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Molecule Carrier Design: Structuralizing Xanthan Using TMA Chloride

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The question of how to ensure effective administration has greatly plagued the medical and food industries. Whether it's cancer drugs or nutrient molecules, without stable carriers these compounds become inactive before they reach their destinations. Ensuring successful administration of these drug molecules requires the discovery of substances that can form rigid, protective structures. Xanthan polysaccharide solution proves to be such a candidate, and the goal of this research is to identify how to facilitate its structuralization.

The overall procedure calls for 1.0% xanthan to be dissolved in water with a 3 millimolar concentration of Tetramethylammonium (TMA) added. As shown in the figure below, 20 microliters of this TMA-xanthan sample were loaded onto glass rods with *Z*, the distance between the rods, initially at 1 millimeter.

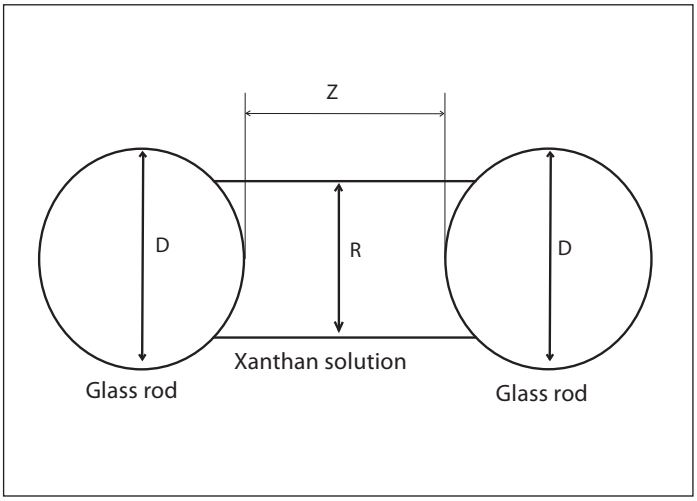
Samples were allowed to dry in an environment of 66% relative humidity in order to simulate body condition. Stretching the samples as long as possible without breaking (i.e., increasing *Z*) fosters structuralization. In a 2015 *Journal of Purdue Undergraduate Research* article, "Developing Viable Carriers for Bioactive Molecules Using Biopolymers," I illustrated the apparatus used for this purpose.

Xanthan samples thin out in the middle as drying proceeds, making stretching difficult. Samples exhibit viscous behavior from loading up to when *R*, the shortest radial distance of the sample, becomes about two-thirds the length of *D*, the vertical diameter of the glass rod. Transition from viscous behavior to a gel behavior then starts, and when *R* becomes less than half of *D*, only gel behavior is observed.

The results suggest that stretching of TMA-xanthan samples should occur in that transition stage to decrease the probability of the sample breaking.

This could increase final *Z* by about 50% compared to other methods. X-ray diffraction will be used in the future to identify packing structure.

Research advisor Srinivas Janaswamy writes: "Polysaccharides are ubiquitous biopolymers and are used in food, pharmaceutical, and medicinal applications as thickeners, viscosifiers, and gelling agents. Their utilization to deliver bioactive compounds is quite elegant and efficient, especially in gaining protection from external stresses and increasing the bioavailability. Research on xanthan certainly opens up the possibility on the design and development of innovative and cost-effective delivery systems."



Top (microscope) view of stretching the xanthan sample with two glass rods. *D* represents the vertical diameter of the glass rod and is 1 millimeter. *R* represents the shortest radial distance of the sample. Note that in reality the xanthan sample thins out between rods so that *R* is the smallest in the middle of the two rods. *Z* is the distance between the glass rods. The longer *Z* can become without breaking the sample, the better the stretch.

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