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Securing a Healthier Environment

The Bio21 Institute is focusing the power of its interdisciplinary research infrastructure, technology and expertise on the goals of understanding the biological activities of chemicals at the molecular and ecosystem levels and developing new insecticides, paving the way for securing a healthier environment.

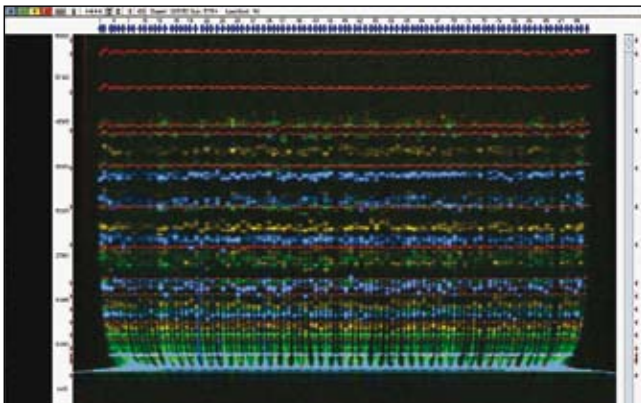
Insecticides

The Bio21 Institute's drug discovery infrastructure is transferable to the discovery of new chemical insecticides targeting insect pests that threaten agriculture and the health of humans and companion animals. Unfortunately, current insecticides also kill non-pest insects, and the target insects develop resistance to these chemicals, due to changes in genes encoding the target proteins.

Institute-based ARC Centre for Environmental Adaptation Research (CESAR) researchers, led by Phil Batterham and Ary Hoffmann, have teamed up with other Bio21 Institute researchers to apply genomic, proteomics and chemical approaches to:

- determine the structures of relevant genes and target proteins
- discover how pesticide resistance relates to the insecticide-target protein interaction
- design and synthesize new inhibitors with potential as more effective pesticides.

The knowledge gained will enable the design of new inhibitors with potential as insecticides and the optimisation of the candidate insecticide's structure for specific targeting of pest insects, thereby minimising any harmful impact on the environment and reducing further development of resistance.



Heavy metals and metal-protein complexes

Copper and other heavy metals prevalent in the environment are required for life but, in excess, are highly toxic. Copper is an important contributor to diseases such as Alzheimer's, osteoporosis and cardiovascular disease. Institute-based pathologists, biochemists and chemists are collaborating with genetics researchers to examine the biological impact of copper and to find the genes that tightly control copper concentrations in the body. Chemicals, which counter the copper ion-dependent formulation of disease-causing amyloid, are being assessed for their potential as candidate drugs for the treatment of Alzheimer's and related diseases.

Biomonitoring

The cut off concentrations at which environmental chemical pollutants affect biological systems can be determined using insect populations as biomonitors. The biological impact of climatic change can similarly be assessed. Institute-based researchers, working with Federation Fellow, Ary Hoffmann (Genetics and Zoology), are using molecular genetic approaches to enhance the use of insect population systems as environmental biomonitors. Adaptation responses to environmental variables are also being investigated at the biochemical level using the Institute's metabolomics facilities. The Institute's capability for this research includes a substantial purpose-built insect containment facility.

Atmospheric Free Radicals

Biological ageing results in part from random oxidative damage to tissues by harmful reactive oxygen and nitrogen species and other free radicals, formed by either metabolic processes or the actions of environmental radiation, ozone and other atmospheric pollutants. The Institute-based ARC Centre for Free Radical Research, led by Carl Schiesser, provides the core of critical mass in free radical chemistry research. The atmospheric nitrate radical is of exceptional importance as it triggers

chemical transformations in the night-time troposphere. The bio-surfaces of organisms, for example respiratory tract surfaces, are directly exposed to these pollutants. As a defence, these cellular surfaces contain integrated antioxidant systems. When the antioxidant defences are overwhelmed, oxidative damage may occur, including inflammatory and potentially injurious processes within respiratory tissues. Bio21 Institute chemists and biologists, led by Uta Wille, are teaming up to investigate the damaging effects of nitrate radicals on protein and lipid test systems to gain insights into their adverse impact on human welfare and potential preventive measures.

Free Radical-dependent amyloid formation linked with cardiovascular disease

Free Radical damage of amino acid side chains in amyloid-forming proteins has the potential to induce pathogenic forms of amyloid in vascular tissue, resulting in cardiovascular disease. Geoff Howlett and other Institute-based biochemists and chemists are investigating the mechanism of free radical-induced amyloid formation with a view to understanding the role of free radical damage in the pathology of amyloid diseases and developing inhibitors with therapeutic potential.