



Product-to-parent reversion increases ecosystem exposure to and environmental persistence of 17α -trenbolone

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The product-to-parent reversion of metabolites of trenbolone acetate (TBA), a steroidal growth promoter used widely in beef cattle production, was recently observed to occur in environmental waters. The rapid forward reaction is by direct photolysis (i.e. photohydration), with the much slower reversion reaction occurring via dehydration in the dark. The objective of this study is to quantify the potential effect of this newly discovered reversible process on TBA metabolite concentrations and total bioactivity exposure in fluvial systems. Here, we demonstrate increased persistence of TBA metabolites in the stream and hyporheic zone due to the reversion process, increasing chronic and acute exposure to these endocrine-active compounds along a stream. The perpetually dark hyporheic zone is a key location for reversion in the system, ultimately providing a source of the parent compound to the stream and increasing mean in-stream concentration of 17α -trenbolone (17α -TBOH) by 40% of the input concentration under representative fluvial conditions. We demonstrate generalized cases for prediction of exposure for species with product-to-parent reversion in stream-hyporheic systems. Recognizing this risk, regulatory frameworks for compounds undergoing product-to-parent reversion will require new approaches for assessing total exposure to bioactive compounds. We discuss the role of regulating “joint” or “mixture” bioactivity as an emerging paradigm for more meaningful management of micropollutants.