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In vitro evaluation of cell metabolism by hyperpolarized ^{13}C-NMR and future biological applications

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Abstract

Metabolism plays a critical role in cell survival and function, especially under challenging conditions such as hypoxia. To gain deeper insights into the metabolic dynamics of cells in hypoxic environments, we used hyperpolarized ^{13}C-NMR, a state-of-the-art technique that allows real-time, non-invasive observation of metabolic pathways. In this study, cancer cells and *Saccharomyces cerevisiae* were used as model systems to investigate changes in glycolytic flux and other metabolic pathways under hypoxia. Hyperpolarized ^{13}C-NMR offers a unique advantage by significantly enhancing signal detection of metabolites, allowing us to monitor key intermediates in real time.

The goal of our research is to control and manipulate cellular metabolism under hypoxic conditions by developing novel molecular tools. These tools aim to modulate specific metabolic pathways and offer potential therapeutic insights for cancer treatment, where hypoxia-induced metabolic shifts are well documented. In addition, we are studying how yeast, a model organism with a well-defined metabolic network, responds to oxygen deprivation, providing comparative insights that may have broader biological applications.

Our results highlight the versatility of hyperpolarized ^{13}C-NMR in metabolic studies and open new possibilities for real-time observation and manipulation of cellular functions in various biological systems. The future implications of this research extend to both medical and industrial fields, providing a pathway towards targeted metabolic control in disease treatment and biotechnological applications.