**INGESTIBLE VACCINE: PLANTIBODIES**

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**ABSTRACT:**

Plantibody is a plant derived antibody, which has been produced by genetically engineered plants. Antibodies which have proven itself as an important part of immune system in many organisms act by recognizing viral antigens and other dangerous compounds and signal a response to it. In plant body formation, antibody coding genes from mammals will be inserted into plant’s genome, where they function same as natural mammalian antibodies. In plants, these antibodies produces large amount of viable proteins by action of endomembrane and secretory system of these antibodies. Later, these can be extracted from plant tissues for humans use or can be administered as such in the form of edible vaccine. Thus, plants can be used as source for human antibody production by recombinant technology.

**Keywords:** antibodies, coding, genome, viable protein, recombinant technology.

**INTRODUCTION:**

According to recent survey it is found that, global annual spending on pharmaceuticals has reached to almost 1.2 trillion US dollars. The first pharmaceutically relevant protein made in plant was human growth hormone in the yaer 1986. since the many other human protein have been produced in a diverse range of crops.First antibody was expressed in tobacco in 1989. Firstexperimental vaccine: hepatitis B virus surface antigen(HBV) was produced in 1992. Range of recombinant proteins has extended to include industrial enzymes, technological proteins used in research , milk proteins, biopolymers, and many more.

Nowadays, one of the most promising methods of producing proteins and other medicinal substances such as antibodies and vaccines is the use of transgenic plants. Transgenic plants are the ones, whose DNA is modiﬁed using genetic engineering techniques. The aim is to introduce a new trait to the plant which does no occur naturally in the species. [A transgenic plant contains a gene or genes that have been artiﬁcially inserted. The inserted gene sequence is known as the transgene, it may come from an unrelated plant or from a completely different species.](http://cls.casa.colostate.edu/TransgenicCrops/what.html) The purpose of inserting acombination of genes in a plant, is to make it as useful and productive as possible.

A plantibody is an antibody produced by genetically modified crops. [The term “Plantibodies” was created to describe the products of plants that have been genetically modified to express antibodies and antibody fragments in plants](https://pdfs.semanticscholar.org/e3d6/057a0ee5a70bb53a4a4d960429276550c7ca.pdf). Plants are used as factories for large scale production of clinically viable proteins, which can later be purified from plant tissue [1].By targeting intercellular space, chloroplast, seeds, and tubers of plant , plantibodies are produced.

**ADVANTAGES:**

They possess some advantages over conventional methods like

* Plants provide scalable production capacity and flexibility, hence provide low upscale costs.
* Plants are cost effective and the most abundant source of protein on the planet, produce lots of biomass (corn, tobacco) especially can produce and hold many of our target products.
* Plants can express and process most prokaryoticand eukaryotic proteins.
* Increased stability of such antibodies.
* Cost effective than mammalian system.
* Higher yields in shorter periods of time relative to using animals.
* Easy technology for harvesting and processing plant as infrastructure for large-scale plant growth and processing is already available.
* Farms, large greenhouses, and plant factories can be used for cultivating transgenic plants.
* Decrease health risks that arise from contamination with human pathogens and/or toxins. Plants are free from animal and human pathogens :safety
* High specificity in vitro and in vivo diagnostics.
* Low toxicity therapeutic applications,
* High drug approval rates (24 approved mabs) major products in biotechnology (240 in clinical trials),
* Potential long-lasting benefits.
* Plant seed permit stockpiling of inexpensiveinventory:easy storage with long shelf life.
* No cold chain transport required: low cost.

Plant can send target proteins into specific intracellular compartments where they are more stable and consumption of that particular part of plant is edible vaccine, even the purification of the antibody can be eliminated when the recombinant protein is confined in particular plant tissue. Example of such antibodies are Construction of tobacco plants expressing 4 transgenes by Quadruple transgenics efficiently assembled secretory immunoglobulins, Anti-rabies virus mAb after exposure treated with Ab which was used to be made in horses later tried first time as mAb made in transgenic plants 4 genes 2 H, 2 where transgenic plant for each one and crossing plants were used and later used single binary vector with two promoters.

**Plant transformation / transgenic plant production**

The Plant Transformation or transgenic plant production process include following steps:

* Isolate: DNA from a mammal containing an antibody-coding gene.
* Insert: the gene of interest into Ti-plasmid from Agrobacterium by cutting with restriction enzymes and joining with DNA ligase.
* Introduce: the recombinant Ti plasmid to plant cells in culture. DNA segment of interest is transferred to the plant chromosome.
* Regenerate: the transgenic plant in vitro or farms, greenhouses, etc.



**DISADVANTAGES:**

Possibility of plantibody strains contaminating food crops. We can get around this by using only plants that do not serve as a food source for people or livestock.

Possibility of transgenic plants to produce allergenic compounds and transfer their antigens into the end products, causing new allergic reactions in the recipient mammal(s).

**APPLICATION:**

Plantibodies are used for treatment of immune disorders, cancers and other inflammatory diseases. Several plant produced antibodies are undergoing clinical trials.

1. The first plantibody created from tobacco was called CaroRx. It is a clinically advanced anti- *Streptococcus mutans* secretory IgA plantibody that specifically binds to the bacterium and protects humans from dental caries [2].
2. A humanized antibody against herpes simplex virus glycoprotein B which was expressed in soya bean [3].
3. Antibodies against Bacillus anthracis developed in transgenic strains of tobacco and tested in mice which can prove useful in anthrax epidemic in future [4].
4. Antibodies against ovarian, testicular and colon cancer as well as melanoma, B- cell lymphoma and human papilloma virus expressed in transgenic tobacco [5].
5. Tobacco plantibody against Newcastle disease virus in poultry [6].
6. The production of anti- Ebola virus antibodies has been explored in plants. They used a high yielding geminivirus based expression system in tobacco plant, Nicotiana benthamiana, for the production of a mAb (6D8) that protected animals from Ebola virus infection [7].
7. Hepatitis B vaccine (CB-Hep.1) in tobacco plants [8].
8. Vaccine against HIV virus [9].
9. T84.66 is a monoclonal antibody that can recognize carcino embryonic antigen which is a tumor associated glycoprotein was produced from transgenic tobacco by agro infiltration [10].

**CONCLUSION:**

Transgenic plants have been shown to be the most productive and economical system for making antibodies for human use as they play a key role in providing therapeutics and edible vaccines, which are cheap and easy to administer. [This is true considering that not only tobacco, but also many other common plants such as corn, moss and soybeans have become hosts for antibodies and have the capacity to cure, treat or lessen the detrimental effects of multiple diseases.](https://nhsjs.com/2010/the-potential-of-plantibodies) The low-cost, high-scalability, and safety characteristics of a plant-based production system offer an attractive alternative for both commercial pharmaceutical production and for manufacturing products for the developing world[9](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4994546/#R9). Furthermore, adoption of plants as bioreactors on a larger scale would reduce the cost of antibody therapy and increase the number of patients with access to these treatments [11]. In light of their numerous advantages, it seems likely that plantibodies are the potential panacea for human and animal health challenges in the foreseeable future. As their use in solving human health problems seem to be increasing, we advocate that their application should also be exploited in the field of veterinary medicine. Lastly, this important biotechnological breakthrough should be embraced in Africa where there is great diversity of crops and plants that can be readily explored by the pharmaceutical industry for therapeutic, immunoprophylactic, improved livestock productivity and other purposes.

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