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A Review on Algal Plasmid DNA

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Authors' contributions

This work was carried out in collaboration between both authors. Author SRS designed the study. Author AA wrote the first draft of the manuscript, analyses of the study and managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Plasmid plays a crucial role in molecular biotechnology as vectors. Once it is believed that plasmids are found only in prokaryotes but the development in molecular Bio-technology proves that plasmids are also found in eukaryotes such as yeasts and some algae. Several researches are carried out to isolate the plasmid DNA from both micro and macro algae. This review gives an overview about the plasmid DNA of various Algae.

Keywords: Plasmid; algal plasmid; plasmid like DNA; LMW.

ABBREVIATIONS

LMW : Low Molecular Weight
HMW : High Molecular Weight

1. INTRODUCTION

Plasmids are small circular extra chromosomal DNA that can replicate independently [1]. They are most commonly found in prokaryotes such as Bacteria and Achaea as double stranded molecules. They are unknown in animals and not common in land plants [2]. While chromosomal DNA contain essential genetic information, plasmids often carry additional genes that may benefit the survival of the organism, such as UVC resistance, catabolism of unusual carbon sources, resistance to antibiotics, heavy metals

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and pesticides, degradation of complex organic matter are coded in plasmids [3]. This Plasmids are widely used as vectors in molecular cloning, serving to drive the replication of recombinant DNA sequences within host organisms. In addition plasmids have an importance because of the large amount of genetic material that can be transferred in a single conjugation event.

2. ALGAL PLASMIDS

Algae are large, diverse group of photosynthetic organisms. Most are aquatic and autotrophic and lack many of the distinct cell and tissue types, such as stomata, xylem, and phloem, which are found in land plants. The term algae includes diverse group of organisms from unicellular to multicellular.

The recent development in the field of molecular biotechnology proved that some group of marine algae also contains plasmids. Several researches are carried out to isolate the plasmid DNA from various types of algae such as diatoms, green, brown, red algae and Euglenoid flagellates.

2.1 Red Algae

Among the 21 genera 8 were found to contain circular dsDNA plasmids [4]. The plasmid DNA was conformed that clones of the two plasmids of *Gracilariopsis lemaneiformis* (GL4.4 and GL3.5 kbp) does not hybridize with each other, with the nuclear, plastid or mitochondrial genomes of *G. lemaneiformis*, or with any DNA genomes of the other red algae examined. These autonomously replicating plasmids are present in high copy number per cell and in constant proportion to each other [5]. Red algal plasmids may provide useful vectors for transforming economically important red algal species [5].

2.2 Diatoms

Plasmid DNA was identified from 5 of 18 tested species (*Navicula pelliculosa, N. incerta, Phaeodactyl umtricornutum, Cylindrotheca closterium, C. fusiformis, Nitzschia alba, N. angularis, N. angularis, N. frustulum, N. laevis, N. ovalis, Cyclotella nana, Skeletonema costatum, Chaetoceros gracilis, Amphiprora* sp. strain SIO, *Amphora* sp. strain T-34*, Nitzschia*sp. strain Mono Lake, *Nitzschia*sp. strain SIO). Each species contain more than one type of plasmid [6]. They share sequence homology with chloroplast and/ or nuclear DNA [7].

2.3 Brown Algae

Plasmid was isolated in two different species of *Pylaiella littoralis* and *Sphacelaria* sps. as small circular molecules. *Sphacelaria* plasmids are ranging from 31 µm to more than 70 µm. *Pylaiella littoralis* plasmids are ranging from 17.8 ±1 µm to more than 37.9 ±3 µm [2].

2.4 Green Algae

Until recently, very few green algae were known to have plasmids.In *Acetabularia cliftoni* covelantly closed small circular DNA molecules were found associated with chloroplast [8]. These mini circles closely resemble the 3.13 µm mini circles discovered in Euglena by Nass and Ben-Shaul [9]. Linear plasmid like molecules with chloroplast homologies reported from *Chlamydomonas moewusii* [10]. Similar condition was created artificially in *Chlamydomonas reinhardtii* [11,12]. Abundant low molecular weight compounds were found in the seven genera of the order Siphonocladales and two genera of cladophoraes [9]. Cloned restriction fragments of this LMW molecules hybridize solely to themselves in southern blots, whereas the heterologous probe specific for chloroplast 23S ribosomal DNA hybridize only with HMW DNA [13]. This indicates that the LMW DNA indeed extra chromosomal and it may be autonomously replicating. Many of these clones hybridize to RNA species in Northern blots of total RNA, and sequencing has revealed that these molecules contain open reading frames (ORFs) potentially encoding at least portions of proteinaceous components of photosystems II and I [14].

In addition to that Plasmid DNA were also discovered in *Euglena gracilis* [15,16,14].

3. CONCLUSION

The recent development in the field of molecular biotechnology helps to open many secrets about the eukaryotic plasmids. The algal plasmid has variety of advantages such as containing unusual stress responsive genes particularly for salt stress. These genes can be easily incorporated into host organisms for genetic transformation study for crop varieties. They also help to study about phylogenetic characters of an alga.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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