Plantibodies: paving novel avenues for immunotherapy

Abstract

Plantibodies are derived from transgenic plants through genetic engineering technology. This review article emphasizes the significance of plant derived antibodies, various methods for production of transgenic crops, potential application and limitations.

Keywords: plantibodies, transgenic, vaccines

Introduction

Infectious disease accounts for approximately 25% of all deaths worldwide, 63% of death in children and 45% of the death has been reported from developing countries. Vaccination is one of the effective means in preventing infectious diseases. World Health Organization states that 30 million children born every year are deprived of immunization by the modern standards available in the country. The above scenario alerts the need for large scale production of vaccines against infectious diseases so as to increase the global immunization compliance. Strategies for implementation of novel routes for immunization and the production of edible vaccines are the areas of future research work. The concept of green revolution originated in 1960s in response to the prodigious transfer of species within the same kingdom (plant to plant) or between kingdoms (bacteria to plant). Inserted DNA is slightly modified for efficient expression within the host. The target for new transgenic DNA is the nucleus of the plant cell. Transgenic crops can be generated by the biolistic method (particle gun method) or by Agrobacterium tumefaciens infection. The concept of green revolution is that transgenic crop is free of contamination with mammalian pathogens thus reducing the screening costs for viruses & bacterial toxins. Relative ease of genetic manipulation and reduced economical constraints offer added advantage over transgenic animals. Plants might also provide an ideal vehicle for oral delivery of vaccine antigens owing to the presence of thick cell wall composed of cellulose and sugars that may provide protection against degradation by the gastrointestinal tract.

Advantages of transgenic plants over animals

Production of recombinant proteins in plants and their administration provides an added margin of safety when compared to that produced from transgenic animals. The salient feature of plantibodies is that transgenic crop is free of contamination with mammalian pathogens thus reducing the screening costs for viruses & bacterial toxins. Relative ease of genetic manipulation and reduced economical constraints offer added advantage over transgenic animals. Plants might also provide an ideal vehicle for oral delivery of vaccine antigens owing to the presence of thick cell wall composed of cellulose and sugars that may provide protection against degradation by the gastrointestinal tract.

Methods of production of transgenic plant

Transgenic crops are composed of genes that are derived from species within the same kingdom (plant to plant) or between kingdoms (bacteria to plant). Inserted DNA is slightly modified for efficient expression within the host. The target for new transgenic DNA is the nucleus of the plant cell. Transgenic crops can be generated by the biolistic method (particle gun method) or by Agrobacterium tumefaciens infection.
tumefaciens mediated transformation method. In the gene gun method (Micro Projectile Bombardment) DNA is bound to tiny particles of gold or tungsten which is subsequently shot in to plant tissue under high pressure using gun. Agrobacterium method makes use of soil dwelling bacteria-Agro bacterium tumefaciens. It has the ability to infect plant cells with a piece of its DNA that is integrated in to a plant chromosome, through a tumor inducing plasmid that can control the plant’s cellular machinery.\(^5\)

**Sources of transgenic crops**

Many recombinant proteins have been expressed in several important agronomic species of plants which includes tobacco, corn, tomato, potato, banana, alfalfa, canola, spinach, maize, lettuce etc.\(^2\)

**Techniques for purification of Plantibody**

i. Filtration
ii. Immunofluorescence
iii. Chromatography
iv. Diafiltration
v. Polymer fusion\(^4\)

**Evaluation techniques for plantibody**

i. Radioimmunoassay
ii. ELISA & western blot analysis
iii. Immunofluorescence

**Applications of plantibody**

The achievements of plant derived vaccines and sera can be classified under two categories
i. Vaccines and antibodies for infectious diseases
ii. Vaccines and antibodies for cancer
List of infectious diseases includes Respiratory Syncitial Virus (RSV), HIV, anthrax, diphtheria, SARS and small pox virus.\(^6\) Hepatitis B surface antigen (HBsAg), rabies virus glycoprotein E coli heat labile enterotoxin, Norwalk viral capsid protein are the medically important antigens expressed in the transgenic plants. Plant derived vaccines offers the advantage of convenient storage, elimination of health professionals for their delivery and the use of renewable resources for large scale production.\(^2\)

**CaroRx (Dental caries vaccine)**

Plant derived antibody that is currently in Phase II clinical trial is a chimericsecretory Ig A/G from the Guy’s hospital London was produced from transgenic tobacco plant. The antibody is specific for the major adhesins of streptococcus mutans which are responsible for dental caries. Topical application following oral prophylaxis helps to prevent recolonization by streptococcus mutans and leads to the replacement with harmless endogenous flora.\(^7\)

**Monoclonal antibodies**

T84.66 is a monoclonal antibody that can recognize carcinoembryonic antigen which is a tumor associated glycoprotein. This antigen is widely used as a tumor markerfoecorectal carcinoma, breast carcinoma and pancreatic carcinoma. This antibody was produced from transgenic tobacco by agro infiltration.\(^6\)

**Immunotherapy**

Plantibodies may also be used as topical immunotherapeutic agents. Various cytokines, growth factors, hormones, recombinant enzymes made from transgenic plants are under different phases of clinical trial.\(^12\) Plantibodies reactive with epidermal growth factor were recently licensed to treat epithelial cancers. In the near future these antibodies may emerge as therapeutic tool in the treatment of oral cancer

**Limitations**

i. Plant derived recombinant proteins or antibodies possess increased risk of immunogenicity or allergenicity.\(^11\)
ii. Transgenic plant and product contamination by mycotoxins, pesticides, herbicides and endogenous metabolites.
iii. Regulatory issues, particularly for therapeutic proteins requiring approval for human use.\(^3\)

**Conclusion**

Plant biotechnology is a fascinating arena for future research works and molecular farming can even challenge the established production technologies for large scale production of vaccines. Plantibodies serves as an alternative production system for meeting the demand of vaccine production and can be used for global health.

**Acknowledgements**

None.

**Conflict of interest**

The author declares no conflict of interest.

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