Feedstuffs, August 7, 2017 Feedstuffs Reprint

Diet particle size has energy effects for finishing pigs

NUTRITIONISTS often refer to the particle size work of Wondra et al. (1995) or similar studies, which clearly defined that reductions in grain particle size will lead to improvements in feed:gain.

It is common to take that type of data set and apply energy uplift values to the grain component within a formulation system to take advantage of the energy gained through particle size reduction while ensuring that other dietary components are appropriately formulated relative to the energy content of the diet.

To fully account for the change in feed:gain noted in that study between the 800- and 400-micron treatments, the corn can be roughly estimated to have supplied about 120-200 kcal/kg more energy at the smaller particle size.

In a study published in the *Journal of Animal Science* by Saqui-Salces et al. (2017), the authors explored how whole-diet particle size affects nutrient availability to the pig and how particle size might be associated with gut and whole-body hormonal and metabolite responses. In this study, the authors used late-finishing pigs for a period of 49 days to evaluate three diet types, with each diet also being further ground to obtain coarse and fine treatments that differed solely in grind size.

*Dr. Mark Newcomb is senior nutritionist at NutriQuest.

Bottom Line

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MARK NEWCOMB*

Diets included: (1) a corn and soybean meal diet (CSB), (2) a corn/soybean meal diet with 35% dried distillers grains (DDG) and (3) a corn/soybean meal diet with 21% soybean hulls (SBH).

Coarse diets had particle sizes of 615, 603 and 675 microns, while the fine diets were 364, 352 and 408 microns, respectively.

A very notable result of this study was that energy digestibility, measured as either digestible energy (DE) or metabolizable energy (ME), was improved by particle size reduction of the total diet, regardless of diet formulation (Table).

The main effect particle size reduction had on ME was an increase of 3.3%, or approximately 125 kcal/kg, for the fine versus coarse diets in the study.

If this caloric response were to be applied only to the corn used in the diet, then the increase in corn ME would have been 191, 240 and 125 kcal/kg, respectively, for the three diet compositions used in the study. This lack of consistency in the calculated corn ME change suggests that the other dietary components were also affected by the particle size reduction.

When evaluating the digestibility of various energetic nutrients, improvement in fat (measured as ether extract), protein and neutral detergent fiber (NDF) digestibility were all evident in this study. Somewhat surprisingly, NDF digestibility for the DDG diet was improved the most, with a 12% increase. This improvement could be associated with nearly half of the improved caloric response noted in that treatment due to particle size reduction.

Particle size reduction was not effective for improving macro-mineral digestibility but did improve some of the micro-mineral digestibility measurements. In and of themselves, these mineral digestibility changes have a limited formulation effect on cost. Interestingly, however, the authors did demonstrate a correlation for the digestibility of several micro-minerals with both hormonal responses and circulating bile acids. The relevance of these changes is not well understood.

It is interesting to note that diet composition or particle size *per se* did not result in major gut hormonal changes but did seem to affect insulin and the insulin:glucose ratio. It is unclear, since the study evaluated only a single blood sample, if diet composition affected just the absorption rate of nutrients and if that change translated into just the insulin response observed, or if total glucose uptake was perhaps affected by the particle size reduction.

Energy balance and apparent total tract digestibility of nutrients in pigs fed test diets ground to fine or coarse particle sizes

	Diet composition x particle size						Pooled	P-value		
Dietary	CSB		DDG		SBH		std. error			
treatment	Fine	Coarse	Fine	Coarse	Fine	Coarse	of means	DCxPS*	DC	PS
Number of pigs	8	8	8	8	8	8	—	—	—	—
Energy										
Gross energy, kcal/kg	4,278	4,287	4,502	4,519	4,395	4,427	—	—	—	—
DE, kcal/kg	3,949	3,796	3,993	3,835	3,864	3,798	26	0.59	0.32	< 0.01
ME, kcal/kg	3,824	3,672	3,853	3,703	3,760	3,688	32	0.69	0.53	< 0.01
Dry matter										
Intake, g/day	2,640	2,441	2,528	2,632	2,383	2,376	99	0.28	0.09	0.66
Digestibility, %	92.0[a]	90.0[ab]	89.0[ab]	86.0[b]	88.0[ab]	87.0[b]	1.2	0.65	< 0.01	< 0.01
NDF										
Intake, g/day	189	174	348	362	477	473	10	0.54	< 0.01	0.49
Digestibility, %	70	61.6	74	62.8	81.4	80.7	5.9	0.23	0.01	< 0.04
Ether extract										
Intake, g/day	122	113	157	163	162	161	3.7	0.49	< 0.01	0.79
Digestibility, %	75.0[a]	51.0[d]	69.0[ab]	57.0[cd]	78.0[a]	65.0[bc]	2.3	0.01	< 0.01	< 0.01
Crude protein										
Intake, g/day	425	406.3	431.3	456.3	387.5	393.8	2.6	0.31	< 0.01	0.66
Digestibility, %	90	87	87	84	82	80	1.3	0.73	< 0.01	0.02

[a,b,c,d]Values within a row of diet composition x particle size, treatments or diets with different superscripts are different (P < 0.05).
*DC x PS = interaction effect between diet composition (DC) and particle size (PS).

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The Bottom Line

Studies by Kansas State University researchers (Wondra et al., 1995; Goodband and Hines, 1988) have consistently demonstrated improved feed efficiency with a reduced particle size of grain components. However, in this study, a marked impact on whole-diet particle size was evident.

The magnitude of the response to whole-diet particle size reduction could be interpreted to suggest that the effects noted were due to improved digestibility across many or all of the energy ingredients found in the diet.

It would be interesting to have a study where grinding the grain component was separated from grinding the entire diet, but from these data, it appears likely that whole-diet particle size reduction improved energy digestibility across the entire diet, although the magnitude varied depending on the raw materials included in the diet.

References

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