ARE THERE REALLY TOO MANY EUKARYOTE LGTs? A REPLY TO WILLIAM MARTIN

Luis Boto

Departamento de Biodiversidad y Biología Evolutiva

Museo Nacional de Ciencias Naturales (CSIC)

C/ José Gutierrez Abascal 2

28006 Madrid

Spain

Phone number: (34)914111328 Ext.1143

E-mail: mcnb119@mncn.csic.es

In a recent “think again” paper in this journal (1) William Martin questions not only the importance of lateral gene transfer (LGT) in eukaryotic evolution but the proper existence of lateral (or horizontal) gene transfer to eukaryotes besides endosymbiotic gene transfer or eventually horizontal transfer of transposable elements. This paper follows to a previous one by Ku and Martin (2) proposing that the main cases of eukaryotic LGTs in the scientific literature could be explained by endosymbiotic gene transfer from mitochondrial and chloroplast precursors, massive gene loss or contamination of eukaryotic genome assemblies with bacterial sequences.

The two main arguments in Martin’s paper against LGT in eukaryotes is that there are no evidence of accumulative effects of this transfer to eukaryotic genomes and, that in contrast to prokaryotes, eukaryotes do not exhibit pangenomes.

I do agree with Dr. Martin in that prokaryotes and eukaryotes are different in relation to the extent of LGT and its importance in their respective evolutionary processes. Lateral gene transfer from bacteria to eukaryotes is obviously more complicated than transfer between bacteria. Different gene structure and regulatory mechanisms for gene expression between bacteria and eukaryotes, the presence of a nuclear envelope and, perhaps the most important, the existence of a germ line in some eukaryotes impose important barriers to the transfer of genetic material between bacteria and eukaryotes (3-4). In this sense, it is clear that the acquisition of foreign genetic material and its stable integration in eukaryotic genomes is a difficult process. But to my knowledge this is widely recognized by defenders of the some role for LGT in eukaryotic evolution.

However, the absence of accumulative effects of LGT in eukaryotic genomes cannot be an argument against the existence of LGT events in some particular moment of the past evolutionary history of specific eukaryotic lineages. From the reported cases of LGT in eukaryotes is clear that some eukaryotic groups seem to be more prone to the acquisition of foreign genetic material than others. Living in close association with virus, bacteria and other unicellular eukaryotes or having life cycles including a vegetative phase are factors that could explain these differences among eukaryotes. In this sense, LGTs in eukaryotes can be envisioned as rare or improbable events emerging from a complex process (4 and references therein) but that they happen sometimes in the evolutionary history of eukaryotes in the same mode that an improbable event, the merging of an archaea and a bacteria, drive to the eukaryogenesis. In this scenario, the accumulative effect of these transfers is not necessarily an outcome.

Similarly, the absence of eukaryotic pangenomes as those of prokaryotes can be well understood considering LGTs in eukaryotes as contingent events occurring during eukaryotic evolution. Even so, eukaryotic pangenomes has been recently described in unicellular eukaryotes (5)

I do agree with Dr. Martin in the need to be careful evaluating the raising claims of LGT to eukaryotes. However, it is somewhat surprising that Dr. Martin, a strong defender of the endosymbiotic origin of eukaryotes, minimizes the possibility that contingent events of lateral

gene transfer could have occurred eventually in some eukaryotic lineages driving the acquisition of some adaptive traits in these lineages.

References

- (1) W. F. Martin, *Bioessays* 2017, 39, 1700115.
- (2) C. Ku, W. F. Martin, *BMC Biol.* 2016, 14, 89.
- (3) D. A. Baltrus, *Trends Ecol. Evol.* 2013, 28, 489-495.
- (4) L. Boto, *J. Biosci.* 2015, 40, 465-472
- (5) B.A. Read *et al.* *Nature* 2013, 499, 209-213