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# Time-Dependent Release kinetics of Nano Plastics from Disposable Cups

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## Abstract

Microplastic pollution is a growing concern, but the potential human exposure to even smaller nano plastics, especially from ubiquitous sources like disposable cups, remains understudied. This study addresses this critical gap by investigating the time-dependent leaching kinetics of nano plastics from disposable cups during steeping with hot water. Disposable cups were steeped in ultrapure water (90-95°C) for varying durations (1, 3, 5, 10, and 15 minutes) with continuous stirring at 100 RPM to ensure homogenous mixing. Following steeping, the leachate was subjected to Fourier-transform infrared spectroscopy (FTIR) analysis to identify the type of leached plastic film. Nanoparticle Tracking Analysis (NTA) was employed for its superior sensitivity in detecting nanoparticles. NTA analyses were performed on 20 replicates (n=20) of each leachate sample to ensure statistical significance. The NTA software tracked Brownian motion of nanoparticles within a 30-second video recording, allowing for the determination of size distribution and concentration of leached nano plastics. This study revealed a time-dependent release profile of nano plastics from the disposable cups. NTA analyses demonstrated a statistically significant increase in nano plastic concentration in the leachate with extended steeping durations. Furthermore, a Monte Carlo simulation, incorporating established hot beverage consumption patterns, estimated a potentially significant chronic daily intake (CDI) and lifetime intake (LTI) of nano plastics from regular use of disposable cups. These findings highlight a concerning release of nano plastics from disposable cups with hot water, suggesting a potential route for human exposure. The study emphasizes the need for further research on the potential health risks associated with chronic nano plastic ingestion and the development of sustainable alternatives to disposable cups. This research contributes to a more comprehensive understanding of human exposure to nano plastics from common environmental sources and lays the groundwork for future investigations into the associated health implications.

**Keywords:** Nano plastics, disposable cups, leaching kinetics, hot water, Fourier, transform infrared spectroscopy (FTIR), Nanoparticle Tracking Analysis (NTA), chronic daily intake (CDI), lifetime intake (LTI), human exposure

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