Investigating the Influence of Coal Ash Heavy Metal Leachate on Thyroid Hormone Concentration, Hormone Receptor Gene Expression and Spectral Sensitivity in Danio rerio

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As global energy needs have skyrocketed in the past decade, energy byproduct has increased in tandem. Places like Mooresville, North Carolina; Pineville, Indiana; and southeastern Puerto Rico serve as coal ash fill sites and cancer cluster hotspots. Yet, as energy companies deny any link between ash and endocrine disruption, evidence points to ash heavy metals prompting thyroid toxicity. The goal of this study was to determine if coal ash heavy metal leachate can alter the light sensitivity, gene expression, or hormone production of thyroid processes within Danio Rerio. Danio Rerio or zebrafish larvae were chosen to replicate disruption, as they have recently emerged as a model organism for thyroid diseases and disorders. To quantify endocrine disruption, zebrafish were exposed to artificially created coal ash leachate, and raised until 6dpf. As zebrafish color cones show insights into thyroid-catalyzed morphological development, zebrafish larvae movement was recorded in response to specialized light sequences. RT-PCR was performed to determine potential disruption in the regulation of thyroid-related genes, namely TPO, DIO2, DIO3, and THRß. Finally, immunosorbent assay kits quantified the amount of thyroid hormone TH4. Results indicate that coal-ash leachate significantly disrupts zebrafish behavioral response and gene expression, but not TH4 hormone levels. Additionally, results provide novel insights into zebrafish medium-wavelength color cone development. As legislation surrounding coal ash containment continues to weaken, the outcomes of this experiment will be invaluable to communities around the globe— seeking to uncover possible connections between ailments afflicting their neighbors and the coal ash that underlies their homes.

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