Chemicals and materials

Unless otherwise specified, reagents were used as received without further purification. $FeCl_3.7H_2O$, Sulfuric acid, nitric acid were purchased from J.T. Baker (India). $KMnO_4$, $FeCl_3.6H_2O$ and were purchased from Riedel-de Haën (Seelze, Germany). Sinapinic acid (3-(4-hydroxy-3,5-dimethoxyphenyl)prop-2-enoic acid) and natural graphite (-20+84 mesh, 99.9%) were purchase from Alfa Aeser (Great Britain). Methanol (HPLC grade) and potassium permanganate were purchased from Merck. Co (USA). The de-ionized water obtained from a Milli-Q Plus water purification system (Millipore, Bedford, MA, USA) was used for all experiments.

Instruments and methods

UV, fluorescence, FT-IR, SEM and TEM measurements

The pH and conductivity of the solutions were measured by a pH meter (720P, Istek, South Korea). All chemical structures and mass calculations were performed by the software program ACD - Chemsketch V12. The UV measurements were undertaken in an UV spectrophotometer (Perkin Elmer 100, German). The fluorescence spectra were performed in a fluorescence spectrophotometer (F-2700 Hitachi Co., Japan), equipped with a xenon arc lamp (150.0W). The scan speed was set at 120.0 nm min^{-1}. All spectra were drawn and fitting by using the software of Origin V6.0. The Fourier transform infrared (FT-IR) spectra of graphene were recorded on a FT-IR spectrometer (Spectrum 100, Perkin Elmer, USA). The scanning electron microscope (SEM) images were acquired using a SEM (JOEL 6700F, Japan). The size distribution of nanoparticles were determined by a Transmission electron microscope (TEM, JEOL-301, Tokyo, Japan). XRD has measured by Bruker AXS D8 Advance, German. Raman spectra were measured by PeakSeeker™ and PeakSeeker Pro™, Agiltron Inc, wavelength 785nm, laser power 150mW.

MALDI-TOF MS detection

The MALDI-TOF-MS analysis were performed by employing both positive and negative ion modes on a time-of-flight mass spectrometer (Microflex, Daltonics Bruker, Bremen, Germany) with a 1.25-m flight tube. Desorption/ionization was obtained by using a 337nm nitrogen laser with a 3-ns pulse width. The accelerating potential in the source was maintained at +20kV. All MALDI-MS spectra were obtained at the average of 200 laser shots. The laser power was adjusted to slightly above the ionization threshold to obtain good resolution and signal-to-noise ratios. The dried droplet method was used for all experiments. Sinapinic acid was used as the matrix for bacteria study. To check the reproducibility, all experimental results were repeated at least three times.

Preparation of GONPs:

A round flask contain natural graphite (1.0 g) was placed in an ice-bath (with sodium chloride to decrease the temperature), which was then subjected to magnetic stirring (Ciramec). After that nitric acid (10.0mL, 69-72%) was added into the flask, Sulfuric acid (15.0 mL, 96.0%) and subsequent potassium permanganate (3.0g, ≥99%) were added gradually into the mixture. The temperature was kept < 0°C by using ice-sodium chloride bath. After removing the ice-bath, the hydrogen peroxide (30-32%, 15.0 mL) was added dropwisely to remove the excess of permanganate (till bubbles stop). After magnetic stirring for 2h, distilled water (200.0mL) was poured slowly into the mixture to obtain a dark brown colloidal suspension. Further stirred for another 30 min, the dispersion was filtered then washed several times with a 5.0 wt% HCl solution to remove metal ions.

Preparation of stable graphene aqueous dispersion

The GONP aqueous dispersion with concentration of ~0.5 mg/mL was ultrasonicated (Sunway Scientific corporation, LC30H) for 30 min and followed by centrifugation at 4000rpm for 1h. The above GONP colloidal dispersion (10.0mL) mixed with hydrazine solution (5.0µL, 35.0wt% NH_2-NH_2 in water) and ammonium hydroxide solution (35.0µL, 28-30wt%, J.T.Baker) was added into the flask. The mixture was subjected to magnetic stirring in an oil-bath at 100 ºC for 2h to reduce GONPs to graphene nanosheet. The synthesized graphene nanosheet was characterized using Transmission electron microscope (TEM),

Preparation of Graphene@Chitosan

About 2g of graphene was dispersed in 50mL of de-ionised water via sonication for 2h. Solution composed from 2g of chitosan in 50mL with 1@acetic acid was added to previous solution for 5h. The prepared nanoparticles sedimented by ultracentrifugation at 18Kg for 20min. It was washed several times. Amount of chitosan that immobilized to graphene nanosheet was 20%.

Preparation of Magnetic Nanoparticles

Preparation has been taken from reference with modifications [60]. That based on co-precipitation of ferrous and ferric salts as shown in supporting file. A 0.63 g of $FeCl_2 \cdot 4H_2O$, and 1.73 g of $FeCl_3 \cdot 6H_2O$ are dissolved in 25 mL of double distilled water , then 40mL of ammonia solution (28%) are added dropwise prior to precipitation. The solution was purged with nitrogen and stirred in a water bath at 90 ◦C for 3 h. About 0.3g of chitosan was dissolved in 30 mL 3% of acetic solution to give a final concentration of 1.5% (w/v). 0.1 g magnetic particles were added in the chitosan solution in a four-neck rounded bottom flask and was stirred at 60 ◦C for 2 h. The precipitate was washed with petroleum ether, ethanol and distilled water in turn until pH was about 7. Then, the precipitate was dried in a vacuum oven at 50 ◦C.

Bacteria culture

Staphylococcus aureus (BCRC 10451) and *Pseudomonas aeruginosa* (BCRC 10303) standard cultures were purchased from Bioresource Collection and Research Center (Hsin-Chu, Taiwan) and were cultivated at 37˚C and maintained on DifcoTM Nutrient broth (Becton and Dickinson, France, 8.0g per 1.0L) and Agar plates (Gen Chain Scientific (GCS), New York, USA, with 1.5% agar). Both bacteria cells were grown individually overnight at 37 ˚C using agar medium and then harvested via noodle then resuspended in sterile deionised water(1mL).

Plate Count Protocol

The number of target organisms present in the sample was determined by surface plating 0.1mL of *Pseudomonas aeruginosa* and *Staphylococcus aureus* dilutions on agar (Difco Laboratories). After incubating at 37˚C for 24h; the presence of the organisms was confirmed by the color of the colonies on the media; *Staphylococcus aureus* was golden; while *Pseudomonas aeruginosa* was blue-green on agar.

Fig.S1

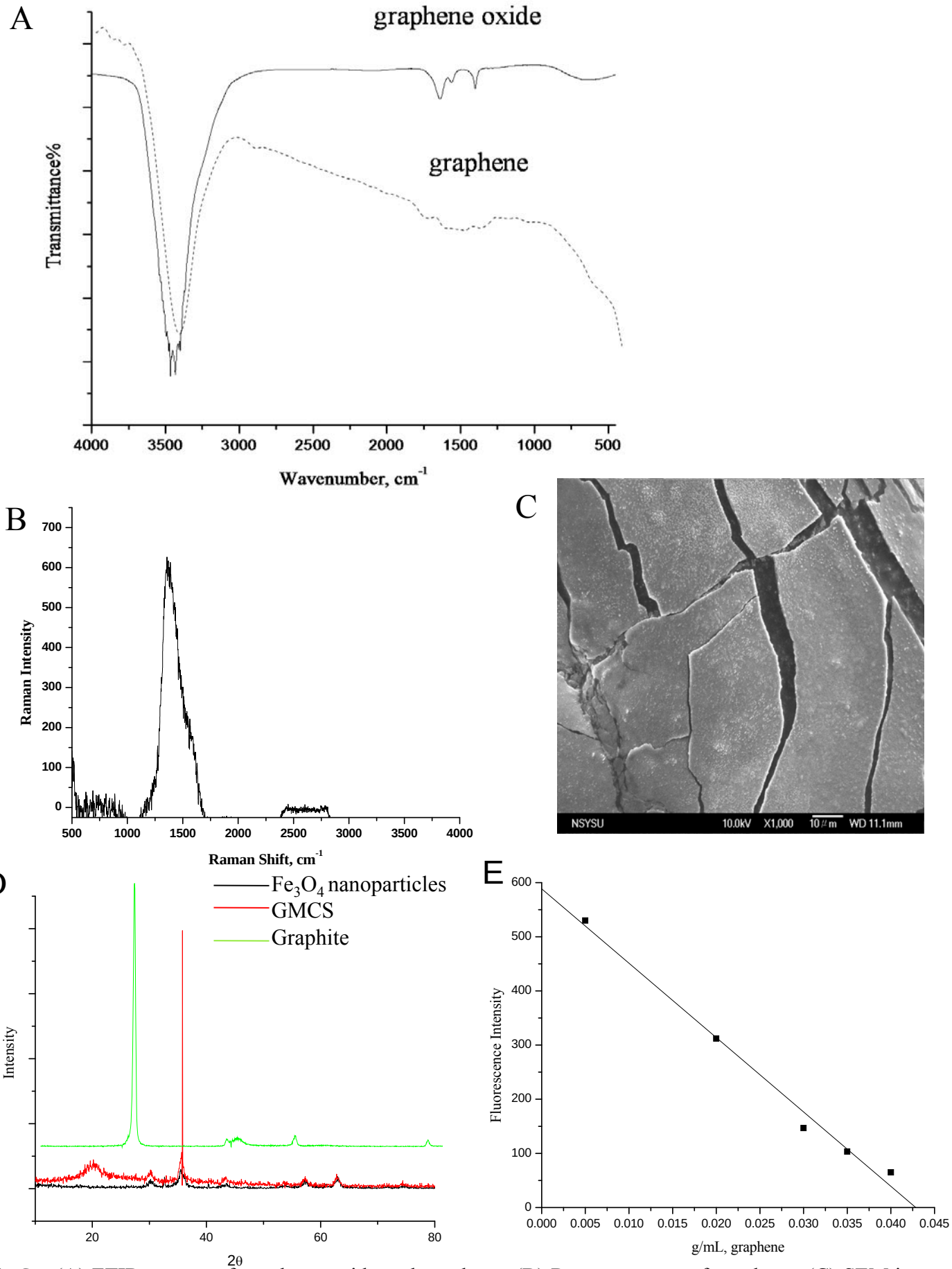

Fig.S1: (A) FTIR spectra of graphene oxide and graphene, (B) Raman spectra of graphene, (C) SEM image, (D) XRD analysis of magnetic nanoparticles, graphite and GMCS and (E) calibration curve of graphene@chitosan

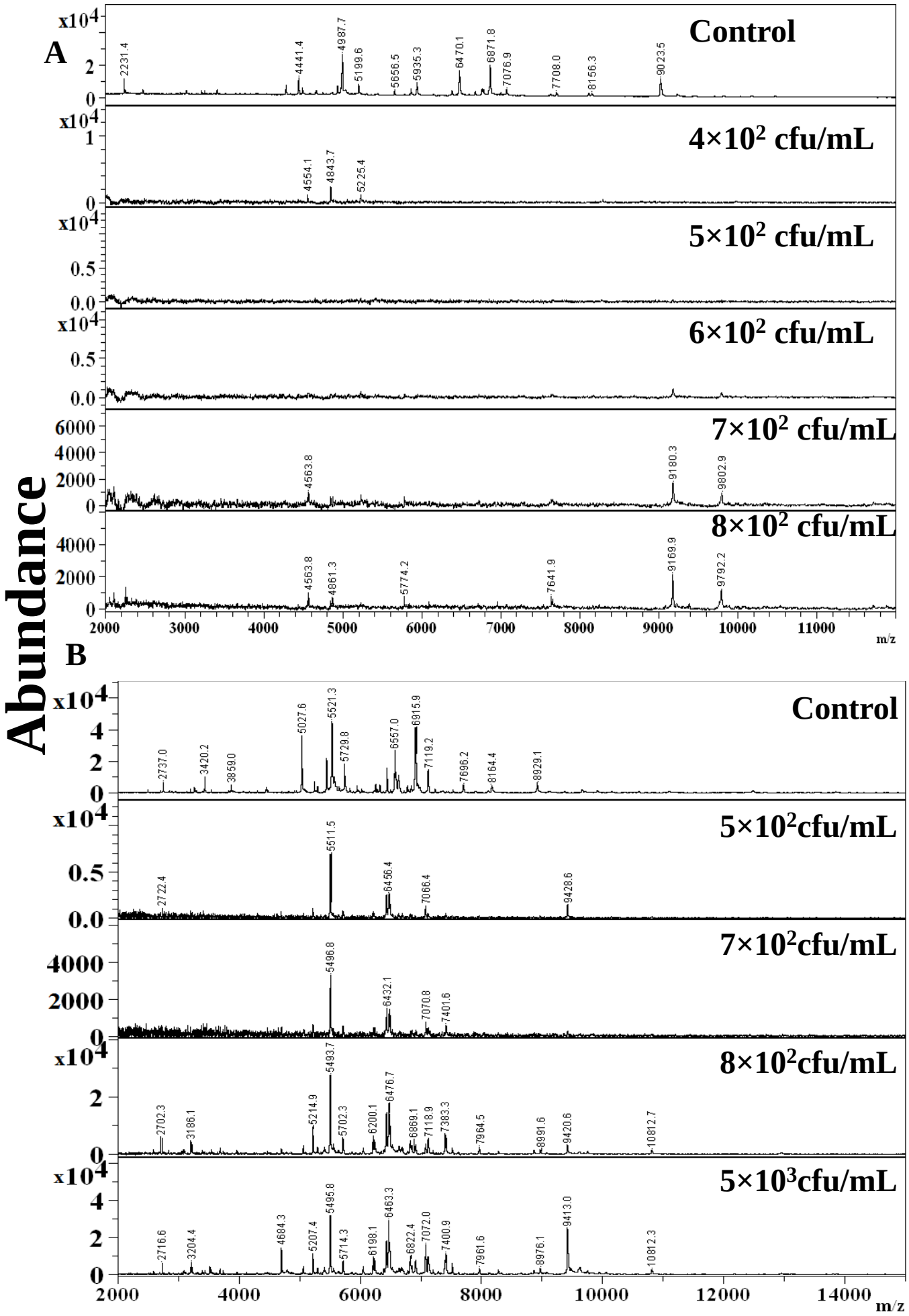

Fig.S2: Direct analysis of standard suspension with different colony of *pseudomonas aeruginosa* (A) and *Staphylococcus aureus* (B)

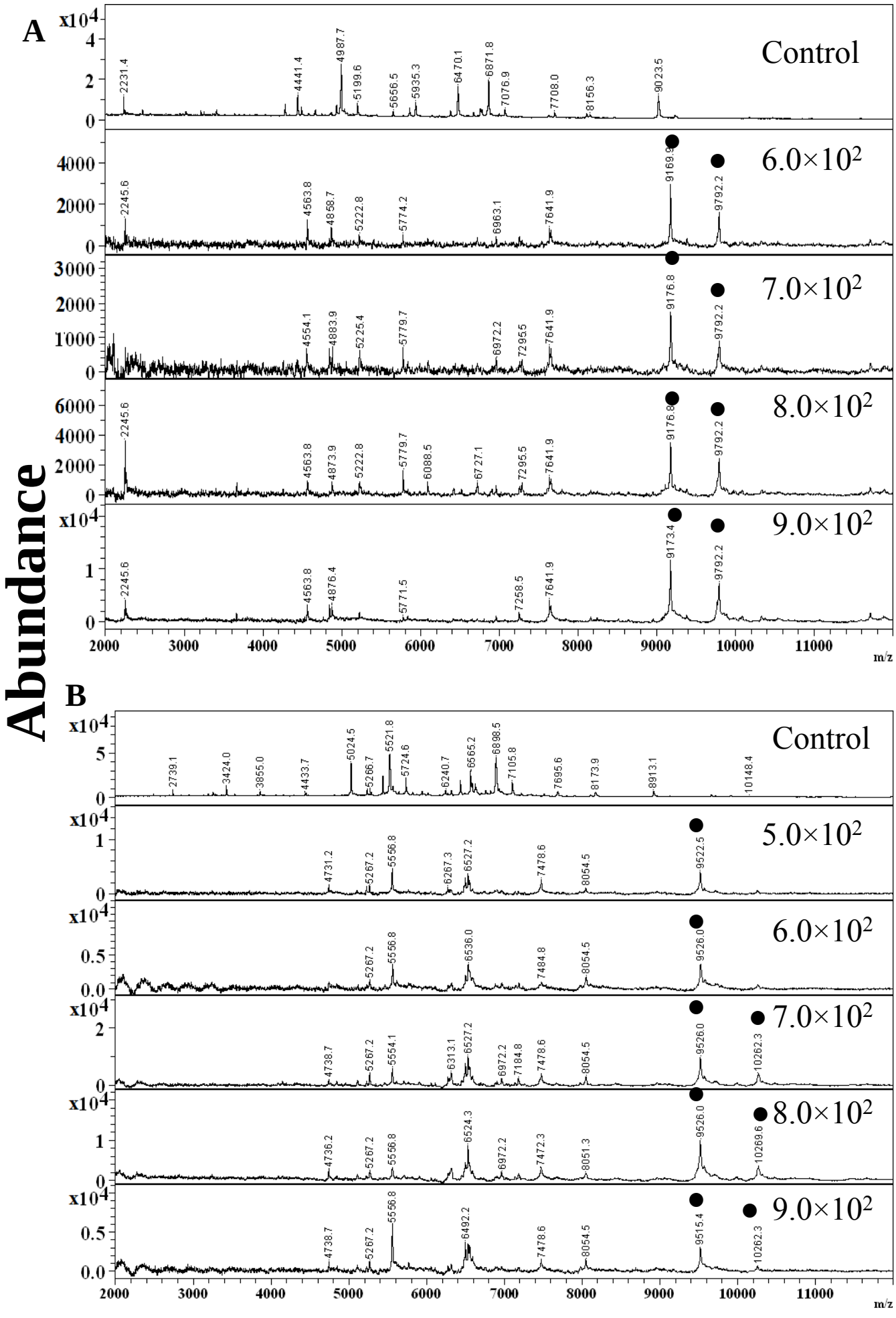

Fig.S3: Direct analysis of blood sample with different colony of *pseudomonas aeruginosa* (A) and *Staphylococcus aureus* (B). Peaks market by (●) represent blood peaks.