Contribution ID: **36** Type: **Poster**

Exploring the protective effect of salt against pH-mediated inactivation of Influenza A virus

Introduction

Respiratory viruses, including influenza virus and SARS-CoV-2, primarily transmit via the airborne route as aerosolised particles and droplets. The chemical composition of aerosol particles undergoes rapid changes as they enter and persist in the environment, which in turn can impart effects on the viruses contained within these particles. Depending on air composition, aerosols can acidify on exposure to indoor air , which can inactivate those enveloped viruses which are sensitive to acidic pH as a trigger for cellular entry.
We have previously developed and utilised a biophysical model to demonstrate the relationship between acidifying respiratory aerosols and Influenza A virus (IAV) inactivation, wherein particles become mildly acidic following exhalation and inactivate IAV within minutes. Aside from acidic pH, we have also identified high salt molality, primarily that of sodium chloride (NaCl), as a stressor of IAV in drying droplets. Having identified high NaCl molality and acidic pH as independent stressors upon IAV, we sought to explore and define the effect of simultaneous IAV exposure to both acidic pH and high NaCl molality, as such conditions reflect those encountered by IAV in aerosol particles in indoor air.

Methods

Using bulk-phase experiments, we exposed the typical Influenza A lab strain PR8 to a range of pH values within the mildly acidic range, coupled with a range of NaCl molality from zero to saturation (6.1 molal). We measured inactivation kinetics in the order of both minutes and hours, to define the decay rate of infectivity for each condition. We then investigated the mechanism of inactivation using immunofluorescence. Using antibodies specific to the pre- and post-fusion conformations of IAV haemagglutinin (HA), we assessed conformational changes elicited by the combination of pH and NaCl molality.

Results

Somewhat surprisingly, we found a protective effect of high NaCl molality when viruses were incubated at mildly acidic pH including that below the fusion (and thus inactivation) pH of IAV. The addition of NaCl to acidic buffers reduced the inactivation rate of viruses and drastically extended the time for which viruses remained infectious. Specifically, in the presence of 2.8 molal NaCl , the fusion pH shifted down by at least 0.3 pH units, and in fully saturated NaCl solutions a similar effect was seen when compared to solutions with physiological salt concentrations. The change in fusion pH may be explained by the ability of NaCl to stabilize HA in its pre-fusion confirmation, such that a lower pH is required to trigger the conformational change to the post-fusion state.

Conclusions

We have previously shown that acidic pH is inactivating towards IAV, as well as high salt molality at neutral pH. Until now, these conditions have only been studied in isolation. Here we demonstrate that salt is protective of IAV infectivity in acidic conditions, potentially due to a stabilising effect on HA. It is thus our belief that pH and salt should be considered jointly when assessing the inactivating kinetics of IAV in respiratory aerosols.

Primary author: CHARLTON, Frank (EPFL)

Co-authors: Ms TERRETTAZ, Céline (EPFL); Ms LEUENBERGER, Gloria (EPFL); KOHN, Tamar (EPFL)

Presenter: CHARLTON, Frank (EPFL)