# Waters of Concern

## Colorado State study finds antibiotics used for growth, prevention of diseases in food animals can make their way into waterways.

A Colorado State University (CSU) study indicated that antibiotic drugs used specifically for enhancing growth, preventing diseases and increasing feed efficiency in food animals, such as cattle, are making their way into public waterways.

The study, which identifies in waterways antibiotics that come from both human and animal uses, is the first to pinpoint drugs specifically from animal sources. For example, the antibiotic monensin, used exclusively in ag applications, is used as a marker in the study and was measured only in waterways located near animal feeding operations (AFOs). The study also is among the first to measure the compounds in stream and riverbed sediment and found that the concentration of antibiotics was 20 times to 1,000 times greater in sediment than in the surrounding water.

### Answering questions

According to a separate collaborative Federal Drug Administration (FDA) and CSU College of Veterinary Medicine and Biomedical Sciences environmental assessment for the use of monensin in the feed of beef cattle, these levels are below concentrations that could result in environmental impact or effects on human health. The study's authors point out that the results do not necessarily implicate waste management practices of AFOs, but rather reveal that animal antibiotics are making their way into streams and rivers.

"The presence of antibiotics in waterways drives two primary concerns," said Ken Carlson, associate professor of civil engineering and principal investigator of the project. "The first is the potential toxic dangers of these compounds to fish, plants and other aquatic organisms — as well as to humans through drinking water — because water treatment plants generally cannot remove all of these compounds. There is also a potential, which we are currently studying, that these types of animal and human antibiotics have in contributing to the emergence of strains of disease-causing bacteria that are resistant to even high doses of drugs."

Carlson added that future studies are needed to determine exactly how the antibiotics make their way into public waterways, how long the drugs stay in water and sediment, and how to better understand potential dangers to aquatic life, animals and humans. The presence of pharmaceutical compounds in urban wastewater discharge is also recognized as an important issue and is being studied by researchers across the country.

### Improving practices

As a result of the findings, the CSU group is beginning to work with the ag community to identify best management practices (BMPs), such as waste handling, that will minimize the release of these compounds to the environment and contribute to sustainable ag practices in the future.

"Our group wants to work closely with the agricultural community to develop simple approaches for reducing the release of these antibiotics," said Amy Pruden-Bagchi, assistant professor of civil engineering and co-principal investigator of the study.

Pruden-Bagchi said these compounds end up in waterways because only a fraction of the drugs are completely metabolized by animals or humans, which means the medicine's active compounds often pass through the body and are discharged into public wastewater systems or waste lagoons. Since these compounds are still active, the ultimate fate of these antibiotics is an important environmental issue.

For two years, the CSU research group has been studying the occurrence, transport and fate of antibiotics used for human and animal-production purposes in the environment. The specific objective is to understand the extent of occurrence of these compounds in different areas of the Cache la Poudre watershed in Colorado and to determine the relative contributions from urban and ag sources.

### Antibiotic discoveries

Since the use of antibiotic medicines began more than 40 years ago, AFOs have been increasing the use of feeds fortified with these compounds. Although active remnants of human pharmaceuticals, such as estrogen from birth control pills, have been known to make their way into the environment for many years, only recently have researchers identified a significant number and quantity of veterinary medicines in the environment.

In a landmark study, the U.S. Geological Survey measured concentrations of 24 antibiotics in water samples from 139 streams and rivers across 30 states in 1999 and 2000; the compounds were found in 80% of the sampled streams. However, the antibiotics measured had other uses than just for animal growth stimulation, and it could not be determined if the antibiotics entered streams through wastewater treatment plants or AFOs.

"The most important question that needs to be addressed relates to the occurrence and source, either urban or agriculture, of these compounds," said Jessica Davis, professor of soil and crop sciences and co-principal investigator of the project. "The study's objective was to begin measuring the occurrence of a range of antibiotics in the environment and in suspected sources. Assuming the goal is to minimize discharge of antibiotics to the environment, we can then begin identifying approaches for reducing the release from both urban and agricultural sources."

### Study details

The study, funded by the U.S. Department of Agriculture (USDA) and the university's Agricultural Experiment Station, was conducted on the Cache la Poudre River, which originates near the Continental Divide in Rocky Mountain National Park and flows through steep, mountainous terrain for about 43 miles before entering Fort Collins.

After traveling through Fort Collins, the river moves through about 45 miles of ag landscape, on which more than 50 livestock operations are located, before it joins the South Platte River in Greeley. Five testing sites were established along the river from its mouth to its merger with the South Platte. There are no significant tributaries to the Poudre River, which helps make this an ideal watershed to study the occurrence of the introduction of antibiotics into the watershed through natural areas, as well as urban and ag landscapes.

Among the compounds measured were five tetracyclines and concentrations of three ionophore antibiotics. Although tetracycline drugs are extensively used for treating human diseases, they also are extensively

used as animal antibiotics in the United States. The ionophore antibiotics are of special interest because they are used exclusively in ag applications.

Of the five sites, the only site where no antibiotics were detected was the site in the mountains before the river flows through urban or ag landscapes. By the time the river had exited the third testing site in Fort Collins, six of the monitored 11 antibiotics were found in samples, indicating urban sources of contamination such as wastewater treatment plant discharges. At the final site in Greeley, where the river converges with the South Platte, all five of the tetracyclines monitored were present, showing both urban and ag influences.

Notably, monensin, used only for animals, was found only at sample sites near ag-influenced regions of the watershed.

Another important finding of the study was the significantly greater concentration of the three ionophore antibiotics in the sediment, compared to the overlying water. For monensin, the concentration in the sediment was approximately 1,000 times greater than in the river. Salinomycin was about 500 times greater in the sediment than the water column, and narasin was 100 times greater in sediment than water. However, this is still below safe concentrations for aquatic life and humans.

Future phases will study mechanisms for transport of these compounds to the stream and identify additional strategies for minimizing the release of these compounds to the environment.

**Editor's Note:** *This article was written by Brad Bohlander, communications specialist for the CSU Communications and Marketing Department, which supplied this article.*