Smashed Fission Yeast Walls

Structural Discontinuities
Related to Wall Growth

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ABSTRACT

Twenty-three samples of fission yeast cells (Schizosaccharomyces pombe) were smashed by shaking them with glass beads. The samples represented all phases of the culture cycle, with the lag and log phases emphasized. Ruptured walls of the smashed cells were observed by phase-contrast and electron microscopy. Ruptures were tabulated with respect to their magnitudes and locations. Ruptures occurred not at random, nor at sites directed by geometry, but predominated in certain definable wall regions. These discontinuities were correlated with morphogenetic activities of the cell. Thus, the extensile end was found to be most

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fragile through most of the culture cycle. Also fragile was the nonextensile end, its edge more than its middle. Further, the data were applied to the testing of predictions from extant models (Johnson endohydrolytic softening model and Wessels presoftened-posthardened and crosslinking model) for hyphal tip extension. The frequency of rupture at the extensile (old) end of the cell was qualitatively predicted by both models; the frequency at the nonextensile (new) end was not predictable by either. Rupture frequencies and characteristics at other regions conformed to predictions by one or the other model, but rarely by both.

Index Entries: Tip growth; cell walls; models; morphogenesis; fission yeast.

INTRODUCTION

Walled cells must be ruptured before their constituents can be fractionated. Rupture of cells by grinding with sand (low impact) or by shaking with glass beads (high impact) is a time-honored preliminary to fractionation.

With the exception of a single photomicrograph by Mitchison (see Fig. 2 in ref. 1) in whose brief discussion the most frequently ruptured locus was mentioned, no one to our knowledge seems to have realized that useful information about the cells' walls could be obtained by analyzing the location of breaks after rupture. Hoping to learn more about walls and their morphogenesis, we have been smashing fission yeast cells (*Schizosaccharomyces pombe*) with glass beads.

We presumed that the ruptures would be located either at random or in nonrandom patterns. Nonrandom patterns might reflect either walls with uniform toughness but with rupture patterns directed by simple geometry, or walls with structural discontinuities, nonuniform toughness, possibly reflecting their growth habit. According to Mitchison's assumptions (2), the cell approximates a cylinder with hemispherical ends (see Fig. 1). Direction by simple geometry to such a wall of uniform toughness would cause most of the ruptures to occur at the hemispherical ends, with neither end favored. The data rule out random ruptures and nonrandom ruptures directed by simple geometry.