mRNA VACCINES: A NEW ERA OF VACCINES

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INTRODUCTION

- mRNA is a ribonucleic acid that transfers the genetic code from DNA in the cell nucleus to a ribosome in the cytoplasm where translation takes place. mRNA vaccines work by introducing a fragment of mRNA into the host cell that corresponds to a viral protein, usually a small fragment of a protein found in the outer membrane of the virus. This mRNA is translated inside the cell, giving rise to the desired viral protein. The immune system then recognizes this protein and generates antibodies, which recognize these proteins as foreign, attach to them and mark them for destruction.

OBJECTIVES

The objectives of this literature review are:

- Review the structure of mRNA.
- See the mechanism of action of the mRNA vaccines.
- What are the forms of administration of the mRNA vaccine.
- Provide an overview of the development of mRNA vaccines against cancer and emerging animal and zoonotic diseases.

STRUCTURE

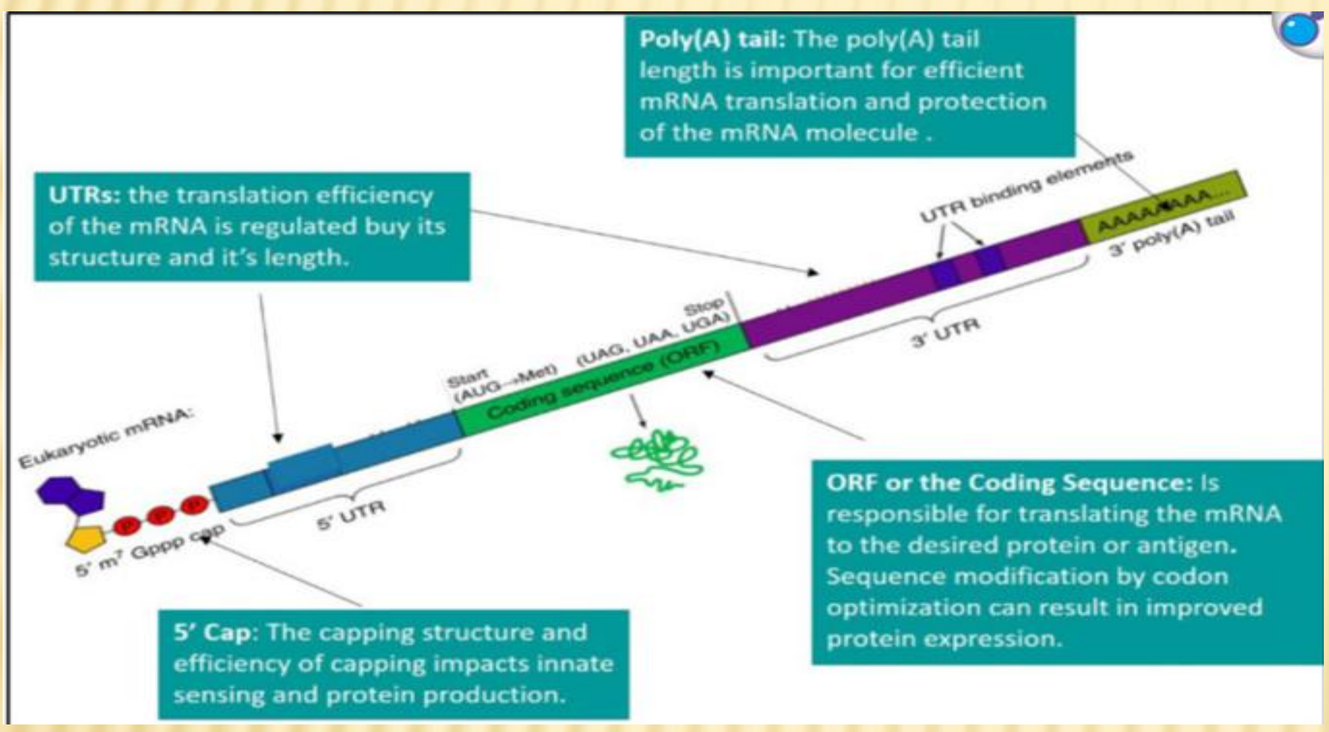

Figure 1: structure and functions of each region that makes up mRNA (Gote et al., 2023).

MECHANISM OF ACTION

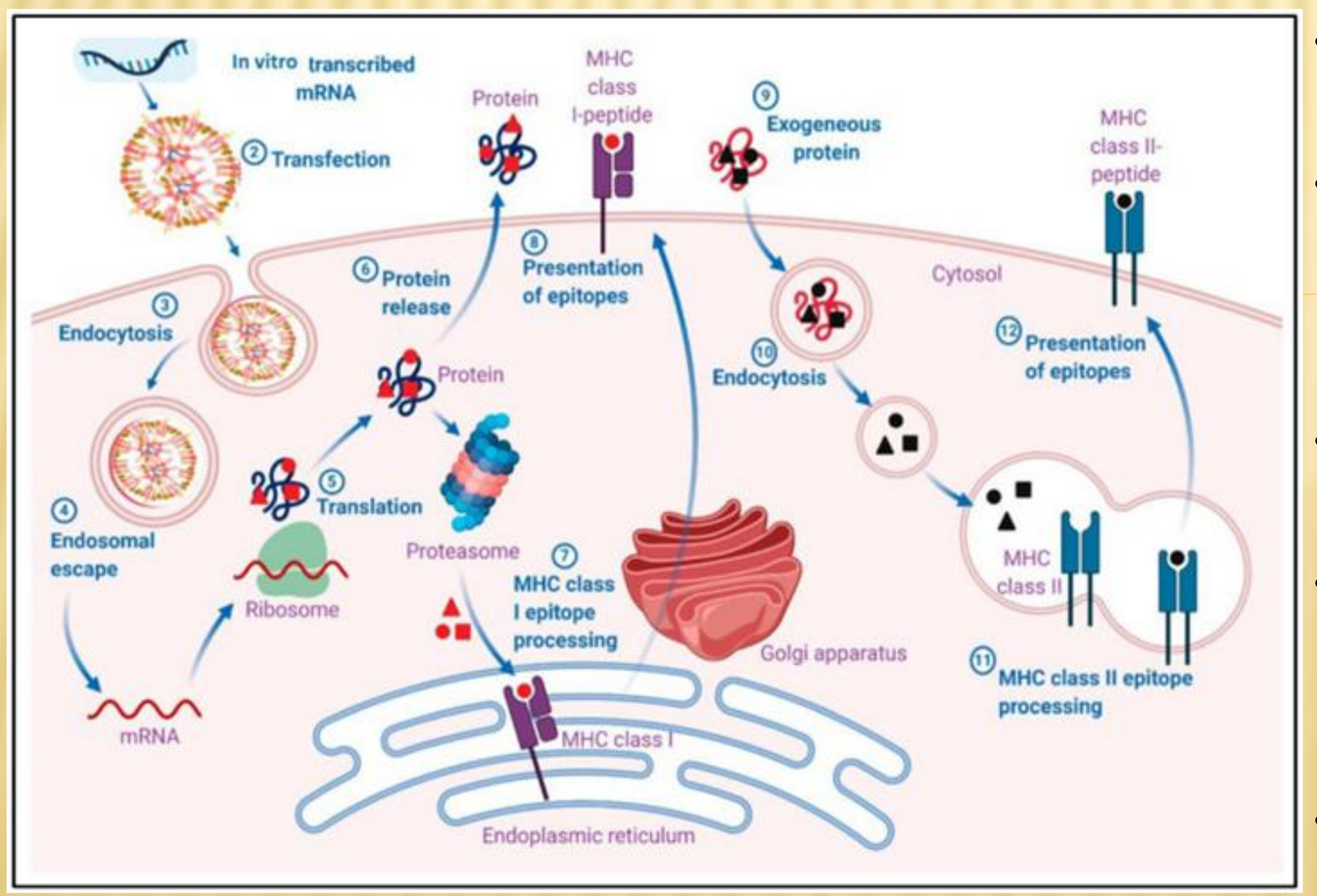

Figure 2: mechanism of action of mRNA once it has injected into the host (Gote et al., 2023).

FORMS OF ADMINISTRATION

Direct injection or physical delivery of naked mRNA
CD ex vivo charge delivery system
Administration system formulated with protamine
Polymer-based delivery system
Cationic lipid-based delivery system

mRNA VACCINES AGAINST CANCER

- The occurrence of tumors is closely related to the abnormality of the tumor immunological microenvironment.
- The therapeutic approach of immunotherapy is based on the modulation of the immune system to recognize and destroy cancer cells.
- These mRNA vaccines have become a potential option as a new effective tumor therapy due to: their short half-life, they are cheaper and the risk of integration of the genome sequence into the host is much lower and with this the possibility of genetic mutation.
- As shown at Figure 3, there are 4 different types of vaccines:

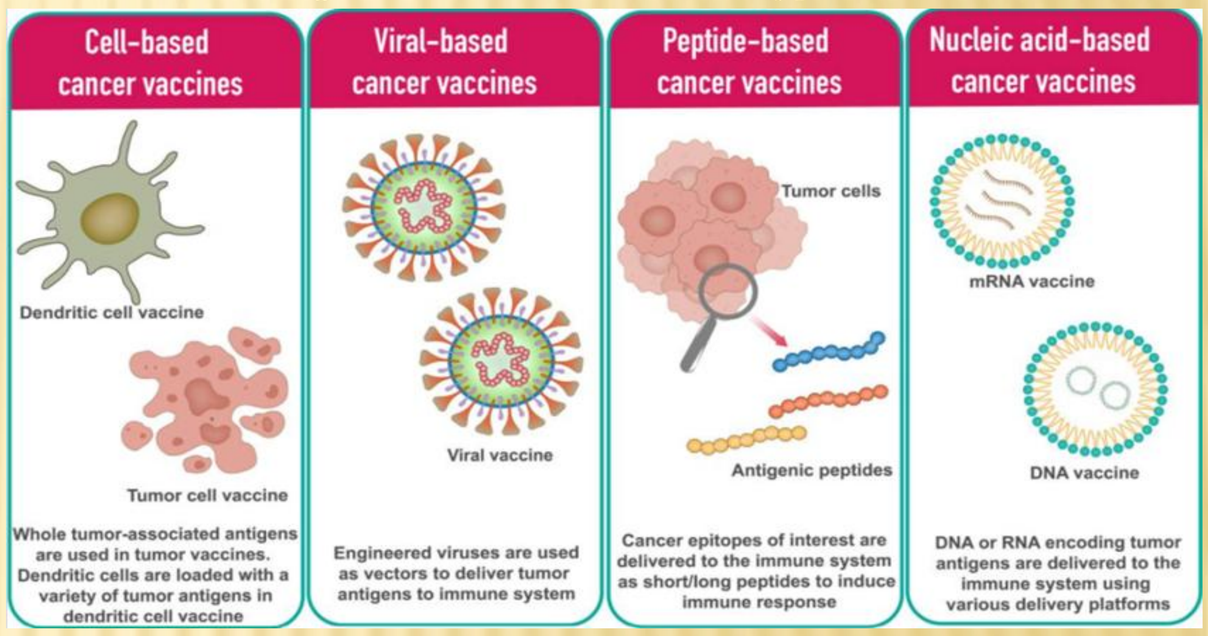

Figure 3: cancer vaccine platforms (Vishweshwaraiah & Dokholyan 2022).

mRNA VACCINES AGAINST EMERGING ANIMAL AND ZOONOTIC DISEASES.

- Currently, vaccines in the veterinary field are quite limited, but there are some examples such as: foot-and-mouth disease, rabies, influenza and vaccines against zoonotic flaviviruses transmitted by mosquitoes.
- These vaccines have the advantage of not having a risk of infection or reversion to virulence, they provide simultaneous immunizations against multiple pathogens and are quite easy to design.
- Although they have some drawbacks such as instability, the relatively high cost of their manufacture and current delivery limitations make the use of mRNA vaccines in the veterinary field difficult.

DISCUSSION

- As conclusions from this work, we can conclude that these vaccines have a wide range of advantages that make them very versatile and useful for different fields of medicine.
- This is due to the structure of mRNA, which despite its size and negative charge that complicates its ability to cross the lipid bilayer of the cell membrane, has made it possible to develop different techniques that modify the structure to improve the effectiveness of vaccines and solve the deficits that they present.
- We can also conclude that this technology seems to be a very promising tool to fight cancer and emerging animal and zoonotic diseases. Although there is still a lot of research ahead and many studies to be carried out, it seems that this is the right path to follow in the future.