17.1H: Production of Vaccines, Antibiotics, and Hormones

Biotechnological advances in gene manipulation techniques have further resulted in the production of vaccines, antibiotics, and hormones.

Learning Objectives

• Discuss the methods by which biotechnology is used to produce vaccines, antibiotics, and hormones.

Key Points

• Vaccines use weakened or inactive forms of microorganisms to mount the initial immune response through the use of antigens, which are produced through use the genes of microbes that are cloned into vectors.
• Antibiotics, agents that inhibit bacterial growth or kill bacteria, are produced by cultivating and manipulating fungal cells.
• Hormones, such as the human growth hormone (HGH), can be formulated through recombinant DNA technology; for example, HGH can be cloned from a cDNA library and inserted into \( E. coli \) cells by cloning it into a bacterial vector.

Key Terms

• bactericidal: that which kills bacteria
• bacteriostatic: that which slows down or stalls bacterial growth
• antigen: a substance that binds to a specific antibody; may cause an immune response
Production of Vaccines, Antibiotics, and Hormones

Vaccines

Traditional vaccination strategies use weakened or inactive forms of microorganisms to mount the initial immune response. Modern techniques use the genes of microorganisms cloned into vectors to mass produce the desired antigen. The antigen is then introduced into the body to stimulate the primary immune response and trigger immune memory. Genes cloned from the influenza virus have been used to combat the constantly-changing strains of this virus.

Antibiotics

Antibiotics are biotechnological products that inhibit bacterial growth or kill bacteria. They are naturally produced by microorganisms, such as fungi, to attain an advantage over bacterial populations. Antibiotics are produced on a large scale by cultivating and manipulating fungal cells. Many antibacterial compounds are classified on the basis of their chemical or biosynthetic origin into natural, semisynthetic, and synthetic. Another classification system is based on biological activity. In this classification, antibiotics are divided into two broad groups according to their biological effect on microorganisms: bactericidal agents kill bacteria, and bacteriostatic agents slow down or stall bacterial growth.

Hormones

Recombinant DNA technology was used to produce large-scale quantities of human insulin (a hormone) in *E. coli* as early as 1978. Previously, it was only possible to treat diabetes with pig insulin, which caused allergic reactions in humans because of differences in the gene product. In recent times, human growth hormone (HGH) has been used to treat growth disorders in children. The HGH gene was cloned from a cDNA library and inserted into *E. coli* cells by cloning it into a bacterial vector. The bacteria was then grown and the hormone isolated, enabling large scale
commercial production.

LICENSES AND ATTRIBUTIONS

CC LICENSED CONTENT, SHARED PREVIOUSLY

- Curation and Revision. Provided by: Boundless.com. License: CC BY-SA: Attribution-ShareAlike

CC LICENSED CONTENT, SPECIFIC ATTRIBUTION

- OpenStax College, Biology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44551/latest...ol11448/latest. License: CC BY: Attribution
- OpenStax College, Biology. November 5, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...ol11448/latest. License: CC BY: Attribution
- OpenStax College, Biology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...ol11448/latest. License: CC BY: Attribution
- OpenStax College, Introduction. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44551/latest...B17_00_01.jpg. License: CC BY: Attribution
- OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_05.jpg. License: CC BY: Attribution
- OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_03.jpg. License: CC BY: Attribution
- OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_02.jpg. License: CC BY: Attribution
- OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_04.jpg. License: CC BY: Attribution
- OpenStax College, Biology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...ol11448/latest. License: CC BY-SA: Attribution-ShareAlike
- OpenStax College, Biology. October 23, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...ol11448/latest. License: CC BY: Attribution


• OpenStax College, Introduction. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44551/latest..._B17_00_01.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_05.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_03.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_02.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_04.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_06.png. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...ol11448/latest. License: CC BY: Attribution


• OpenStax College, Introduction. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44551/latest..._B17_00_01.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_05.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_03.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_02.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_04.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_06.png. License: CC BY: Attribution


• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...ol11448/latest. License: CC BY: Attribution


• OpenStax College, Introduction. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44551/latest..._B17_00_01.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_05.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_03.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_02.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_04.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_06.png. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_07.png. License: CC BY: Attribution

• GMO corn label RoundUp Liberty Link Herculex I Cruiser Mid Rate. Provided by: Wikimedia. Located at: http://commons.wikimedia.org/wiki/File:RoundUp_Liberty_Link_Herculex_I_Cruiser_Mid_Rate.jpg. License: CC BY: Attribution

• OpenStax College, Biology. October 23, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...ol11448/latest. License: CC BY: Attribution


• OpenStax College, Introduction. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44551/latest..._B17_00_01.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_05.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_03.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_02.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_04.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_06.png. License: CC BY: Attribution

• GMO corn label RoundUp Liberty Link Herculex I Cruiser Mid Rate. Provided by: Wikimedia. Located at: http://commons.wikimedia.org/wiki/File:RoundUp_Liberty_Link_Herculex_I_Cruiser_Mid_Rate.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_09.jpg. License: CC BY: Attribution


• OpenStax College, Biology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...ol11448/latest. License: CC BY: Attribution


• OpenStax College, Introduction. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44551/latest/Figure_B17_00_01.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest/Figure_17_01_05.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest/Figure_17_01_03.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest/Figure_17_01_02.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest/Figure_17_01_04.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_06.png. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_07.png. License: CC BY: Attribution

• GMO corn label RoundUp Liberty Link Herculex I Cruiser Mid Rate. Provided by: Wikimedia. Located at: http://commons.wikimedia.org/wiki/File:GMO_corn_label_RoundUp_Liberty_Link_Herculex_I_Cruiser_Mid_Rate.jpg. License: CC BY: Attribution


• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_09.jpg. License: CC BY: Attribution

• OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...e_17_01_08.jpg. License: CC BY: Attribution

• OpenStax College, Biology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest...ol11448/latest. License: CC BY: Attribution


OpenStax College, Introduction. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44551/latest/Figure_B17_00_01.jpg. License: CC BY: Attribution

OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest/Figure_17_01_05.jpg. License: CC BY: Attribution

OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest/Figure_17_01_03.jpg. License: CC BY: Attribution

OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest/Figure_17_01_02.jpg. License: CC BY: Attribution

OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest/Figure_17_01_04.jpg. License: CC BY: Attribution

OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest/Figure_17_01_06.png. License: CC BY: Attribution

OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest/Figure_17_01_07.png. License: CC BY: Attribution


OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest/Figure_17_01_09.jpg. License: CC BY: Attribution

OpenStax College, Biotechnology. October 16, 2013. Provided by: OpenStax CNX. Located at: http://cnx.org/content/m44552/latest/Figure_17_01_08.jpg. License: CC BY: Attribution