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Analysis of the Osmo-Sensing Mechanism in Yeast

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Summary

Adaptation to high salt and high osmolarity conditions is a fundamentally important biological response of all types of cells, ranging from bacteria, fungi, plants, and animals. In yeast, for example, external high salt and high osmolarity conditions activate the HOG (High Osmolarity Glycerol) MAP kinase (MAPK) pathway, which is essential for yeast to adapt to and survive on those conditions. MAP kinase cascades are conserved signaling modules composed of three sequentially activated kinases (MAPKKK, MAPKK, and MAPK). The yeast high osmolarity glycerol (HOG) pathway can be activated by either of two upstream pathways, termed the SHO1 or SLN1 branches. However, neither the osmosensor nor the signal generator of the SHO1 branch has been clearly defined.

Here, we show that the mucin-like transmembrane proteins Hkr1 and Msb2 are the potential osmosensors for the SHO1 branch. Hyperactive forms of Hkr1 and Msb2 can activate the HOG pathway only in the presence of Sho1, while a hyperactive Sho1 mutant activates the HOG pathway in the absence of both Hkr1 and Msb2, indicating that Hkr1 and Msb2 are the most upstream known elements in the SHO1 branch. Hkr1 and Msb2 individually form a complex with Sho1, and, upon high external osmolarity stress, appear to induce Sho1 to generate an intracellular signal. Furthermore, Msb2, but not Hkr1, can also generate an intracellular signal in a Sho1-independent manner.