

NUTRITIONAL STRATEGIES TO MANAGING PORK MARKET DISRUPTIONS

FREQUENTLY ASKED QUESTIONS FROM THE WEBINAR

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Authors: Dr. Laura Greiner: greinerl@iastate.edu, Dr. John Patience: jfp@iastate.edu, Amanda Chipman: chipmana@iastate.edu, Dr. Dan Andersen: dsa@iastate.edu, Dr. Brett Ramirez: bramirez@iastate.edu, Colin Johnson: colinj@iastate.edu, David Stender: dstender@iastate.edu, Mark Storlie: mstorlie@iastate.edu, Russel Euken: reuken@iastate.edu, Matt Romoser: mromoser@iastate.edu, Dr. Chris Rademacher: crjdvm@iastate.edu, Dr. Jason Ross: jwross@iastate.edu, Sherry Hoyer: shoyer@iastate.edu.

Additional Contacts: <https://www.extension.iastate.edu/ag/swine>

FIBER

Q. What are my other options for high fiber ingredients besides DDGS?

A. The cost of all ingredients, including high fiber ingredients, varies by location and over time. So, message #1 here is to always keep an eye on ingredient costs because they can change as conditions change. And what is economical in one location may be priced out of the market in another. But high fiber ingredient options with greater than 25% NDF include (typical NDF % in brackets): corn cobs (81), soybean hulls (59), safflower meal (56), brewers grains (49), sugar beet pulp (45), corn germ meal (44), alfalfa meal (42), sunflower meal (37), wheat middlings (35), sorghum DDGS (34), corn bran without solubles (33), wheat bran (32), dehulled sunflower meal (30), wheat shorts (29), rice bran (26), dehulled safflower meal (26).

Q. Will the use of high fiber diets lead to the build-up of solids in the pit?

A. Using an example of a 35% DDGS diet or 20% soy hulls diet, it generally depends on how you grind them. A 35% DDGS inclusion rate with minimal additional grind results in 30% greater volume of manure solids than a corn-soymeal diet. However, given time microbial activity in pit storage would reduce that to 10-15%. While complicated, there is likely a 10% increase in solids content. The rationale is this: with large pigs fed maintenance diets and consuming high rates of water plus the consideration of inoculated bacteria rich pits they will break down some of the digestible solids. **Foaming** in the manure may be of greater concern dependent on the fiber type, any fat source and/or if a varied bacteria also entered with the fiber source. Data courtesy of Dr. Dan Andersen

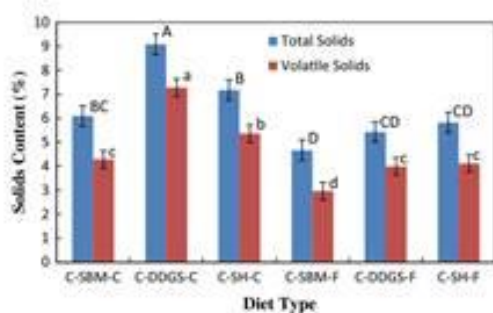


Fig. 1. Total and volatile solids concentrations for C-SBM-C (Corn-Soybean Meal-Coarse), C-DDGS-C (Corn-DDGS-Coarse), C-SH-C (Corn-Soybean Hulls-Coarse), C-SBM-F (Corn-Soybean Meal-Fine), C-DDGS-F (Corn-DDGS-Fine), C-SH-F (Corn-Soybean Hulls-Fine). Error bars represent the standard error of the mean. Capital letters indicate differences ($\alpha = 0.05$) among total solids concentrations and lower case letters represent differences among volatile solids concentrations.

Table 1
Ingredient concentration of diets.

Ingredient	Diets		
	C-SBM ^a	C-DDGS ^b	C-SH
Ingredient, as-fed basis, %			
Corn	79.72	62.50	57.34
Soybean hulls	0.00	0.00	20.75
Soybean meal	18.00	0.00	16.80
Soybean oil	0.30	0.00	3.32
Distiller's dried grains with solubles	0.00	35.10	0.00
Limestone	0.87	1.15	0.60
Monocalcium phosphate (21% P, 17% Ca)	0.41	0.10	0.49
Sodium chloride	0.35	0.35	0.35
Vitamin mix	0.20	0.20	0.20
Trace mineral mix	0.15	0.15	0.15
L-Lys-HCl	0.00	0.39	0.00
L-Trp	0.00	0.03	0.00
L-Thr	0.00	0.03	0.00

^a C-SBM = corn-soybean meal.

^b C-DDGS = corn-distiller's dried grains with solubles.

^c C-SH = corn-soybean meal-soybean hulls.

CALCIUM CHLORIDE

Q. Other than calcium chloride, are there other non-typical ingredients that diets could consider to change dietary electrolyte balance (dEB) or dietary undetermined anion (dUA) in order to reduce feed intake?

A. Ammonium chloride is also an acid salt, and should have the same effect. We (JFP) have conducted one study with ammonium chloride and it certainly had the same metabolic effect as calcium chloride. But unfortunately, we were not interested in growth effects at that time, and it was not measured, but in theory, it could be an option to consider, if pricing was favorable. It would reduce issues with calcium chloride that are associated with the very high dietary calcium.

Q. What about the economics of using calcium chloride?

A. One of the challenges of this approach to restricting growth is the economics. Anhydrous calcium chloride will cost about 28 cents per lb so 80 lb will add about \$18 per ton to the cost of the feed, assuming the CaCl₂ is replacing corn. But monosodium phosphate will also be needed (see next question) and that will add another \$35 per ton. If regular finisher costs \$160/ton, daily feed cost would be about 52 cents per pig. If calcium chloride reduces feed intake by 35%, and the diet costs about \$213 per ton, daily feed cost will be about 45 cents per pig. If you are holding the pigs for 3 weeks, the savings per pig would be \$1.50. However, the pigs on calcium chloride would gain less so the value or cost of reduced growth also needs to be factored into the calculation.

Q. How important is the dietary calcium:phosphorus ratio when feeding calcium chloride.

A. It is probably very important for 2 reasons. First, calcium chloride added at 4% of the diet increases calcium from about 0.50% to 1.50%. In the Iowa State studies, the calcium to STTD phosphorus ratio was held constant; this may be a bit extreme, but additional phosphorus would need to be added to the diet. The exact amount is uncertain but it is well known that the calcium to phosphorus ratio is less important when phosphorus is present in excess. The other reason, however, is the impact of feeding a diet that is so acidogenic; remember, calcium is an acidic salt. The skeleton is actually part of the body's buffering system, and if the acid load on the body is extreme, it can lead to bone resorption which is an acid consuming process. Therefore, it would not be wise to compromise the pig's ability to rebuild bone when feeding an acid salt. But the question is a good one. If less phosphorus was added to the diet in the monosodium phosphate, the relative economics

of using calcium chloride would improve. The issue of skeletal development is one reason why this approach to reducing feed intake is recommended only for a short period of time – perhaps in the range of 3 to 4 weeks. It is clear that much more research on this topic is warranted.

Q. Are there other issues I should be aware of when using calcium chloride

- A. Ulcers could be a problem, so animals need to be monitored closely for symptoms. It also means that levels of Vitamin K in the diet should be reviewed.

97% CORN DIET

Q. Is it necessary to add potassium to the 97% corn diet?

- A. The initial discussion around potassium during the webinar was that these diets may be low in potassium due to soybean meal being excluded. However, upon further evaluation of the diets, the potassium level in these diets will be approximately 0.32% which is adequate for finishing pigs (NRC requirement of 0.17 ppm). So, potassium would not need to be added. On the other hand, feeding excess potassium has not been shown to provide benefit, even with low protein, amino acid balanced diets.

Q. What would be the effect of a 97% corn diet on % lean if fed for 3 weeks?

- A. This is definitely a concern because amino acids would be highly deficient, both in terms of absolute percent of the diet, but also as a ratio to energy. Unfortunately, there are no data to help to answer this question. In old genetics, there is no question that loins would get smaller and backfat would get thicker. However, modern genetics may respond differently to the short term feeding of very low protein diets. The best guess of the panel right now is that it would be a concern, but how much of a concern is not known.

Q. How low does lysine have to be to restrict growth?

- A. Lowering the concentration of lysine in the diet may not lower feed intake very much but it will reduce growth rate. The amino acid that is frequently associated with feed intake is tryptophan. To achieve a notable reduction in growth rate in late finishing, lysine should be lowered by at least 10%.

If a complete barn fill is being managed from loading, it is recommended to not be too aggressive in lowering lysine or other amino acids at the lower pig weights. Damage done to carcass composition in the way of reduced protein gain and increased fat accretion cannot be undone later on. Therefore, modest lowering of lysine (keeping amino acid ratios constant) initially followed by increasing reductions as the pigs grow is recommended; perhaps 5% reduction early on, gradually increasing to a 15-20% reduction in late finishing. The exact program will depend on how aggressive growth rate needs to be reduced and how much impact on carcass can be tolerated.

If the need to slow growth down disappears, and pigs are returned to their normal feeding program part way through the fill, some degree of compensatory gain will be observed. Therefore, some of the lost weight can be recovered. However, compensatory gain is unlikely to completely overcome impaired carcass quality.

GENERAL QUESTIONS ON NOVEL DIET FORMULATIONS

Q. Are there other issues I need to consider when formulating these novel diets?

A. Yes, whenever ingredients with which we have little experience are brought into our formulations, there is a need to return to first principles. The level of all essential nutrients should be reviewed to ensure that inadvertent deficiencies do not occur. This might mean adjustment in the add rate of trace mineral or vitamin premixes. It could mean revision of amino acid digestibilities because fiber, for example, reduces their availability. There would also be a need to look at amino acid interactions, such as the branched chain amino acids. And it could require that dietary electrolyte balance (dEB (mEq/kg) = $\text{Na}^+ + \text{K}^+ - \text{Cl}^-$) or dietary undermined anion (dUA (mEq/kg) = $[\text{Na}^+ + \text{K}^+ + \text{Mg}^{+2} + \text{Ca}^{+2}] + [\text{Cl}^- + \text{P}^{-1.8} + \text{S}^{-2}]$) have to be considered as well. In addition, consider any impacts on feed intake and evaluate the nutrients accordingly to ensure g/d of the essential nutrients are being met appropriately.

Q. Are vices more likely to be a problem when feeding, for example, low protein diets, high fiber diets or diets containing calcium chloride

A. Whenever using diet formulations that are unfamiliar to us, the question of vices will always arise. Diet by itself may or may not encourage social vices, but when other triggers are present in the barn, deficiencies in nutrients can appear to be the trigger. For this reason, diets deficient in minerals or vitamins are not recommended (see below for exceptions). Deficiencies in amino acids have also been identified as a trigger, but the data on this topic are speculative.

STOCKING DENSITY

Q. With typical animal flows, newly weaned pigs need a home whether markets are being shipped out or not. Crowding will occur and this will reduce gain. Is this part of the strategy to deal with disrupted flow of pigs to market?

A. While altering stocking density in the nursery (double stocking) can be done with minimal impact on piglet performance, increasing stocking density on market ready pigs to reduce growth rate is not recommended. It may occur as a consequence of impaired animal flow, but it is not recommended as a strategy by itself to slow growth rates.

BARN TEMPERATURE

Q. Do you have a temperature humidity index (THI) value to use for pig comfort and what would be recommended to impair appetite and slow growth without excessive heat stress?

A. 62°F is “ideal” temperature for a heavy market pig with an upper thermoneutral zone limit of 67°F, beyond that, we should expect ADG to decrease. Running barn temperatures above 78°F is considered too hot based on the graph below and can potentially be a welfare concern and therefore is not recommended. It is understood that barns may experience these temperatures during the summer months natural based on geographical location; however, other methods of cooling should be used at this temperature. Respiration rates should be monitored as an indicator of potential dangers of heat stress. To most effectively impair appetite, evening temperatures must be kept in the higher range; otherwise, pigs simply change from eating during the day to increasing feed intake in the evening. Data courtesy of Dr. Brett Ramirez

		Relative Humidity (%)																		
		5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
Air Temperature (°F)	54	57	56	56	56	56	56	56	56	56	56	55	55	55	55	55	55	55	55	55
	56	58	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57
	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
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	68	63	63	64	64	64	65	65	65	65	65	66	66	66	67	67	67	68	68	68
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	82	70	70	71	72	72	73	74	74	75	76	76	77	78	78	79	80	80	81	82
	84	71	71	72	73	74	74	75	76	77	77	78	79	79	80	81	82	82	83	84
	86	72	72	73	74	75	76	76	77	78	79	79	80	81	82	83	83	84	85	86
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	92	75	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92
94	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	
96	76	77	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	
98	77	78	80	81	82	83	84	85	86	87	88	90	91	92	93	94	95	96	97	
100	78	79	81	82	83	84	85	86	88	89	90	91	92	93	95	96	97	98	99	

Dark Green: thermoneutral conditions

Light Green: upper range of thermoneutral conditions

Yellow, Alert: Prepared to take necessary cooling measures; increase ventilation rate; monitor animal behavior for signs of heat stress such as panting or open mouth

Light Red, Danger: Apply additional cooling by spraying or misting the animals with water (make sure that there is plenty of air movement during this phase); start tunnel ventilation, where applicable

Dark Red, Emergency: Avoid.

Adapted from: Heat Stress Indices for Livestock

(<https://www.ipic.iastate.edu/info/HeatStressIndicesLivestock.pdf>)

LOW FEED INTAKE

Q. What is considered adequate for vitamins and trace minerals?

- A. The NRC identifies appropriate mineral requirements for finishing pigs. Whenever there is a potential for a lower feed intake than expected, a nutritionist needs to review the intake of vitamins and minerals. The NRC sets appropriate guidelines for minimum requirements and these should be followed. Studies demonstrated that pigs can be fed diets for up to 4 weeks without supplemental mineral levels, but it can impair adfi, meat quality and meat nutritional value (Mavromichalis et al, 1999; Shaw et al, 2002; Ma et al, 2012).

Q. Assuming I tried to restrict growth during early grower period (i.e. ~55 lb) and then the market changes and diets can be returned to optimal growth close to harvest, can pigs still compensate if they are already 185 lbs or greater?

A. Pigs may have some type of compensatory response for a short period of time after a period of reduced nutrient intake.

GABLER RESEARCH

Q. Will Dr. Gabler be posting the information on the meat cuts when the trial is complete?

A. At this time, the current objective is to assess the carcass composition of the pigs in the trial. Facility permitting, there should be data available for review on carcass composition.

Q. Have you tried to estimate the number of days added and cost of each of these technologies?

A. Estimated number of days added and the costs will be evaluated as additional data are collected. Weekly updates will be provided as the data become available. An additional extension piece is being completed at this time that discusses the potential economic impact of these treatments (<https://www.ipic.iastate.edu/information/EconomicConsiderationsSlowingGrowth.pdf>). Please refer to: <https://www.ipic.iastate.edu/covid19.html> to follow the trial findings. You may also sign up for regular emails as new items are posted.

Q. Have any vices been noted in this study?

A. In the current study, the pigs are individually housed and so interactive vices have not been noted.

Q. Can you share some economics around the different phases of the study?

A. Yes, below is a table that shows the estimated cost/pig by week as well as the cumulative cost (3 weeks of data). There is also an estimated cost/lb of gain. The cost/lb of gain will be elevated compared to typical comparisons.

	Control	10% NDF	20% NDF	30% NDF	97% Corn	85% Corn	4% CaCl	2% CaCl
Phase 1								
\$/pig/phase	3.475	3.252	3.395	3.034	2.429	3.251	2.744	3.662
Phase 2								
\$/pig/phase	3.759	3.288	3.996	3.761	2.421	3.383	2.554	4.119
Phase 3								
\$/pig/phase	4.100	3.404	4.049	3.969	2.409	3.757	2.462	4.333
Cumulative								
ADG	2.87	2.18	2.46	2.23	1.16	2.27	0.39	2.2
ADFI	7.31	6.29	7.11	6.57	6.15	7.61	3.67	6.62
Total gain	60.27	45.78	51.66	46.83	24.36	47.67	8.19	46.2
Total feed	153.51	132.09	149.31	137.97	129.15	159.81	77.07	139.02
\$/pig	11.339	9.928	11.439	10.776	7.263	10.396	7.746	12.120
\$/pig/lb gain	0.188	0.217	0.221	0.230	0.298	0.218	0.946	0.262

SYNERGISM

Q. Which of these options are synergistic or compatible and are there any combinations that would not be advised?

- A. At this time, there are no data available to show the degree in which using these programs in combination would alter growth or potentially be of concern. However, certain programs carry a greater inherent challenge and should only be done on their own.

VICES/MORBIDITIES/MORTALITIES

Q. Should we be concerned with vices on the low CP/ low AA ratio diets?

- A. Whenever using diet formulations that are unfamiliar to us, the question of vices will always arise. Diet by itself may or may not encourage social vices, but when other triggers are present in the barn, deficiencies in nutrients can appear to be THE trigger. As mentioned above, diets deficient in minerals or vitamins are not recommended. Deficiencies in amino acids have also been identified as a trigger, but the data on this topic are speculative.

Q. Would Mag Ox reduce vices?

- A. Some studies have shown that the use of magnesium oxide can reduce stress in finishing hogs while other studies are inconclusive. If it is beneficial, like other nutritional interventions, the benefits are likely to be short-lived.

OTHER STRATEGIES

Q. How do we handle additives?

- A. Additives can provide benefit such as gut health and further nutrient digestion and improved feed efficiency. All additives should be discussed with your nutritionist to determine if the return on the investment is supportive at this time.

Q. Would increasing micron size of ground corn help in any way to slow the pig down?

- A. No. Corn particle size will impact mainly feed efficiency. Pigs will try to adjust their feed intake to reach their desired caloric intake but often, diet composition or environmental conditions make this impossible.

Q. Can we feed low cost diets that meet the requirements and then implement these diets at around 200 lbs?

- A. If a complete barn fill is being managed from loading, it is recommended to not be too aggressive in lowering lysine or other amino acids at the lower pig weights. Damage done to carcass composition in the way of reduced protein gain and increased fat accretion cannot be undone later on. Therefore, modest lowering initially followed by increasing reductions in amino acids as the pigs grow is recommended; perhaps 5% reduction early on, gradually increasing to a 20% reduction in late finishing. The exact program will depend on how aggressive growth rate needs to be reduced and how much impact on carcass can be tolerated.

ECONOMIC IMPACT

Q. If don't have a good, cheap fiber, could the poor F:G cost more than just selling pigs a little heavy?

A. Whether or not the feed conversion will be cost effective is dependent on many factors such as the packer matrix, how heavy the pigs are, current growth rate, and how long the wait will be before the pigs can be marketed. Consult with your local Field Service representative or the Iowa State Economics department and they could assist you with determining the impact of the different strategies and how that will work with the packer marketing window. Depending on the current situation and availability, secondary markets that are used for sows may need to be considered for overweight market hogs. Please refer to the <https://www.ipic.iastate.edu/covid19.html> website for additional information. Currently, there is a pdf entitled: "Economic Considerations for Reducing Growth Rates and Feed Intake in Finishing Pigs" that discusses this question (<https://www.ipic.iastate.edu/information/EconomicConsiderationsSlowingGrowth.pdf>). This pdf will continue to be updated.

Q. Can we increase salt? What is a safe level?

A. We have not been able to find any published data that suggests that high salt levels will reduce growth rate or feed intake in growing pigs – unless water is restricted. Recent studies at Kansas State University showed that levels of added salt up to 0.75% did not impair growth rate or feed intake in growing pigs. Much older data from Purdue suggest that 1% added salt does not impair growth rate, and presumably feed intake. In all instances, good quality drinking water is absolutely essential to avoiding what is known as salt toxicity. Data on much higher levels of salt could not be found, but even if effective, they would have to be considered highly risky.

LOWER P DIETS

Q. Do you have any thoughts on lower phosphorus levels and higher Ca:P ratio?

A. Feeding a diet that is even slightly deficient in phosphorus is going to impair growth rate, but it is also going to adversely affect skeletal development. The effect will be exacerbated by widening the Ca:P ratio. It would be dangerous to feed such diets to pigs for more than a couple of weeks because we do not have the data to define the correct levels to feed, or how long they can safely be fed to pigs, without impairing their well-being. Therefore, this is not a strategy that we would recommend.