Maintaining egg shell quality by vaccination

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Egg shell quality is determined by traits like smoothness, shape, structure (stability, thickness) and colour. The normal chicken egg shell is 0.3-0.4mm thick and consists of approximately 95% calcium carbonate, which is binding to an organic matrix made of proteins.

When eggs do not present a clean, normal and undamaged shell, they will be graded as 'B', or undergrades. The occurrence of undergrade eggs is usually broader than the frequency of actual shell quality deficiencies.

The former can be quite often resulting from equipment failures or inefficacies, poor handling of eggs, which is basically an inadequate management, where good shells have been abused. The latter is indeed a defective formation of the shell itself – a real case of inferior shell quality.

Inactivated vaccines induce a long lasting immunity.

Besides nutritional factors (lack of calcium, over/under dosage of phosphorus and vitamin D), environmental factors (housing, stress, heat) and the bird itself (genetics, age) there are various diseases in poultry that may have an effect on the formation of the egg shell. Deficiencies in egg shell quality will lead to serious economic losses:

- In commercial laying flocks, undergrade eggs have the lowest market value.
- Colour, shape and texture variations decrease the marketability of the egg.
- Suboptimal shells are less likely to withstand the stresses of equipment and management (cage slope, egg belts, conveyors, grading machines, casing, etc), cracking or breaking before market.
- In breeding flocks hatchability can be negatively influenced by thicker or thinner shells.

Consequently, there is a great interest in the poultry sector to minimise production losses, by control of those diseases that may influence egg shell quality – namely vaccination.

Here, we focus on some important diseases that can have a negative effect on egg shell quality. Nevertheless, these can not be controlled by the application of a good vaccination programme alone. Vaccination must be always accompanied by hygiene, biosecurity and appropriate management practices.

Infectious bronchitis control

Infectious bronchitis (IB) can be seen as one major cause for economically significant production losses in commercial laying hens worldwide.

The disease is caused by a highly contagious coronavirus with numerous serotypes. The virus leads to an infection of the respiratory tract but is also able to infect the reproductive tract as well as the urogenital tract (nephropathogenic strains).

Severity of the disease is strongly influenced by the immune status of the birds. In young chickens respiratory signs like gasping, coughing and nasal discharge prevail. In adult layers and breeders respiratory symptoms can be less severe. Instead those birds will show a serious drop in egg production and an increased number of deformed, pale coloured, rough shelled or thin shelled eggs.

Those alterations of the egg shell are caused by inflammation of the oviduct with a decrease in pH leading to disturbance of the egg shell formation. Even after production has recovered to normal the poor egg shell quality may remain over a longer period.

In layer and breeder pullets younger than three weeks of age, infection with IB can lead to a permanent damage of the reproductive tract with devastating effects for future egg production ('false layers').

Control of IB can be achieved by the use of both live and inactivated vaccines. Live attenuated IB-vaccines can be used from day of age onwards (depending on the vaccine strain) and are usually applied via drinking water, eye drop or spray.

Live vaccines are mostly used in broilers and as a primary vaccination in layers and breeders. In order to protect laying birds throughout the production period continuous revaccination with live vaccines is possible. Inactivated vaccines are applied to layers and breeders mostly prior to onset of lay in order to prevent production losses.

Initial priming with a live vaccine is necessary to reach the full potential of the inactivated vaccine. If properly used, inactivated vaccines can provide immunity during production. Besides that they allow for the combination with antigens against other diseases.

The choice between different IB vaccine strains should depend on the regional field situation. Ideally the vaccine is chosen based on the knowledge of the prevalent serotype on the premises. Commonly used vaccine strains are those of the Massachusetts serotype (H120, H52), which has a broad protection spectrum also against other serotypes (including some variant strains).

Newcastle disease control

Newcastle disease (ND) is an infectious, highly contagious disease of domestic poultry, which can be found in almost all regions worldwide. It is caused by an avian paramyxovirus serotype 1.

Differences in pathogenicity and tropism

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to certain organs between ND strains lead to a variety of clinical signs. They may vary from very mild ones, with few or no symptoms, to respiratory infections, greenish diarrhoea and possible nervous symptoms. In its most severe form the disease is characterised by a very short and acute course with mortality of up to 100%.

In breeders and layers, ND may also have an influence on egg production and egg shell quality. Therefore, first signs of the disease in layers and breeders can be thin shelled or shell less eggs, followed by a sudden and severe drop in egg production resulting in serious economic losses.

In order to prevent birds from showing clinical signs of ND, vaccination is the method of choice. Both live and inactivated vaccines can be used. Live vaccines contain mostly lentogenic (low pathogenic) ND strains and are usually applied by mass application (drinking water and spray).

The most commonly used vaccine strains are Hitchner and La sota. Depending on the vaccine strain used and the status of maternal immunity, application from day of age onwards is possible.

Live vaccination will not only lead to systemic immunity but will also induce a local respiratory immunity, which will fight the virus right at the entry and prevent further invasion of the body.

Inactivated ND vaccines are often used in combination with other inactivated antigens (for example IB, IBD, EDS, Reo).

They can be applied to adult birds before and during egg production. In any case it is very important that the vaccination programme is adapted to the regional epidemiological situation (field pressure) in order to achieve optimal protection level.

Egg drop syndrome

Egg drop syndrome (EDS) is caused by an adenovirus. The virus can be vertically transmitted but stays latent in most of the cases until peak of lay is being reached.

Then the virus is reactivated and horizontal transmission takes place as infected birds excrete the virus. Infected birds appear apparently healthy. The only clinical signs in infected flocks are failure to reach peak of production and/or a reduction in egg production (up to 40%) as well as alterations of the egg shell.

Live vaccines are the best primers for ND and IB protection.

Different to infectious bronchitis, drop in egg production and egg shell alterations occur nearly at the same time. The target organ of the virus is the oviduct; especially the epithelial cells of the pouch shell gland.

The shell gland is responsible for the synthesis of shell pigments and for transfer of calcium carbonate onto the shell membranes. Consequently, EDS infections lead to pale, thin shelled and even shell less eggs.

However, misshapen and ridged eggs are not a feature of EDS. Discolouration of brown shelled eggs is usually the first sign of the infection. Thin shelled and shell less eggs follow quickly after. Usually those altered eggs can be detected for 2-3 weeks (up to six weeks is possible).

Vaccination can give good protection against clinical signs of EDS. Flocks are being vaccinated at 14-18 weeks of age, latest four weeks prior to onset of lay, with an inactivated vaccine. Combinations with other inactivated antigens (for example ND, IB, IBD) are possible. If birds are properly vaccinated they are protected against the disease and show reduced virus excretion.

Under certain conditions, other infectious diseases are related to egg shell degradation, such as by avian pneumoviruses.

Conclusion

In order to ensure and maintain egg shell quality which meets the requirements of the egg and breeding sector, vaccination is an indispensable tool. Infectious diseases leading to egg shell alterations can be effectively controlled by vaccination and in that way production losses are reduced.

Certainly vaccination programmes have to be adapted to regional situations and needs, and biosecurity measures have to accompany the vaccination strategy. ■

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