Nikolay Englevskiy: Creating a module for ImageJ for quantative evaluation of endogenous oxidation in mitochondria of blood lymphocytes

Abstract

The enzyme succinate dehydrogenase (SDH) in mitochondria oxidizes succinic acid, an alternative source of energy for a cell in extreme conditions. The activity of SDH in cells is an important index of the organism's reaction to stress. Classic methods of cytochemical evaluation of this index reveals high levels of enzyme activity when at rest, which makes it difficult to measure increased levels as a response to stress. A new method of staining mitochondrial SDH shows basic activity of the enzyme at rest, which can establish a more precise degree of change in SDH's activity in conditions of stress.

We wrote a new module of ImageJ to evaluate the level of SDH activity in mitochondria . The level of SDH activity is particularly apparent in the red channel of cell's RGB image, because this channel encodes the most stored active SDH in the cell. In order to visualize the granules of SDH, we stained the cell with neutral red dye, which renders the SDH visible in contrasting purple and black. The new module counts the granules of SDH, thus recording the energy potential of each cell. The data are recorded into the archive as a table that can be analyzed statistically. The module can analyze large quantities of images sequentially and continuously to create statistically precise data on cellular energy potential. This protocol was tested with different resolutions of images and gave a high convergence of results.

The new module of ImageJ lets us evaluate the oxidation of endogenous succinic acid to a high degree of accuracy, revealing precise levels of SDH activity in mitochondria.

Succinic acid not only is an effective source of energy in mitochondria, but also performs a regulatory role in signaling pathways, which are responsible for activation of the synthesis of adrenalin and noradrenalin. The new module of ImageJ offers a method to evaluate mitochondrial SDH activity, with the potential to contribute to these areas of inquiry:

1. Quantitative research on the hypothalamic-pituitary-adrenal system,

2. Fundamental research on cellular activity,

3. Improving the quality of applied clinical diagnostic prcedures.

Keywords

quantification, activity succinate dehydrogenase

Administrative data

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Type: Poster (portrait)

From:
http://imagejconf.tudor.lu/ - **ImageJ User and Developer Conference**

Permanent link:
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Last update: **2010/11/12 09:04**