URLs

BACTERIAL CHROMOSOMES

Be my baby

The details of a method to synchronize a large population of *Escherichia coli* cells, and the insights into *E. coli* chromosome segregation that this method has revealed, are reported in two new studies from Nancy Kleckner's laboratory.

Until now, investigators have been unable to carry out high-resolution studies of chromosome segregation in this model organism, owing to the difficulty in obtaining a large population of cells going through the cell cycle in synchrony. Now, writing in *Molecular Microbiology,* Bates *et al.* describe a technique — the 'baby cell' column — which allows them to do just that by providing very large numbers of cells in which chromosome segregation can be studied in the context of a well defined cell cycle determined by molecular methods.

Briefly, flagellin synthesis is transiently induced in exponentially growing *E. coli* cells that carry a 'sticky' mutation in the flagellin gene, and the cells are then attached to glass beads by the induced flagella. Once the beads are packed in a column, flagellin synthesis is switched off, so when fresh media is passed through the column using a peristaltic pump, it flushes out newly divided, non-flagellated cells, which can then be collected and cultured synchronously through at least two rounds of cell division.

In an accompanying *Cell* paper, Bates and Kleckner go on to describe the analysis carried out on this synchronous population, mainly by flow cytometry. Visualization of the origin of replication (*ori*) and other key loci showed that the sister chromosomes remain tightly co-localized until most of the chromosome has been replicated, and a single major transition event then separates them into different halves of the dividing cell. Chromosome separation is thought to be active, powered by pushing forces between the sister chromosomes, and the loss of cohesion triggers a global chromosomal rearrangement. Further fine positional analysis of the movement of the *ori* and terminus (*ter*) regions after nucleoid splitting revealed the movements of each locus that generate the characteristic 2-fold symmetrical arrangement of these regions (known as '*ter* in–*ori* out').

These results do not support either of the two existing models for *E. coli* chromosome segregation, one of which postulates a role for *ori* analogous to that of the eukaryotic centromere and the second of which suggests a role for mid-cell-located replisomes. Instead, the mechanism appears to be analogous to the separation of sister chromosomes in eukaryotic cells that occurs during mitotic prometaphase. Bates and Kleckner therefore hypothesize that chromosome segregation in *E. coli* represents a 'primordial sister segregation mechanism to which microtubule-based processes were later added'.

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References and links

ORIGINAL RESEARCH PAPERS Bates, D. *et al*. The *Escherichia coli* baby cell column: a novel cell synchronization method provides new insight into the bacterial cell cycle. *Mol. Microbiol*. 15 June 2005 (doi:10.1111/j.1365-2958.2005.04693.x) | Bates, D. & Kleckner, N. Chromosome and replisome dynamics in *E. coli*: loss of sister cohesion triggers global chromosome movement and mediates chromosome segregation. *Cell* **121**, 899–911 (2005)