How to prevent vaccination failure

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Vaccination failure is often blamed on poor quality vaccine. However, the pharmaceutical industry is highly regulated and has robust internal controls in place. Vaccine failure due to problems of vaccine quality is therefore rare. Usually vaccine failure is the result of much simpler things such as inappropriate storage, vaccine transport and administration, poorly managed house environment, field challenge with very virulent or variant pathogens, immunosuppression and interference.

This article will discuss the most frequently seen causes of vaccine failure and how they can be prevented.

Storage and transport

If vaccines are not stored and transported at constant temperatures of between 2-8°C the shelf life of the vaccine will be reduced (see Fig. 1). This will result in 'weak' vaccines that will not achieve the same protection as intact vaccines. The use of dedicated fridges that can cope with extreme climatic conditions with minimum-maximum thermometers is essential for maintaining vaccine quality. Vaccines should be stored to ensure that they do not come into contact with the back of the fridge since this can result in freezing-thawing.

If large amounts of vaccine are stored it is important to ensure that the function of the fridge is not impeded so that the temperature range is kept between 2-8°C.

Transportation of vaccines from the place of storage to the site of administration should occur in dedicated cool boxes with ice packs so that optimal temperatures are maintained. The cool box must be kept clean, but be free of chemical residues which can inactivate the vaccine if they come into contact with it.

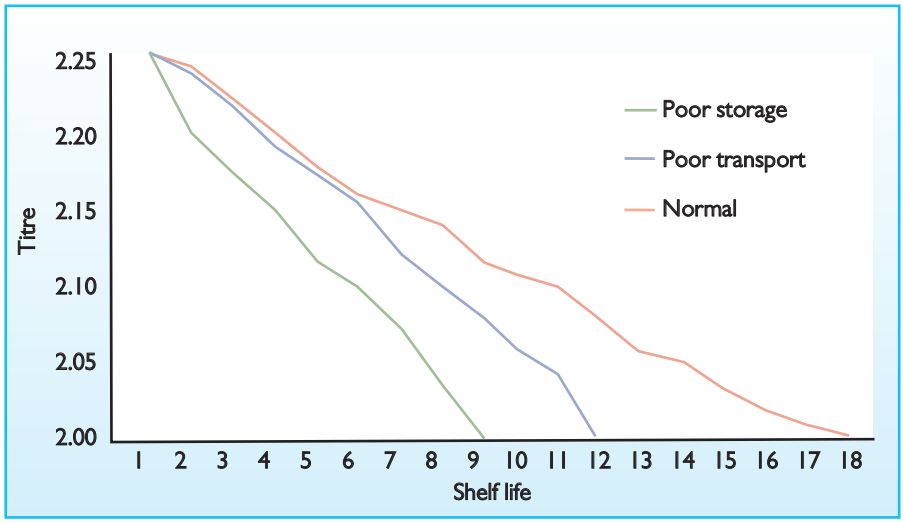
Reconstitution

Live vaccines should be reconstituted on a clean surface. The stock solution can easily become contaminated during mixing, particularly if it is done inside the poultry house or on the annex floor. Such contamination can result in local or systemic bacterial infections and increased mortality.

Hands should be clean, but free of soap and disinfectants; it is good practice to wear disposable gloves.

The use of dedicated utensils – plastic bucket, measuring jug and plastic stirrer – is recommended. These tools must be clean, but free of any chemical residues that could inactivate live vaccines.

Fig. 1. The effect of poor storage and transport conditions on vaccine shelf life.



Blue dye on the tongue of the bird to assess vaccination technique.

Vaccine protection

Some chemicals are designed to kill viruses and bacteria; as little as 0.5-1.0ppm of chlorine can kill live viral vaccines resulting in partial or no protection. If the drinking water is treated with chemicals (chlorine or water sanitisers) treatment should be stopped at least 24 hours before vaccination. Remember tap water is usually treated with varying amounts of chlorine or chloramines.

Treating the water to be used for vaccination with a low fat milk solution (2g of skimmed milk powder per litre of water) or with a commercially available chlorine neutraliser will protect the vaccine against inactivation by such chemicals.

The vaccine vials should be opened under the water at least 20 minutes after skimmed milk powder addition and the solution mixed thoroughly.

Ensure a good water line sanitation programme is in place. Biofilm in the drinker line can bind the vaccine and inactivate it.

Biofilm and scale should be removed from

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the drinker lines and drinkers (cups, bell drinkers) prior to vaccination using suitable products. Flush the lines thoroughly to ensure no chemical residues are left in the system.

Drinking water vaccination

Vaccination via the drinking water is a simple and quick method of vaccinating a flock, but poor distribution of live vaccines can result in a low uptake of the vaccine. The water intake of very young birds can vary and be irregular. This needs to be kept in mind with early vaccinations.

Check that all drinkers work properly and that the drinker space is sufficient. If the flock has uniformity problems the drinker height should be checked to ensure that all birds can access the water.

The aim when vaccinating via drinking water is to ensure that the water containing the vaccine is consumed by the flock within two hours. The amount of water required for vaccination should be estimated using the following steps:

- Measure water consumption the day before vaccination.
- Record water intake over a two hour period starting 45 minutes after feeding.
- Add 5% to this figure to account for increased water consumption on the day of vaccination. On the day of vaccination water should be removed from the flock one hour before vaccination occurs, water withdrawal should be started 45 minutes after feeding by draining and lifting up the waterlines.

During vaccination walk through the birds regularly to encourage uniform vaccine consumption. Check that the light intensity is sufficient; if it is too dark, the birds will not be able to see the drinkers, for example the water droplet at the nipple.

Measuring efficiency

It is important to assess the efficiency of vaccination once it has been completed.

If chlorine neutralisers or dyes are used, the collection of 100 birds from four different areas of the house and observation of tongue staining will give a good indication of the uniformity of vaccine consumption.

The aim is to have more than 90% of the tongues well stained.

Spray vaccination

Live respiratory vaccines are often administered by the spray technique. The most frequently seen issues with this application method are poor coverage, wrongly selected particle size and contamination.

The stock solution is ideally made up using distilled water. Deionised water is also widely used. Commercially available deionised water however can be contaminated with bacteria which can cause local or systemic bacterial infection, particularly in young chickens. Industrial deionised water should therefore be decontaminated by boiling. A safe alternative is using bottled, low mineral content still water.

The spray equipment should be operational, clean, but free of any chemical residue and if operated by batteries these should be fully charged. The type of sprayer used will depend upon the age of the chicks and the droplet size to be produced. Always turn the fans and hot air blowers off to prevent droplets being blown away from the chickens; however the period of time without the fans on should not result in any stress to the flock.

Air inlets and curtains should also be closed. Dimming the lights will calm the chickens and ensure good, even coverage. Once the vaccination is completed the inlets and curtains should be opened and the fans, heaters and lights should be switched back on. Day old chicks can be sprayed using spray in the hatchery or be sprayed with pressure sprayers on arrival at the farm. If sprayed on farm the birds should be left in the boxes for 20 minutes to allow them to dry. However, if the chicks have travelled a long distance it is better to postpone vaccination and provide instant access to water and feed.

The spray vaccination can be completed a day or two after placement. For priming always use a coarse spray (60-150um), small droplets (<10um) can penetrate deeper into the respiratory tract causing vaccine reactions in naïve chickens. Coarse droplets can be generated by pressure sprayers (for example knapsack sprayers developed for spray vaccination) and controlled droplet application devices (CDA). After chickens have been properly primed with a coarse spray they can be sprayed with an atomiser which produces smaller droplets (20-50um).

If the droplet is too big, it will quickly sink to the floor without reaching the chicken.

If it is too small, it will evaporate quickly, particularly in warmer weather. In hot and dry environments spray vaccination should be carried out early in the morning or at night to prevent vaccine loss by evaporation.

It is important to ensure that a good air quality is maintained when spray vaccinating as dusty air and high levels of ammonia (>10-20ppm) can aggravate the reaction.

When using a killed vaccine the following issues should be avoided:

- Poor storage conditions; this will shorten the shelf life of the product resulting in partial protection.
- Do not use vaccines which have exceeded their expiry date; this can also lead to partial protection.
- Improper setting and filling of the vaccine guns, lack of agitation of the bottle and not warming up the vaccine appropriately can cause under dosing and result in low levels of protection.

Conclusions

Most of the issues mentioned above are seen to occur quite frequently in the field. Good basic vaccination procedures should be in place if vaccination failure is to be prevented and for immunisation against disease to be effective and uniform. ■