Gene 'relocation' key to most evolutionary change in bacteria

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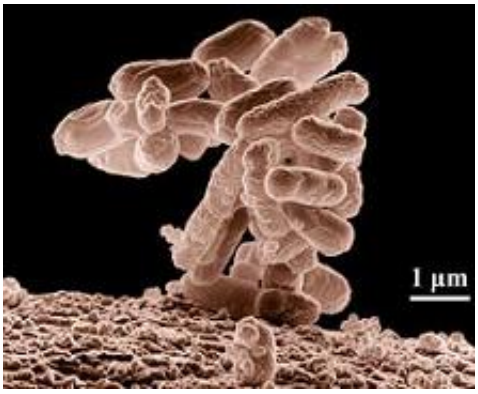

Low-temperature electron micrograph of a cluster of E. coli bacteria, magnified 10,000 times. Each individual bacterium is oblong shaped.

(PhysOrg.com) -- In a new study, scientists at the University of Maryland and the Institut Pasteur show that bacteria evolve new abilities, such as antibiotic resistance, predominantly by acquiring genes from other bacteria.

The researchers new insights into the evolution of bacteria partly contradict the widely accepted theory that new biological functions in bacteria and other microbes arise primarily through the process of gene duplication within the same organism. Their just released study will be published in the open-access journal PLoS Genetics on January 27.

Microbes live and thrive in incredibly diverse and harsh conditions, from

boiling or freezing water to the human immune system. This remarkable adaptability results from their ability to quickly modify their repertoire of protein functions by gaining, losing and modifying their genes. Microbes were known to modify genes to expand their repertoire of protein families in two ways: via duplication processes followed by slow functional specialization, in the same way as large multicellular organisms like us, and by acquiring different genes directly from other microbes. The latter process, known as horizontal gene transfer, is notoriously conspicuous in the spread of antibiotic resistance, turning some bacteria into drug-resistant 'superbugs' such as MRSA (methicillin-resistant Staphylococcus aureus), a serious public health concern.

The researchers examined a large database of microbial genomes, including some of the most virulent human pathogens, to discover whether duplication or horizontal gene transfer was the most common expansion method. Their study shows that gene family expansion can indeed follow both routes, but unlike in large multicellular organisms, it predominantly takes place by horizontal transfer.

First author Todd Treangen, a postdoctoral researcher in the University of Maryland Center for Bioinformatics and Computational Biology and co-author Eduardo P. C. Rocha of the Institut Pasteur conclude that because microbes invented the majority of life's biochemical diversity -- from respiration to photosynthesis --, "the study of the evolution of biology systems should explicitly account for the predominant role of horizontal gene transfer in the diversification of protein families."

More information: "Horizontal Transfer, Not Duplication, Drives the Expansion of Protein Families in Prokaryotes," *PLoS Genetics*, Todd J. Treangen and Eduardo P. C. Rocha. doi:10.1371/journal.pgen.1001284

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