VACCINES OF POULTRY

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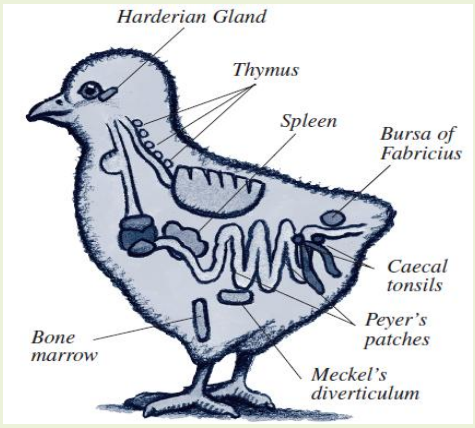
Poultry diseases vaccines



Survival of disease causing agents in the environment

Disease agent	Survival time
• Avian influenza	Days to months
• IBD (Gumboro)	Months
• Coccidiosis	Months
• Fowl Cholera	Weeks
• Coryza	Hours to days
• Marek's Disease	Months to years
• Newcastle Disease	Days to months
• Mycoplasma	Hours to days
• Salmonellosis (Pullorum)	Weeks

Viral vaccines

Infectious Bronchitis

All live and inactivated commercial vaccines must be licensed. Strains used in live virus vaccines generally require attenuation. At present, many countries only permit live vaccines of the Massachusetts type, such as the H120. Some countries may also have licensed vaccines to other live strains such as Connecticut, Arkansas, or Delaware 072 (USA) or the 4/91 strain (United Kingdom). Live vaccines may be given as aerosols, in the drinking water, or by the intraocular route (eyedrop).

The efficacy of inactivated vaccines depends heavily on proper priming with a live vaccine(s). Inactivated vaccines must be administered to birds individually, by intramuscular or subcutaneous injection. Variant strains may be used to prepare inactivated autogenous vaccines for controlling IB in layers and breeders, subject to local legislative requirements.

Live vaccines confer better local immunity in the respiratory tract and also may protect against a wider antigenic spectrum of field strains. However, vaccination with live vaccines may not protect layer flocks against variant serotype challenge especially common on farms with flocks of multiple ages where production drops as early as 40 weeks of age are not uncommon. Live vaccines carry a risk of residual pathogenicity associated with vaccine back-passage in flocks. However, proper mass application techniques (e.g. spray or drinking water) can achieve uniform distribution of the vaccine in the flock and avoid back-passage. Furthermore, the use of vaccines at manufacturer's recommended dosages will also help avoid back-passage reversion that may be caused by fractional dose application.

There are prospects for genetically engineered vaccines and in-ovo vaccination

For IB vaccines, important differences among countries may arise regarding the challenge virus to be used for potency tests, and its validation. Traditionally, the virulent M41 (Mass 41) strain of the Massachusetts type has been used for challenge tests of both live and inactivated vaccines. Although this type is still common, it is often not the only or the dominant type in many countries and it may be advisable to prepare vaccines from other types. It is logical for challenges to be made by the same type as present in the vaccine. Establishing criteria for

validating the challenge virus may be more difficult for non-Massachusetts types, because of their lower virulence in general. Inactivated vaccines are usually expected to protect against drops in egg production. The traditional M-41 challenge should cause a drop of at least 67% in the unvaccinated controls, which was considered by some IB specialists as being excessive as too dependent on the chicken genetic line and on particular challenge parameters. When using other types much lower drops in egg production may be regarded as satisfactory, depending on published evidence of the effects of these strains in the field. It therefore seems necessary to relax the criteria for Massachusetts type challenges, and the European Pharmacopoeia now defines a satisfactory drop in egg production for Massachusetts types to be at least 35%, and for non-Massachusetts types to be at least 15%, provided that the drop is 'commensurate with the documented evidence' (European Pharmacopoeia).

Infectious laryngotracheitis

ILT is usually controlled with live vaccines. **Vaccines may be used in response to disease outbreaks,** or may be used routinely in endemic areas. Repeated doses may be required to afford good protection. Live attenuated ILT vaccines produced in cell cultures or embryonated hens' eggs are most commonly used. In recent years, live recombinant (vectored) vaccines have been produced using herpesvirus of turkeys or fowlpox virus to express ILTV glycoproteins. There has also been some recent work with genetically engineered deletion-mutant vaccines and the results of these initial studies look promising. For attenuated ILT vaccines, the live virus seed is a suitably attenuated or naturally avirulent strain of ILTV. Live attenuated ILT vaccines may be administered by eyedrop, spray or in the drinking water. Recombinant vaccines may be delivered by wing-web puncture, subcutaneous injection or in-ovo inoculation. There are advantages and disadvantages associated with each of the different types of vaccine and the different methods of delivery. For example, vectored vaccines may only be partially protective and **live attenuated ILT vaccines may have residual virulence that can cause clinical disease**, especially if administered by spray and a small droplet size is produced and inhaled**. Live attenuated ILT vaccines may also revert to higher levels of virulence following bird-to-bird passage and persist in the field**. **For this reason, it may be difficult to discontinue vaccination once it has been started.** Subclinical mixed infections of vaccine and field virus, in vaccinated birds, can cause severe disease in unvaccinated in-contacts. Natural recombination

between attenuated vaccine strains of ILTV to produce virulent viruses has been reported and is also a risk for other live vaccines. The use of multiple different ILTV vaccines in the same populations should therefore be avoided (Coppo et al., 2013).

infectious laryngotracheitis virus does not replicate in turkeys

Duration of Immunity:

The results of vaccination will depend on many factors, including dose schedule and route of administration. Some degree of protection should be given, over a period of several months.

Avian Influenza

It is important that vaccination alone is not considered the solution to the control of HPAI or H5/H7 LPAI subtypes if eradication is the desired result. Without the application of monitoring systems, strict biosecurity and depopulation in the face of infection, there is the possibility that HPAI and H5/H7 LPAI viruses could become endemic in vaccinated poultry populations. Long-term circulation of the virus in a vaccinated population may result in both antigenic and genetic changes in the virus and this has been reported to have occurred in Mexico, China (People‟s Rep. of), Egypt, Indonesia and other countries. Currently used vaccines and the use of vaccination have been reviewed.

In this chapter, conventional vaccines are limited to inactivated influenza A virus vaccines. **These vaccines have been used against HPAI, H5/H7 LPAI or non-H5/H7 influenza A having been prepared from infective allantoic fluid inactivated by beta-propiolactone or formalin and emulsified with mineral oil**. Live conventional influenza vaccines against any subtype are not recommended.

The existence of a large number of virus subtypes, together with the known variation of different strains within a subtype, pose serious problems when selecting strains to produce inactivated influenza A vaccines. In addition, some isolates do not grow to a sufficiently high titre to produce adequately potent vaccines without costly preconcentration. While some vaccination strategies use autogenous vaccines, i.e. vaccines prepared from isolates specifically involved in an epizootic, others rely on vaccines prepared from viruses possessing the same haemagglutinin subtype as the field virus and capable of yielding high concentrations of antigen.

Since the 1970s in the USA, inactivated influenza A vaccines have been used primarily in turkeys against H5/H7 LPAI and non-H5/H7 influenza a viruses. These viruses may cause severe clinical signs, especially in exacerbating circumstances. Significant quantities of this vaccine have been used. In recent years in the USA, most of the inactivated influenza A vaccine has been used in breeder turkeys to protect against H1 and H3 swine influenza viruses. Vaccination against H9N2 influenza A virus has been used extensively in Asia and the Middle Easz. Vaccination against HPAI of H5N2 subtype was used in Mexico following outbreaks in 1994–1995 (Villareal, 2007), and against H7N3 subtype in Pakistan following outbreaks in 1995. **In Mexico, the HPAI virus was eradicated**, but LPAI virus of H5N2 has continued to circulate, while in Pakistan, HPAI viruses genetically close to the original HPAI virus were still being isolated in 2004. Following the outbreaks of HPAI caused by H5N1 virus in Hong Kong in 2002 (Sims, 2003), a vaccination policy was adopted using H5N2 vaccine and subsequently replaced with H5N1 vaccine. Beginning in 2004, the widespread outbreaks of H5N1 HPAI in several countries of South-East Asia and Africa resulted in emergency and prophylactic vaccination being applied in China (the People‟s Rep. of), Indonesia, Vietnam and Egypt. Inactivated H7N7 influenza A vaccine was used in Korea (Dem. Rep. of) during 2005 to control a HPAI outbreak. Similarly, preventive vaccination against H5N1 HPAI has been permitted for outdoor poultry and zoo birds in several European Union countries in recent years. Italy has extensively used the tool of serological (heterologous neuraminidase) DIVA with vaccination to control recurrent epidemics of H7 LPAI. A bivalent H5/H7 prophylactic vaccination programme was also developed as a result of an evolving epidemiological situation.

Live recombinant virus-vectored vaccines with H5 influenza A virus haemagglutinin gene inserts have been licensed and used in a few countries since 1997, mostly in chickens, and include recombinant fowl poxvirus, recombinant Newcastle disease virus and recombinant herpesvirus turkey vaccines. A recombinant duck enteritis virus in domestic ducks is being tested for potential licensure and use in China

Fowl pox

Fowlpox and pigeonpox virus vaccines of chicken embryo or cell culture origin are available from the majority of biological companies that produce poultry vaccines. The vaccines

are used in susceptible flocks where the disease has been endemic or has been diagnosed in previous flocks.

Passively acquired immunity should be taken into consideration during vaccination of progeny from flocks that have either had a recent natural infection or been recently vaccinated. As passive immunity (for 2–3 weeks) may interfere with vaccine virus multiplication, such progeny should be vaccinated only after the decline of passively acquired antibody. Fowlpox vaccine is applied by a wing web stab method.

Pigeon pox was preferred in prevention of diphtheritic form fowl pox

Precaution:

It is usually recommended not to vaccinate birds that are in lay. Avoid human contact with the live vaccine. Standard fowlpox vaccine is not to be used in pigeons, though they can be vaccinated with pigeon pox vaccine. In many countries, pigeon pox vaccine has been superseded by attenuated live fowlpox vaccine designed for use in day-old chicks. These products have been safely used in pigeons in the absence of an available pigeon pox vaccine

Duration of immunity (approximately 6–12 months) by testing at intervals after vaccination, using separate groups of birds for each test.

Infectious bursal disease (IBD)

IBDV vaccines have been reviewed recently. Four major types of vaccines are available for the control of IBD, these are**: i) live attenuated vaccines; ii) immune-complex vaccines; iii) live recombinant vectored vaccines expressing IBDV antigens; and iv) inactivated oil-emulsion adjuvanted vaccines.**

To date, **IBD vaccines have been made with serotype 1 IBDV only**, although a serotype 2 virus has been detected in poultry. The serotype 2 virus has not been associated with disease, but its presence will stimulate antibodies. Serotype 2 antibodies do not confer protection against serotype 1 infection, neither do they interfere with the response to type 1 vaccine. There have been numerous descriptions of antigenic variants of serotype 1 virus. Cross-protection studies have shown that inactivated vaccines prepared from classical serotype 1 virus require a

high antigenic content to provide good protection against some of these variants. IBD vaccines that contain both classical and variant IBD serotype 1 viruses are now licensed. vvIBDV strains with limited antigenic changes as compared with „classical" serotype 1 viruses have emerged since 1986. **Active immunisation with a „classical" serotype 1 virus or vaccine provides a good protection against the vvIBDVs, however the latter viruses are less susceptible to neutralisation by MDA than „classical" pathogenic viruses**.

Live IBD vaccines are produced from fully or partially attenuated strains of virus, known as „mild", „intermediate", or „intermediate plus" („hot"), respectively. In India intermediate plus strain enough to cross protect against all IBD strain. Oral route is better.

Marek's disease

Control of MD is essentially achieved by the widespread use of live attenuated vaccines. **Commercial biological products mainly used in the control of MD are the 'cell associated' live virus vaccines**. Lyophilised cell-free vaccines are rarely used. Marek's disease vaccines are injected subcutaneously into day-old chicks after hatch or in ovo at the 17th to 19th day of embryonation.

Serotype 1 This includes all the pathogenic strains of the virus, ranging from strains that are very virulent plus (e.g. 648A), very virulent (e.g. Md/5, Md/11, Ala-8, RB-1B), virulent (e.g. HPRS-16, JM GA), mildly virulent (e.g. HPRS-B14, Conn A) and finally to weakly virulent (e.g. CU-2, **CVI-988**). These strains may be attenuated by passage in tissue culture, with loss of pathogenic properties but retention of immunogenicity, to provide strains that have been used as vaccines. Those that have been used commercially include attenuated HPRS-16 and CVI-988 (Rispens) strains. Attenuated variants of the very virulent stains have been used in experimental vaccines to protect against the variant form of acute MD caused by the very virulent stains. Md11/75C/R2/23 is one such strain. licensed for use in the United States of America. Serotype 1 vaccines are prepared in a cell-associated ('wet') form that must be stored in liquid nitrogen.

Serotype 2 This includes naturally avirulent strains of MDV (e.g. **SB-1**, HPRS-24, 301B/1, HN-1), and several of these have been shown to provide protection against virulent strains. The SB-1 and 301B/1 strains have been developed commercially and used, particularly

with HVT, in bivalent vaccines for protection against the very virulent strains. Serotype 2 vaccines exist only in the cell-associated form.

Serotype 3 This contains the strains of naturally avirulent **HVT** (e.g. FC126, PB1), which are widely used as a monovalent vaccine, and also in combination with serotype 1 and 2 strains in bivalent or trivalent vaccines against the very virulent strains of MDV. HVT may be prepared in a cell-free form as a freeze-dried (lyophilised) vaccine or in a cell-associated ('wet') form.

Genetically engineered recombinant vaccines based on the existing live MD vaccines can offer simultaneous protection against other avian diseases, depending on the protective antigens engineered into the recombinant vaccine. **A number of recombinant vaccines based on HVT vectors that induce protection against avian diseases such as avian influenza, infectious bursal disease, Newcastle disease and infectious laryngotracheitis are commercially available**.

Newcastle disease

NDV strains used in conventional commercial live virus vaccines fall into two groups: lentogenic vaccines, such as Hitchner-B1 , LaSota, V4, NDW, I2 and mesogenic vaccines, such as Roakin, Mukteswar and Komarov. Strains from both these groups have been subjected to selection and cloning to fulfil different criteria in their production and application. The mesogenic vaccine viruses all have two pairs of basic amino acids at the F0 cleavage site and ICPI values of around 1.4. This means that infections of birds with these viruses would fall within the intended definition of ND, but as these vaccines are used primarily in countries where ND is endemic this may not necessarily preclude their use. In the USA, the 9CFR 121.3b.818 states that NDV strains with ICPI values equal to or greater than 0.7 are virulent and reportable, leaving NDV isolates of low virulence to be used as vaccines. The European Union stated in their Commission Decision 93/152/EEC (European Commission, 1993) that for routine ND vaccination programs the viruses used as live NDV vaccines are to be tested under specific conditions and have an ICPI of less than 0.4 or 0.5, depending on the dose of vaccine given. The OIE Biological Standards Commission similarly recommended in 2000 that in principle vaccines should have an ICPI exceeding 0.4

Live virus vaccines may be administered to birds by incorporation in the drinking water, delivered as a coarse spray (aerosol), or by intranasal or conjunctival instillation. A live vaccine formulated from a NDV of low virulence for use in ovo has been licensed for use in the USA. Some mesogenic strains are given by wing-web intradermal inoculation. Vaccines have been constructed to give optimum results through application by specific routes.

Inactivated vaccines are considerably more expensive than live vaccines, and their use entails handling and injecting individual birds. They are prepared from allantoic fluid that has had its infectivity inactivated by the addition of formaldehyde or beta-propiolactone. This is incorporated into an emulsion with mineral oil or vegetable oil, and is administered intramuscularly or subcutaneously. Individual birds thus receive a standard dose. There is no subsequent spread of virus or adverse respiratory reactions. Both virulent and avirulent strains are used as seed virus although, from the aspect of safety control, the use of the latter appears more suitable. As no virus multiplication takes place after administration, a much larger amount of antigen is required for immunisation than for live virus vaccination.

The duration of immunity depends on the vaccination programme chosen. One of the most important considerations affecting vaccination programmes is the level of maternal immunity in young chickens, which may vary considerably from farm to farm, batch to batch, and among individual chickens. For this reason, one of several strategies is employed. Either the birds are not vaccinated until 2–4 weeks of age when most of them will be susceptible, or 1-day-old birds are vaccinated by conjunctival instillation or by the application of a coarse spray. This will establish active infection in some birds that will persist until maternal immunity has waned. Revaccination is then carried out 2–4 weeks later. Vaccination of fully susceptible 1-day-old birds, even with live vaccines of the lowest virulence, may result in respiratory disease, especially if common pathogenic bacteria are present in significant numbers.

Re-vaccination of layers should be done at sufficiently frequent intervals to maintain an adequate immunity. Vaccination programmes often employ slightly more pathogenic live virus vaccines to boost immunity than those used initially. These more pathogenic live vaccines may also be used following initial vaccination with oil emulsion inactivated vaccines. Layers that have high serological titres for NDV are protected against drop in egg production and poor egg quality (shell-less, soft shelled eggs, off-coloured eggs). The level of homology between the

vaccine strain and the field virus can influence the degree of protection against reduced egg production.

When devising a vaccination programme, consideration should be given to the type of vaccine used, the immune and disease status of the birds to be vaccinated, and the level of protection required in relation to any possibility of infection with field virus under local conditions. Two examples of vaccination programmes that may be used in different disease circumstances are listed here. For the first example, when the disease is mild and sporadic, it is suggested that the following order of vaccination be adopted: live Hitchner-B1 by conjunctival or spray administration at 1 day of age; live Hitchner-B1 or LaSota at 18–21 days of age in the drinking water; live LaSota in the drinking water at 10 weeks of age, and an inactivated oil emulsion vaccine at point of lay. For the second example, when the disease is severe and more widespread, the same protocol as above is adopted up to 21 days of age, and this is followed by revaccination at 35–42 days of age with live LaSota in the drinking water or as an aerosol; this revaccination is repeated at 10 weeks of age with an inactivated vaccine (or a mesogenic live vaccine) and again repeated at point of lay. The first protocol is generally applicable to countries were virulent NDV in not endemic and is intended to minimise productivity losses by using a milder vaccine during the initial vaccination. Considering possible constraints of ND vaccination, particularly applying to live vaccines, proper immunisation should be validated by serological testing of vaccinated flocks. Regardless of which test system would be applied, i.e. ELISA or HI, humoral immune response should be demonstrated at the flock level

When HI is used to evaluate the immune response after vaccination, it should be taken into account that HI titres are greatly influenced by the quality of vaccine, the route and method of administration, environmental and individual factors, but also depend on the species (e.g. generally the HI response of some species, such as turkey and pigeon, is lower than that of chicken). It is also recommended to inactivate nonspecific haemagglutinating agents often present in the serum of some species such as game birds (pheasant, partridge, etc.), quails, ostriches and guinea fowl, by heat treatment in a water bath at 56°C for 30 minutes.

Single vaccinations with live lentogenic virus may produce a response in susceptible birds of about 4– 6 log2 , but HI titres as high as 11 log2 or more may be obtained following a vaccination programme involving oil-emulsion vaccines. The actual titres obtained and their

relationship to the type of protection and duration of immunity for a given flock and programme are difficult to predict. Variation in HI titres may occur for nonspecific factors, for instance due to the antigenic correlations, infection with other AMPVs (e.g. APMV-3) may result in significant increased titres to NDV. The HI titre is also influenced by the characteristics of antigen used. For instance, the use of the homologous La Sota antigen in the HI assay after vaccination with this virus resulted in significantly higher titres than when heterologous Ulster virus was used (Maas et al., 1998). Furthermore, reference antigens produced with historic strains may reduce the sensitivity of HI assay when used for the detection of antibodies against ND viruses currently circulating. For this reason it is important to investigate the antigenic relationships between the antigen used in the laboratory and current circulating viruses, and between vaccine strains and reference HA antigens, to avoid misjudgements in estimating serum antibody titres.

The advent of recombinant DNA technology has resulted in the development of novel NDV vaccines. One class consists of vector vaccines, which consist of a suitable carrier virus that expresses one or more immunogenic NDV proteins (usually F and/or HN), thereby inducing an immune response against both NDV and the vector virus itself. Examples of such vector vaccines are recombinants based on Vaccinia virus, Marek‟s disease virus and avian adeno-associated virus.

Chicken Infectious Anaemia

Commercial live vaccines are available in several countries

Chicken Infectious Anaemia Vaccine, Inactivated is emulsified suspension of highly immunogenic strain (VH/CAP/02 strain) of Chicken Infectious Anaemia virus (CAV), chemically inactivated and oil adjuvanted to get stable emulsion. Selection of highly immunogenic strains of CAV for vaccine preparation confers protection to bird.

An inactivated vaccine has been tested in SPF breeder hens.Vaccinated hens showed seroconversion and their offspring wereprotected against challenge. Unfortunately, viral titers in MSB1 cells are generally low and therefore inactivated vaccines may not be cost-effective.

Although recombinant vaccines expressing VP1 and VP2 are certainly possible these have not been licensed to date.

Advantages:

- Prevent immunosuppression and infection of opportunistic secondary pathogens.
- Prevent excretion of virus and horizontal spread in commercials.

Inclusion Body Hepatitis

Inclusion Body Hepatitis / Hydropericardium Syndrome (IBH/HPS) Fowl serotype 4 (F AdV-4) is grown on SPF chick embryo. It is chemically inactivated and oil adjuvanted to get stable milky white emulsion.

Avian Reo Virus

Avian Reo Virus vaccine, Inactivated is emulsified suspension of highly immunogenic strains of Reo virus (VH/ARV/TS/5, VH/ARV/MAP/4 strain) chemically inactivated and oil adjuvanted to get stable emulsion. Selection of highly immunogenic strains of Reo virus for vaccine preparation confers protection to bird against Reo viruses. The product meets pharmacopeial standards.

Initial attempts to prevent early infection by simple immunisation were based on controlled exposure of one-day-old chicks to live virus . Later, passaged versions of the SI 133 strain were used for vaccination of one-day-old chicks. However, in general, the use of live vaccines in chicks at one-day-old has not been very successful. This may be related to the poor intestinal immunity in very young chicks after immunisation at this stage.

Recent developments have involved the use of coarse spray administration of a cell culture clone of strain Sll33/6 6 (19). This preparation resulted in higher antibody levels than egg-passaged vaccine. Inactivated reovirus vaccines are frequently administrated to breeder

flocks in combination with other killed preparations against, for example, Newcastle disease and egg drop syndrome 1976

Bacterial Diseases

MG/MS

The preferred method of control is to maintain MG- and MS-free flocks. Vaccination should be considered only in situations where field exposure is inevitable, such as on multi-age sites. Potential exposure of neighbouring poultry flocks should also be carefully considered.

Two types of vaccines are available for the control of MG. **These are mild to avirulent MG strains used as live vaccines, or inactivated oil-emulsion bacterins**. The subject of MG vaccination has been reviewed by Whithear (1996). Although there is antigenic variability among MG strains, it is thought that vaccination with a single strain is sufficient.

Live Vaccine:

The use of live vaccines is equivalent to 'controlled exposure'. The objective is to infect the flock with a mild, immunogenic MG strain at an age when little or no significant damage occurs. Such exposure results in resistance to challenge later in life, such as on multi-age commercial sites. Successfully vaccinated birds are resistant to respiratory disease, airsacculitis, and egg production drops caused by MG. Vaccination also results in reduced levels of egg transmission in breeders.

The F strain of MG has been the most commonly used vaccine strain. It is a naturally occurring strain of mild to moderate virulence for chickens, but it is virulent for turkeys. It ordinarily spreads slowly from bird to bird. When administered to healthy chickens via the upper respiratory tract, little or no respiratory reaction is observed. However, when administered by aerosol or in the presence of other respiratory disease agents, such as Newcastle disease or infectious bronchitis virus, respiratory signs and airsacculitis may result. Vaccinated chickens are permanent carriers, so a single dose is adequate. Use of F strain vaccine in each replacement flock on a multi-age site will eventually result in displacement of the field strain with the vaccine

strain. Strains ts-11 and 6/85 are avirulent and spread to unvaccinated birds does not occur or occurs very poorly when birds are in very close contact

Commercial pullets are usually vaccinated between 12 and 16 weeks of age, but vaccination of younger or older birds is permissible. It is essential that vaccination occurs before the flock is naturally infected. Vaccination in cases of probable early field exposure can be carried out in birds as young as 2–4 weeks of age. **For the F strain, intranasal or eyedrop administration is preferred**. Administration in the drinking water may result in some birds being missed unless the procedure is carried out properly. Aerosol administration should also be done carefully, so that all birds are exposed. A respiratory reaction should be expected at approximately 5–7 days after vaccination if aerosol administration is used. Vaccinated flocks should be tested with the agglutination test approximately 3–4 weeks post-vaccination to be sure that all birds were properly exposed. It is desirable that birds be vaccinated at an age when there is no reaction to other respiratory vaccines. Strain ts-11 should be administered by eyedrop, and 6/85 is given as a fine spray. Vaccination with ts-11 results in a low but distinctive serological response by serum plate agglutination, HI, and ELISA, but vaccination with 6/85 does not ordinarily result in a serological response. **No post-vaccination reaction should be observed with 6/85 or ts-11. Flocks vaccinated with F strain or ts-11 are culture positive for the life of the flock, but 6/85 may be difficult to recover later than 4–6 weeks after vaccination**.

Commercial live vaccines should be used within 1–2 hours after reconstitution. Lyophilised vaccine should be stored at 4°C. Some manufacturers supply the vaccine frozen. Such vaccine should be stored in liquid nitrogen, dry ice, or at –70°C or colder. Live MG vaccine is not stable for long periods at ordinary freezer temperatures. Storage for more than a few days at –20°C should be avoided.

Strains 6/85 and ts-11 are inherently safer than F strain, although the level of protection may be somewhat less, and may be useful as the primary vaccine strain on a multi-age site or as a ‘second generation vaccine’ on sites previously using F strain vaccine. They may also be preferred in situations where inadvertent exposure of neighbouring poultry flocks is of concern. F strain displaces wild-type MG more efficiently than either ts-11 or 6/85, but ts-11 has been used to eradicate F strain MG from a multi-age commercial egg-production site. Multi-age

sites where strain 6/85 is consistently used often test MG-negative, suggesting that it has displaced the wild-type strain.

Live vaccines have also been used in some countries in broiler breeder pullets. In Australia, ts-11 live vaccine is being extensively used in broiler breeder pullets as well as in commercial layers. F strain vaccine has been used in broiler breeder pullets raised under multi-age conditions in some Latin American countries for several years; more recently there has been limited use of strains ts-11 and 6/85. There has been limited use of the 6/85 strain as a vaccine for commercial turkeys in the USA, but no good data on its effectiveness are available. Generally, vaccination of turkeys with live vaccines is not recommended and vaccination of broilers with either live or inactivated vaccines has not been successful. None of the vaccines has been validated for use in game birds.

A live vaccine for MS is available in several countries for use in broiler breeder and layer chickens. It is produced from a temperature-sensitive mutant, MS-H (Markham et al., 1998). Its characteristics and method of use are similar to those for the MG vaccine, ts-11.

Inactivated Vaccine

MG bacterins are prepared from a concentrated suspension of whole cells that is emulsified into an oil adjuvant. A high antigen content is essential. Bacterins are ordinarily used in commercial pullets to provide protection against egg-production drops that occur after MG exposure on multi-age layer sites. They may also be used to reduce the level of egg transmission in breeder pullets. Use of bacterins in broilers is limited by the fact that birds vaccinated before 1–2 weeks of age are not protected. Although bacterins may provide protection against respiratory signs, airsacculitis, and egg-production losses, vaccinated flocks are readily infected. The duration of immunity is not known, but most flocks are exposed within 1–2 months after vaccination.

Administration is by the intramuscular or subcutaneous route, usually with a dose of 0.5 ml per bird. There is a risk that a persistent reaction at the site of vaccination will require trimming of carcasses of spent fowl vaccinated by the intramuscular route, so subcutaneous administration in the upper dorsal part of the neck is the most commonly used route. Two doses are preferred, but cost and labour considerations may dictate the use of a single dose, usually

between 16 and 18 weeks of age for commercial pullets. A multidose syringe may be used. All equipment should be cleaned and sterilised between flocks, and vaccination crews should exercise proper methods of biosecurity when travelling between flocks. Vaccine should be stored at 2–8°C up to the time of use. It should not be frozen or exposed to strong light. A similar bacterin for MS is also licensed in the USA, but it has received limited use.

Fowl cholera (avian pasteurellosis)

Killed Vaccine:

Fowl cholera may be caused by any of 16 Heddleston serotypes of P. multocida, although certain serotypes appear to be more often associated with disease. The P. multocida vaccines in general use are inactivated, containing aluminium hydroxide or oil adjuvant, prepared from cells of serotypes selected on the basis of epidemiological information. Commercial vaccines are usually composed of serotypes 1, 3, and 4. Vaccination plays a significant role in the control of this disease

Inactivated vaccine is normally administered by intramuscular injection in the leg or breast muscles, or subcutaneously at the back of the neck. Two doses are typically administered at 2- to 4-week intervals. As with most killed vaccines, full immunity cannot be expected until approximately 2 weeks after the second dose of a primary vaccination course. Vaccination of diseased birds or those in poor nutritional status should be avoided as a satisfactory immune response may not be generated in such circumstances.

Live vaccine:

Live vaccines containing modified P. multocida are not generally used except in North America. Live vaccines are typically administered in the drinking water or wing web. Vaccination of diseased birds or those in poor nutritional status should be avoided as a satisfactory immune response may not be generated in such circumstances.

Salmonellosis

Although both live and inactivated vaccines have been prepared for use against S. Gallinarum, the vaccine most widely used is made from the rough **9R strain**. It is normally only

employed in chickens. The number of viable organisms per dose is important; these organisms can survive in vaccinated birds for many months and may be transmitted through the egg (and perhaps from bird to bird). Vaccination may reduce flock losses, but will not prevent infection with field strains. In addition, vaccination with 9R may sometimes precipitate high mortality in infected birds, and may stimulate the production of transient antibodies. It is usual to vaccinate at 8 weeks and again at 16 weeks of age. Antimicrobials should be avoided before and after vaccination

Currently available vaccines, however, have only a minor role to play in the control of fowl typhoid as they offer short-lived protection against clinical disease and limited or variable protection against infection. Autogenous or locally produced vaccines can also be used to control clinical disease, but care must be taken to avoid strain instability leading to reversion to virulence. Control can best be achieved by biosecurity, hygiene, good management, monitoring and removal of infected flocks. Commercially available 9R vaccines have been used for reduction of S. Enteritidis in laying flocks in some countries but may be prohibited or are not commercially available in some countries where fowl typhoid is not present. Even in countries with fowl typhoid, use of vaccine may complicate control as it does not prevent infection, only reduce clinical disease and allow production to continue from infected flocks. It is therefore preferable to aim for eradication of the organism rather than acceptance of on-going disease, but this is often not economically viable in large multi-age holdings as eradication of red mites is necessary to ensure continued freedom from infection.

Most vaccines are produced in highly industrial commercial processes and are regulated by national veterinary medicines licensing authorities. Smaller quantities of emergency herd vaccines or autogenous vaccines are produced by private laboratories, but each production has to be specifically licensed. It is recommended that a validated commercial vaccine is used unless there is no alternative because of the need to maintain quality and avoid risk associated with reversion to virulence. Live vaccines must also be bacteriologically distinguishable from field strains or surveillance and control programmes may be compromised. Observations from some countries suggest that it is not always straightforward to distinguish between S. Gallinarum vaccines and field strains. There will inevitably be some interference with serological monitoring for S. Gallinarum and potential interference with serological monitoring for S. Enteritidis, unless

a stepwise approach is used in which a sensitive LPS-based ELISA is used to test for antibodies to O9 antigens and positive sera are further tested with a flagella antigen ELISA, which will give a negative reaction in cases of S. Gallinarum infection. Recent work on the molecular mechanisms of infection should lead to the development of improved vaccines in future.

Autovaccine also used in the field by isolation of organism

Infectious Coryza

Commercial IC bacterins are widely available. They must contain at least 10^8 colony-forming units/mL to be effectives.

1.Four strain(A,B,C2 and C3)

2.Formulated with water in oil emulsion. **VISA adjuvant**

3.Prolongs the immunity for long time.

4.Corya disease-2 time vaccination.

Colibacillosis

A commercial vaccine containing F11 (PapA) fimbrial antigen and flagellar antigen (FT) is licensed in Europe for use in broiler breeders to provide natural passive immunity to progeny of vaccinated hens.

Inactivated Vaccines: Effective inactivated vaccines against various serotypes including O2:K1 and O78:K80 have been produced. They provide protection againstthe homologous serogroups, but no significant cross-protection against heterologous serogroups.

Live Vaccines: A live vaccine prepared from a naturally occurring, nonpathogenic, piliated *E. coli* strain (BT-7) was efficacious when used in chickens older than 14 days of age. Protection against both homologous and heterologous strains was demonstrated. *E. coli* J5, a mutant strain that has incomplete endotoxin in the cell wall exposing Gram-negative core antigen, was both safe and effective for protecting chicks.

Recombinant and Mutant Vaccines*:* A *carAB* mutation of a virulent O2 serotype caused defective utilization of arginine and pyrimidines, increasing the requirements by the mutant.

Necrotic enteritis:

Active and passive immunity through vaccination against *C. perfringens*and its toxins appears to offer good protection against infection. Protection wasalso induced through oral vaccination with a live alpha-toxindeficient isolate of *C. perfringens*

Coccidiosis Vaccines:

Live vaccines have been prepared from attenuated lines of oocysts. The Coccivac products pioneered in this growing family,which now includes several other live vaccines in various countries(Coccivac®, Immucox®, Paracox®, Livacox®, BioVet®,Advent®, Nobilis®, In-OvoCox®, and others).

NO	DISEASE	VIRUS	Vaccine Strain	TRANSMISSION	INCUBATION PERIODS	RESISTANT OUTSIDE HOST	DISINFECTANT
1	Newcastle disease	Paramyxo virus (APMV-1)	NDB1, Lasota, R2B,F1, NDVH,s CLONE 30	Horizontal (ingestion (faecal/oral route) and inhalation)	2-15 days	Survive on chicken skin for up to 160 days and in bone marrow for nearly 200 days	Inactivated by formalin, phenolics and oxidising agents (e.g. Virkon®); chlorhexidine, sodium hypochlorite (6%)
2.	Avian influenza	*Orthomyxovirus Type A*	H5N1 (HP) H9N2 (LP)	Horizontal	The incubation period for influenza is short in all species. In poultry, it can be a few hours to a few days in individual birds, and up to 2 weeks in the flock	24-36 hours	sodium hypochlorite, 60% to 95% ethanol, quaternary ammonium compounds, aldehydes (glutaraldehyde, formaldehyde), phenols, acids, povidone-iodine and other agents.Common household agents, including 1% bleach, 10% malt vinegar or 0.01-0.1% dishwashing liquid
3.	IBD	Avibirna virus	Intermediate Standard, Intermediate plus, IBD MB strain, 228E, D78.	Horizontal	2-3days	122 days poultry house, 52 days in feed and water	The virus is sensitive to sodium hydroxide, iodinated and chlorinated derivatives
4.	IB	Corona virus	Massachusetts, H120, IBM41 strain, Arkansas, Connecticut, Delaware	Horizontal	18 - 36 hours		Formaldehyde, chlorine releasing agents, or quaternary ammonium compounds
5.	ILT	Gallid herpesvirus	-	Horizontal	5-12	Persist in tracheal exudates and tissues for weeks or months. Latent infection and carrier	Chemical disinfectants, such as coal tar derivatives, formalin, hypochlorite and iodophors, effectively inactivate ILTV on contact
6.	CAV	Circovirus	GD-G-12, CAV P4	Horizontal and Vertical transmission	7 to 14 days		Resistant to lipid solvent., Orthodichlorobenzen, Quaternary ammonium compound.

8.	Fowl pox	Poxvirus	Avipox, Pigeon pox.	Horizontal	4-20 days	1 to 2 days	sodium hydroxide (1:500), cresol (1:400) and phenol (3%)
9.	IBH	Serogroup In of Avian Adenoviruses (Tipto n Strain)	Adenovirus Type 4 strain	Horizontal and vertical transmission	9–14		Quaternary ammonia-based disinfectant
10.	EDS	Serogroup III of Avian Adenovirus Strain BC14, virus 127)	EDS 76 Strain	Vertical and horizontal	10- 14 days		Resistant to commonly using disinfects Iodophor and aldehyde disinfectants effective if they are allowed to contact the virus for prolonged periods
11.	AE	Picorna virus		Vertical and horizontal	5 to 14 days	150 days	Citric acid, Bicarbonate
12.	MD	Herpes	Rispens CVI198 (Serotype1) SB1 (Serotype 2) HVT (Serotype 3)	Vertical and horizontal	3-25 weeks	Months to years	Vircon S, 5% formalin
13.	Lymphoid leukosis	*Avian Alpharetrovirus*		Vertical and horizontal	4 – 6 months		Vircon S, 5% formalin
14.	REO Malabsorption syndrome Runting & Stunting syndromes	Orthoreovirus	S1133, 1733	Vertical and horizontal	1 – 3 days	60 days	Lye and 0.5 % organic iodine solution
15.	Avian nephritis viral infection	Astroviruses		Vertical and horizontal	3 – 4 days		Alcoholic solution, phenol, lipid solvent.
16.	Turkey Rhinotracheitis/ Swollen Head Syndrome	Avian Metapneumovirus of Paramyxo viridae		Horizontal			

References:1. OIE manual –World health organization. 2. Disease of poultry, Y.M. Saif