

## Supporting Information

# Study of the Pathogen Inactivation Mechanism in Salt-Coated Filters

**Ilaria Rubino<sup>a,1</sup>, Sumin Han<sup>a,1</sup>, Euna Oh<sup>a</sup>, Surjith Kumaran<sup>a</sup>, Matthew Lawson<sup>a</sup>, Yu-Jin Jung<sup>b</sup>, Ki-Hye Kim<sup>b</sup>, Noopur Bhatnagar<sup>b</sup>, Su-Hwa Lee<sup>c</sup>, Hae-Ji Kang<sup>d</sup>, Dong-Hun Lee<sup>d</sup>, Ki-Back Chu<sup>d</sup>, Sang-Moo Kang<sup>b</sup>, Fu-Shi Quan<sup>c,e,\*</sup>, and Hyo-Jick Choi<sup>a,\*</sup>**

<sup>a</sup>Department of Chemical and Materials Engineering, University of Alberta, Edmonton, AB T6G 1H9, Canada.

<sup>b</sup>Center for Inflammation, Immunity & Infection, Institute for Biomedical Sciences, Georgia State University, Atlanta, GA 30303, USA.

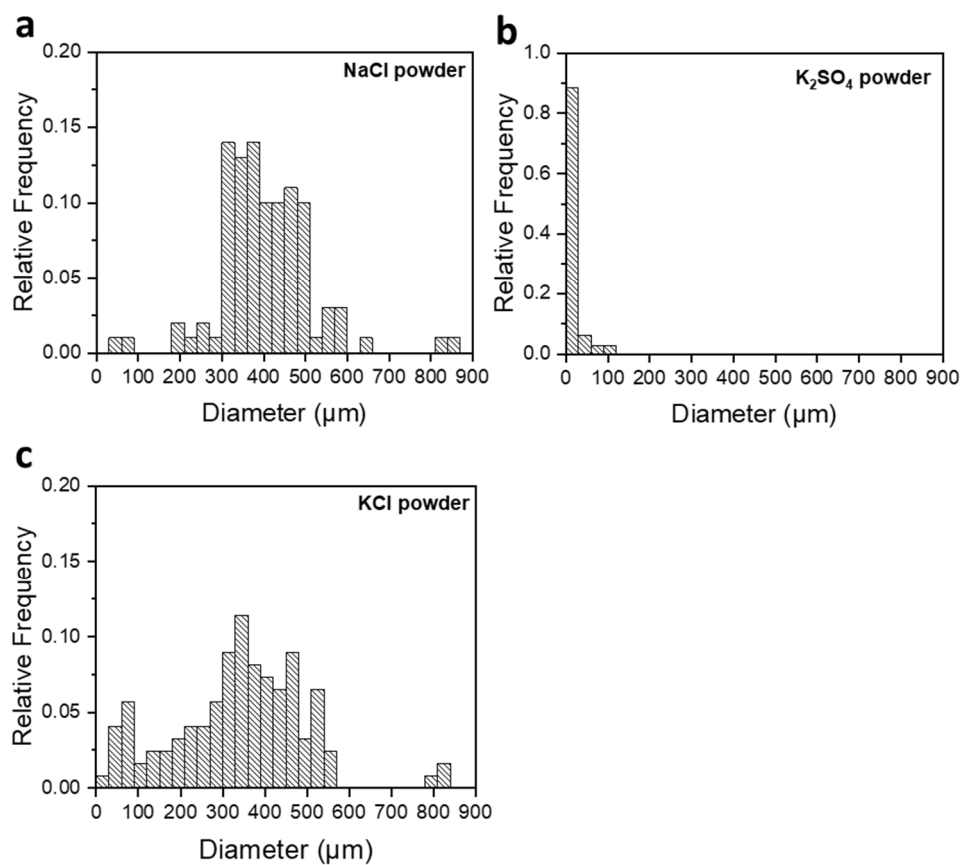
<sup>c</sup>Department of Medical Zoology, Kyung Hee University School of Medicine, Seoul, 130-701, Korea.

<sup>d</sup>Department of Biomedical Science, Graduate School, Kyung Hee University, Seoul, 130-701, Korea.

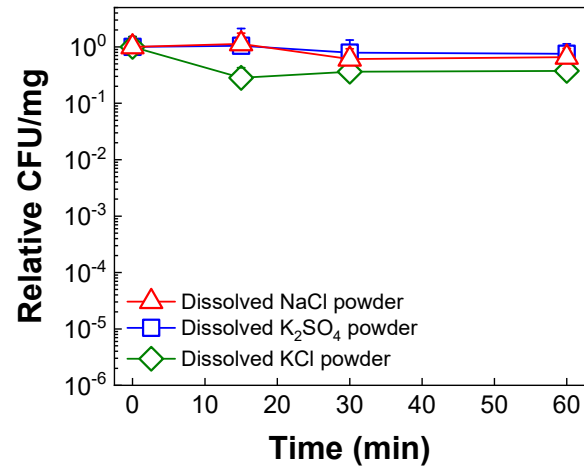
<sup>e</sup>Department of Medical Research Center for Bioreaction to Reactive Oxygen Species and Biomedical Science Institute, School of Medicine, Graduate school, Kyung Hee University, Seoul, 130-701, Republic of Korea.

<sup>1</sup>These authors contributed equally to this work.

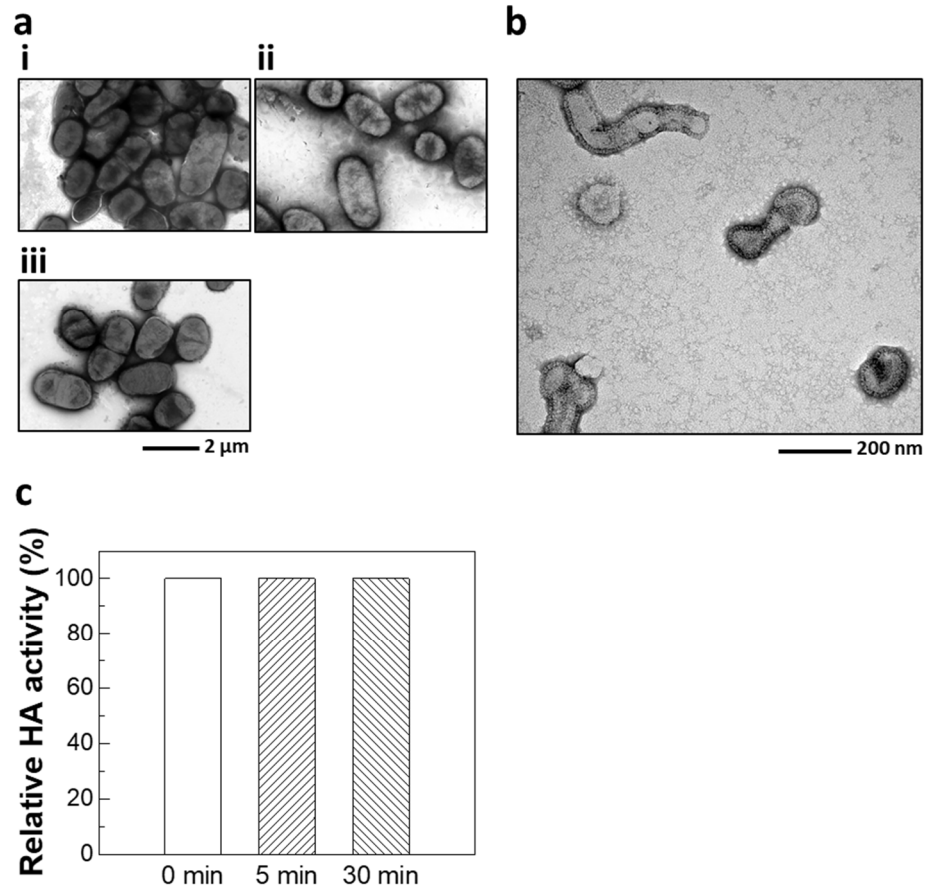
\* Corresponding author: fquan01@gmail.com (F.-S.Q); hyojick@ualberta.ca (H.-J.C).



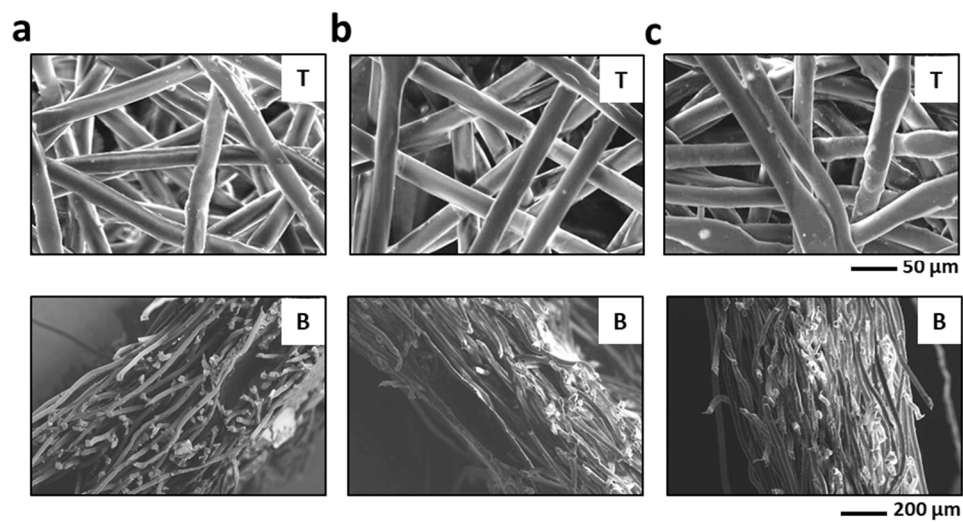
**Figure S1.** Salt powder size. Histogram of NaCl (a),  $\text{K}_2\text{SO}_4$  (b), and KCl (c) powder size ( $n = 100$  for (a),  $n = 181$  for (b),  $n = 123$  for (c)).



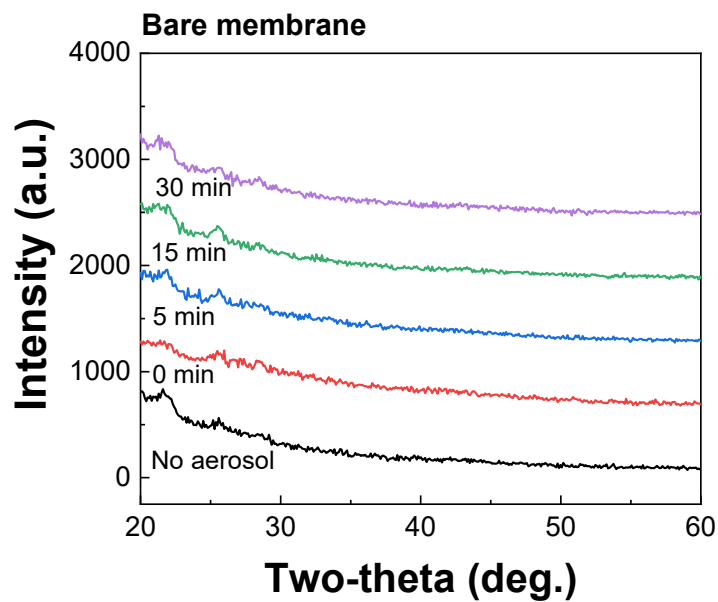
**Figure S2.** Bacteria incubation in dissolved salt powders. CFU change showing the effect of incubation time on *K. pneumoniae* exposed to dissolved salt powders during the experiments ( $n = 4-20$ , mean  $\pm$  SD).



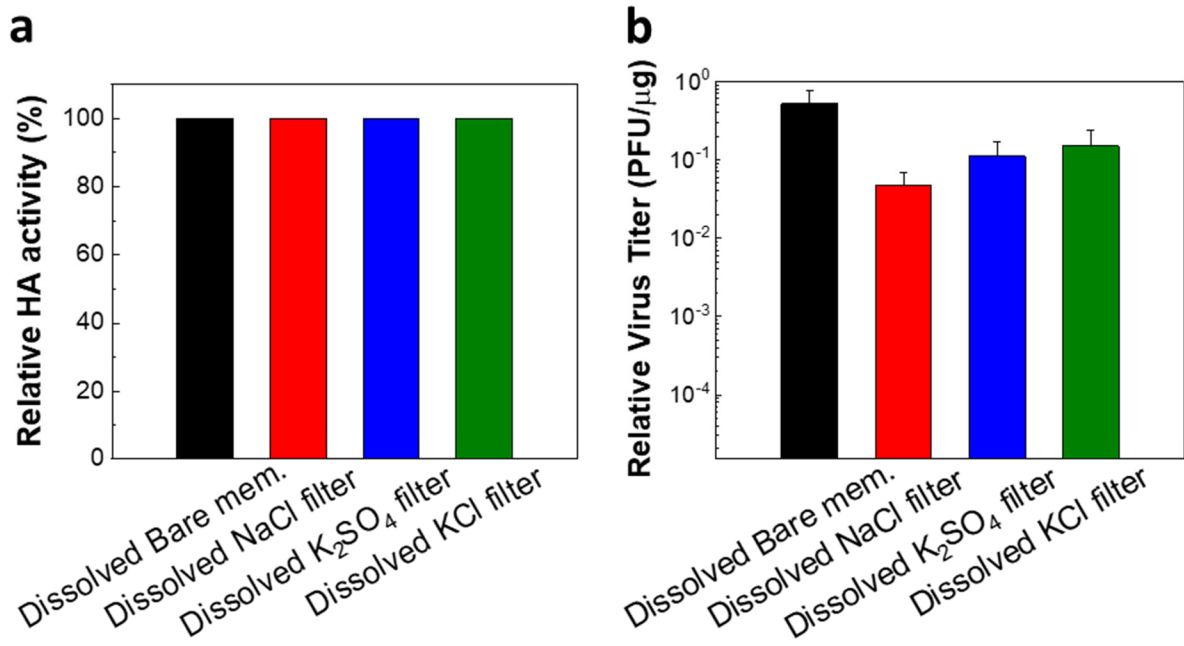
**Figure S3.** Effect of osmotic pressure on pathogens. (a) TEM images of *K. pneumoniae* following incubation in NaCl 29 w/v % (i),  $K_2SO_4$  10 w/v % (ii), and KCl 26 w/v % (iii) solutions for 30 min. (b) TEM images of PR/34 virus following incubation in NaCl 29 w/v % solution for 30 min. (c) HA titer showing the effect of incubation time on PR/34 virus exposed to sucrose 200 w/v % solution ( $n = 8$ , mean  $\pm$  SD).



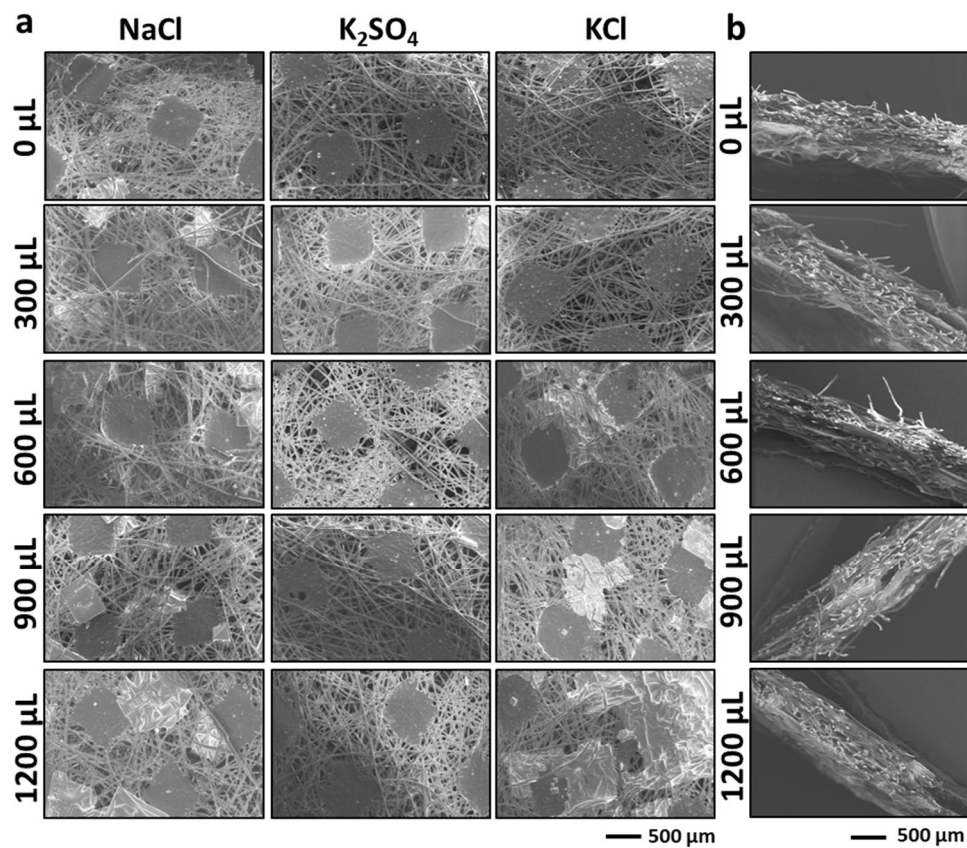
**Figure S4.** Plan-view (T: top) and cross-sectional (B: bottom) SEM images of NaCl (a), K<sub>2</sub>SO<sub>4</sub> (b), and KCl (c) filters.



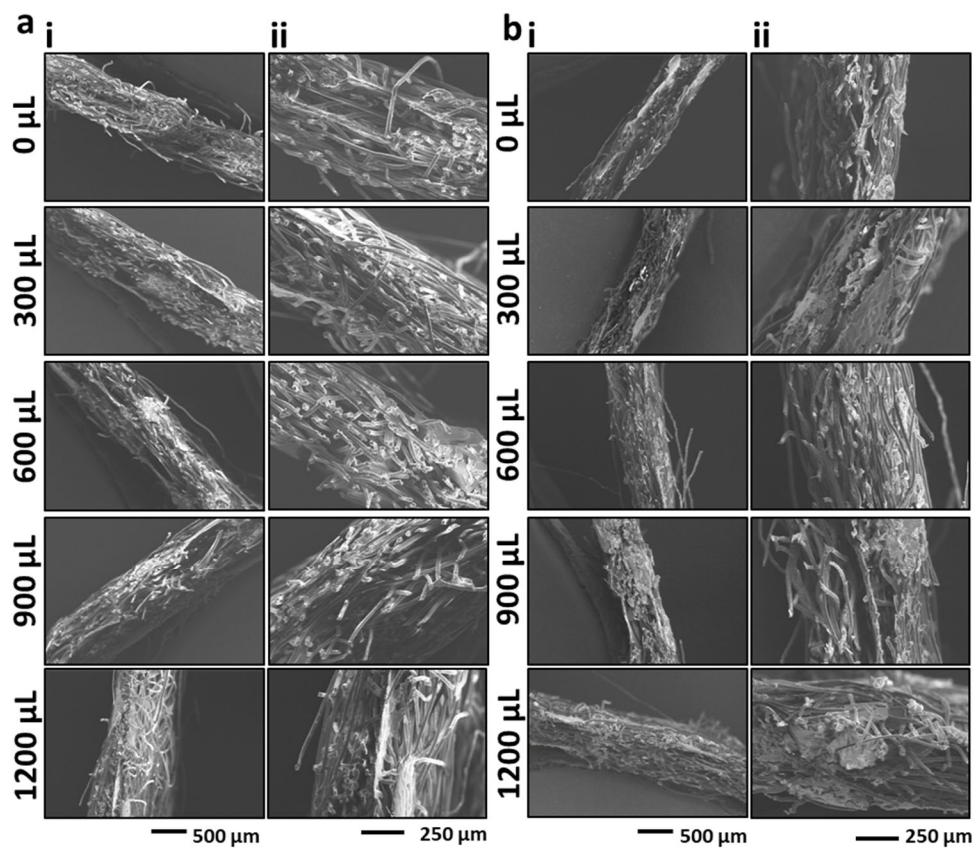
**Figure S5.** XRD spectra of bare membrane before aerosol exposure (no aerosol), right after (0 min), and at 5, 15, and 30 min.



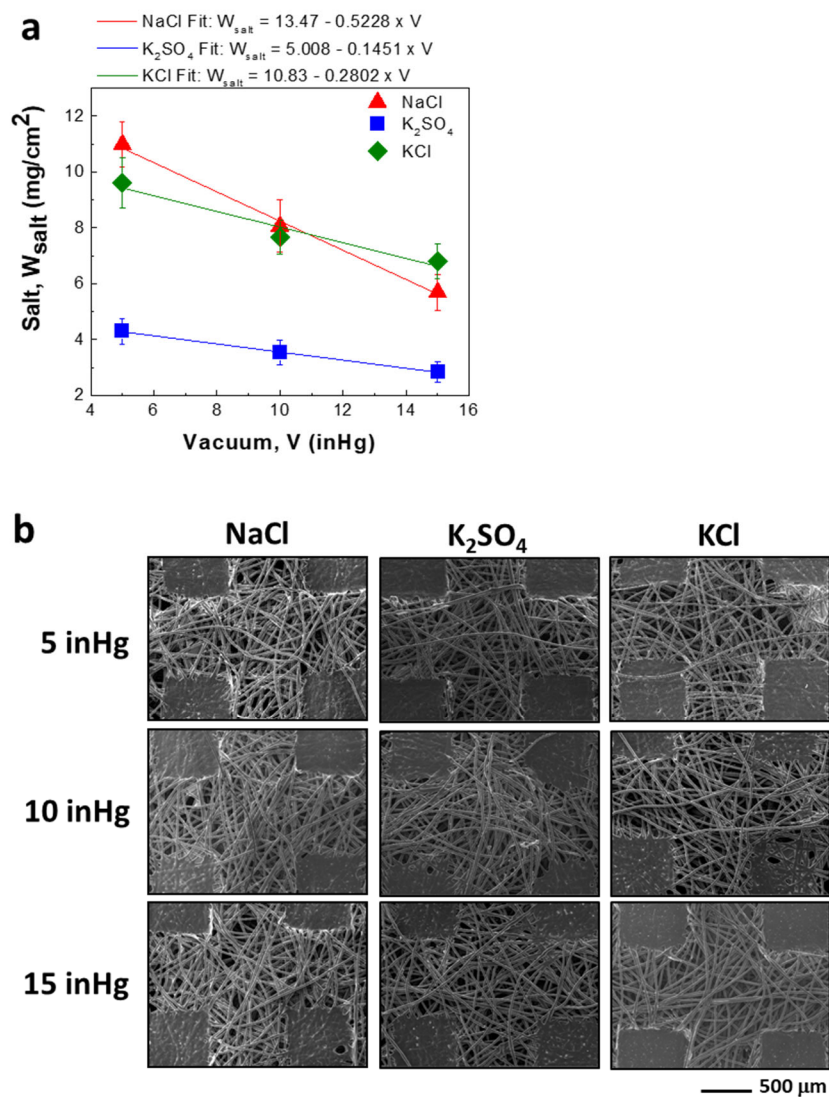
**Figure S6.** Virus incubation in dissolved salt-functionalized filters. HA titer (a) and virus titer (b) showing the effect of osmotic pressure on PR/34 virus exposed to dissolved bare, NaCl<sub>600</sub>, K<sub>2</sub>SO<sub>4</sub><sub>600</sub>, and KCl<sub>600</sub> for 60 min ( $n = 8-53$  for (a),  $n = 5-33$  for (b), mean  $\pm$  SD). Relative: with respect to 0 min. Mem: membrane.



**Figure S7.** (a) Low-magnification SEM images of filters functionalized with NaCl (left),  $K_2SO_4$  (center), and KCl (right), showing the morphology of the salt coatings at different amounts of coated salt. (b) Low-magnification, cross-sectional SEM images of NaCl-functionalized filters, showing the morphology of the salt coatings at different amounts of coated salt.



**Figure S8.** (a, b) Cross-sectional SEM images of  $\text{K}_2\text{SO}_4$  (a) and  $\text{KCl}$  (b) functionalized filters, showing the distribution of the salt coatings at different amounts of coated salt (i: low magnification, ii: high magnification).



**Figure S9.** Production of salt-coated filters with vacuum application. (a) Relationship between level of vacuum applied during salt coating ( $V$ ) and amount of salt coated on the filters ( $W_{\text{salt}}$ ) ( $n = 6\text{--}15$ , mean  $\pm$  SD). Linear fit equations are shown ( $P < 0.001$ ). (b) Low-magnification SEM images of filters functionalized with NaCl (left),  $K_2SO_4$  (center), and KCl (right), showing the morphology of the salt coatings at different levels of vacuum applied during coating.

**Table S1.** Salt and sucrose solution conditions used for tests of the osmotic pressure effect on bacteria and virus during aerosol drying. \*Saturated condition.

<b>NaCl</b> <b>Concentration</b> <b>(w/v%)</b>	<b>K<sub>2</sub>SO<sub>4</sub></b> <b>Concentration</b> <b>(w/v%)</b>	<b>KCl</b> <b>Concentration</b> <b>(w/v%)</b>	<b>Sucrose</b> <b>Concentration</b> <b>(w/v%)</b>
29*	10*	26*	200*
26	7	18	
18	4	10	
10			