Figure 3: VA EDR vs. Agitation Curves For Different Scales Of Vertical-Wheel Bioreactors

- Cell densities >800,000–900,000 cells/mL consistently achieved after six days at three different bioreactor scales, with over 10 billion viable hMSCs produced in a single 15 L bioreactor → further process optimization possible
- Cell recovery efficiency ~86% at 15 L scale (includes in-vessel dissociation, harvest, wash, and concentration)

Figure 4: Correlation Between VA EDR And hiPSC Aggregate Morphology

- Computational fluid dynamics modeling used to calculate volume average energy dissipation rate (VA EDR) for various combinations of bioreactor scales and agitation rates → VA ED Rs plotted to generate best-fit curves
- Example of how VA EDR can be used as a predictive tool to minimize guesswork during process scale up:
  1) At small scale (0.1 L), determine the RPM that yields optimal aggregates (60 rpm) → the corresponding VA EDR is the "target VA EDR" (6.1E-4 m²/s³)
  2) Find the target VA EDR on larger scale curves → corresponding agitation rate will produce similarly optimal aggregates (30 rpm @ 0.5 L and 15 rpm @ 15 L)
- Results from multiple experiments with various collaborators: uniformly spherical hiPSC aggregates achieved at various scales and agitation rates when VA EDR falls within suggested range of 3.0E-4 to 1.5E-3 m²/s³