ParticleSentry^{AI} software code was used to analyze particle formation in antibody formulations subjected to extensional flows and hydrodynamic shear in a paper published recently in the Journal of Pharmaceutical Sciences.

Interfacial Adsorption Controls Particle Formation in Antibody Formulations Subjected to Extensional Flows and Hydrodynamic Shear

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Abstract:

During their manufacturing and delivery to patients, therapeutic proteins are commonly exposed to various interfaces and to hydrodynamic shear forces. Although adsorption of proteins to solid−liquid interfaces is known to foster formation of protein aggregates and particles, the impact of shear remains controversial, in part because of experimental challenges in separating the effects of shear from those caused by simultaneous exposure to interfaces. Extensional flows (occurring when solutions flow through sudden contractions) exert localized elongational forces that have been suspected to be damaging to proteins. In this work, we measured aggregation and particle formation in formulations of polyclonal and monoclonal antibodies subjected to extensional flow, high shear (105s_1) and exposure to stainless-steel/water interfaces. Modification of the surface charge at the stainless-steel/water interface changed protein adsorption characteristics without altering shear profiles, enabling shear and interfacial interactions to be separated. Even under conditions where antibodies were subjected to high hydrodynamic shear and extensional flow, production of subvisible particles could be inhibited by modifying the stainless-steel surface charge to minimize antibody adsorption. Digital images of particles recorded by flow imaging microscopy (FIM) and analyzed with machine learning algorithms were consistent with a particle formation mechanism by which antibodies adsorb and aggregate at the stainless steel/water interface and subsequently form particles when shear displaces the interfacial aggregates, transporting them into the bulk solution. Topographical differences measured using atomic force microscopy (AFM) supported the proposed mechanism by showing reduced levels of protein adsorption on surface-charge-modified stainless-steel.