

Bioterrorism and easy access to biotechnology and its inputs

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Resumo

Os fundamentalismos surgiram no Ocidente a partir de questões religiosas e posteriormente difundiram-se para outras partes do mundo tomando outras conotações, principalmente políticas. As técnicas de manipulação genética difundiram-se pelas universidades, que formam mestres e doutores com os conhecimentos básicos sobre clonagem gênica, que se tornou de domínio público. Todos os insumos para clonagem gênica podem ser adquiridos por meio de catálogos via internet. Podem-se recrutar profissionais fanáticos e com a competência para a manipulação genética de organismos patogênicos, lado perverso da biotecnologia. Os conflitos étnicos, culturais e religiosos estão associados a um cenário de contrastes entre os países ricos e carentes de matéria-prima e aqueles pobres, mas detentores de insumos básicos e energia, e atingem a sua forma mais aguda nos fundamentalismos. Grupos de fanáticos têm pleno acesso a essa biotecnologia. Estariam assim as populações civis vulneráveis aos ataques do bioterrorismo com armas biológicas geneticamente modificadas?

Palavras-chave: Clonagem molecular. DNA recombinante. Armas biológicas. Guerra biológica. Risco. Bioterrorismo. Engenharia genética.

Resumen

El bioterrorismo y la facilidad de acceso a la biotecnología y sus insumos

Los fundamentalismos surgieron en el occidente basado en cuestiones religiosas y posteriormente se difundió para otras partes del mundo, tomando otras connotaciones, sobre todo políticas. Las técnicas de manipulación genética han propagado por las universidades, que forman másteres y doctores con los conocimientos básicos acerca de la clonación genética que se hizo dominio público. Todos los insumos para la clonación genética pueden ser adquiridos a través de catálogos a través de internet. Se pueden reclutar profesionales competentes para la manipulación genética de organismos patogénicos, lado perverso de la biotecnología. Los conflictos étnicos, culturales y religiosos están asociados a un escenario de contrastes entre los países ricos y carentes de materia prima y los países pobres poseedores de insumos básicos y energía, alcanzando su forma más aguda en el fundamentalismo. Grupos de fanáticos tienen total acceso a esa biotecnología. ¿Estarían, de esa forma las poblaciones civiles vulnerables a los ataques del bioterrorismo con armas biológicas genéticamente modificadas?

Palabras-clave: Clonación molecular. ADN recombinante. Armas biológicas. Guerra biológica. Riesgo. Bioterrorismo. Ingeniería genética.

Abstract

Bioterrorism and easy access to biotechnology and its inputs

Fundamentalism arose in the West based in religious matters and afterward diffused to other parts of the world with other connotations, especially political. Genetic manipulation techniques spread to universities, which has given masters and doctors the basic knowledge on gene cloning, which has become public domain. All inputs for gene cloning may be obtained through online catalogs. Fanatic professionals may be recruited, with qualification for genetic manipulation of pathogenic organisms, the negative side of biotechnology. Ethnic, cultural and religious conflicts are linked to a series of contrasts between countries that are rich but with a lack of raw materials and the poor countries that possess basic input and energy sources, when it reaches the highest fundamentalist form. Fanatic groups have complete access to this biotechnology. Are civilian populations in vulnerable to bioterrorist attacks involving genetically modified biological weapons?

Key words: Cloning, molecular. DNA, recombinant. Biological warfare agents. Biological warfare. Risk. Bioterrorism. Genetic engineering.

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For the purposes of the present study, the fundamentalisms are originated from the most conservative currents of Protestantism which was developed in the United States of America (USA) between 1870 and 1925. The fundamentalist Protestants were radically contrary to the modernization of Christianity. The Iranian revolution and the emergence of Al-Qaeda showed that fundamentalism has a transnational and transcultural character, becoming a global phenomenon ¹.

The term fundamentalism has emerged with journalists from the beginning of the 1970s, when they referred to Christian Protestants and the radical Muslim who defend the social conservatism through mobilization and radicalization of political and cultural traditionalism and religious inflexibility ². The modernization of society with urbanization makes emerge the cultural and religious pluralism, which can be seen as an erosion of the religious identity and able to create threats to the institutions and secular behaviors. According to Riesebrodt ³, there are no answers to understand how these movements come up, why they are coming up and which their meaning for the future of society is. It is in fundamentalist religions which emerge the extremist groups, which are responsible for violence and conflicts incited to mark position and presence.

According to Leonardo Boff ⁴, fundamentalism is not only associated to religious issues. All the systems – cultural, political, economic and artistic – which are shown as exclusive holders of a truth and carriers of a unique solution to the problems should be considered as fundamentalists. Currently, we live under a fierce empire of several fundamentalisms. The fundamentalism is understood as the radicalization of the truth in which each group call themselves as the exclusive holder of such truth and they rely in a state of economic or political power, in order to impose it to the others. The religions teach to their adepts that they are the chosen ones and the others who do not belong to the group are against them. There is no surprise in this subject, as we know the origin of most part of the religions in cults originated from tribal and violent societies ⁵.

The social nature of human beings can be attributed to the beginnings of human life by the fossil evidences of the hunters and collectors from African savannahs. Only by associating to groups our ancestors could slaughter a big hunt and eat meat. With this, they enriched their diets, which was an important step regarding the evolutionary progress of the species. When we are associated to groups, the

possibilities of achieving individual goals are more successful.

Since this primordial era, there already was the division of labor, according to the individual abilities. The main achievements of humanity were made under the coalition of individuals with specific abilities. As an example, it is possible to mention coalitions among individuals who are physically weaker, but with intelligence to build utensils, with those ones of great physical force, but without such abilities. Together, they supplied the deficiencies of each other and both were successful in the fight for survival. So, no matter how modern and technological our society is, the tribalization is still rooted in our instincts ⁵. In view of this, the nationalisms, borders, internal and external groups, and, consequently, the conflicts are still resistant. All this would be the consequence of our genetic and evolutionary heritage of the apes which live in flocks and form coalitions. The threat of the external enemy contributes to increase the cohesion of the group, because there is safety in the quantity of individuals ⁵.

The background for bioterrorism

The expansion of humanity was such that, nowadays, we live in a global city and the borders and nationalisms take a new meaning. The geographical expansion and the demographic growth increased drastically the demand for consumer goods – which, in turn, has focused on the energy demand. As a consequence, the demand for food and more lands have also increased. It is in this context that genomic biotechnology is inserted, by bringing the perspective of the increase of food and energy production for the humanity and the perspective of new and more efficient therapies for illnesses as cancer and neurological diseases, among others.

Genomic biotechnology was born in the West, in an academic way, and then it was explored by biotechnological industry. The mark of this process was the creation of the company Genentech, in 1976, in the USA. Nowadays, the Market counts on more than 2,500 products biotechnologically developed and properly protected by patents, which are present in daily life in a more or less known way by the population.

The possibility of increasing drastically the food production, finding new cures and, mainly, making exorbitant profit in the market with the products developed were factors which encour-

aged the genomic biotechnology. As a consequence, this knowledge was spread to all universities and research institutions. Any student with a master's or doctoral degree in molecular biology or genetics can identify isolate, clone and multiply a gene.

If dissemination of knowledge meets the aim of granting to all humanity the access to new technologies potentially benign, we cannot forget that, currently, any former postgraduate student of these areas can be recruited by a fundamentalist group to perform these techniques with spurious goals. Genes which encode toxins can be synthesized in laboratories and then inserted into bacterial plasmids. In addition, it is also possible to insert other resistance genes to antibiotics and take to the fermenter to produce large quantities. As a final product of this process, there is a highly resistant pathogenic organism, which can be easily transported to any location within a small flask.

The inputs to clone a gene are available on internet and they can be purchased by catalog. These inputs range from equipment, such as a machine to synthesize copies of genes and a machine to amplify DNA segments (thermocycler), electrophoresis equipment, apparel for DNA microinjection, and others, as well as all reagents needed to perform cloning, such as restriction enzymes, primers for DNA synthesis, as defined in the methodology of this article. The ease of access to these inputs makes bioterrorism an almost palpable possibility.

Thinking under the perspective of fundamentalist groups, the advantages to adopt this military method are several. The detection of facilities for the production of biological weapons by using satellites is difficult, since it does not require a large apparatus. In addition, perhaps the most important reason, the artifacts can be easily transported and disseminated; they can be transmitted person to person; they cause high mortality and panic in the population; they lead to social disruption; they are difficult to take preventive actions and they can destabilize governments, making them more attractive to fanatic terrorist groups. It is possible to build a biological instrument of mass destruction much cheaper than an atomic bomb and equally efficient.

Currently, large multinational companies patent genes and clone processes related to food and medicine production –essential inputs to humanity. Such processes have the safeguard of international institutions which are above the power of states and the needs of population. The industrialized nations are the largest holders of these patents, because they precisely house the headquarters of these

companies, which reinforces the maintenance of state of the art.

However, even this apparent control is not able to prevent that marginalized groups to this process have access to such biotechnology and implement cloning processes. The genetic code is universal, i.e., the same for the vast majority of beings, and gene transfer technologies are in the public domain. Thus, the genes to be cloned and amplified, and the goals of this technology can be as varied as possible, including those ones preached by fundamentalist groups. The production of pathogenic virus as a biological weapon is far more complex and expensive than pathogenic bacteria, which are easy to be obtained and multiplied, because viruses are more unstable and more difficult to spread in the environment.

Thus, this study aims to contextualize genomic biotechnology in the scenario of designing biological weapons. The purpose of determining what would be needed to produce biological weapons and the level of difficulty of this process, with the view that obtaining and dominating knowledge on the genetic manipulation of pathogenic microorganisms has escaped from the control of the State were also sought. This survey is considered important so that academy, international institutions and governments may think about this possibility, which every day seems closer to the instance of probabilities. At the same time that fundamentalism currents are disseminated both the East and the West, societies become vulnerable to this type of biological risk. The greatest example of this was the episodes of contamination by anthrax in the USA after the attack on the Twin Towers – a fact also attributed to the terrorist network Al-Qaeda.

Method

The method to collect data which supported these reflections consisted of two basic procedures: 1) search in literature all inputs needed for the construction of recombinant bacteria, such as reagents and equipment; 2) search in the internet companies which sell these supplies and equipment and the availability immediate delivery to any address, even if the purchase is made by an individual.

The literature search used the following sources: 1) the survey on the Internet was made from the keywords gene cloning, genetic manipulation, genetic engineering, recombinant DNA, molecular genetics, molecular biology, genetically modified

organisms, enzymes restriction; 2) websites were searched from the best known search engine: Google. The process of research has been undertaken for six months (July to December 2011), and the findings were extensively cataloged and then used as substrate to the author's considerations.

Results

Equipment

Biofermenter: has the ability of producing bacteria in large scale. It is easy to acquire and operate. **Equipment for a laboratory of molecular biology and microbiology:** glasshouses, acetic chambers, microscopes, centrifuges, water bath, thermal cycler, electrophoresis tanks, electrophoresis power, DNA micro-injector;

Reagents: Bacterial culture medium, kits of antibodies, DNA, restriction enzymes, salts for the preparation of the buffer solution for the electrophoresis, pigments for electrophoresis gels, reagents for purification and DNA elution. Inputs for amplification reaction of DNA segments, called as PCR (Polymerase Chain Reaction), which requires the enzyme Taq polymerase, adenine, cytosine, and guanine thymine-dinucleoside triphosphates, specific primers (reaction initiators), kits for DNA eluting of the bands of electrophoresis gel and DNA purification kits;

Creation of recombinant DNA: (inputs) restriction enzymes which cut DNA in programmed sequences, DNA ligase enzymes, DNA polymerase, polynucleotide kinase. Selection of the best plasmids to serve as a vector for gene into the bacterium;

Cellular transformation: electroporation is a technique used to make cell competent, i.e., to ease entry of plasmids which are on the outside, making them penetrate the bacterial cell and to be incorporated into the genome of the bacterium.

Input and equipment providers

All inputs were mentioned were researched on web pages by searching for companies which are providers of these reagents and laboratory equipment. Both in Brazil and in other countries, they are always available for shipment by express delivery companies. Thus, the acquisition is an impersonal process, since there is no contact between the supplier and the group which will perform gene cloning. The first contact with the companies which sell such equipment and inputs is through a quote request.

No matter which country is, the values of these materials are anchored in U.S. dollars. The inputs can range from \$ 900 for a kit PCR reaction, \$ 10,000 in thermal cycler, to \$ 40,000 in an equipment of DNA microinjection. By taking into account all the supplies and equipment, with \$ 350,000 it is possible to set up a laboratory with the basic items to clone genes. Furthermore, it is possible to obtain gene cloning manuals for free on the internet. It should be noted, moreover, that the prices of equipment and reagents are perfectly accessible to terrorist/fundamentalist groups.

Research and control on the conditions of availability of genes which produce the most dangerous toxins to the man

The most known genes and biological agents with potential of usage in bioterrorism are under monitoring and control of Center for Disease Control (CDC-USA), which has a database about the main types of bacteria and toxins which can be used in bioterrorism, as well as the antidotes and procedures to be adopted in case of attack, since USA are one of the most wanted targets of this type of action.

Genes and agents which are likely to be used in cloning for bioterrorism 6

Virus: equine encephalitis, ebola, yellow fever, equine morbillivirus, smallpox, hemorrhagic fever;

Bacteria: *Bacillus anthracis*, *Brucella*, *Clostridium botulinum*, *Franciella tularensis*;

Toxins: aflatoxin, botulinum toxin, clostridium toxin, ricin, saxitoxin, enterotoxic *Staphylococcus*, tetrodotoxin, micotoxin T-2.

Discussion on the origins of risks

In a time based on ethnical and religious conflicts, of disputes for market reserves and for ideological hegemony, the fundamentalist groups may use genomic biotechnology as a tool in favor of their cause.

From the principle of any gene can be cloned in any organism, and that all the inputs to carry out this process are widely available, the construction of genetically modified organisms to be used as tools (weapons) of this or that cause (fundamentalism), is no longer likely to happen, in fact.

So, the "construction" of highly pathogenic bacteria, of infectious fungi and new agricultural

pests by fundamentalist factions may endanger all the humanity, since we are a planetary population, with a very dynamic flux of people and products. All the current conflicts are resulted from economic, religious and ethnical issues, as well as the disputes for the hegemony on essential resources for humanity. In this context, the genomic biotechnology emerges as an additional instrument which fundamentalist groups can use.

The consequences of the dissemination of pathogenic and genetically modified organisms are unpredictable, because microbes do not know cultures, languages, territories and/or geopolitical borders. Due to the ease of transportation and flow of people, no matter which the place of origin of contamination is, the impact becomes international. By taking into account that, in this framework, the speed of transmission of infectious pathologies increased in a unforgettable way in the 20th century, due to the improving of means of transport – air and inland means –, a fact which provides the pandemic dissemination of diseases. In addition, the popularization of the use of these means makes the epidemic control much more difficult, and sometimes, very slow.

So, by taking into consideration all these factors, it is essential to question: which is – in fact – our vulnerability in front of fanatic groups which acquire the domain of genetic manipulation technology? For all these reasons, it is possible to say that we started to live with this risk, because this study allows noting that inputs and equipment for the production of biological weapons are of are very easy acquisition and the knowledge for their production is largely disseminated. Bioterrorism will not be used in battlefields in war time, as happened with the chemical weapons (war gases) in the Second World War, but it will terrorize civil population and subjugate governments.

However, the known dissemination methods restricted, and relatively successful indoors, to contaminate foods, attack iconic corporations in their countries or destroy plantations. The widest disseminations of pathogenic and genetically modified micro-organisms require pulverizations in aerosol, demanding the use of more sophisticated equipment and it is a barrier to terrorist groups 8.

Those ones who use bioviolence for attacks are more organized and more focused on their purposes than the institutions of the responsible countries to safeguard their citizens. For this reason, the strategies to prevent bioviolence require international actions which demand many diplomatic efforts, and

most countries do not have such articulations. The underestimation of the real danger of bioviolence leads the countries to adopt wrong measures, both of prevention as of contingency 8. In parallel, the genomic sequence techniques of bacteria and virus have become faster and more efficient. Thus, the genomes of all pathogenic micro-organisms, which may affect man, domestic animals and agricultural plantations, have already been sequenced. The PCR technique is very fast and sensitive, and it is an efficient method of forensic investigation to trace such organisms. Results of genetic analysis of micro-organisms with this technique may respond in less than 24 hours 9. In the world, the United States are the best structured country for anti-bioterrorism. Through the database of “genetic signatures” of pathogens in CDC, there are conditions of an almost immediate 6.

Still, it is important to highlight that when a biological agent is disseminated initially in a silent and gradual way. Only after the recording of many cases, with the same symptoms of the infection, the responsible authorities will take the appropriate measures. In addition, in many cases, depending on the policy of the State, the international organs will not take long to be called due to the fear of the government of many countries which are interfered by the international control organs.

such as World Health Organization (WHO), or by the hegemonic powers. Thus, the control and the search for a solution will tend to be more retarded, increasing even more the vulnerability of the human beings all over the planet.

Final considerations

The information found in this study, which are related to the ease of inputs and equipment acquisition, the lack of control of this process, as well as the dissemination of knowledge on the production technique, allow inferring that there are reasons to take into account that bioterrorism risk is upcoming and worrying. The relations of the industrialized nations with the other countries and cultures establish a state of vulnerability, in which such countries are explored and their population and culture are subjugated. The vulnerable ones are explored in their riches, oppressed in their culture and their rights to citizenship are denied.


So, bioterrorism could be the instrument by which these vulnerable peoples or groups could respond to the oppression. Given the increasing

economic hiatus and power amongst individuals, groups and population all over the planet, which was maximized by globalization, it is not an absurd

to imagine that such situation may happen. And, in front of this verge, it is essential to stimulate the ethical reflection.

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