Supplementary Results

Horizontal gene transfer from bacteria to plants

The topology of the phylogenetic tree of the GHRB clade does not follow the phylogeny of the tree of life derived by analysis of ribosomal RNA and other universal genes [1]. In particular, the topology of the GHRB clade suggests a possible premise for a horizontal gene transfer (HGT) from α-proteobacteria to plants. A BLAST search using the sequence of hydroxyphenylpyruvate reductase from the plant *Coleus blumei* (HPPR_PLESU) as a query identified several closely homologous enzymes from other core angiosperms, mostly monocots and eudicots, including multiple nodulating plants. These enzymes form the homologous cluster comprising two *A. thaliana* hydroxypyruvate/glyoxylate reductases, HPR2 and HPR3, respectively. The highest scoring hits after plant proteins appeared to be α-proteobacterial proteins, with *Agrobacterium* homologs in the top (55% sequence identity), suggesting that the α-proteobacteria transferred the genes to the plants. The most similar bacterial proteins that have been studied experimentally are 2-keto-D-gluconate dehydrogenase from *Gluconobacter oxydans* (2KGR_GLUOX) and hydroxypyruvate/glyoxylate reductase from *S. meliloti* (Q92LZ4_RHIME), which also possesses activity for 2-keto-D-gluconate. In *Oryza sativa*, the potential HGT was followed by extensive recent gene duplications of the transferred gene, as suggested by high sequence similarity between its paralogs.

The postulated HGT might have occurred just after early diversifications of mesangiosperms [2], in a common ancestor of monocots and eudicots. As the closest bacterial proteins belong to α-proteobacteria symbiotic with plant roots, it might be a consequence of symbiosis with N_2-fixing α-proteobacteria, dated at around 100 million years ago [3]. Numerous cases of HGT from bacteria to eukaryotes have been demonstrated previously, although this process is assumed to be much less frequent than HGT between bacteria [4]. A case of a similar interdomain transfer was reported previously for γ-glutamylcysteine ligases [5].

Additional references

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