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The role of biosensors and biological weapons in national defence and security operations

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Abstract

The knowledge of biotechnology plays an important role in the development of biological weapons. Biological weapons are considered an attractive factor in war for several reasons: ease of manufacture, low cost, confirmed injury, increased number of victims, large losses incurred by other countries. Biological weapons detection methods are among the most important means of military defense. Biological sensors are used in early detection of weapons. Biotechnology is of paramount importance in all fields of medicine, engineering, agriculture, industry, as well as military life. The key applications of biotechnology in the military are in the areas of sensor systems and systems for protection from espionage. Among the most important countries that have applied knowledge of bioweapons technology into their security system are the USA and China. Despite the enormous advantages of biotechnology, it has negative effects in biological weapon production. Therefore, the near future will witness a tremendous boom in biotechnology. DNA profiling also plays an important role in detection of crime. The overall aim of the review is to emphasize the importance of biotechnology towards solving bioterrorism and other forms of security challenges in an environment.

Keywords: Biotechnology, biosensor, bio weapons
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Introduction

History has proven that human development is a tool for sustainable development and progress of self-sufficiency of a country that has generally followed the development and applications of science and technology, which pedals and answers back to the necessities and benefaction of a country. Many countries in the developed world have made more advances in biotechnology (Justice & Sandra, 2019). In the 21st century, a new type of biological sciences emerged, namely biotechnology, which played an important role in making biological fields more accessible in different disciplines. Biotechnology can be considered a multi-purpose field as it has rivaled traditional methods in all fields (McLeod & Nerlich, 2017. According to the International Union of Pure and Traditional Chemistry, biotechnology is the application of biochemistry, microbiology, biological and chemical engineering to industrial products and the environment. (Luísa et al., 2019).

Biotechnology has a great influence in various aspects of life, as it has affected agriculture,

industry, medicine, and food through transfer of a set of genes loaded on a vector into the cell. Inside the cell, a vector attaches these genes to the organism's genome, producing a genetically modified organism that carries the desired characteristics of these transgenes (Huda and Munazza, 2019). Biotechnology contributes to life, however disadvantages emerged, as others used it in wars to produce biological weapons, which are more difficult to destroy than nuclear weapons because of the ability of cells to multiply and spread very quickly. The importance of biotechnology in defense and secrecy denoted in the formation of bio-sensors, production of biological weapons and the use of DNA fingerprints in crime detections (Araceli et al., 2017).

Biosensors

The rapid development of biotechnology and sensor tools facilitated the emergence of the so-called biosensor. It is a powerful and innovative analytical device that has many uses in the civil and defense sectors (Paolo & Evgeny, 2020). Compared to traditional methods, the biosensor combines the physical sensor with a part of the biochemical recognition component (organelles, proteins, nucleotides, antibodies). The biosensors work with high efficiency and speed against biological risk factors in the form of specificity and selection in detecting these target molecules. (Alisa et al., 2018). The sensor consists of three parts: the biological sensitive part, the physical and chemical transducer and the detector. (Feiyun et al., 2020).

Biosensors are considered one of the most widely applied technologies due to their small size, ease of carrying, accuracy of results, low cost and energy rationalization (Miroslav et al., 2019). Biosensors have many uses. In medicine, they are used to monitor diabetes mellitus, measure certain vitamins, and diagnose diseases. It is used to measure the quality of water and measure the percentage of heavy metals in it, and it is also used to measure air quality and to detect whether it contains microorganisms in the field of biological warfare. In addition to discovering medicines and their conformity with global health standards, discover whether food contains drug residues (Miroslav et al., 2019).

Technological development has led to the emergence of biosensors and they have been widely used in the civil and defense sector. Modern biosensors were much better compared to the traditional methods due to its dependence on a biological field in addition to a physical field (Thomas et al., 2020). In the field of biotechnology, biosensor was used for the rapid detection and control of diseases and the detection of microorganisms, while in the field of defense, it was used to develop strategies based on pre-assembled groups of soldiers, to identify risk factors and threats that soldier will face, in addition to examining the physical and psychological condition of the soldier and monitoring of stress among the soldiers. It also has the ability to rapidly detect neurotoxic compounds using the enzyme Acetyl cholinesterase as well as toxic genes using calf thymus DNA (Ude et al., 2018). In the defense sector, biosensors are combined with nano sensors to enhance the accuracy of physiological monitoring and the quality of the emergency personnel response (Naumih, 2020). The idea of a biological sensor in military life depends on the discovery of biological damage.

In recent years, biosensors have been integrated into the operational and planning fields. There are portable and implanted vital sensors that are used to protect the individual from bioweapons attacks during emergencies, and it also enhances continuous monitoring through sensing networks and remote monitoring and provides smart helmets that rely on brain plans to know the health status of soldiers when exposed to stress (Yifen et al., 2019). There is also a device called Canary that gives an early warning to pilots when they are exposed to the risk of losing consciousness as a result of working under a high-power area, so the device alerts the pilot through a nut transported on a screen connected to a computer device. The canary turns the aircraft to autopilot mode, so the pilot is safe from danger (George et al., 2019).

Moreover, the physiological observation of soldiers started to attract more attention in the defense community at the beginning of the twenty-first century. Their ability to withstand stress in crises and emergencies, and soldiers' surveillance may come by using wearable real time physiological status monitoring (RT-PSM) devices (Friedl, 2018):

1. Technological enhancement by gathering information about the individual status to improve self-regulation, capacity distribution and improved team sensing/situational awareness.
2. Examine the failure rates that the soldier will be exposed to due to psychological and physical stress.
3. Taking notice of any danger to the soldier.
4. Disclosing any injuries sustained by the soldier.
5. Long term health risk associated with the soldier.
6. Monitor the risks to which it is exposed as a result of its long-term use.

Biological weapons

The history of biological threats goes back to ancient times. Poisons, viruses and plants provided the beginning of biological wars. This was done through water poisoning and the spread of pests that infect humans with diseases and loss of lives. Advances in biotechnology pose grave demands to arms control for coming years. The growing talents of biological sciences and the world wide unfold of the underlying technology increase the chance of the technology via small groups or individuals with the necessary technical competence (Riaan et al., 2017).

Biotechnology has become a pretext for biological warfare, since biotechnology gives room for manipulation of microorganisms to cause diseases, eliminate beneficial organisms, infect crops with pests and make them carcinogenic to consumers (human and animals) (Aucouturier, 2020). In the future, all countries will strive to develop the field of biotechnology, and scientists will strive to develop their laboratories and research to catch up with the developed countries in biological warfare, so that each country can protect itself, and the strong country will be the one that has attained biotechnological advancement (Aucouturier, 2020). Throughout the centuries, since the wars of the middle Centuries until now, biological wars have been integrated to provide armies with additional attacks to repel the enemy and defeat them (Carus, 2017).

Biological warfare uses biological toxins and microorganisms to disable or destroy the enemy. Biological weapons or biological agents are usually disease-causing organisms, or genetically modified organisms, that are intentionally used to develop bioweapons (Clark and Pazdernik, 2016). *Bacillus anthracis* causing anthrax, *Yersinia pestis* which causes plaque and hemorrhagic fever, are among the most important uses in biological warfare (Flora, 2020). In the past era, development in scientific research and biotechnology made it easy to use these weapons, especially since genetic engineering carries the most important aspect of genetic manipulation (Britannica, 2020).

The major roles of biological agents is their superior ability to infect large numbers of individuals and groups in a short time, such as what happened in the spread of smallpox and anthrax, where the rate of infections increased and resulted in an increase in the rate of death (Hayoun & King, 2020). The technology of biological weapons is used by organized and funded terrorist organizations funded by the countries that are the incubators of these weapons, as it does not require high production methods, and there is a time between the spread of these weapons and the occurrence of war (Williams et al., 2020).

One of the advantages of these weapons is that they work without anyone feeling them until after the disaster, which caused panic in the hearts of the enemies, because in addition to spreading disease and the high number of victims, they caused panic and terror in the souls of others and difficult to identify (Flora, 2020).

DNA profiling

In the technological age, development in science has become rapid and it is no longer limited to solving scientific problems only while it is used in solving life and legal problems. The discovery of DNA contributed to solving many problems of descent, in addition to identifying the perpetrators and perpetrators of accidents (Litvinenko, 2020). DNA is the main part of life, as it carries the genetic code that is passed down through the generations. The currency in which a person's genetic code is determined is known as DNA profiling (Curtis et al., 2018). The problem facing scientists was the small amount of DNA used, but with the discovery of PCR technology,

it became possible to form multiple copies of DNA in a short time (Michaeli, 2018).

DNA profiling has emerged as the most effective method in criminal investigation. It was found to be very well received and accepted by many scientists in the detection of crime due to its accuracy and high efficiency compared to other methods of analysis (Michael, 2021).

Conclusion

Security and biodefense is rising as a vigorous showcase for novel applications. The prime of the bio-warfare specialists depends on the monetary, specialized and financial capabilities of the state or organization. Vital avoidance respites on building a solid widespread standard that rejects improvement of such weapons. Auxiliary avoidance recommends early location and expedient treatment of illness. The therapeutic community plays a vital part in auxiliary avoidance by taking interest in illness examination and detailing, hence giving the primary sign of biological weapon utilization . In addition, continued research to improve investigation and the search for improved diagnostic capabilities such as biosensors will further strengthen secondary prevention measures. The new biosensor technology has important advantages when compared to the traditional detection methods. Biosensors for the recognition and quantification of biological weapons signify an assembly of rational tools that have planned significance when counter measures are planned.

Recommendation

Government should provide biosensors to security personnel in order to reduce the risk of losing personnel during battle .

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