Comparative study of the efficacy of commercial single-dose vaccines

Commercially available vaccines against Mycoplasma hyopneumoniae are effective in preventing the appearance of clinical signs and lung lesions, as well as reducing the frequency and severity of these lesions; however, several articles have described differences between commercial vaccines in their efficacy in controlling the disease.

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Mycoplasma hyopneumoniae (M. hyo) is one of the most widespread pathogens globally, causing significant losses in growth and, therefore, economic losses. It is considered the main causative agent of enzootic pneumonia (EP), as well as one of the main agents involved in the porcine respiratory disease complex (PRDC).

M. hyo adheres to the pseudo-stratified ciliated epithelium that covers almost the entire respiratory system, thus compromising its defence capacity and triggering a significant inflammatory reaction at the pulmonary level.

Thus, it causes clinical pictures of a dry, chronic and non-productive cough. It is a bacterium that does not penetrate the individual's organism, as other pathogens can do, but rather it remains on the surface of the mucosa of the respiratory system, destroying the histological structure of the epithelium.

Consequently, it 'dismembers' the defence mechanisms of the host and, as a result, facilitates the infection of other concomitant agents, not only by its direct action but also by an indirect effect.

There are several factors we can consider in the control of M. hyo infections. First, optimising management practices and housing conditions will have a positive impact on disease control. Several factors should be considered in this regard: farm size, stocking density, production system, the purchase and introduction of new animals, biosecurity, and optimisation and improvement of housing conditions.

Another control point could be antibiotic therapy; numerous papers have been published with the aim of demonstrating the variable efficacy of different types of treatment to minimise effects. In addition, vaccination is a control mechanism.

Previous studies show that in some countries approximately 70% of pig production is vaccinated against M. hyo each year, a trend that increases as the industry becomes more innovated. Commercially available vaccines are effective in preventing the appearance of clinical signs and lung lesions as well as in reducing the frequency and severity of these lesions; nevertheless, several articles have described differences in the efficacy between commercial vaccines in controlling the disease.

However, despite their efficacy for control, to the authors' knowledge, to date no literature has been able to demonstrate the role of vaccination in reducing colonisation.

Within the wide range of monovalent vaccines available, most are for intramuscular administration, except for one vaccine for intra-dermal administration.

Several studies have demonstrated not only the greater efficacy of Porcilis M Hyo ID single dose compared to other intramuscular vaccines (in terms of average daily gain, reduction of clinical signs and lung lesions), but also increased levels of local protection at the pulmonary level compared to some vaccines, measured in the form of IgA and IL-10.

Objective

The objective of this field study was to compare two commercial M. hyo vaccines against an unvaccinated control group, one vaccine administered intramuscularly and the other intradermally, based on different strains of M. hyo, to evaluate possible differences in the growth of pigs on a commercial farm, as well as the control of associated lung lesions.

Table 1. Description of the study groups.

Group	Weeks	M. hyo vaccination	No. of animals with individual identification
Control (C)	1 & 2	NO	440
Intradermal (ID)	3 & 4	Porcilis M Hyo ID	440
Intramuscular (H)	5 & 6	Competitor	440

Materials and methods

This field study was developed on a commercial farm with production at two sites. One site was the sow farm with weekly batches weaning at four weeks and growing piglets up to nine weeks old, and the other site was the finishing unit consisting of three identical barns with a capacity of 1,250 animals each.

This was a farm with a history of PRDC problems, diagnosed both by laboratory analysis and by lung lesions on the farm and in the slaughterhouse. For the trial, all the piglets produced during six consecutive weeks were included.

All piglets were vaccinated before weaning with the same vaccine against PCV2 (Porcilis PCV), whereas the vaccination programme against M. hyo determined the creation of three groups (Table 1): two weeks of production without vaccination against M. hyo (group C, control), two weeks of production with piglets vaccinated with Porcilis M Hyo ID single dose (group ID), and the last two weeks with piglets vaccinated with a competitor's product (group H).

Each of these three groups were housed in a different finishing barn at the finishing unit associated with the trial. All vaccinations were carried out according to the product data sheet.

All groups were 'randomised' in terms of age at weaning, the parity number of the sow, and the study avoided introducing low viable piglets. From each week of production, 220 piglets were individually identified, so that each group consisted of a total of 440 individually identified piglets.

These pigs were weighed at three points during the study: at weaning, just before entry into the finishing barn, and just before the start of loading for slaughter. In addition, blood samples were taken from 16

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pigs from each group at 3, 6, 9, 13, 17, and 21 weeks of age to evaluate the presence of other agents involved in PRDC.

At the time of the last weighing prior to the start of the loads, bronchoalveolar scrapings were taken from 30 pigs from each of the groups for rt-PCR analysis for M. hyo.

Once the loads to the slaughterhouse started, a study of lesions consistent with EP was carried out using the 0-5 method and for pleuritis using the SPES method.

This was a blind study carried out by external personnel not involved in the trial. For the slaughterhouse evaluations, the first and last loads from each barn were excluded, as well as the shared loads to avoid possible confusions.

For the statistical analysis, only individuals with complete data were studied. For these studies, the SPSS v.22 package was used, ANOVA for the study of weights and bronchoalveolar scrapings, and Chi-square for qualitative variables, with the application of the Bonferroni correction for multiple comparisons.

Results

The results from the distinct groups are shown in Tables 2, 3 and 4. The analysis of serum samples showed that PRRS virus infection behaved in the same way in all groups, with all piglets PCR negative at three weeks of age, the time of vaccination, with the first positives appearing at six weeks of age in all groups.

With respect to PCV2, no viraemic pigs were detected in any group except at 21 weeks of age, but with log values below 10E3, which are not clinically relevant, and which were similar in the three groups, with no consistent clinical signs appearing at any time. Seroconversion to both Actinobacillus pleuropneumoniae and M. hyo was present in all animals sampled; with respect to M. hyo, seroconversion upon vaccination was detected in group H, as well as a slightly earlier infection than in the other two groups, already visible at 17 weeks of age, and which continued until the pigs were slaughtered as it was also detected in the lung evaluations.

Discussion

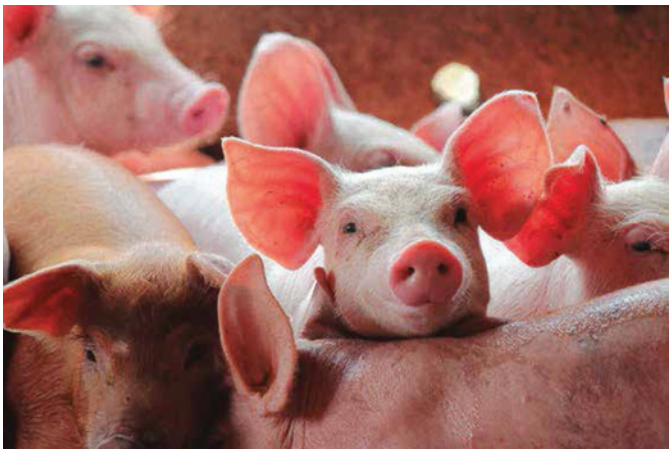
The trial was developed as a longitudinal study in which weaned piglets were included for six consecutive weeks. The reason for choosing this protocol, rather than one in which the different groups were mixed in the same week, was to eliminate the interaction effect of treatments within the same week.

In addition, the protocol used in this trial made it possible to avoid the possible interaction between the different treatment groups if they were to have been temporarily housed together.

It has been published in other studies that, when cohabiting, the control group can benefit from the decrease in infection pressure promoted by the presence of vaccinated groups; similarly, cohabitation can mask this same effect in a less effective vaccine with respect to another that confers greater protection. On the other hand, this design also facilitated slaughterhouse evaluation.

Despite the extreme care taken in the selection of piglets at birth, unfavourable differences in weaning weights were detected for the control group.

It was considered that this was possibly due to the average age of the weaned piglets (average of one day less than the other groups) and perhaps to a higher incidence of neonatal diarrhoea in this group. This



fact was taken into consideration for the statistical analysis of the rest of the weights in the study.

Despite the initial inconvenience, it gives consistency to the study, since a study of this style that does not start considering weights at weaning but rather at the entrance to the finishing unit, for example, can mask this type of initial effect.

When randomising the piglets in the groups, great care was taken to ensure that all groups included the same number of piglets born to first parity sows, since this is considered an important risk factor in detecting a high prevalence of M. hyo at weaning and, consequently, a higher incidence of EP during the growth phase.

At Weight 3, when compared to the C group, statistically significant differences were only found in favour of the ID group (p=0.001; 4.4kg). Although group H had a higher weight than group C, the differences were not significant. Again, the average age of the animals in each group could be an influential factor since the pigs in group C were an average of one day older than the other two groups, and some studies show that the individual growth of the pigs at these ages can be close to 1kg per day.

In addition, and associated with the presence of lung lesions compatible with EP that were detected in the slaughterhouse evaluation, if the weight were to be taken on the day the animal was slaughtered, the differences found would probably have been greater.

As for the bronchoalveolar scrapings, there was a significant difference in the negativity of the pigs in the ID group compared to the other two groups, where practically all the animals were positive by rt-PCR. This fact may serve to consolidate the detected differences in weights, and it could be hypothesised that this is related to the greater local protection conferred by this intradermal vaccine. Likewise, although it is true that in group H a smaller number of animals were evaluated due to problems with access to the processing plant, we can see that significant differences were again observed in favour of the ID group compared to the other two groups.

In this case, the differences are observed both in the analysis of lesions compatible with EP and pleuritic lesions, which are also lower in the ID group. Some studies relate increased lesions produced by Actinobacillus pleuropneumoniae (App) with those cases in which there is co-infection with M. hyo. ■

References are available from the authors on request

Table 2. Results of the growth study.

Study group	Weight 1		Weight 2		Weight 3	
	Age (days)	Av. wt (kg)	Age (days)	Av. wt (kg)	Age (days)	Av. wt (kg)
C	21.8	5.84[a]	57.0	16.01	162.3	93.05[a]
ID	22.4	6.30[b]	57.4	16.78	161.4	97.45[b]
H	22.8	6.13[b]	57.3	16.61	160.9	93.44[a]

[a,b] different superscripts in the same row indicate statistically significant differences

Table 3. Results of bronchoalveolar scrapings (rtPCR M. hyo; EXOone Mycoplasma hyopneumoniae oneMIX, qPCR).

Study variable	Study group			P value
	C	ID	H	
Positive samples	29/30 (96.7%)[a]	11/30 (36.7%)[b]	30/30 (100%)[a]	<0.001

[a,b] different superscripts in the same row indicate statistically significant differences

Table 4. Results of the evaluations at the slaughterhouse.

Study variables	Study group			P value
	C	ID	H	
Disease index (NE)	0.8	0.5	0.7	0.368
EP prevalence (positives/evaluated and %)	153/303 (50.5%)[a]	138/393 (35.1%)[b]	87/185 (47.0%)[a]	<0.001
Maximum lesions (positives/evaluated and %)	6/303 (2.0%)	2/393 (0.5%)	1/185 (0.5%)	0.123
Pleuritis prevalence (positives/evaluated and %)	119/303 (39.3%)[a]	88/393 (22.4%)[b]	55/185 (29.7%)[a,b]	<0.001
APPI	0.7	0.4	0.7	0.331

[a,b] different superscripts in the same row indicate statistically significant differences