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GENETICALLY MODIFIED BAKTERIA VS. AIDS

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Preface

Our Motivation

Genetic engineering was at first an overwhelming topic for us. We have learned a few things in class but could not really see its significance in greater context. Searching for a suitable topic we realized that we both were interested in diseases caused by genetic inheritance and in ways to fight diseases by modified genes. After a little research we came across AIDS. This topic inspired us immediately and we faced the following questions:

Is there a way to fight HIV with genetically modified bacteria?

If yes, how does it work? If no, are there alternative methods?

What are the ethical aspects of it?

AIDS is one of the most tragic diseases worldwide. At the end of 2013 there were 35 million people living with AIDS. We chose this topic because we think it is our duty to combat this virus with the technology that we have even if AIDS is more common in the developing countries.

Introduction

Genetic engineering is a part of modern biotechnology which deals with the modifications of genes in general. The first experiments using this method were made in the USA in 1973. It is used to isolate genes from a cell and analyse the information stored in them. Using this technology, genes can be inserted into, removed from the genotype of a living organism or be modified. Therefore we can produce microorganisms, plants and animals with specific characteristics.

General Information and History of the HIV-Virus (AIDS)

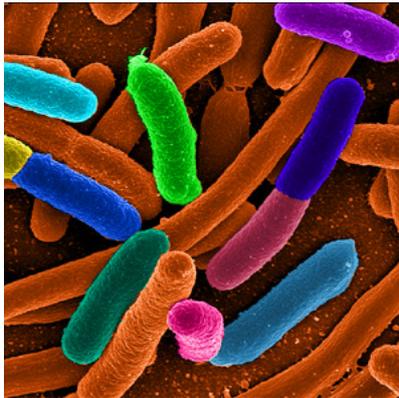


Fig.1 E.Coli

AIDS is caused by the **Human Immunodeficiency Virus (HIV)**, which originated in non-human primates in Sub-Saharan Africa. While various sub-groups of the virus acquired human infectivity at different times, the global pandemic had its origin in the emergence of one specific strain – HIV-1 subgroup M – in Léopoldville in the Belgian Congo (now Kinshasa in the Democratic Republic of the Congo) in the 1920s.

Two types of HIV exist: HIV-1 and HIV-2. HIV-1 is more virulent, is more easily transmitted and is the cause of the vast majority of HIV infections globally. Especially homosexuals and drug addicted people are more likely to pick up the virus, because they do not protect themselves the way they should (unprotected sex, repeated use of injection needles)

In our paper we are concerned with the question if there is a possibility to fight the HIV virus with the help of genetically modified bacteria. We found a paper where scientists of the US National Academy of Sciences used genetically modified bacteria living in the human body to produce chemicals. These chemicals should stop new infections. But they are not able to cure already infected people. Nevertheless, the research is still at an early stage and they hope it could lead them to a practical and cost effective way to fight the HIV virus.

Alternative methods to prevent HIV infection are microbicide creams and gels that can be applied to the genitals. The problem there is, that people have to grease their genitals always before they have sex. Obviously this is not very practical. Another more simple way to prevent HIV infection is the use of a condom.

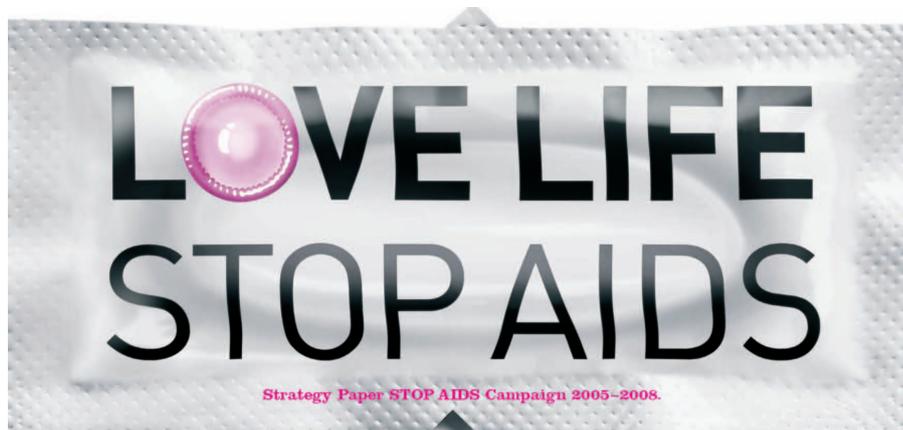


Fig. 2 Swiss HIV prevention campaign

Description of the Engineering Technique

Genetic engineering is a branch of biotechnology. In 1973 in USA the first experiments using genetic engineering were made. This method is used to isolate genes from a cell and observe the information stored in them. With genetic engineering, genes can be inserted into or removed from the genotype of a living organism. Using this we can also modify genes. In this way it is possible to produce microorganisms, for example plants with a specific gene from a bacteria in it.

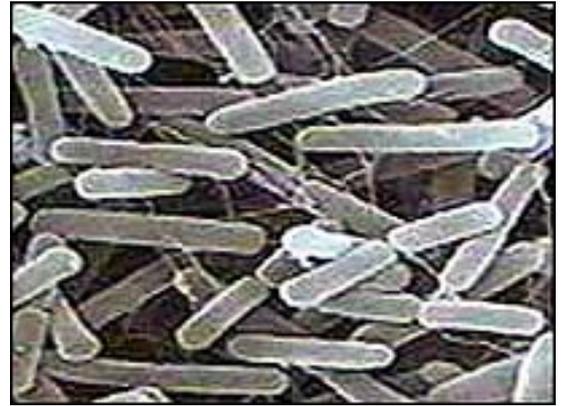


Fig. 3 genetically modified E.Coli

The infection with the virus occurs on the surface of the gut and reproductive areas which are normally coated with a layer of bacteria. For the research the scientists modified one specific type of E. Coli (one of these bacteria which are part of the layer) so that it began to separate proteins which can block HIV from infecting its target cells.

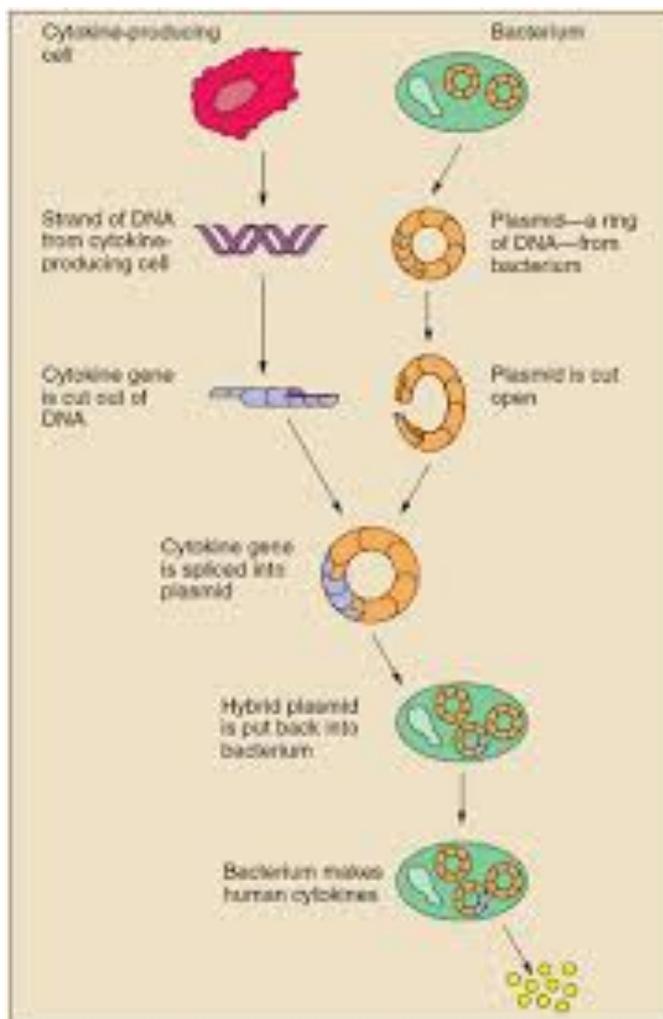


Fig. 4 Simple model

Interview



Prof. Dr. Karin J. Metzner, M.D.

She works at the University Hospital in Zurich in the Division of Infectious Diseases and Hospital Epidemiology.

She gladly agreed to response to our following questions.

Fig. 5 Prof. Dr. Karin J. Metzner, M.D.

Questions:

1. Do you think that the spreading of HIV could be stopped or at least reduced by the help of using genetically modified bacteria (E.Coli)?

The concept itself is very good and it would be a very easy method if we could manage to control it. But there were only few studies made yet and also none of them has been successful.

2. What are (better) alternative methods?

Early recognising and therapies of as much people as possible are other methods. In my opinion this is the most promising way to reduce the spreading of HIV.

3. What part plays the HIV-prevention?

We thought that prevention is the best alternative method, but unfortunately HIV-prevention does not earn such a huge success as we hoped.

4. For Swiss patients a HIV positive diagnosis is no longer an obligatory death sentence. But what are the main concerns for Swiss patients suffering from HIV?

A HIV- diagnosis is always accompanied by great psychotic stress. People think about their health, the money that they have to spend for very expensive therapies, also if there might be resulting sicknesses and what the effects of long-lasting medical treatments are. And of course family is a big concern. Because it is a huge challenge to accept HIV for the patient itself but also for the family members.

Discussion

The global HIV/AIDS spread continues to grow at an enormous rate. There are now more than 40 million people infected with HIV and most of them will die in the next 10 years. Last year there were 5 million new infections. Most HIV transmission worldwide is through unprotected sex. Also unprotected anal sex is another high-risk activity that is also practiced globally by both homosexual and heterosexual individuals. Ingestion of HIV-containing breast milk by children is another common way of infection.

Attempts to slow the spread of HIV by behavioural measures have had little success, and no widely available biomedical intervention is available.

A new approach is therefore urgently needed. The new method of using genetically modified bacteria sounds very promising. Clearly the advantages would be huge if the product would stop the infection of the HIV virus completely for anybody without any risks. We think also that the ethical aspects of this method are justifiable.

But lots of researches, clinical tests and checks have to be done before this technique can be actually used by people. And yet it is unclear whether and especially what consequences could appear.

The scientists of the US National Academy of Sciences believe that the method could be adapted to deliver bacteria secreting different proteins to different parts of the body.

Although originally designed to prevent new HIV infections, they believe it could also be used, in combination with drug therapy, to treat people already carrying the virus.

Dr. Tim Farley, of the World Health Organization, said: *"In principle a technique such as this which enhances the body's defences against HIV sounds like a great idea. Clearly there are many steps to be completed in the development and clinical testing of the product, and there may be special safety concerns over unexpected side effects due to deliberately colonising the gastrointestinal tract with genetically engineered bacteria."*

Lisa Power, of the Terrence Higgins Trust said: *"This research is promising and is based on a clever idea, using naturally occurring bacteria to improve resistance to transmission.*

"However, we are a very long way off its practical use in humans, and until then, condoms are the best defence we have against HIV and most other sexually transmitted infections."

Summary

After first starting troubles we found an interesting topic. But even then we were not clear about what would lie ahead of us. As AIDS is one of the worst and well-known diseases we started our research about that. We first started to find out what genetic engineering is and what techniques there exist. After that we wrote down our general questions and things we would like to know and then chose our questions to prepare our paper.

Before knowing how to combat AIDS we first had to know more facts about AIDS, so that we can really understand what we can change to improve the situation. We then came to a point where some of our questions were not satisfied. So we searched for someone who has more knowledge of our topic and we were able to find Prof. Dr. Metzner and asked her some questions. Now we had all our information to write our paper.

Through our paper we learned much more about AIDS itself and the significance of AIDS prevention and combating. We realized that scientists are on a good way to fight AIDS with genetic engineering methods but we also had to learn that it needs time to do more research and to confirm the results and side effects.

While we were writing our paper we more and more realized how real and important our topic is and how many people's life it would save when a successful product is finally on the market. So we both hope that scientists will do their best against AIDS and that there will be a day when AIDS is curable.

Last but not least we would like to thank Mr. Ruggle who gave us the chance to learn many new things about this very interesting topic and of course we want to thank Mrs. Metzner for her support.

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