

255 Using environmental swabbing to quantify the effectiveness of chemical disinfectant to reduce the quantity of porcine epidemic diarrhea virus RNA on feed manufacturing surfaces.

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Porcine epidemic diarrhea virus (PEDV) is a possible hazard in feed mills that could impact swine health. If the virus enters a feed mill, it quickly becomes widely distributed and is difficult to decontaminate from surfaces. The objective of this study was to evaluate a variety of liquid and dry sanitation treatments that could be used to reduce the amount of PEDV found on feed manufacturing surfaces in feed mills. This experiment was replicated 3 times and was designed as a 5 × 10 factorial with main effects of 5 different feed manufacturing surfaces and 10 sanitizing treatments. Surfaces included stainless steel, plastic, rubber, woven polypropylene tote bag, and sealed concrete coupons (103 cm²). One milliliter (1 × 10⁵ TCID₅₀/mL) of stock PEDV was applied to each surface and allowed to completely dry for 60 min. Next, chemical treatments were applied for 15 min: 1) no sanitation treatment (control); 2) untreated rice hulls; 3) rice hulls treated with formaldehyde-based commercial product (Sal CURB; Kemin Industries Inc., Des Moines, IA), 4) liquid formaldehyde-based commercial product (Sal CURB); 5) dry commercial benzoic acid and eubiotic blend (VevoVital and CRINA; DSM Nutritional Products Inc., Parsippany, NJ); 6) liquid ammonium chloride, isopropanol, and hydrogen peroxide-based commercial food-grade sanitizer (DrySan Duo; Ecolab, St. Paul, MN); 7) liquid hydrogen peroxide commercial product (INTERvention; Virox Technologies Inc. Ontario, Canada); 8) liquid quaternary ammonium glutaraldehyde commercial product (Synergize; Preserve International, Reno NV); 9) liquid sodium hypochlorite commercial sanitizer (Bleach; Clorox, Oakland, CA); and 10) liquid medium-chain fatty acid blend of caprylic, capronic, and capric acids. The quantity of PEDV RNA was determined using quantitative reverse

transcription PCR (qRT-PCR). All main effects and interaction were highly significant ($P \leq 0.001$). Concentrated liquid Sal CURB was the sanitizer most effective at removing PEDV RNA across surfaces followed by liquid bleach (42.9, 35.2, and 26.2 CT for Sal CURB, bleach, and untreated control, respectively). Rubber belting obtained from a bucket elevator retained the most PEDV RNA of any tested surface, whereas the polyethylene tote bag retained the least (28.0 and 31.4 CT for rubber and tote bag, respectively). Additional research is necessary to identify the role of sanitizer on PEDV infectivity and to develop dry sanitizers capable of removing PEDV mRNA on animal food manufacturing surfaces.

Key Words: feed manufacturing surfaces, porcine epidemic diarrhea virus, sanitation

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256 Evaluating the roles of surface sanitation and feed sequencing on mitigating *Salmonella enteritidis* contamination on animal food manufacturing equipment.

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The objective of this study was to evaluate the efficacy of flushing surfaces with untreated feed vs. the use of 2 different chemical sanitizers on residual surface and feed *Salmonella enteritidis* contamination. First, a *Salmonella*-negative batch of poultry feed was mixed in 9 laboratory-scale paddle mixers. A feed sample was collected, and targeted locations on surfaces within the mixer were swabbed to confirm *Salmonella*-negative status. Next, a *Salmonella*-positive batch of poultry feed was mixed and sampled, and mixer surfaces were swabbed. Mean *Salmonella enteritidis* contamination across all 9 mixers was 3.63 cfu/g for sampled feed and 1.27 cfu/cm² for surface contamination. Next, the mixers manufactured one of the following treatments (3 mixers/treatment): 1) none (control), 2) concentrated commercial product containing a eubiotic blend of essential oils (benzoic acid and blend of essential oils: thymol, eugenol, piperine, and other essential oil compounds), or 3) rice hulls treated with a 10% (wt/wt)

Table 254.

	CON	Prot	PV	PVH	SEM	P-value
Nursery ADG, kg/d	0.29	0.29	0.29	0.31	0.015	0.22
Nursery ADFI, kg/d	0.42 ^b	0.42 ^b	0.42 ^b	0.45 ^a	0.018	0.05
Nursery G:F	0.69	0.68	0.69	0.68	0.013	0.93
End nursery BW, kg	15.85	15.80	15.70	16.39	0.790	0.24
Finisher ADG, kg/d	0.87	0.86	0.84	0.88	0.015	0.15
Finisher ADFI, kg/d	2.33	2.32	2.34	2.45	0.054	0.17
Finisher G:F	0.38 ^x	0.37 ^{xy}	0.36 ^y	0.36 ^{xy}	0.005	0.09
End BW, kg	137.4	135.9	133.7	139.7	2.48	0.15
Phase 2 ATTD ash, %	80.9 ^a	82.2 ^b	81.6 ^{ab}	81.0 ^a	0.42	0.05
d 12 WBC, 1,000/μL	13.34 ^b	18.15 ^a	16.28 ^{ab}	19.11 ^a	1.25	0.03
d 12 hematocrit, %	30.7 ^y	32.2 ^{xy}	34.2 ^x	34.6 ^x	1.08	0.07

addition of a medium-chain fatty acid (MCFA; 1:1:1 blend of caprylic, caproic, and capric acids). Each treatment was previously weighed and manufactured prior to inoculation of *Salmonella*. After each treatment, each mixer manufactured another 2 batches of *Salmonella*-free feed (Sequence 1 and Sequence 2). Feed samples were collected and surfaces were swabbed between each batch of feed. Mixers were not physically cleaned after each sequence, only feed discharged from the mixers. Manufacturing sequence ($P < 0.0001$) but not treatment ($P > 0.05$) impacted feed or surface contamination of *Salmonella* enteritidis. There was *Salmonella*-positive residue in the batch of feed manufactured immediately after the positive control batch. However, no *Salmonella* residue was detected in batches of feed treated with either the commercial essential oil blend or MCFA. Low levels of *Salmonella* residue were observed from feed (0.7 cfu/g for commercial essential oil blend) and surfaces (0.1 cfu/cm² for MCFA) manufactured in Sequence 1, but no residue was observed by Sequence 2. This data suggests that sequencing of feed during manufacturing reduces *Salmonella*-positive contamination within animal food and on manufacturing surfaces, particularly after the second batch or with the use of chemical treatments.

Key Words: feed manufacturing surfaces,
Salmonella, sanitation
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257 Standardized ileal digestible amino acids and digestible energy contents in high-protein distiller's dried grains with solubles fed to growing pigs.

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Chemical composition and, therefore, potential nutritive value of corn distiller's dried grains with solubles (DDGS) is constantly evolving as the ethanol industry innovates processes to improve ethanol yield. The objective of the present study was to determine standardized ileal digestibility (SID) of AA (Exp. 1) and DE (Exp. 2) contents in high-CP (approximately 45% DM) DDGS (HP). Two HP samples (HP-A and HP-B) were procured at 2 different time points from a local company and tested along with a commodity DDGS (CON) sample for comparison. Three semipurified cornstarch-based (approximately 20% CP, as-fed basis) diets were formulated with DDGS as the sole source of AA. A fourth N-free diet was prepared for endogenous N loss. In Exp. 1, 8 ileal cannulated barrows (23.9 kg BW) were used in a replicated 4 × 4 Latin square design. Pigs were fed at 2.8 times maintenance energy requirements. In each period, pigs were adjusted to diets for 5 d followed by 2 d, 8 h continuous ileal digesta collection. In Exp. 2, 9 barrows (24.9 kg BW) were assigned to the 4 diets in a repeated 4 × 4 Latin square design such that in each period, one of the diets was fed to an extra pig ($n = 9$). In each period, pigs were adjusted to diets for 7 d followed by 5 d of fecal

sample collection. In the statistical analysis, diet was the fixed effect whereas period and pig were random effects. The DE content in DDGS was calculated by the difference method. The analyzed CP was 30.1, 42.3, and 43.1% DM in CON, HP-A, and HP-B samples, respectively; the corresponding values for GE were 5,067, 5,425, and 5,407 kcal/kg DM, respectively. The concentrations of fat and NDF were comparable among the DDGS samples. Except for Arg and Val, the SID values for indispensable AA were not different ($P > 0.05$) among the 3 DDGS samples. However, HP samples had greater ($P < 0.05$) SID content of indispensable protein and CP than CON samples. The SID of Lys content was 4.9, 6.1, and 7.4 g/kg DM for CON, HP-A, and HP-B, respectively, and corresponding values for Met and Thr were 4.6, 6.8, and 7.4 g/kg DM and 6.8, 9.5, and 10.1 g/kg DM, respectively. The DE content in HP samples was higher than in CON samples ($P < 0.01$; 3,614, 4,494, and 4,555 kcal/kg DM for CON, HP-A, and HP-B, respectively). In conclusion, HP DDGS had higher digestible AA and energy contents than CON DDGS.

Key Words: high-protein distiller's dried grains with solubles, pigs, standardized ileal digestibility of amino acids and digestible energy
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258 Effects of rapeseed feeding on swine metabolome.

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Rapeseed meal (RSM) is a rich source of AA, lipids, fiber, minerals, and vitamins. Despite its favorable nutrient content, the antinutrient properties of bioactive phytochemicals within rapeseed pose challenges in adopting rapeseed meal as a major component of swine feed. In this study, the control diet containing 14% soybean meal (SBM) and the rapeseed diet containing 20% RSM were formulated to have similar NE and standardized ileal digestible AA content. To understand the influences of RSM feeding on metabolic homeostasis, 40 nursery pigs, 17.8 ± 2.7 kg initial BW, were equally split into 2 groups and pair fed with control and rapeseed diets, respectively. On d 21, all pigs were sacrificed for harvesting serum, digesta, and liver samples. All samples were examined by LC-MS-based metabolomic analysis for determining the metabolic effects of these 2 diets. Rapeseed exposure markers, including sinapine, sinapic acid, and gluconapin, were identified in the digesta by an unsupervised principal component analysis (PCA) model