



Bio21 Molecular Science and
Biotechnology Institute

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Fighting Infections & Allergies

Advancing human health through early diagnosis and discovery of new treatments of infections and related diseases: Research is driven by core interdisciplinary expertise and substantial investments in platform technologies. Importantly, our resources provide a public good capability at a time when the field is not a priority for big pharma, despite the serious health threat these pathogens pose for more than half the world's population.

Major programs

- Human pathogens and related host-pathogen-interactions
- Microbiology of the gastrointestinal tract
- Oral health and microbial disease
- Allergies
- Viruses and autoimmune diseases
- Transmissible prion and related neurotoxic diseases
- Sheep pathogens
- Antibiotic synthesis and characterisation

Critical mass in research in these areas is achieved through interdisciplinary collaborations between Institute research groups and strategic partnerships within the wider Bio21 community, particularly:

- The University of Melbourne's Veterinary School and Department of Microbiology & Immunology
- The Walter and Eliza Hall Institute
- Neurosciences Victoria
- The Royal Melbourne, Royal Children's, Royal Women's and Dental Hospitals' infectious and inflammatory disease programs
- Bio21 Institute-based company Bioscreen, specialising in gastrointestinal bacterial diagnostics.

Human Pathogens: Investigations of host-pathogen interactions and new drug targets and the design and testing of candidate drugs and vaccines are focused on pathogenic protozoa and mycobacteria causing Leishmania, tuberculosis and malaria. Key to these investigations are the uses of x-ray protein crystallography, mass spectrometry, NMR spectroscopy, cryo-electron microscopy and bioinformatics to define potential drug targets as well as the metabolic environment of these pathogens and the use of the knowledge gained to identify inhibitors with potential as new drugs.

Oral Health and Microbial Disease: The Institute-based Dental Biotechnology group and associated Cooperative Research Centre for Oral Health are investigating common oral diseases at the immunological and molecular level. The primary aim is to identify new targets for therapeutics to combat diseases, using genomics, proteomics, metabolomics and synthetic chemistry approaches. Major interests are in periodontitis and dental caries and how these affect patients systemically. Related research into bacterial infection-caused degeneration of tooth mineral structures has already resulted in the discovery of a novel tooth-mineralisation protecting peptide and its commercialisation as the tooth paste additive, Recaldent.

Gastrointestinal Microbiology: The characterisation of gastrointestinal microflora by classic microbiology and molecular diagnostic techniques by the Bio21 Incubator-based company Bioscreen, provides a platform for investigatory adoptions of gut microflora to chemotherapy and trauma, which influence the health state of patients.

Allergies: The Institute provides the functional proteomics and metabolomics capability of the plant biotechnology, plant allergy program led by researchers from the Faculty of Land and Food Resources and backed by 16 international patents. The primary aims are to counter allergic properties of rye grass and develop new candidate vaccines for the treatment of childhood allergies:

- Molecular diagnosis of allergies in patients suffering from hay fever and allergic asthma
- Vaccines for safer treatment of severe allergies, based on genetically engineered pollen, tested initially using the Veterinary Science School's sheep model for asthma
- Genetically modified rye grass with reduced allergenic properties.

Viral and Autoimmune Diseases: Institute researchers are engaged in the characterisation of molecular processes responsible for fighting viral infection and the related processes of tissue incompatibility and autoimmune diseases, particularly diabetes and autoimmune diseases of the stomach. Proteomics approaches and animal models of autoimmune disease and chronic inflammation are being used to identify the factors responsible for the immune system attacking its own tissues and to develop new treatments for autoimmune disorders.

Transmissible Prion and Related Neurotoxic Diseases:

The neurotoxicity and pathogenesis of 'mad-cow'-causing prion, Alzheimer's and Parkinson's diseases are being investigated. For example, research on prion diseases, which are transmissible neurodegenerative disorders, aims to understand the processes by which the normal prion protein folds into the abnormal infectious form, giving rise to protein plaques characteristic of the neurodegenerative disorders. Related programs investigate Alzheimer's-associated plaque-forming neurotoxic proteins and the role of metal ions in this process, as well as the design of inhibitors of plaque formation. From a public health perspective, a priority of these investigations is the development of rapid and sensitive diagnostic tests for prion infection and other plaque formation.

Sheep Pathogens: The Institute-linked Centre for Animal Biotechnology, together with the Australian Wool Innovation and Meat & Livestock Australia, is developing new vaccines for controlling sheep pathogens. The pathogens include gastrointestinal parasite infections, which increasingly are acquiring resistance to currently available drugs, and bacterial infections of the gut and lungs. Priorities are the development of vaccines targeting pathogen-specific antigens and the optimisation of host donobutic, neutrophil and mast cell participation in immune responses.

Antibiotic Synthesis and Characterisation:

The synthetic and analytical chemistry resources of the Institute are being harnessed to design and synthesize a number of antibiotics and their analogues, including novel protein-protein interaction inhibitors of multimetric enzymes and antibiotics identified through natural product screening. Related projects involve investigation of peptide antibiotic-membrane interactions with a view to developing more effective antibacterial compounds.

