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Molecular change of dissolved organic matter and patterns of bacterial activity in a stream along a land-use gradient

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Streams and rivers receive considerable amounts of terrestrial organic matter. A large proportion of that carbon is humic-like material and dominated by lignin and tannin compounds. During the way from mountain springs to the lowlands, the production of autochthonous DOM due to the photosynthesis of algae increases. DOM in streams and rivers is mainly processed by heterotrophic bacteria. This processing is done by planktonic, suspended stream water bacteria or by epilithic bacteria associated in biofilms. Previous studies have shown that the activity of planktonic bacteria was related to DOM quality while activity of biofilm bacteria was not due to benthic algae and extracellular polymeric substances as additional carbon sources in biofilms (1). However, DOM quality was assessed by bulk optical parameters only, e. g. freshness and humification index. Thus, we tested the hypothesis that biofilm bacterial activity is related to some DOM components if the DOM composition is more highly resolved by molecular characterization which was measured by Fourier transform ion cyclotron resonance mass spectrometry (FTICR MS) in a stream along a land-use gradient. Furthermore, bacterial activity was measured in short-term incubations (bacterial production) and in long-term bacterial growth experiments with stream DOM. FTICR MS data and bacterial production data were combined by Spearmans rank correlation.
The average carbon oxidation state decreased strongly from upstream to middle stream and kept nearly constant further downstream. In parallel the humification index and the relative intensities of relatively unsaturated and oxygen-rich components decreased from upstream to middle stream. From about 700 components six were positively correlated by high level of significance with bacterial production in biofilms. One component was negatively correlated to biofilm production and another to planktonic bacteria production.

Reference

1) Kamjunke, N., Herzsprung, P., Neu, T. R., 2015. Quality of dissolved organic matter affects planktonic but not biofilm bacterial production in streams. Sci. Total Environ. 506-507, 353-360.