

Effects of extrusion on nutrient and energy digestibility in cereal grains fed to growing pigs

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Introduction

Extrusion may improve the nutritional value of cereal grains because of increased gelatinization and digestibility of starch (Stein and Bohlke, 2007; Rojas et al., 2016). Extrusion may also increase the digestibility of crude protein (CP) amino acids (AA) and concentration of metabolizable energy (ME). Cereal grains generally contain more than 50% starch, which may result in positive responses to extrusion, but this has not been experimentally verified. Therefore, experiments were conducted to test the hypothesis that the ileal digestibility of AA and starch, the apparent total tract digestibility (ATTD) of gross energy (GE), and the ME in corn, wheat, and sorghum are increased by extrusion.

Materials and Methods

Yellow dent corn, wheat, and sorghum were ground to approximately 500 microns and divided into 2 batches. One batch of each grain was extruded. In Exp. 1, seven pigs (initial BW = 14.2 kg) with intestinal cannulas were used to determine ileal digestibility of CP, AA, and starch in each grain. In Exp. 2, 48 pigs (initial BW = 15.1 kg) were used to determine ATTD of GE and ME in the 6 sources of grain.

Results and Discussion

Extruded grains had greater ($P < 0.001$) digestibility of starch than non-extruded grains (Table 1). This increase is most likely a result of starch gelatinization in the 3 cereal grains (data not shown). The standardized ileal digestibility (SID) of CP in wheat and sorghum were not affected by extrusion, but extruded corn had greater SID of CP than non-extruded corn (interaction, $P < 0.05$). The reason for this increase may be that heat from extrusion changes the 3-dimensional structure of protein, and thus, increases access of digestive enzymes to the peptide bonds (Stein and Bohlke, 2007; Rojas et al., 2016). Results of Exp. 2 demonstrated that the ATTD of GE was increased by extrusion of corn or sorghum, but that was not the case for wheat (interaction, $P < 0.001$). Extrusion increased concentration of ME in all cereal grains, but differences were greater when corn and sorghum were extruded compared with wheat (interaction, $P < 0.001$). In conclusion, extrusion increases digestibility of starch, CP, and energy, and ME in cereal grains fed to growing pigs, but the effects of extrusion depend on source of cereal grain.

Table 1. Energy and nutrient digestibility of non-extruded or extruded corn, wheat, and sorghum fed to growing pigs.

Item	Corn		Wheat		Sorghum		SEM
	-	+	-	+	-	+	
AID of Starch ² , %	90.7	99.2	94.1	98.8	93.2	99	1.3
SID of CP ^{2,3} , %	74.8 ^c	94.9 ^a	87.7 ^{ab}	92.1 ^{ab}	82.2 ^{bc}	87.7 ^{ab}	2.5
ATTD of GE ^{1,2,3} , %	88.2 ^b	92.4 ^a	86.9 ^{bc}	88.3 ^b	84.8 ^c	91.5 ^a	0.6
ME ^{1,2,3} , MJ/kg	14.0 ^b	15.2 ^a	13.5 ^c	14.1 ^b	13.4 ^c	14.9 ^a	0.1

^{a-d}Within a row, means without a common superscript differ ($P < 0.05$).

¹Effect of grain source ($P < 0.05$); ²Effect of extrusion ($P < 0.05$); ³Interactions grain source and extrusion ($P < 0.05$).

References

- Rojas, O.J., Vinyeta, E. & Stein, H.H. (2016). Effects of pelleting, extrusion, or extrusion and pelleting on energy and nutrient digestibility in diets containing different levels of fiber and fed to growing pigs. *J. Anim. Sci.* 94: 1951-1960.
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