

Detection of pharmaceuticals in surface water of a middle Tennessee urbanizing watershed.

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ABSTRACT

Pharmaceuticals have become important chemicals of emerging concern in surface and ground water resources. They have been shown to be relatively stable in aquatic environment and may negatively impact aquatic ecosystems. Recent studies have reported pharmaceutical drugs including steroids, prescription drugs such as antibiotics, anti-depressants, anti-inflammatory drugs, hormones and over the counter (OTC) drugs in aquatic environment. We conducted a study to detect the incidence of pharmaceuticals in Stones River (East fork), Rutherford County. Stones River watershed drains a large portion of Rutherford County including Murfreesboro, Tennessee. Our central hypothesis is that the incidence of pharmaceuticals in surface water in urbanizing and rural watersheds exists, partly due to catchment land uses and outfall discharges. Grab water samples were collected from Stones River for three seasons, winter, summer, and fall 2014, 2015 and 2016 respectively. Water quality data was also collected in-situ using multi-parameter sondes. The water samples collected were analyzed for the presence of human pharmaceutical compounds using GC-MS. The pharmaceuticals detected included those used for treatment of chronic alcoholism, diabetes, antibiotic drug and anti-inflammatory conditions. While the scope of the study did not include actual concentration of the pharmaceuticals, the incidence of pharmaceuticals was detected in the river.

INTRODUCTION

- The Stones River watershed is located in Middle Tennessee.
- The Watershed has approximately 1,461 miles of streams. It drains a total area of 936 square miles that drains to the Cumberland River.
- While water is a renewable resource, it is also a finite resource, hence both quantity and quality are very important for human health and ecosystem sustainability.
- However, increase in human population and urbanization has exacerbated the anthropogenic pollution of aquatic environments.
- Tests for pharmaceuticals and personal care products conducted by United States Geological Survey (USGS) in 1999 and 2000 in 139 streams in 30 states indicated that pharmaceuticals and personal care products were found in 80% of the streams sampled (Kolpin et al., 2002; Kim et al., 2009).
- In December 2006, *Environmental Science & Technology* devoted an entire special issue (volume 40, number 23) to the topic of emerging contaminants.
- In a recent study (Kaur, 2016) pharmaceuticals and personal care products were detected in three rivers (Collins River, Cumberland River and Stone River) in middle Tennessee.

I. Objectives

- To assess temporal variation of pharmaceuticals in surface water in East Fork Stones River.
- To identify the most frequently detected pharmaceuticals in the streams monitored.

II. Hypothesis

- Incidence of pharmaceuticals in the streams will fluctuate as a function of the seasons.
- Presence of pharmaceuticals in surface water contribute to the impairment of water quality.

MATERIALS AND METHODS

- For this study Stones River watershed was chosen that drains a large portion of Rutherford County with drainage area of 262 square miles.
- Sampling of pharmaceuticals and physicochemical water quality parameters were taken during a span of 3 seasons: **Summer**, **Fall**, and **Winter** for 7 weeks.
- The pharmaceuticals were analyzed using GC-MS at the University of Georgia Environmental Analysis Laboratory, an EPA certified Lab.
- Solid Phase Extraction (SPE) was used to separate compounds in a sample based on their polarities and solubilities in specific solvents.



Fig. 1. East Fork Stones River

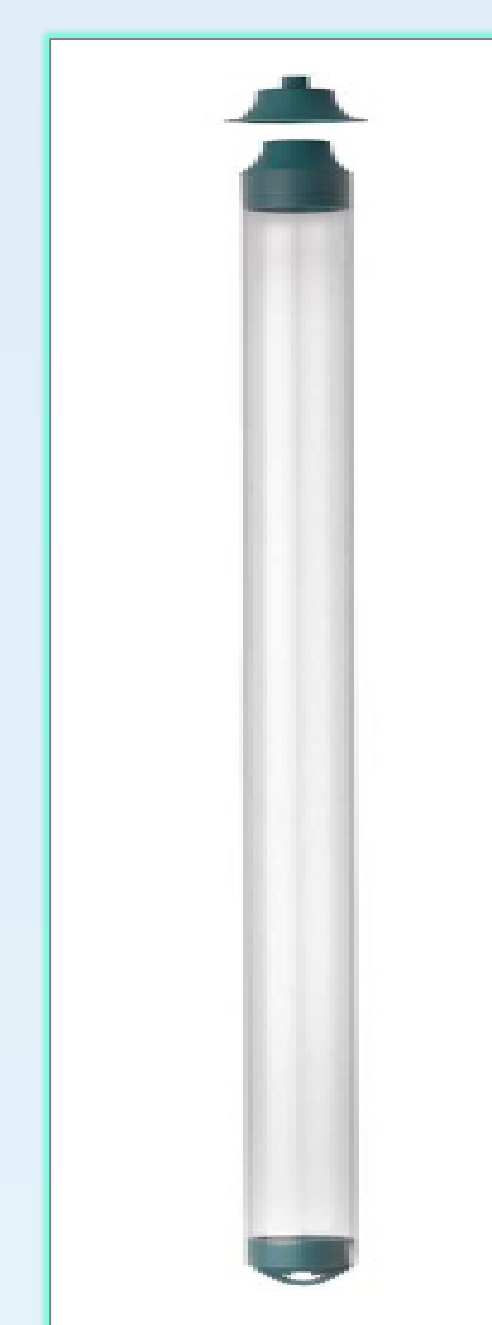


Fig. 2. Bailer



Fig. 3. Sampling Container



Fig. 4. Eureka Manta2™



Fig. 5. GC-MS

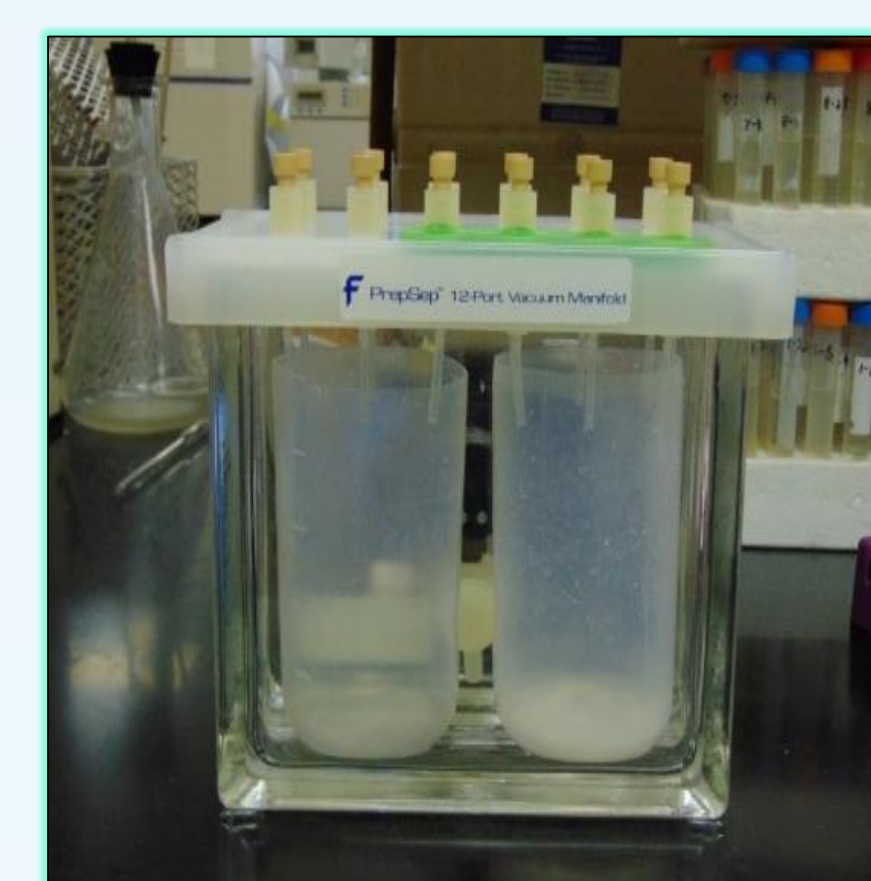


Fig. 6. Vacuum Manifold



Fig. 7. Loading of water samples

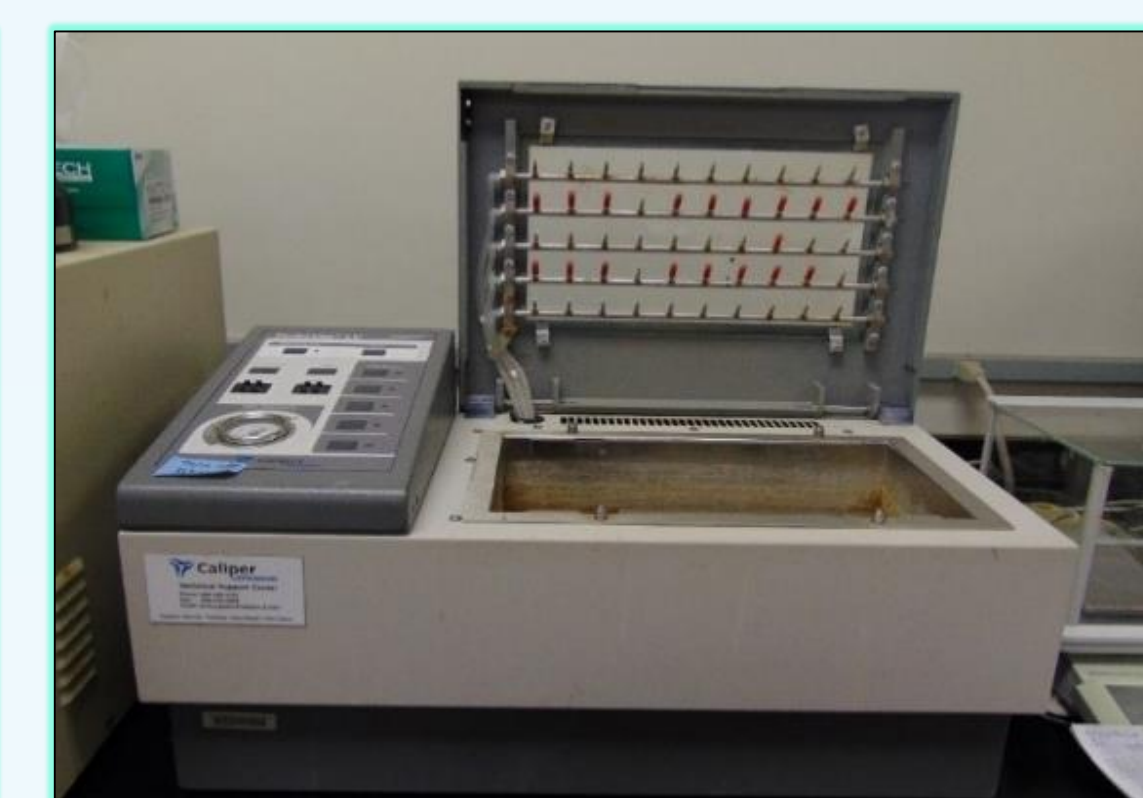


Fig. 8. Water bath used for evaporation

RESULTS

- The data collected was subjected to analysis of variance (ANOVA) using the General Linear Model (GLM) procedures of Sigma Plot.
- Differences in pharmaceuticals detected in the stream along with the water quality parameters, in response to seasonal variation, and their interactions were tested at $p < 0.05$.

Table 1. Pharmaceuticals detected in Stones River during Summer 2014 sampling

#	Chemical name	CAS number	Use/description
1	Thiazolidine	504-78-9	Drug usually indicated in cases of type II diabetes for decreasing blood sugar; Antibiotic drug penicillin also contains a thiazolidine ring.
2	Disulfiram	97-77-8	Drug used for the treatment of chronic alcoholism by producing an acute sensitivity to ethanol (alcohol)
3	Methyl palmitate	112-39-0	Anti-inflammatory; Anti-fibrotic (prevent liver fibrosis)

Table 2. Pharmaceuticals detected in Stones River during Fall 2014 sampling

#	Chemical Name	CAS number	Use/description
1	DEET	134-62-3	Anti-spermatogenic Agents; Insect Repellents; Insecticides
2	Nonadecane	629-92-5	Pharmaceuticals
3	Trimethoprim	738-78-5	Antibiotic

Table 3. Pharmaceuticals detected in Stones River during Winter 2015 sampling

#	Chemical name	CAS number	Use/description
1	Disulfiram	97-77-8	Drug used for the treatment of chronic alcoholism by producing an acute sensitivity to ethanol (alcohol)
2	Nonadecane	629-92-5	Pharmaceuticals
3	DEET	134-62-3	Antispermatogetic Agents; Insect Repellents; Insecticides

SUMMARY

- In summary pharmaceuticals were detected in East Fork Stones River in each season.
- However some pharmaceuticals (Methyl Palmitate, Thiazolidone, and Disulfiram) and other organic chemicals such as DEET and Thiram were detected more often.

ACKNOWLEDGEMENT

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