Formation of Pellet Fines during the Feed Manufacturing Process, Transportation and Feed Line Delivery, and their Nutrient Composition

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Abstract. *Maintaining quality pellets with a low percentage of fines is essential to achieve growth performance benefits from pelleting diets for swine and poultry. Therefore, we investigated the formation of fines during the pelleted feed manufacturing process, transportation, and feed line delivery at the farm. A second objective was to determine the chemical composition of the pellets and fines. Results indicated that pellet durability index (PDI) was increased from the pellet mill to the fat coater, but decreased between the fat coater and load-out. Correspondingly, percentage fines were similar from the pellet mill to the cooler, but then increased at the fat coater and at load-out. Dry matter, ether extract, and acid detergent fiber were greater in fines compared to pellets, whereas crude protein was decreased in fines. The percentage of fines formed during truck unloading was not influenced by unloading speed but tended to increase from the front to the rear compartment. There was no effect of feed line location (6, 35, and 76 m from the bin) on pellet PDI, percentage fines, or the nutrient profile of pellets or fines. Across locations, fines had decreased crude protein and phosphorus, but increased acid detergent fiber, crude fiber, calcium, ether extract, and starch compared to the composition of pellets. Understanding the steps in the feed manufacturing and delivery process may allow for alternative methods to reduce the formation of fines in pelleted feeds.*

Keywords. *Feed line, Feed mill, Feed truck, Fines, Pellet durability index, Pellets.*

Pellet quality and its subsequent effects on pig performance have been studied in recent years. Nemechek et al. (2015) found that pellet fines should be minimized to achieve the maximum benefit from pelleting finishing pig diets. It is expected that each 10% increase in pellet fines worsens feed efficiency by 1%. Thus, providing pigs with high quality pelleted diets with a low percentage of fines is important to ensure the positive effects of pelleting on pig performance are realized. Reducing the percentage of fines in pellets can be accomplished in a number of ways, such as by manipulating diet formulation, conditioning time and temperature, or post-pelleting handling techniques (Muramatsu et al., 2013).

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When pellets exit a pellet mill, they are not immediately loaded onto a truck for delivery, but are instead moved through the feed mill for cooling and fat application and then placed into bins prior to loading onto a feed truck. Then, feed is typically transported and unloaded through a high output auger and dropped vertically into an on-farm bin. Feed truck drivers are sometimes incentivized to be efficient in the delivery process, leading them to load bins as quickly as possible. The process that pellets must undergo during delivery and unloading is suspected to physically damage them and increase the percentage of fines; however, few studies have evaluated manufacturing and delivery factors that may influence pellet damage. If the formation of fines can be better understood, feed mills may be able to implement strategies to reduce pellet damage.

Moritz (2013) observed that when pelleted turkey diets were moved along a feed line, a greater percentage of fines were present in feeders closest to the feed bin. The authors also reported differences in phytase levels between pellets and pellet fines. This resulted in differences in feed nutrient content between the front and back of the barn. This difference in nutrient profile, along with the preferences of pigs to consume pellets compared to fines (Skoch et al., 1983), is compounded when separation occurs in the feed line when transferring feed from bins to feeders. This variation in nutrient content may lead to increased growth variability within a single barn. Currently, little data exists to predict the formation of fines after the pelleted feed manufacturing

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process or the possible differences that may exist in nutrient composition between fines and pellets in swine diets.

Thus, the objectives of this study were to determine 1) the process location at which formation of fines occur and the nutrient concentration of whole pellets and their fines; 2) the effect of feed truck unloading RPM on pellet quality and unloading time, and 3) the effect of conveying distance on pellet quality and nutrient concentration of whole pellets and their fines.

Materials and Methods

In experiments 1, 2, and 3, feed was manufactured at the same commercial feed mill in Northwest Iowa. Diets were pelleted using a 500-hp pellet mill (Pioneer Pellet Mill, Bliss Industries, Ponca City, Okla.) with a 4.4- × 38.1-mm die, counter-flow cooler (OPFLO, Bliss Industries, Ponca City, Okla.), and a twin screw liquid fat coater (TMX Mistcoater, APEC, Lake Odessa, Mich.). All samples were collected from each run, stored at room temperature and analyzed within 24 h for pellet durability index (PDI) via a Holmen NHP200 (Tekpro Limited, Norfolk, United Kingdom) and percentage fines (*ASAE Standards*, 1987). For PDI, pellets are placed into a 2.5-mm diameter perforated mesh hoper in the Holmen NHP200. Pellet durability index is defined as the percentage of initial mass of pellets that remain within the hopper after air is blown into the hopper at 70 mBar. Fines were characterized as material that would pass through a #6 Tyler Sieve (3,360-µm opening) during 15 s of manual shaking. During fines determination, a subsample of both the fines and pelleted fraction was reserved and analyzed for dry matter (DM; AOAC 934.01, 2006), crude protein (CP; AOAC 990.03, 2006), ether extract (AOAC 920.39 A, 2006), calcium (AOAC 965.14/985.01, 2006), phosphorus (P; AOAC 965.17/985.01, 2006), and acid detergent fiber (ADF; Van Soest, 1963; Ward Laboratories, Inc. Kearney, Neb.). In addition, crude fiber (AOAC 978.10, 2006) and starch (AOAC 996.11, 2006) were analyzed for samples from experiment 3.

Experiment 1

A study was conducted where samples were collected from four swine and two turkey diets (table 1). Samples were collected during discharge from the pellet mill, cooler, fat coater, and at loadout to determine progression of fines formation during the manufacturing process (fig. 1). Samples were collected from the pellet mill, fat coater, loadout using a sample probe inserted across the entire cross section of the stream. Samples were collected in a barrel from the sample port attached to the conveyer downstream from the cooler. One 1-kg sample of pelleted feed was collected every 15 to 20 min from 7 to 10 different manufacturing runs for each diet throughout a 3-wk period. Feed manufacturing runs varied from 54 to 134 tons of feed.

Samples collected at the pellet mill discharge were immediately placed in a bench-top pellet cooler to reduce the temperature of the pellets to ambient temperature (22± 2°C). The second sampling port was located under the screw auger immediately after the pellets were discharged from the cooler. The third sampling port was below the fat coater where post-pelleting liquid fat was added to 5 of the 6 diets. The diet that did not have fat added post-pelleting was directed through the fat coater for the duration of the experiment to replicate the transportation process through the fat coater the other diets experienced. The last sampling occurred during load-out as feed was exiting the discharge into the feed truck.

Experiment 2

A single 8-compartment 21.7-tonne high output auger unit feed truck (Walinga Inc., Guelph, Ontario) was used in this experiment. Pellets from a swine diet (table 1) were used in experiment 2. In order to achieve different unloading speeds, the truck motor was set to 1 of 3 pre-selected speeds:

Table 1. Composition of experimental diets (as-fed basis).[a]

	Experiment and Diet Formulation							
	1						2	3
Item	Swine				Turkey		Swine	Swine
Ingredient,%								
Corn	77.56	76.08	61.09	65.2	64.34	68.97	85.54	74.95
Soybean meal (46.5% CP)	17.35	11.55	8.44	20.22	18.43	16.08	9.5	19.97
DDGS	---	5	20.4	---	---	---	---	---
Wheat middlings	---	---	7.5	6.39	---	---	---	---
Meat scraps	---	---	---	--	7.54	5.22	---	---
Animal/vegetable blend fat	2	4.37	0.35	5.51	73.9	7.51	2.75	2.57
Limestone	0.72	0.9	1.2	0.71	5.5	0.64	0.8	0.82
Monocalcium phosphate (21% P)	---	---	---	---	---	---	0.25	0.25
Dicalcium phosphate (18% P)	1.07	0.84	---	0.6	1	---	---	---
Salt	0.42	0.46	0.41	0.41	2.8	0.32	0.35	0.35
Copper[b]	0.02	0.02	0.05	0.05	0.5	0.03	0.02	0.02
L-lysine	0.52	0.5	0.4	0.48	4.1	0.4	0.52	0.61
DL-methionine	0.05	0.01	---	0.09	2.2	0.2	---	0.09
L-threonine	0.11	0.09	---	0.11	0.1	0.01	0.09	0.16
L-tryptophan	0.01	0.01	---	---	---	---	0.03	0.03
Betaine	---	---	---	---	2.7	0.27	---	---
Vitamin trace mineral premix	0.15	0.16	0.17	0.24	4.1	0.36	0.15	0.15
Ractopamine HCL, 19.8g/kg	---	---	---	---	---	---	---	0.03
Total	100	100	100	100	100	100	100	100

[a] All diets were pelleted using a 500-hp pellet mill (Pioneer Pellet Mill, Bliss Industries, Ponca City, Okla.) with a 4.4- × 38.1-mm die, counter-flow cooler (OPFLO, Bliss Industries, Ponca City, Okla.), and a twin screw liquid fat coater (TMX Mistcoater, APEC, Lake Odessa, Mich.).

[b] Copper source varied between copper sulfate and tribasic copper chloride (Micronutrients Inc., Indianapolis, Ind.).

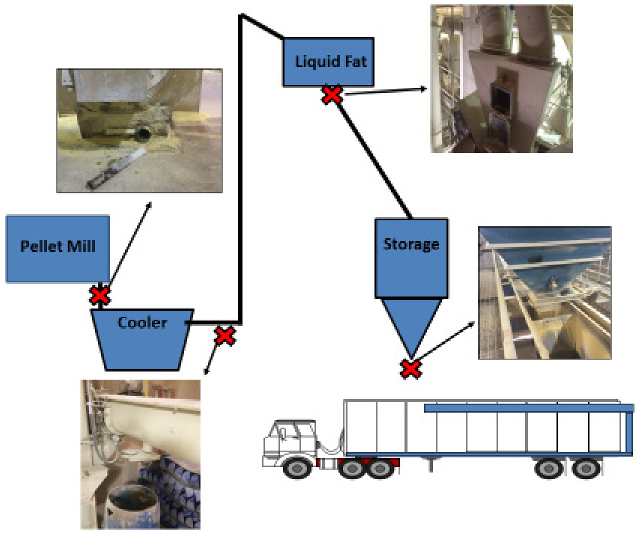

Figure 1. Process flow diagram of the pellets moving through the feed mill. The red X denotes each sampling location within the feed mill. Samples were collected from the pellet mill, fat coater, and loadout using a sample probe (as depicted in the pellet mill picture above) inserted across the entire cross section of the stream. Samples were collected in a barrel from the sample port attached to the conveyer downstream from the cooler.

1) lowest attainable speed, 900 RPM; 2) intermediate speed, 1,150 RPM; and 3) highest attainable speed, 1,400 RPM. The feed truck was equipped with a 30.4-cm diameter floor auger, 40.6 cm diameter vertical auger, and a 30.4-cm diameter boom auger measuring 9.7 m long at the posterior of the truck. The truck speed of 900 RPM resulted in the three augers within the trailer having speeds of 84, 207, and 280 RPM for the floor, vertical, and boom auger, respectively. The truck speed of 1,150 RPM resulted in the three augers within the trailer having speeds of 122, 263, and 316 RPM for the floor, vertical, and boom auger, respectively. Finally, the truck speed of 1,400 RPM resulted in the three augers within the trailer having speeds of 159, 318, and 354 RPM for the floor, vertical, and boom auger, respectively. Unloading speeds were randomly assigned to each compartment within the truck. Six truckloads of pelleted feed with 8 compartments per a truckload resulted in 48 samples used for this experiment. Therefore, there were 16 replications per unloading speed and 6 replications per compartment. The compartment located closest to the truck cab was denoted as Compartment 1 and the compartment located closest to the rear of the truck was denoted as Compartment 8.

As the truck was loaded with pelleted feed in the mill, samples were taken directly under the load-out spout for each compartment using a sampling probe inserted across a cross sectional area of the pellet stream. Thus, a baseline value for percentage fines and PDI was determined for each compartment. Once loading was complete, the truck was driven within 96.6 km by the same route to the same central location, and feed was unloaded into a different feed truck to collect samples and auger motor load data. The boom auger was equipped with a 240- × 30.4-cm reinforced cardboard sleeve to prevent spilling during the unloading process, and the boom was raised until it was approximately 6.1 m off of the ground to simulate a typical feed bin height.

Unloading time for each compartment began when the slide gate under the compartment was opened, and stopped when feed was no longer exiting the boom. Three separate samples were taken while each compartment was unloaded. Samples were taken from below the boom auger sleeve.

Experiment 3

Six identical wean-to-finish swine barns were used to determine the effects of feed line location on pellet quality and nutrient segregation. Therefore, pellets from a swine diet (table 1) were used in experiment 3. Feed samples were taken directly below the boom auger at the top of the feed bin to establish a baseline for initial PDI for each feed bin. Feed was allowed to flow into the barn for 24 to 36 h to ensure that feed initially sampled would be present at the feeders.

Each barn was approximately 79 m long × 12 m wide, and was equipped with two 6-m tall tandem bins located at the front of each barn. Bins were hopper bottomed and contained a flex auger system with a common pitch screw, therefore, making them funnel flow bins. Two screw conveyor feed lines were present in each barn, and spanned approximately 76 m from the bin to the final feeder on each line. At 24 to 36 h after placement, 1-kg feed samples were collected from each feed line directly below the spout connection at the feeder closest to the bin (6 m), an intermediate distance to the bin (35 m), and the farthest from the bin (76 m) for each feed line. Samples were analyzed for percentage fines and PDI.

Statistical Analysis

Data were analyzed using the PROC MIXED procedure of SAS (SAS Institute, Inc., Cary, N.C.). In experiment 1, location or feed form (pellet vs. fines) was used as the experimental unit for the physical and chemical analysis, respectively. Location, run, and location within run were considered a random effect for physical analysis. Pairwise comparisons were used to determine differences. Compartment or feed line was used as the experimental unit for experiments 2 and 3, respectively. Preplanned contrasts were used to determine the interaction and linear and quadratic effect of unloading speed and compartment on pellet quality and unloading time for experiment 2. The interaction of feed form and feed line location, linear and quadratic effect of feed line location, and the main effects of feed line location and feed form were determined for experiment 3. Results were considered significant at $P \leq 0.05$ and a tendency at $P \leq 0.10$.

Results and Discussion

In experiment 1, PDI was different ($P < 0.05$) between locations in the mill; increasing from the pellet mill to the fat coater, but then decreasing between the fat coater and load-out (table 2). The largest increase in PDI was between the cooler and fat coater (6.3%). This increase in PDI can be explained by the increase in percentage fines, due to the weaker parts of the pellets being removed as fines and leaving a

Table 2. Effect of mill sample location on pellet durability and percentage fines (exp. 1).[a]

Item (%)	Pellet Mill	Cooler	Fat Coater	Load-out	SEM	Probability, P <
Pellet durability index	77.0[d]	78.3[c]	84.6[a]	81.9[b]	0.82	0.001
Pellet fines	9.44[c]	8.54[c]	14.20[b]	20.46[a]	0.77	0.001

[a] Eight to 10 samples were taken from each location in the mill within a run for 8 runs over 3 weeks.
a,b,c,d Superscripts within a row are different (P < 0.05).

more durable pellet. Percentage fines were similar from the pellet mill to the cooler, but then increased (P < 0.05) as pellets exited the fat coater, and again from the fat coater to load-out. The largest increase in fines was between the cooler and fat coater and between the fat coater and load out (5.7 and 6.3%, respectively). The worsening of pellet quality from fat applied in the feed mixer has led many producers to include fat after pelleting using post pellet liquid application as conducted in the experiment herein. In the current experiment; however, PDI was reduced after fat was applied, suggesting that post pellet liquid application of fat may actually begin to soften the pellet. As for nutrient analysis, dry matter and ether extract were greater (P < 0.05) and ADF tended to be greater (P < 0.08) in fines compared to pellets, whereas CP was lower (P < 0.05) in fines compared to pellets (table 3).

In experiment 2, there was an unloading speed × trailer compartment interaction (P = 0.031) for unloading time (table 4). The difference in unloading time from the first to last compartment was greatest at the slowest unloading speed and similar at the two highest unloading speeds (70 vs. 35 vs. 37 s for 900, 1,150, and 1,400 RPM, respectively). The percentage of fines formed was not influenced by unloading speeds (table 5). The percentage of fines formed during unloading tended to increase (quadratic; P = 0.081) from the 1st to the 8th compartment, with the maximum percentage of fines formed occurring in the 5th compartment (table 6).

Previous research has demonstrated different strategies for reducing pellet deterioration during storage and handling (Heijnen, 2014). Silo design is one area that can influence the amount of pellet damage that occurs. Flat wall silos increase the pressure on the product leading to more pellet damage compared to corrugated silo plates. This results from pressure build-up directed toward the bottom of the silos. A smoothed walled silo also leads to increased pressure on the product compared to pile planking silos. In addition, silo height and proper hopper design are important to maintain pellet quality. When handling pellets the goal is to minimize the height from which pellets are dropped and move all pellets at the same speed. Although, asymmetric hopper design helps enhance the flow ability of mash feed, it creates a difference in speed among pellets. This generates more fines for pelleted diets. In addition, it is recommended for silo height not to exceed 15 m (Heijnen, 2014). Similar to our experimental design, Cardeal et al. (2014) investigated the effects of transport on pellet quality. Samples were collected as feed was discharged from the pellet mill, from inside the truck, as the truck discharged into an on-site bin, and inside the barn towards the front, middle, and end of the feed line. The percentage of intact pellets significantly decreased post pelleting, but only during discharge into the on-site farm bin. They noted a reduction of intact pellets of 15%, which was less than that in the current study, with an associated 10% increase in pellet fines within the mill, and another 10% increase during discharge from the truck. It should be mentioned that samples were only taken at the pellet die unlike the current experiment where samples were taken at 4 points within the mill. Similar to our findings, Cardeal et al. (2014) described an increase in PDI after the pellet die, which is most likely a result of the cooling process removing moisture from the pellet. Alternatively, the increase in PDI after the pellet die may be due to the poorest quality pellets being degraded early in the manufacturing process, leaving only the hardest and most durable pellets as they move through the

Table 3. Nutrient composition of fines and pellets collected after the fat coater and load out (exp. 1).[a],[b]

Item,%	Fines	Pellets	SEM	Probability, P < Fines vs. Pellets
DM	88.83	88.32	0.16	0.031
CP	13.58	15.24	0.48	0.021
ADF	4.09	3.59	0.20	0.087
Ca	0.74	0.74	0.07	0.975
P	0.50	0.53	0.02	0.354
Ether extract	9.00	7.71	0.42	0.039

[a] Samples from the fat coater and load out were combined to make a composite sample within run and form (pellets or fines) for analysis.
[b] One turkey and three swine diets were sent to a commercial lab with five replications within diet for a total of 20 samples of both fines and pellets.

Table 4. Interactive effects of trailer compartment and unloading speed on unloading time (exp. 2).[a]

	Truck Speed (RPM)				Probability, P <
Compartment[b]	900	1,150	1,400	Pooled SEM	Compartment × Truck Speed
1	222	153	127	17.4	0.031
2	228	145	107		
3	203	134	113		
4	173	132	98		
5	173	126	123		
6	174	119	90		
7	162	114	93		
8	152	118	90		

[a] Values represent the amount of time (s) to unload 3 tons of feed. Six truck loads were used for the trial which resulted in a total of 48 samples collected. Within each truck load, unloading speeds were randomly assigned to each of the 8 compartments within the truck. This provide 16 replications/unloading speed and 6 replications/compartment.
[b] The compartments were numbered 1 to 8 starting with the compartment nearest the cab and ending with the compartment nearest the rear of the trailer.

Table 5. Main effects of truck unloading speed on pellet quality (exp. 2).[a]

	Truck Speed (RPM)				Probability, P <	
Item (%)	900	1,150	1,400	SEM	Linear	Quadratic
Pellet durability index	83.9	80.8	84.5	2.06	0.826	0.192
Fines formed[b]	10.4	10.6	12.4	1.37	0.291	0.631

[a] Six truck loads were used for the trial which resulted in 16 replications/unloading speed.
[b] Fines formed were calculated by subtracting the amount of fines present during unloading from the amount of fines present during loading per compartment.

Table 6. Main effects of trailer compartment on pellet quality (exp. 2).[a]

Item (%)	Compartment[b] 1	2	3	4	5	6	7	8	SEM	Probability $P <$ Linear	Quadratic
Pellet durability index	85.6	76.7	85.9	81.8	77.9	85.3	85.7	85.5	3.54	0.388	0.279
Fines formed[c]	8.2	7.3	11.9	9.9	16.3	11.9	12.5	10.7	2.27	0.083	0.081

[a] Six truck loads were used for the trial which resulted in 6 replications/compartment

[b] The compartments were numbered 1-8 starting with the compartment nearest the cab and ending with the compartment nearest the rear boom auger.

[c] Fines formed were calculated by subtracting the amount of fines present during unloading from the amount of fines present during loading per compartment.

feed mill. In a notable difference from our experimental design, Cardeal et al. (2014) observed that using a larger discharge opening on the feed truck auger resulted in an improved percentage of intact pellets, potentially because there was less friction within the auger, allowing pellets to maintain their structural integrity compared to pellets discharged using the smaller auger.

In experiment 3, there were no interactions between feed line location and nutrient profile of the fines and pellets. There was no effect of feed line location on PDI or percentage fines (table 7). Fines formed at a feeder location was not reported due to difficulty in estimating because of bin unloading fashion with time. There was no difference in DM between fines and pellets. Fines had decreased ($P < 0.05$) CP and P, but greater ($P < 0.05$) ADF, crude fiber, Ca, ether extract, and starch when compared to the composition of pellets (table 8).

In the current experiment, percentage fines was numerically lowest at the last feeder on the feed line, but there was no difference between locations in the barn. This was unexpected, but may be explained by Winowiski (1998), who sampled pelleted feed as it was discharged from a storage bin. Feed was sacked off as it was discharged, and every tenth bag was sampled for percentage fines. For the first 60% of the feed from the bin, percentage fines remained relatively constant (15% fines). However, as the last 40% of the bin was discharged, the percentage of fines increased from 15 to 40%. This data suggests that fines and pellets were segregating inside the bin, and that a larger proportion of pellets were discharged at the beginning, followed by an increasing quantity of fines towards the end of discharging the bin. In the current experiment, samples were taken 24 to 36 h after feed was placed in the bin and had begun to discharge into the barn. The bins sampled were within the first 20% to 40% of the bins capacity, which most likely led to a larger than expected quantity of pellets being present in our samples. Thus, the quantity of fines was actually reduced in the samples collected during a single time point from entry into the bin until it was sampled at the feeders. More research is needed to fully understand the level of fines discharged as the bin empties relative to initial quantity at unloading.

In addition to measuring PDI, differences in the nutrient

Table 7. Effects of feed line location on pellet quality (exp. 3).[a]

Item,%	Feeder Location[b] Front	Middle	Back	SEM	Probability, $P <$ Linear	Quadratic
Pellet durability index	87.9	87.5	87.3	0.40	0.838	0.270
Pellet fines	18.3	20.0	16.6	2.23	0.290	0.993

[a] Two feed lines from 6 commercial wean to finishing barns were sampled which resulted in 12 replications/feeder location sampled.

[b] The front, middle, and back feed line location were 6, 35, and 76 m from the bin, respectively.

Table 8. Effects of feed line location and feed form on nutrient composition (exp. 3).[a]

Item (%)	Feed Form Fines	Pellets	SEM	Probability, [b] $P <$ Feed Form Main Effect
DM				
Front[c]	88.4	88.5	0.10	0.459
Middle	88.5	88.4		
Back	88.5	88.3		
CP				
Front[c]	12.3	15.2	0.14	0.001
Middle	12.4	15.5		
Back	12.5	15.2		
ADF				
Front	3.5	3.1	0.24	0.011
Middle	3.7	3.2		
Back	3.8	3.2		
Crude fiber				
Front	2.8	2.1	0.09	0.001
Middle	2.7	2.3		
Back	2.8	2.3		
Ca				
Front	0.48	0.46	0.012	0.003
Middle	0.48	0.43		
Back	0.45	0.44		
P				
Front	0.37	0.41	0.006	0.001
Middle	0.37	0.40		
Back	0.37	0.40		
Ether extract				
Front	6.2	5.2	0.11	0.001
Middle	6.3	5.3		
Back	6.1	5.2		
Starch				
Front	47.6	44.6	0.42	0.001
Middle	47.2	44.6		
Back	47.3	45.0		

[a] Two feed lines from 6 commercial wean to finishing barns were sampled which resulted in 12 replications/feed line location sampled.

[b] There were no interactions of feed line location and feed form and no main effect of feed line location.

[c] The front, middle, and back feed line location were 6, 35, and 76 m from the bin, respectively.

profiles of the pellets and their associated fines were determined in our studies. Mortiz (2013) observed that when pelleted diets were moved along a feed line in a turkey barn, a greater percentage of fines were present in feeders closest to the feed bin. In contrast, Sellers et al. (2014) observed that when augering feed to feeders at the farm, the amount of pellets present at the feeder decreased along the feed line from 0 to 55 m. In the current experiment, there were no differences in pellet fines along the feed line. This may be due in part to when samples were taken as the bin unloaded or to potential differences in initial percentage of fines present in the diet. Moritz (2013) also noted that phytase, which was added using post pellet liquid application, was more concentrated in the fines compared to the pellets. The quantity of total phytase present in the feed was subsequently reduced from the first to the last feeder. In the present studies, phytase concentration was not measured; however, differences were found in fat composition between pellets and fines, which was applied through a post pellet liquid application system. This may suggest that post pellet liquid application of phytase or fat may lead to increased concentrations in the fines of the diet. This is also in agreement with Engelen and van der Poel (1999), who reported that when vitamin E and phytase were added to pelleted feed using spray application, fines had significantly greater concentrations of both vitamin E and phytase. They also reported that when xylanase was sprayed on a pelleted feed with only 9% fines, the fines had a significantly higher concentration of xylanase compared to the pellets. This resulted in fines providing 23% of the total xylanase activity, even though they physically represented 9% of the total feed amount. More recently, Sellers et al. (2014) investigated the effects of mixer or post pellet liquid addition of phytase and fat in diets with 25% or 45% fines in the diet. They reported that when fat and phytase were added at the mixer, the diet had worse pellet quality as noted by the increased amount of pellet fines.

Myers et al. (2013) suggested that poor PDI leads to increased segregation of the pellets and fines, and possible increases in feed wastage. The preference of pigs to consume pellets compared to pellet fines may lead to nutrient imbalances or possible deficiencies. The differences in CP, fiber components, Ca, and P of the pellets and associated fines as seen in the current experiment may also be cause for concern when formulating to meet the metabolic needs of the pigs when fed a pelleted diet, especially in cases where pellet fines are very high.

Conclusion

In conclusion, pellet quality is worsened as pellets are transported through the feed mill. As feed was then transported to the barn, it appears that the front compartments of the feed truck closest to the cab resulted in fewer fines formed during the unloading process which was unexpected. Decreasing unloading speed significantly increased the quantity of time it took to unload a single compartment, but did not change fines formation. Thus, high unloading speeds may be used without jeopardizing pellet quality, and may improve delivery efficiency. Once pellets were delivered to the farm, pellet quality of our tested samples was similar between feed line locations within a commercial wean-to-finish barn. There were significant differences between the fines and pellet nutrient profiles, as noted by the increased concentration of ADF, crude fiber, Ca, ether extract, and starch in the fines, and decreased CP and P when compared to pellets. Understanding where the formation of fines occurs during the feed manufacturing and delivery process may allow for the development of strategies to reduce pellet deterioration.

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