

Electronic Supporting Information

New protic ionic liquids for fungi and bacteria removal from paper heritage artefacts

Nataša Dimitrić^a, Nemanja Spremo^a, Milan Vraneš^a, Sanja Belić^a, Maja Karaman^a, Strahinja Kovačević^b, Milica Karadžić^b, Sanja Podunavac-Kuzmanović^b, Daniela Korolija-Crkvenjakov^c and Slobodan Gadžurić^{a†}

^a*Faculty of Sciences, University of Novi Sad, Trg D. Obradovića 3, 21000 Novi Sad, Serbia*

^b*Faculty of Technology, University of Novi Sad, Bulevar Cara Lazara 1, 21000 Novi Sad, Serbia*

^c*Academy of Arts, University of Novi Sad, Đure Jakšića 7, 21000 Novi Sad, Serbia*

Figs. S1-S9. FTIR spectra of investigated protic ionic liquids

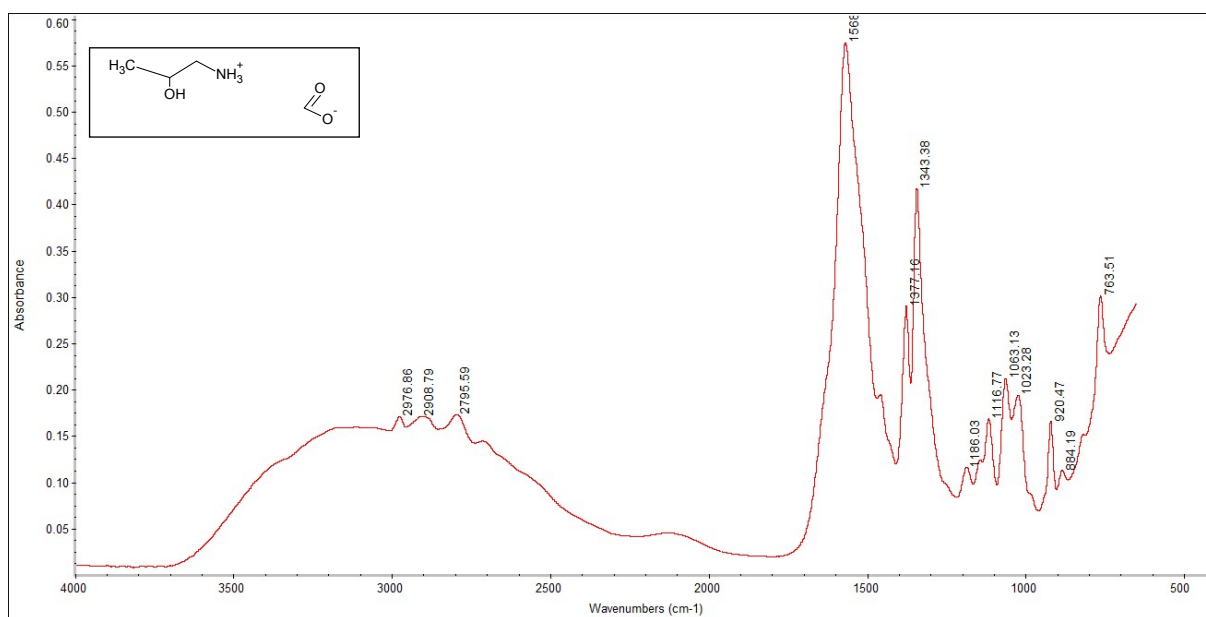


Figure S1. FTIR spectra of For

2976 (asym. ν O-H); 2908 (asym. ν N-H); 2795 (asym. ν C-H); 1568 (asym. ν COO⁻); 1377 (stretching ν C-O); 1343 (asym. rocking ν CH₂); 1116 (stretching ν C-N); 1063 (stretching ν C-C); 1023 (NH wagging); 920 (CH₂ rocking vibration).

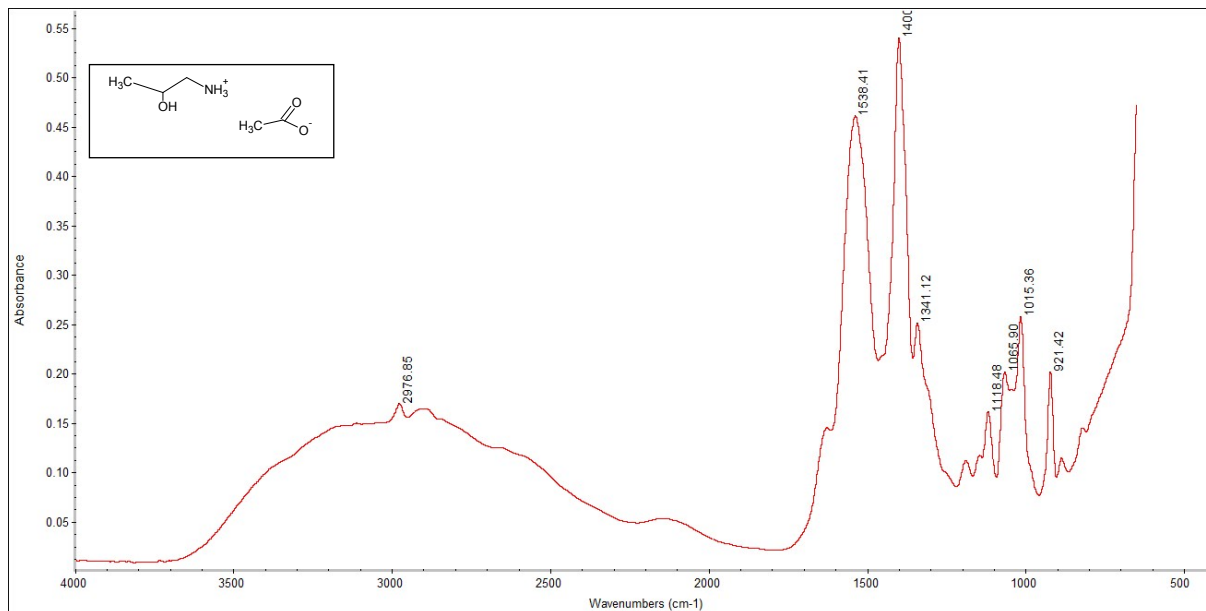


Figure S2. FTIR spectra of Ac

2976 (asym. ν N-H); 1538 (asym. ν COO⁻); 1400 (stretching ν C-O); 1341 (asym. rocking ν CH₂); 1118 (stretching ν C-N); 1065 (stretching ν C-C); 1015 (NH wagging); 921 (CH₂ rocking vibration).

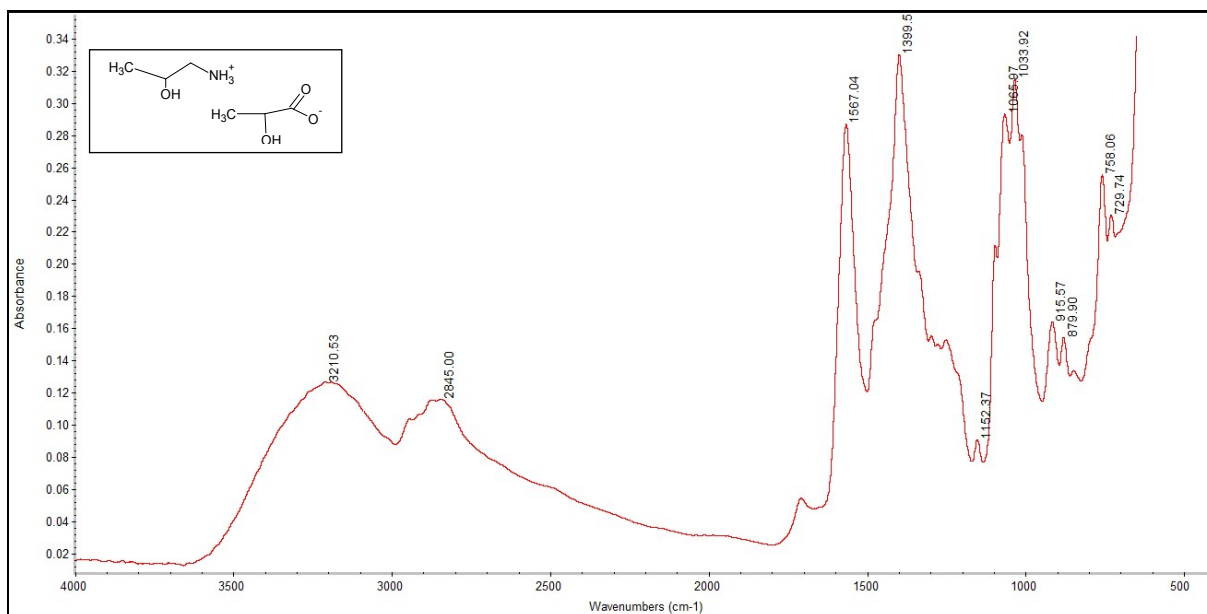


Figure S3. FTIR spectra of Lac

3210 (asym. ν O-H); 2845 (asym. ν C-H); 1567 (asym. ν COO⁻); 1399 (stretching ν C-O); 1065 (asym. rocking ν CH₂); 1033 (stretching ν C-N); 915 (stretching ν C-C); 879 (NH wagging); 758 (CH₂ rocking vibration).

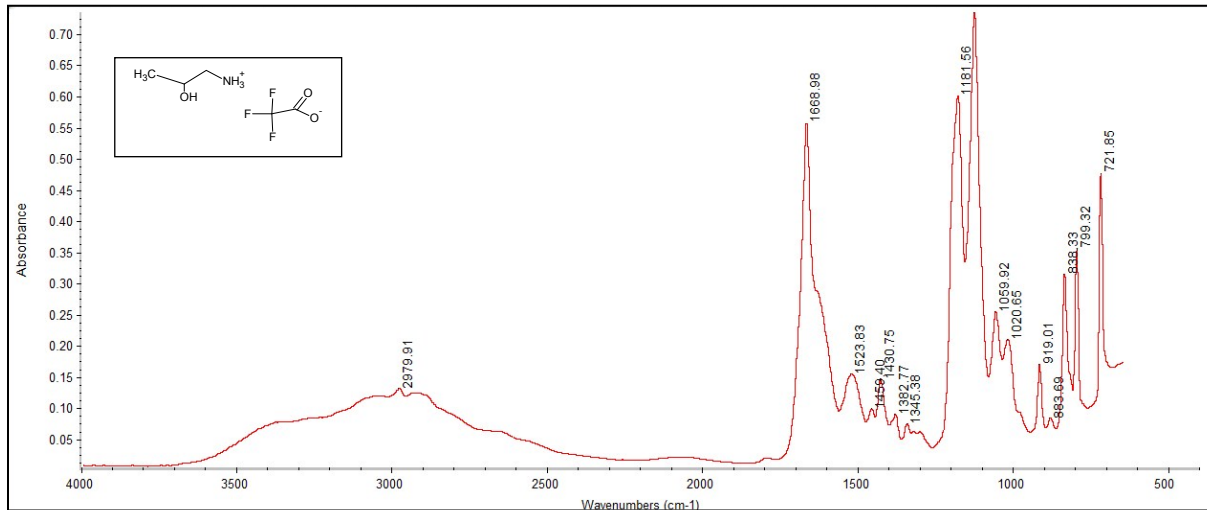


Figure S4. FTIR spectra of TFA

2979 (asym. ν N-H); 1668 (asym. ν COO⁻); 1430 (stretching ν C-O); 1382 (asym. rocking ν CH₂); 1345 (vibration sym. CF₃); 1059 (stretching ν C-N); 1020 (stretching ν C-C); 883 (NH wagging); 799 (CH₂ rocking vibration); 721 (deformation sym. CF₃).

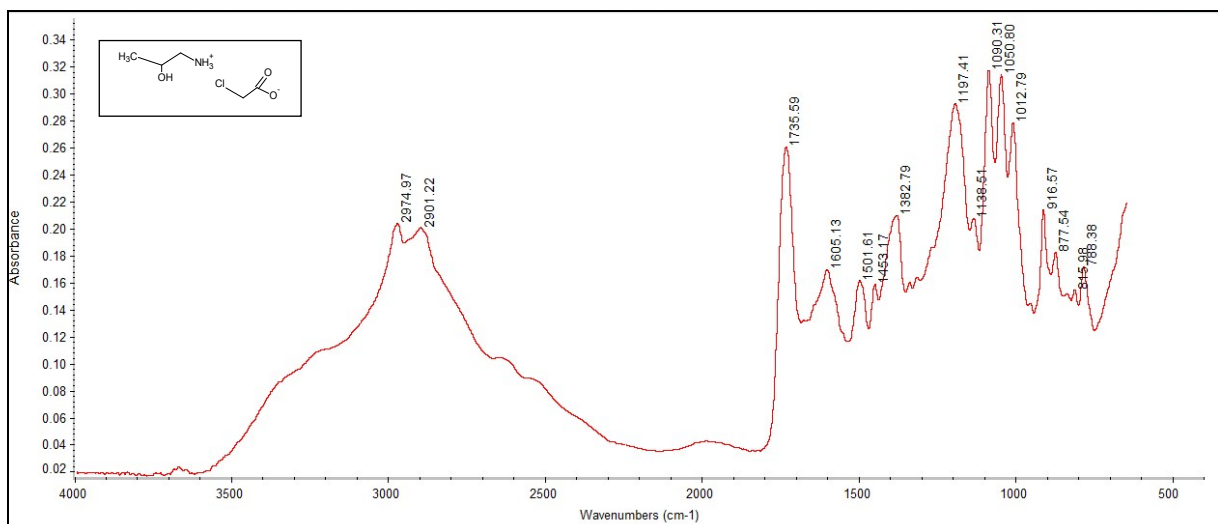


Figure S5. FTIR spectra of CIA

2974 (asym. ν N-H); 2901 (asym. ν C-H); 1735 (asym. ν COO⁻); 1453 (deformation scissors CH₂) 1382 (stretching ν C-O); 1197 (asym. rocking ν CH₂); 1050 (stretching ν C-N); 1012 (stretching ν C-C); 916 (NH wagging); 815 (CH₂ rocking vibration); 788 (stretching ν C-Cl).

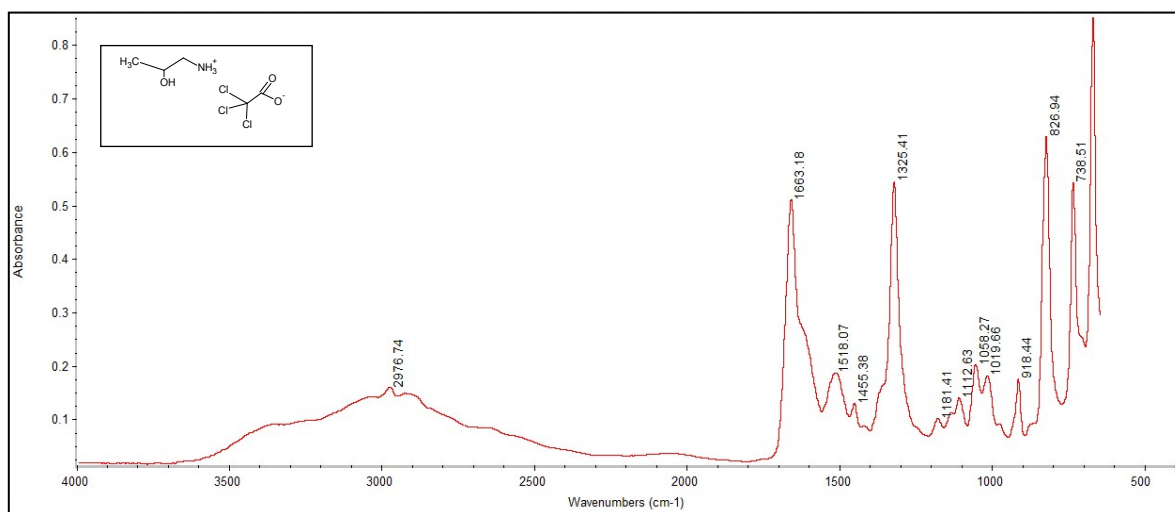


Figure S6. FTIR spectra of TCIA

2976 (asym. ν N-H); 1663 (asym. ν C-H); 1518 (asym. ν COO⁻); 1455 (stretching ν C-O); 1325 (asym. rocking ν CH₂); 1058 (stretching ν C-N); 1019 (stretching ν C-C); 918 (NH wagging); 826 (stretching ν CCl₃) 738 (CH₂ rocking vibration).

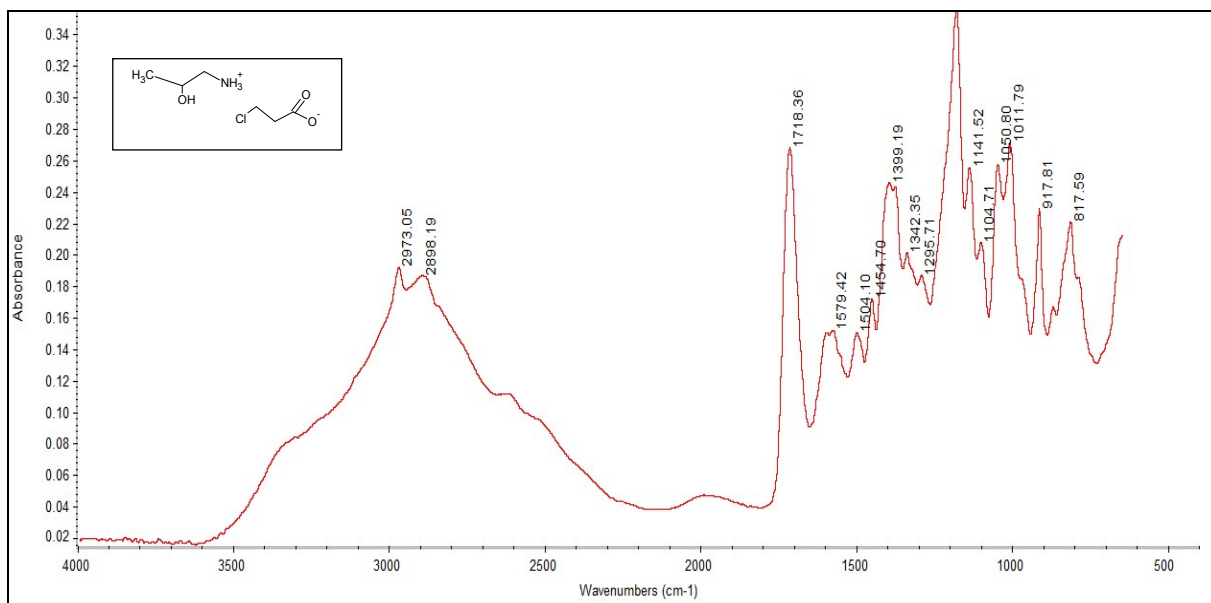


Figure S7. FTIR spectra of 3-CIP

2973 (asym. ν N-H); 2898 (asym. ν C-H); 1718 (asym. ν COO⁻); 1454 (deformation scissors CH₂) 1399 (stretching ν C-O); 1342 (asym. rocking ν CH₂); 1104 (stretching ν C-N); 1050 (stretching ν C-C); 1011 (NH wagging); 917 (CH₂ rocking vibration); 817 (stretching ν C-Cl).

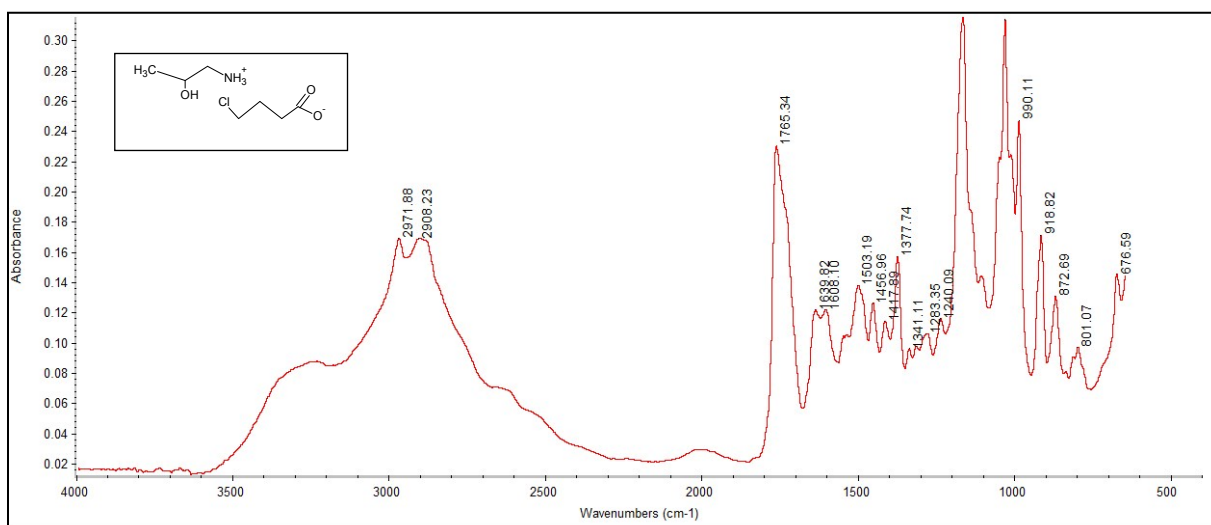


Figure S8. FTIR spectra of 4-CIB

2971 (asym. ν N-H); 2808 (asym. ν C-H); 1765 (asym. ν COO⁻); 1456 (deformation scissors CH₂) 1377 (stretching ν C-O); 1341 (asym. rocking ν CH₂); 990 (stretching ν C-N); 918 (stretching ν C-C); 8721 (NH wagging); 801 (CH₂ rocking vibration); 676 (stretching ν C-Cl).

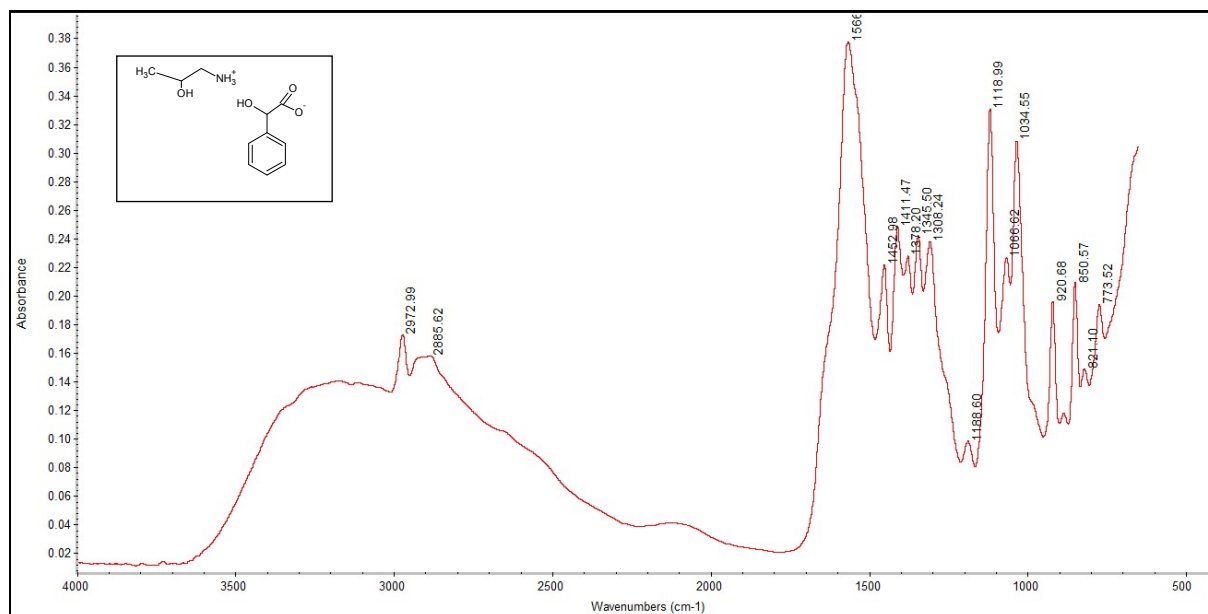


Figure S9. FTIR spectra of Man

2972 (asym. ν O-H); 2885 (asym. ν C-H); 1566 (asym. ν COO⁻); 1452 (valence stretching vibration CC); 1411 (deformation vibration CH); 1378 (stretching ν C-O); 1345 (in-plane bending mode δ O-H); 1308 (stretching C-C); 1118 (stretching ν C-N); 1066 (stretching ν C-C); 1034 (NH wagging); 920 (CH₂ rocking vibration); 850 (in-plane bending mode γ CC); 773 (out-of-plane deformation γ CC).

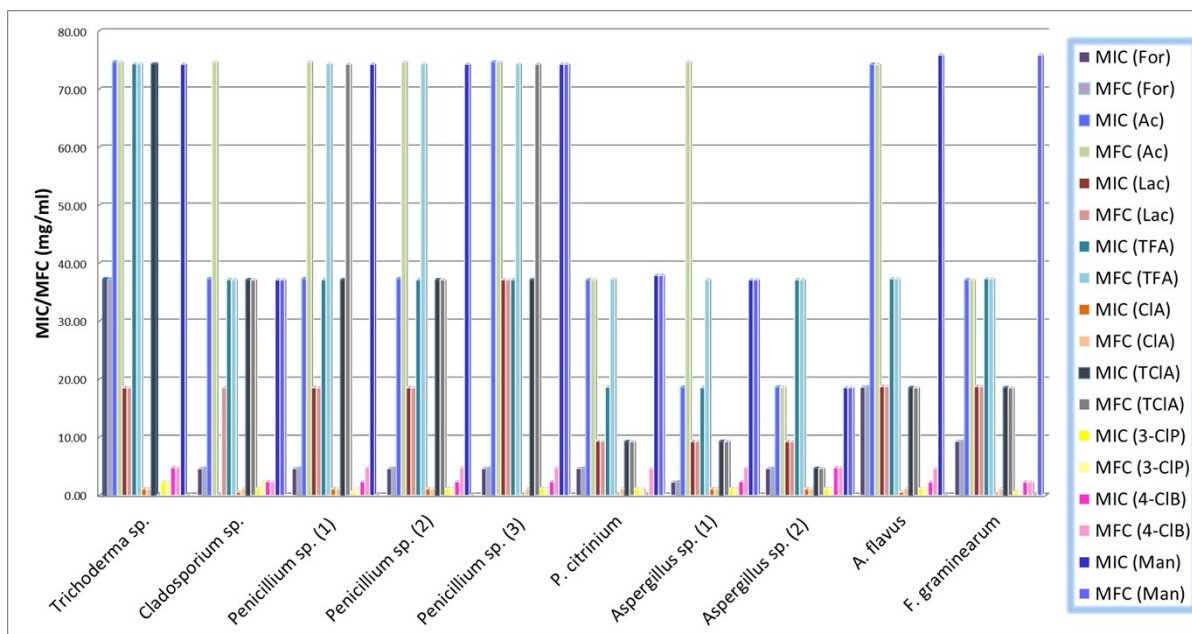


Figure S10. Antifungal activity of newly synthesized nine different protic ionic liquids

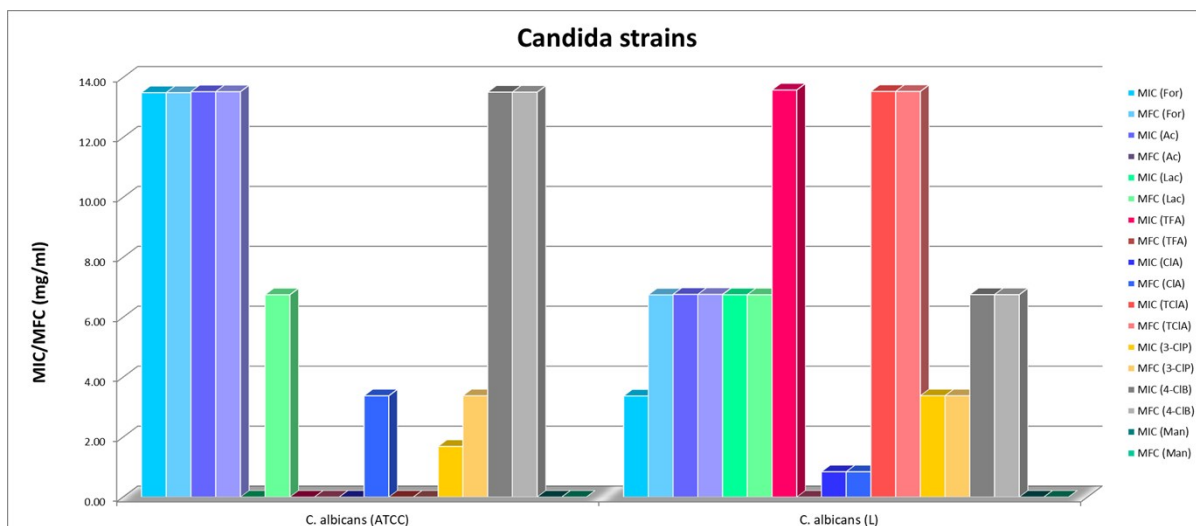


Figure S11. Antifungal activity of newly synthesized nine different protic ionic liquids

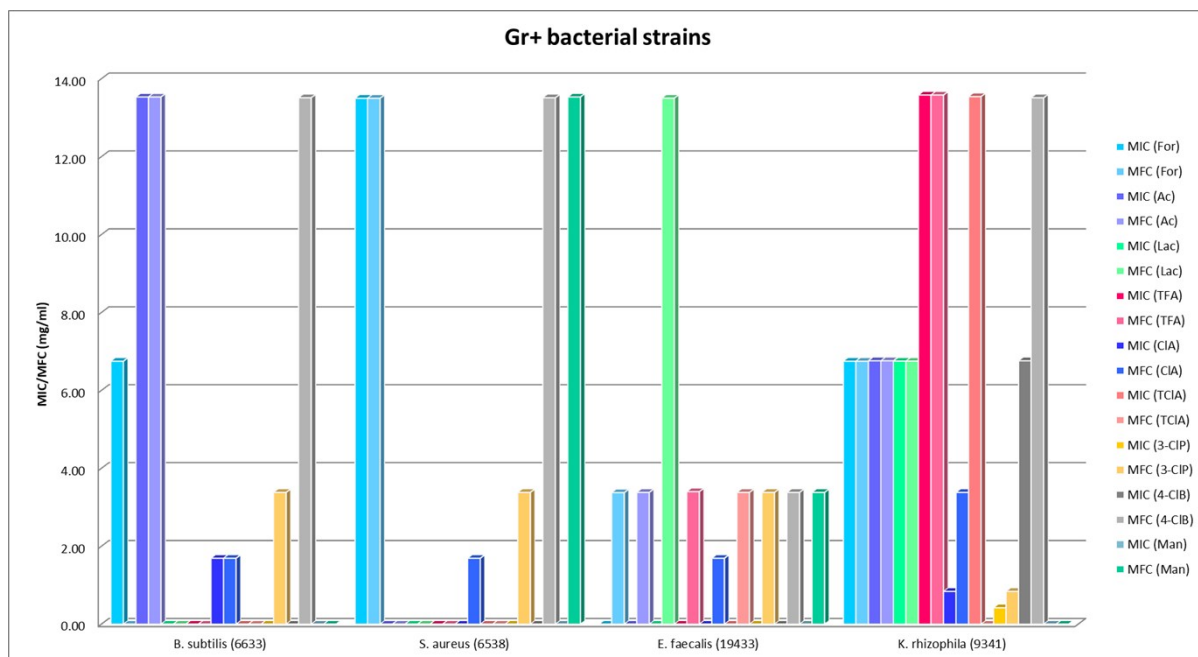


Figure S12. Antibacterial activity of newly synthesized nine different protic ionic liquids on Gr+ bacterial

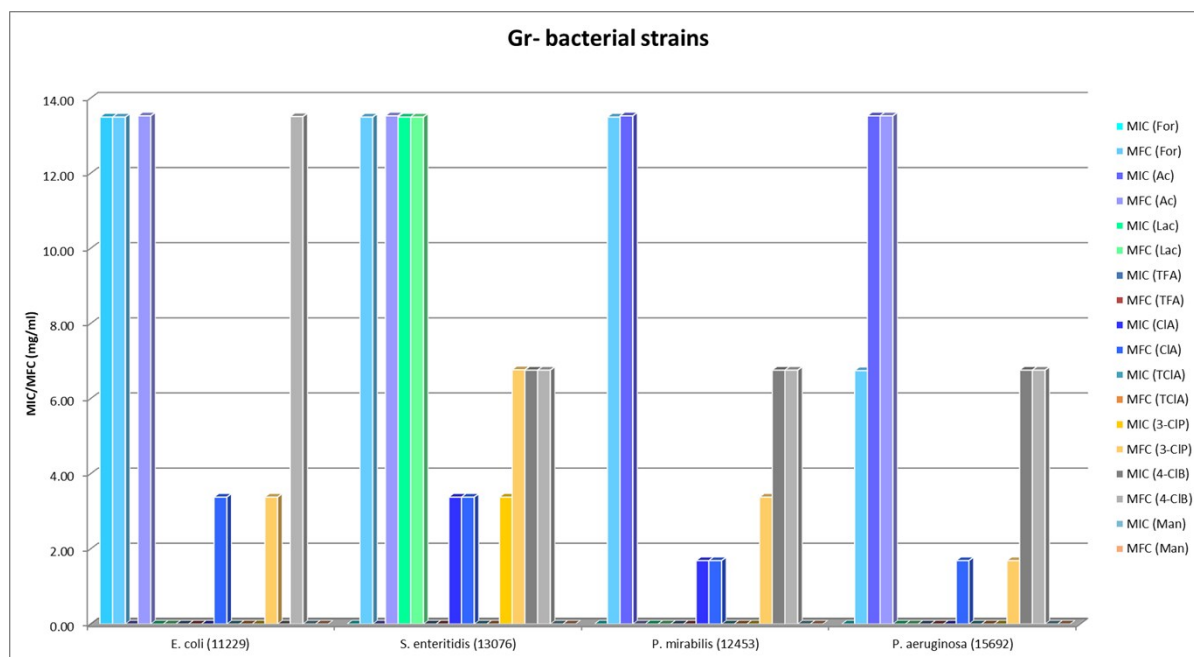


Figure S13. Antibacterial activity of newly synthesized nine different protic ionic liquids on Gr- bacterial

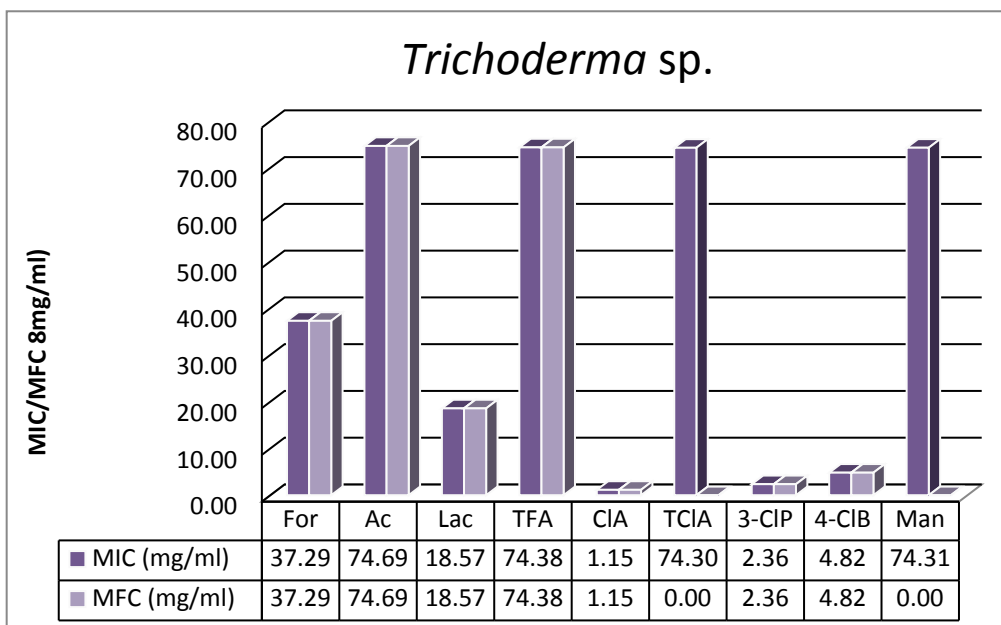


Figure S14. Antifungal activity of newly synthesized nine different protic ionic liquids on *Trichoderma sp.*

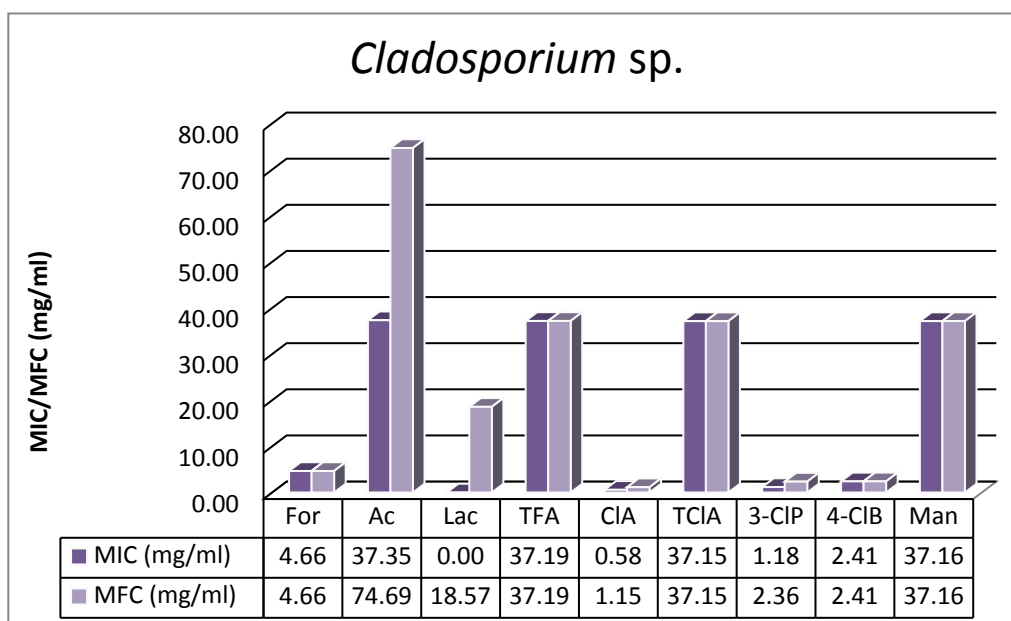


Figure S15. Antifungal activity of newly synthesized nine different protic ionic liquids on *Cladosporium sp.*

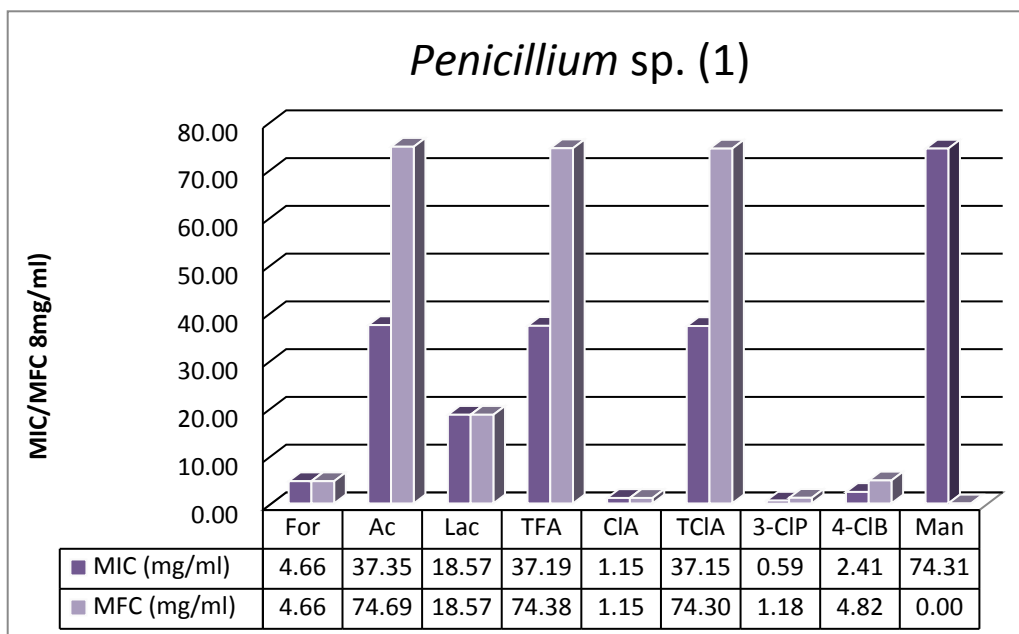


Figure S16. Antifungal activity of newly synthesized nine different protic ionic liquids on *Penicillium sp.* ⁽¹⁾

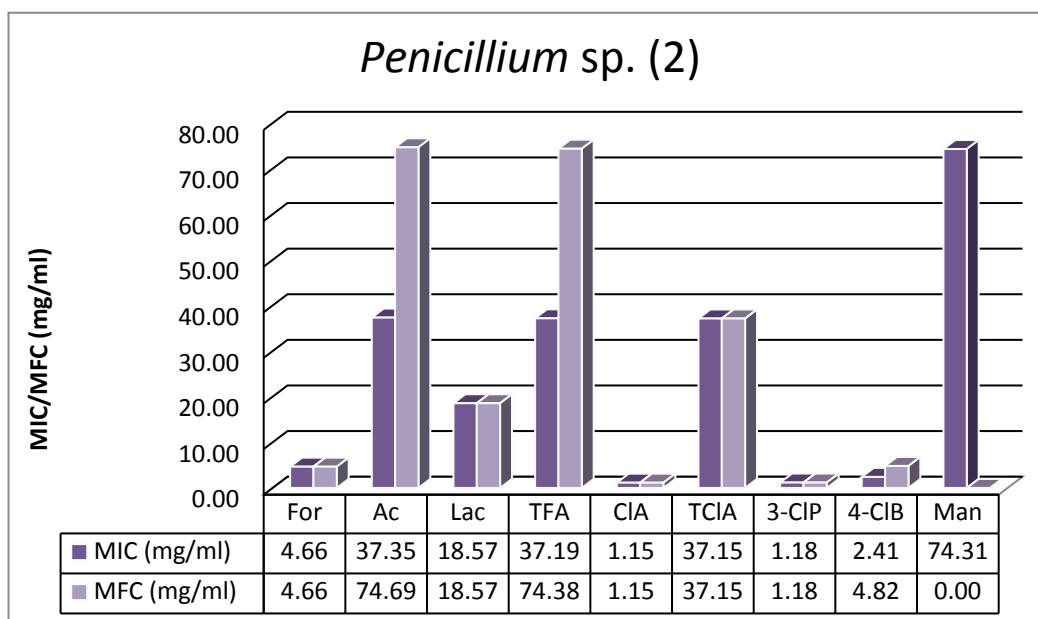


Figure S17. Antifungal activity of newly synthesized nine different protic ionic liquids on *Penicillium sp.* ⁽²⁾

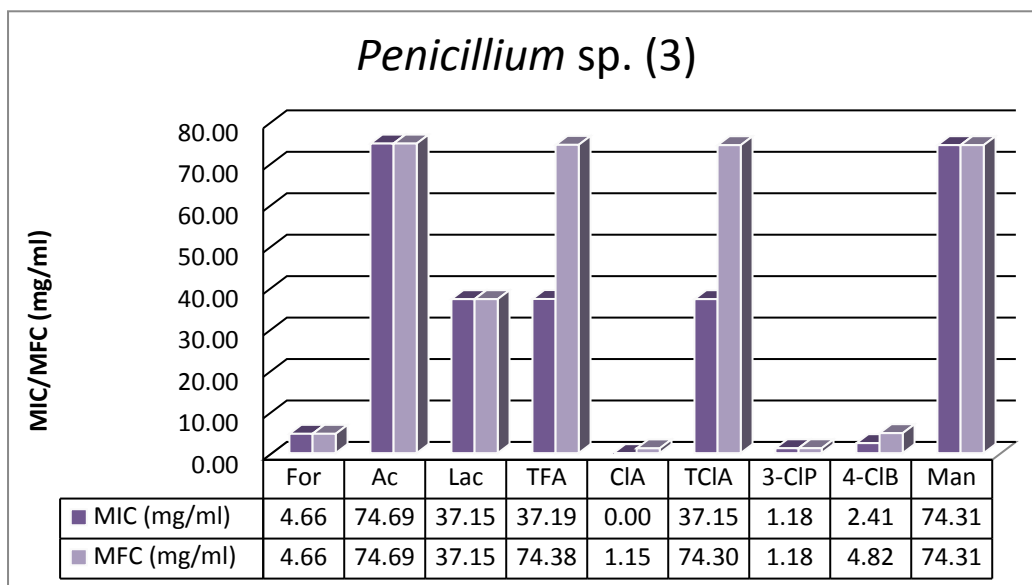


Figure S18. Antifungal activity of newly synthesized nine different protic ionic liquids on *Penicillium sp.* ⁽³⁾

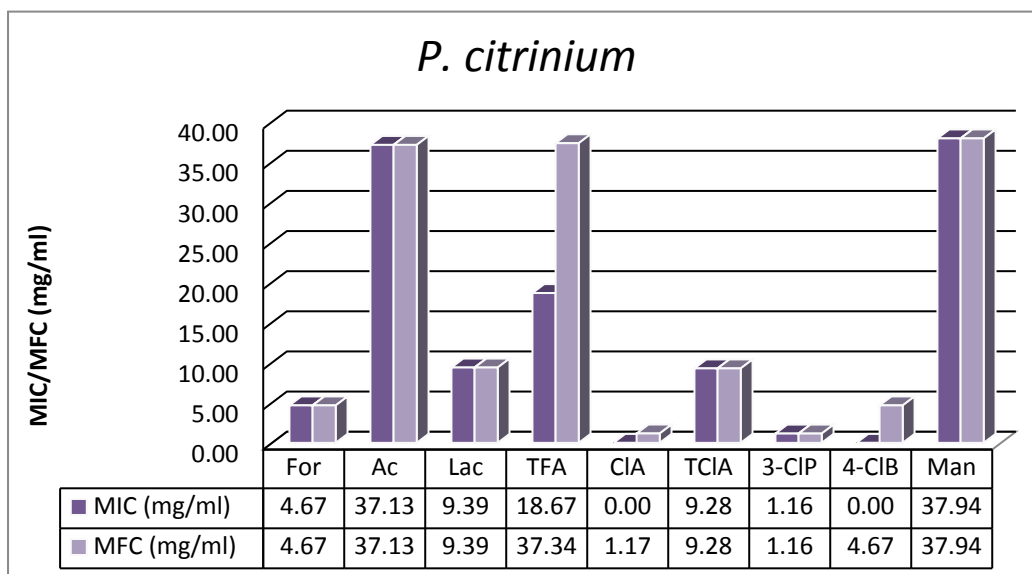


Figure S19. Antifungal activity of newly synthesized nine different protic ionic liquids on *P. citrinum*

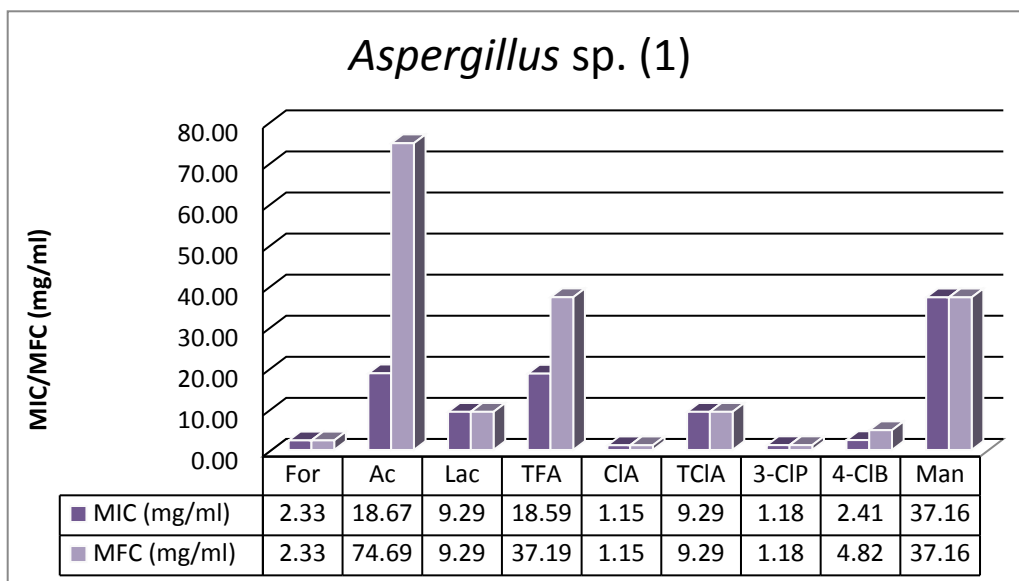


Figure S20. Antifungal activity of newly synthesized nine different protic ionic liquids on *Aspergillus sp.* ⁽¹⁾

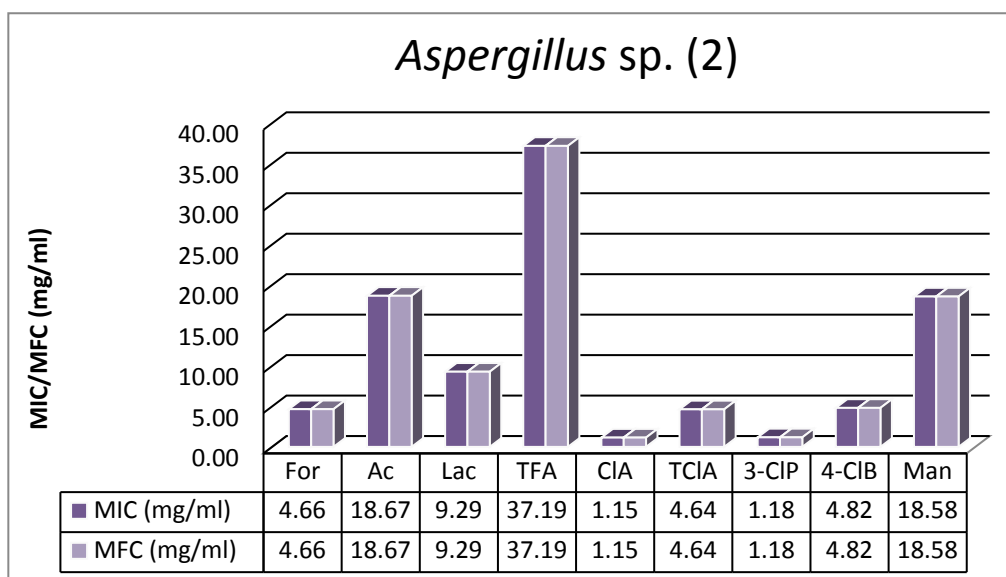


Figure S21. Antifungal activity of newly synthesized nine different protic ionic liquids on *Aspergillus sp.* ⁽²⁾

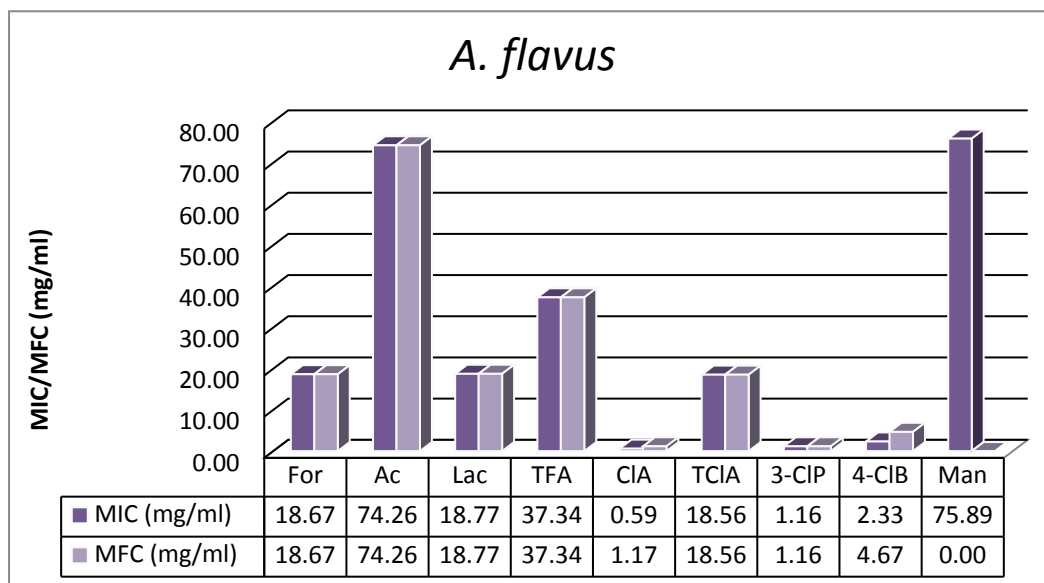


Figure S22. Antifungal activity of newly synthesized nine different protic ionic liquids on *A. flavus*

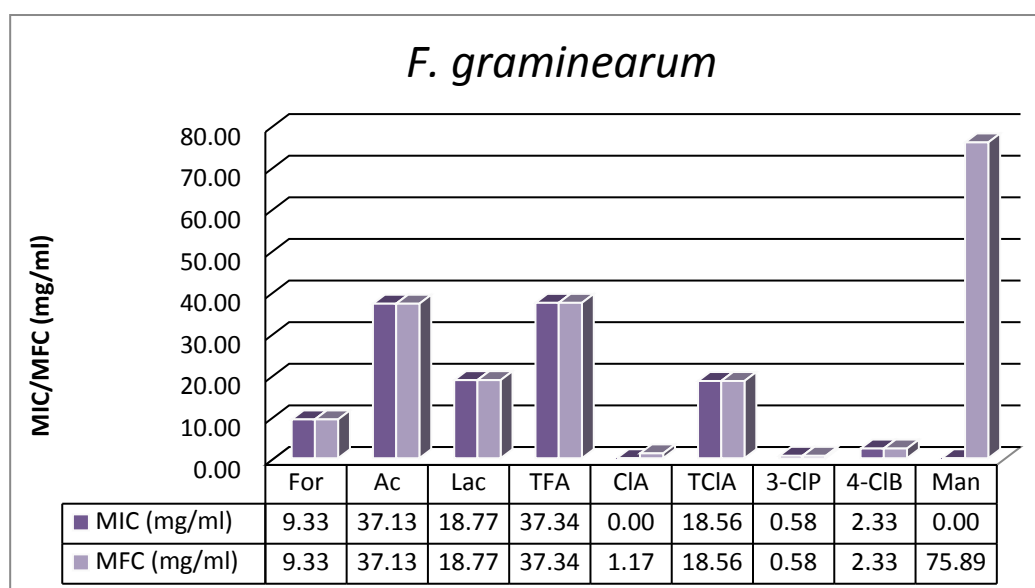


Figure S23. Antifungal activity of newly synthesized nine different protic ionic liquids on *F. graminearum*