

# Detecting the undetected

New **TEAGASC** research is measuring veterinary pharmaceuticals in our groundwater for the first time.

## Background

Due to increased intensification of food production systems in Ireland, and more broadly within Europe, veterinary pharmaceuticals have become a critical component in animal husbandry. Administration of these products can potentially lead to their occurrence in environmental waters, such as groundwater. This has led to them being considered as potential emerging groundwater contaminants of concern. In Ireland, groundwater accounts for approximately 26% of the public and private drinking supply, with some regions relying on groundwater for up to 75% of their drinking water. This research focuses on investigating the groundwater occurrence of two groups of veterinary pharmaceuticals commonly used in Irish agriculture: anthelmintics (used in food-producing animals to treat helminths, which are parasitic worms); and, anticoccidials (used primarily in poultry production for treating coccidiosis, an intestinal parasitic disease).

## Challenges

The term 'emerging contaminant' refers to both chemical compounds that are newly developed, and chemicals whose fate and toxicity in the environment is unknown. Anthelmintics and anticoccidials fall into the latter category, with limited information available on their environmental occurrence, fate and ecotoxicity, particularly in groundwater. A common factor thought to contribute to this shortage of information is the lack of suitably sensitive and comprehensive analytical methodologies for detecting these contaminants at environmentally relevant concentrations. The majority of methods available relate to the detection of these pharmaceuticals in foods of animal origin, with very few methods applicable to water, and those that are applicable only include a limited number of compounds (<12). There is also no regulatory

monitoring of these pharmaceuticals in environmental waters, with no definitive legislative limits specific to groundwater or drinking water. This is despite the fact that up to 90% of the administered dose can be excreted by the animal into the environment. Once in the environment, these drugs can further break down into transformation products (TPs), which can be more harmful than the parent product. The main objective of this research was to develop comprehensive analytical methods and apply them to investigate the occurrence of these contaminants in Irish groundwater.

## Analytical methodologies

Two comprehensive, highly sensitive analytical methods were developed, validated and applied to investigate the occurrence of 40 anthelmintic compounds (including 13 TPs) (Mooney *et al.*, 2019) and 26 anticoccidial compounds (Mooney *et al.*, 2020), respectively, in groundwater samples. The main approach to analysis is summarised in **Figure 1**. Once collected, the contaminants were extracted from water samples using a technique called solid phase extraction (SPE), which allows for the simultaneous extraction and purification of the contaminants from large volumes of water sample. Following extraction, the contaminants were detected and quantified by liquid chromatography tandem mass spectrometry (LC-MS/MS), which is considered the most powerful technique for the quantitative determination of veterinary drugs in complex matrices. Both methods were extensively validated and deemed fit for purpose. The method limits of detection (LODs) ranged from 0.5-20 ng/L for the anthelmintics and 0.1-20 ng/L for the anticoccidials.

## Occurrence studies

The methods were applied in two separate studies to investigate the occurrence of anthelmintics and anticoccidials throughout Ireland. For each study, sampling sites were selected to be representative of different animal production systems and hydrogeological settings. In 2017, 106 sites were sampled for the 40 anthelmintics, with 16 different compounds detected across 22% of sites. Detections were of the order of 1-41 ng/L. Temporal studies suggest that an increased frequency of



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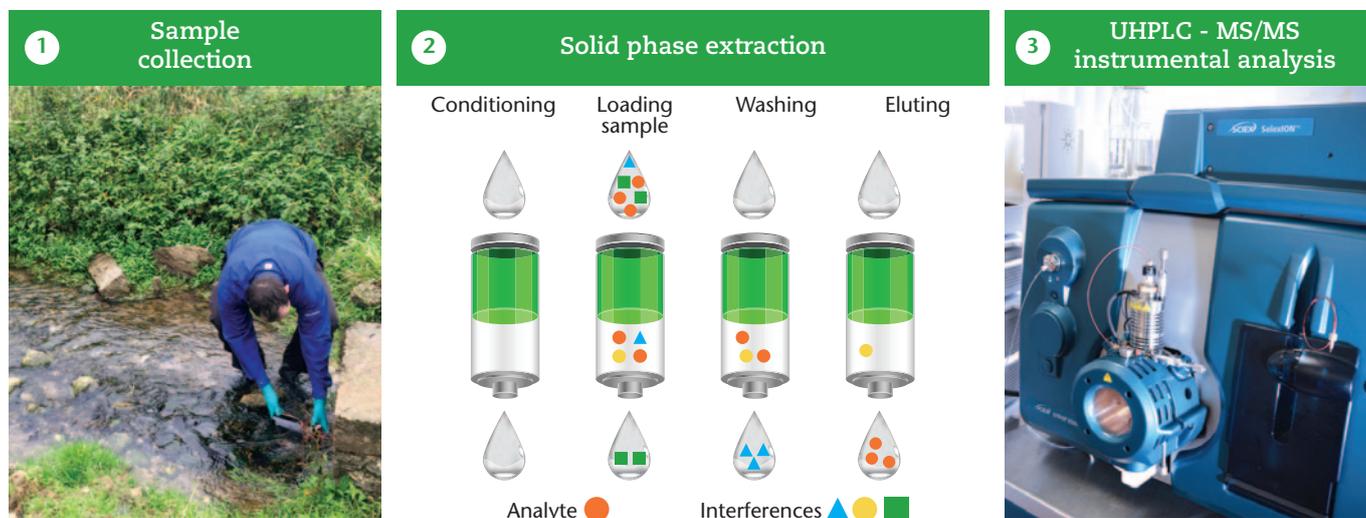


FIGURE 1: Three main steps of the analytical approach.

anthelmintic detections between February and March may coincide with the end of the closed period for winter. In a separate study in 2018, 109 sites were sampled for the 26 anticoccidials, and seven different compounds were detected at 24% of sites, with concentrations in the range of 1-385 ng/L. Statistical analysis has shown that the presence of poultry activity (poultry farms and poultry manure landspreading) is a significant driver of the occurrence of anticoccidial compounds. Both studies are the first of their kind in Ireland, and report on the first occurrences of these veterinary compounds in Irish groundwaters.

### Conclusion

The two developed methods are considered the most comprehensive currently available for application to environmental water samples. These methods will allow for more comprehensive occurrence studies to be carried out, providing more information to better inform on the environmental fate and occurrence of anthelmintics and anticoccidials in environmental waters. Overall, this study highlights that these veterinary pharmaceuticals are occurring in our groundwater, and therefore may require more appropriate consideration with regard to potential groundwater quality and environmental concerns, given that their use is anticipated to continue, if not increase, as a result of agricultural intensification and climate change.

### References

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