Mechanical disassembly of viral cages probes the interaction of single stranded RNA and the coat proteins

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High resolution cryo-electron microscopy structures of nucleocapsids qualitatively indicate the interaction degree between single-stranded (ss) RNA and coat proteins (CPs) in viruses but lack the direct evaluation of its effects on the virus capsid. Here we study the mechanical uncoating of three variants of the human picobirnavirus(hPBV) virus-like particles (VLPs) which differ in the N-terminal of their CPs: (i) hPBV CP contains the full-length CP sequence; (ii) hPBV Δ45-CP lacks the first 45 N-terminal residues; and (iii) hPBV Ht-CP is the full-length CP with an N-terminal 36-residue tag that includes a 6-His segment. We used Atomic Force Microscopy (AFM) to induce and monitor mechanical disassembly of individual hPBV particles. First, whereas Δ45-CP particles that lack packaged ssRNA exhibited a fast post-breakage indentation, CP and Ht-CP particles that pack ssRNA showed a gradual behavior after being fractured. Second, mechanical fatigue experiments revealed that the increased length of N-terminal (Ht-CP) in 8% makes the virus particles to crumble ~10 times slower than wild type N-terminal CP, indicating an enhanced RNA cargo retention after Ht-CP particles have been crack-opened. Our results indicate that the three differentiated N-terminal topologies of the capsid lumen result in distinct disassembly dynamics as a consequence of their particular interaction with the packaged RNA.

References

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Figures

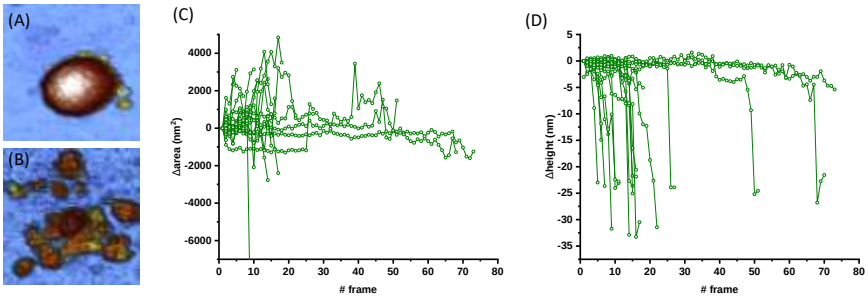

Figure 1: Evolution of an individual CP particle under mechanical fatigue procedure. (A) Frame #0 shows the intact particle, (B) frame #12 is the image of the final collapsed state. (C) Evolution of the particle surrounding covered area with debris for CP VLP. (D) Evolution of the particle height for CP virus particle.