Chitosan nanomagnets for effective extraction and sensitive mass spectrometric detection of pathogenic bacterial endotoxin from human urine

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Abstract:

Direct analysis and profiling of a complex endotoxin without any prior purification or sample treatment techniques using chitosan nanomagnets coupled with MALDI-MS techniques has been demonstrated. Surface modified magnetic nanoparticles such as Fe3O4 and CuFeO2 with chitosan were synthesized and characterized by using UV, TEM, and FTIR. Endotoxin (lipopolysaccharides (LPS)) was spiked into human urine and recovery enabled using chitosan nanomagnets. For the first time, the use of CuFeO2@chitosan and Fe3O4@chitosan nanomagnets for affinity based separation and enrichment of trace levels of endotoxin and direct detection using MALDI-MS has been successfully achieved. The chitosan nanomagnet based recovery of endotoxin from urine samples showed a high degree of sensitivity compared to the conventional MALDI-MS analysis, where the lowest detectable endotoxin concentration was 30 mg mL□1 (0.15 mg, 5 □L). The Fe3O4@chitosan nanomagnet approach has 67 times higher sensitivity at 450 □g mL□1 (2.25 □g, 5 □L) compared to the direct MALDI-MS analysis. However, CuFeO2@chitosan nanomagnets appeared to be more effective than Fe3O4@chitosan nanomagnets (about 4 times) and 250 times more sensitive for separation at 120 □g mL□1 (0.6 □g, 5 □L) and detection of endotoxin from urine. The current approach proposes a novel MALDI-MS platform using the chitosan nanomagnets for extraction/detection of endotoxin from clinical samples such as human urine which can be further applied for biomedicine/clinical application for rapid, sensitive, direct and effective detection for bacterial infections.

Keywords:

Magnetic nanoparticles Endotoxin Chitosan Pathogenic bacteria Urine MALDI-MS

Published In:

Journal of Materials Chemistry B , 1 , 2463-2475