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Reactivity and transfer of DOM model-solutions through soil columns: Can cola, whole milk and green tea help enlightening DOM behavior and reactivity in soils?

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Dissolved organic matter (DOM) attracts the attention of numerous scientists around the world. Despite its small proportion of the total soil organic matter (SOM), DOM is regarded as one of the most reactive SOM fractions. Due to its dissolved state, it is easily transportable through porous media. Various studies concerning its properties and functions in terrestrial and aquatic environments have been carried out, where DOM is usually addressed as a whole. Its heterogenic and variable character make it difficult, probably impossible, to clearly define its chemical composition. Yet, there is the need to find out more about the individual compounds or families of compounds that can be part of a complex DOM solution. How can they determine reactivity and transport behavior? To what extent do size, structure and functionalities matter? Model compounds or DOM model-solutions with “reduced” or “predictable” complexity can be helpful in answering such questions.

We investigated the transport of three DOM model-solutions with similar carbon content, but different molecular composition through soil columns to study their transfer through the soil. Experiments were conducted under biotic and abiotic conditions. Cola, whole milk and green tea have been found to be adequate DOM model-solutions representing three different categories of DOM: Category (i) Cola; mainly containing low molecular weight sugars, category (ii) milk; containing a mixture of higher molecular weight proteins and fats and low molecular weight sugars, category (iii) green tea; mainly composed of high molecular weight compounds (polyphenols). The difference of the three model-solutions is also reflected by their respective fluorescence patterns

that vary greatly corresponding to the relative molecular size. The breakthrough curves show a greater retention of solutions containing high molecular weight compounds, such as fats and polyphenols, in comparison to cola. Only the cola solution showed an initially rapid breakthrough similar to the conservative tracer followed by a decreasing concentration in later stages due to biodegradation. Green tea eluted significantly after the tracer, signifying a strong retention of molecules through sorption. The results suggest that reactivity and transport behavior of a DOM sample can be anticipated from molecular structure, size and amounts of individual compounds present in DOM.