Development and *In Vitro* Bioactivity Profiling of Alternative Sustainable Nanomaterials

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Sustainable, environmentally benign nanomaterials (NMs) are being designed as alternatives based on functionality to conventional metal-based nanomaterials (NMs) in order to minimize potential risk to human health and the environment. Development of rapid methods to evaluate the potential hazard of alternatives before entering the marketplace is critical for informing material design and utilization. Cellular based high-throughput screening (HTS) assays, currently being utilized in the ToxCast chemical screening project, are valuable to evaluate the differences in the bioactivities of conventional NMs and their alternatives. Preliminary research has focused on development of nanoparticles (NPs) from natural biopolymer materials that will maintain integrity for intended applications and then rapidly degrade post-use. These NMs, infused with active components, would become inert after use and could serve as novel NM platforms in oral drug delivery or environmental remediation. Biodegradable cellulose and lignin NPs have been synthesized by an environmentally-friendly water-based antisolvent precipitation process based on pH-jump. The hydroxpropyl methylcellulose phthalate NPs (~200-300 nm in diameter) dissolve above pH ~ 5.5 limiting their potential applications. However, the synthesized lignin NPs (~30-100 nm in diameter) have been stabilized up to pH ~ 9, allowing them to be stable in physiological conditions for their intended use and in the HTS assays (pH ~7.2). The next phase of research will focus on further characterizing lignin NPs and evaluating bioactivity of infused particles pre- and post-use using ToxCast assays. This research takes an innovative and proactive approach to enhance the safety of materials, inform hazard assessment upstream, and move nanotechnology toward sustainability based on green chemistry principles.

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