Invertebrate Gastrointestinal Modeling of CNT-Protein Nano-Carriers for Oral Prostate Cancer Therapeutics

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Oral cancer therapeutics often fail due to drug degradation within the gastrointestinal tract before systemic absorption. This study evaluated the gastrointestinal stability of a carbon nanotube erythrocruorin nano-carrier designed to deliver the anticancer compound coumarin under digestive conditions relevant to oral prostate cancer treatment. The experiment tested whether the nano-carrier could maintain its structure and retain coumarin when exposed to gut-like environments. The invertebrate Armadillidium vulgare (pill bug) was used as a model organism with segmented gut regions, pH gradients, and digestive enzymes similar to human gastrointestinal systems. Carbon nanotube nano-carriers containing erythrocruorin and coumarin were immersed in extracted gut contents under four conditions: control, mild pH, high pH, and enzyme-rich environments, simulating stomach and intestinal conditions. Coumarin retention was quantified using fluorescence measurements, and nano-carrier integrity was assessed microscopically. Results showed that the nano-carrier retained 98% of coumarin under control conditions and 92% under mild pH conditions, with integrity of 100% and 95%, respectively. Retention decreased to 75% in high-pH environments and 60% in enzyme-rich conditions, with integrity reduced to 80% and 65%. Statistical analysis confirmed significantly lower retention in high-pH and enzyme-rich environments compared to controls. These findings indicate that the carbon nanotube-erythrocruorin nano-carrier demonstrates strong stability under mild digestive conditions but degrades under harsher environments. This system shows promise for improving oral drug delivery by increasing resistance to enzymatic and pH-mediated breakdown.

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