PublisherInfo		
PublisherName	:	BioMed Central
PublisherLocation	:	London
PublisherImprintName	:	BioMed Central

Evolutionary origins of photosynthetic organisms

ArticleInfo		
ArticleID	:	3632
ArticleDOI	:	10.1186/gb-2000-1-2-reports0055
ArticleCitationID	:	reports0055
ArticleSequenceNumber	:	29
ArticleCategory	:	Paper report
ArticleFirstPage	:	1
ArticleLastPage	:	3
ArticleHistory	:	RegistrationDate : 2000–5–16 Received : 2000–5–16 OnlineDate : 2000–7–19
ArticleCopyright	:	BioMed Central Ltd2000
ArticleGrants	:	

ArticleContext	:	130591122

Devaki Bhaya

Abstract

New phylogenetic analyses have suggested that a single primary endosymbiosis occurred at the origin of green plants, red algae and glaucophytes.

Significance and context

It is widely agreed that one of the primary events in the evolution of photosynthetic organisms was the endosymbiotic event in which a cyanobacterium-like ancestor was engulfed by a eukaryote to generate a cell with a primitive photosynthetic plastid. It is also hypothesized that three major lineages of photosynthetic eukaryotes - green plants (green algae and higher plants), red algae and glaucophytes (eukaryotic algae with chlorophyll *a* as well as phycobilisomes, in which the chloroplast is surrounded by a peptidoglycan wall) - all originated from this primary event. Although evidence from chloroplast structure and genome analyses support this claim, phylogenetic analyses of nuclear genes have yielded either inconclusive or contradictory results. Moreira *et al*. have attempted to resolve this long-standing debate by using new genomic information to provide conclusive support for the sisterhood of red algae, green plants and glaucophytes.

Key results

To test the evolutionary relationship of green plants and red algae, 24 complete elongation factor (EF-2) sequences encoded by nuclear genes were used to carry out an exhaustive maximum-likelihood search which was rooted by U5 snRNP-specific protein sequences. This phylogenetic analysis convincingly groups the red algae with the green algae and land plants (referred to as GR monophyly). This is in agreement with other distance and maximum-parsimony analyses carried out by the authors. To avoid the bias often introduced by 'single gene' analyses, the authors also compiled a set of nuclear protein markers and carried out phylogenetic analyses using these markers. In this case, however, only seven out of the thirteen markers supported the GR monophyly hypothesis. The authors do not provide adequate explanation of this anomaly. With the limited data-set currently available, Moreira *et al*. also show that the red algae, green plants and glaucophytes possibly make up a monophyletic group.

Links

Supplementary information to *Nature* **405**:69-72 is freely available.

Reporter's comments

According to the authors, this is the first clear evidence from the analysis of nuclear genes for the monophyly of red algae and green plants, which agrees with results derived from chloroplast and mitochondrial markers. GR monophyly has important implications for the nature of the ancestral plastid: it must have contained chlorophylls *a* and *b*, phycobilisomes and unstacked thylakoids. Monophyly also implies the loss of different ancestral features from each of the lineages, emphasizing the incredible plasticity of chloroplasts. Given the bewildering diversity of extant photosynthetic organisms and the plethora of secondary endosymbiotic events (such as the engulfment of photosynthetic eukaryotes by other non-photosynthetic eukaryotes) that are known to have occurred, it is certainly essential to resolve the issue of very early endosymbiotic events. Whether this paper has finally settled this controversy remains to be seen. One general point that emerges is that rapid sequencing of genes (and genomes) from diverse photosynthetic organisms will certainly help to confirm some of these hypotheses, as well as unveiling new insights into secondary endosymbioses.

Table of links

Nature

Supplementary information to *Nature* **405**:69-72

References

1. Moreira D, Guyadev H Le, Phillipe H: The origin of red algae and the evolution of chloroplasts. Nature. 2000, 405: 69-72. 0028-0836