

University of South Bohemia

Faculty of Science

Department of Molecular Biology and Biochemistry



RNDr. Thesis

**Experimental examination of EFL and MATX
eukaryotic horizontal gene transfers: co-existence of
mutually exclusive transcripts predates functional
rescue**

Mgr. Petr Růžička

České Budějovice, 2011

Růžička P., 2011: Experimental examination of EFL and MATX eukaryotic horizontal gene transfers: co-existence of mutually exclusive transcripts predates functional rescue. RNDr. thesis, in English. 29 p., Faculty of Science, University of South Bohemia, České Budějovice, Czech Republic.

Publication:

Szabová J., Růžička P., Verner Z., Hampl V., Lukeš J. (2011) Experimental examination of EFL and MATX eukaryotic horizontal gene transfers: co-existence of mutually exclusive transcripts predates functional rescue. *Mol Biol Evol* In press: 10.1093/molbev/msr060

Anotation:

Many eukaryotic genes do not follow simple vertical inheritance. Elongation factor 1 α (EF-1 α) and methionine adenosyl transferase (MAT) are enzymes with complicated evolutionary histories and, interestingly, the two cases have several features in common. These essential enzymes occur as two relatively divergent paralogs (EF-1 α /EFL, MAT/MATX) that have patchy distributions in eukaryotic lineages that are nearly mutually exclusive. To explain such distributions, we must invoke either multiple eukaryote-to-eukaryote horizontal gene transfers (HGTs) followed by functional replacement, or presence of both paralogs in the common ancestor followed by long-term co-existence and differential losses in various eukaryotic lineages. To understand the evolution of these paralogs, we have performed *in vivo* experiments in *Trypanosoma brucei* addressing the consequences of long-term co-expression and functional replacement. In the first experiment of its kind, we have demonstrated that EF-1 α and MAT can be simultaneously expressed with EFL and MATX, respectively, without affecting the growth of the flagellates. After the endogenous MAT or EF-1 α was down-regulated by RNA interference, MATX immediately substituted for its paralog, while EFL was not able to substitute for EF-1 α , leading to mortality. We conclude that MATX is naturally capable of evolving patchy paralog distribution via HGTs and/or long term co-expression and differential losses. The capability of EFL to spread by HGT is lower and so the patchy distribution of EF-1 α /EFL paralogs was probably shaped mainly by deep paralogy followed by long term co-existence and differential losses.

Declaration:

I hereby declare that I did all the work, presented in this thesis, by myself or in collaboration with the co-authors of the published article.

Further, I declare that in accordance with the Czech legal code § 47b law No. 111/1998 in its valid version, I consent to the publication of my RNDr. thesis (in an edition made by removing marked parts archived by the Faculty of Science) in an electronic way in the public access to the STAG database run by the University of South Bohemia in České Budějovice on its web pages.

České Budějovice, 18 April 2011

.....
Petr Růžička

Co-authors agreements

We declare here that Petr Růžička contributed significant part to the publication “Szabová J., Růžička P., Verner Z., Hampl V., Lukeš J. (2011) Experimental examination of EFL and MATX eukaryotic horizontal gene transfers: co-existence of mutually exclusive transcripts predates functional rescue. *Mol Biol Evol* In press: 10.1093/molbev/msr060“

Mgr. Jana Szabová

RNDr. Zdeněk Verner

Mgr. Vladimír Hampl, PhD.

Prof. RNDr. Julius Lukeš, CSc.

Contents

Abstract	2
Introduction	3
Materials and methods	6
Results	10
Discussion	11
Acknowledgements	16
Literature cited	17
Figure legends	22