

Findings Of Antibiotics In Groundwater Under Worst Case Criteria In The Agricultural Environment in Germany

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Intensive livestock farming lead to the application of pharmaceuticals, particularly antibiotics. Up to 80 % of the veterinary medicines are excreted by the animals and enter the environment via spreading of manure and slurry. Studies show that antibiotic residues occur in manure and slurry, in soil, in soakage and in surface waters. In some cases they were also detected in ground and drinking water. However, the degree of groundwater pollution by antibiotic residues from livestock farming is unknown. Monitoring programs or a threshold value for groundwater do not exist. Therefore the Federal Environment Agency supported a project that aimed to investigate near-surface groundwater samples in regions of a high livestock density and a high risk of exposure to antibiotics.

For suitable monitoring, worst case criteria lead to the selection of sampling sites and antibiotics analyzed. A preliminary literature study was carried out to identify the veterinary pharmaceuticals of highest potential for groundwater contamination. As a result 23 relevant antibiotics were selected, belonging to the groups of tetracyclines, sulfonamides, macrolides, fluorochinolones and lincosamides. 48 Sampling sites were selected characterized by several parameters supporting percolation of the compounds of interest.

In 2012 and 2013 groundwater samples were taken from each measuring point and analyzed with multi-methods, based on solid phase extraction (SPE) and liquid chromatographic separation coupled to tandem mass spectrometry (LC-MSⁿ). The detection limits ranged from 1 to 15 ng/L for all substances. Additionally, all groundwater samples were tested for the antiepileptic carbamazepine as municipal wastewater tracer because some antibiotics, e.g. sulfamethoxazole (SMX), are used both in human and veterinary medication

The total of 100 groundwater samples represent young, recently developed groundwater. Thus, exhibiting high potential for leaching of antibiotics into the groundwater. Out of the 23 investigated antibiotics only 3 sulfonamides could be detected. Tetracycline and all other antibiotics could not be verified. With regard to the 48 sampling sites, at 39 locations no veterinary antibiotics were detected. At seven locations sulfonamides were detected at low concentrations (<100 ng/L) and at two locations SMX was repeatedly detected at concentrations above 100ng/L, with a maximum of 950 ng/L. Sulfadiazine and sulfadimidine could be found at concentrations slightly above the detection limit. We can conclude that translocation of veterinary antibiotics into near-surface groundwater is not ubiquitous in Germany. However, unfavorable conditions show presence of antibiotics in groundwater with high seasonal variability.