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41. Effects of pelleting and particle size reduction of corn on digestibility of starch, amino acids, fibre and fat, and concentration of net energy in corn-soybean meal diets fed to group-housed pigs

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Introduction Nutrient digestibility in diets fed to pigs is increased by reducing particle size of cereal grains because the increase in surface area of grain particles leads to greater interactions with digestive enzymes (Lancheros et al., 2020). Pelleting also increases digestibility of nutrients primarily because starch in cereal grains is gelatinised and anti-nutritional factors are inactivated by heat, moisture, and pressure that are applied to ingredients during pelleting (Rojas et al., 2016). However, pelleting may also reduce particle size of grain (Vukmirović et al., 2017), and it is not known if improvements in nutrient digestibility obtained by reducing particle size of grain and those reduced by pelleting are additive or if there are interactions between particle size reduction and pelleting. Therefore, two experiments were conducted to test the hypothesis that particle size reduction and pelleting, separately or in combination, increase ileal digestibility of starch and amino acids (AA), apparent total tract digestibility (ATTD) of fibre, protein and fat, and concentration of net energy (NE) in corn-soybean meal diets fed to group-housed pigs.

Material and methods Six corn-soybean meal-based diets were used in a 3 × 2 factorial with three particle sizes of corn (700, 500, or 300 μm) and two diet forms (meal or pelleted). Diets did not contain any feed additives including phytase, carbohydrase, or emulsifier. A nitrogen (N)-free diet was also used in Exp. 1 to determine the basal endogenous losses of AA. In both Exp. 1 and 2, pigs were allowed *ad libitum* access to feed and water. In Exp. 1, seven barrows (initial weight = 59.3 kg; SD = 2.77) with a T-cannula in the distal ileum were allotted to the seven diets using a 7 × 7 Latin square design with seven periods. Ileal digesta were collected and analysed for titanium, starch, and AA. In Exp. 2, twenty-four pigs (initial weight = 29.5 kg; SD = 1.40) were allotted to the six diets using a 6 × 6 Latin square design with six calorimeter chambers (i.e., four pigs with two barrows and two gilts/chamber) and six periods. Oxygen consumption and CO_2 and CH_4 productions were measured during fed and fasting states and faecal and urine samples were collected and analysed for gross energy (GE), total dietary fibre (TDF), N, and acid hydrolysed ether extract (AEE). Data were analysed using the Proc Mixed of SAS (SAS Institute Inc, Cary, NC, USA). The statistical model included diet as a fixed effect and pig and period or chamber and period, respectively for Exp. 1 and 2, as random effects. Contrast coefficients were used to determine effects of diet form, linear effects of particle size, and the interaction.

Results Data from Exp. 1 indicated that there were no interactions in the apparent ileal digestibility (AID) of starch and standardised ileal digestibility (SID) of arginine, histidine, isoleucine, tryptophan, and total AA (Table 1; data not shown except for the SID of total AA). Interactions were observed for the SID of leucine, lysine, methionine, phenylalanine, threonine, and valine ($P < 0.05$; data not shown). Regardless of particle size, values for the AID of starch and the SID of most AA were greater ($P < 0.05$) in pelleted diets than in meal diets (data not shown). Regardless of diet form, values for the AID of starch and the SID of most AA were linearly increased ($P < 0.05$) by reducing corn particle size (data not shown). Results from Exp. 2 indicated that regardless of particle size of corn, the ATTD of GE, N, and AEE, and concentration of NE, were greater ($P < 0.05$) compared with meal diets. Regardless of diet form, the ATTD of GE, N, and AEE, and concentration of NE, were increased (linear; $P < 0.05$) by reducing particle size of corn, but the increase was greater in meal diets than in pelleted diets (interaction; $P < 0.05$). There were no significant effects of reducing particle size of corn or pelleting on the ATTD of total dietary fibre.

Table 1. Effects of diet form and particle size of corn on standardised ileal digestibility (SID) of total amino acids (AA) and concentration of net energy (NE) in diets fed to growing pigs[a] (Exp. 1 and 2)

Item, % Diet form	Meal			Pellet			SEM	Contrast *P* value		
Corn particle size, µm	700	500	300	700	500	300		Diet form	Particle size[b]	Interaction
SID of total AA	86.05	86.60	87.91	86.93	89.04	90.27	1.37	0.014	0.006	0.074
ATTD of gross energy, %	88.26	89.70	90.89	91.08	92.22	91.79	0.45	<0.001	<0.001	<0.001
ATTD of AEE, %	67.12	68.53	77.13	83.33	83.60	84.97	1.45	<0.001	<0.001	<0.001
ATTD of nitrogen, %	83.19	84.56	85.49	85.63	87.56	87.25	0.97	0.002	0.031	0.021
ATTD of total dietary fibre, %	62.71	61.85	63.48	63.07	66.30	63.75	2.52	0.395	0.765	0.896
NE in diets, kcal/kg	2 735	2 739	2 838	2 857	2 957	2 926	60	<0.001	0.015	0.004

[a] Each least squares mean represents seven observations for Exp. 1 and six observations for Exp. 2, respectively;
[b] Linear effects of particle size of corn; ATTD, apparent total tract digestibility; AEE, acid hydrolysed ether extract.

Conclusion and implications Pelleting increased nutrient digestibility and NE in diets fed to growing pigs. Reducing particle size of corn also increased digestibility of nutrients and NE, but increases were greater in meal diets than in pelleted diets. The results from these experiments imply that pelleting may also reduce the particle size of diets, and thus the effects of reducing particle size in pelleted diets may not be as efficient as it was in meal diets.

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