

The Untapped Potential of Laser Scanning Cytometry in Genome Damage, Proteome and Nutritional Diagnostics at the Single Cell and Sub-Type Level

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Michael Fenech is renowned for his research in nutrition and genetic toxicology and for developing the cytokinesis-block micronucleus (CBMN) assay, a gold-standard method used internationally to measure DNA damage in human cells. His key goal is to determine the nutritional requirements for DNA damage prevention using in vitro systems, molecular/cytogenetic epidemiology and placebo-controlled human dietary trials. Dr. Fenech's proposal of a novel disease prevention strategy based on personalized diagnosis and prevention of DNA damage by appropriate diet/life-style intervention has led to the Genome Health Clinic concept, which has been translated into practice (www.reach100.com.au). Dr. Fenech's laboratory has further developed the CBMN assay into a 'cytome' assay consisting of six complementary biomarkers of DNA damage and cytotoxicity and in 2009 developed an improved qPCR method to measure absolute telomere length, a molecular biomarker of accelerated aging. He was awarded the Flinders University Convocation Medal in 2007, the Alexander Hollaender Award (USA) in 2008 and the honorary title of Adjunct Professor (University of South Australia) in 2009 for his leadership and contributions to environmental/public health sciences internationally. His publications have been cited 6,500 times.

Abstract

Laser scanning cytometry (LSC) provides the opportunity for high-content analysis of cells based on multiple parameters. Nutritional genomics is increasingly being recognized as an important research discipline of relevance in disease prevention. This is because (i) DNA damage is now recognized as the most fundamental pathology causing developmental defects, accelerated aging and degenerative diseases and (ii) nutritional deficiency or excess is emerging as a major determinant of genome integrity. LSC enables the simultaneous detection of DNA damage events at the molecular and cytogenetic level as well as proteins expressed in response to DNA insults.

The presentation will explore the potential of LSC to also measure nutritional status at the single-cell level and to relate this to multiple biomarkers of genome instability within the same cell. These developments could revolutionize diagnostics of nutritional status of individuals using small tissue samples obtained by minimally invasive methods and enable measurement of the impact of dietary change on nutritional and genome integrity profile at the single-cell level and in multiple cell types using cell-type specific surface markers. These technologies are likely to become essential tools for translating the Genome Health Clinic concept, based on diagnosis and personalized nutritional prevention of DNA damage, into practice. Some preliminary data on these approaches in lymphocytes and buccal cells will be presented.