The Effects of Hexabromocyclododecane (HBCD) on Toll-like receptors (TLRs) Expression in Human Immune Cells

Hexabromocyclododecane (HBCD), a flame retardant widely used in applications such as building insulation, furniture upholstery, and textiles, is recognized as an environmental contaminant. Consequently, HBCD has been detected in various environments, including wildlife, human breast milk, and blood serum. Toll-like receptors (TLRs) are critical proteins of the innate immune system, playing a pivotal role in the body's first line of defense against pathogens. They initiate signaling pathways involving mitogen-activated protein kinases (MAPKs), which activate transcription factors such as NF-κB and AP-1, leading to the production of pro-inflammatory cytokines, including interleukin 1-beta (IL-1β) and IL-6. Previous studies have demonstrated that HBCD promotes the upregulation of IL-1β and IL-6 in a MAPK-dependent manner, with this cytokine stimulation relying on TLR4. Based on these findings, we hypothesize that HBCD may influence the protein expression levels of TLRs in human immune cells. This study explores the effects of HBCD on the protein expression of transmembrane TLRs 1, 2, and 4, as well as intracellular TLRs 3 and 8. Preliminary data suggest variations in protein expression levels across different TLRs, with donor-specific differences observed. These findings indicate that HBCD may directly or indirectly interact with specific TLR receptors, contributing to its mechanism of stimulating pro-inflammatory cytokine production. This preliminary evidence provides insight into how HBCD elevates pro-inflammatory cytokines in the absence of appropriate stimuli, potentially leading to chronic inflammation.