Development of a Bio-Soft Splint from Corn Husk Cellulose Fibers for Orthopedic Applications.

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Abstract

In this study, we develop composite materials for orthopedic soft splint applications and investigate their tensile strength, thermal ventilation, water resistance and biodegradability. Cellulose fibers were extracted from corn husks using sodium hydroxide and hydrogen peroxide treatments and incorporated into a composite matrix of corn starch, glycerol and acetic acid. Four cellulose fiber loadings 0.25, 0.50, 0.75 and 1.00 g were investigated. Cellulose fiber content significantly affected the properties of the bio-soft splints. The specimen reinforced with 0.75 g of cellulose fiber exhibited the highest tensile strength of 44.93 ± 3.96 N, highest water contact angle of 81.62° ± 7.49° and highest weight loss after biodegradation of 33.33%. Thermal ventilation tests indicated all formulations exhibited similar temperature values ranging from 39 to 41°C, suggesting comparable heat dissipation properties. Furthermore, FTIR analysis confirmed formation of hydrogen bonding interactions within the composite structure, contributing to improved mechanical performance. In conclusion, incorporation of 0.75 g of cellulose fiber provided the most suitable formulation for biodegradable soft splints due to superior mechanical strength, water resistance and biodegradability. This study demonstrates the potential of utilizing corn husk agricultural waste as a value-added biomaterial, reducing use of synthetic materials and promoting environmentally friendly medical biomaterials for future orthopedic applications.

Keywords: Orthopedic splint, Natural fiber, Corn husk cellulose