265g Protein-Polymer Interactions and Flavor: a Microfluidic Study

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Whether you find a wine smooth or astringent may have a clear physical chemical explanation. In recent years, the importance of a polymer's architecture on its physical properties has been recognized. We are interested in studying the effect of the polymer's macromolecular architecture on their interactions with proteins. The aggregation caused by naturally occurring polymers in wine impart noticeable differences in flavor.

We have developed a microfluidic platform in order to study a variety of protein-polymer interactions. We monitor polymer-protein interactions by means of fluorescence resonance energy transfer (FRET) where the polymer molecules are unlabeled and two populations of protein molecules are fluorescently labeled with a FRET donor and a FRET acceptor pair. Because FRET signal is highly distance-dependent, it provides a clear measure of association and aggregation.

In our initial studies we are interested in the effects of polymer branching on protein aggregation and have chosen a model system of dendrimers of different generations. We study Poly(amidoamine) PAMAM dendrimers and fluorescently labeled Streptavidin. We can manipulate the overall charge of PAMAM dendrimers through the dendrimer generation (G0, G2, G4) or by adjusting the solution pH.

We create a microfluidic device made from polydimethylsiloxane (PDMS). Our channels have all four walls made from PDMS which we chemically modify to minimize protein and polymer adsorption. We introduce the protein solution into the center of a three lane microfluidic device. The laminar flow in these channels allows us to directly compare polymer or control solutions interacting with the protein solution by interdiffusion. Our initial results show qualitative differences between Streptavidin/PAMAM generation2 (G2) and Streptavidin/PAMAM generation4 (G4) interactions. As molecules move along the channel they interdiffuse and interact. We observe both a shift in peak position as well as changes in intensity profiles as we move down the channel. The peak position shift indicates that indeed both polymers interact with Streptavidin and that changes in intensity profiles are not solely caused by diffusion. Differences between intensity profiles of Streptavidin/PAMAM G2 and Streptavidin/PAMAM G4 show that indeed both polymers interact differently with Streptavidin molecules; we are currently analyzing these FRET profiles to provide a quantitative measure of protein-polymer interaction.

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