

Supplementary Information

Analyst

High-sensitivity visualisation of contaminants in heparin samples by spectral filtering of ^1H NMR spectra

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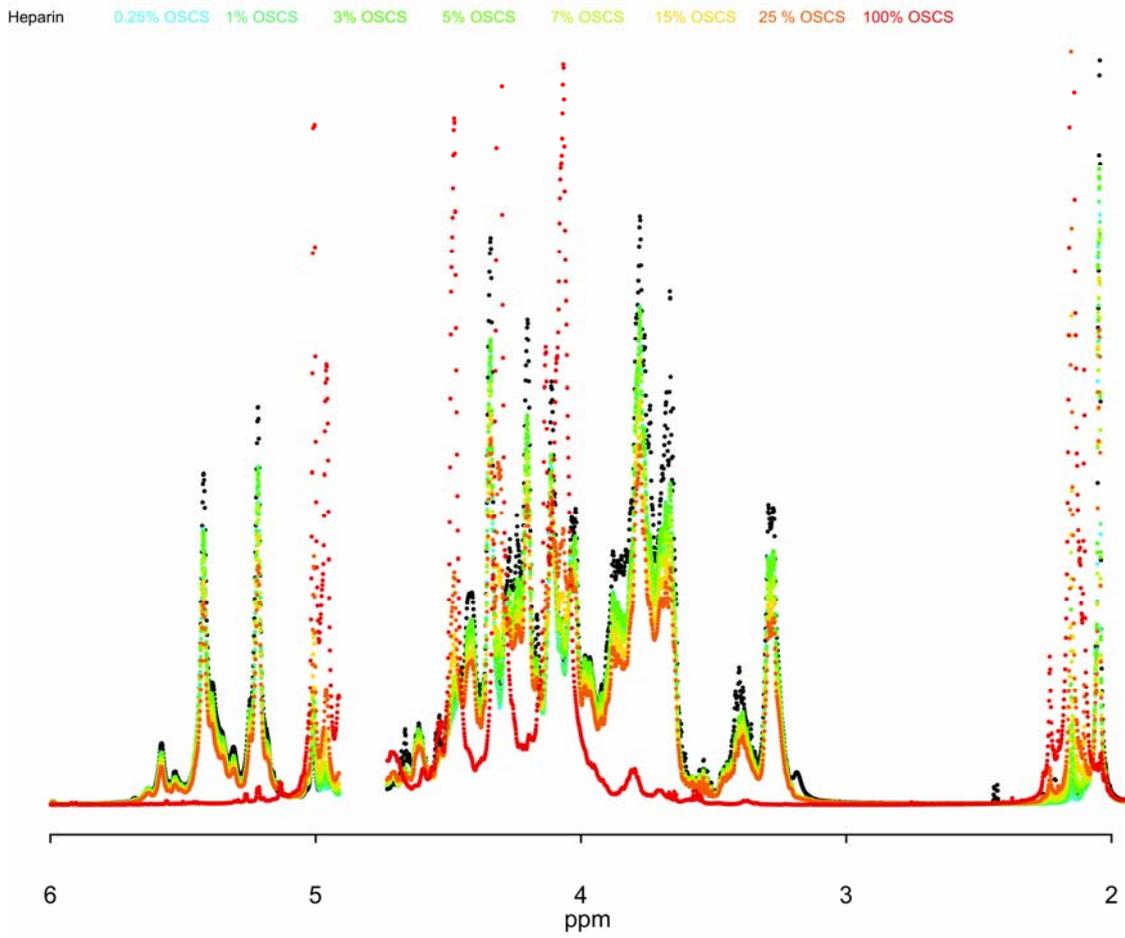


Figure S1 Illustrative plot of the binned and cut heparin-OSCS [0.25-25%] spectra.



Figure S2. Reconstructed spectra of the OSCS [0.25 - 25 %] contaminant. The above spectra were created by subtracting the heparin 2D-COS power spectrum away from the specific OSCS [0.25 -25 %] plus heparin dataset power spectrum. The power spectrum is the diagonal of the 2D-COS spectrum, or the variance of the covariance matrix.

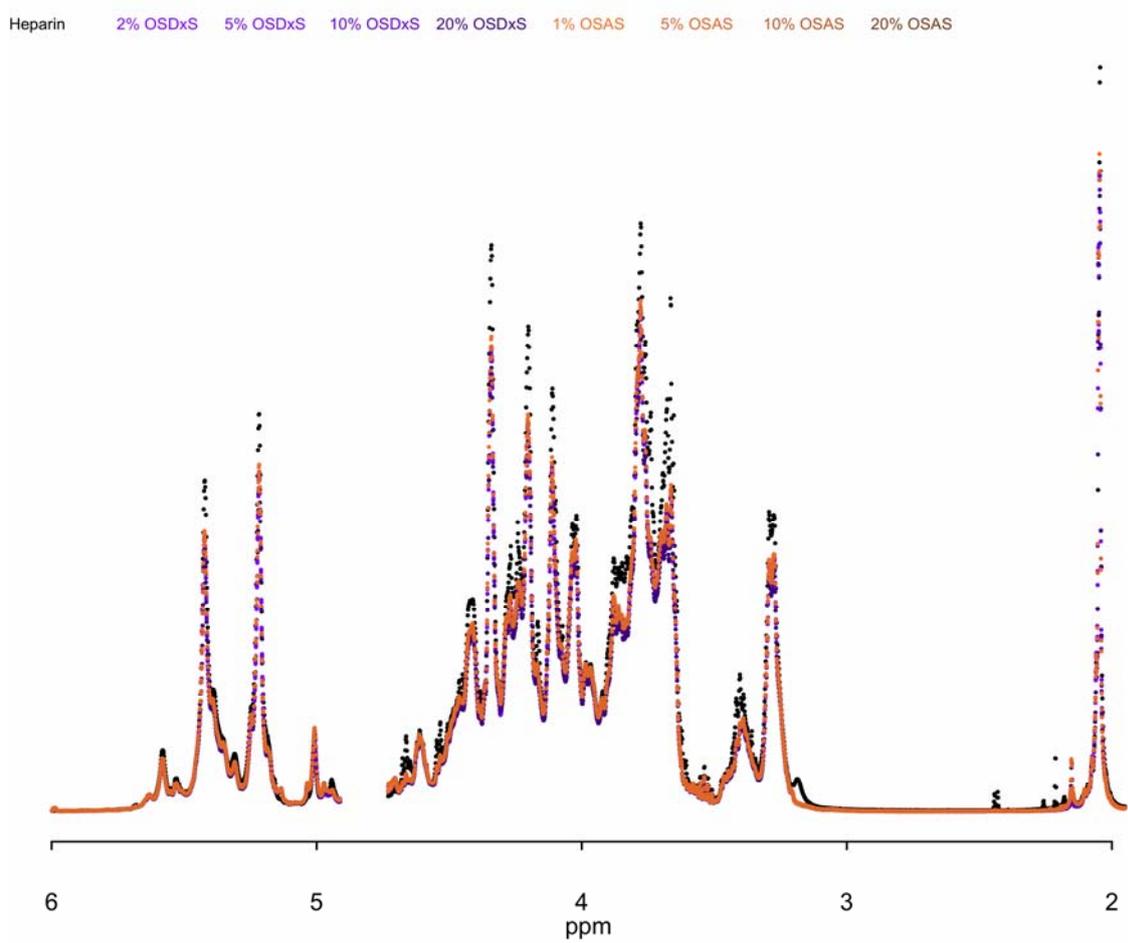


Figure S3 Illustrative plot of the binned and cut heparin-OSDxS/OSAS [2-20%] spectra.

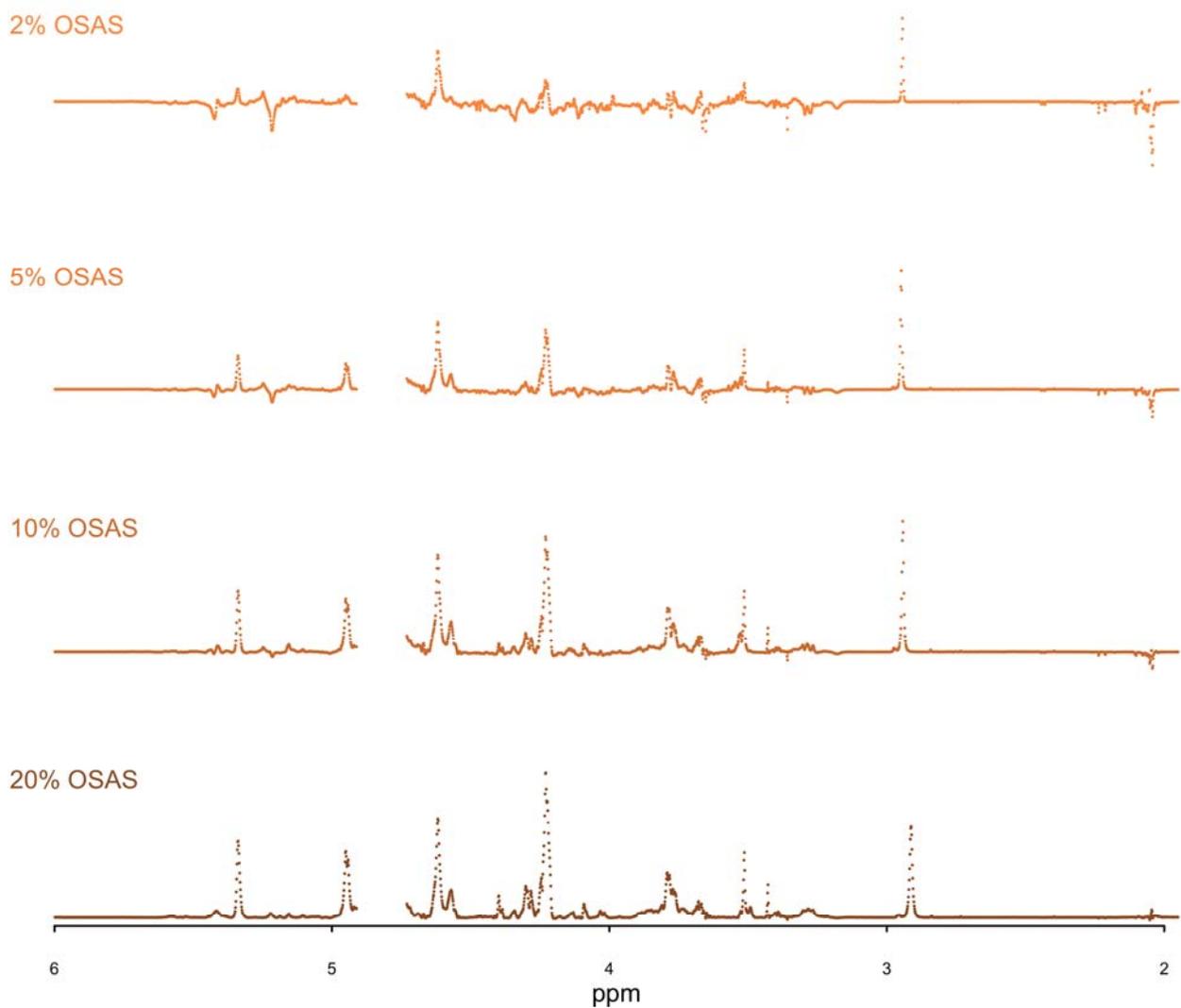


Figure S4. Reconstructed spectra of the OSAS [2 - 20 %] contaminant. The above spectra were created by subtracting the heparin 2D-COS power spectrum away from the specific OSAS [2 - 20 %] plus heparin dataset power spectrum. The power spectrum is the diagonal of the 2D-COS spectrum, or the variance of the covariance matrix.

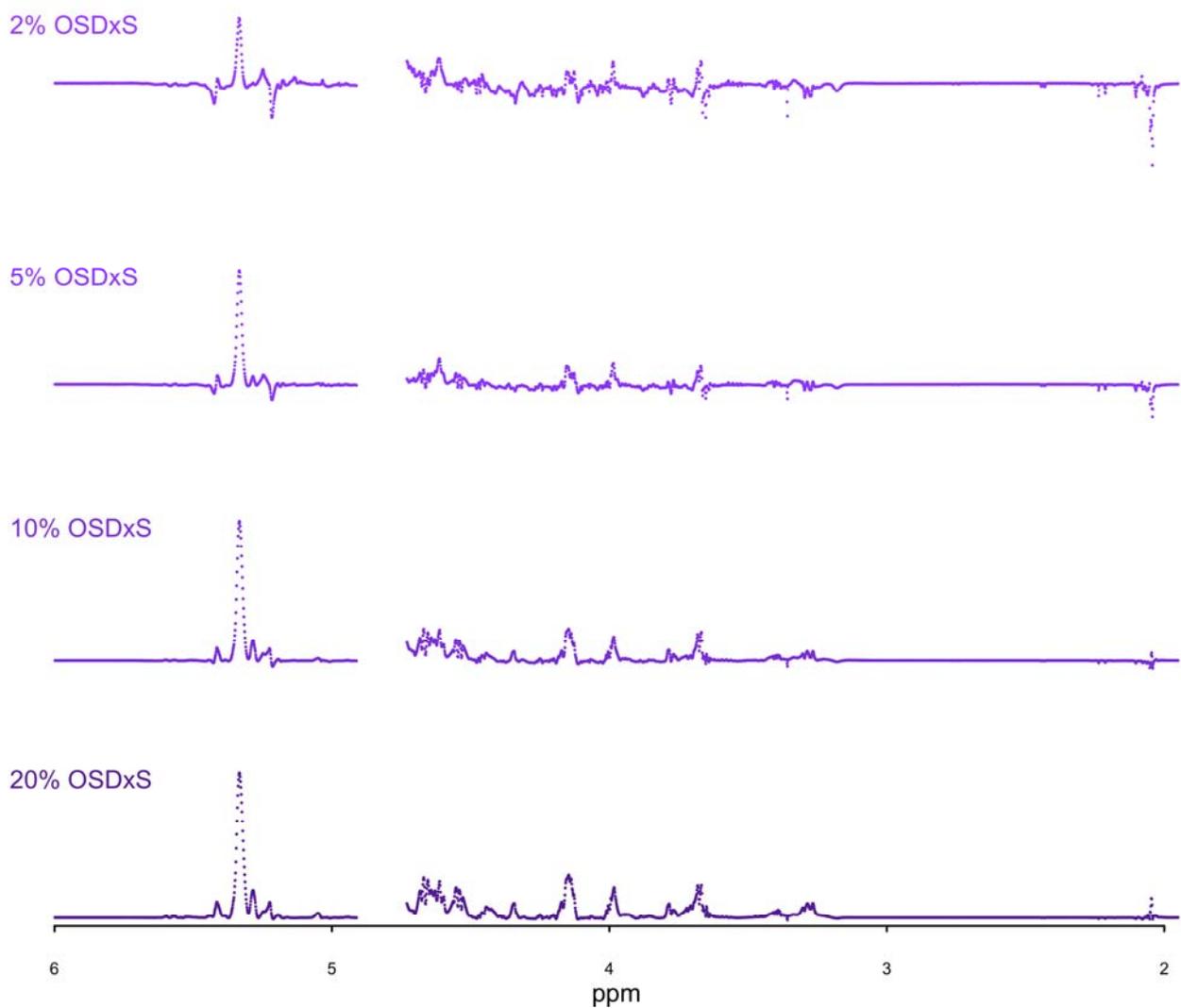


Figure S5. Reconstructed spectra of the OSDxS [2 - 20 %] contamination. The above spectra were created by subtracting the heparin 2D-COS power spectrum away from the specific OSDxS [2 - 20 %] plus heparin dataset power spectrum. The power spectrum is the diagonal of the 2D-COS spectrum, or the variance of the covariance matrix.

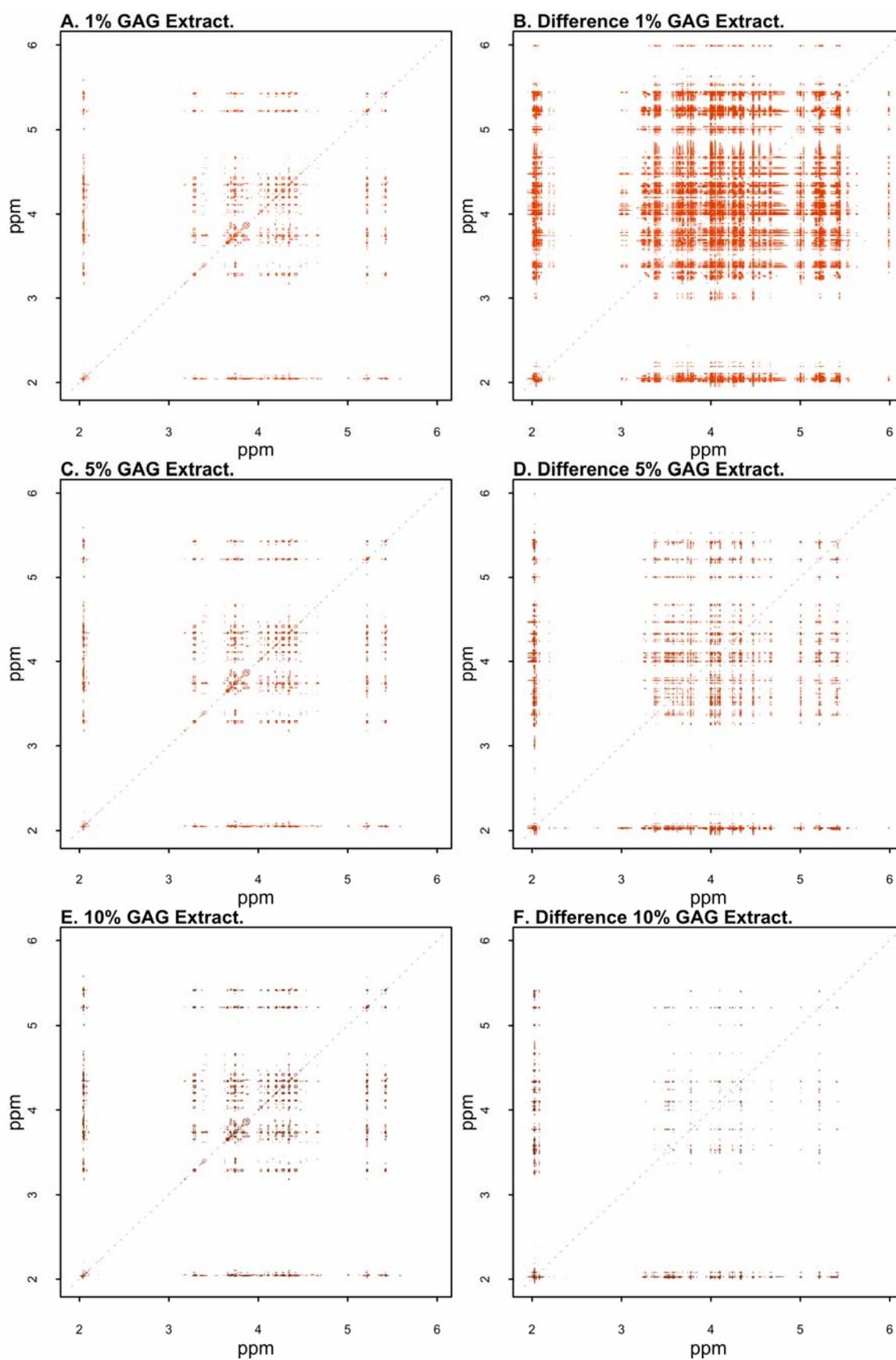


Figure S6 2D-COS analysis of unpurified GAG extract¹ (1, 5 and 10 % (w/w)) added to a pharmaceutical heparin sample. Panels A (1% w/w), C (5% w/w) and E (10 w/w) show the 2D-COS spectra generated when the contaminants were added to the heparin library. Panels B, D and F are the difference 2D-COS spectra, the contaminated heparin added to the heparin library 2D-COS minus the 2D-COS spectra of the heparin

dataset.

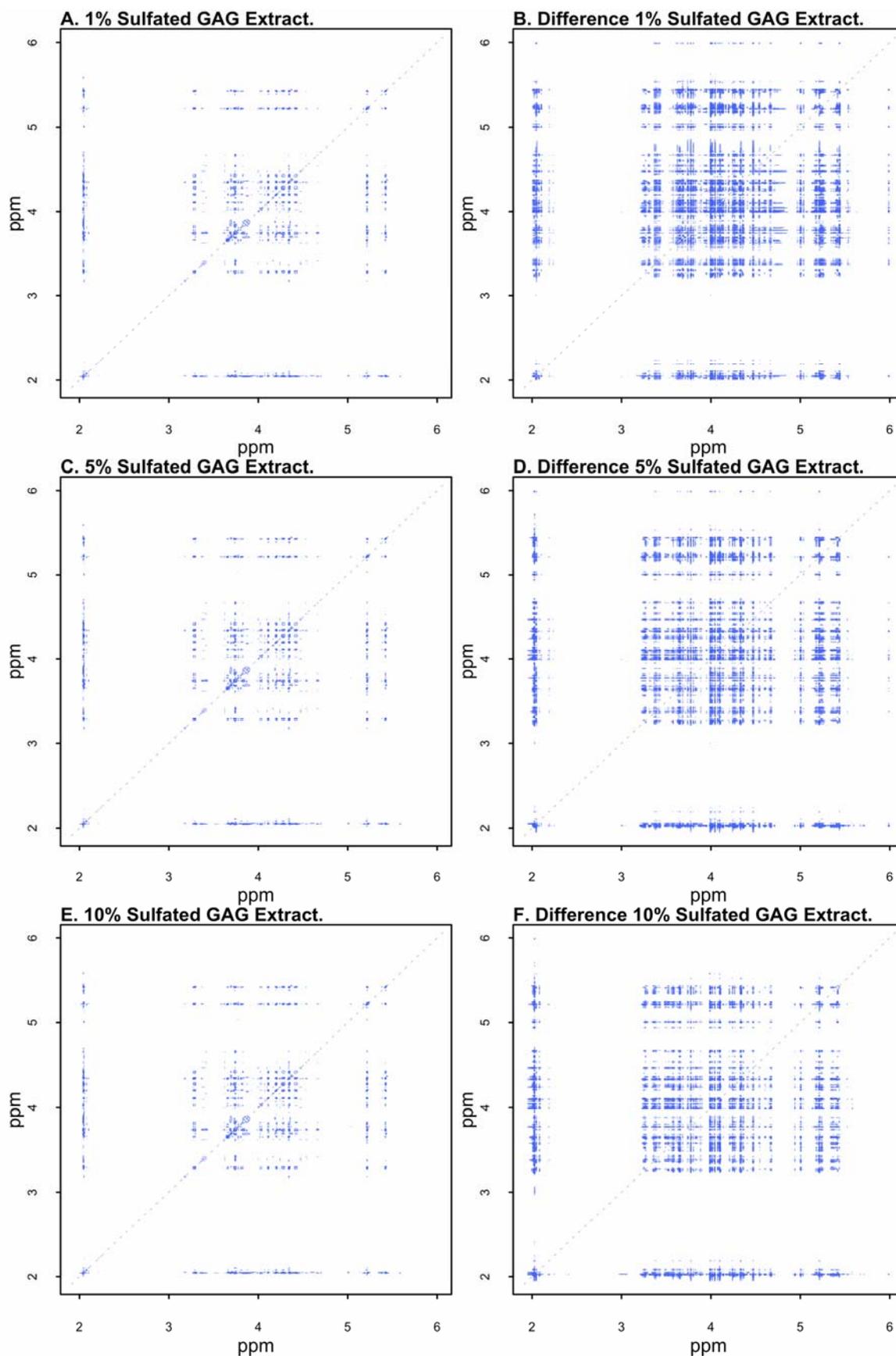


Figure S7 2D-COS analysis of unpurified sulfated GAG extract ¹ (1, 5 and 10 % (w/w)) added to a pharmaceutical heparin samples. Panels A (1% w/w), C (5% w/w) and E (10 w/w) show the 2D-COS spectra generated when the contaminants were added to the heparin library. Panels B, D and F are the difference

2D-COS spectra, the contaminated heparin added to the heparin library 2D-COS minus the 2D-COS spectra of the heparin dataset.

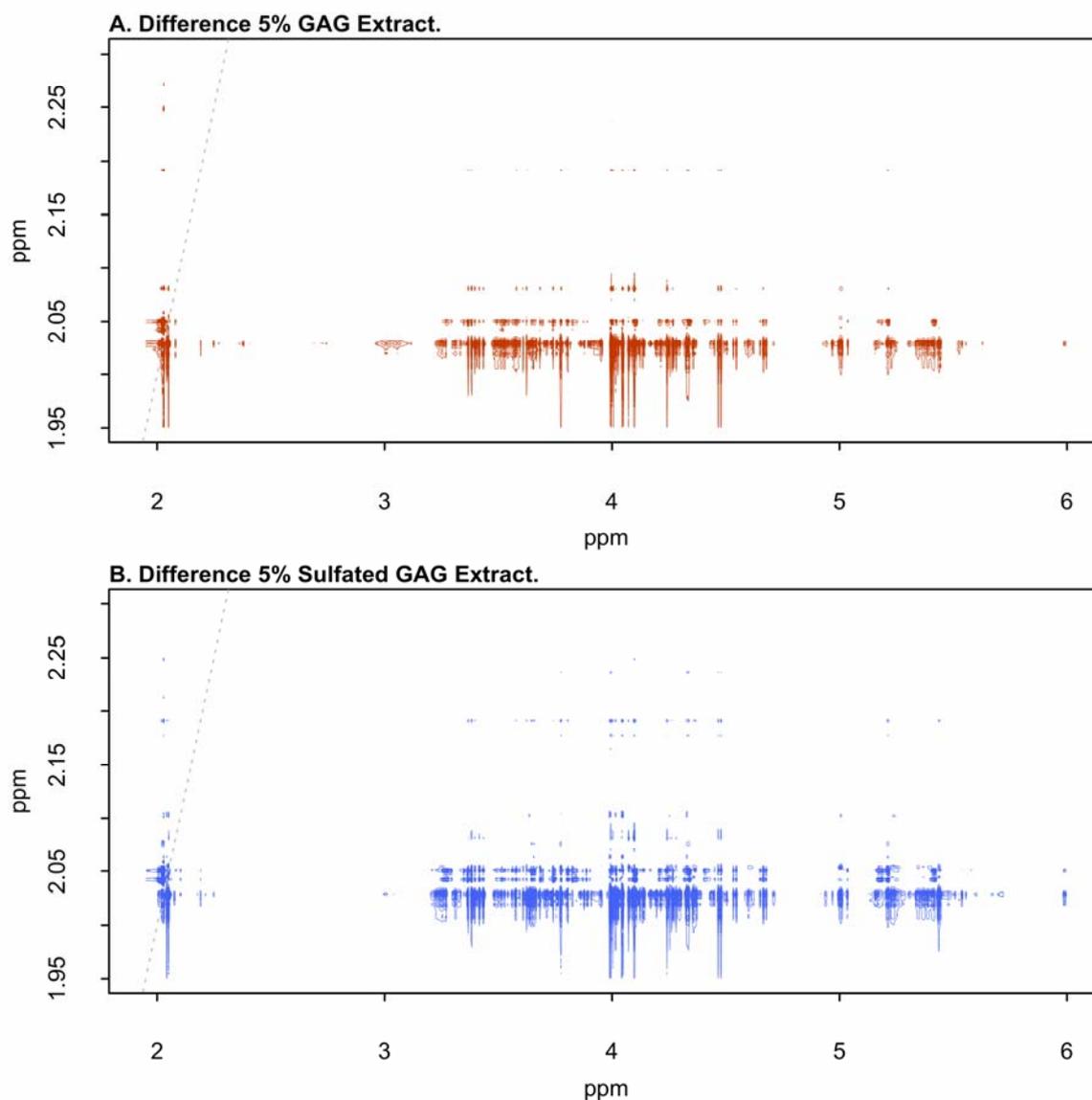


Figure S8 The N-acetyl region of the 2D-COS. Difference analysis of (A) unpurified GAG extract¹ (5% w/w) and (B) sulfated GAG extract¹ (5% w/w) added to a pharmaceutical heparin sample. The difference spectra were generated by subtracting the 2D-COS spectrum of the heparin reference library from the 2D-COS spectrum of the heparin reference library including the contaminated heparin sample. The multiple cross peak correlations reveal how complicated the pollutant is in this case.

1. M. Guerrini, Z. Zhang, Z. Shriver, A. Naggi, S. Masuko, R. Langer, B. Casu, R. J. Linhardt, G. Torri and R. Sasisekharan, *Proc Natl Acad Sci U S A*, 2009, **106**, 16956-16961.