

BIOINFORMATICS SEMINAR

The Origin of the Eukaryotic Cell: a genomic investigation Part 2

WHAT DOES THE MICROSPORIDIAN E.CUNICULI TELL US ABOUT THE ORIGIN OF THE EUKARYOTIC CELL?

Hyman Hartman
Center For Biomedical Engineering
MIT

Abstract

The genome of the microsporidian *E.cuniculi* has been sequenced. It has 11 chromosomes, which contain 2.9 million base pairs. It has 1997 open reading frames. Approximately 44 percent of the open reading frames (i.e. proteins) have known functions. (1) The small number of proteins of this cell implies that *E.cuniculi* is approaching the minimal eukaryotic cell. What then can the genome of the intracellular microsporidian parasite *E.cuniculi* tell us about the origin of the Eukaryotic cell? The answer is a great deal as we are dealing with a "minimal" eukaryotic cell which like a virus has eliminated all but the most essential functions of a Eukaryotic cell.

In a previous paper we collected a set of proteins that were found in all eukaryotic cells but were not found in Bacteria or Archaea (1). We called this set Eukaryotic Signature Proteins (ESPs). The point of this paper is to compare the ESPs found in *E.cuniculi* with those found in *Giardia.lambliia*. The surprising result is the overwhelming agreement between the ESPs of *E.cuniculi* and the ESPs of *Giardia*.

When we analyzed those ESPs from *Giardia* we concluded that: **"The existence of this set of diverse ESPs contradicts the simple assumption that the eukaryotic cell is a fusion of Archaea and Bacteria. Furthermore, the existence of ESPs supports the hypothesis that the eukaryotic cell evolved by the endosymbiosis of Archaea and Bacteria in a third cell called a Chronocyte. For the most part the ESPs are evolved from the proteins of the Chronocyte and not from the proteins of the Archaea or Bacteria. We hypothesize that the Chronocyte was an RNA-based cell that branched away from the Progenote before the Archaea and Bacteria. It had a cytoskeleton that enabled it to engulf prokaryotic cells. It had a complex internal membrane system where lipids and proteins were synthesized. It also had a complex internal signaling system involving calcium ions, calmodulin, inositol phosphates, ubiquitin, cyclin and GTP binding proteins. The nucleus was formed when the Archaea and Bacteria were engulfed by the Chronocyte"** (2).

This is what the extra cellular parasite *Giardia* told us about the Origin of the Eukaryotic Cell and this what the intracellular parasite *E. cuniculi* will now tell us about the Origin of the Eukaryotic cell.

1 Katina MD. et.al. Nature (2001) Vol. 414 p 450-453

2 Hartman H and Federov PNAS (2002) Vol .99 p1420-5.

**This is a joint work with Alexei Fedorov of the Dept of Molecular Biology at Harvard University, Cambridge, MA 02138*

Monday March 10, 2003

11:00 a.m. – 1:00 p.m.

(Talk starts at 11:30)

Building NE43, Room 941

Refreshments at 11am in NE43-941

(LCS, 200 Tech Square, Cambridge, MA)



Massachusetts Institute of Technology
Department of Mathematics &
Theory of Computation Group
Lab for Computer Science
Cambridge, MA 02139

<http://www-math.mit.edu/compbiosem/>