Does Heat Stress Alter the Pig's Response to Dietary Fat Source, as it Relates to Apparent or True Total Track Digestibility?

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Summary and Implications

Heat stress affects a plethora of pork production variables, in part stemming from a reduction of feed intake. The experimental objective was to investigate the effect of heat stress on the pig's response to dietary fat in terms of growth performance and digestibility over a 35 d finishing period. A total of 96 barrows were randomly allotted to 1 of 9 treatments arranged as a 3 × 3 factorial with the main effects of environment [thermonetural (TN), pair-fed thermoneutral (PFTN), or heat stress (HS)] and diet [a corn-soybean meal based diet with 0% added fat (CNTR), or the CNTRL with 3% added tallow (3%TAL), or 3% added corn oil (3%CO)]. Pigs were individually housed to record intake. Fecal samples were collected on d 17 (~ 114 kg). No significant interactions between environment and diet were observed ($P > 0.100$). HS decreased ADFI (27.8%; $P < 0.001$), ADG (HS = 0.72, TN = 1.03, PFTN = 0.78 kg/d; $P < 0.001$), and G:F (HS = 0.290, TN = 0.301, PFTN = 0.319; $P = 0.006$). G:F but not ADG or ADFI tended to increase with added fat (CNTR = 0.292, 3%TAL = 0.303, 3%CO = 0.314 g/100 g; $P \leq 0.073$). Environment had no impact of TTTD of AEE ($P = 0.118$). In summary, HS decreased ADFI, ADG, G:F and ATTD of AEE, but had no significant impact on TTTD of AEE. Therefore, the pig's response to dietary fat source is not different in heat stress conditions as compared to thermoneutral conditions.

Introduction

Heat stress results in major losses to the pork industry through a plethora of production variables. Dietary fat is included in swine diets during seasonally warm conditions to minimize the heat of digestion and to maintain energy intake. The experimental objective was to investigate the effect of heat stress on the pig's response to dietary fat in terms of growth performance and digestibility of apparent (ATTD) and true total tract digestibility (TTTD) of acid hydrolyzed ether extract (AEE) over a 35 d finishing period.

Materials and Methods

A total of 96 barrows (PIC 337 × C22/29) with an initial BW of 100.4 ± 1.2 kg were randomly allotted to 1 of 9 treatments arranged as a 3 × 3 factorial, with the main effects of environment [TN (thermonetural: constant 24°C; ad libitum access to feed), PFTN (pair-fed thermoneutral: constant 24°C; limit-fed based on previous HS daily feed intake), or HS (heat stress: cyclical 28°C nighttime, 33°C-35°C daytime; ab libitum access to feed)] and diet [a corn-soybean meal based diet with 0% added fat (CNTR), 3% added tallow (3%TAL; iodine value = 41.8), or 3% added corn oil (3%CO; iodine value = 123.0)]. Pigs were individually housed to record intake. Titanium dioxide was included at 0.4% as an indigestible marker. Fecal samples were collected on d 17 (~ 114 kg). TTTD (%) of AEE was calculated by correcting ATTD of AEE for endogenous fat losses at 20 g of AEE/kg of dry matter intake. Data were analyzed using PROC MIXED with environment and dietary treatment as fixed effects, and replicate (2 replicates of 48 barrows) as a random effect.

Results and Discussion

No significant interactions between environment and diet were observed ($P > 0.100$; Table 1). Rectal temperature (HS = 39.0, TN = 38.1, PFTN = 38.2°C) increased due to HS ($P < 0.001$). HS decreased ADFI (27.8%; $P < 0.001$), ADG (HS = 0.72, TN = 1.03, PFTN = 0.78 kg/d; $P < 0.001$), and G:F (HS = 0.290, TN = 0.301, PFTN = 0.319; $P = 0.006$). G:F but not ADG or ADFI tended to increase with added fat (CNTR = 0.292, 3%TAL = 0.303, 3%CO = 0.314 g/100 g; $P \leq 0.073$). HS tended to have the lowest ATTD of AEE (HS = 59.0, TN = 60.2, PFTN = 61.4%, $P = 0.055$). Inclusion of dietary fat, and a source that was unsaturated increased ATTD of AEE (CNTR = 41.6, 3%TAL = 67.9, 3%CO = 71.2%, $P < 0.001$). TTTD of AEE of 3%CO-based diets was higher (99.3%) than that of CNTR (97.3%) and 3%TAL-based diets (96.3%; $P = 0.012$). Environment had no impact of TTTD of AEE ($P = 0.118$). In summary, HS decreased ADFI, ADG, G:F and ATTD of AEE, but had no significant impact on TTTD of AEE. Therefore, the pig's response to dietary fat source is not affected by HS. The inclusion of dietary fat cannot fully overcome the negative effects of HS.

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Table 1. Effects of ad-libitum feed intake in thermal neutral conditions (TN)[1], pair-feeding in thermal neutral conditions (PFTN)[1], or heat stress (HS)[2] and additional inclusion of no dietary fat (CNTR), 3% tallow (TAL), or 3% corn oil (CO) on growth performance, rectal temperature[3], respiration rate[3], apparent total track digestibility (ATTD)[4], and true total track digestibility (TTTD)[4] of acid hydrolyzed ether extract (AEE)

	Treatments										P value[5]			
	TN			PFTN			HS							
Parameter	CNTR	TAL	CO	CNTR	TAL	CO	CNTR	TAL	CO	SEM	T	E	DF	E × DF
ADG, kg	1.00[a]	0.99[a]	1.10[a]	0.78[b]	0.80[b]	0.74[b]	0.72[b]	0.69[b]	0.76[b]	0.04	<0.001	<0.001	0.491	0.413
ADFI, kg	3.58[a]	3.35[a]	3.44[a]	2.54[b]	2.42[b]	2.52[b]	2.54[b]	2.41[b]	2.51[b]	0.13	<0.001	<0.001	0.124	0.978
G:F, kg	0.287[bc]	0.295[bc]	0.320[ab]	0.307[abc]	0.332[a]	0.317[ab]	0.282[c]	0.284[c]	0.304[abc]	0.016	0.011	0.006	0.073	0.500
RR[6], bpm	37.1[b]	36.8[b]	35.0[b]	34.8[b]	34.5[b]	33.8[b]	79.3[a]	77.4[a]	78.1[a]	2.1	<0.001	<0.001	0.692	0.904
RT[7], °C	38.1[b]	38.1[b]	38.2[b]	38.2[b]	38.2[b]	38.2[b]	39.0[a]	39.0[a]	38.9[a]	0.1	<0.001	<0.001	0.653	0.191
ATTD, %	41.3[e]	67.9[bcd]	71.5[ab]	42.9[de]	68.4[bcd]	72.8[a]	40.4[e]	67.3[cd]	69.4[bc]	1.3	<0.001	0.054	<0.001	0.886
TTTD[8], %	97.1	96.4	100.1	98.8	96.8	99.9	96.2	95.7	98.0	0.7	0.082	0.118	0.012	0.932

[a-c]Within a row, least squares means lacking a common superscript differ, $P < 0.05$.

[1]Constant thermal neutral environment of ~24.0°C.

[2]Diunral heat stress environment of ~33.0°C between 0800 h to 2000 h and ~28.0°C 2000 h to 0800 h from d 0 to d 7, ~33.5°C between 0800 h to 2000 h and ~28.0°C 2000 h to 0800 h for d 7 to d 14, ~34.0°C between 0800 h to 2000 h and ~28.0°C 2000 h to 0800 h for d 14 to d 21, ~34.5°C between 0800 h to 2000 h and ~28.0°C 2000 h to 0800 h for d 21 to d 28, and ~35.0°C between 0800 h to 2000 h and ~28.0°C 2000 h to 0800 h for d 28 to d 35.

[3]Measured daily at 1100 h.

[4]Measured on d 17.

[5]Probability values for main effects of treatment (T), environment (E), and dietary fat (DF), as well as the environment × dietary fat interaction (E × DF).

[6]Respiration rate (breaths per minute).

[7]Rectal temperature (°C).

[8]TTTD (%) of AEE was calculated by correcting ATTD of AEE for endogenous fat losses at 20 g of AEE/kg of dry matter intake.