Molecules of Life

FEBS3+ Meeting

organized by the Slovenian Biochemical Society,
Croatian Society of Biochemistry and Molecular Biology,
Hungarian Biochemical Society &
Serbian Biochemical Society

and

11th Meeting of the
Slovenian Biochemical Society

September 16-19, 2015
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Book of Abstracts

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Redox regulation: from redox congeners to a systemic molecular physiology approach

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Redox chemistry lies at the basis of life, providing mechanisms that are directly involved in the generation of cellular energy. Furthermore many redox reactions regulate cellular functions, thus linking ATP production with oxygen demand and mitochondrial functioning. Mitochondrial respiration generates the superoxide anion that precedes different redox congeners, referred to as reactive oxygen species (ROS). Increased concentrations of ROS underlie cellular oxidative stress when the redox balance is shifted towards a prooxidative state. When ROS production is controlled and compartmentalized, the ROS participate in different subtle redox modifications of regulatory molecules. Thus ROS are involved in the regulation of cellular functions. Several cellular active enzymatic mechanisms participate in ROS production, such as NADPH oxidase or cyclooxygenases, which serve as mediators of cellular functions. On the other hand, redox balance is provided by a set of antioxidant enzymes that utilize NADPH and GSH to prevent an uncontrolled shift towards a more oxidative cellular milieu. The sum of these processes is stable but dynamic redox homeostasis. With cellular gases, NO and H_2S, the small redox congeners form a discrete cellular redox-based and reversible network referred to as redox signaling, which is characterized by reversibility and short-lasting activity. The chemical properties of the generated signaling molecules determine the extent and magnitude of their physiological impact. These mediators are ideally suited for short-range effects by virtue of their ability to diffuse through tissue. This is especially important in the physiological regulation and fine-tuning of small vessel vascular tone and smooth muscle contractility. The link between local oxygen demands, the energetic state and physiological regulation is mediated by complex redox interactions in erythrocytes where the redox state can trigger different output signals ranging from NO to ATP. In erythrocytes, phase transitions of redox congeners are partially achieved by superoxide dismutase activity, which has been proposed to represent an enzymatic stabilizer of the cellular feedback mechanism that controls the cell's redox equilibrium, and of the physiological levels of NO.