Unraveling the mechanisms that control cell growth and size

3 January 2018, by Tim Stephens

Kellogg, professor of molecular, cell, and developmental biology at UC Santa Cruz and corresponding author of the study.

Yeast is a relatively simple organism, yet it works in the same fundamental ways as human cells. The same signaling network that controls cell growth in yeast is thought to operate in more complex organisms too, including humans.

"Fundamental discoveries in yeast are directly applicable to humans," Kellogg said. "If we can understand how growth control works in normal cells, and how it goes wrong in cancer cells, we could potentially exploit that knowledge to kill cancer cells."

The new study looked at how cell growth and size are limited by the availability of nutrients. In previous work, Kellogg's team had identified a protein required for nutrient modulation of cell size. Further investigation showed that this occurs through the protein's effects on the TORC2 signaling network.

Led by co-first authors Rafael Lucena and Maria Alcaide-Gavilán, both postdoctoral researchers in Kellogg's lab, the team used a variety of techniques to work out the details of how molecular signals are relayed through this network, enabling the cell to respond to changing nutrient levels. A key role in this process is played by ceramides, which are building blocks for structural molecules in the cell membrane. The study found that ceramide-dependent signals control both cell size and growth rate.

"The same signals control growth rate and cell size, which explains why cell size is proportional to the growth rate set by the availability of nutrients," Kellogg said.

Additional work is needed to clarify some details of the signaling network and explore its effects.
throughout the cell. Kellogg is also eager to apply the new findings to studies of human cells.

He noted that in advanced biology textbooks, the section on cell growth is typically just one page long, and cell size is covered in a short paragraph. "We want to write a whole new chapter on cell growth and size for the textbooks," Kellogg said.