



Emerging Organic Contaminants Arising in Rural Environments: Investigations in Karst and Fractured Bedrock Aquifers

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Introduction

Emerging organic contaminants (EOCs) are becoming more and more of a growing international concern with respect to their occurrence in and contamination of groundwater bodies. In Ireland, due to increased intensification of the food production in response to Food Wise 2025, agro-chemicals such as veterinary drugs and crop protection agents have become a critical component of agriculture. The administration and application of such substances can potentially lead to their occurrence in groundwater. As a result, loss of agro-chemicals to water is not only a matter of international scientific interest, but potentially a health risk to humans and the environment.

There is limited information available on the occurrence and associated levels of these agro-chemicals in the environment with information on the occurrence of metabolite and transformation products (TPs) even more scarce. This project is part of the Irish Centre of Research in Applied Geosciences (iCRAG). It will fill the void in current research and provide data on EOC occurrence in Irish groundwater.

Project aim and objectives

The project aim is to investigate the occurrence of EOCs arising from rural activities in Irish karst and fractured bedrock aquifers. The primary focus will be on the loss to groundwater of three main groups of anti-parasitic agents (anthelmintics, anti-coccidials and pyrethroid insecticides) which represent some of the most widely used veterinary compounds in Irish agriculture production. Project objectives include:

1. Investigate the occurrence of EOCs and its relationship to the chemical characteristics of the compounds, to include both parent compounds and transformation products (TPs) where appropriate.
2. Determination the source of EOC detections.
3. Determine the transport pathway factors involved in EOC occurrence

Methodology

1. Comprehensive literature review to establish the method performance capability required. To include review of legislative requirements, expected levels in the environment and best analytical techniques available.

2. Development and optimisation of three comprehensive multi-analyte solid phase extraction (SPE) (Fig. 1) techniques for the determination of anthelmintics, anti-coccidials and pyrethroids respectively in water with ultra-high performance liquid chromatography tandem mass spectrometry (UHPLC-MS/MS) instrumental determination (Fig. 2).

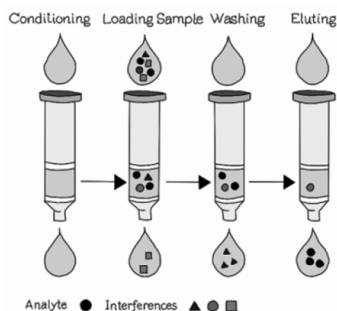


Figure 1: Solid Phase Extraction

3. Application of the developed method to environmental samples with an initial pilot sampling programmes targeting high risk sites to allow for refinement of the analytical parameters and to inform future sampling programmes.

4. Investigation of the spatial occurrence of EOCs in Irish groundwater



Figure 2: instrumental analysis by UHPLC-MS/MS

5. Assessment of temporal occurrence of groundwater EOCs to examine seasonal aspects in terms of timing of application and groundwater recharge activity.

Expected outcomes

The work carried out as part of this overall project will help to assess whether or not anti-parasitic agrochemicals are an issue in Irish groundwater. In addition, this work will contribute to evaluating environmental effects of agricultural expansion under Food Wise 2025 in terms of investigating such potential rural groundwater concerns, which may not previously have been considered adequately in an Irish context. Not only will the project help assess Irish groundwater quality; it will also contribute to international research by providing more comprehensive multi-analyte analytical methods for determination of both parent compounds, and more importantly TPs. These methods will allow us to obtain better understanding of the occurrence and fate (i.e. mobility) of TPs in the environment, which lacks understanding at present.

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