Summary of Studies Supporting USDA Product Licensure

Establishment Name	Intervet Inc.
USDA Vet Biologics Establishment Number	165A
Product Code	2799.21
True Name	Lawsonia Intracellularis Bacterin
Tradename(s) / Distributor or Subsidiary (if different from manufacturer)	Porcilis Ileitis - No distributor specified
Date of Compilation Summary	July 15, 2020

Disclaimer: Do not use the following studies to compare one product to another. Slight differences in study design and execution can render the comparisons meaningless.

<table>
<tr><td>Study Type</td><td>Efficacy</td></tr>
<tr><td>Pertaining to</td><td>Lawsonia intracellularis</td></tr>
<tr><td>Study Purpose</td><td>Demonstrate efficacy against ileitis</td></tr>
<tr><td>Product Administration</td><td>A single 2 mL dose administered intramuscularly</td></tr>
<tr><td>Study Animals</td><td>37 vaccinate and 37 control pigs, 3-4 weeks of age
Group A: 23 vaccinates and 23 placebo controls
Group B: 14 vaccinates and 14 placebo controls</td></tr>
<tr><td>Challenge Description</td><td>Lawsonia intracellularis administered 4 weeks following vaccination</td></tr>
<tr><td>Interval observed after challenge</td><td>Group A: For Ileitis and Colonization, tissues were evaluated 21 days post-challenge
Group B: For Shedding, feces were evaluated three times a week for up to 60 days post-challenge</td></tr>
<tr><td>Results</td><td>
<u>Ileitis</u>
Group A animals were considered affected by the challenge if they presented with a gross lesion score > 1 or a microscopic histopathological lesion score > 0.
<table>
<tr><td rowspan="2">Treatment Group</td><td colspan="2">Gross Lesion Score >1</td><td rowspan="2">Histopathological Lesion Score >0</td><td rowspan="2">Affected</td></tr>
<tr><td>Scorer #1</td><td>Scorer #2</td></tr>
<tr><td>Vaccinate</td><td>12/23</td><td>11/23</td><td>8/23</td><td>14/23</td></tr>
<tr><td>Control</td><td>13/23</td><td>14/23</td><td>22/23</td><td>23/23</td></tr>
</table>
<u>Colonization</u>
Group A animals were considered affected if they presented with a microscopic immunohistochemistry (IHC) score of > 0 or a qPCR value ≥ limit of detection (LOD) for Lawsonia in mucosal scrapings.
<table>
<tr><td>Treatment Group</td><td>Affected</td></tr>
<tr><td>Vaccinate</td><td>10/23</td></tr>
<tr><td>Control</td><td>23/23</td></tr>
</table>
<u>Fecal Shedding</u>
Group B animals were considered affected if they presented with a qPCR value ≥ LOD for Lawsonia in fecal samples for one or more of the post-challenge testing time points. Summary for duration of shedding in days is as follows:
</td></tr>
</table>

<table>
<tr><td></td><td>
<table>
<tr><td>Treatment</td><td>Min</td><td>Q_1</td><td>Median</td><td>Q_3</td><td>Max</td></tr>
<tr><td>Controls</td><td>8</td><td>19</td><td>22</td><td>29</td><td>31</td></tr>
<tr><td>Vaccinates</td><td>0</td><td>8</td><td>12</td><td>19</td><td>29</td></tr>
</table>

Raw data are shown below.</td></tr>
<tr><td>USDA Approval Date</td><td>March 5, 2014</td></tr>
</table>

SCORING GUIDE

Ileitis

Gross Lesion Score
0 – Normal mucosa
1 – Slight mucosal edema or slight hyperemia
2 – Moderate ileitis
3 – Severe ileitis
4 – Severe ileitis plus additionally hemorrhaging and/or necrosis, blood clots or yellowish pseudomembrane

Microscopic Histopathological Lesion Score
0 No diagnostic lesions
1 Mild individual crypt proliferative change
2 Marked proliferative enterocolitis

Colonization

IHC Score
0 Negative, no staining
1 Positive, rare positive staining in fewer than 10 crypts per section
2 Positive, moderate positive staining in 10-20 crypts per section
3 Positive, abundant positive staining in more than 20 crypts per section

qPCR of Mucosal Scrapings
Results shown are Log_{10} DNA copies/reaction
BLD: Below Limit of Detection

Fecal Shedding

qPCR of Fecal Samples
Results shown are Log_{10} DNA copies/reaction
B: Below Limit of Detection
ns: No Sample

RAW DATA TABLES

Vaccinate Group A					
ID	Gross Lesion Scores		Histopathological Score	IHC Score	qPCR of Mucosal Scrapings
	Scorer #1	Scorer #2			
86	0	0	0	0	BLD
90	2	2	0	0	1.5
91	1	1	0	0	BLD
92	2	3	0	0	BLD
96	1	1	1	1	2.5
102	0	0	0	0	BLD
103	2	1	0	0	BLD
104	2	2	0	0	BLD
105	1	1	0	0	BLD
108	2	2	2	3	2.0
110	2	2	1	2	2.8
118	1	1	0	0	0.8
127	2	2	1	2	2.2
132	1	1	2	3	1.6
133	2	2	1	2	2.9
136	1	1	0	0	BLD
140	2	2	0	0	BLD
141	2	2	0	0	BLD
149	1	1	0	0	BLD
151	2	2	2	3	3.9
155	1	1	0	0	BLD
156	1	1	0	0	BLD
161	2	2	1	1	2.2

Control Group A					
ID	Gross Lesion Scores		Histopathological Score	IHC Score	qPCR of Mucosal Scrapings
	Scorer #1	Scorer #2			
85	1	1	1	2	3.3
87	1	1	1	1	2.3
89	2	2	0	0	0.9
95	1	2	1	1	2.2
98	1	1	2	3	4.1
99	2	2	1	2	3.1
100	3	3	2	3	3.7
107	2	2	2	3	3.0
112	1	1	2	3	2.6
113	3	3	2	3	3.5
114	3	3	2	3	3.3
120	0	0	2	3	2.1
122	4	4	2	3	2.0
124	2	2	1	1	1.2
128	1	1	1	1	2.2
134	0	0	1	1	2.6
137	1	1	1	1	2.1
143	1	1	1	1	2.2
145	2	2	2	3	4.5
152	2	2	1	1	2.8
157	3	3	2	3	3.8
160	2	2	1	1	3.1
163	4	4	2	3	4.1

Fecal Shedding Group B

		Day Post-Challenge																									
ID	Treatment	-3	4	6	8	11	13	15	18	20	22	25	27	29	32	34	36	39	41	43	46	48	50	53	55	57	60
84	Vaccinate	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
88	Vaccinate	B	B	B	B	B	B	1.4	3.0	ns	3.3	3.2	2.8	1.7	1.2	B	B	B	B	0.7	B	B	B	B	B	B	B
94	Vaccinate	B	B	B	B	B	B	B	B	B	B	0.8	1.1	1.1	B	B	B	B	B	B	B	B	B	B	B	B	B
106	Vaccinate	B	B	B	B	B	0.7	0.6	1.7	1.1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
111	Vaccinate	B	B	B	B	B	B	B	0.6	1.0	1.1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
121	Vaccinate	B	B	B	0.6	0.5	0.9	2.0	3.1	2.7	1.3	B	0.5	B	B	B	B	B	B	B	B	B	B	B	B	B	B
123	Vaccinate	B	B	B	B	B	B	B	1.8	1.8	1.0	B	0.7	B	B	B	B	B	B	B	B	B	B	B	B	B	B
130	Vaccinate	B	B	B	B	B	B	B	1.6	2.4	2.5	2.8	3.2	3.7	3.5	3.6	3.3	3.6	3.6	3.4	3.3	2.9	3.4	3.5	3.1	2.5	1.5
131	Vaccinate	B	B	B	B	1.1	1.2	2.1	2.6	2.8	2.2	2.5	2.5	2.7	2.1	1.5	0.7	B	B	B	B	B	B	B	B	B	B
138	Vaccinate	B	B	B	B	B	B	B	B	0.9	B	B	0.9	0.5	0.5	1.0	B	B	B	B	B	B	B	B	B	B	B
150	Vaccinate	B	B	B	B	B	B	B	2.3	2.9	1.0	3.4	2.1	1.2	B	B	B	B	B	B	B	B	B	B	B	B	B
153	Vaccinate	B	B	B	B	B	B	1.2	2.1	1.5	1.5	B	0.9	B	B	B	B	B	B	B	B	B	B	B	B	B	B
162	Vaccinate	B	B	B	B	0.6	0.6	1.0	4.4	3.3	2.8	1.5	B	0.5	B	B	B	B	B	B	B	B	B	B	B	B	B
165	Vaccinate	B	B	B	B	0.7	0.6	1.1	2.4	1.5	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
82	Control	B	B	B	B	B	B	B	1.4	1.8	1.8	1.5	0.9	B	B	B	B	B	B	0.9	0.9	B	B	B	B	B	B
83	Control	B	B	B	B	B	0.8	2.0	3.5	3.1	1.4	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
93	Control	B	B	B	1.0	2.7	3.4	4.6																			
109	Control	B	B	B	B	2.0	3.1	3.5	4.5	4.1	2.8	2.1	2.1	1.7	B	B	B	B	B	B	B	B	B	B	B	B	B
115	Control	B	B	B	0.6	2.0	2.0	2.4	4.0	4.2	3.7	2.0	1.2	0.5	B	B	B	B	B	B	B	B	B	B	ns	B	B
116	Control	B	B	B	B	B	B	1.3	2.2	1.9	1.3	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
119	Control	B	B	B	B	1.4	2.6	3.8	3.8	3.7	3.7	1.5	1.4	0.8	B	B	B	B	B	B	B	B	B	B	B	B	B
125	Control	B	B	B	B	1.5	1.7	2.7	4.6	5.1	4.6	4.4	4.0	2.5	3.7	B	B	B	0.6	B	B	B	B	B	B	B	B
126	Control	B	B	0.9	2.2	2.6	2.8	4.5	5.1	5.5	5.0	3.6	3.7	4.1	1.1	3.1	1.9	B	B	B	B	B	B	B	B	B	B
129	Control	B	B	B	B	1.4	1.7	2.5	5.2	5.5	5.0	4.5	4.0	2.1	2.4	4.2	4.3	2.0	B	B	B	B	B	B	B	B	B
144	Control	B	B	B	B	1.0	1.5	2.6	4.1	4.0	3.4	3.1	3.1	2.7	2.3	1.8	B	B	B	B	B	B	B	B	B	B	B
146	Control	B	B	B	B	0.5	B	1.0	1.6	2.5	2.7	1.4	1.5	0.8	B	B	B	B	B	B	B	B	B	B	B	B	B
148	Control	B	B	B	B	B	B	ns	1.6	B	1.0	2.3	2.1	0.8	B	B	B	B	B	B	B	B	B	B	B	B	B
154	Control	B	B	B	0.9	1.7	2.9	3.6	2.2	4.9	4.3	3.5	3.0	1.5	B	B	B	B	B	B	B	B	B	B	B	B	B

The firm affirmed that ID 93 died as a result of the challenge.

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<tr><td>Study Type</td><td>Efficacy</td></tr>
<tr><td>Pertaining to</td><td>Lawsonia intracellularis</td></tr>
<tr><td>Study Purpose</td><td>Demonstrate 20-week duration of immunity against ileitis</td></tr>
<tr><td>Product Administration</td><td>A single 2 mL dose administered intramuscularly</td></tr>
<tr><td>Study Animals</td><td>38 vaccinate and 40 control pigs, 3-4 weeks of age
Group A: 24 vaccinates and 25 placebo controls
Group B: 14 vaccinates and 15 placebo controls</td></tr>
<tr><td>Challenge Description</td><td>Lawsonia intracellularis administered 20 weeks after vaccination</td></tr>
<tr><td>Interval observed after challenge</td><td>Group A: For Ileitis and Colonization, tissues were evaluated 21 days post-challenge
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Group A animals were considered affected by the challenge if they presented with a gross lesion score > 1 or a microscopic histopathological lesion score > 0.
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<tr><td>Vaccinate</td><td>5/24</td><td>5/24</td><td>5/24</td><td>5/24</td></tr>
<tr><td>Control</td><td>15/25</td><td>16/25</td><td>19/25</td><td>19/25</td></tr>
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<u>Colonization</u>
Group A animals were considered affected if they presented with a microscopic immunohistochemistry (IHC) score of > 0 or a qPCR value ≥ limit of detection (LOD) for Lawsonia in mucosal scrapings.
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<tr><td>Treatment Group</td><td>Affected</td></tr>
<tr><td>Vaccinate</td><td>13/24</td></tr>
<tr><td>Control</td><td>23/25</td></tr>
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<u>Fecal Shedding</u>
Group B animals were considered affected if they presented a qPCR value ≥ LOD for Lawsonia in fecal samples for one or more of the post challenge testing time points. Samples were collected every 2-3 days. Summary for duration of shedding in days is as follows:
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	<table><tr><td>Treatment</td><td>Min</td><td>Q_1</td><td>Median</td><td>Q_3</td><td>Max</td></tr><tr><td>Controls</td><td>10</td><td>17</td><td>19</td><td>21</td><td>36</td></tr><tr><td>Vaccinates</td><td>0</td><td>5</td><td>7</td><td>12</td><td>25</td></tr></table> Raw data shown below
USDA Approval Date	March 6, 2014

SCORING GUIDE

Ileitis

Gross Lesion Score
0 – Normal mucosa
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qPCR of Mucosal Scrapings
Results shown are Log_{10} DNA copies/reaction
BLD: Below Limit Of Detection

Fecal Shedding

qPCR of Fecal Samples

Results shown are Log_{10} DNA copies/reaction
B: Below Limit Of Detection

RAW DATA TABLES

Vaccinate Group A					
ID	Gross Lesion Scores		Histopathological Score	IHC Score	qPCR of Mucosal Scrapings
	Scorer #1	Scorer #2			
629	1	1	0	0	0.5
634	1	1	0	0	1.2
638	1	1	0	0	BLD
639	1	1	0	0	BLD
641	1	1	0	0	BLD
645	0	0	0	0	1.0
648	0	0	0	0	1.0
653	0	1	0	0	1.7
655	1	1	0	0	BLD
659	1	1	0	0	BLD
663	0	0	0	0	BLD
665	2	2	0	0	0.7
670	0	0	0	0	1.8
673	1	1	0	0	BLD
674	0	0	0	0	BLD
675	1	0	0	0	BLD
676	1	1	0	0	0.7
681	2	2	2	2	3.5
683	2	2	0	0	0.7
684	2	3	2	3	3.5
691	1	1	0	0	0.7
698	2	3	0	0	BLD
699	1	1	0	0	BLD
707	1	1	0	0	1.4

Control Group A					
ID	Gross Lesion Scores		Histopathological Score	IHC Score	qPCR of Mucosal Scrapings
	Scorer #1	Scorer #2			
631	2	2	2	3	3.9
632	4	4	2	3	5.0
633	3	3	2	3	4.1
637	1	2	2	3	4.0
643	3	3	2	3	2.1
649	2	3	2	3	4.0
651	2	2	2	2	3.3
652	1	0	2	2	1.0
654	3	3	2	2	2.2
661	0	0	0	0	1.1
662	1	1	0	0	0.5
668	4	4	2	2	3.6
669	3	3	2	3	3.7
671	0	0	0	0	1.5
678	3	3	2	2	3.9
679	1	1	2	3	1.1
685	2	2	2	3	2.8
686	1	1	0	0	BLD
687	0	0	0	0	0.7
689	4	4	2	2	3.2
694	1	1	1	1	1.1
696	3	3	2	3	3.0
701	1	1	0	0	BLD
706	2	2	1	1	2.8
709	2	2	1	1	2.1

Fecal Shedding Group B

		Day Post-Challenge																					
ID	Treatment	-3	2	4	7	9	11	14	16	18	21	23	25	28	30	32	35	37	39	42	44	46	49
630	Vaccinate	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
640	Vaccinate	B	B	B	2.4	2.5	2.5	2.6	2.1	3.3	2.6	0.6	B	B	B	B	B	B	B	B	B	B	B
644	Vaccinate	B	B	B	B	B	1.4	1.7	0.8	B	B	B	B	B	B	B	B	B	B	B	B	B	B
646	Vaccinate	B	B	B	B	1.9	2.4	0.9	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
656	Vaccinate	B	B	B	B	1.3	2.3	2.9	2.3	1.4	B	B	B	B	B	B	B	B	B	B	B	B	B
664	Vaccinate	B	B	B	B	1.2	2.0	2.6	0.9	B	B	B	B	B	B	B	B	B	B	B	B	B	B
672	Vaccinate	B	B	0.9	1.9	2.2	1.8	1.2	B	B	B	B	0.6	1.0	B	B	B	B	B	B	B	B	B
677	Vaccinate	B	B	1.3	2.7	3.4	3.9	4.5	4.3	4.1	3.0	B	B	B	B	B	B	B	B	B	B	B	B
688	Vaccinate	B	B	B	0.7	0.9	1.1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
692	Vaccinate	B	B	B	0.9	1.1	1.0	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
700	Vaccinate	B	B	B	B	B	B	1.9	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
703	Vaccinate	B	B	B	B	B	B	B	0.7	B	B	B	B	B	B	B	B	B	B	B	B	B	B
704	Vaccinate	B	B	B	1.9	1.8	2.0	3.1	3.2	1.4	B	B	B	B	B	B	B	B	B	B	B	B	B
708	Vaccinate	B	B	B	0.9	2.1	3.1	1.9	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
628	Control	B	B	B	B	1.5	1.5	1.9	2.1	2.5	2.6	1.9	1.8	B	B	B	B	B	B	B	B	B	B
642	Control	B	B	B	0.7	2.0	3.0	3.5	3.6	3.2	2.4	1.8	B	B	B	B	B	B	B	B	B	B	B
647	Control	B	B	B	B	1.0	1.5	2.5	3.2	3.3	3.3	2.9	2.6	1.2	B	B	B	B	B	B	B	B	B
650	Control	B	B	B	B	B	1.6	2.2	2.7	2.7	3.2	2.4	2.2	2.3	1.4	B	B	B	B	B	B	B	B
657	Control	B	B	B	0.5	0.9	1.8	1.8	1.7	0.6	B	B	B	B	B	B	B	B	B	B	B	B	B
660	Control	B	B	B	0.7	1.8	2.7	3.6	3.5	3.6	2.9	1.1	B	B	B	B	B	B	B	B	B	B	B
667	Control	B	B	B	1.9	2.3	3.9	5.0	5.2	4.3	5.7	4.8	5.0	3.7	3.8	3.6	3.2	3.8	2.6	0.5	B	B	B
680	Control	B	B	B	1.4	1.2	3.3	4.2	4.1	4.2	4.7	4.5	4.7	4.0	3.0	B	B	0.6	B	B	B	B	B
682	Control	B	B	1.1	1.4	2.6	2.8	3.1	2.7	2.5	2.1	1.8	1.4	B	B	B	B	B	B	B	B	B	B
693	Control	B	B	B	B	1.2	1.7	1.9	2.2	1.0	B	B	B	B	B	B	B	B	B	B	B	B	B
695	Control	B	B	B	1.9	2.3	3.3	4.8	5.2	4.3	2.7	3.0	1.5	B	B	B	B	B	B	B	B	B	B
697	Control	B	B	B	1.2	2.8	3.1	4.8	4.5	4.5	4.5	3.6	0.6	B	B	B	B	B	B	B	B	B	B
702	Control	B	B	1.2	1.9	2.2	3.7	3.7	2.9	2.2	1.7	B	B	B	B	B	B	B	B	B	B	B	B
705	Control	B	B	0.7	2.3	2.9	4.0	5.7	5.4	5.2	4.9	3.2	0.6	B	B	B	B	B	B	B	B	B	B
711	Control	B	B	B	1.5	2.0	2.7	3.7	3.7	3.3	3.3	1.8	1.6	B	B	B	B	B	B	B	B	B	B

<table>
<tr><td>Study Type</td><td>Efficacy</td></tr>
<tr><td>Pertaining to</td><td>Lawsonia intracellularis</td></tr>
<tr><td>Study Purpose</td><td>Demonstrate efficacy against ileitis</td></tr>
<tr><td>Product Administration</td><td>Two 1 mL doses administered intramuscularly at a 3-4 week interval</td></tr>
<tr><td>Study Animals</td><td>40 vaccinate and 38 control pigs, 3-6 days of age
Group A: 25 vaccinates and 23 placebo controls
Group B: 15 vaccinates and 15 placebo controls</td></tr>
<tr><td>Challenge Description</td><td>Lawsonia intracellularis administered 4 weeks following the second vaccination</td></tr>
<tr><td>Interval observed after challenge</td><td>Group A: For Ileitis and Colonization, tissues were evaluated 21 days post-challenge.
Group B: For Shedding, feces were evaluated three times a week for up to 51 days post-challenge.</td></tr>
<tr><td>Results</td><td>
<u>Ileitis</u>
Group A animals were considered affected by the challenge if they presented with a gross lesion score > 1 or a microscopic histopathological lesion score > 0.
<table>
<tr><td rowspan="2">Treatment Group</td><td colspan="2">Gross Lesion Score >1</td><td rowspan="2">Histopathological Lesion Score >0</td><td rowspan="2">Affected</td></tr>
<tr><td>Scorer #1</td><td>Scorer #2</td></tr>
<tr><td>Vaccinates</td><td>6/25</td><td>6/25</td><td>1/25</td><td>14/25</td></tr>
<tr><td>Control</td><td>19/23</td><td>18/23</td><td>22/23</td><td>23/23</td></tr>
</table>
<u>Colonization</u>
Group A animals were considered affected if they presented with a microscopic IHC score of > 0 or a qPCR value ≥ LOD for Lawsonia in mucosal scrapings.
<table>
<tr><td>Treatment Group</td><td>Affected</td></tr>
<tr><td>Vaccinates</td><td>4/25</td></tr>
<tr><td>Control</td><td>22/23</td></tr>
</table>
<u>Fecal Shedding</u>
Group B animals were considered affected if they presented a qPCR value ≥ LOD for Lawsonia in fecal samples for one or more of the post challenge testing time points. A summary of duration of shedding in days is as follows:
</td></tr>
</table>

	<table><tr><th>Treatment</th><th>Min</th><th>Q_1</th><th>Median</th><th>Q_3</th><th>Max</th></tr><tr><td>Controls</td><td>15</td><td>22</td><td>24</td><td>26</td><td>36</td></tr><tr><td>Vaccinates</td><td>1</td><td>10</td><td>13</td><td>17</td><td>22</td></tr></table> Raw data shown below
USDA Approval Date	March 6, 2014

SCORING GUIDE

Ileitis

Gross Lesion Score
0 – Normal mucosa
1 – Slight mucosal edema or slight hyperemia
2 – Moderate ileitis
3 – Severe ileitis
4 – Severe ileitis plus additionally hemorrhaging and/or necrosis, blood clots or yellowish pseudomembrane

Microscopic Histopathological Lesion Score
0 No diagnostic lesions
1 Mild individual crypt proliferative change
2 Marked proliferative enterocolitis

Colonization

IHC Score
0 Negative, no staining
1 Positive, rare positive staining in fewer than 10 crypts per section
2 Positive, moderate positive staining in 10-20 crypts per section
3 Positive, abundant positive staining in more than 20 crypts per section

qPCR of Mucosal Scrapings
Results shown are Log_{10} DNA copies/reaction
BLD: Below Limit Of Detection

Fecal Shedding

qPCR of Fecal Samples
Results shown are Log_{10} DNA copies/reaction
B: Below Limit Of Detection
ns: No Sample

RAW DATA TABLES

Vaccination Group A					
ID	Gross Lesion Scores		Histopathological Score	IHC Score	qPCR of Mucosal Scrapings
	Scorer #1	Scorer #2			
117	1	1	0	0	BLD
118	0	0	0	0	BLD
121	1	1	0	0	BLD
130	0	1	0	0	BLD
138	2	2	0	0	BLD
147	1	1	0	0	BLD
149	1	1	0	0	1.8
153	1	1	0	0	BLD
155	1	1	0	0	1.0
167	0	0	0	0	BLD
169	1	1	0	0	BLD
172	1	1	0	0	BLD
174	1	1	0	0	BLD
180	1	1	0	0	BLD
185	1	1	0	0	0.5
191	2	2	0	0	BLD
193	0	1	0	0	BLD
203	2	2	0	0	BLD
206	2	2	0	0	BLD
211	2	2	0	0	BLD
219	1	1	0	0	BLD
235	1	1	0	0	BLD
237	1	1	0	0	BLD
239	1	1	0	0	BLD
242	3	3	2	3	3.9

Control Group A					
ID	Gross Lesion Scores		Histopathological Score	IHC Score	qPCR of Mucosal Scrapings
	Scorer #1	Scorer #2			
119	4	4	2	3	4.6
123	4	4	2	3	3.5
127	3	3	2	3	3.6
132	2	2	2	3	3.4
144	2	1	2	3	3.4
148	1	1	1	2	2.7
151	4	3	2	3	4.2
152	2	2	2	3	3.6
163	1	1	1	1	1.4
170	1	1	2	3	4.1
176	2	2	2	3	3.3
178	2	2	1	2	2.9
183	4	4	2	3	4.6
186	3	3	2	3	4.1
187	3	3	2	3	3.8
195	3	3	2	3	4.4
204	1	1	1	1	2.0
208	2	2	2	3	2.4
227	3	3	2	3	BLD
233	2	2	0	0	BLD
236	2	2	2	3	3.1
243	4	4	2	3	4.0
249	3	3	2	3	4.4

Fecal Shedding Group B

		Day Post-Challenge																					
Pig ID #	Treatment	-1	5	7	9	12	14	16	19	21	23	26	28	30	33	35	37	40	42	44	47	49	51
114	Vaccine	B	B	B	B	B	B	B	B	1.7	B	B	B										
128	Vaccine	B	B	B	B	1.0	1.3	0.6	1.1	1.7	B	B	B	B	B	B	B	B	B	B	B	B	B
136	Vaccine	B	B	B	B	B	B	B	B	B	0.6	B	B	B	B	B	B	B	B	B	0.9	0.6	1.7
141	Vaccine	B	B	B	B	0.6	0.9	1.2	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
142	Vaccine	B	B	B	B	B	B	B	B	B	B	B	B	0.8	B	0.6	B	B	B	B	B	B	B
157	Vaccine	B	0.8	0.5	1.4	2.5	3.2	3.0	3.5	3.0	3.3	1.6	B	B	B	B	B	B	B	B	B	B	B
162	Vaccine	B	B	B	0.6	2.0	2.2	2.4	2.0	2.0	1.4	0.7	B	B	B	B	B	B	B	B	B	B	B
177	Vaccine	B	B	B	B	B	B	1.0	0.9	1.1	1.2	0.8	B	B	B	B	B	B	B	B	B	B	B
182	Vaccine	B	1.3	2.5	2.7	2.5	3.7	3.7	1.8	1.1	B	B	B	B	B	B	B	B	B	B	B	B	B
189	Vaccine	B	B	B	B	B	1.4	0.6	B	B	1.4	1.5	B	B	B	B	B	B	B	B	B	B	B
192	Vaccine	B	B	B	B	B	1.2	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
207	Vaccine	B	B	B	B	B	B	B	0.5	1.0	1.1	1.4	1.1	1.2	0.9	B	B	B	B	B	B	B	B
214	Vaccine	B	B	B	B	B	0.7	B	B	B	B	B	1.5	B	B	B	B	B	B	B	B	B	B
232	Vaccine	B	B	B	B	B	1.0	0.8	1.2	2.2	2.6	2.4	1.3	1.9	B	B	B	B	B	B	B	B	B
246	Vaccine	B	B	B	B	1.8	2.1	2.9	1.7	1.2	B	B	B	B	B	B	B	B	B	B	B	B	B
115	Placebo	B	B	B	B	2.0	2.3	3.5	4.2	4.1	3.5	3.1	2.0	2.2	B	B	B	B	B	B	B	B	B
131	Placebo	B	B	1.3	2.2	3.7	4.2	5.4	4.4	3.7	3.4	2.7	2.4	2.2	B	B	B	B	B	B	B	B	B
135	Placebo	B	B	B	B	B	B	1.4	2.4	2.8	2.9	3.1	2.1	2.7	B	B	B	B	B	B	B	ns	B
140	Placebo	B	B	B	B	B	B	0.7	1.8	2.7	2.7	2.9	2.1	2.6	1.6	1.4	1.2	B	B	B	B	B	B
143	Placebo	B	B	B	B	B	B	1.3	3.3	3.8	4.2	3.8	3.3	2.8	2.1	1.9	B	B	B	B	B	B	B
156	Placebo	B	1.6	2.2	2.2	4.4	4.8	4.6	4.3	3.8	3.7	3.1	2.1	1.6	B	B	B	B	B	B	B	B	B
171	Placebo	B	B	1.2	1.7	3.0	4.0	4.6	5.4														
173	Placebo	B	B	0.7	2.2	2.8	3.8	4.5	3.9	4.2	4.5	3.6	2.1	0.9	B	B	B	B	B	B	B	B	ns
184	Placebo	B	1.6	3.2	3.7	5.2	5.6	5.1	3.5	4.8	5.0	4.8	5.0										
194	Placebo	B	B	B	0.9	1.8	2.4	3.2	4.0	4.0	3.7	3.2	1.4	0.9	B	B	B	B	B	B	B	B	B
200	Placebo	B	B	B	0.9	1.2	1.9	2.0	2.9	3.5	3.6	3.7	2.1	2.2	B	B	B	B	B	B	B	B	B
210	Placebo	B	B	B	0.6	1.1	1.9	2.2	2.8	3.1	3.8	2.9	1.3	1.9	1.0	1.2	B	B	B	B	B	B	B
222	Placebo	B	B	B	B	B	0.9	1.7	1.9	2.7	1.5	3.4	3.6	4.2	3.6	3.8	3.8	3.1	3.0	2.6	2.1	0.6	B
238	Placebo	B	B	B	1.3	2.4	3.2	4.2	5.3	5.4	4.9	4.7	4.3	3.4	0.8	B	B	B	B	B	B	B	B
241	Placebo	B	B	B	0.8	2.1	2.8	3.3	4.4	4.0	4.4	4.4	3.8	3.6	3.6	3.7	2.6	B	B	B	B	B	B

The firm affirmed that ID 114 and 171 were removed due to causes unrelated to the vaccination or challenge.
ID 184 was removed due to severe ileitis.

Study Type	Safety
Pertaining to	All
Study Purpose	Demonstrate safety of product under typical use conditions
Product Administration	Two doses administered intramuscularly 3 weeks apart
Study Animals	665 pigs, 3-5 days of age at first administration, three study sites in three geographically distinct locations.
Challenge Description	NA
Interval observed after challenge	Animals were observed for at least 1 hour following completion of all vaccinations, and then daily for 21 days, or until resolution of any adverse events.
Results	

Adverse Events (AE) (Total 665 pigs)	**Number**
Injection Site Swelling[1] *	441
First Vaccination	
S (<1.5 cm)	35
M (1.5 to 5 cm)	76
L (>5 to 10 cm)	1
Second Vaccination	
S (<1.5 cm)	246
M (1.5 to 5 cm)	82
L (>5 to 10 cm)	1
Respiratory tract infection NOS	220
Death[2]	27
Diarrhoea	27
Dyspnoea	14
Respiratory tract disorder NOS	13
Lameness	9
Unthrifty	9
Ataxia	2
Anaphylaxis[3] *	1
Abscess NOS	1
Lethargy	1
Rectal prolapse	1
Trauma NOS	1
Cellulitis	1
No adverse events	163

Subjects may have had AE's in more than one VeDDRA Preferred Term and are counted once in each appropriate class.

[1] Injection site swellings resolved within 1- 25 days.

	[2] Deaths affirmed by licensee to have a cause other than vaccination. [3] Animal recovered within 10 minutes after vaccination. *Vaccine related AE. NOS = Not otherwise specified
USDA Approval Date	February 8, 2019

Study Type	Safety
Pertaining to	All
Study Purpose	Demonstrate safety of product under typical use conditions.
Product Administration	One dose administered intramuscularly
Study Animals	1,220 pigs, 17-31 days of age, at five study sites in three geographically distinct locations.
Challenge Description	NA
Interval observed after challenge	Animals were observed once between one and four hours after vaccination, and then daily for 14 days, or until resolution of any adverse events.
Results	

Adverse Events (AE) (Total 1,220 pigs)	**Number**
Injection Site Swelling[1] *	453
S (<1.5 cm)	291
M (1.5 to 5 cm)	148
L (>5 to 10 cm)	14
Anaphylactic-type reaction*	24
Systemic disorder NOS[2]	22
Death by euthanasia (Septicemia)	6
Scour	4
Found dead (Septicemia)	3
Death by euthanasia (Systemic disorder NOS)	2
Lameness	2
Meningitis	2
Ataxia	1
Death (Anaphylactic-type reaction)*	1
Death by euthanasia (Hernia NOS)	1
Death by euthanasia (Meningitis)	1
Found dead (Bronchopneumonia)	1
Found dead (Systemic disorder NOS)	1

*Vaccine related AE.
[1]Injection site swellings resolved within 1- 19 days.
[2]Pigs that failed to achieve performance in the barn equal to that of their contemporaries, and included pigs defined as lethargic, rough haired, depressed, thin, gaunt, off feed, unthriftness, anorexia, starve-out.
NOS = Not otherwise specified

USDA Approval Date	July 31, 2015