Mechanisms of Micronanoplastic Uptake and Translocation in the Small Intestinal Epithelium by Pathway Inhibition Using a Triculture Model

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Millions of tons of plastic are produced annually with less than 10% of the amount being recycled, generating large amounts of waste. Micronanoplastics (MNPs) can be defined as small particles of plastics that form by environmental degradation and are considered a serious environmental hazard. Aside from contaminating the environment, MNPs also end up in the human body, raising the need to further study how this impacts human health. In this study, the uptake and translocation of ingested MNPs was assessed using a polysterene model MNP and a triculture small intestinal epithelium (SIE) cellular model coupled with simulated digestions. Several energy dependent pathways are involved in endocytosis and by using certain inhibitors to block these pathways, the micronanoplastic uptake mechanisms can be studied. The inhibitors used for this study are 2-deoxy-D-glucose, sodium azide, chloroquine, dyngo, 7-keto-cholestorol, cytochalasin D, and amiloride, each with varying concentrations. Simulated digestion of the oral, gastric, and small intestinal phases was done with polystyrene MNP at different concentrations to obtain the small intestinal phase digesta. A triculture model which includes enterocytes, HT29 and M-cells cells was treated with the inhibitors and then exposed to the digesta. We allowed for uptake and translocation to occur for 4 hours after which we measured the MNP concentration in the basolateral compartment to determine which pathways were involved with the passage of the MNPs. Following treatment and uptake, the contents within the basolateral and apical compartments of the triculture transwell model were collected and underwent fluorescent analysis to determine MNP concentrations for each pathway treated by the inhibitors. Data showed most uptake was via passive diffusion, with some contribution from actin-dependent pathways (i.e., phagocytosis). Furthers studies utilizing uptake gene siRNA knockdown should be conducted to get more accurate results. Because of the ever-growing threat presented by plastic pollution and wastes, this is an area in critical need for further study. Supported by R25ES020721.