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ENHANCING NIGERIA'S SECURITY CAPACITY THROUGH BIOTECHNOLOGY

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Abstract

The race by developed Nations to enhance their security capacities in recent times calls for careful and deliberate actions by other third world countries. No less thanks to the ongoing war between Russia and Ukraine. It seems bigger Nations are suddenly becoming bullies due to their perceived superior military might. Since everything is fair and square in war, all kinds of weapons including bioweapons are now been deployed in order to subdue opponents. Apart from these developed Nations who are constantly developing their defense capacity, rogue states and terrorist organizations are also exploring novel methods of creating weapons of mass destruction. The intentional release of traditional or combinatorial bioweapons remains one of the most important challenges that will continue to shape national and global security in the nearest future. Therefore, in order to use biotechnology for medical intelligence, forensic operations, bio-threat awareness, and mitigation, attention has to be redirected towards the development of molecular techniques in boosting our security system. This article is an attempt to highlight some of these benefits and challenges that field of biotechnology confronts in terms of biodefence. Issues related to the analysis of pathogen genomes and emerging methods and knowledge management and their impact on intelligence, forensics, biosecurity, and policymaking will also be discussed. The essence of the essay is a wake-up call to our authorities on the need to develop their local capacity via the instruments of science and technology especially biotechnology in order to ensure the security of our country.

Keywords: ***Security, Biotechnology, Molecular Techniques, Bioweapons, Nigeria***

Introduction

Security remains every nation's top priority especially with the current on-going conflict between Russia and Ukraine. It behoves on any country to know that after the first and second world wars, novel weapons are continuously been developed in anticipation of a possible third world war. Chemical and nuclear weapons were used in the previous wars but with developments in Biotechnology, it is generally envisaged that any full-scale global conflagration might lead to deployment of biological weapons. This is because biotechnology is rapidly developing with enormous potentials in bioweapon production [1]. Let us examine a few of these areas in order to appreciate the application of biotechnology to military power now and in the nearest future. The human genome project since its completion defines the microcosm of life sciences and lifts medical

research to new levels. Revealing genetic structure and structure function relationship of most organisms has deepened our understanding of how to control and change a human being's battle effectiveness. Bioinformatics which is the study of gene and protein molecules using information technology is gradually expanding to other domains. In a nutshell, a knowledge of the genome of pathogenic organism can help Scientists to mass produce them in the laboratory as war heads or simple lethal ammunitions which can be utilized in any war situation. With proteomics, we can develop new cells or tissues especially in the battle field that will improve healing of wounded soldiers or even develop bio protective wears like bullet proofs against explosives. The application of biotechnology in bolstering military might of any nation is endless if such potentials are fully explored [2]. The goal of this review is to enlightened our leaders to know that military biotechnology especially in terms of defence should not be ignored now that threats of terrorism is on the rise globally. Rogue organizations and bigger nations might like to bully unprepared or smaller nations with such weapons in time to come. Therefore, the earlier we deploy our attention to such research, the safer and better for our country.

Bio Attack: Real or Potential

Though biological weapons are under ban from a number of United Nations conventions, quiet a number of terrorist organizations and dissident countries are in a rat race to acquire them. So, their full-scale use whether legally or otherwise is only a matter of time. No nation of the world is capable of ensuring total security of its citizens against a biological attack especially when contagious agents are involved. Closely related to other naturally occurring outbreaks, the harm caused by bio agents in bioweapons are terribly incredible. This is because they are highly mobile, microscopic, and capable of crossing borders unnoticed placing all countries at risk. The consequences whether in form of diseases or waves of panic can quickly spread in a tightly connected world [3]. In the face of these perceived and real threat, there is need for a global system of surveillance and response in order to make the world safer especially sub-Saharan Africa. The United Nation is leading efforts toward making countries understand the need for synergy and collaboration for a quick response in events of bioterrorist onslaught anywhere in the world. Also, the World Health Organization (WHO) has a network of collaborating laboratories and institutes with experts to tackle any emergency that might likely arise due to natural or man-made epidemics [4]. In addition, standards are set for alert and surveillance, verification, communications, and coordination of all activities connected to outbreaks of diseases across the globe. It must be emphasized here that a global system operating in real time facilitate swift and responsible counter measures by making sure that laboratories and public health facilities are kept sharp due to the uncertainties associated with disease outbreaks. The call is for every stakeholder involved with emergency response to be alive to their responsibilities as outbreaks of infectious diseases are on the rise daily. Any planned programme should be targeted at providing mechanisms for sharing expertise and experience among nations. Such a global system will also ensure that reports of outbreaks of both natural and artificial pandemics and epidemics are rapidly communicated around the world for proper vigilance. Diseases emanating from a bioterrorist attack may be mistaken at the onset with those that might be of natural causes thereby evading response until great damages must have occurred. This is why investigation of any kind of suspicion should be given all the seriousness it deserves. Rumour verification, authenticating genuine complains from the public,

and providing help in a politically neutral atmosphere enhances quick response and frank reporting. This also makes sure that a network of highly skilled first responders are deployed to contain the challenge especially in countries lacking capacity [5]. How then is our country prepared to counter some of these obvious security threat considering our military capacity? The answer is better left in our individual imagination.

Bio-Warfare and Bioterrorism

Warfare in this twenty first century is assuming different dimensions due to so many factors. In fact, war will no longer be conventional as nations keep inventing novel and more potent weapons. One of the strategies is the use of biological agents to annihilate enemies and this type of warfare is known as bio-warfare. Bio-warfare is actually not a recent development as history has shown that armies have used it at different times and dispensations right from when Nations started getting involved in wars. In 300 BC for example, the Greeks, Romans, and Persians contaminated their enemy's water supply with dead animal carcasses as a war strategy. Though they may not have known that out of these decaying corpses were very deadly microbes, they did not know however that whoever consumed such contaminated water is most likely to die or contract a disease [6]. Going forward to 400 BC, the Scythian archers coated their arrow heads in decomposing dead bodies before shooting their enemies. The history of bioterrorism is inter twined with that of bio-warfare as the application of bioweapons was predominantly characterized by the weaponization of pathogens for sabotage in different societies at different time in history. Bioterrorism covers a large spectrum of concerns from catastrophic terrorism with mass causalities to micro events using low technology but producing civil unrest, disruption, disease, disabilities and deaths [7]. The aim of bioterrorism is not only to cause mortality and morbidity, but to also lead to social and political breakdown. It is a threat that has come to stay in the current century and is gradually evolving from mere speculation to real danger. Terrorism in any guise is bad but worse of it all is bioterrorism because the mode of action of bio agents is not easily detected. Transmission is less cumbersome but the effect is far reaching. The success of any biological attack is often calculated by the extent of fear coming from the event whereby psychological and political disruption is more pronounced than the direct lethal effect of the agent used. The threat of biological warfare seems remote to most industrialized and developing nations. However, the threat of bioterrorism, in which biological agents are used by extremists as weapons against civilian populations, is a matter of concern. Nations and dissident groups exist that have both the motivation and access to skills to selectively cultivate some of the most dangerous pathogens and to deploy them as agents in acts of terrorism or bio-warfare. Although a bioterrorist attack is difficult to predict, the consequences of a successful attack could be devastating and cannot be imagined. Bioterrorism and its effects can impose heavy demands on the public health care system which will be called upon to handle the consequences. An effective public health care system with strong disease surveillance, rapid epidemiological and laboratory investigation, efficient medical management, information, education and communication (IEC) will be required to counter any act of covert or overt bioterrorist attack [8].

Recent Advances

As researchers continue to transition from the era of DNA sequencing into the era of DNA synthesis, it may soon become feasible to synthesize any virus whose DNA sequence is known. This was first demonstrated in 2001 when Dr. Eckard Wimmer re-created the poliovirus and again in 2005 when Dr. Jeffrey Taubenberger and Terrence Tumpey re-created the 1918 influenza virus. The progress of DNA synthesis technology will also allow for the creation of novel pathogens. According to biological warfare expert, Dr Steven Block, genetically engineered pathogens "could be made safer to handle, easier to distribute, capable of ethnic specificity, or be made to cause higher mortality rates". The growing accessibility of DNA synthesis capabilities, computational power and information means that a growing number of people will have the capacity to produce bioweapons soon if international regulations are not put in place. Scientists have been able to transform the four letters of DNA—A (adenine), C (cytosine), G (guanine), and T (thymine)—into the ones and zeroes of binary code. This transformation makes genetic engineering a matter of electronic manipulation, which decreases the cost of the technique [9]. According to former US Secretary of State Hillary Clinton, "the emerging gene synthesis industry is making genetic material more widely available. A crude but effective terrorist weapon can be made using a small sample of any number of widely available pathogens, inexpensive equipment, and college-level chemistry and biology." [9].

Enhancing National Biodefense Capacity Through Biotechnology

Strong public health and biodefense research is essential for the prevention, detection, and management of biological threats and infectious diseases. Over the last century, the focus of biodefense research has shifted in response to modern advances in biotechnology. Specifically, a biological revolution is underway, generating promising new gene editing and synthetic biology technologies that may transform modern medicine, but also present a threat to public health if misappropriated. As biotechnology becomes increasingly globalized, it is important that we establish new strategies and tools for infectious disease detection and surveillance that will help us protect against bioterrorism and manage disease outbreaks or help us to enhance our bio-warfare capacity. Rapid advances in next-generation sequencing (NGS) technologies have helped advance biodefense research by enabling the development of new methods for identifying and characterizing pathogens. Amplification and sequencing of the 16S rRNA gene allow for high-throughput detection of prokaryotic communities, while shotgun metagenomic sequencing approaches capture the composition and functional potential of multi-domain populations. Metagenomic analyses used for pathogen detection and identification are often time sensitive. The results help inform high-stakes decision-making, such as choosing an appropriate medical treatment, deciding if a food product should be recalled due to contamination, or determining if an area should be shut down due to a suspected act of bioterrorism. In addition, geospatial and temporal metagenomic analyses are essential for tracking the dynamic responses of microbial populations to changes in environmental or human health. However, improvements in precision, sensitivity, speed, cost, and accuracy of NGS and downstream analyses are necessary for effective utilization in biodefense research [10]. Other molecular techniques necessary for military biotechnology are further discussed below:

i. Human Genome Literacy

As scientific research continues to reveal the functions of specific genes and how genetic components affect disease in humans, vaccines and drugs can be designed to combat particular pathogens based on analysis of their particular molecular effect on the human cell.

ii. Immune System Enhancement

In addition to enabling more effective drug development, human genome literacy allows for a better understanding of the immune system. Thus, genetic engineering can be used to enhance human immune response to pathogens.

iii. Viral and Bacterial Genome Literacy

Decoding the genomes of viruses and bacteria will lead to molecular explanations behind virulence and drug resistance. With this information, bacteria can be engineered to produce bio-regulators against pathogens. For example, Xoma Corporation has patented a bactericidal/permeability-increasing (BPI) protein, made from genes inserted into bacterial DNA, which reverses the resistance characteristic of particular bacteria against some popular antibiotics.

iv. Efficient Bio-Agent Detection and Identification Equipment

Because the capability of comparing genomes using DNA assays has already been acquired, such technology may be developed to identify pathogens using information from bacterial and viral genomes. Such a detector could be used to identify the composition of bioweapons based on their genomes, reducing present-day delays in resultant treatment and/or preventive measures.

v. New Vaccines

Current scientific research projects involve genetic manipulation of viruses to create vaccines that provide immunity against multiple diseases with single treatment regimen.

vi. New Antibiotics and Antiviral Drugs

Currently, antibiotic drugs target DNA synthesis, protein synthesis, and cell-wall synthesis processes in bacterial cells. With an increased understanding of microbial genomes, other proteins essential to bacterial viability can be targeted to create new classes of antibiotics. Eventually, broad-spectrum, rather than protein-specific, anti-microbial drugs may be developed.

Techniques to Enhance Efficacy of Bioweapons

Scientists and genetic engineers are considering several techniques to increase the efficacy of pathogens in warfare. Some of them are explained below:

a. Binary Biological Weapons

This technique involves inserting plasmids, small bacterial DNA fragments into the DNA of other bacteria in order to increase virulence or other pathogenic properties within the host bacteria.

b. Designer Genes

According to the European Bioinformatics Institute, as of December 2012, scientists had sequenced the genomes of 3139 viruses, 1016 plasmids, and 2167 bacteria, some of which are published on the internet and are therefore accessible to the public. With complete genomes available and the aforementioned advances in gene synthesis, scientists will soon be able to design pathogens by creating synthetic genes, synthetic viruses, and possibly entirely new organisms.

c. Gene Therapy

Gene therapy involves repairing or replacing a gene of an organism permanently changing its genetic composition. By replacing existing genes with harmful genes, this technique can be used to manufacture bioweapons.

d. Stealth Viruses

Stealth viruses are viral infections that enter cells and remain dormant for an extended amount of time until triggered externally to cause disease. In the context of warfare, these viruses could be spread to a large population, and activation could either be delayed or used as a threat for blackmail or domination.

e. Host-Swapping Diseases

Much like the naturally occurring West Nile and Ebola viruses, animal viruses could potentially be genetically modified and developed to infect humans as a potent bio-warfare agents.

f. Designer Diseases

Biotechnology may be used to manipulate cellular mechanisms to cause disease. For example, an agent could be designed to induce cells to multiply uncontrollably, as in cancer, or to initiate apoptosis, programmed cell death.

g. Personalized Bioweapons

In coming years, it may be conceivable to design a pathogen that targets a specific person’s genome. This agent may spread through populations showing minimal or no symptoms, yet it would be fatal to the intended target on the long run. In addition to creating bioweapons, the emerging tools of genetic knowledge and biological technology may be used as a means of defence against these weapons in the event of war or bioterrorist attack.

Future Of Warfare

As a result of the exponential increase in computational power combined with accessibility to genetic information and biological tools to the general public and lack of governmental regulations in many parts of the globe, concerns are raised about threats of bio attack arising from outside the military. The US government has cited the efforts of terrorist networks, such as al Qaida, to recruit scientists capable of creating bioweapons as a national security concern and "has urged countries to be more open about their efforts to clamp down on the threat of bioweapons". "There are those who say: 'the First World War was chemical; the Second World War was nuclear; and that the Third World War – God forbid – will be biological'. As such no nation should be caught napping any longer.

Biotechnology especially genetic engineering will be very attractive to individuals or groups in producing genetically destructive pathogens due to their simplicity, cost, and easy to manipulate characteristics. The field of biotechnology is indeed rapidly growing in every ramification making textbooks becoming obsolete even before they are published. Knowing what is out in the public domain and the ease of getting the material, equipment, and recipes could be an incentive to those groups or individuals who want to maliciously develop their own bioweapons [11]. The "gene" is no more a boxed or mythical phenomenon but a carefully studied substance. The quick rate at which biotechnology has opened new findings in the world of genetic engineering via the human genome project shows that every kind of organism can now be re-created. These stunning revelations have led to research into the characteristics and causes of diseases through a consortium of scientists around the world whose aim is to discover the more complex attributes of human genomes. The knowledge and the capability to generate new strains of organisms are here to stay and man's imagination is the only limit.

Conclusion

Let it be known that military technology is not exportable even if it seems so. This simply means that every sovereign must look inward to develop its indigenous technology when it comes to military hardware. Biotechnology, with its dual-use nature, could be among the most inspiring life-giving discoveries of the 21st century, but it could also become the world's most lethal weapon if used negatively. The threat from genetically engineered pathogens will continue to dominate the future of biological warfare. It has been historically documented that conventional biological weapons have been used overtly and covertly. Hence, rogue nations, groups, and individual actors, given the opportunity to use these highly lethal bioweapons, will likely mount an attack to fight off the great powers or to dominate regional enemies. Their threatened use can also be helpful in deterring attacks by rivals. Conventional biological weapons, as deadly as they are, might be nothing compared to the lethal effects of genetically engineered pathogens as biological warfare agents. Nigeria should not and other developing countries should begin to commit resources into research in these areas without further ado.

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