EMERGING RESEARCH FRONTS - 2008

October 2008

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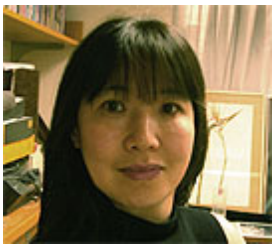
Jen Sheen talks with *ScienceWatch.com* and answers a few questions about this month's Emerging Research Front Paper in the field of Plant & Animal Science.



Article: Role of the Arabidopsis glucose sensor HXK1 in nutrient, light, and hormonal signaling
Authors: Moore, B;Zhou, L;Rolland, F;Hall, Q;Cheng, WH;Liu, YX; Hwang, I;Jones, T;Sheen, J
Journal: SCIENCE, 300 (5617): 332-336 APR 11 2003
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SW: Why do you think your paper is highly cited?

Glucose plays essential regulatory roles in gene expression, physiology, metabolism, cell proliferation, growth, and aging, but the molecular mechanisms underlying the glucose signal transduction pathway remain elusive in plants and animals. This paper provides the first conclusive genetic and biochemical evidence that a specific *Arabidopsis* hexokinase (HXK1) acts as glucose sensor and integrates nutrient, light, and hormonal signaling to modulate plant growth, a fundamental problem linked to many areas of plant research.

SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

It has been assumed that the regulatory roles of glucose are mediated through its metabolism, and require the catalytic activity of hexokinase or glucokinase in yeast, plants, mammals, and humans. Our studies provide compelling evidence that *Arabidopsis* HXK1 possesses dual catalytic and sensing functions. We show that the catalytically inactive HXK1 can still serve its sensor functions in gene expression, cell proliferation, root and inflorescence growth, and leaf expansion and senescence, thus demonstrating the uncoupling of glucose signaling from glucose metabolism.

"We have just identified novel components of the nuclear HXK1 signaling complex in Arabidopsis."

SW: Would you summarize the significance of your paper in layman's terms?

The paper shows that glucose, as a nutrient, has essential regulatory roles in controlling gene expression, cell growth, and hormonal responses in plants. The evolutionarily conserved enzyme HXK1, conventionally known to be responsible for glucose metabolism, can also serve as a sensor to initiate diverse glucose responses important for every aspect of plant life.

SW: How did you become involved in this research and were any particular problems encountered along the way?

I discovered that glucose is a powerful repressor of photosynthesis gene transcription in leaf cells when I was developing a cell-based system to facilitate the studies of gene regulation and signal transduction in plants. Many people believed that the glucose effect is mediated through metabolism, not signal transduction, and studies performed in isolated plant cells are artifacts and cannot reflect true regulation in whole plants.

SW: Where do you see your research leading in the future?

We have just identified novel components of the nuclear HXK1 signaling complex in *Arabidopsis*. The work opens a previously unexpected new direction to advance our understanding of the glucose sensing and signaling network, as well as the role of HXK1 as a master regulator of transcription and hormonal signaling central to plant growth.

SW: Do you foresee any social or political implications for your research?

Our research on the fundamental and evolutionarily conserved mechanisms of glucose sensing and signaling carried out in plants may offer new insight into glucose regulation in humans with implications for treatment of diabetes, obesity, cancer, and aging.

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Related information: view a Fast Moving Front comment by Jen Sheen from September 2005.

Keywords: glucose signal transduction pathway, arabidopsis hexokinase, glucose sensor, hormonal signaling, uncoupling of glucose signaling from glucose metabolism, gene regulation and signal transduction in plants.

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