Evaluation of the efficiency of one dose of autogenous MJPRRS® vaccine with 10% extra adjuvant in reducing PRRS virus replication and mortality in PRRS naïve 21 day old pigs prior to and during viremia

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Introduction

As the swine industry moves forward in eliminating or improving its ability to manage PRRS virus, understanding the impact of vaccines and how they play a role in this goal become even more important. Unfortunately there continues to be an incomplete understanding of immunity relating to this disease, which makes it more difficult for vaccines to always be effective or how to make vaccines more effective. Today one's option for vaccine includes either commercial modified live vaccine or killed autogenous vaccine. Most of the published information and field data experience surrounds the use of commercial modified live vaccines. Historically, killed vaccines in general have been thought to be marginal at best in efficacy. The purpose of this study was to gain a better understanding of the role and efficacy that the autogenous MJPRRS® vaccine may play in controlling or managing the PRRS virus.

Materials and methods

Challenge virus used was a field isolate with a 1-18-2 RFLP (Group D-4 under MJPRRS® Virus Grouping). Virus inoculum was prepared by two methods. The virus culture was inoculated into a naïve 21 day old pig and serum was collected 5 days later. The same virus culture inoculated on cell culture and harvested 7 days later. Both challenge materials were negative for PCV-2 and Mycoplasma. Table 1 summarizes results.

Trial one (Vaccination of PRRS naïve pigs and challenged with PRRSV 32 days later)

Pigs allowed to acclimate to environment for 7 days before receiving a 2 ml-dose of autogenous MJPRRS® with extra adjuvant (a dose consisted of 1.8 ml MJPRRS and 0.2 ml Emulsigen-D® from MVP Laboratories, Omaha, NE). All pigs received 2 mls of M+Pac at this time because the source farm was reported as Mycoplasma-positive. Four groups of 11 pigs were assigned and challenged with either serum or culture material. Challenge dose used was 0.5mls IM and 0.5mls IN dosage.

Trial two (Challenged with PRRSV and vaccinated 4 days later)

Pigs challenged with PRRS virus at arrival. Challenge dose used was the serum origin inoculum administered at a 10-fold diluted 0.5ml IM and an undiluted 0.5ml IN. Pigs vaccinated with a 2 ml-dose MJPRRS with the extra adjuvant at 4 days post challenge. Two groups of 12 pigs were assigned and either challenged-vaccinated or challenged-unvaccinated.

Statistical analysis

Statistical analysis of data was completed at Iowa State University. For trial one, data analysis for study was performed using the GLIMMIX procedure in SAS software, version 9.2. P-values less than or equal to 0.05 were considered significant. Log transformation of RNA copies/ml was completed and denoted as logy. This is a repeated measure, so the logy variable was analyzed using a linear model and a variance-covariance model that incorporates correlations for all of the observations arising from the same piglet. Day and vaccine are treated as the fixed effect. The data was assumed to be Gaussian, and their likelihood was maximized to estimate the model parameters. It was identified that the unstructured matrix was the best to

Table 1:

Type of inoculum	ORF6-copies per ml	Calculated IVP's per ml	$TCID_{50}$
Serum	10^9	2,341	10^2
Culture	10^{10}	24,416	10^3

use as the variance-covariance matrix. It was than determined that the vaccine and day factor had significant effect on the logy. Least square means of logy for vaccine and day factor showed a significant effect with the vaccine. Partitions of the vaccine and day interaction effect for all levels of variable day were than created. This is shown in table 5 as vaccine compared to no vaccine at days 5, 11, 12 post challenge.

For trial two, data analysis for study was performed using the MIXED and GLEMMEX procedure in SAS software, version 9.2. P-values less than or equal to 0.05 were considered significant. Log transformation of RNA copies/ml was completed and denoted as logy. This is a repeated measure, so the logy variable was analyzed using a linear model and a variance-covariance model that incorporates correlations for all of the observations arising from the same piglet. Day and vaccine are treated as the fixed effect. The data was assumed to be Gaussian, and likelihood was maximized to estimate the model parameters. It was identified that the unstructured matrix was the best to use as the variance-covariance matrix. It was than determined that the day factor and interaction between vaccine and day had significant effect on logy. Partitions of the vaccine and day interaction effect for all levels of variable day were than created. This is shown in table 6 as vaccine compared to no vaccine by days 1, 2, 7, and 10 post vaccination.

Results and discussion

For trial one, table 2 shows average rectal temperature differences between groups. Temperatures were taken at days post challenge. The baseline temperature for groups prior to challenge was 102.5. Raw data would demonstrate that a fever response occurred 48hrs after challenge with minimal differences between groups.

Table 3 shows mortality differences between MJPRRS® vaccinates and non-vaccinates. Vaccinates averaged 4.5% mortality (1 of 22hd) and non-vaccinates averaged 18% (4 of 22hd).

Table 4 compares virus replication in MJPRRS® vaccinates versus non-vaccinates. Analysis of data and statistical methods were previously discussed. All pigs were bled at day 5, day 11, and day 23 post PRRS challenge. PRRS quantitative PCR's were completed. A statistically significant reduction in virus replication was demonstrated in the MJPRRS® vaccinated groups at day 5 and day 11 post challenge as compared to non-vaccinates. No difference was detected at day 23 but it is speculated that group size at this point may have contributed to this due to higher mortality in non-vaccinates.

For trial two, table 5 shows average rectal temperature differences between groups. These pigs were challenged with PRRS virus and vaccinated with MJPRRS® 5 days post challenge with the goal to mimic vaccination during peak viremia. Temperatures were taken at day of vaccination, day 3, day 4, and day 7 post vaccination. The baseline temperature of pigs at time of challenge was 102.5. Data demonstrates that pigs were feverish at time of vaccination and no differences noted between groups.

Table 2: Average rectal temperature, trial one

Challenge with	Test group	Day 2	Day 5	Day 8	Day 11	Day 15	Day 23
Serum	Myco only	105.2	105.4	105.0	104.4	103.5	102.5
	Myco & MJPRRS	105.8	104.5	105.0	104.1	102.8	102.9
Culture	Myco only	106.2	105.0	105.9	105.5	103.5	103.2
	Myco & MJPRRS	106.4	104.4	105.3	103.6	103.4	102.1
Overall	Average	105.9	104.8	105.3	104.4	103.3	102.7

Table 3: Mortality, trial one

Challenged with	Test group	Mortality at day 23 post challenge
Serum	Myco only	3 of 11 (27%)
	Myco & MJPRRS	1 of 11 (9%)
Culture	Myco only	1 of 11 (9%)
	Myco & MJPRRS	0 of 11 (0%)

Table 4: Virus replication, trial one

Simple effect comparisons of MJPRRS® days least squares means by days

Simple effect level	Myco- only	Myco & MJPRRS	Estimate	Standard error	DF	T value	Pr > |t|
Days 5	No	Yes	0.5558	0.2618	40	2.12	0.0400
Days 11	No	Yes	1.0552	0.3890	40	2.71	0.0098
Days 23	No	Yes	0.5903	0.5715	36.1	1.03	0.3085

Table 5: Average rectal temperatures, trial two

Challenge with	Test group	Day of vaccination	Day 3 post vaccination	Day 4 post vaccination	Day 7 post vaccination
Serum	No vaccination	104.2	104.4	104.4	104.0
	MJPRRS	104.3	104.8	104.2	104.2

Table 6 shows mortality differences between vaccinates and non-vaccinates. Both groups demonstrated high mortality.

Table 7 compares virus replication in MJPRRS® vaccinates and non-vaccinates when receiving vaccine while clinically active with PRRS virus (vaccination occurred day 5 post challenge). Analysis of data and statistical methods were previously discussed. All pigs were bled at day 1, day 2, day 7 and day 10 post vaccination. This correlates with day 5, day 7, day 12, and day 15 post virus challenge. PRRS quantitative PCR's were completed. A statistically significant reduction in virus replication was demonstrated in the MJPRRS® vaccinated group at day 7 and day 10 post vaccination despite being already viremic.

Conclusion

Data derived from this trial demonstrated that one dose of autogenous MJPRRS® vaccine with 10% extra adjuvant was able to statistically reduce PRRS virus replication in PRRS naïve 21 day old pigs when challenged 32 days after vaccination and able to reduce PRRS virus replication in PRRS clinically active pigs when vaccinated 5 days post challenge. Additionally a reduction in mortality was noted in the naïve pigs vaccinated and challenged 32 days later as compared to the non-vaccinate group.

Table 6: Mortality, trial two

Challenged with	Test group	Mortality at day 10 post vaccination
Serum	No vaccination	3 of 12 (25%)
	MJPRRS	2 of 12 (16%)

Table 7: Virus replication, trial two

Tests of effect slices for vaccine day sliced by day

Day	Num DF	Den DF	F value	Pr > F
1	1	22	0.46	0.5033
2	1	22	0.02	0.9002
7	1	22	4.38	0.0480
10	1	22	11.84	0.0023