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Chloroplast genomes and GMOs. History, features and perspectives on plastid transgenesis in plant biotechnology

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Chloroplasts provide life on our planet, by creating carbohydrates, amino acids, lipids and O_2 through the process of photosynthesis. Two billion years ago, a eukaryotic ancestor entered symbiosis with photosynthetic cyanobacterium, giving rise to chloroplasts. During evolution, chloroplasts transferred most protein-coding genes of free-living bacteria to the nucleus, but retained a semi-autonomous genetic status — their own genomes and transcription and translation machinery.

The genetics of plastids began in 1909, when Baur and Correns described the non-Mendelian, maternal inheritance of *Pelargonium* leaf color: green, white and variegated. The presence DNA in chloroplasts (chDNA) was prove in the 1960s, and later have been shown, that male chDNA in zygotes is specifically degraded, assuring maternal inheritance in most plants.

The plastid transformation was first described in the unicellular green alga *Chlamydomonas reinhardtii* [1]. This method of plant biotechnology is an alternative to traditional introduction of foreign DNA into the nucleus, and has a number of advantages: (a) the large copy number of chDNA offers high-level transgene expression; (b) site-specific integration of foreign genes reduces the number of transgenic lines to be evaluated; (c) the lack of gene silencing or position effects in chloroplast genomes; (d) the chloroplast employs a prokaryotic gene expression system, and allows the expression of polycistronic genes [2]. Thus, chloroplasts are becoming attractive hosts for the introduction of new agronomic traits, as well as for the biosynthesis of high-value pharmaceuticals, biomaterials and industrial enzymes.

Keywords: chloroplasts; plastid genetics; plastid transformation.

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