

# Engineered Chitosan Hemostats: Synthesis Optimization and Functional Validation for Critical Arterial Bleeding Management

**Kaibo Wang, Zifeng Zhang<sup>\*</sup>, Shouren Zhang, Baocheng Yang**

Institute of Nano-Structured Functional Materials, Huanghe Science and Technology College, Zhengzhou, China

## Email address:

zhangzifeng@hhstu.edu.cn (Zifeng Zhang), baochengyang@infm.hhstu.edu.cn (Baocheng Yang)

<sup>\*</sup>Corresponding author

## Abstract

Leveraging its inherent biocompatibility and demonstrated hemostatic capabilities, chitosan has emerged as a cornerstone biomaterial in advanced wound management systems, particularly for exuding and traumatic injuries. However, the poor mechanical strength of the formed clots can lead to a high risk of secondary bleeding. Here, this study has successfully developed chitosan hemostatic particles (M-CS) capable of arresting arterial hemorrhage by particle size distribution and combining this with lauric acid modification. By integrating physical obstruction, electrostatic forces, and hydrophobic effects, M-CS creates a dense clot matrix that withstands arterial blood flow independently of systemic coagulation pathways. In vitro coagulation tests showed that M-CS reduced whole blood clotting time by 23% compared to unmodified CS. Based on rheological characterization, the M-CS-formed clot matrix demonstrated a 48% higher storage modulus than the commercially available CELOX<sup>TM</sup> and a five-fold increase over the control group. Moreover, in a Bama minipig femoral artery injury model, M-CS achieved successful hemostasis within 300 s, and reduced blood loss by 12%. The findings lay a robust technological groundwork not only for enhanced hemostatic stability in arterial bleeding management but also for expedited translational advancement in pre-hospital emergency care, particularly for compressible truncal hemorrhage.

## Keywords

Hemostatic Material, Chitosan, Arterial Hemorrhage, Emergency Medical Response