Exploring Redox Reactions: From Molecular Mechanisms to Practical Applications

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Did you know that simple dietary choices like combining pumpkin seeds with dark chocolate or green tea can boost your health when you're feeling sick? Or that drinking beet juice mixed with broccoli or garlic before exercise can enhance your performance? These everyday tips, including the best choice of wine for your health, along with many surprising scientific insights, are grounded in the fascinating field of bioinorganic chemistry.

In this talk, we will delve into the mechanisms by which both redox-active and redox-inactive inorganic entities, such as manganese, iron, superoxide (O_2^-), hydrogen sulfide (H_2S), and zinc, modulate redox reactions. These processes can trigger cascades of signaling events with far-reaching implications for health and medicine. Our research explores how these metal centers and small inorganic molecules influence oxidative stress and biological redox signaling.

We utilize advanced techniques involving high pressure and low temperature to uncover how these mechanisms can be harnessed to develop potential pharmaceuticals, adjuvants, and therapy enhancers. The applications are broad and impactful, ranging from longevity and cancer radiation therapy to neurovascular regulation, blood pressure control, heart function, and even enhancement of COVID-19 therapies. Moreover, we will illustrate how high-pressure environments may support deep-sea microbes, enabling them to live for over 100 million years.

By integrating fundamental molecular-level research with practical applications, we aim to highlight the importance of redox reactions in both biological and environmental contexts. Join us as we explore the potential of bioinorganic chemistry to transform health and environmental strategies, offering new approaches to therapy and sustainability.