Atrazine Concentrations in Drinking Water Supplies in Three Kentucky Counties

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Introduction

Atrazine is the second most used herbicide in the United States. It is a triazine herbicide used to prevent pre- and post- emergence of broadleaf weeds in crops, including corn, sugarcane, lupines, and pine. Chemicals in the triazine class are known endocrine disruptors and carcinogens making their exposure to humans potentially dangerous. A study performed by Hayes et al. (2002) described atrazine's effect on male frogs. This research highlighted the potential impact of low doses (<3 ppb) of atrazine in the ecosystem and initiated the evaluation of its impacts in the United States. Considering the body of research illustrating the human health and ecosystem impacts of atrazine, investigating the occurrence of atrazine in local water supplies is critical in understanding human exposures and related public health outcomes.

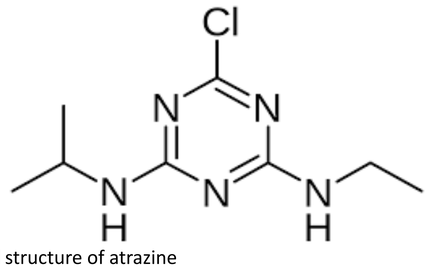

Figure 1. Chemical structure of atrazine

As part of the triazine family of chemicals, atrazine (Figure 1) is unique in its mobility and resistance to metabolism. This is evident based on levels observed in drinking water supplies, its ubiquitous occurrence in surface and groundwater water during the growing season, as well as its prevalence in waterbodies of the Midwest due to the large amount of acreage planted with corn. In multiple studies, Atrazine has been shown to have multiple adverse effects on amphibians and mammals in their environment.

Methods

Using the U.S. EPA's Atrazine Monitoring Program data, the relationship between Atrazine concentrations in drinking water and source water, both raw and finished water, was investigated in three Kentucky counties. An analysis of the occurrence of atrazine was conducted to evaluate the levels in source water and finished drinking water, assess differences between Kentucky counties, and explore exposure scenarios for public health protection.

Atrazine Concentration in source water (raw) and drinking water – Ohio County Public Drinking water system in 2016

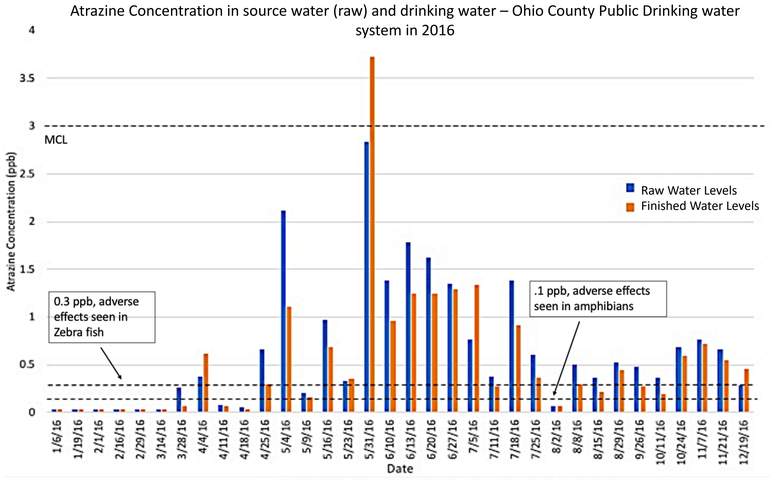

Figure 2. Atrazine concentrations in source water (raw) and finished drinking water for the Ohio County public drinking water system in 2016

Atrazine Concentration in source water (raw) and drinking water – Butler County Public Drinking water system in 2016

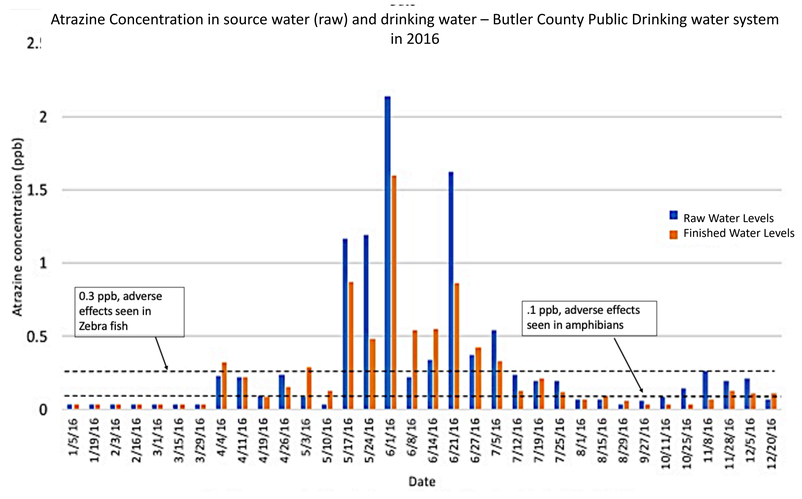

Figure 3. Atrazine concentrations in source water (raw) and finished drinking water for the Butler County public drinking water system in 2016

Atrazine Concentration in source water (raw) and drinking water – Muhlenberg County Public Drinking water system in 2016

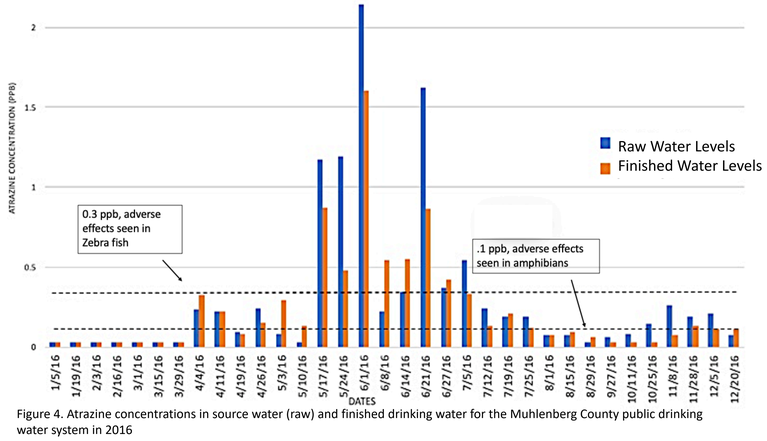

Figure 4. Atrazine concentrations in source water (raw) and finished drinking water for the Muhlenberg County public drinking water system in 2016

Other considerations

Kentucky is known for its karst landscapes that include caves, sinkholes, and flowing groundwater streams (Figure 5). Karst is defined as a type of terrain formed by the dissolution of soluble rocks such as limestone, dolomite and gypsum. This type of topography allows for precipitation to penetrate the soil and flow into the subsurface of the ground from higher elevation generally towards a stream in lower elevation which dissolves small fractures in bedrock. This leads to large cave systems as well as sinkholes. Due to the direct flow conduits from surface to ground water and back, contamination can quickly reach a drinking water supply.

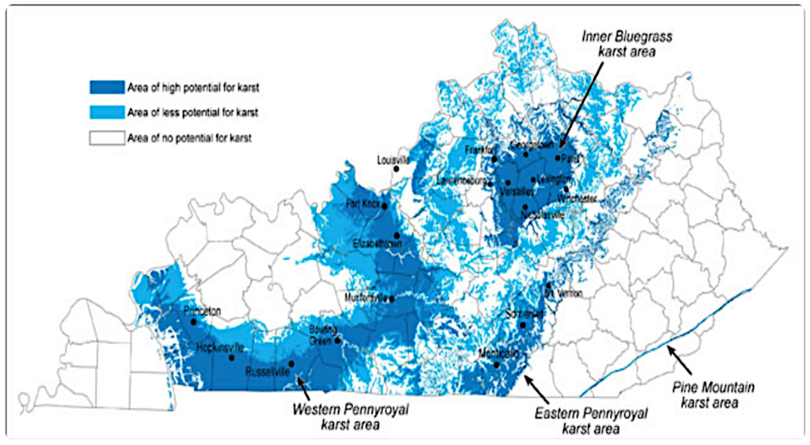

Figure 5. Areas of Kentucky with the potential for Karst (Kentucky Geological Survey, https://www.uky.edu/KGS/karst/)

Results & Discussion

It was hypothesized that source water (raw water) would have a higher concentration of Atrazine than finished water for the water supplies in this study. This hypothesis was proven incorrect, as there were multiple instances in the data that showed a higher finished water concentration than raw water. Our results show that 22.3% of finished water samples in Ohio County were higher than raw water samples with 17.3% and 14.8% of finished water samples being higher in Butler and Muhlenberg Counties, respectively. Figures 2, 3 and 4 show the data collected. Future research will focus on exposure assessment and observed health outcomes related to Kentucky citizens consuming atrazine contaminated drinking water.

Acknowledgements

Figure 1- By J3D3 - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=35191195.

Figure 2- Kentucky Geological Survey. (n.d.). Karst, Kentucky Geological Survey, University of Kentucky. Retrieved from https://www.uky.edu/KGS/karst/.