

Functional Foods for Keeping Lungs Healthy in Polluted Cities

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The Pollution Problem



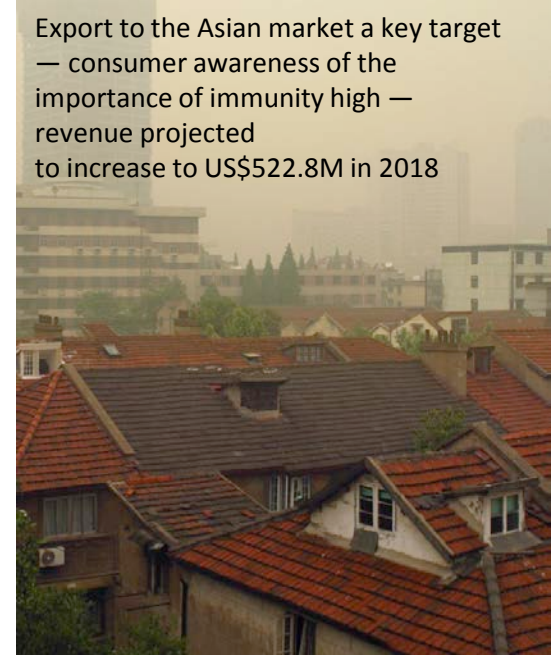
- Air quality and pollution is a growing world concern
 - Difficult to contain
 - Seasonal and weather effects
- Air pollution is caused by:
 - Vehicles
 - Natural disasters
 - Industrial activity



The Cost of Pollution

- 3.7M deaths linked to air pollution
 - 88% deaths in low/middle income countries
 - 60% of China had 'very poor' air quality
 - SE Asia and Western Pacific countries very affected
- Air pollution increases burden of chronic and acute diseases
 - Asthma, COPD, lung infections, pneumonia, stroke, heart attacks

Export to the Asian market a key target
— consumer awareness of the importance of immunity high —
revenue projected to increase to US\$522.8M in 2018



Health Burden of Pollution



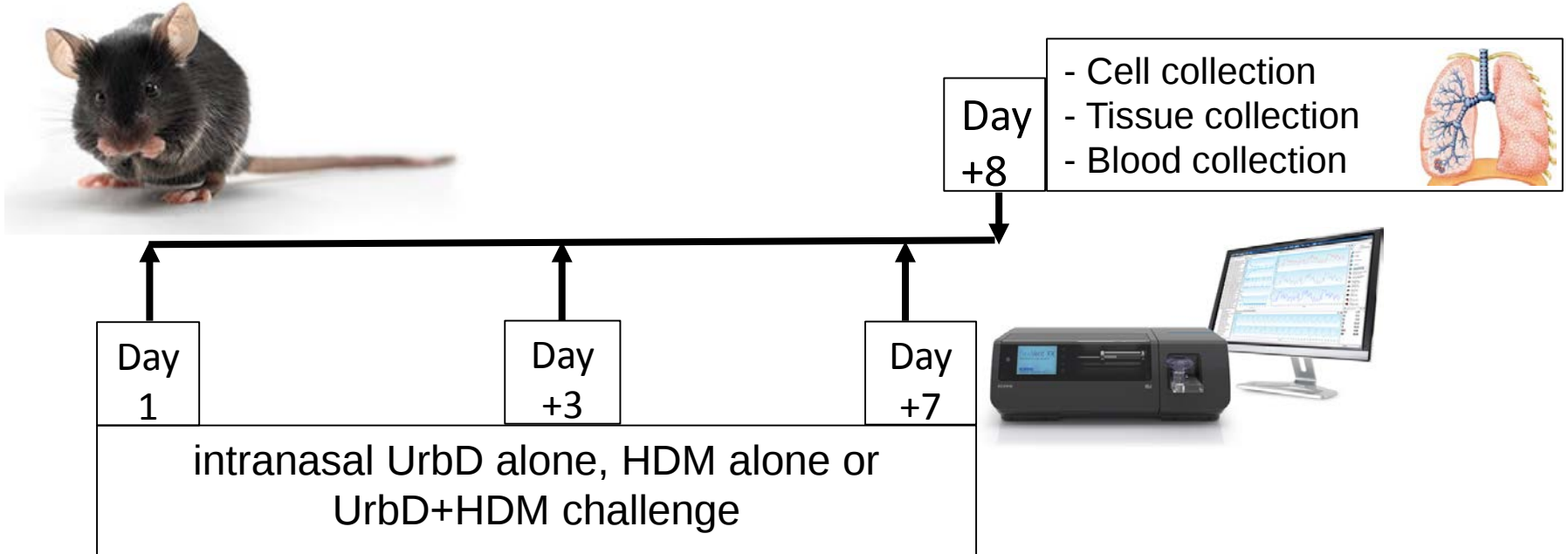
- Inhalation of airborne hazards results in:
 - Immune cell activation and infiltration
 - Increased mucous and cytokine production
 - Oedema, swelling, fibrosis/scarring
 - Chronic inflammation
 - Tissue damage/loss of function
- Penetrance of particles deep into the lung and potential entry into blood stream
 - Act as a site for fibrosis and scarring
 - Can lead to systemic effects



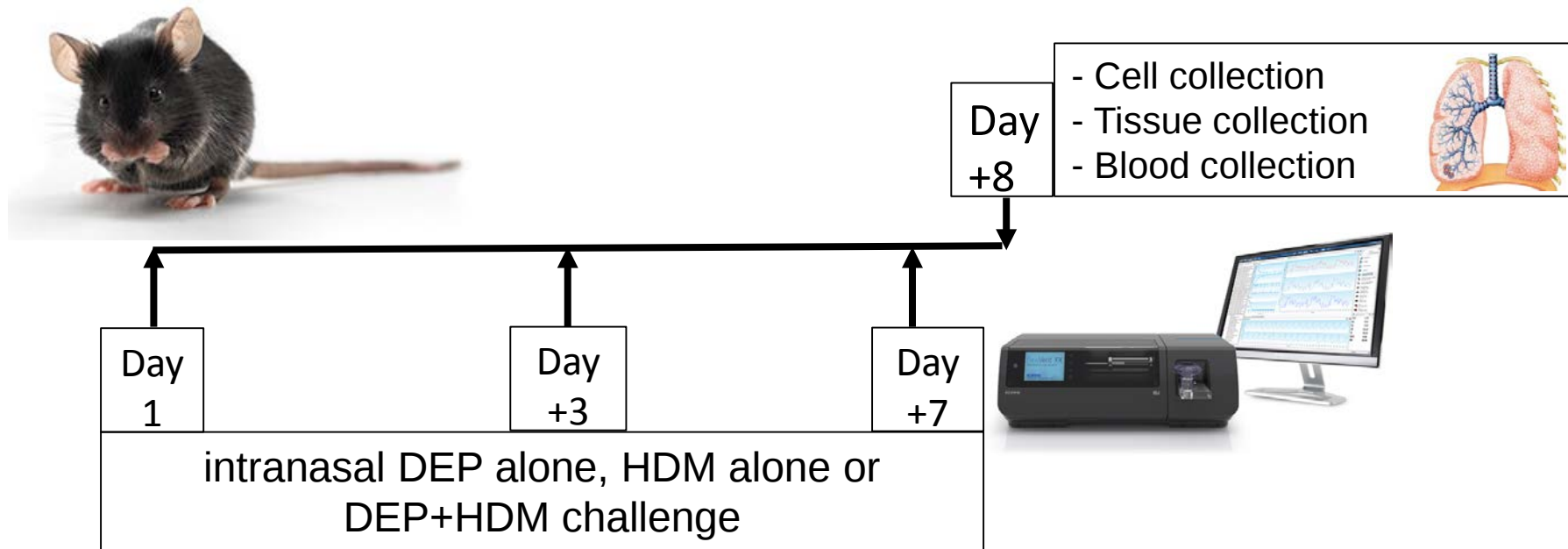
Modelling Pollution-Mediated Inflammation

- Source/type of pollution:
 - Particle type
 - Size
 - Mixed samples or single type
- “Real” environmental samples versus standardised samples
 - Which environment to choose?
 - Relevance of standardised samples to real world
 - Consistency between batches
- Frequency and duration of exposure
- Outcome measures

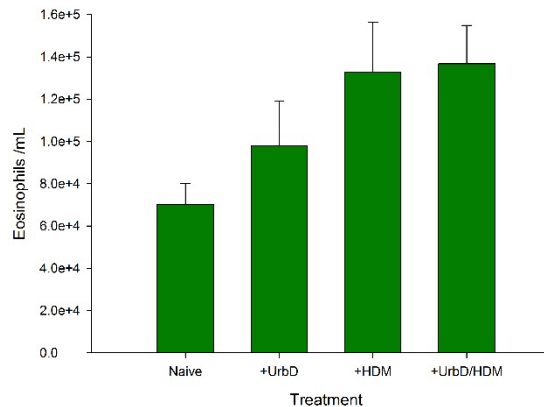
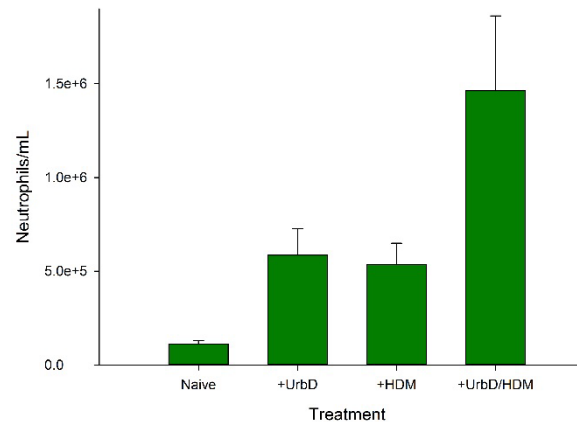
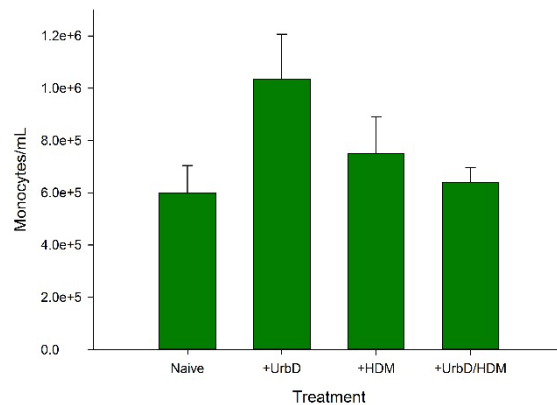
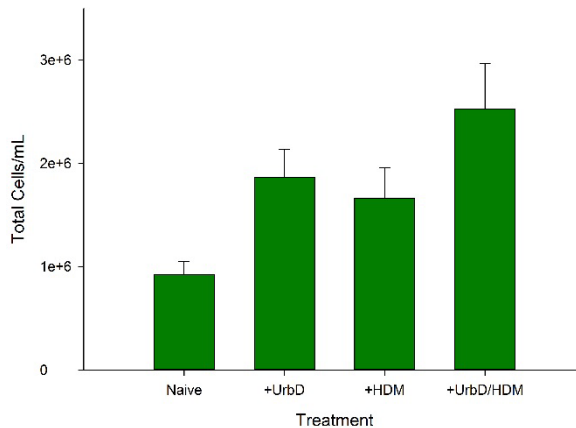
Modelling — Urban Dust



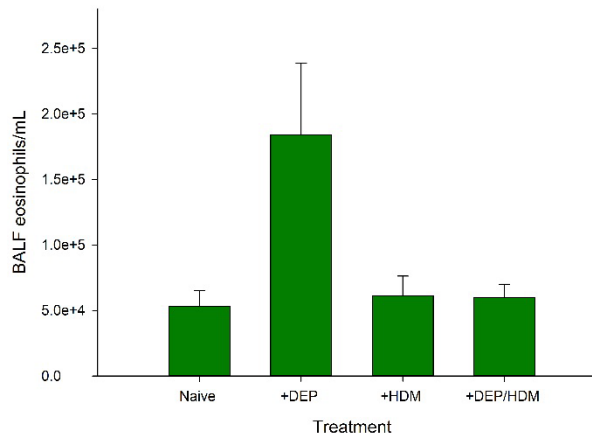
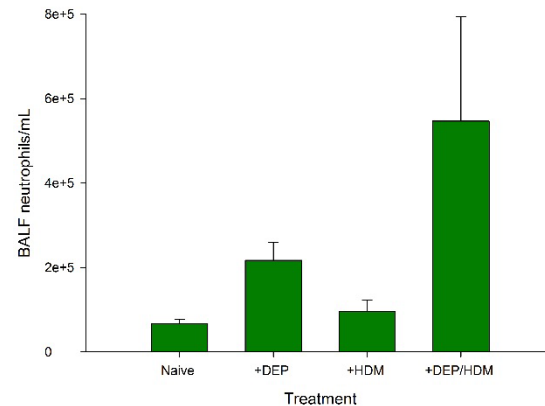
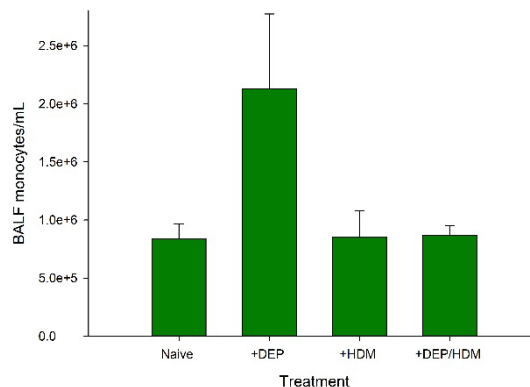
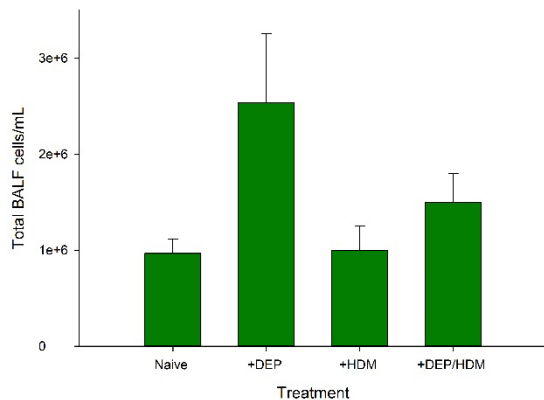
Modelling — Diesel Exhaust Particles



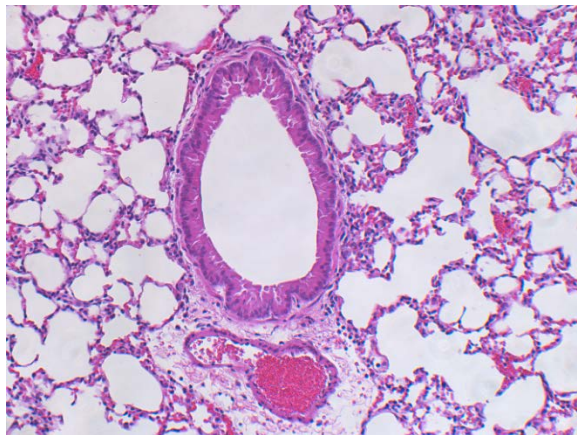
Urban Dust induced inflammation — cell infiltration



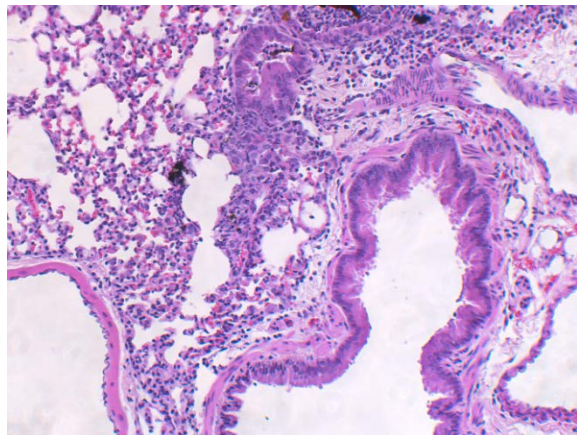
Diesel Exhaust induced inflammation — cell infiltration



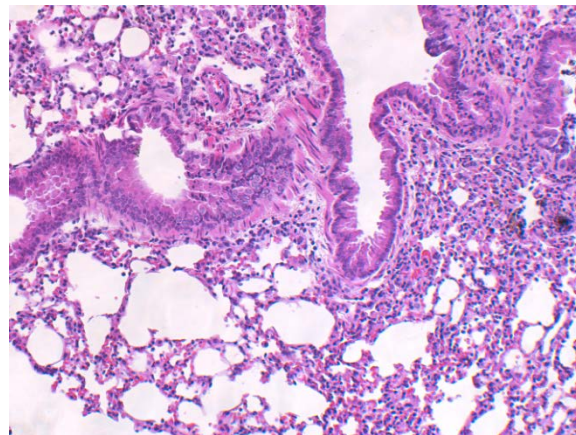
Urban Dust induced inflammation — H&E staining



Naive

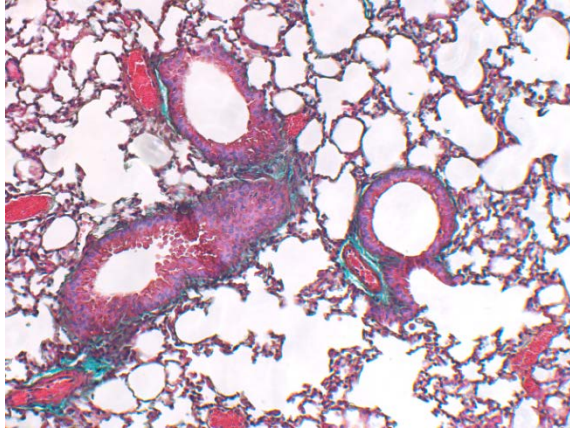


UrbD

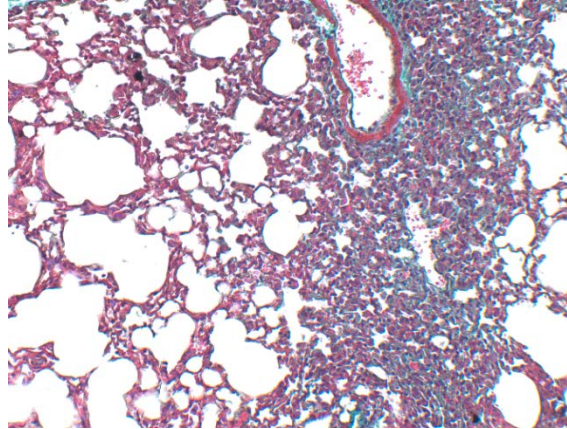


UrbD/HDM

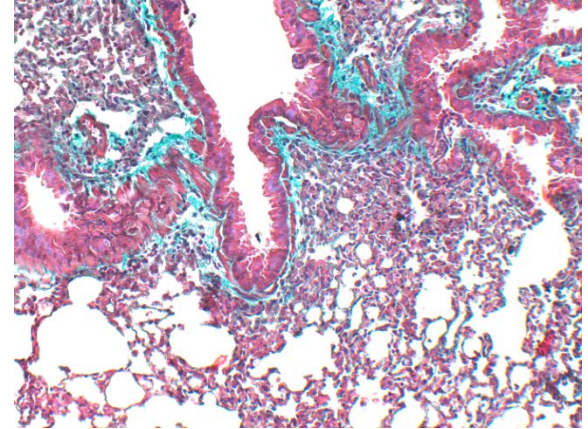
Urban Dust induced inflammation — Masson's Trichrome staining



Naive

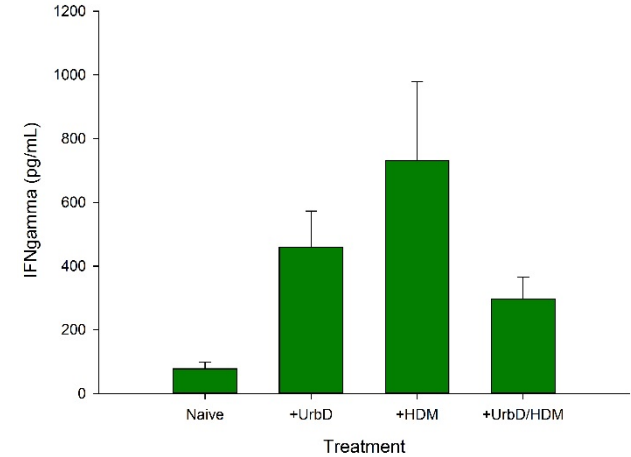
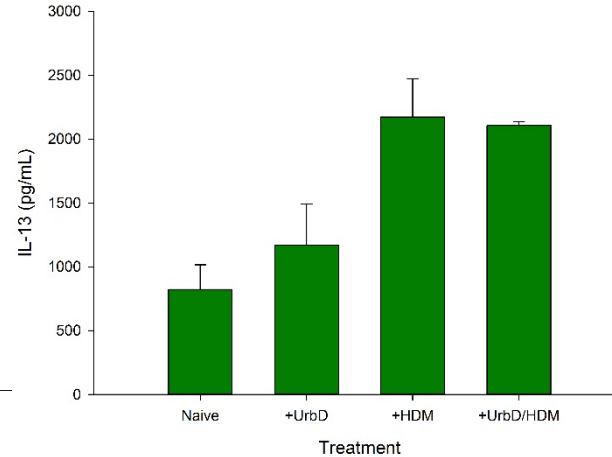
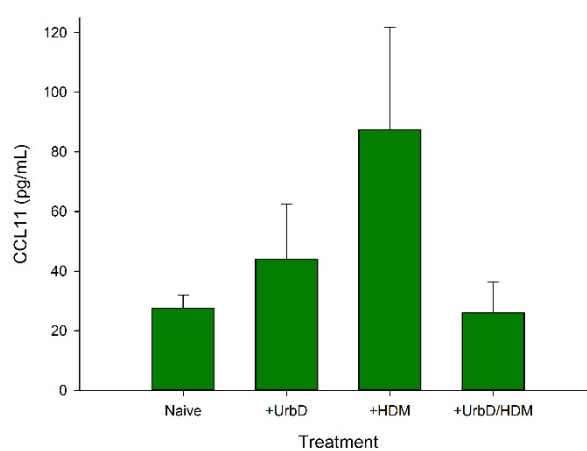


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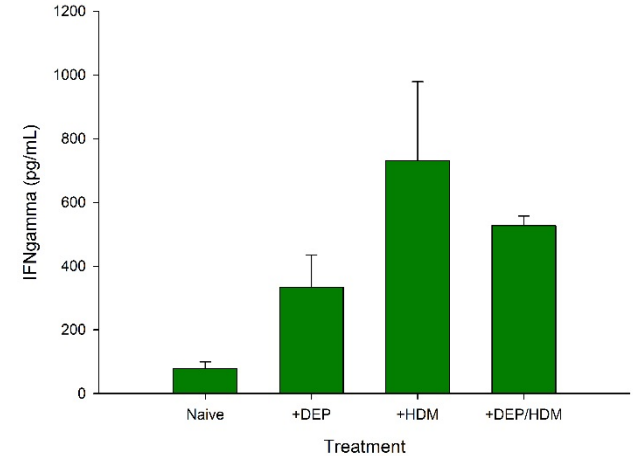
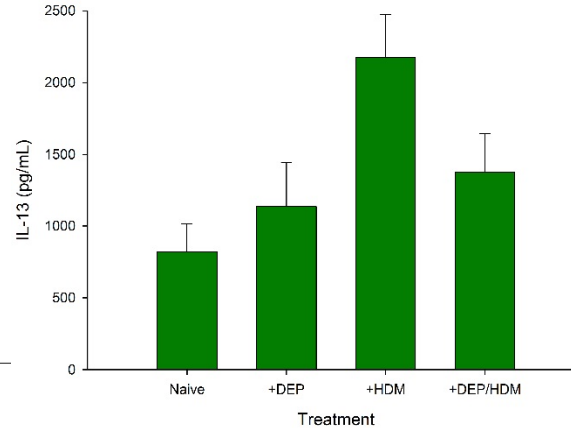
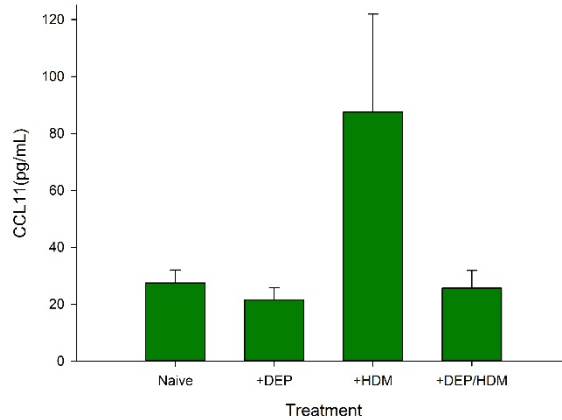


UrbD/HDM

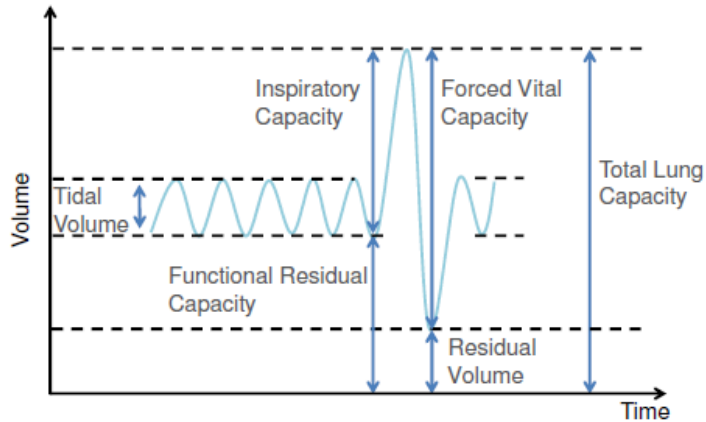
Soluble Biomarkers



Soluble Biomarkers



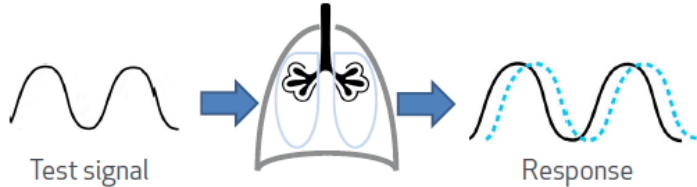
Functional Measurements



- Inflammation and tissue damage affects airflow
- Respiratory mechanic measurements
 - Lung stiffness
 - Obstructions
 - Structural damage
 - Airflow constriction



Functional Measurements



- “Flexivent” system measures:
 - FEV (forced expiration volume)
 - FEF (forced expiration flow)
 - FVC (forced vital capacity)
 - Resistance and compliance
 - Tissue elastance
- These measurements translate from pre-clinical to human studies



Future Directions

- Can we identify food products that offer protection against air pollution-induced lung inflammation?
 - Currently testing food products as proof of principle in the models
 - Have we selected the right outcome measures?
 - What is the mechanism behind any effects we see?
- Moving from pre-clinical models into the “real world”
 - Clinical trials
 - In New Zealand? Overseas?
- What information do consumers and industry want and need?
 - Health claims



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