Plastics Destroying Your DNA: An Inquiry into the R-Loop Inducing Behaviors of Bisphenol A and Its Implications

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Bisphenol A (BPA), a widely used plastic monomer, is a known estrogen disruptor, which has massive potential implications for public health. Estrogen can cause R-loops, a three-stranded nucleic acid structure composed of a single-stranded DNA and a DNA:RNA hybrid, which often causes DNA double-strand breaks. The goal of this project was to analyze the effects of BPA on ER-positive breast cancer cells, particularly focusing on R-loop formation and resulting effects on chemotherapeutics. Cells were treated with BPA and/or 4-hydroxytamoxifen and analyzed through molecular biology techniques. MCF7 cells treated with BPA had higher proliferation rates, a 4-10 fold increase in R-loop formation, elevated levels of DNA double-strand breaks, and a 4 fold increase in cells containing micronuclei. With no BPA, the EC50 for tamoxifen was 12.87 uM, but with just 1 ng/ml of BPA, the EC50 nearly doubled to 21.02 uM. My results show that BPA, in concentrations relevant to average consumers and plastics workers around the world, induces R-loop formation, DNA double-strand breaks, and checkpoint activation, and therefore, could be a mutagen. This is particularly important for those who would be more affected by these acute responses to BPA, such as children and the elderly. These results call for a more responsible use of plastics, not just for environmental reasons, but also for the potential health risks to our population. Constant DNA damage, especially from double-strand breaks caused by R-loops, is a crucial component in the development of cancer.