

Adjuvants designed for *M. hyopneumoniae* vaccines

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For many years vaccination of animals has been practised to prevent infectious diseases using inactivated organisms or modified live organisms. Vaccines containing inactivated organisms require an adjuvant to induce an appropriate immune response.

A vaccine adjuvant enhances the specific immune response to the antigen, leading to an improved effectiveness of the vaccine, including immunological protection, efficacy and acceptable dosing regimens. Adjuvants can be classified according to their origin (mineral, bacterial, plant) and their composition (emulsion, suspension).

With regard to *Mycoplasma hyopneumoniae* (*M. hyo*) vaccines, inactivated whole cell vaccines are currently available.

The adjuvants used in commercially available *M. hyo* vaccines include aluminium hydroxide, carbopol (polymer), mineral oil or biodegradable oil.

Commercially available vaccines are offered in different solutions. Vaccines containing carbopol or aluminium hydroxide are produced as water based suspensions, whereas the oil adjuvant vaccines are produced as different emulsions.

These different adjuvants have their own specific characteristics in pigs which are as follows:

- The pig tolerates aluminium hydroxide, but frequent re-vaccinations are needed.
- Oil in water (o/w) adjuvants have better immune stimulating properties than aluminium hydroxide. However, due to

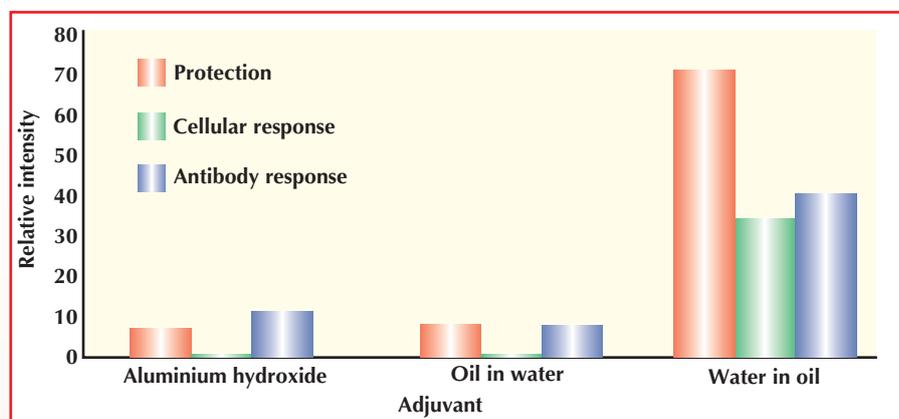


Fig. 1. Immune response characteristics of pig vaccines three months after injection, using different adjuvants.

a relatively quick release of antigen, the duration of immune stimulation is short.

To achieve a long term protection, a vigorous adjuvant oil is needed. In commercially produced vaccines, mineral oil is used as the stimulating oil phase. Oil in water adjuvanted vaccines are more aggressive and can cause local reactions, such as inflammations and abscesses.

● Water in oil (w/o) emulsions are made of very small droplets of antigenic medium dispersed in biodegradable oil. The oil captured antigen is slowly released after the injection and, therefore, provides a smooth but long lasting stimulation of the immune system.

In general, the onset of immunity is modulated by the progressive liberation of the antigen after only a few days and is maintained for a long period, compared to other adjuvant systems.

The typical immune response charac-

teristics of these three adjuvants have been investigated by Dupuis (2002) and are shown in Fig. 1.

Two important types of emulsions are used for *M. hyo* vaccines. One is an oil in water (o/w) emulsion, where the continuous phase is water and the dispersed phase is mineral oil based (for example Amphigen + Drakeol + Thiomersal), the other is the water in oil (w/o) emulsion, where the antigenic phase is made of droplets dispersed into a continuous oily phase (Impran in Ingelvac *M. hyo*).

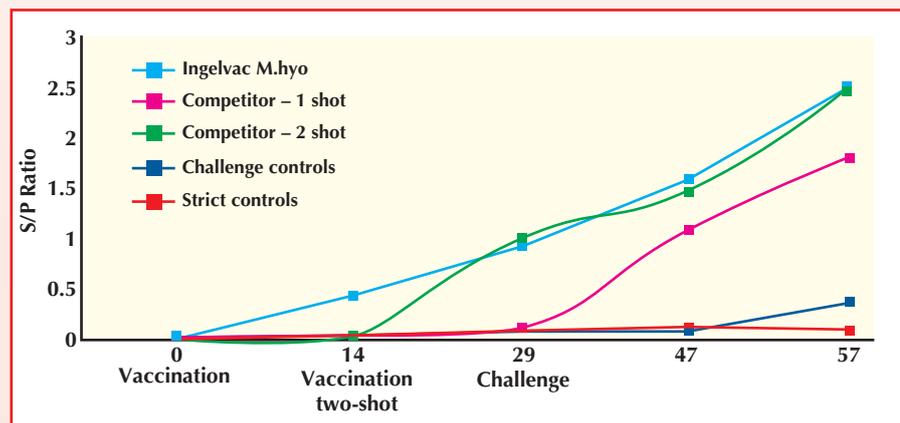
Focusing on a single dose vaccine with long term efficacy, current research has shown that the development of innovative w/o emulsions provide the following advantages over adjuvants containing mineral oils:

- The slow release of the antigen ensures both a progressive and long stimulation of the immune system.
- The biodegradability ensures a faster immune response.
- The non-mineral oil w/o emulsion minimises any possible local side effect at the injection site.

Since the polarity of the oils can be adjusted to the antigen, non-mineral w/o adjuvants have become more efficient.

Depot one shot vaccines were designed with all the advantages mentioned above. Roof (2001) compared the humoral and cellular immune response to vaccination with a mineral oil based product, Ingelvac *M. hyo*, unvaccinated and challenged controls as well as strict (unchallenged and unvaccinated) controls.

Fig. 2. Serology response, following vaccination with different mycoplasma vaccines.



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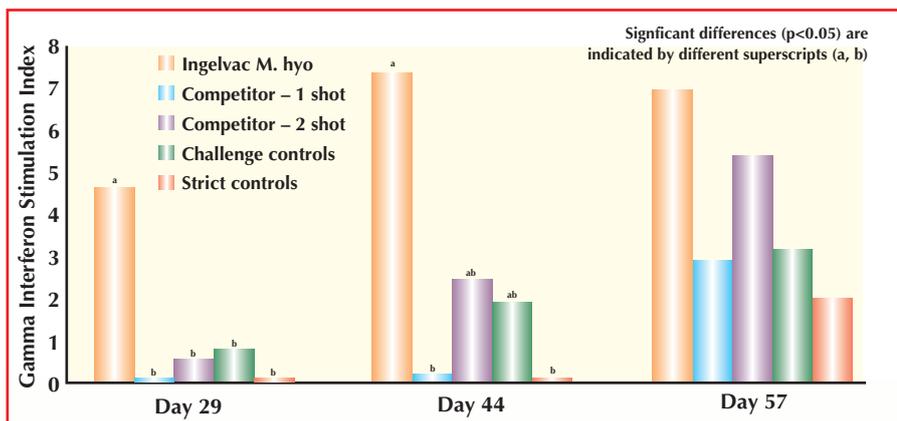


Fig. 3. Cellular immunity, measured as gamma-interferon stimulation index, following vaccination with different mycoplasma vaccines.

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As shown in Figs. 2 and 3, the depot one shot Ingelvac M. hyo provides the best results in stimulating both the humoral and the cellular immunity.

Strikingly, Hoogland et al. found an influence of different adjuvants on the severity of PCV2 associated diseases.

In short terms, they found out that the mineral oil in water adjuvants increased the severity of PCV2 associated lesions, viraemia length, and increased the amount of PCV2 in serum and tissue.

Therefore, the authors recommend that producers with recurrent PCV2 associ-

ated diseases may want to consider switching to non-aggressive products.

The smooth but rapid onset of immunity and a long lasting protection provided by modern depot one shots are proven. In a recent study Roof (2004) has shown that Ingelvac M. hyo induced significant levels of protection by two weeks post vaccination.

This is the fastest onset of immunity for a M. hyo vaccine, when compared to conventional two dose or one dose competitor's regime, which induce the onset of immunity between 3-5 weeks following vaccination.

The aqueous phase of the emulsion of Ingelvac M. hyo seems to be responsible for this rapid immunity.

Subsequent release of the depot antigen from the oily phase may be responsible for the long lasting immunity. This durable protection, lasting 34 weeks following vaccination with Ingelvac M. hyo, was shown recently in a field setting by Genzow et al. (2004).

In conclusion, optimum emulsion formulations, using new biodegradable oils and well tolerated surfactant, enabled the development of very stable pig vaccines.

Ingelvac M. hyo, containing the non-mineral oil adjuvant Impran, utilises the advantages of w/o emulsions efficiently by providing the fastest onset of immunity, an optimised release of the antigen over time and an outstanding long lasting immunity of up to 34 weeks.

Further, researchers showed that, in later stages of infection with PCV-2, mineral oil adjuvanted M. hyo vaccines increase the severity of PCV2 associated lesions. Water in oil based adjuvanted vaccines, such as Ingelvac M. hyo, provide an excellent option for a safe and efficacious vaccination against enzootic pneumonia. ■

References are available from the author on request