Introduction

Enzootic pneumonia caused by *Mycoplasma hyopneumoniae* is one of the major chronic respiratory tract diseases, that principally affects growing pigs in intensive production.

Enzootic pneumonia causes substantial economic losses which may be attributable to increased susceptibility to other respiratory pathogens [1, 2] and reduced zootechnical performances [10, 11].

Methods to control chronic infections with *M. hyopneumoniae* are limited to the use of antibiotics, environmental and management improvement, and vaccination.

The purpose of the present study was to evaluate, under field conditions in France, the efficacy of vaccination with SUVAXYN M.HYO® (Fort Dodge Animal Health) in the control of enzootic pneumonia caused by *M. hyopneumoniae*.
Material and methods

EXPERIMENTAL DESIGN AND TREATMENTS

This experiment was a controlled and randomised clinical field study.

It was conducted by the Centre Technique des Productions Animales et Agro-Alimentaires, in Brittany, the largest and economically dominant area of pig production in France.

Three farrow-to-finish piggeries, identified as suffering from chronic enzootic pneumonia caused by *M. hyopneumoniae*, through serological analysis and lesion observations at slaughter, were included in the study.

Within each of the three piggeries selected, piglets from four successive batches of sows were randomly allocated into two treatments groups. All the piglets of a given batch received the same treatment: a whole batch of piglets was vaccinated either with a dose of 2 ml of SUVAXYN M.HY0®, between 3 and 10 days of age and 2 weeks later, or with the same dose of placebo, according to the same vaccination schedule. The study was blinded using a product code letter which was only broken at the end of the statistical analysis of results.

A total of 2447 piglets (1179 in the vaccinated group and 1268 in the placebo group) were included in the study and individually monitored from the first vaccination up to slaughter, i.e. over a total experimental period of 10 months.

MEASUREMENTS

Local and general adverse reactions were checked at the vaccination time, and 24 and 48 hours later. Five piglets per batch were blood sampled for *M. hyopneumoniae* antibodies titration (ELISA) just before the first vaccine or placebo injection, 3 weeks after the second one, and at slaughter. The animals were individually weighed at the beginning and at the end of the fattening period, just before slaughter and average daily gains (ADG) per batch were calculated. The mortality rate, and the average number of days of treatment for respiratory disease per pig (therapeutic index), were calculated.

At slaughter, the percentage of lungs showing pneumonia lesions was recorded and pneumonia lesions were scored based on the validated scoring system described by MADEC and KOBISCH [5]. A sample of lungs showing pneumonia lesions was collected at slaughter. A seroconversion to *M. hyopneumoniae* was checked by immunofluorescence. Pleuritis lesions and abscesses were also recorded and scored using a 0-1-2 scale (0: no pleuritis lesion, 1 = pleuritis lesions which allow the separation of the lung from the carcass, 2 = pleuritis lesions with no separation of the lung from the carcass possible). The carcass muscle ratio was recorded.

STATISTICAL ANALYSIS

Incidence of lungs with pneumonia lesions, pleuritis rates and mortality rates were compared by the Mantel-Haenszel Chi² test adjusted on the piggeries. The pneumonia lesion scores, the ADGs and the muscle ratio were compared between flocks by a 2 factors analysis of variance (group x piggery).

The pleuritis lesion scores were compared by the Mean Score Statistic.

No statistical analysis was performed on the rate of abscesses and on the abscess score (too few animals affected).

The therapeutic index was compared between groups by the Kruskal-Wallis test.

General adverse reaction rates were analysed by the Fisher’s Exact Test. No statistical analysis was performed for local adverse reactions (no local adverse reaction was observed).

All statistical analysis were done using a α value of 5 % (p ≤ 0.05) and using the software SYSTAT® [12].

Results

At slaughter, the rate of lungs harbouring pneumonia lesions was significantly lower in the vaccinated group (p < 0.001): the frequency of pneumonia lesions was reduced from 73.9 % in the placebo group to 56.2 % in the vaccinated group (table I). In addition, the average pneumonia lesion score in affected pigs was significantly decreased (p < 0.001) from 7.0 in the placebo group to 5.6 in the vaccinated group (table II).

The pleuritis rate was also significantly lower (p < 0.05) in the vaccinated group (table III). It was 3.8 % in the vaccinated group and 6.2 % in the placebo group. In addition, the pleuritis lesions were significantly less severe (p < 0.05) in the vaccinated group (table IV). In particular, the incidence of score 2, the score responsible for carcass condemnation at slaughter, was substantially lower in this group.

The rate of lungs with abscesses was 0 % in the vaccinated group and 0.25 % (2/801) in the control group in which abscesses were observed on only 2 lungs, with a score 1.

No significant difference could be observed in the average daily gains (ADGs). However, the higher ADGs were associated with the lower pneumonia lesion scores (graph I). Moreover, in the farm in which pneumonia lesions were the most severe, an improvement of 4.8 % of the ADG was observed in the vaccinated group.

No significant difference was obtained for the other parameters described in table V.

No local adverse reaction was observed. One vaccinated piglet showed nervous signs 24 hours after vaccination, which disappeared spontaneously in the following days and which were not attributed to vaccination.

In the three farms and in all the successive batches tested, *M. hyopneumoniae* was isolated from the lungs affected by pneumonia collected at slaughter. A seroconversion to *M. hyopneumoniae* was observed in all the batches tested.
### Table I — Frequency of pneumonia.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Lungs with no pneumonia lesions (%)</th>
<th>Lungs with pneumonia lesions (%)</th>
<th>Total (%)</th>
<th>Statistical analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccine</td>
<td>376 (43.77)</td>
<td>483 (56.23)</td>
<td>859 (100.00)</td>
<td>P &lt; 0.001</td>
</tr>
<tr>
<td>Placebo</td>
<td>201 (26.10)</td>
<td>569 (73.90)</td>
<td>770 (100.00)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>577</td>
<td>1052</td>
<td>1629</td>
<td></td>
</tr>
</tbody>
</table>

### Table II — Distribution of lung lesion score\(^{(1)}\) by farm.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Farm 1 (SD(^*))</th>
<th>Farm 2 (SD)</th>
<th>Farm 3 (SD)</th>
<th>Total (SD)</th>
<th>Statistical analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccine (A)</td>
<td>5.99 (4.22)</td>
<td>5.82 (3.91)</td>
<td>4.27 (3.81)</td>
<td>5.60 (3.99)</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>Placebo (B)</td>
<td>6.04 (3.83)</td>
<td>6.90 (4.48)</td>
<td>8.19 (5.93)</td>
<td>7.02 (4.78)</td>
<td></td>
</tr>
<tr>
<td>% of decrease</td>
<td>([(B-A)/B])</td>
<td>0.8% (15.7%)</td>
<td>4.79% (47.9%)</td>
<td>20.2% (20.2%)</td>
<td></td>
</tr>
</tbody>
</table>

* SD = Standard deviation

\(^{(1)}\) scale 1 to 28

### Table III — Rate of pleuritis.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No pleuritis lesion (%)</th>
<th>Pleuritis lesions (%)</th>
<th>Total</th>
<th>Statistical analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccine</td>
<td>845 (96.24)</td>
<td>33 (3.76)</td>
<td>878</td>
<td>p &lt; 0.05</td>
</tr>
<tr>
<td>Placebo</td>
<td>751 (93.76)</td>
<td>50 (6.24)</td>
<td>801</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1596 (95.06)</td>
<td>83 (4.94)</td>
<td>1679</td>
<td></td>
</tr>
</tbody>
</table>
TABLE IV. — Distribution of the pleuritis scores.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Score = 0 (%)</th>
<th>Score = 1 (%)</th>
<th>Score = 2 (%)</th>
<th>Total</th>
<th>Statistical analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccine</td>
<td>845 (96.24)</td>
<td>14 (1.59)</td>
<td>19 (2.16)</td>
<td>878</td>
<td></td>
</tr>
<tr>
<td>Placebo</td>
<td>751 (93.76)</td>
<td>19 (2.37)</td>
<td>31 (3.87)</td>
<td>801</td>
<td>p &lt; 0.05</td>
</tr>
<tr>
<td>Total</td>
<td>1596 (95.06)</td>
<td>33 (1.97)</td>
<td>50 (2.98)</td>
<td>1679</td>
<td></td>
</tr>
</tbody>
</table>

NS : no statistically significant difference (p > 0.05).

TABLE V. — Zootechnical results.

<table>
<thead>
<tr>
<th></th>
<th>Vaccine</th>
<th>Placebo</th>
<th>Statistical analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average daily gain (g)</td>
<td>797</td>
<td>795</td>
<td>NS</td>
</tr>
<tr>
<td>Carcass muscle ratio (%)</td>
<td>60.7</td>
<td>60.8</td>
<td>NS</td>
</tr>
<tr>
<td>Therapeutic index (days)</td>
<td>1.72</td>
<td>0.02</td>
<td>NS</td>
</tr>
<tr>
<td>Mortality rate (%)</td>
<td>2.96</td>
<td>2.45</td>
<td>NS</td>
</tr>
</tbody>
</table>

NS : no statistically significant difference (p > 0.05).

GRAPH 1. — Relation between the pneumonia score and the average daily gain.
Discussion

The two treatment groups were similar for the distribution of treatments per farm, for sex ratio and for the weight at the beginning of the fattening period.

The sites included in the study were exposed to a very high Mycoplasma hyopneumoniae challenge, as shown by the extremely high pneumonia rate observed in the placebo group at slaughter (73.9 %). Despite this high challenge, a significant decrease in the pneumonia rate was obtained by the vaccination.

The high Mycoplasma hyopneumoniae challenge was also indicated by the severity of pneumonia lesions in the placebo group. The average pneumonia score (7.02) observed in this group is very high compared to usual scores obtained in this production area. A significant decrease in the pneumonia score was obtained by the vaccination. Moreover, in the farm showing the highest average score in the placebo group (farm 3, average score 8.19), vaccination decreased the severity of the lesions by about 50 %.

Average daily gains obtained in this study were consistent with usual ADGs currently obtained in Brittany [9]. No significant difference was observed between the ADGs of the two experimental groups, although the effect of the vaccine on pneumonia rate and lesions was demonstrated.

In the particular conditions of a field clinical trial, management techniques or health status of the farm can interfere with the effects of vaccination or treatment against respiratory diseases on the improvement of zootechnical parameters. The vaccination or the treatment is applied only to some experimental pig batches selected within a farm where most of the contemporary animals remain unvaccinated or untreated. This prevents any decrease of the infection pressure. In addition, in the field, vaccination against Mycoplasma hyopneumoniae is known not to produce systematically an improvement of ADGs before all the successive pig batches of a given farm have been vaccinated and before the slaughter of the last unvaccinated batch from this farm, which corresponds to several months of use [3].

On the other hand, in the present study, a higher ADG was observed with the vaccine in the farm where pneumonia lesions were the most severe (farm 3). This result may be explained by the fact that in this farm, the pneumonia was so severe that its impact on growth was higher than the contribution of the other environmental factors. Some animals (298 in total) from all farms and from both groups did not lose their identification ear tag during the slaughter process. In this subsample, the correspondence between individual growth and pneumonia lesion could be observed for each animal. The average daily gain decreased with the severity of pneumonia lesions in the placebo group.

A significant decrease in the pneumonia score was obtained by the vaccination. Moreover, in the farm showing the highest average score in the placebo group (farm 3, average score 8.19), vaccination decreased the severity of the lesions by about 50 %.

Regarding the therapeutic index, the results were not interpretable because in one farm tiamulin was orally administered to the two batches in the tested groups (to all animals of these batches), for digestive problems (diarrhoea) at the pre-fattening stage. As tiamulin is also prescribed for respiratory infections, these collective treatments had to be included in the calculation of the therapeutic index.

Conclusion

The present study has demonstrated the safety and the efficacy of vaccination with SUVAXYN M.HYO® in the control of enzootic pneumonia caused by Mycoplasma hyopneumoniae, under field conditions, in France.

In herds chronically infected with Mycoplasma hyopneumoniae, vaccination with SUVAXYN M.HYO® reduced not only the rate of pneumonia, but also the severity of pneumonia lesions. It also reduced the frequency and the severity of pleuritis lesions.

Acknowledgements

The authors wish to thank Mr PHILIPPE and Mr GOUEDARD, from ZOOPOLE développement, Centre Technique des Productions Animales et Agro-alimentaires, for their precious technical assistance throughout the experimental period.

References


