Applications of Transcriptomics in Ecotoxicology

Introduction

Transcriptomics has emerged as a tool for ecological risk assessment, specifically how organisms respond to changes in the external environment. Ecotoxicogenomics is the application of genomic technologies such as trasncriptomics to study the adverse effects of environmental chemicals. Applications include defining the toxicological profiles of chemicals, evaluating risk from exposure, understanding the mechanism of action of chemicals, highlighting individual susceptibilities, and identifying biomarkers of exposure and risk.

Novel Application of Transcriptomics

Gene expression is an indicator of toxicant exposure and disease state. Ecotoxicology identifies the effects of chemical pollutants. Custom-made microarrays (Figure 1) have been used to understand responses of organisms to environmental stressors.
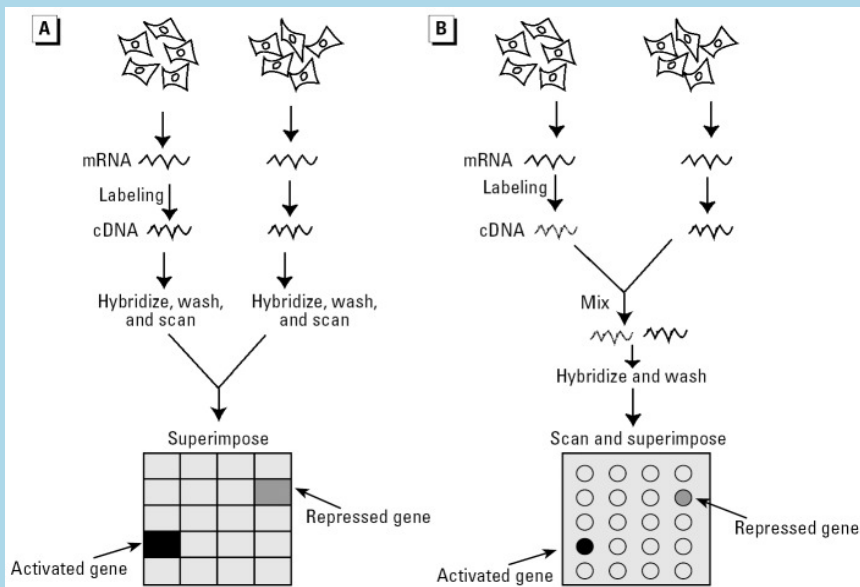

Figure 1. Gene expression analyses by microarray Lettieri, 2006.
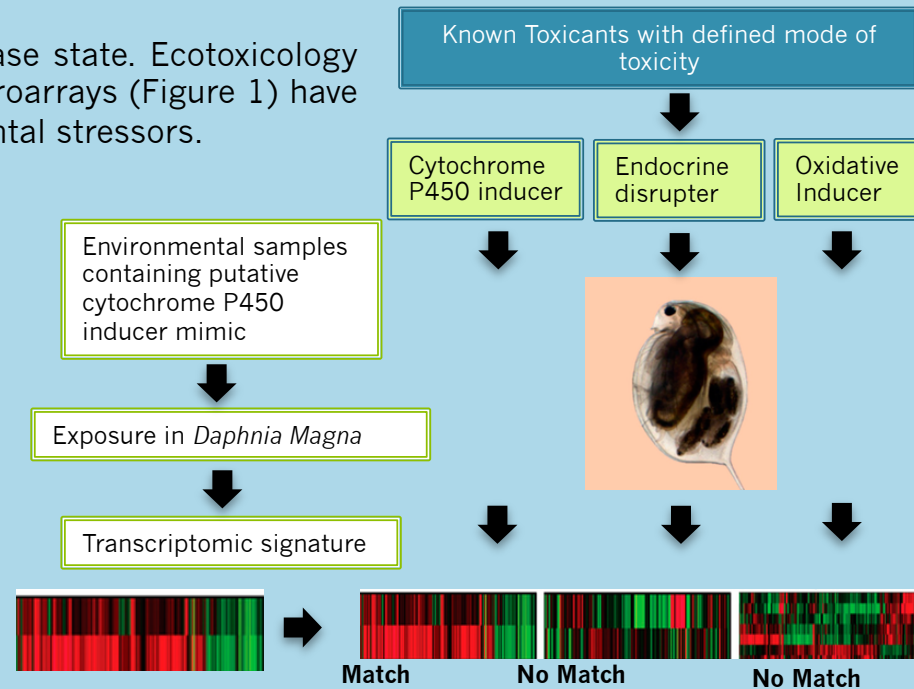

Figure 2 Modified from Jeong Kim *et. al,* 2015. The utility of gene expression signatures to explore the possible mode of toxicity of an unknown environmental toxicant

Case Study

Microarrays in toxicology allow the Identification of early biomarkers of exposure and the definition of Mode of Action or gene patterns associated to chemicals or environmental stressors. Jeong Kim *et. al* demonstrate the potential utility of gene expression profiling in ecotoxicology by identifying novel biomarkers and relevant modes of toxicity in the plankton, *Daphnia magna* (Figure 2).

Conclusion

Transcriptomics has been found to be a successful tool in ecotoxicology, from ecological risk assessment to environmental exposure diagnosis. Technical hurdles still exist such as technology cost, computational cost, and lack of communications between researchers. Despite these hurdles, there is great potential for transcriptomics to be used in environmental monitoring programs and management.

References: ·Milan *et. al* 2015. *Environmental Pollution*. 197:90-98. ·Jeong Kim *et. al*. 2015. *International Journal of Molecular Sciences*. 6(6), 12261-12287. ·Schirmer *et. al*, 2010. *Anal Bioannal Chem*. 397:917-923. –Lettieri. 2006. Environ Health Perspect.114(1):4-9.