The Role of Vaccination and Lab Monitoring in the Control of Poultry Diseases
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Outline
- Avian health and immune system
- Basics of Vaccination in Poultry
  - Types of vaccines
  - Vaccine delivery
  - Vaccine failure
- Lab Monitoring
  - Tasks
  - Serologic tests and interpretation

Disease development depends...
- Bird’s condition
  - Health or state of wellbeing
  - Level of protection/immunity
- Invading pathogen/organism
  - Number
  - Virulence or strength

Defense System Against Infections
Specific Immune System
- Primary Organs
  - Yolk sac: Maternal immunity
  - Bone Marrow: Precursor blood cells
  - Thymus gland: T-cells (cell mediated immunity)
  - Bursa of Fabricius: B-cells (humoral/antibodies)
- Peripheral lymphoid tissue
  - Harderian gland
  - Cecal tonsils
  - Spleen
  - GALT

Vaccination
- To trigger immune system so to produce antibodies → fight invading casual organisms
- Vaccination is a way of obtaining a control result with a minimum of harm to the birds
  - A natural invasion caused infection will be uncontrolled and has the possibility of causing severe damage

Basics of Vaccination in Poultry
Elements of a Vaccination Program

1. Stimulation & Maintenance of Protective Immunity
2. Development of Immunologic Memory
Basics of Vaccination in Poultry

Requirements for Good Immune Response

- Good Nutrition
- No Immune Suppression
- No Stress
- Correct Vaccine Storage
- Correct Administration Technique
- Correct Vaccination Program

Healthy Birds

GOOD IMMUNE RESPONSE

Basics of Vaccination in Poultry

Types of vaccines

- **Live and live-attenuated**: either low dose or mild forms of disease organism
- **Inactivated**: Result may be weaker and shorter immunity than live vaccines due to their inability to infect and multiply in the host. Use adjuvant to compensate
  - **Killed (whole unit)**: high dose of dead pathogen
  - **Sub-unit**: purified antigens extracted from the disease organism
  - **Conjugate**: contain the antigen bound to a compound to form a complex that is detectable by the immune system
  - **DNA**: purified DNA for the antigens that stimulate an immune response to a disease organism
- **Recombinant**: Incorporates DNA of the pathogen into another organism that will be delivered as a live vaccine

Basics of Vaccination in Poultry

Live vaccines

**Advantages**

- Create complex immunity
  - Humoral + cell-mediated
  - Different classes of antibodies
- Rapid onset of vaccination
- Easy mass application
- No adjuvants needed
- No hypersensitivity reactions
- Production in big quantities

**Disadvantages**

- Vaccine agent is present in poultry population
- Possibility of shedding of the vaccine agent
- Post vaccinal reactions are possible

Basics of Vaccination in Poultry

Inactivated vaccines

**Advantages**

- No introduction of a “new living agent”
- No shedding of the vaccine agent
- No post vaccinal reactions
- Accurate individual vaccination

**Disadvantages**

- Reactions of hypersensitivity possible
- Slow onset of protection
- Humoral immunity only
- High labor costs for application
- Expensive production of high quality vaccines

Basics of Vaccination in Poultry

Vector vaccines

**Advantages**

- Bi- or multivalent antigens
- No shedding of the vectored agent
- Accurate individual vaccination
- In ovo vaccination is possible
- Long-lived immune response
- Potential to differentiate between infected and vaccinated (DIVA).

**Disadvantages**

- High labor costs for application, if parenteral
- Effective for systemic pathogens compared to respiratory/non-systemic
- Slow onset of protection
- Previous exposure to carrier may compromise immunity of the vectored agent
- Expensive production
- Possibility of creating new pathogens

Basics of Vaccination in Poultry

Individual delivery of vaccine

- **Ocular**
  - Vaccine makes its way into the respiratory tract via the lacrimal duct
  - Use only specific diluent
- **Injection: wing web, subcutaneous, intramuscular**
  - Use only sterile equipment
  - Into the wing by a special needle(s)
  - Use specific diluent for live vaccines
Basics of Vaccination in Poultry

Mass application

- **Drinking water**
  - All equipment used for vaccination is carefully cleaned and free of detergents and disinfectants
  - Only cold, clean water of drinking quality is used
  - Ensure that all birds drink during the vaccination phase

- **Spray**
  - Delivered onto the chickens (or into the air above the chickens)

Basics of Vaccination in Poultry

Vaccine Monitoring

- Ascertain whether the vaccine has work or "taken"
- Many cases birds react approximately 5-7 days post-vaccination by showing signs of illness — slight cough, lethargy
- Blood samples may be taken and sent to the lab for serology assays (detection of antibodies)

Basics of Vaccination in Poultry

Reasons for Vaccine Failure

- Administration of a sub-optimal dose of vaccine
  - Poor vaccine quality (rare)
  - Improper handling of the vaccine during transport and storage
  - Errors in the vaccination technique
- Immune suppression
  - Immune suppressive viral infections
  - Stress
  - Mycotoxins
- High levels of maternal antibodies
- Strong field challenge

Basics of Vaccination in Poultry

Reasons for Vaccine Failure

- The causative agent is not covered by the used vaccine (e.g. IBV variants, AIV subtypes)
- Vaccination is too late
  - Birds are already infected at time of vaccination
  - Field infection occurs before development of vaccinal immunity
- Weaning of vaccinal immunity after time

Laboratory monitoring

Lab Tasks

- Organize disease control program
- Early warning systems
  - Corrective action can be taken before disease / production losses
- Measure vaccine performance
- Diagnostic services
- Research on infections

Serologic Monitoring Tests

**Agglutination test**

- Simplest and least expensive
- Multiple avian species
- Qualitative (Pos / Neg)
- False reaction → use as screening tool
- Examples:
  - *Salmonella Pullorum/Gallinarum*
  - *Mycoplasma gallisepticum* (MG) and *M. synoviae* (MS)
Serologic Monitoring Tests

Agar gel immune diffusion (AGID)
- Semi-quantitative
- Difficult to interpret (especially weak positives)
- Cannot be automated
- Example:
  - Avian influenza

Serologic Monitoring Tests

Hemagglutination inhibition (HI)
- Gold standard for serologic assays
- Quantitative assay
- Highly specific
- Examples:
  - Avian influenza subtypes
  - Infectious bronchitis serotype
  - Confirmation MG and MS
  - Newcastle disease

Serologic Monitoring Tests

Enzyme-linked immunosorbent assay (ELISA)
- Preferred method for commercial poultry
- Quantitative and easily automated
- False reaction ➔ may need confirmation
- Species specific

ELISA interpretation

- Mean Titer - Intensity of response
  - Baseline titers
- %CV - Uniformity of response
  - Excellent: <30%
  - Good: 30-50%
  - Needs improvement: >50%
- Mean Titer Over Time - Persistence of response
### Serologic Tests

<table>
<thead>
<tr>
<th>Disease</th>
<th>Serologic test</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avian influenza</td>
<td>ELISA</td>
<td>Chickens and turkey only; if positive, confirm with AGID.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All species; if positive perform HI.</td>
</tr>
<tr>
<td>Newcastle disease</td>
<td>ELISA</td>
<td>Chickens and turkey only; All species.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HI and N groups determination.</td>
</tr>
<tr>
<td>Salmonellosis</td>
<td>ELISA</td>
<td>Chickens and turkey only; All species.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If positive confirm with rickettsia.</td>
</tr>
<tr>
<td>Poultry myxovirus</td>
<td>ELISA</td>
<td>Chickens only.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If positive confirm with rickettsia.</td>
</tr>
<tr>
<td>Avian myeloblastic</td>
<td>ELISA</td>
<td>Chickens only.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If positive confirm with rickettsia.</td>
</tr>
</tbody>
</table>

### Example for organized monitoring program in layers

<table>
<thead>
<tr>
<th>Age</th>
<th>Sample</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>Transfer box paper</td>
<td>Salmonella. MG – IBD – AI</td>
</tr>
<tr>
<td>Week 9</td>
<td>Serum</td>
<td>ND – IBV - etc.</td>
</tr>
<tr>
<td>Week 16</td>
<td>Droppings</td>
<td>Salmonella MG –ND – AI -etc</td>
</tr>
<tr>
<td>Week 22</td>
<td>Droppings</td>
<td>Salmonella ND – AI – MG -etc</td>
</tr>
<tr>
<td>Week 45</td>
<td>Serum</td>
<td>MG –ND – AI -etc.</td>
</tr>
<tr>
<td>Week 62</td>
<td>Droppings</td>
<td>Salmonella MG –ND- AI -etc</td>
</tr>
</tbody>
</table>

### Example for organized monitoring program in broilers

<table>
<thead>
<tr>
<th>Age</th>
<th>Sample</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>Transfer box paper</td>
<td>Salmonella MG – IBD – AI</td>
</tr>
<tr>
<td>10 days</td>
<td>Droppings</td>
<td>Salmonella MG – IBD – AI</td>
</tr>
<tr>
<td>Marketing Age</td>
<td>Serum</td>
<td>ND – IBV – AI – IBD</td>
</tr>
</tbody>
</table>

### Summary

- Avian immune system
- Role of vaccination
- Types of vaccines and delivery
- Vaccine monitoring