



Contribution ID : 93

Type : Oral

Neutron Reflectometry Unravels Allergen-Lung Surfactant Monolayer Interactions in the Development of Pollen-Induced Thunderstorm Asthma

Wednesday, 24 November 2021 14:00 (15)

Pollen-induced thunderstorm asthma outbreaks affect thousands of individuals globally. Australians in particular suffer from it every year. Pollens, the major culprit in thunderstorm asthma, are biological microparticles produced by flowering species of the plants. Pollens encounter stormy environments including lightning and humidity in thunderstorms, which results in liberation of associated allergen proteins and probable reactions with reactive oxygen nitrogen species (RONS) from the environment, before inhalation. Since allergen proteins are much smaller in size than whole pollen, they can travel deep down in the lower airways where they initially interact with the lung surfactant monolayer present within the lumen of alveoli. Although meteorological, pathological and immunological analyses support the role of pollen allergens in exacerbating asthma, the physicochemical basis of this phenomenon is underinvestigated.

In this talk, we present a model system to study the interactions between an allergen protein and a lung surfactant monolayer composed of solid-supported dipalmitoylphosphatidylcholine (DPPC) monolayer. We mimic the stormy environment with plasma-activated water (PAW) and employ advanced analytical tools and techniques such as quartz crystal microbalance with dissipation (QCM-D) and neutron reflectometry (NR) to investigate the effect of RONS on the allergen protein and its subsequent interactions with the DPPC monolayer. Our experimental analysis revealed the attachment of RONS on the allergens when exposed to the PAW, and QCM-D showed mass adsorption profiles. Furthermore, NR showed the monolayer insertion and aggregation propensity of the allergens, providing a deeper mechanistic insight into these interactions. The findings of this research will enable effective diagnostic strategies and therapeutics for the treatment of thunderstorm asthma.

Level of Expertise

Student

Presenter Gender

Man

Pronouns

He/Him

Which facility did you use for your research

Australian Centre for Neutron Scattering

Students Only - Are you interested in AINSE student funding

Yes

Do you wish to take part in the Student Poster Slam

No

Condition of submission

Yes

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Session Classification : Biomedicine, Life science & Food Science

Track Classification : Biomedicine, Life science & Food Science