

## THE PRODUCTION OF BIOPHARMACEUTICALS IN PLANTS

### S u m m a r y

The use of plants for medicinal purposes dates back thousands years but genetic engineering of plants to produce desired biopharmaceuticals is much more recent. "Molecular farming" is the production of recombinant proteins in plants. It is intended to increase the power of agriculture to cultivate and harvest transgenic plants producing recombinant therapeutics. Molecular farming has the potential to provide diagnostic and therapeutic tools in both health care and the life science.

In the past decade, plants have been actively considered as an important expression system and a number of recombinant proteins such as hepatitis B (HbsAg) or cholera toxin B were produced in this system. Plant expression system may be useful for pro-

ducing pharmaceuticals, as large amount of protein can be produced at a relatively low cost. In addition, plants are capable of complex post-traslational modification as that in *Eukaryota*. Preliminary clinical trials using transgenic lettuce plants expressing hepatitis B virus surface antigen showed encouraging immune response in human volunteers, thus suggesting that human may be immunised orally against HBV with plants expressing the viral antigen.

Plant – derived biopharmaceuticals are cheap to produce and store, easy to scale up for mass production and safer than those derived from animals. Positive sides as well as possible negative concerns connected with molecular farming are discussed in the article.