Supporting Information

Performance of Fabrics for Home-Made Masks Against the Spread of COVID-19 Through Droplets: A Quantitative Mechanistic Study

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Supporting Video Captions

Video S1. Droplets ejected by the metered-dose inhaler, followed by the cloud of aerosolized medicine from the inhaler.

Video S2. Droplet challenge of commercial medical mask material at 25 mm from the inhaler nozzle.

Video S3. Droplet challenge of single layer of T-shirt fabric at 25 mm from the inhaler nozzle.

Video S4. Droplet challenge of 2 layers of T-shirt fabric at 25 mm from the inhaler nozzle.

Video S5. Incident droplets against a sample placed 300 mm from the inhaler nozzle.

Video S6. Wetting and water absorption behavior of medical mask (non-soaking), fabric 1 (used shirt fabric, slow soaking), and fabric 4 (used undershirt fabric, fast soaking).

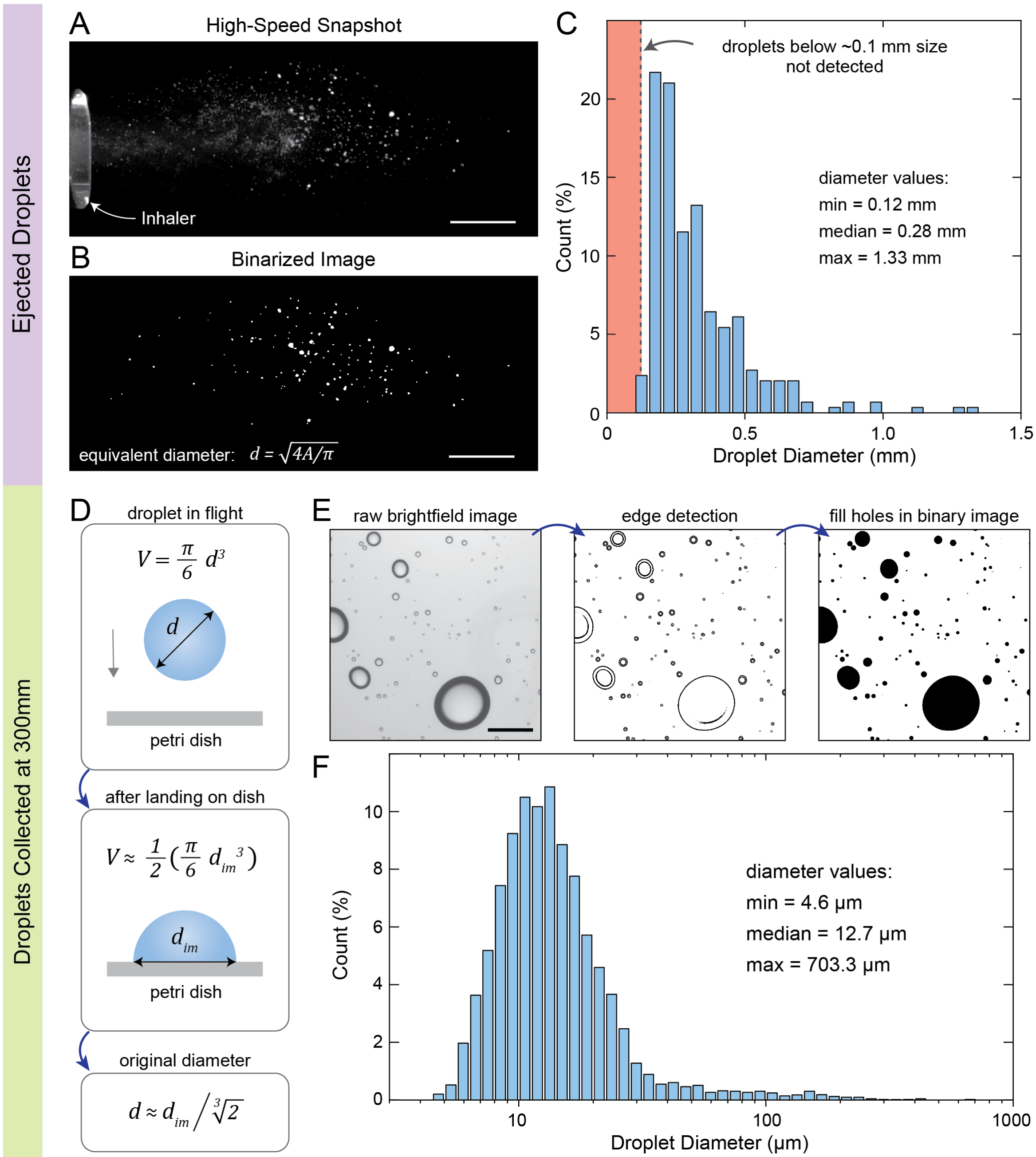

Figure S1. Characterization of droplet size. (A) Representative image of droplets ejected by the inhaler. Droplets are illuminated by a laser for clear visualization. Scale bar: 10 mm. (B) Corresponding binary image which was analyzed to calculate the area and thereby the equivalent diameter. Scale bar: 10 mm. (C) Histogram showing the size distribution of droplets that were detected from image analysis. Droplets with diameters less than 0.1 mm were not detected by this method. (D) Schematic illustration of the method of droplet size estimation from the diameter of landed droplets. (E) Representative images of droplets collected at 300 mm from the inhaler nozzle, illustrating the image analysis scheme. Scale bar: 250μm. Scale bar is omitted in the second and third panels for visual clarity. (F) Histogram showing the size distribution of droplets collected at 300 mm. Note that the x-axis is log-scaled.

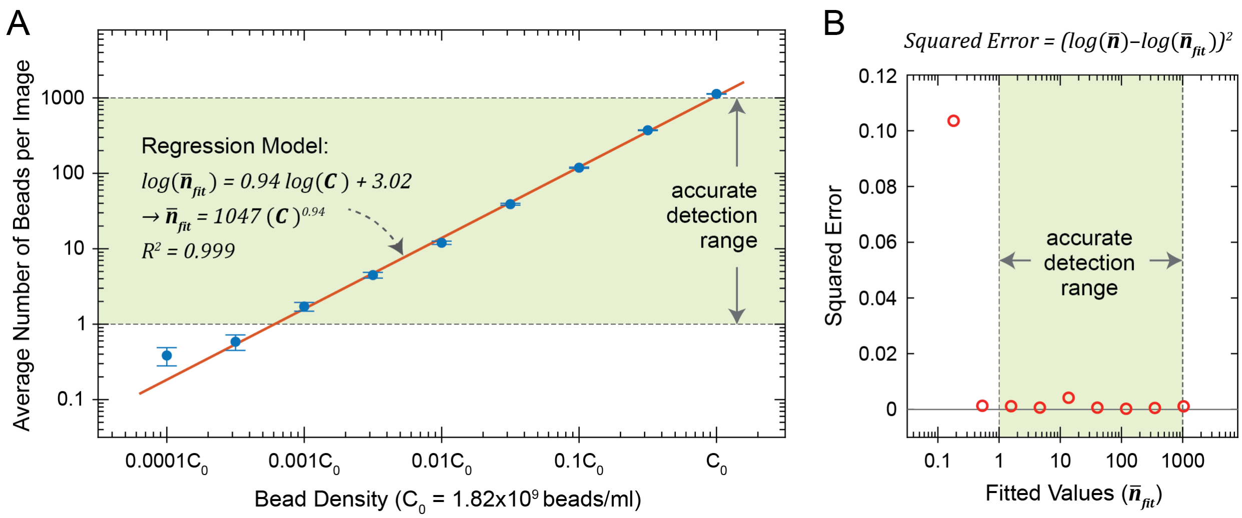

Figure S2. Validation of fluorescent particle (bead) counting method. (A) Log-log plot of average number of beads per image, $\bar{n}$, measured by analysis of confocal images vs. the known bead density in the gelatin mixture. Error bars represent ±95% confidence interval of the mean. (B) Squared error vs. fitted value plot. Here, fitted values are given by the regression model shown in (A). For the sample with a known bead density of 1.82×10^5 beads/ml (*i.e.* $0.0001 \times C_0$ where $C_0 = 1.82 \times 10^9$ beads/ml), measured $\bar{n}$ values deviate significantly from the regression model. For extra safety, we ignore this and the adjacent sample (5.75×10^5 beads/ml, *i.e.*, $0.000316 \times C_0$) and take $\bar{n} = 1$ as our lower detection limit. Since densities that corresponded to $\bar{n} > 1000$ were not tested, we take $\bar{n} = 1000$ as our upper detection limit. Hence, within the range $1 < \bar{n} < 1000$, the measured average number of beads per image, $\bar{n}$, accurately predicts the bead density in the gelatin mixture.

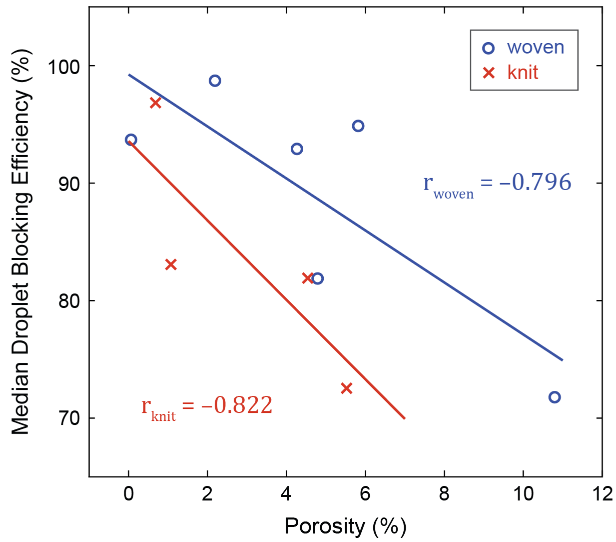

Figure S3. Median droplet blocking efficiency vs porosity plots for woven and knit fabrics with regression lines.

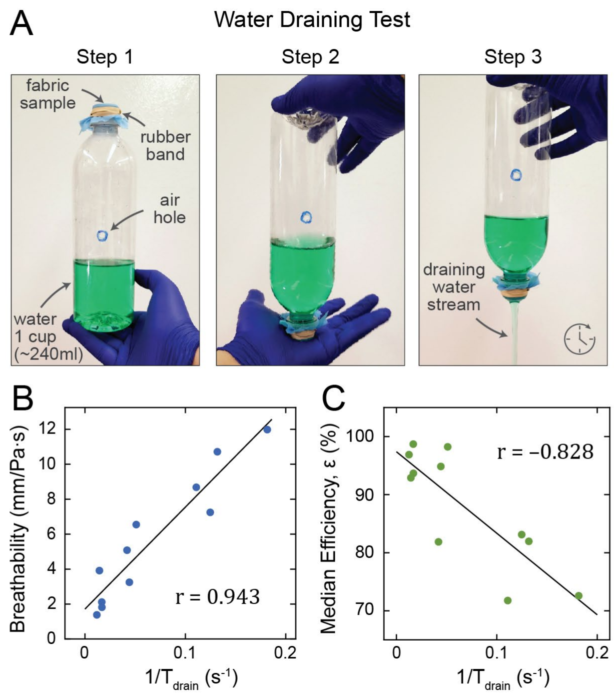

Figure S4. Water permeability test. (A) Step-by-step demonstration of the water draining test. Green food coloring is added to the water for clear visualization. Plots with regression lines of (B) breathability vs. inverse of the draining time and (C) median droplet blocking efficiency vs. inverse of the draining time.

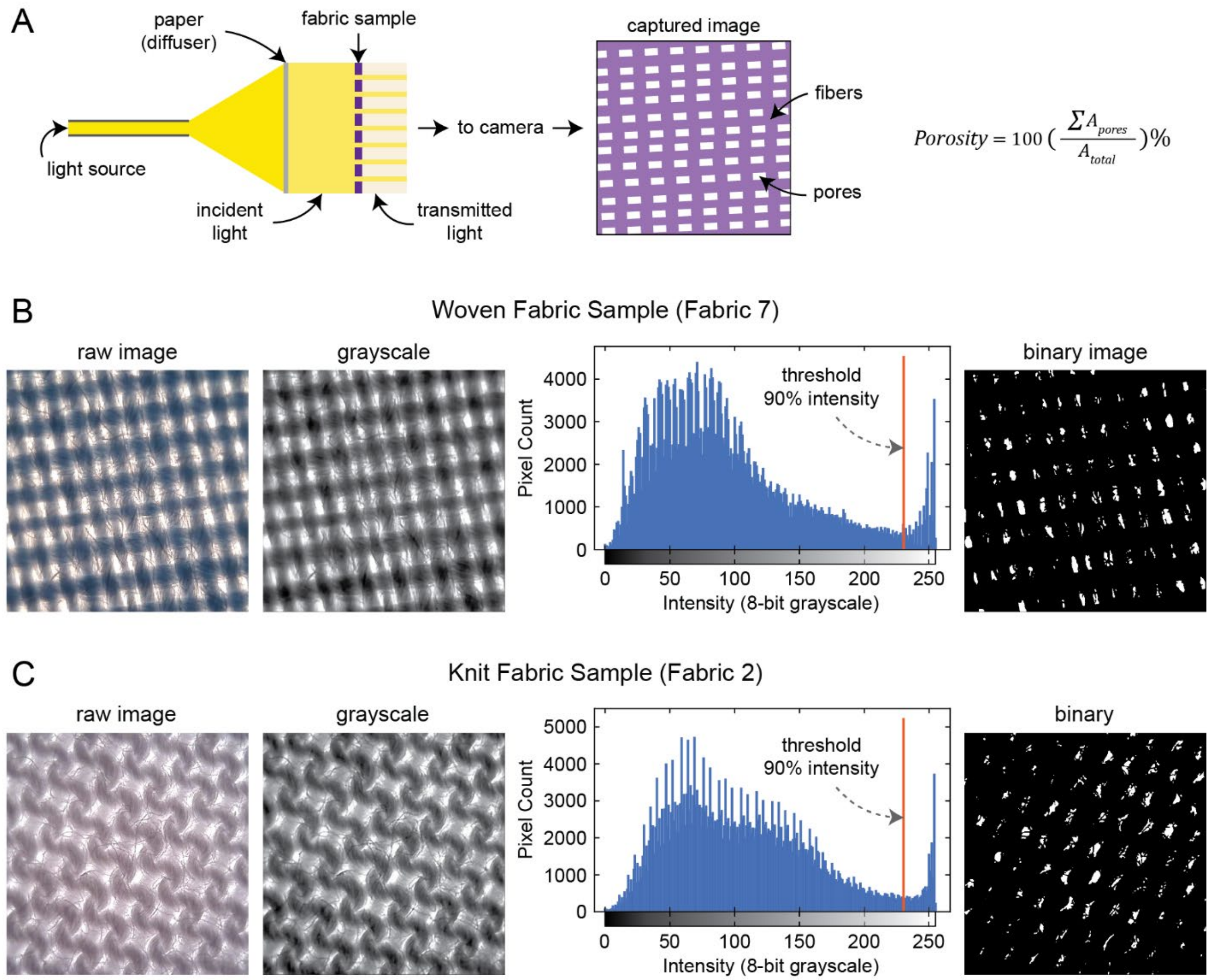

Figure S5. Measurement of fabric porosity. (A) Schematic illustration of the measurement method. Fabrics are imaged while being illuminated by diffuse light from the backside to identify pores. Porosity is calculated as the fraction of fabric area occupied by pores. (B, C) Image analysis scheme illustrated by two examples; one woven and one knit fabric. Raw images were converted to grayscale and median filter was applied to reduce noise. Intensity histograms show that the pores can be identified as a distinct peak towards the right-hand-side (brightest areas of the image). A threshold at 90% intensity was applied to binarize the images. Binary images were used for calculating porosity.

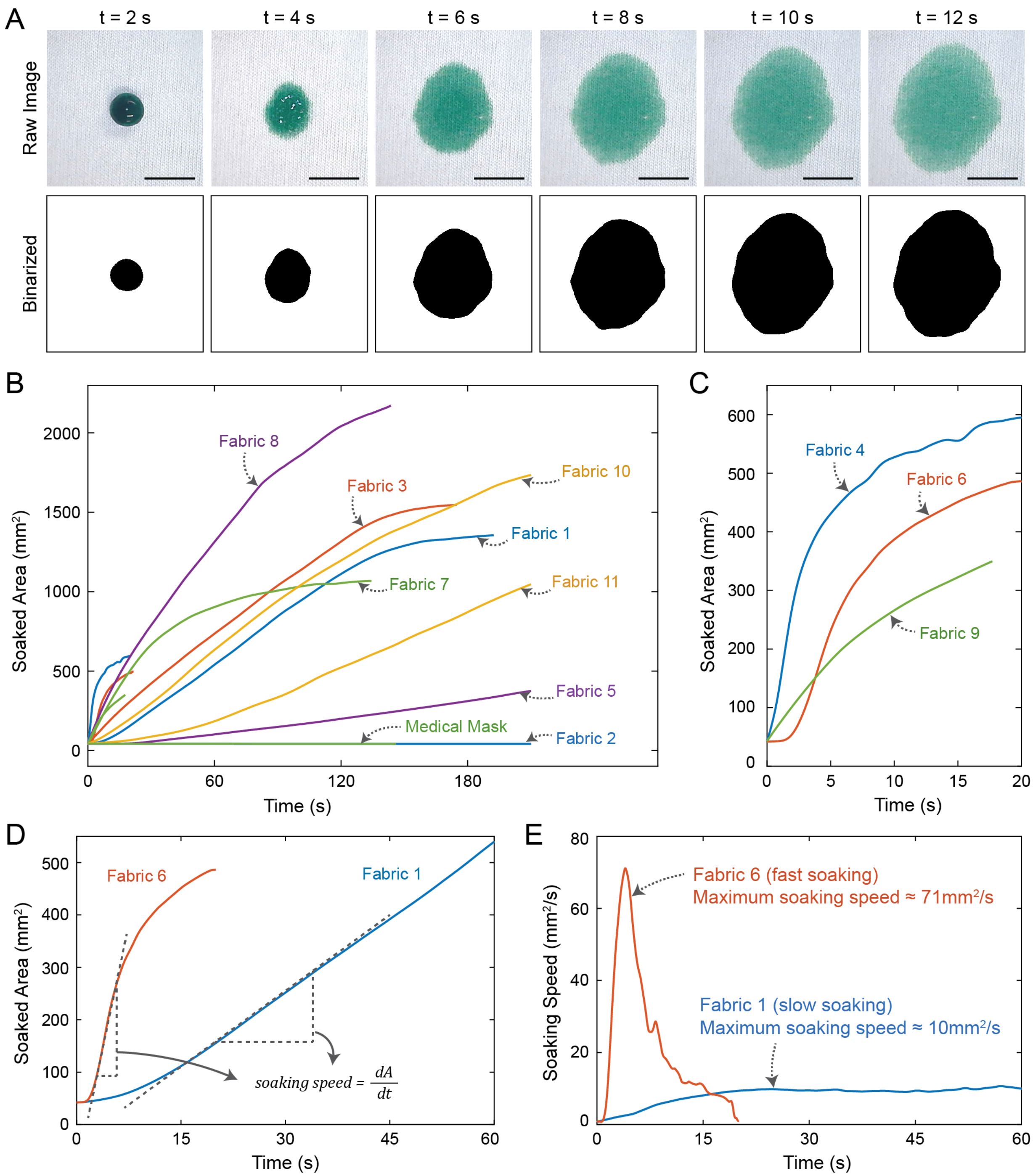

Figure S6. Measurement of water soaking speed. (A) Top row: Snapshots from water soaking test on T-shirt fabric (fabric 6) with green food coloring added for contrast. Scale bars: 10 mm. Bottom row: Corresponding binary images which were used to quantify soaked area. (B, C) Soaked area plotted against time for all fabrics tested. (D) Soaking speed is calculated as the time derivative of soaked area. Area vs. time plots for a fast soaking sample (fabric 6) and relatively slow soaking sample (fabric 1) are shown as examples. (E) Soaking speed vs. time plotted for fabrics 6 and 1.