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Sal CURB® and CaptiSURE™ as Part of a Feed Biosecurity Program[1,2,3]

Abstract

Feed has been identified as a risk factor for viral infection in pigs.[4,5] Ingredients such as formaldehyde and medium chain fatty acids (MCFA) have been shown to mitigate this risk.[5,6] Three studies were conducted, using a rigorous field-based model to assess the potential efficacy of mitigants after successful bench-top level and bioassay-based testing. Study 1 consisted of a control with no feed mitigation and 2 mitigants (Sal CURB® at 6.5 lb./ton and CaptiSURE™ at 20 lb./ton). Study 2 consisted of a control with no feed mitigation and 1 mitigant (organic acid blend at 5.5 lb./ton). Study 3 consisted of a control with no feed mitigation and 1 mitigant (CaptiSURE at 10 lb./ton). To infect pigs, a novel model was used placing an ice block into feed, containing 3 viruses – Porcine Reproductive and Respiratory Syndrome Virus (PRRSV), Porcine Epidemic Diarrhea Virus (PEDV) and Senecavirus A (SVA). Pigs in the positive control treatment became infected with all three viruses, in all three studies. In study 1, pigs in the Sal CURB and CaptiSURE treatments remained free of infection throughout the trial. In study 2, pigs in the CaptiSURE treatment remained free of infection, with the exception of 1 pig, which tested positive for PEDV, but did not exhibit symptoms of disease. In study 3, pigs in the organic acid treatment became infected with PEDV and SVA, but not PRRSV. These studies demonstrate the ability of formaldehyde to prevent a viral infection through contaminated feed and a blend of MCFA to reduce the risk of viral transmission through feed.

Materials and Methods

Treatments for each study are shown in Table 1. Pigs (initial BW approximately 33 lbs.) were randomly assigned to treatment groups and separated into rooms, with one treatment per room (16 pigs/pen, 6 pens/treatment). All treatment groups received the viral challenge on d0 and d6. Products tested include Sal CURB, an aqueous blend of formaldehyde and propionic acid; CaptiSURE, a liquid energy source from palm kernel oil, containing MCFA; and an organic acid blend containing propionic acid and formic acid.

Table 1. Treatment and inclusion level by study number.

Study #	Treatment	Mitigant Inclusion Level (lb./ton)
1	Positive Control	0.0
	Sal CURB®	6.5
	CaptiSURE™	20.0
2	Positive Control	0.0
	CaptiSURE™	10.0
3	Positive Control	0.0
	Organic Acid Blend	5.5

Facilities

The study was conducted at a Biosecurity Safety Level-2 facility (Pipestone Applied Research, Pipestone, MN) set up to model a commercial barn. The BSL-2 facility consisted of 6 individual rooms with filtered intake and exhaust air, clean and dirty hallways and bio- secure entry practices between rooms. Pigs were sourced from herds documented to be free of all 3 viral pathogens used in these studies by monthly testing and clinical history. Feeding duration of the study was 15 days.

Virus Challenge

Feed was challenged by creating a 454g “ice block,” consisting of 100 mL of PRRSV (5 logs TCID50/mL, Ct = 21.38), 100 mL of PEDV (5 logs TCID50/mL, Ct = 24.25), 100 mL of SVA (5 logs TCID50/mL, Ct = 20.72) and 154 mL of minimal essential medium. Blocks were frozen at -80° C and dropped into each feed bin on days 0 and 6 of the study. The blocks were allowed to melt and augured into the designated room for pigs to consume via natural feeding behavior.

Metrics

Ante-mortem samples, including feed samples and oral fluids, collected across the 6 pens from each of the 3 rooms at 0, 6 and 15 days post-inoculation (DPI). Post-mortem samples were collected from 30 pigs from each room at 15 DPI. Diagnostics on collected samples included serum for PRRSV, tonsil for SVA and rectal swabs for PEDV. Samples were evaluated for the presence of viral nucleic acid by PCR and nucleic acid sequencing of the ORF 5 was performed on select samples, as needed. In addition, start and end body weights were collected from all pigs (0 and 15 DPI). Differences in growth performance between groups were analyzed for

significance ($P < 0.05$) using ANOVA. In addition, pigs were scored daily for the presence of clinical signs, including dyspnea/weight loss/rough hair coat (PRRSV), diarrhea (PEDV) and lameness/vesicles (SVA).

Results

Feed samples indicated the presence of RNA from all viruses regardless of treatment. Similarly, oral fluid samples tested positive for viral RNA regardless of treatment. This indicated feed in the bins was successfully contaminated using the ice block model, resulting in delivery of all 3 viruses to all rooms. The presence of viral RNA in feed samples treated with formaldehyde or MCFA has previously been documented and did not indicate the presence of infective virus, but rather indicates the presence of RNA.[7]

Pigs in the positive control treatments were infected by all three viruses as determined by diagnostic analysis and observation of clinical signs (Table 2). Pigs in both the Sal CURB and CaptiSURE 1.0% treatments remained free of clinical signs of viral infection for each of the three viruses and tested negative for all three viruses upon completion of the study. One pig in the CaptiSURE 0.5% treatment tested positive for PEDV by rectal swab, while no clinical signs of infection were exhibited. Pigs in the organic acid treatment exhibited clinical signs of PEDV and SVA and tested positive for both viruses upon completion of the study.

Table 2. Postmortem sample results and growth performance measures.

		Infection (pig)[1]			Disease (pen)[2]			ADG (lb./d)
Study #	Treatment	PRRSV	PEDV	SVA	PRRSV	PEDV	SVA	ADG
Study 1	Sal CURB®	0%	0%	0%	0%	0%	0%	2.06[a]
	CaptiSURE™ (1.0%)	0%	0%	0%	0%	0%	0%	2.09[a]
	(+) control	100%	13%	43%	100%	17%	100%	1.71[b]
Study 2	CaptiSURE™ (0.5%)	0%	3%	0%	0%	0%	0%	1.14[a]
	(+) control	100%	100%	30%	100%	100%	100%	0.31[b]
Study 3	Organic Acid Blend	0%	27%	20%	0%	17%	17%	1.63[a]
	(+) control	100%	77%	20%	100%	100%	100%	0.93[b]

[a,b] Differences in growth rate determined to be significant at $P < 0.05$.

[1] Represented by virus recovered from animals (PRRSV=serum, PEDV=rectal swabs, or SVA=tonsil)

[2] Represented by clinical signs of disease (diarrhea, dyspnea, rough hair, or lameness)

Conclusions

This large scale, field-based model demonstrated the risk of contaminated feed as a vehicle for viral transmission to pigs. Both formaldehyde and MCFA at 20 lb./ton were effective at preventing transmission of all three viruses through feed in this model. MCFA at 10 lb./ton was able to reduce the transmission of PEDV and pigs remained free of clinical signs throughout the trial. Organic acid blend showed limited efficacy to reduce the risk of viral transmission through feed. Sal CURB and CaptiSURE may be used as part of a comprehensive biosecurity plan.

References

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