In the Twilight of Trenbolone: The Vampire Steroid

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Trenbolone acetate (TBA) is a high-value steroidal growth promoter administered to beef cattle whose metabolites are potent endocrine disruptors. We demonstrate that the rapid phototransformation of TBA metabolites, long thought to mitigate their environmental risk, is actually reversible in surface waters. This product-to-parent reversion results in unique diurnal cycling and substantial regeneration of TBA metabolites at rates that are strongly temperature- and pH-dependent. The implications of reversible phototransformation are substantial, including systematic underestimation of TBA metabolite ecological risks, while reversion intermediates can react to yield uncharacterized, yet likely bioactive, TBA analogs. Analogous phenomena also occur for structurally similar steroids, including human pharmaceuticals, suggesting a new class of environmental contaminants whose behavior confounds nearly all current predictive fate models and regulatory ecosystem risk assessment paradigms.

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