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Effects of Perfluorooctanoic Acid and Nano Titanium Dioxide on The Physiological Defense of The Mussel *Mytilus coruscus*

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Perfluorooctanoic acid (PFOA), a surfactant that is widely used, is known to be harmful to marine life's development, metabolism, immune system, and genetics. It is not fully known, nevertheless, how PFOA and titanium dioxide nanoparticles (nano-TiO₂) affect each mussel's unique defense mechanisms. This study investigates the defense mechanisms and regulatory processes of thick-shell mussels, *Mytilus coruscus*, subjected to different concentrations of nano-TiO₂ (0 and 0.1 mg/L, size: 25 nm) and PFOA (0, 2, and 200 µg/L) over a period of 14 days.

The combined exposure to PFOA and nano-TiO₂ results in significantly lower numbers of byssal threads (NBT), byssal thread length (BTL), diameter of distal byssal threads (DDB), diameter of proximal threads (DPB), diameter of middle threads (DMB), adhesive plaque area (BPA), and breaking force of byssal threads (N) when compared to the control group. Furthermore, the morphological surface of the broken byssal threads smoothed out, but the adhesive plaques' surface roughened out. The mussel foot exhibited dispersed tissue organization and damaged villi. Additionally, there was an upregulation of the adhesion gene *mfp-3* as well as byssal thread strength genes (*preCOL-D*, *preCOL-NG*). The combined stressors of PFOA and nano-TiO₂ negatively impacted the function of byssal threads, weakened the structure of the foot, and resulted in a compensatory upregulation of adhesion and byssal thread strength gene expression. Organic and particulate pollutants in marine ecosystems seriously disrupt the vital life processes of organisms, endangering their ecological roles and the overall equilibrium of the ecosystem.



Figure 1: Mussels under observation

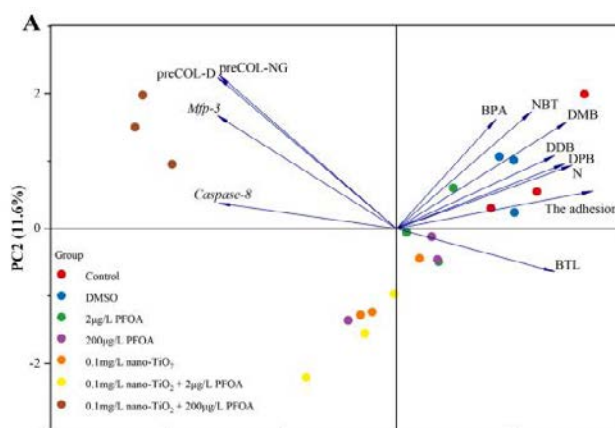


Figure 2: PCA results of byssal threads exposed for 14 days to different levels of pollutants. Both the loadings of the variables (↑) and the scores of the experimental conditions are shown.