

Bioterrorism: The Role of Genetics and Molecular Biology

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ABSTRACT

Science and technology can replace the ideology adopted to achieve human progress and prosperity. Development of bioterrorism is related to the development of genetic science and the development of biotechnology nowadays. One of the uses of biological agents as a tool of terror is the use of microbes that can be adapted into stealth viral vector which causes a variety of dangerous diseases for humans. Therefore, early awareness is needed about this case. Without the understanding and awareness of the community and the active role of the parties involved in dealing with the effects of bioterrorism, it will threaten national security such as security, public health and the economy.

Keywords: bioterrorism, genetics, molecular biology

INTRODUCTION

Background in science can be used for good and destructive purpose. In the hands of irresponsible scientists, science can be used to make effective weapons systems. The widespread misuse of science in this decade, especially in the field of life sciences (biology) because of its high effectiveness. Therefore, biological weapons as microbes or microbial products, in the last years of this century are often used as a means of terrorism that hit various countries, including Indonesia.

Bioterrorism means the use of microbes as a means of terrorism. Wars involving biological weapons/microbes are called germ warfare or biological warfare (Nester *et al.*, 2007; Tortora *et al.*, 2007). Bioterrorism which can be used not only microbes but also microbial products. As a target, not only humans, but also animals and plants. Biological warfare agents can be natural or genetically modified. Genetic modification of microorganisms is common and is worrisome if the technique is misused, as the progress in cell and molecular biology

technology has opened new and dangerous possibilities (Roffey *et al.*, 2002).

Biological weapons are often referred to as the nuclear weapons of the poor. The costs and technology needed to make biological weapons are much lower and easier than nuclear or chemical weapons. Even so, the effect of mass destruction is no less great than the two weapons. Unlike nuclear weapons, biological weapons have many types. Because biological weapons using biological agents such as viruses, bacteria, and fungi are likely to increase with the emergence of various new fatal infectious diseases such as Ebola virus, Lassa virus and others. However, the right agent has been used as a biological weapon is a bacteria that has long been known to humans, easily obtained in nature and not difficult to handle.

On the other hand, hence the pathogenic microbes have been known for a long time, the treatment also has been found with various antibiotics and prevention can be done by vaccination. However, biological weapons with agents that have been engineered are far more frightening because

they are resistant to antibiotics, deadly and stable in culture. This character is usually caused by a single gene collection, so it is easily transferred from one type of bacteria to another. This biological weapon can only be developed by several countries that have sophisticated microbiology laboratories.

According to the Centers for Disease Control and Prevention (CDC), Bioterrorism is classified into 3 parts, namely:

- Group A (High Risk): Biological agents that have a very high risk that can cause dangerous conditions in state security. The characteristics of diseases caused by this class of microbes are contagious, high mortality, and can cause great social unrest. E.g. *Bacillus anthracis* and smallpox virus.
- Group B (Moderate Risk): Biological agents in group B have a high risk even though the scale is lower than group A. E.g. Salmonella and encephalitis virus.
- Group C (Low Risk): Biological agents in group C have a low risk. Biological agents can be engineered to be disseminated in the future, because they are easy to obtain, easy to produce, easy to spread and have the potential to have adverse effects on health that cause high morbidity and mortality. E.g. *Mycobacterium tuberculosis* are resistant to various (multidrug-resistant) antibiotics and influenza viruses.

There are a great variety of biological agents that could potentially be used for biological warfare (Boyer, 2006). The ideal microbe for bioterrorism has very reliable characteristics, can be targeted precisely at the target, cheap, durable, not visible, efficacious, easily obtained, and easily transportable (Lederberg, 2000; Lew, 2000). Reliability and efficacy means having the effect that terrorists expect. Cheap and easy to obtain means affordable prices and can be

obtained through illegal channels. Four microbes for bioterrorism commonly used are *Bacillus anthracis*, *Clostridium botulinum*, *Yersinia pestis*, and smallpox virus (Nester *et al.*, 2007). There are still many other microbes that can be used as biological weapons even though the frequency of their use is less. These microbes are the Ebola virus, influenza virus, Lassa Fever Virus, Salmonella, *Mycobacterium tuberculosis* and the causes of encephalitis virus (Bauman *et al.* (2007), Cinti & Hanna (2007), and Goering *et al.* (2008).

Case

The history of bioterrorism has actually been hundreds of years old. Tartar forces were the first group to use bioterrorism in 1346. Tartar forces throw pes patients behind the opponent's defense line. This begins with well water pollution that uses dead human or animal bodies to prevent enemies from getting fresh drinking water. When the city could not be taken, the attackers threw the bodies of their soldiers who died of plague on the city walls. In this way, the epidemic begins which then spreads through people with devastating effects. The next group was British troops in America in 1736, German troops in World War I, Rajneeshees (a religious sect in the United States) in 1984, and Aum Shinrikyo (a religious sect in Japan) in 1995. The Dai Nippon army dropped tubes containing fleas and *Yersinia pestis* on the Chinese mainland during the China-Japan War (1937-1945). Rajneeshees contaminate food in restaurants and supermarkets with *Salmonella enterica* (Cinti and Hanna, 2007; Tortora *et al.*, 2007). Bioterrorism attacks were also reported in the United States in 1984. At that time, a Buddhist sect spread salmonella bacteria that were put into food to prosecutors, doctors and dentists to seize control of local government.

According to Vermont Department of Health, it was stated that in 1972 an

international agreement had been agreed to prohibit the use of biological weapons and was signed by 140 countries. Even so, there are still violations committed in secret by several countries. It is believed that up to now it is still secretly continuing to carry out research on the development of biological weapons with certain objectives, for example, to invade other countries (Farida, 2009).

The bioterrorism has become a warm topic of discussion since the attack on the Twin Towers of the World Trade Center. According to the calculation of the Office of Technology Assessment at the American Congress in 1993, 100 kg of *Bacillus anthracis* spores distributed over the capital of Washington could cause 3 million victims. In fact, the spread of similar bacteria from the Russian biological weapons manufacturing plant in the city of Yekaterinburg on April 2-3, 1979 has claimed the lives of 'tens of thousands of people' in the surrounding area according to the Union for Chemical Safety report, even though the government's official report was only 66 people (Graeves, 1999).

The spread of H5N1, H7N9 virus and the Middle East Respiratory Syndrome Corona Virus (Mers-Cov) in 2012 was also associated with bioterrorism which caused many patients to die.

In Indonesia, according to Professor of Faculty of Biochemistry and Biomolecular Sciences, Universitas Airlangga, Prof. Dr. drh. Chairul Anwar Nidom MS, non-natural facts that reinforce the notion that there is bioterrorism in Indonesia, including Avian Influenza that has occurred since 2003 but until 2015 or 12 years later, it has not been resolved, including the 2009 swine flu which is also unnatural in structure. Likewise, the avian influenza virus that attacked the ducks in 2012, was not the same as the previous avian influenza virus and there are similarities with similar viruses in China.

Global conspiracy theorists mention bioterrorism as a threat, although until now scientists have found no evidence of the use of biological weapons in the epidemic.

The Bioterrorism Threat

Bioterrorism is an international scale threat that must be anticipated by every country, including Indonesia. Even though Indonesia may not be considered as a target country, it still has to anticipate the follow-up effects that might occur due to the accidental taking of a biological agent by someone from another place.

According to terrorism observer Ridlwan Habib, the threat of bioterrorism should be watched out even though it has not been seen clearly. Without adequate readiness, in addition to security disturbances, Indonesia can experience serious mass health problems both in humans, animals and the environment, which will also result in severe economic impacts.

The threat of bioterrorism can also be caused by the ease of obtaining biological substances, especially those provided by terrorist sponsor countries that can have such substances as potential sources of obtaining biological materials for terror groups. The use of relatively sophisticated technology by terrorists is not only able to prove the involvement of the state in the attack, but terrorist groups can also be very difficult to be controlled and may be able to turn around using the technology provided against the sponsoring state itself. Another possible source of obtaining biological substances for warfare is buying or stealing from laboratories that are related to government-level biological weapons programs. The existence of information technology and the internet makes the skills needed to provide biological substances more widely (Erviyanto, 2012).

In Indonesia there may be no cases of attacks using biological weapons that kill

people in bulk, but there are indications of bioterrorism in agriculture and animal husbandry. One popular case that is thought to be the result of bioterrorism activities is the case of the spread of the avian influenza virus in Indonesia, which had caused the economy to plummet due to the decline in poultry product sales. Also the entry of a number of types of grains and animals from abroad illegally, which may contain seeds of animal and plant diseases that can endemic in Indonesia.

This can be seen from the case of the entry of various types of seeds through Juanda International Airport, Indonesia and the delivery service (Juanda Mail Processing Center/JMPC) in Sidoarjo without being equipped with quarantine documents. During the period of August-December 2017, approximately 41 detentions were carried out. Detention can be carried out on coordination and good cooperation between the Balai Besar Karantina Pertanian (BBKP) Surabaya, Bea Cukai and JMPC. The seeds are dominated by food crops (Rice, Corn, and Soy), Ornamental Plants (*Nepenthes* sp./Semar Bags, Sunflower Seeds, Ginseng seeds, etc.), and Fruits (Durian, Orange and Watermelon). These commodities are brought/shipped from Malaysia, China, Singapore, India, Canada, Hong Kong, Korea, and so on. While the material originating from the animal that is crossed consists of 67 kg of Peacock feathers from Malaysia, 30 kg of Goose Feather and 25 kg of pork. Based on the risks, the plant seeds are a high risk, so if they are already planted and contain diseases, it will be difficult to be controlled. Destruction was carried out by burning and stockpiled at the Animal Quarantine Installation (IKH) in Surabaya.

The findings of Chinese bioterrorism attacks on Indonesia became more evident, following the successful seizure of 16 kilograms of rice seeds from three Chinese men at Soekarno Hatta Airport on October,

2017. These seeds were secured because they wanted to be brought into Indonesian territory without going through procedures. However, after a laboratory test by the Agriculture Quarantine Center (BBKP) of Soekarno-Hatta Airport, as much as 16 kilograms of illegal Chinese rice seeds contained harmful bacterial viruses. The seeds are found in a suitcase packed in a tin. The bacteria contained in rice seeds are considered harmful to Indonesian agriculture such as *Dickeya Chrysanthemi*. The perpetrators deliberately put the rice seeds into a suitcase that had been packed in six cans, to trick the officers into an unclear appearance on X-rays (Sulaiman, 2017).

Knowledge and Attitude regarding Bioterrorism

The plaque that infect in Indonesia must be examined not only in terms of public health, but from various aspects that can threaten national resilience, namely the ability and resilience of the Indonesian people in maintaining their existence to carry out their lives according to their ideals and images that include Astra Gatra geography, demography, natural resources, ideological, political, economic, social and military power (Wijanarni, 2007).

Indonesia needs to take the first steps to prepare and save time if the plaque such as avian influenza virus recur, such as securing targets that might be objects of attack, identifying indicators early, building biological expertise and analyzing community disease pathogens and veterinarians. Early anticipation of plaque as a potential threat of bioterrorism is very important, given that biological weapons that are openly or clandestinely can have a negative impact on various aspects of life and will disrupt the sovereignty of the Indonesian Nation (Nidom, 2015).

To prevent the possibility of using or conducting bioterrorism in Indonesia, the

government need to be done (Ervianto, 2012), including:

1. Collect data on researchers and companies engaged in chemistry and biology.
2. Providing high incentives to nuclear, chemical and biological experts so that they cannot be easily collected by foreign agents or countries.
3. It is not easy to give research permits to foreign researchers, especially those who research related to biological and chemical problems.
4. Collaborate with other countries and intelligence agencies to share information and developments regarding the possibility of a nuclear terrorist attack or terrorist bioterrorism.
5. Conduct training and evacuation of the community in the event of a bioterrorism attack

Scientists as a profession have an important role and are obliged to develop science and technology that is beneficial to humans and minimize damage to the environment and to others.

Genetic and Molecular Biology Role

Rapid developments in molecular biology, genetics and genomics are undoubtedly creating a variety of environmental, ethical, political and social challenges for advanced societies. But they also have severe implications for international peace and security because they open up tremendous avenues for the creation of new biological weapons (Aken and Hammond, 2003). Genetics and molecular biology are knowledge related to bioterrorism processes. Even Microsoft Founder Bill Gates told the Munich Security Conference that genetic engineering could be a terrorist weapon derived from computer synthetic viruses and could kill tens of millions of people. Innovation, cooperation

and careful planning can dramatically reduce the risk by each of these threats.

The World Organization for Animal Health (OIE) has indicated that 60% of pathogenic microbes in humans come from zoonotic microbes. It can transmit from animals to humans and the other way around; 75% of new diseases in humans in the world come from zoonotic microbes and 80% of microbes used as bioterrorist activity agents come from zoonotic microbes (Vallat, 2011). The problematic human disease cannot be solved alone without understanding that human health issues are interrelated with animal health and the surrounding environment. Around 70% of human and animal disease-causing bacteria have not been identified properly. Therefore, genetics and molecular biology as one of the fastest growing sciences lately is required to play a role in diagnosing, preventing and controlling various threats to disease in humans.

The need for the development of Genetics and Molecular Biology is very important in terms of identifying bacteria, viruses, fungi and other pathogenic microbes that are problems in public health and which can cause harm in the field of agro-economics. Genetic engineering technology also provides a new dimension to produce unlimited products. Application of these technologies can modify the biological functions of an organism by adding or engineering genes in the organism and by finding markers of bioterrorism activities and most importantly prepare vaccines as a comprehensive biodefense.

CONCLUSION

In conclusion, it can be said that the threat of abuse of biological agents is in sight. Domestically, the government, especially at the front guard level, has begun to deal with the threat seriously. Now is the time for academics to start thinking about it.

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