Fabrication of Polyvinyl Alcohol / Chitosan / Bidens Pilosa Composite Electrospun Nanofibers with Enhanced Antibacterial Activities

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Electrospinning of composite polymers requires the components of the composites to be miscible and uniformly blended, otherwise it can lead to failure to form nanofibers. The two extreme cases of miscibility and immiscibility can lead to this failure as interfacial interaction affects the creation of surface tension of the solution. For the polymers to successfully form nanofibers, some degree of hydrogen bonding between the polymers is required. Differential scanning calirometry (DSC) studies revealed an interaction between the polymers PVA and EXT in solutions). This interaction was affected by the addition of chitosan when it was introduced to the above composite solutions. This is most probably due to a selective binding and interactions between chitosan chains and the polymeric chains, which leaded to difficulty in the spinning process. **Figure S1** shows DSC

thermograms of the polymer and composite solutions and revealed slight shift in the T_g peaks with PVA: EXT (**Figure S1b**) compared to PVA (**Figure S1a**). These results were in similar agreement with the findings of Kouchak M *et al* in their study of the DSC characteristics of PVA and Nitrofurazone.

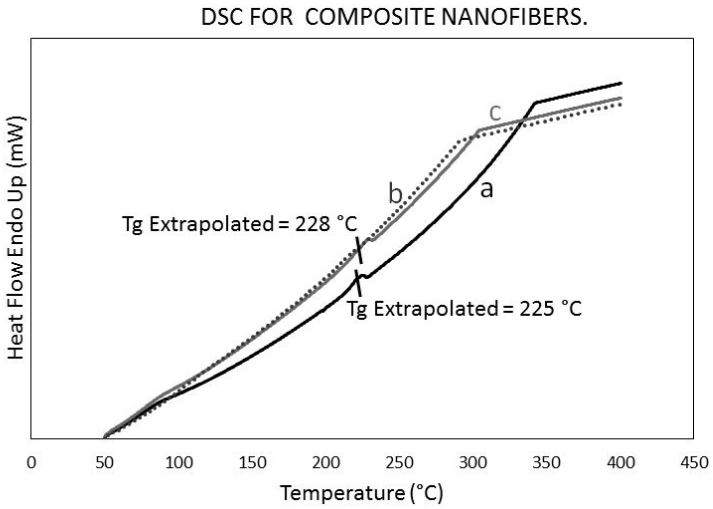

Figure S1. DSC thermograms for (a) PVA, (b) PVA: EXT and (c) PVA: EXT: CS.

Solubility of the composite polymer system reveals the extent to which chemical interaction between the different groups affects their solubility and thus the ability to be electrospun. For the electrospinning process to be successful, the solution has to be uniform with no particulates that can occlude the nozzle. PVA: DBP was uniformly solubilized in which the extract was completely blended with PVA whereas PVA:EXT on the other hand was moderately soluble and left a fraction of residues when blended with PVA and higher amount of sedimentation when chitosan was introduced.

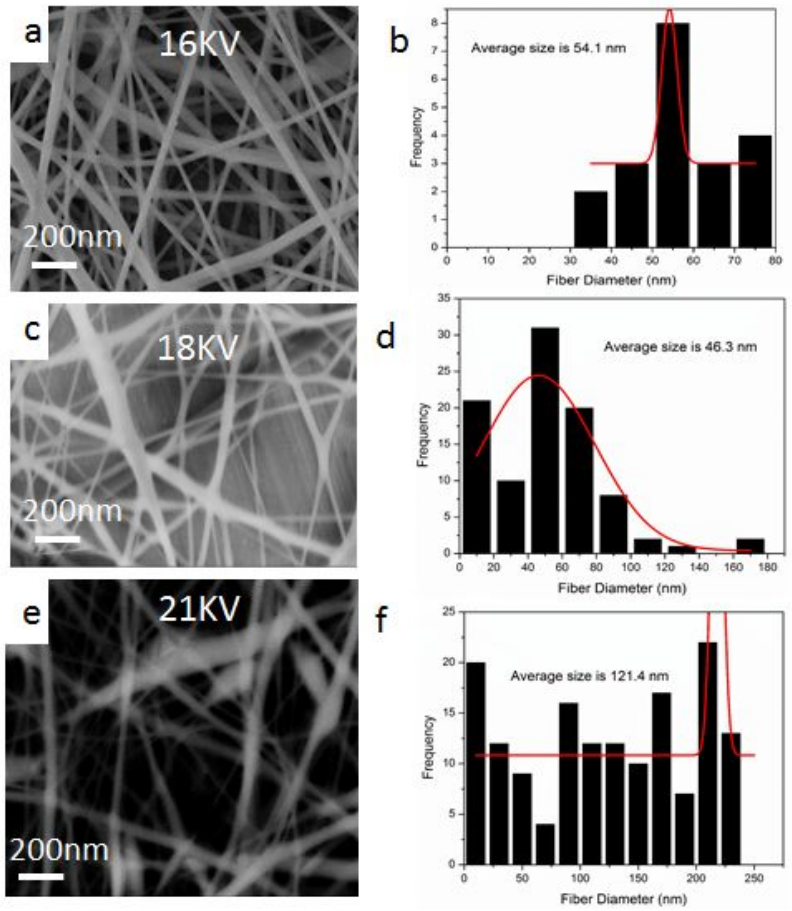

Figure S2. SEM images of PVA: DBP nanofibers with effect of voltage a (16kv), c (18kv) and e (21kv) on 8%, solution flow rate of 1mL/hr, tip to collector distance of 12cm and their corresponding fiber diameter distribution histogram b, d and f.

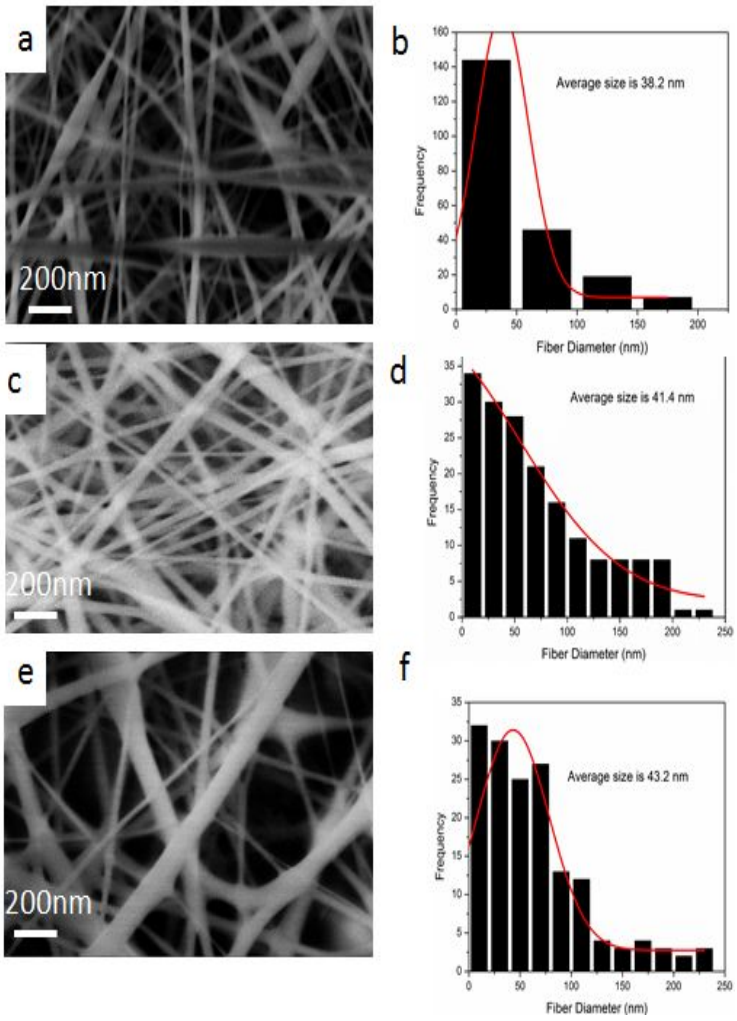

Figure S**3.** SEM images of PVA: DBP nanofibers with effect of the solution flow rate a (0.8mL/hr), c (1mL/hr) and e (1.2mL/hr) at 16kv, tip to collector distance of 12cm with their corresponding fiber diameter distribution histogram b, d and f.

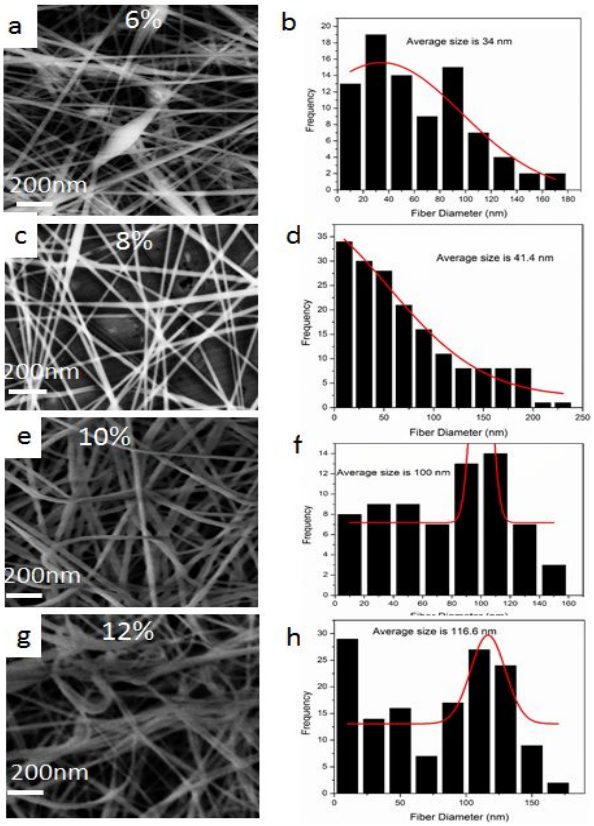

Figure S4. SEM images of PVA: DBP nanofibers electrospun at solution flow rate of 1mL/hour and applied voltage of 16kv from PVA solutions concentration (w/w): a & b) 6%, c &d) 8%, e & f) 10%, and g & h) 12%, (w/w), respectively.

Water Immersion test.

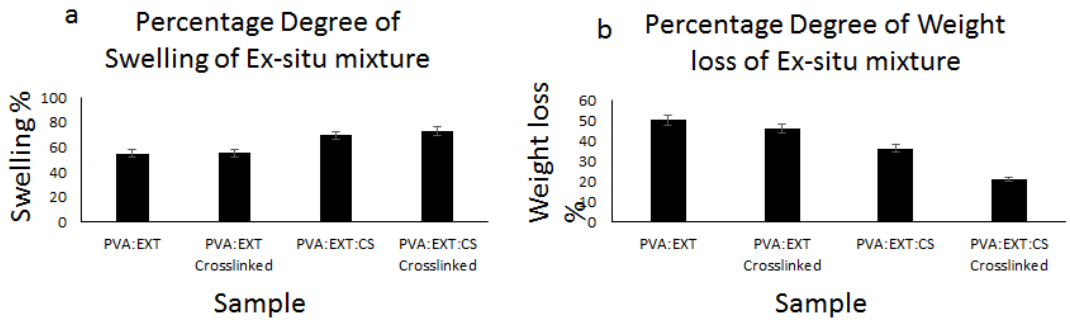

Figure S5. Water Immersion test; (a) swelling capacity and (b) weight loss for Ex-situ PVA: EXT Nanofibers.

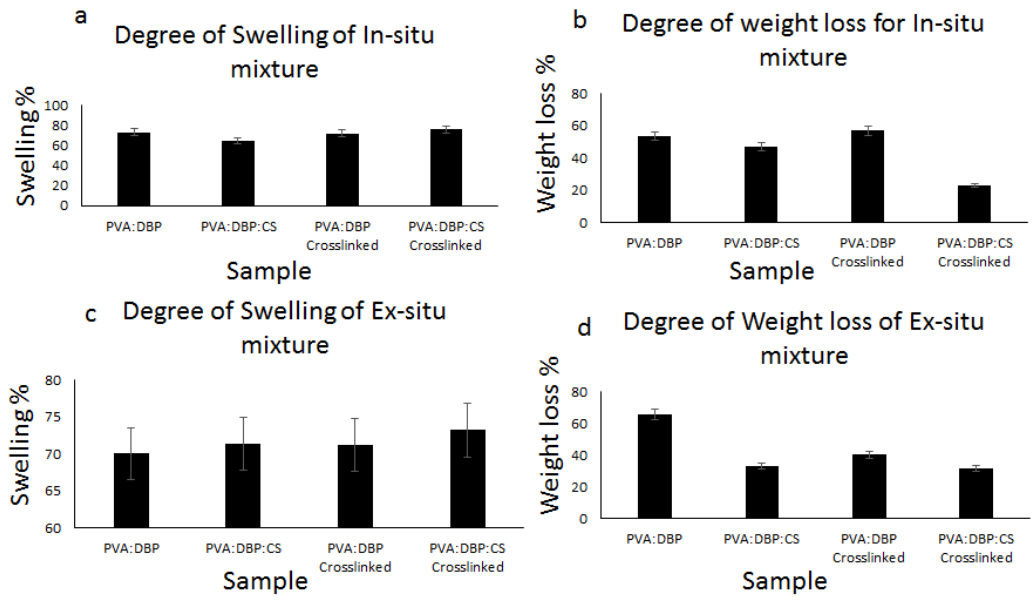

Figure S6. Water Immersion test; swelling capacity (a-In-situ and c-Ex-situ) and weight loss (b-In-situ and d-Ex-situ mixture) of the PVA, DBP and CS derived nanofibers.

FTIR analysis of Interraction of PVA, Distilled Bidens pilosa and Chitosan (PVA: DBP: CS)

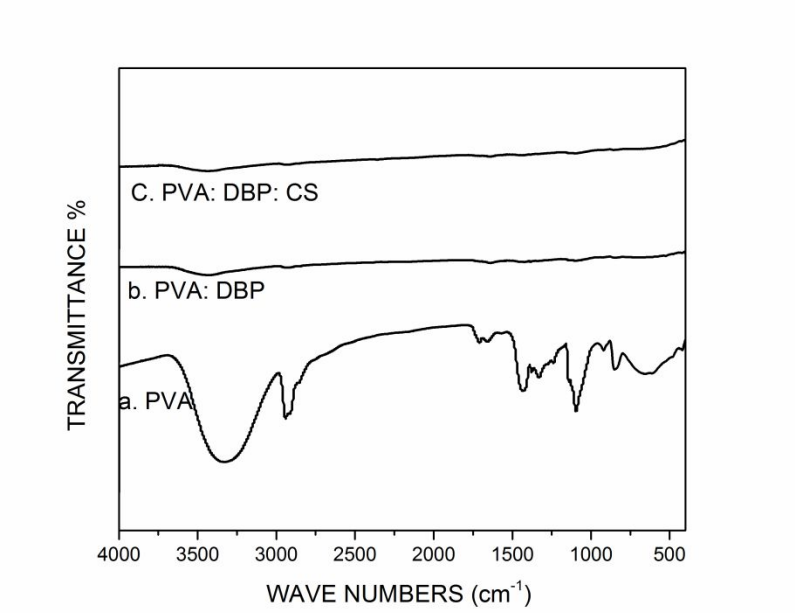

Figure S7. FTIR graph for a. PVA, b. PVA: DBP and c. PVA: DBP: CS

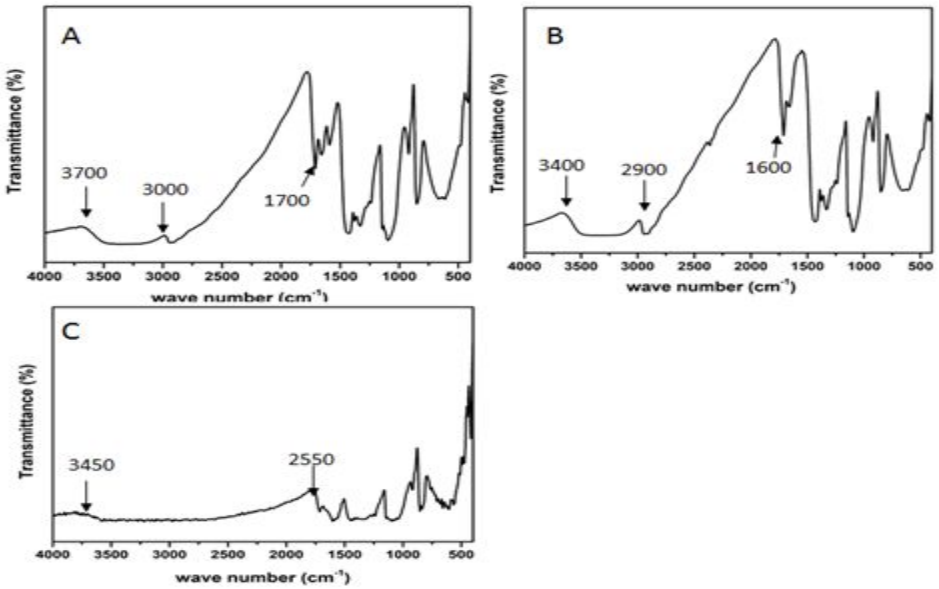

Figure S8. FTIR graph for (A) Cross-linked PVA:CS, (B) Cross-linked PVA: DBP, and (C) Cross-linked PVA: EXT nanofibers.

Antibacterial studies

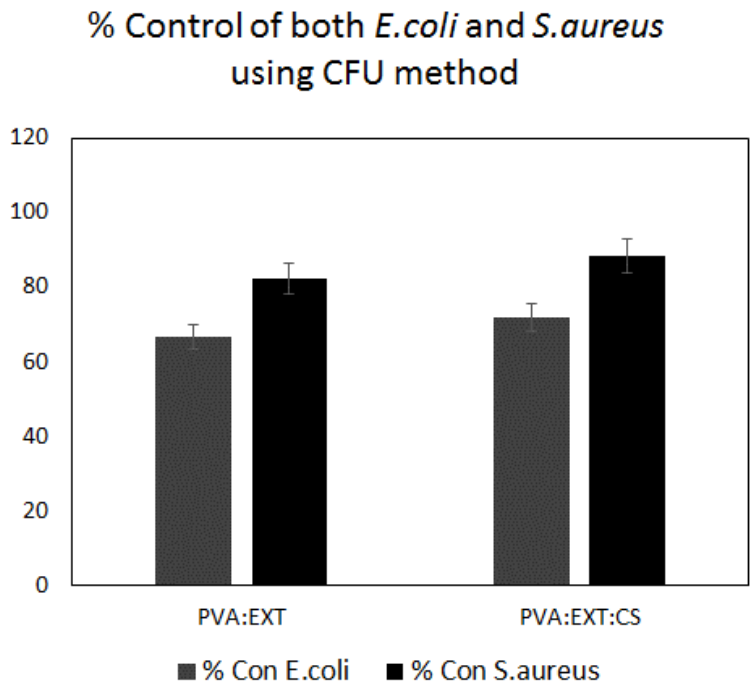

Figure S9. Percentage inhibition of (A) Both *S. aureus* and *E.coli* in the presence of PVA: EXT, and PVA: EXT:CS Ex-situ Nanofibers.

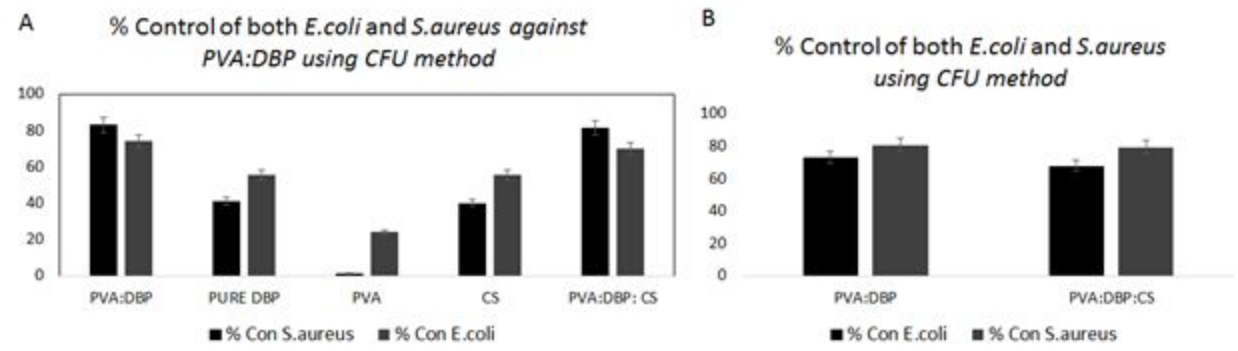

Figure S10. Percentage inhibition of (A) Both *S. aureus* and *E.coli* in the presence of PVA:DBP, PVA, CS, PVA:DBP: CS (In-situ) and Pure Distilled BP and (B) Both *S. aureus* and *E.coli* in the presence of PVA:DBP, and PVA:DBP: CS, (Ex-situ) using CFU method at the 6th dilution.

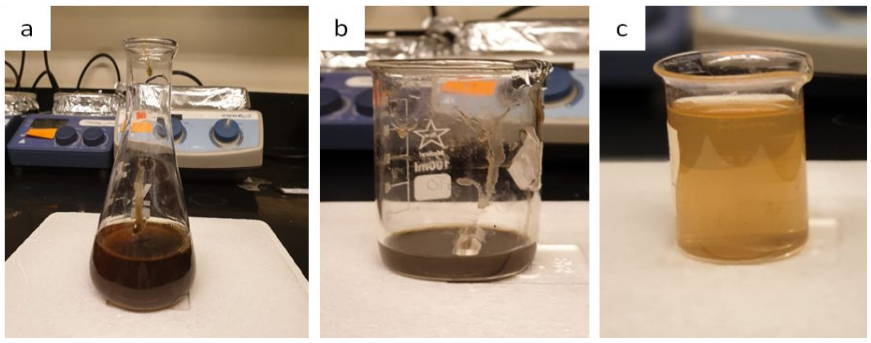

Figure S11. (a) Dissolved Crude extract, (b) Undissolved Extract and (c) Completely dissolved distilled BP.

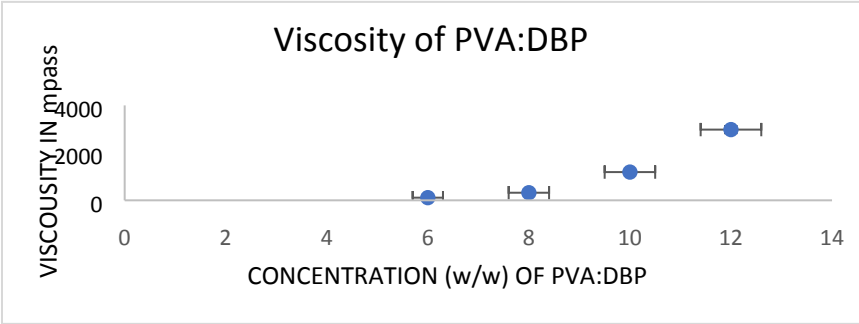

Figure S12. Changes in viscosity upon changing the concentration of PVA:DBP.