PH DRIVEN COLLOIDAL TRANSFORMATIONS OF MS2 VIRUS PARTICLES FOR WATER PURIFICATION

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Viral infection due to contaminated drinking water is the main cause of infantile death by diarrheal disease [1]. Viruses are difficult to remove by common gravity driven filters due to their nanometer scale size. With the global goal of improving virus removal in drinking water treatments, the colloidal structure of a virus model, MS2 bacteriophage, has been investigated; the effects of pH and Suwannee River natural organic matter in water have been studied [2].

Dynamic light scattering, small angle X-ray scattering and cryogenic transmission electron microscopy were used to characterize the colloidal structure of MS2 in water. The results show that the bacteriophage MS2 is a spherical particle with a core-shell type structure and a total diameter of 27nm. The RNA core has a radius of about 8nm and the protein shell forming the virus capsid is about 6nm thick.

The water pH was discovered to have a major influence on the colloidal structure of the virus: at pH above 5, interparticle repulsions stabilize the virus solution. A decrease in pH to 3 led to diminishing of the repulsion forces and micrometer sized virus aggregates. This aggregation process was reversible upon circulating the water pH. In addition, the presence of Suwannee River natural organic matter that simulates the organic components in surface water was found to sterically stabilize the virus particles, reducing aggregates size and promoting disaggregation with pH increase.
These findings will allow a better understanding of virus interactions and can guide the design of advanced water filtration processes for virus removal.

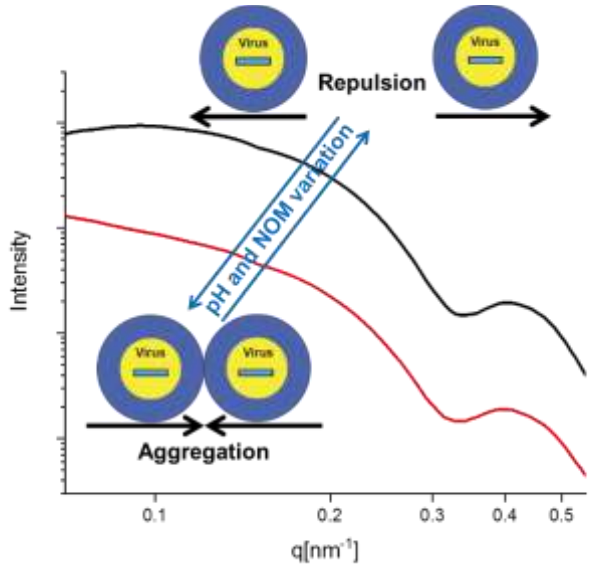

Figure 1 – Water parameters influencing the colloidal state of MS2 bacteriophage from repulsive interactions to aggregation

References:
[1] Kotloff, K. L. et al. Lancet 2013, 382 (9888), 209-22.
[2] Watts S. et al Tailoring virus interaction for drinking water purification. Manuscript in preparation status Mai 2019