An Alternative Suture Material Synthesized From Marine Invertebrates

Wnek, Chloe (School: Marine Academy of Technology and Environmental Science)

Chitosan, derived from chitin in crustacean shells, is one of the most abundant biopolymers found on the earth. It is important for biomedical material drug delivery and hydrogels. It has antimicrobial, antioxidant, and biodegradable properties, all of which are due to its acetylated and deacetylated glucosamine groups. Atlantic horseshoe crab (Limulus polyphemus) chitosan has been used to develop various biomedical applications due to its pure chitin. Horseshoe crab (HC) harvesting regulations have increased, and HC will eventually no longer be a viable resource for chitosan. This project utilizes European green crabs (Carcinus maenas), an invasive species, to develop alternative suture materials. HC sutures were also developed to compare and as a temporary resource. It was hypothesized that HC sutures would be the strongest, and all would be viable suture alternatives. Chitosan was extracted from the shells through demineralization, deproteinization, and deacetylation. The proper weight to solution ratio was found for each shell type by determining chitosan yield. Demineralization and deproteinization were conducted with hydrochloric acid and sodium hydroxide (NaOH). The extracted chitin was deacylated using a higher molarity NaOH. Extracted chitosan was dissolved in acetic acid and placed into a coagulation bath containing NaOH and ethanol to produce suture material. The sutures were tested to determine tensile strength, antimicrobial activity using the Coliscan bacterial method, and protein and element composition using X-ray fluorescence and Bradford Assay spectrophotometry. Cost analysis was performed to determine the production cost of sutures. GC sutures were determined to be the most viable material.

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