where ρw is the water density (0.998 g cm-3), A is the effective area of the membrane (cm2) and l is the membrane thickness in a wet state (cm).

***S3. Disc diffusion method***

***Microbial strains used for the experiments***

All the microbial strains were derived from Microbial Type Culture and Collection (MTCC) as lyophilized slants and were sub-cultured as the 24 h fresh broth culture. The pure bacterial strains including, Staphylococcus aureus (S. aureus, MTCC 121), Bacillus subtilis (MTCC 121) and Escherichia coli (E. coli, MTCC 1302), as well as the pure fungal strains including Candida species (Candida sp, MTCC 2768), Aspergillus flavus (MTCC 277), Penicillium species (MTCC 3321) and Mucor species, Mucor sp, MTCC 3340) were applied in this study.

***Methodology***

Disk diffusion method has been widely used to evaluate the anti-microbial activity of the samples. The agar plate surface was inoculated by spreading a specific volume (100 μL) of the microbial inoculum over the entire agar surface. A disk having a diameter of 5 mm was placed aseptically onto the agar surface. Then, the agar plates were incubated under the compatible conditions dependent on the investigated microorganisms. The anti-microbial agent diffused in the agar medium and inhibited the growth of the microbial strains.

***McFarland (0.5) inoculum preparation***

The slants were swabbed with an inoculation loop and the culture was transferred to the microbial culture broth. The broth was incubated at 37 °C until the growth reached turbidity equal to or greater than that of a 0.5 McFarland standard. The culture was adjusted with sterile distilled water to give a turbidity equivalent to the McFarland 0.5 standard [3]. This can be done by visually comparing the appearance of the black lines through the inoculum and the McFarland standard suspensions, with a fine lighting background (the inoculum and McFarland standard must be in the same-sized tubes).

***Procedure***

Petri plates containing 20 mL Muller Hinton agar were seeded with 24 h culture of bacterial/fungal strains. Uniform disks with the diameter of 5 mm were perforated from the fabricated film and were carefully placed on to the center of the microbial culture inoculated plates. The plates were then incubated at 37° C for 24 h. Then, the anti-microbial activity was assayed by measuring the diameter of the formed inhibition zone around the well.

***S4. Colony count method***

The microbial strains were inoculated in lysogency broth (LB) media and the concentration was adjusted to be 0.5 McFarland standards at 640 nm. The studied membranes were uniformly cut into disks with a diameter of 30 mm and the species culture were inoculated to the films placed in 24 well plates and incubated at 37º C for 24 h. From the incubated samples, a 100 µL solution was taken and then plated onto the nutrient agar plates. The species culture without incubation but with the tested membranes under the same conditions was considered as the negative control. The anti-microbial efficacy of the neat and surface-modified PVDF membranes was calculated by the following equations:

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**Figure S1.** The chemical structures of surface modifiers a) Na-SM, b) Zn-SM and c) Ag-SM.

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**Figure S2.** The NMR spectra of surface modifiers a) Na-SM, b) Zn-SM and c) Ag-SM.

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**Figure S3.** ATR-FTIR spectra of neat and surface modified PVDF membranes after the water filtration test.

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