

## **An Overview of the Advances Made in Biotechnology and Related BTWC Concerns**

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### **Abstract**

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### **Introduction**

The Biological and Toxin Weapons Convention (BTWC) entails prohibition of the development, production and stockpiling and acquisition of biological and toxin weapons. Efforts were made to negotiate a protocol to include detailed investigation and verification to ensure that participating countries fulfilled their obligations of non-acquisition or retention of microbial or other biological agents or toxins harmful to plants, animals and humans, in types and in quantities that would have no justification for prophylactic, protective and other peaceful purposes. However, the discussions were inconclusive.

BTWC is apprehensive of development of dual-use technologies in the areas of genetic engineering, biotechnology and microbiology, for high growth of products and processes that are capable of being used for purposes inconsistent with its objectives and provisions. These include all microbial and other biological agents or toxins, naturally or artificially created or altered, irrespective of their origin or method of production. Increased knowledge of uses of many pathogenic species of micro-organisms, extraction of toxins and other biological agents and the pace of development in civil biotechnology further accentuate the possibilities of production and hostile use of biological agents. Dual-use technologies, even though they may not in principle contravene BTWC, can be used to create agents for offensive purposes. Current efforts by nations focus intensively on technologies for creating new means of protection against biological threats.

Developments in areas like physics and chemistry and engineering, computational and material sciences greatly impact progress in biotechnology. Genetic engineering, biotechnology, toxicology, molecular biology and other related sciences have also made it possible to create a new generation of biological weapons (BW). Scientific and technological developments which would lead to transformation in organisms to be used as BW could include (i) increase in the virulence and antibiotic resistance of pathogenic agents; (ii) enhancing non-transmissible agents for airborne transmission; and (iii) creating organisms or biological products capable of acting on humans and ecosystems (parasites, insect-pests, disease vectors, etc.). Technical developments of major concern to BTWC would include:

**Bio-defence:** BW are capable of inflicting casualties over a large area with military effectiveness. Factors impacting their effectiveness may include use of novel agents that are not well characterized and for which there may not be vaccines or treatment. Decontamination may be difficult if deployed sensors cannot detect the agents utilized. The process of scientific and technological changes in detection, identification, diagnosis and protection provides increased capabilities to counter or protect against BW.

**Genetic modifications:** Advances in genetics and genetic modification techniques are making new types of vaccines feasible. There is considerable research towards genetically modified live vaccines able to immunize simultaneously against multiple antigens. Advances in knowledge of the molecular basis of antigens have led to antibody reagents of improved specificity.

**Mechanism of action of micro-organisms:** Understanding the mechanism of action of micro-organisms gives direct access to the mechanism of action of potential BW agents. Using molecular biology, mechanisms of virulence and infection have been identified; the same techniques may also permit deliberate manipulation of these mechanisms. Transferring certain genetic traits into naturally infectious micro-organisms can potentially create organisms of greater virulence, antibiotic resistance and environmental stability. Changing the microbes genetically could alter their immunogenicity, thereby invalidating vaccines and sero-diagnostic techniques. Otherwise harmless micro-organisms could be altered to produce toxemia or disease: the host would continue to recognize them as innocuous and therefore not defend against them.

**Micro-biological developments:** Human understanding of a number of factors of direct relevance to protein synthesis and assembly has increased enormously. Remarkable progress has been made in the application of this knowledge to the production and isolation of heterologous proteins from *E. coli* and other bacteria like *Yersenia*. Different expression systems are being tried.

**Human Genome Project (HGP):** The immediate benefits of HGP will be the identification and localization of genes causing hereditary diseases and simplification of the development of pharmaceutical drugs for treatment of hereditary diseases. It will also greatly refine their prenatal diagnosis. Investigations also provide sufficient data on ethnic genetic differences between population groups. Such data would also provide target-suitable micro-organisms to attack known receptor sites for which differences exist at cell membrane level or even to target DNA sequences inside cells by viral vectors.

**Toxins and Regulators:** Genetic engineering has made possible large-scale extraction and production of potent toxins, which until now were available only in minute quantities and only upon isolation from immense amounts of natural biological materials. These toxins can now be produced in kilogram quantities in a short time with minimum cost, which could be of military significance. Rapid progress has also occurred in the modification of naturally occurring bioregulators, in understanding the physiological effect of certain essential

biological substances when they are present in abnormal concentrations or under abnormal conditions, and in understanding the possible pathogenic effects of proteins.

Of special interest to BTWC are applications of biotechnology in directed molecular evolution such as genetic modification, recombinant technologies, proteomics, bioinformatics, and synthetic and systems biology. Some of these technologies vis-à-vis potential applications of consequence to BTWC are discussed in the following paragraphs.