Hydrotectives 2.0: Testing Sodium Alginate and Carboxymethyl Cellulose Hydrogel Beads for Targeted Delivery of Acetaminophen

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Objective: Acetaminophen (APAP) should ideally be absorbed in the small intestine, but up to 15% of the drug is released in the stomach, resulting in suboptimal delivery. This study evaluates the APAP loading and release characteristics using hydrogel beads as delivery vehicles. Methods: Two types of hydrogels were prepared; Sodium Alginate (SA) and SA + Carboxymethyl Cellulose (CMC). These were pipetted, using 3 tip sizes (200µL, 1000µL, 5000µL), into a crosslinking solution. The percentage of APAP loaded was calculated using the remaining crosslinking solution and volume. The beads were tested for swelling capacity and average diameter. Release mediums, reflecting the milieu of the stomach and small intestine (1.5pH and 6.5pH), were used to test for percentage of APAP released over time. Results: 5000µL SA beads had the highest percentage of APAP loading (30%). 5000µL SA+CMC beads had the largest average diameter (3.6mm). 200µL SA+CMC beads had the highest percentage of APAP released in the 1.5pH and 6.5pH release mediums (56% and 39%). Centripetal diffusion was observed between the release mediums and SA+CMC beads; all beads disintegrated when the pH exceeded 7.0. Conclusion: SA and SA+CMC beads can be utilized for APAP delivery. SA+CMC beads had a sustained, stable release of APAP, and thus are more appropriate for targeted delivery in the small intestine compared to SA beads. Loading and release characteristics of the hydrogel beads can be further optimized by testing in other pH solutions or integrating surfactants, nanogels, and other polymers.

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