Promises of DNA-based Vaccines in Improving Vaccination Supply in the Developing World

TECNOLÓGICO DE MONTERREY®

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INTRODUCTION.

Addressing health issues and preventing the proliferation of diseases has become the centerpiece of government programs to improve quality of life and reduce health-related costs since prevention is always cheaper than treatment. However, granting worldwide access to vaccines is a complicated process. Vaccine production worldwide is undertaken by a relatively small number of companies mainly located in developed countries. For new vaccines, the initial research approaches to the final licensing stages may take up to 15 years with associated costs in the order of $100 and $300 million. Because of the consequent high prices, the availability of new vaccines in most cases may be initially exclusive to people in developed countries.

Based on recent experience with the A/H1N1/2009 influenza virus pandemic, it is now clear that worldwide vaccine production capacity may be insufficient to cover global demand. With this in mind, it is of great importance to design and establish easy-to-implement and cost-effective vaccine production facilities around the world to aid developing countries in covering, at least partially, their own vaccination needs. Fortunately in this context, the development of DNA-based vaccines may provide a solution to address some of these issues even though the technology is still an emerging one.

CLASSIFICATION OF VACCINES.

Vaccines for viral diseases can be classified into three main groups or generations: live avirulent, killed or subunit viral vaccines (first generation), recombinant vaccines (second generation) and DNA vaccines (third generation), each with their own advantages and disadvantages. Immunoprophyilaxis with inactivated viruses is still the most common approach to preventing viral infections. However, several vaccine production companies around the world are starting to produce fractionated or viral subunit vaccines in wild type or genetically modified organisms and a great number of prototypes are still in the stage of research and development. **Figure 1** presents the main characteristics of each of the vaccine generations.

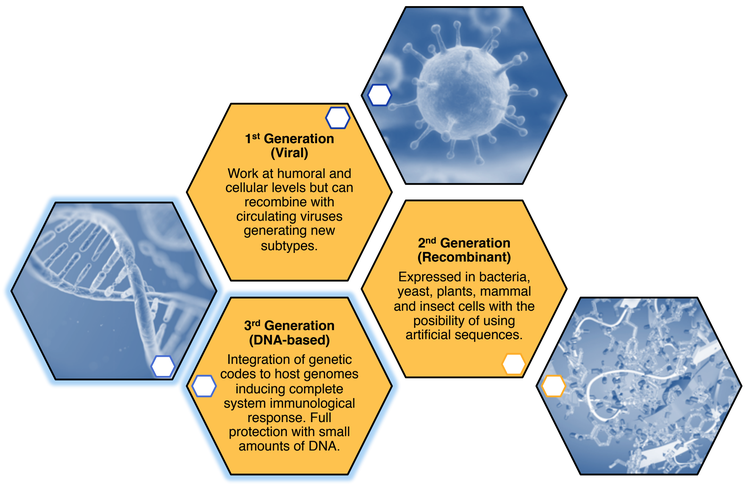

Figure 1. Description of the main characteristics of the three identified generations of vaccines with the main advantages and disadvantages of each class.

CURRENT CHALLENGES AND OPPORTUNITIES.

Time and productivity restrictions in vaccine production are derived from the necessity of generating and propagating viral stocks. Additionally, all approved vaccine formulations require appropriate facilities with strict quality control levels and biosafety measures that need considerable investments making them scarce and limiting vaccine supply. DNA vaccine production should involve much simpler and standardized processing strategies since these molecules possess the exact same characteristics regardless of the sequence being produced. Fermentation processes could be easily substituted with the now available advantages granted by PCR including massive and affordable production trains. **Figure 2** schematizes and compares, from an economical and processing point of view, the different kinds of vaccines previously discussed relative to the estimated hazards involved in handling them.

It should be noted that with 3rd generation vaccines, production and investment costs would be greatly reduced opening the possibility of having more production facilities around the world, which would shorten the time needed for vaccines to reach developing countries. This would also strengthen the possibility to address region-specific diseases. Furthermore, it will also increase production velocity response during pandemic contingencies.

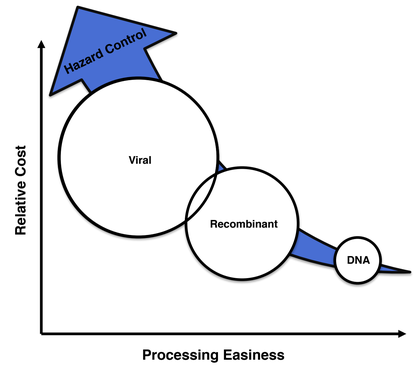

Figure 2. Cost and ease of processing comparison of first generation (viral), second generation (recombinant) and third generation (DNA) vaccines relative to the hazard control required for each one of them. As seen, DNA based vaccines stand out from other types of vaccines due to the simplicity of the molecule and the facilities to handle it.

CONCLUDING REMARKS.

- The introduction of DNA vaccines could present great benefits to those developing countries seeking to provide better health services to their citizens but the main restriction is still the lack of knowledge of the secondary effects that these vaccines could have on humans.
- It is believed that great advances will be made in the following years with the enormous promises that this technology represents to healthcare.
- Great efforts should also be made in finding mechanisms in which the transfer of the intellectual property of DNA vaccine development and production between the owners and the interested governments, institutions and companies is simplified to guarantee access to people around the world regardless of the economical situation of the regions they live in.

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