuticals, the personal care products DEET (insect repellent) and triclosan, four alkylphenol and alkylphenol ethoxylates, 19 hormones, and the illicit drug cocaine and its metabolite benzoylecgonine (Table 1). Cocaine and benzoylecgonine were not initially targeted for analysis in this study. However, they were analyzed due to their coincidental inclusion as analytes within a broader suite of chemicals that were all extracted and analyzed by the same method in the laboratory.

Table 1 Chemicals analyzed in surface water for this study.

Alkylphenols		
4-Nonylphenol diethoxylates		
4-Nonylphenol monoethoxylates		
4-Nonylphenols		
Octylphenol		
Personal Care Products		
DEET		
Triclosan		
Illicit Drugs		
Cocaine		
Benzoylecgonine		
Hormones		
17 alpha-Dihydroequilin		
17 alpha-Estradiol		
17 alpha-Ethinyl-Estradiol		
17 beta-Estradiol		
Allyl Trenbolone		
Androstenedione		
Androsterone		
Desogestrel		
Equilenin		
Equilin		
Estriol		
Estrone		
Mestranol		
Norethindrone		
Norgestrel		
Progesterone		
Testosterone		
Trenbolone		
Trenbolone acetate		
Pharmaceuticals/Medications		
1,7-Dimethylxanthine	Glipizide	Sulfathiazole
10-Hydroxy-amitriptyline	Glyburide	Tetracycline [TC]
2-Hydroxy-ibuprofen	Hydrochlorothiazide	Theophylline

4-Epianhydrochlortetracycline [EACTC]	Hydrocortisone	Thiabendazole
4-Epianhydrotetracycline [EATC]	Ibuprofen	Triclocarban
4-Epichlortetracycline [ECTC]	Isochlortetracycline [ICTC]	Trimethoprim
4-Epioxytetracycline [EOTC]	Lincomycin	Tylosin
4-Epitetracycline [ETC]	Lomefloxacin	Valsartan
Acetaminophen	Meprobamate	Verapamil
Alprazolam	Methylprednisolone	Virginiamycin
Amitriptyline	Metoprolol	Warfarin
Amlodipine	Miconazole	
Anhydrochlortetracycline [ACTC]	Minocycline	
Anhydrotetracycline [ATC]	Naproxen	
Azithromycin	Norfloxacin	
Benztropine	Norfluoxetine	
Betamethasone	Norgestimate	
Caffeine	Norverapamil	
Carbadox	Ofloxacin	
Carbamazepine	Ormetoprim	
Cefotaxime	Oxacillin	
Chlortetracycline [CTC]	Oxolinic Acid	
Ciprofloxacin	Oxytetracycline [OTC]	
Clarithromycin	Paroxetine	
Clinafloxacin	Penicillin G	
Cloxacillin	Penicillin V	
Dehydronifedipine	Prednisolone	
Demeclocycline	Prednisone	
Desmethyldiltiazem	Promethazine	
Diazepam	Propoxyphene	
Digoxigenin	Propranolol	
Digoxin	Roxithromycin	
Diltiazem	Sarafloxacin	
Diphenhydramine	Sertraline	
Doxycycline	Simvastatin	
Enrofloxacin	Sulfachloropyridazine	
Erythromycin-H2O	Sulfadiazine	
Flumequine	Sulfadimethoxine	
Fluocinonide	Sulfamerazine	
Fluoxetine	Sulfamethazine	
Fluticasone propionate	Sulfamethizole	
Furosemide	Sulfamethoxazole	
Gemfibrozil	Sulfanilamide	
Other		
Bisphenol A		

Steroid hormones

The steroid hormones androstenedione, androsterone, testosterone, progesterone, and estrone were all detected in lake water samples. These are either naturally occurring or of anthropogenic origin. Mestranol, a synthetic contraceptive, was detected in one lake at 71.7 ng/L.

Alkylphenols

The endocrine active chemicals nonylphenol and octylphenol, breakdown products of commonly used alkylphenol ethoxylate detergents, were detected in 10 percent and 4 percent of the lakes that were sampled, respectively. Nonylphenol was detected up to 20.1 ng/L, whereas the maximum concentration of octylphenol was 3.8 ng/L.

Table 3 Maximum concentrations of analytes that were detected in this study.

Chemical	Maximum detected (ng/L)
Alkylphenols	
4-Nonylphenol diethoxylate	5
4-Nonylphenol monoethoxylate	0
4-Nonylphenol	0
Octylphenol	2
Personal Care Products	
DEET	125
Triclosan	11.8
Illicit Drugs	
Cocaine	5.3
Benzoyllecgonine	9.5
Hormones	
17 alpha-Dihydroequilin	ND
17 alpha-Estradiol	ND
17 alpha-Ethinyl-Estradiol	ND
17 beta-Estradiol	ND
Allyl Trenbolone	1.1
Androstenedione	7.5
Androsterone	406
Desogestrel	ND
Equilenin	ND
Equilin	ND
Estriol	ND
Estrone	15.5
Mestranol	71.7

Norethindrone	ND
Norgestrel	ND
Progesterone	1
Testosterone	4.1
Trenbolone	ND
Trenbolone acetate	ND
Pharmaceuticals/Medications	
1,7-Dimethylxanthine	ND
10-Hydroxy-amitriptyline	ND
2-Hydroxy-ibuprofen	ND
4-Epianhydrochlortetracycline [EACTC]	ND
4-Epianhydrotetracycline [EATC]	ND
4-Epichlortetracycline [ECTC]	ND
4-Epioxytetracycline [EOTC]	ND
4-Epitetracycline [ETC]	ND
Acetaminophen	ND
Alprazolam	0.4
Amitriptyline	4.1
Amlodipine	ND
Anhydrochlortetracycline [ACTC]	ND
Anhydrotetracycline [ATC]	ND
Azithromycin	ND
Benztropine	0.7
Betamethasone	ND
Caffeine	42.9
Carbadox	121
Carbamazepine	36.7
Cefotaxime	ND
Chlortetracycline [CTC]	ND
Ciprofloxacin	19.4
Clarithromycin	ND
Clinafloxacin	ND
Cloxacillin	ND
Dehydronifedipine	1.6
Demeclocycline	ND
Desmethyldiltiazem	ND
Diazepam	ND

Pharmaceuticals/Medications	
Digoxigenin	ND
Digoxin	ND
Diltiazem	ND
Diphenhydramine	1.1
Doxycycline	ND
Enrofloxacin	ND
Erythromycin-H2O	ND
Flumequine	ND
Fluocinonide	ND
Fluoxetine	4.5
Fluticasone propionate	ND
Furosemide	ND
Gemfibrozil	13.2
Glipizide	ND
Glyburide	ND
Hydrochlorothiazide	ND
Hydrocortisone	ND
Ibuprofen	ND
Isochlortetracycline [ICTC]	ND
Lincomycin	ND
Lomefloxacin	ND
Meprobamate	29.4
Methylprednisolone	ND
Metoprolol	ND
Miconazole	ND
Minocycline	ND
Naproxen	ND
Norfloxacin	ND
Norfluoxetine	ND
Norgestimate	ND
Norverapamil	0.2
Ofloxacin	8.9
Ormetoprim	ND
Oxacillin	ND
Oxolinic Acid	ND
Oxytetracycline [OTC]	ND

Pharmaceuticals/Medications	
Paroxetine	ND
Penicillin G	ND
Penicillin V	ND
Prednisolone	ND
Prednisone	ND
Promethazine	ND
Propoxyphene	ND
Propranolol	ND
Roxithromycin	ND
Sarafloxacin	ND
Sertraline	ND
Simvastatin	ND
Sulfachloropyridazine	ND
Sulfadiazine	ND
Sulfadimethoxine	3.5
Sulfamerazine	12.5
Sulfamethazine	134
Sulfamethizole	2.5
Sulfamethoxazole	57.1
Sulfanilamide	ND
Sulfathiazole	32.8
Tetracycline [TC]	ND
Theophylline	90.6
Thiabendazole	4
Triclocarban	ND
Trimethoprim	6.2
Tylosin	ND
Valsartan	5
Verapamil	ND
Virginiamycin	ND
Warfarin	ND
Other	
Bisphenol A	14.9

