Laboratory simulation finds smaller nanoparticles are subject to enhanced agglomeration in gastrointestinal tract

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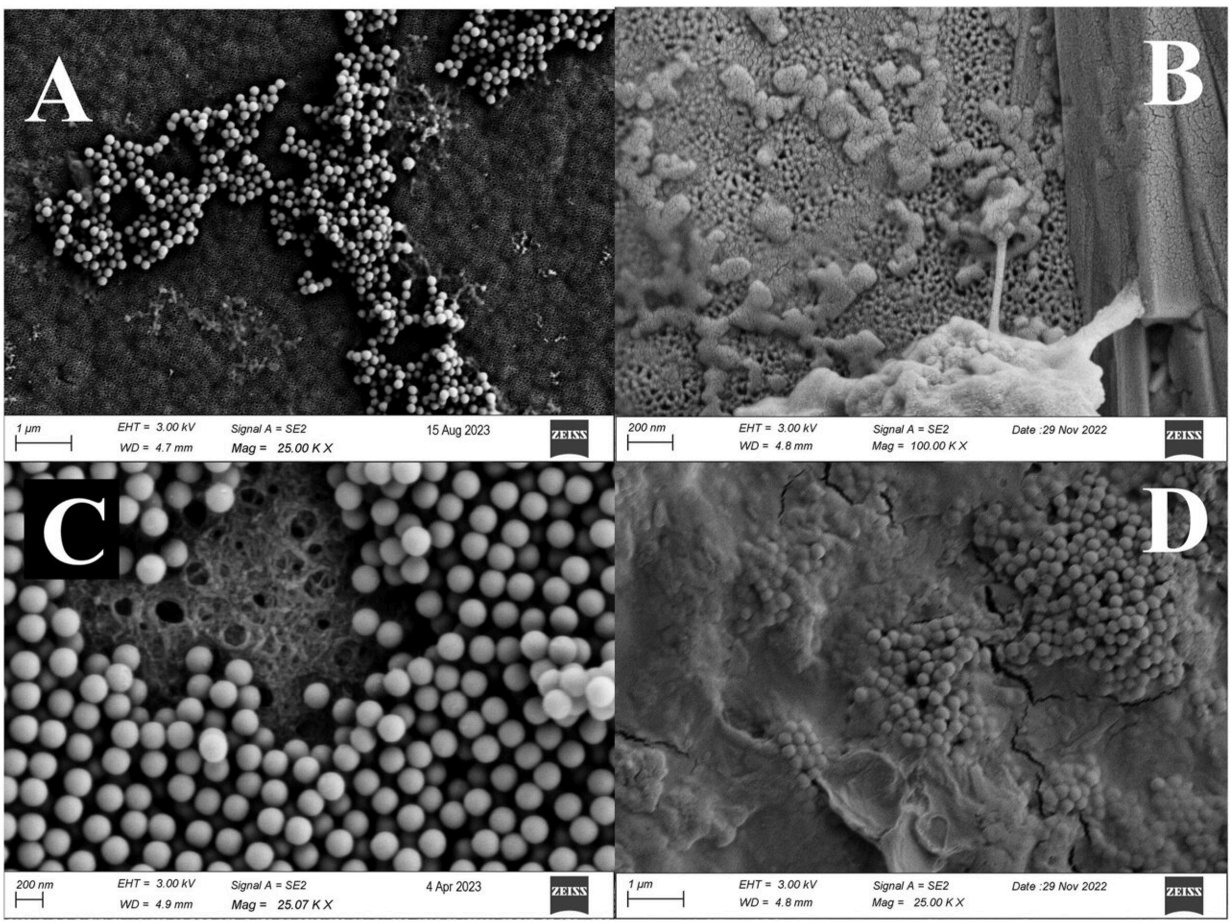


SEM pictures of the polymeric nanoparticles. A) Pristine PLGA NPs B) PLGA NPs after the full gastrointestinal digestion procedure C) Pristine PSL200 D) PSL200 after the full gastrointestinal digestion procedure. Credit: *Chemosphere* (2024). DOI: 10.1016/j.chemosphere.2024.143277

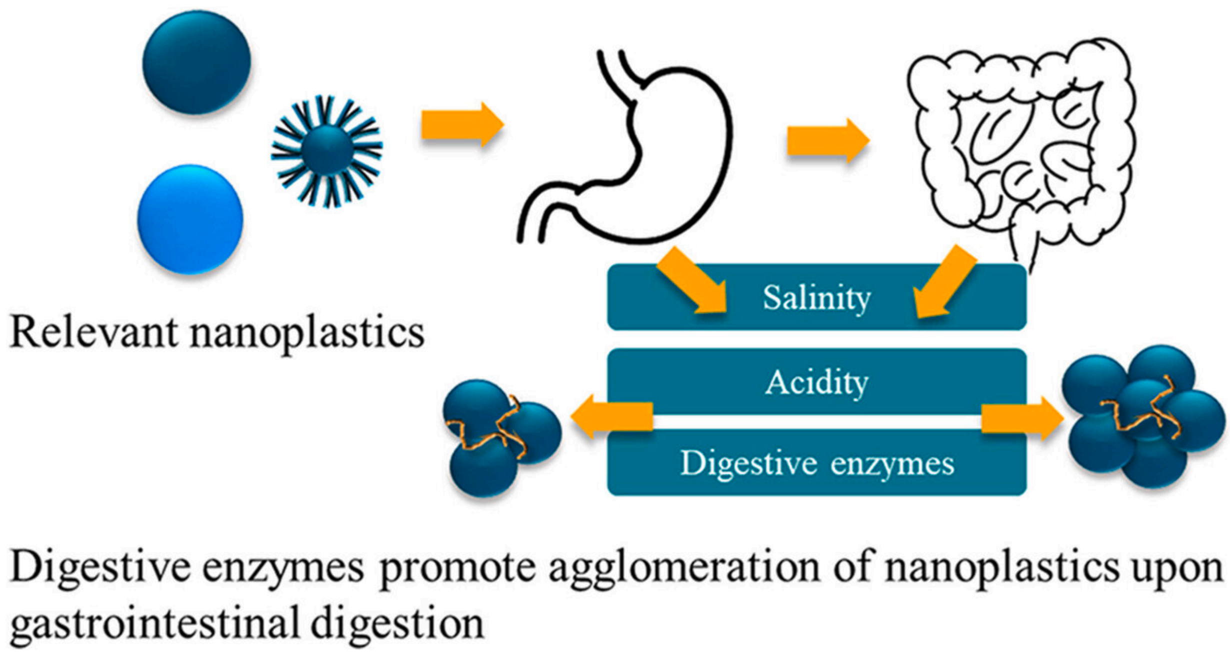
In a laboratory set-up simulating the human stomach and intestine, researchers at the University of Amsterdam have explored the fate of plastic nanoparticles during gastrointestinal digestion. In their paper published in the October issue of *Chemosphere*, they report how a range of model plastic nanoparticles interact with digestive enzymes and form agglomerates.

Their exploratory findings indicate, among others, that smaller nanoparticles are subject to enhanced agglomeration, which might reduce their risk of uptake via cell membranes of the small intestine.

The research was carried out in cooperation between researchers at the Analytical Chemistry group (Ph.D. candidate Maria Hayder, Dr. Alina Astefanei), the Industrial Sustainable Chemistry group (Prof. Gert-Jan Gruter), both at the Van 't Hoff Institute for Molecular Sciences (HIMS), and Prof. Annemarie van Wezel of Environmental Ecology at the Institute for Biodiversity and Ecosystem Dynamics (IBED).

Since the study concerns a laboratory simulation using a simplified model of human gastrointestinal tract, its results cannot be extrapolated to predict any actual health effect of nanoplastics. The research does, however, provide insight into a crucial aspect of understanding nanoplastics' health risk: the fate of nanoplastics in the digestive system.

The paper provides a solid technical foundation for investigating this. It presents a dedicated set of analytical approaches for the characterization of nanoparticles and their agglomerates.



Credit: *Chemosphere* (2024). DOI: 10.1016/j.chemosphere.2024.143277

Digestive enzymes promote agglomeration

One of the more important observations was that the smaller the particles, the greater their tendency to agglomerate in the environment of the human stomach and intestine. This is aided by the presence of digestive enzymes that are secreted by our gastrointestinal tract.

Since such agglomeration increases the effective size of the ingested nanoplastics, this potentially reduces their ability to pass through cell membranes. More surprisingly, the study revealed that even more "stable" types of nanoplastics are affected by digestion. These also agglomerate due to their interaction with the digestive enzymes, and eventually reach the same size as the "less stable" ones.

The study focused on a set of nanoparticles of different composition, size and surface as model representatives of real-life nanoplastics contamination. To make the study possible, these were used in higher concentrations than what would typically be ingested by humans. This allowed the researchers to observe trends that indicate what can be expected in actual digestion of nanoplastics.

By establishing such trends the researchers have demonstrated the value of their set of analytical approaches. They emphasize, however, that nanoplastics analysis is still in its infancy, and requires and deserves further investigation.

More information: Maria Hayder et al, What if you eat nanoplastics? Simulating nanoplastics fate during gastrointestinal digestion, *Chemosphere* (2024). DOI: 10.1016/j.chemosphere.2024.143277

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