Example of essay on symbiosis

Environment, Plants

Article Reflection

Article Reflection

Introduction

Placids can be defined as the endosymbiotic organelles, which substantially rely on the cell of their hosts to survive. Even so, placids are reported to have shown so much diversity in different situations. Therefore, ways through which differences emerge has been addressed. Some of the aspects that contribute to these differences are such as the difference in the lineages from which plastids originated. This is evident given that there are primary and secondary lineages from which the plastids can stem from. Additionally, the cause for the small size of the plastids has been established.

Plastids are the organelles, which are responsible for photosynthesis in eukaryotes. Usually, plastids profoundly depend on their host cell to the extent that most of the proteins remain encoded in the plastid’s nuclear genome. Plastids tend to be diverse with the most familiar one being the plant plastid. Additionally, plastids are involved in biochemical processes like biosynthesis of amino acids and fatty acids. Furthermore, it is believed plastids have been derived from cyanobacteria. However, plastids are different from cyanobacteria in the sense that they have a relatively smaller gene content and size. This is evident given that cyanobacterium genome has 3, 573 (kb), and it contains approximately 3, 200 genes. On the other hand, the plastid such as the one from the red alga has 191 kb and an estimated 250 genes. Moreover, the plastid genomes that stem from the green lineage has a much smaller size. For instance, Marchantia polymorpha, a liverwort has 121kb with regards to its plastic genome as well as 120 clearly identified reading frames. Even so, the protein content of the plastid genome is not highly reduced given that plastids contain approximately between 500 and 5, 000 proteins.

Usually, the plastic proteins that are not present in the plastic genome can be found in the nuclear genome hence the need to target the placid. Actually, three factors are responsible for the reduction observed from a plastid genome. To begin with, gene loss contributes to the decrease in the plastid genome. In this case, the genes that do not possess any selective advantage from the endosymbiotic environment tend to get lost automatically. For instance, the wall of a cyanobacterium will get lost if it does not have plastid lineages. Secondly, gene substitution also has a significant influence on plastid genome’s small size. A gene that was initially in the nuclear genome is relocated to the plastid. Both the cytosolic and plastid proteins are difficult to trace one they have been moved from their locus because they are identical. Gene substitution has had a significant effect on the evolution of the plastid. Even though the replacement of the genes is difficult to explain in definite terms, it has caused the plastid’s reduction thus making it smaller.

Finally, gene transfer is a mechanism that triggers the process of gene duplication, which eventually leads to certain genes being transferred. Moreover, when the duplication occurs, there is a nuclear copy, which is taken to the placid. Consequently, two loci that are redundant are developed with one of them within the nuclear genome and the other is found within a plastid genome. Unfortunately, the redundancy of the loci in most cases results in the losing one of them after a series of deleterious mutations. Therefore, a single locus will remain and in could be left in the nuclear genome.

In order to ensure that a plastid gene goes through a successful transfer up to the nuclear genome, it is necessary to ensure that gene products are properly targeted into the plastid. Polypeptide leaders and transit peptides affect the process so that gene products can get to the right compartment. Interestingly, transit peptides belonging to the plastids of land plants and red algal appear to operate interchangeably.

The content found within plastid genomes is influenced by their lineage. During the 1980s, it was assumed that plastid genomes such as the polymorpha and Nicotiana tabacum have almost the same set of genes of approximately a hundred. However, this perspective has changed with the realization that plastids from different algal groups possessed a different set of genes. For instance, the red algae and the glaucocyphytes have plastids that are much larger than those of the green algae and the plants. Furthermore, they are also able to encode genes for a wide variety of functions within their cells than is possible for the plants and green algae. Unlike the green algae, the plastid genes belonging to the red algae perform several biosynthetic processes like metabolic regulation, nitrogen assimilation, processing, and transporting proteins.

Primary plastids come from three lineages which are the Glaucocystophyte, the red and green lineages. Firstly, the glaucocystophyte are defined as a small group of freshwater that is relatively uncommon together with the unicellular algae, which has remarkably little importance attached to it economically. In fact, this group has on several occasions been neglected by various specialists. Even so, Glaucocystophyte has a crucial position in as far as plastid evolution is concerned. Unlike is the case with other kinds of plastids, the ones from Glaucocystophytes preserve the remains of the bacterial cell wall obtained from cyanobacteria. Secondly, the green lineage, which forms part of the primary plastids, can be associated with green algae like Chlorophyta as well as plants. Usually, the green algae grows in several habitats, and they tend to have so much structural diversity. The plastids of the green algae have two membranes and are even pigmented with chlorophyll. As such, the simple structure of the plant's membrane together with the phylogenic congruence ascertains that the plastid from the green algae has a primary origin. Finally, the red lineage is comprised of plastids from the red algae, which is also known as Rhodophyta. The red algae can be traced from an ancient fossil record. Additionally, they have a restriction in their distribution as they are mostly found only in coastal marines. Although the red algae has two membranes like the green algae, their pigmentation comprises that of phycobiliproteins and chlorophyll.

Besides the three lineages, endosymbiosis has been helpful in enhancing the evolution of plastid. It is believed that the secondary endosymbiont of the cryptomonads may have stemmed from the red alga. Therefore, the secondary plastids have also gone through reduction in their sizes just like being the case for the primary plastids. Contrary from the norm that primary plastids have their origins from the cyanobacteria, the Rubisco is a gene that defies this assumption. Instead, the Rubisco was derived from the several gene duplications that eventually caused the divergence hence the emergence of Rubisco.

Conclusion

The small size of the plastid genome has been caused by factors like gene transfer, gene distribution and the loss of genomes. As such, plastids tend to be smaller than the cyanobacterium genome. Plastids have evolved over time under different lineages thus contributing towards their diversity. In this regard, plastids have been able to acquire their nature through both primary and secondary lineages.

Reference

Delwiche, C. (1999). Tracing the Thread of Plastid Diversity through the Tapestry of Life. The American Naturalist, 154, s164-s177.