MVSc Programme VMC-607
Lecture - 4

Vaccines

Dr. Pankaj Kumar
Assistant Professor
Veterinary Microbiology

Toxoid:

- Some bacteria – Pathogenic- because of exotoxins
- Treating them with 0.5 % ***formaldehyde*** - they retain their immunogenicity
- These formaldehyde treated exotoxins are called “Toxoid”.
- A number of toxoid vaccines are used in Veterinary. For eg: Tetanus toxoid vaccine
- (DPT in Human: An example of Toxoid vaccine)

Sub-unit vaccines:

- Sub-unit vaccines are made up of components of the virulent organism rather than whole virulent organism.

- Based on the fact that immune response generated against whole array of antigen from pathogen does not contribute equally in protection.

Sub-unit vaccines:

- Some of the antigenic components plays major role in inducing protection while others do not.
- Only those components of the pathogen that induces protective immune response instead of using whole organism.
- For example:- Antibody response generated against Haemagglutinin (H) and / or Neuraminidase (N) antigen of Influenza virus is protective.
- Sub-unit vaccines against Influenza virus – contains only H and N antigens.
- Principally, toxoid vaccines are also a type of subunit vaccine

Modern Vaccine Technology

- It is always a need to make vaccines more effective, cheaper and safer.

- Modern molecular biological techniques are used for the development of a number of new generation vaccines like:

a) Subunit vaccines,

b)Genetically attenuated organism as vaccines,

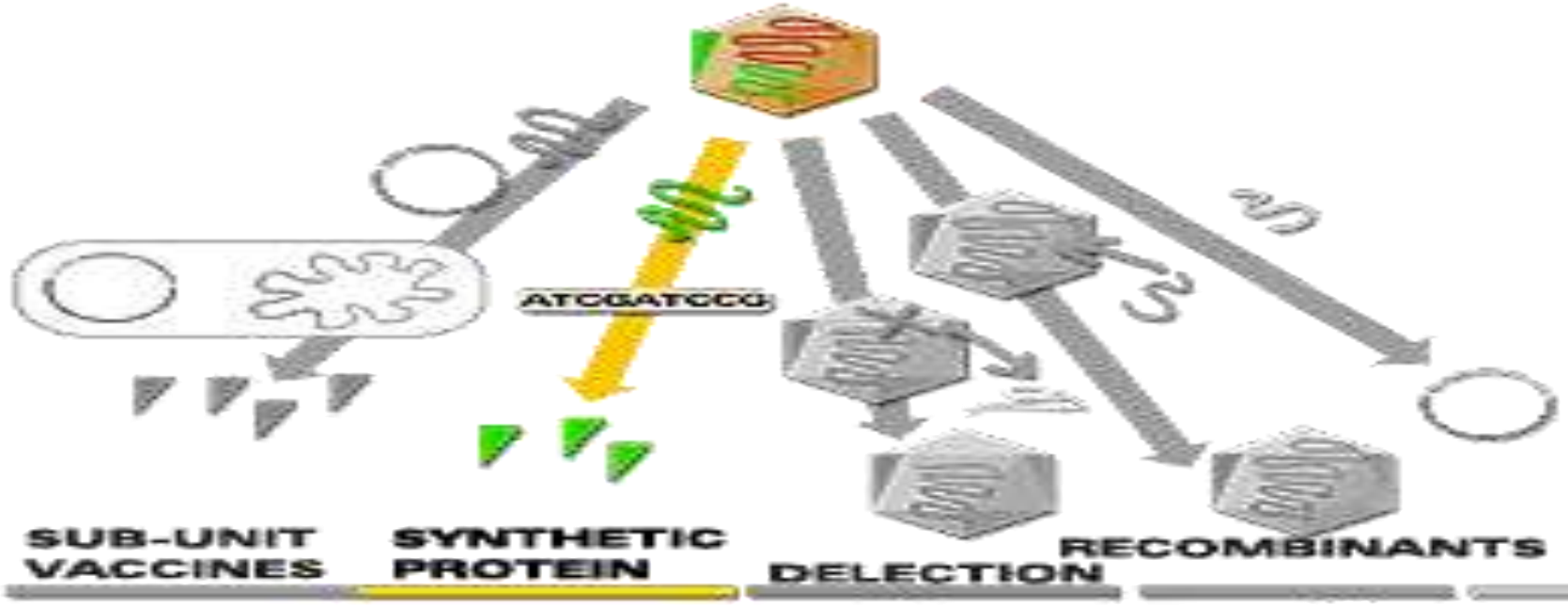
c) Live recombinant organisms as vaccines,

d) DNA vaccines

e) Marker vaccines

f) Edible vaccines

NEW GENERATION VACCINES



INACTIVATED PROTEINS

DELETED LIVE VACCINES

RECOMBINANT LIVE VACCINES

DNA VACCINES

Subunit vaccines:

- Cut any **“gene of interest”** from an organism and express that gene in another host.
- Eg:, the VP 1 gene of FMD virus was cut, cloned into a plasmid and inserted into bacterium *Escherichia coli.*
- This leads into the production of VP 1 protein in *E. coli.*
- The VP 1 protein was harvested, purified, adjuvanted and used for vaccination against FMD.

Genetically attenuated Organism:

- Using molecular techniques, it is possible to delete virulence gene of the organism.
- Virulence gene deleted organisms are capable of growth in the host but cannot produce disease.
- These virulence gene deleted organism are good in inducing efficacious immune response with no risk of reversal of virulence.

Genetically attenuated Organism:

- Pseudorabies virus (Herpesvirus) needs enzyme *thymidine kinase* for their replication in non dividing cells such as neuron

- *Thymidine kinase* deleted pseudorabies virus can infect nerve cells and thus induce protective immune response.

- However, they cannot replicate in neuron and thus compromises with the virulence of the virus

Live recombinant organism:

- Clone gene coding for protective antigen from one organism into another organism which is capable of growth in host.
- Such recombinant organisms, carrying gene of other pathogen, will express the antigen in host along with their own genes.
- A number of viruses like poxvirus, adenovirus, herpesvirus and bacteria like BCG, Salmonella were used for this purpose.
- These organisms can easily be administered through oral, nasal routes or by rubbing on skin.

Live recombinant organism:

- The advantages

  - Expression of protein antigen in the host,
  - its proper folding and
  - post translational modifications like glycosylations.

- *Vaccinia virus recombinant* which contains G protein of Rabies virus (antibodies against G protein neutralizes rabies virus)

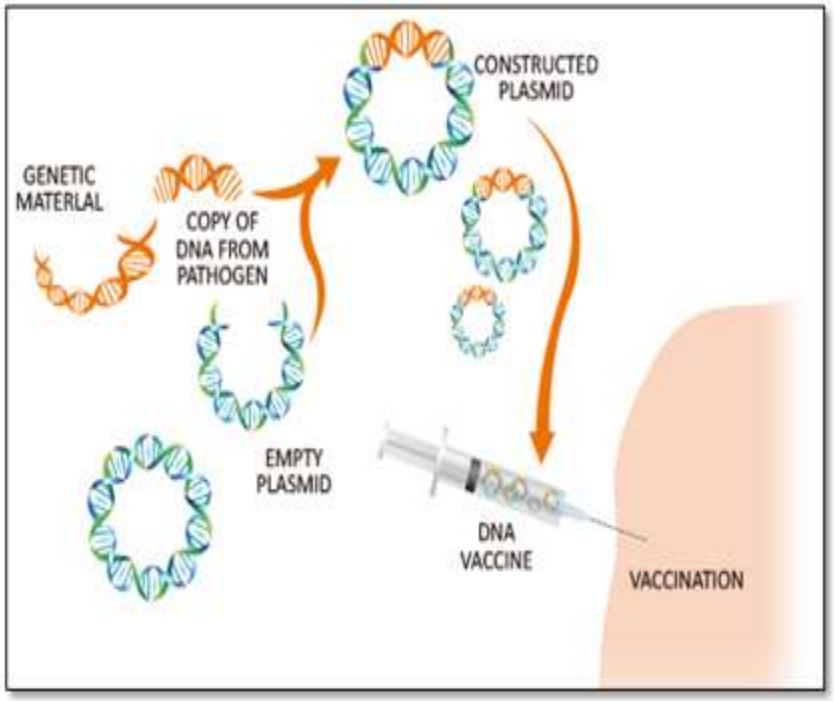
- This vaccine has been used widely for oral vaccination of wild animals in bait.

Live recombinant organism:

- Similarly, Newcastle disease virus gene is cloned in fowl pox virus.
- Recombinant vaccinia or capripox virus carrying Haemagglutinin (H) or Fusion (F) gene of RP was also developed.
- RP gene carrying recombinant capripoxvirus gives protection against both RP as well as lumpy skin disease.

DNA vaccine:

- *"Gene of Interest"* (gene coding for protective antigen)
- Cloned in plasmid vector under strong promoter
- Introduction of such plasmids directly into host tissue
- generate immune response against the gene of interest.
- These plasmids can be delivered into the host cells by various techniques.



DNA vaccine:

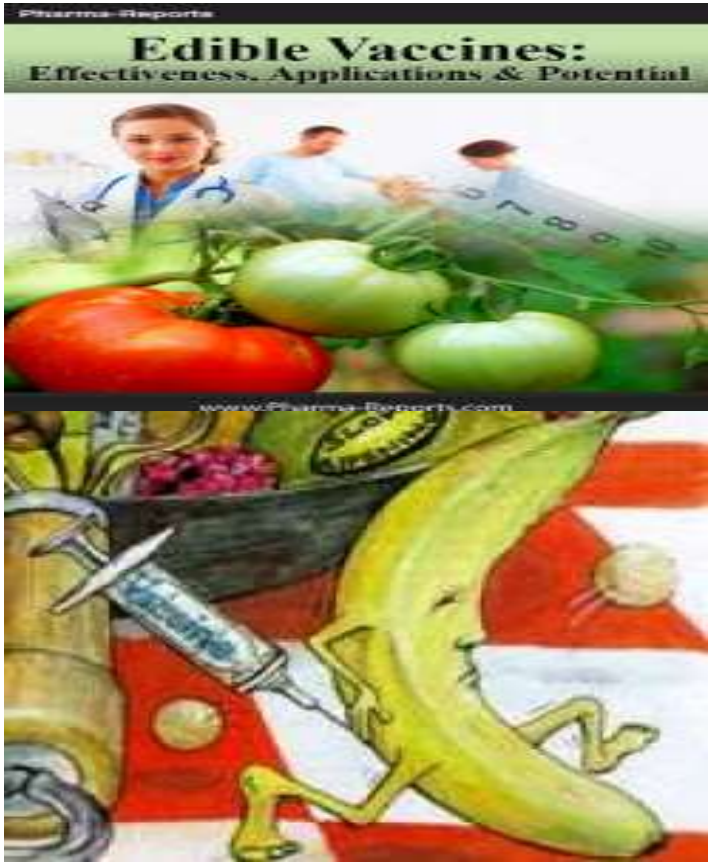
- The simplest one is by injecting them intramuscularly.
- Better delivery of these plasmids to intracellular locations - shooting plasmids adsorbed on gold nanoparticles using “Gene Gun”
- In the host cells, the gene of interest is transcribed, translated, processed and presented to cell of immune system.
- Such vaccines are called “DNA vaccine”.
- DNA vaccine against West Nile virus infection has been used successfully in horses.

Marker vaccines:

- Using molecular biological tools, immunogenic but non protective gene from virulent organism can be deleted.
- Immune response generated in vaccinated animals differs from animals naturally infected with the organis.
- To differentiate vaccinated animals from naturally infected one – Suitable test
- As expected, the test will be positive in naturally infected animals where as negative in vaccinated animals.
- Marker vaccines are also called as DIVA vaccines (*Differentiation of Infected from Vaccinated Animals*).

Edible vaccine:

- It is also possible to clone gene of interest in plants like tobacco, potato and corn.
- The genes of Transmissible gastro-enteritis and Newcastle disease, coding for protective antigen, were cloned in plants
- These plant products were used for vaccination.
- In US, tobacco based Newcastle disease vaccine has been licensed.



THE END