ECI-ACS Conference Transcript, Cody Busch

Hello! My name is Cody Busch. I am a senior biochemistry and mathematics student at Saint Xavier University. My research explores the antimicrobial properties of silver nanoparticle-impregnated wheat gluten biofilms.

Now the purpose of my project is to see whether these biofilms can be used as a suitable alternative for medical first aid bandages. They can possibly resist and kill bacteria while still being made with the same characteristics of a simple household band-aid. I also wish to pursue a career in the medical field, so I found that this was not only an innovative project but also an interesting one that could benefit those who need it the most.

So what we did was we had synthesized these WG biofilms along with varying concentrations of silver and incorporated the silver into these biofilms. Silver nanoparticles are well known to exhibit antimicrobial properties, so we essentially synthesized a “super band aid!”

The WG was synthesized by using gluten from wheat in ethanol and DI water. We denatured the WG by adding heat and acid to enhance the structure of the biofilms as well as to ensure that the secondary and tertiary structures did not interfere with the antimicrobial properties. Glycerol was added thereafter such that dense aggregates would not form, and refolding would not occur. With this method, the quality was optimized. The silver was just made by mixing silver nitrate, sodium citrate, and DI water with heat, and color changes were observed over time.

Colonies of pure pathogens were grown using the quadrant-streak method and flame-loop method on freshly made TSA and MHA. The Kirby-Bauer Procedure was used to obtain our data.

So I had grown pure colonies for these 7 different pathogens and I recorded the zones of inhibition for varying concentrations of silver by itself and for WG biofilms with and without silver and I had noticed that as the concentration of silver decreases, the diameter of the zone also decreases. Therefore, higher concentrations of silver exhibit stronger antimicrobial properties-a direct proportionality. I also observed that the WG biofilms exhibited weaker antimicrobial properties when silver was added as opposed to just the WG alone. Some pathogens resist these properties better than others, but I was actually happy with the results. The math is beyond the scope of this research, but we had calculated that the molarity of the AgNPs was 1.2 × 10-9 M, which may seem very negligible but we obtained very good results from even the smallest concentrations, which I think is just awesome.

Now in terms of the actual make up of the biofilms, we tested various mechanical properties. One of the observations that I had made was that WG biofilms lose mass over time. This can be partially due to the volatile nature of its components. Masses were recorded over 121 hours and by the time it reached a day, the wheat gluten had already lost over 50% of its original mass, but then levels off for larger values of time.

It was also observed that the biofilms absorb water. So to test these absorptive properties, I had submerged the biofilms in water and recorded masses over time similar to what we had done previously. As time increases, the biofilms absorb more and more water like a sponge, but then sharply goes down since the biofilm ruptured, releasing its contents (since it can’t absorb any more).

This proved to be an issue since we could no longer use water displacement to record values for density. So we had measured values for thickness and volume using an electronic caliper to obtain our densities.

So overall, these biofilms can be well applied to how we perceive medicine looking forward. I plan on testing copper nanoparticles next and drawing comparisons to the silver to see if one is better than the other. I also plan to test more pathogens and to obtain minimum inhibitory concentrations. I also plan on testing more mechanical properties such as porosity and examining UV-Vis for the silver and copper.

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