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Toxic Genes Present a Unique Phylogenetic Signature

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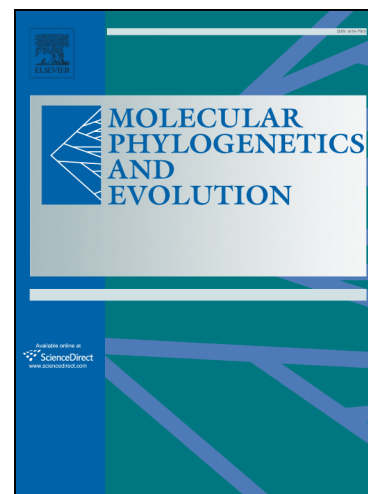
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1 TOXIC GENES PRESENT A UNIQUE PHYLOGENETIC SIGNATURE

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6 1. ABSTRACT

7 Horizontal gene transfer (HGT) is a major part of the evolution of Archaea and Bacteria, to the
8 extent that the validity of the Tree of Life concept for prokaryotes has been seriously questioned.
9 The patterns and routes of HGT remain a subject of intense study and debate. It was discovered
10 that while several genes exhibit rampant HGT across the whole prokaryotic tree of life, others are
11 lethal to certain organisms and therefore cannot be successfully transferred to them. We distinguish
12 between these two classes of genes and show analytically that genes found to be toxic to a specific
13 species (*E. coli*) also resist HGT in general. Several tools we employ show evidence to support
14 that claim. One of those tools is the *quartet plurality distribution* (QPD), a mathematical tool that
15 measures tendency to HGT over a large set of genes and species. When aggregated over a collection
16 of genes, it can reveal important properties of this collection. We conclude that evidence of toxicity
17 of certain genes to a wide variety of prokaryotes are revealed using the new tool of quartet plurality
18 distribution.

20 2. BACKGROUND

21 Most microbial genomes have experienced extensive gene mobility between lineages during their
22 evolution, a phenomenon known as horizontal gene transfer (HGT). This process has been critical in
23 shaping microbial genome evolution both in terms of functional repertoires and of genome architec-
24 ture [10, 17, 25, 26, 29, 31]. Many HGT events result in a gene being copied from the donor genome
25 to the recipient genome, and this process can be mediated by integration of viruses (bacteriophages),
26 transposable elements, or integrative plasmids, often by non-homologous recombination.

keywords: Quartet Plurality; Horizontal Gene Transfer; Gene Toxicity.

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