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Quantifying Pharmaceutical Composite Breakup Using Acoustic Methods

Pharmaceutical formulation is the process of combining a pharmaceutical active together with inactive excipients to produce a well-defined dissolution profile and dosage form of the active compound. For reasons of convenience, most pharmaceutical compounds are delivered orally. The human body will easily absorb water-soluble drugs through this method; however, nearly half of all new drugs are categorized as poorly water-soluble. Undissolved drugs never reach the bloodstream and are excreted, resulting in waste. To enhance the dissolution of poorly water-soluble drugs, we have developed a formulation composite of a water-soluble drug with silica nanoparticles. Strikingly, though the drug and silica do not dissolve rapidly in water, the composites break apart rapidly in water, leading to enhanced bioavailability. Our lab has previously used image analysis to follow the breakup of the composite, but this method is difficult to quantify. Here we present a new method, using an underwater microphone, known as a hydrophone, to gather acoustic information during composite breakup and use this information as a quantitative measure of breakup. We determined that this acoustic information can be quantified and have begun analyzing acoustic data using free acoustic analysis software. For example, the low frequency region of the spectrum appears to be associated with background noise, not fracture events; thus, the high frequency region is our primary focus. The high-amplitude occasional acoustic events represent major cracks in the sample, while the click trains represent more uniform breakup.

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