The Role of Vaccination and Lab Monitoring in the Control of Poultry Diseases

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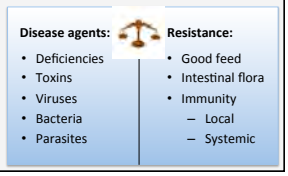
Outline

- 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…

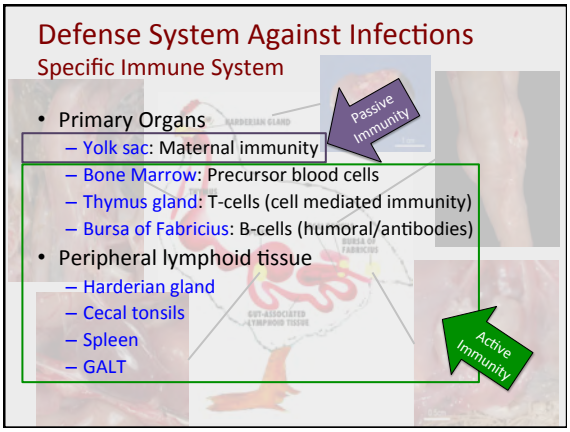
- Bird's condition
  - Health or state of wellbeing
  - Level of protection/immunity
- Invading pathogen/organism
  - Number
  - Virulence or strength



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

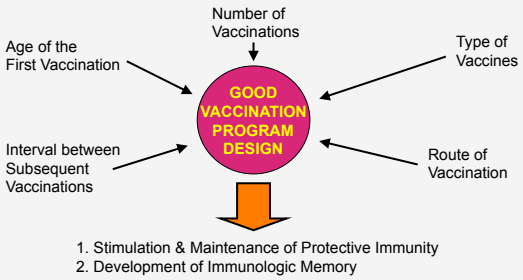


Vaccination

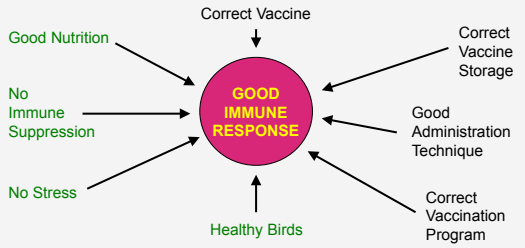
- To trigger immune system so to produce antibodies ➔fight invading casual organisms
- Vaccination is a way of obtaining a control result with a minimum of harm to the birds
  - A natural invasion caused infection will be uncontrolled and has the possibility of causing severe damage

Basics of Vaccination in Poultry

Elements of a Vaccination Program



Basics of Vaccination in Poultry
Requirements for 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 vaccinal protection
- 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

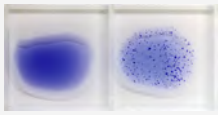
Lab Tasks

- 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

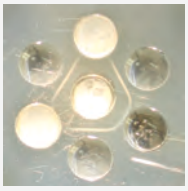


- Simplest and least expensive
- Multiple avian species
- Qualitative (Pos / Neg)
- False reaction → use as screening tool
- Examples:
  - *Salmonella* Pullorum/Gallinarum
  - *Mycoplasma gallisepticum* (MG) and *M. synoviae* (MS)

Serologic Monitoring Tests

Agar gel immune diffusion (AGID)

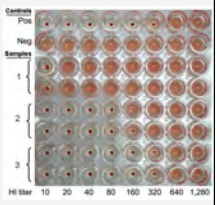
- Semi-quantitative
- Difficult to interpret (especially weak positives)
- Cannot be automated
- Example:
  - Avian influenza



Serologic Monitoring Tests

Hemagglutination inhibition (HI)

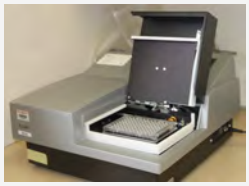
- Gold standard for serologic assays
- Quantitative assay
- Highly specific
- Examples:
  - Avian influenza subtypes
  - Infectious bronchitis serotype
  - Confirmation MG and MS
  - Newcastle disease



Serologic Monitoring Tests

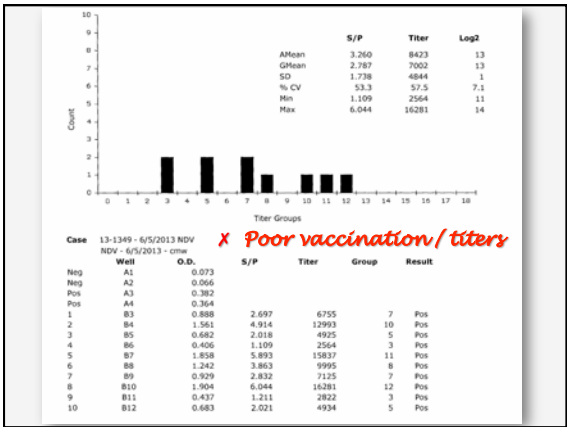
Enzyme-linked immunosorbent assay (ELISA)

- Preferred method for commercial poultry
- Quantitative and easily automated
- False reaction ➔ may need confirmation
- Species specific



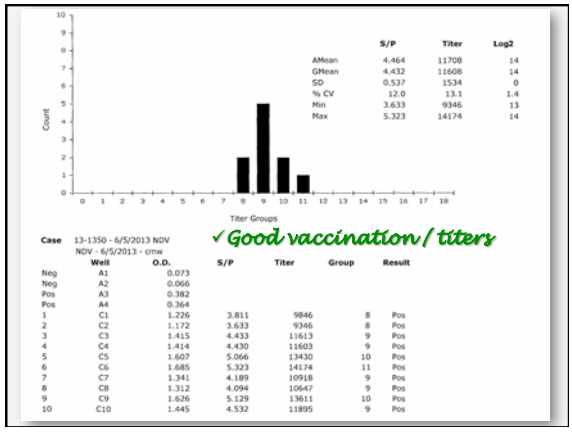
ELISA interpretation

- 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



	S/P	Titer	Log2
AMean	3.260	8423	13
GMean	2.787	7002	13
SD	1.738	4844	1
% CV	53.3	57.5	7.1
Min	1.109	2564	11
Max	6.044	16281	14

Well	O.D.	S/P	Titer	Group	Result
Neg A1	0.073				
Neg A2	0.066				
Pos A3	0.382				
Pos A4	0.364				
1 B3	0.888	2.697	6755	7	Pos
2 B4	1.561	4.914	12993	10	Pos
3 B5	0.682	2.018	4925	5	Pos
4 B6	0.406	1.109	2564	3	Pos
5 B7	1.858	5.893	15837	11	Pos
6 B8	1.242	3.863	9995	8	Pos
7 B9	0.929	2.832	7125	7	Pos
8 B10	1.904	6.044	16281	12	Pos
9 B11	0.437	1.211	2822	3	Pos
10 B12	0.683	2.021	4934	5	Pos



	S/P	Titer	Log2
AMean	4.464	11708	14
GMean	4.432	11608	14
SD	0.537	1534	0
% CV	12.0	13.1	1.4
Min	3.633	9346	13
Max	5.323	14174	14

Well	O.D.	S/P	Titer	Group	Result
Neg A1	0.073				
Neg A2	0.066				
Pos A3	0.382				
Pos A4	0.364				
1 C1	1.226	3.811	9846	8	Pos
2 C2	1.172	3.633	9346	8	Pos
3 C3	1.415	4.433	11613	9	Pos
4 C4	1.414	4.430	11603	9	Pos
5 C5	1.607	5.066	13430	10	Pos
6 C6	1.685	5.323	14174	11	Pos
7 C7	1.341	4.189	10918	9	Pos
8 C8	1.312	4.094	10647	9	Pos
9 C9	1.626	5.129	13611	10	Pos
10 C10	1.445	4.532	11895	9	Pos

Serologic Tests

Disease	Serologic test	Comments
Avian Influenza	ELISA	Chickens and turkeys only. If positive, confirm with AGID.
	AGID	All species. If positive perform HI.
	HI	H and N groups determination
Newcastle disease	ELISA HI	Chickens and turkeys only All species
Infectious bronchitis	ELISA	Chickens only
Mycoplasma	ELISA (MG, MS)	Chickens and turkeys only. If positive confirm with HI.
	Agglutination (MG, MS)	All species. If positive confirm with HI.
	HI (MG, MS, MM)	All species
Salmonella Pullorum/thyphoid	Agglutination Microtiter	If positive confirm with microtiter
Reovirus (viral arthritis)	ELISA	Chickens only
Infectious bursal disease	ELISA	Chickens only
Avian encephalomyelitis	ELISA	Chickens only

Example for organized monitoring program in layers

Age	Sample	Test
Day 1	-Transfer box paper - Serum	- Salmonella. - MG – IBD - AI
Week 9	-Serum	-ND – IBV - etc
Week 16	- Droppings - Serum	-Salmonella -MG –ND – AI -etc
Week 22	- Droppings - Serum	-Salmonella -ND – AI – MG -etc
Week 45	-Serum	-MG –ND – AI -etc
Week 62	- Droppings - Serum	-Salmonella -MG –ND- AI -etc

Example for organized monitoring program in broilers

Age	Sample	Test
Day 1	-Transfer box paper - Serum	- Salmonella - MG – IBD – AI
10 days	- Droppings	- Salmonella
Marketing Age	- Serum	- ND – IBV – AI – IBD

Summary

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