Can We Alter Water Utilization in Growing Pigs by Diet Manipulation?

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Summary

Concerns relating to the use of water resources by the livestock industry, combined with the rising cost of manure management, have resulted in greater interest in defining more precisely the water consumption of pigs. A study was conducted to determine if the crude protein or mineral content of a diet affected water consumption by growing pigs. Although water use was increased when the crude protein or mineral content of the diet was excessive, factors other than the diet appear to have a greater impact on water use by the pig.

Introduction

Limited information is available on the impact of diet composition on voluntary water intake in swine. In Canada, water has traditionally been abundant and inexpensive. However, present concerns relating to the use of water by the livestock industry, combined with the rising cost of manure management, have resulted in greater interest in more precisely defining the water needs of pigs.

Experimental Procedures

A total of 48 barrows (70.2 ± 2 d, 34.3 ± 4.6 kg BW) were housed in individual metabolism pens. A low CP diet, supplemented with lysine, methionine, threonine and tryptophan was compared to a high and to an excessive CP diet. The excess CP diet was formulated to support growth that was 25% above expected. A fourth diet contained excess calcium, phosphorus, and salt (Table 1). Daily water intake (ADWI) and spillage were determined daily using individual water meters connected to bowl drinkers. Faeces and urine were collected on days 11 to 14 of each period to allow us to accurately determine water intake, water output and the water:feed ratio. Water intake included not only drinking water, but also water contained in the feed and water produced by normal metabolic processes. Water output included faeces, urine and water retained as a consequence of growth. Water exhaled from the lungs was not measured.

Results and Discussion

On average, drinking water represented 83% of total water intake; feed and metabolic water represented 3% and 14% of the total, respectively. Of the measured water outputs, growth constituted only 8% of the total, while faeces represented not much more at 9%. Urine output represented 83% of the measured total. If we assume that the unmeasured water balance – the difference between intake and measured output - was primarily water lost through respiration, this would have constituted 49% of the total. Urine would then have represented only 42% of the total daily water balance.

Diet may affect water use by pigs, but environment and water delivery systems have a greater impact.

The ADWI (P=0.06) and water output (P=0.06) tended to increase when pigs received the excess CP diet (ExCP; Table 2). Additionally the water:feed ratio increased when pigs consumed this diet (P=0.01; Table 2). Pigs that consumed the excess mineral diet (ExMin) had increased output of water in faeces (P=0.02; Table 2).

An attempt was made to develop equations to predict water intake of growing pigs from the diet composition or intake of specific nutrients. A prediction equation containing daily intake of feed nitrogen, calcium, phosphorus, sodium, potassium and chloride as independent variables resulted in the highest R^2. It was, however, only able to explain 33% of the variability in water intake. In all cases, the ability to detect treatment differences was hampered by the large variability among individual pigs for water intake and output. The pigs were housed individually in this experiment; however, it had been shown in previous experiments when the pigs were housed in groups that a lack of social interaction was not the cause of this variability.

Implications

Feeding a diet containing excessive dietary protein will result in increased water use by growing pigs. This makes sense as additional water will be needed to remove the by-products of protein breakdown from the body. Surprisingly, reducing CP by increasing the use of synthetic amino acids will not reduce water intake. Although diet composition may influence water utilization in growing pigs, other factors, such as the environment and the design of the water delivery system, appear to have a greater impact. The water:feed ratio was confirmed to be in the range of 2.5:1, provided excess nutrients are not present in the diet.

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[1] Ajinomoto Heartland, Chicago, IL, USA.

Table 1. Composition of experimental diets (as fed basis)[1]

	Low CP	HiCP	ExCP	ExMin
Ingredient, %				
Wheat	64.6	40.2	30.0	38.9
Barley	20.0	30.6	25.2	29.6
Soybean meal	10.8	25.3	40.9	24.6
Canola oil	1.0	1.0	1.0	2.0
Dicalcium phosphate	0.5	0.5	0.5	1.7
Limestone	0.8	0.7	0.6	1.2
Salt	0.4	0.4	0.4	0.9
Nutrients				
DE, Mcal/kg	3.33	3.32	3.37	3.31
gDLys/Mcal DE	2.42	2.42	3.40	2.41
Crude protein, % DM	17.8	21.4	25.4	20.4
Calcium, % DM	0.57	0.51	0.58	1.00
T Phosphorus, % DM	0.47	0.51	0.54	0.76
Sodium, % DM	0.25	0.14	0.16	0.36
Chloride, % DM	0.44	0.28	0.33	0.70
Potassium, % DM	0.55	0.81	0.99	0.76
Electrolyte balance (dEB)	126	178	235	154

[1] All diets contained mineral and vitamin premixes. The Low CP diet also contained NaHCO3, L-Lysine-HCl, DL-Met, L-Thr and L-Try.

Table 2. The effect of dietary protein and mineral content on water balance and performance in growing pigs.

Water Balance, g/d	Low CP	HiCP	ExCP	ExMin	SEM	*P*=
Intake						
Drinking	5500	4952	6265	5489	326	0.06
Feed	194	199	202	201	4	0.62
Metabolic[1]	1002	925	949	937	20	0.05
Total intake	6697	6076	7415	6626	336	0.06
Output						
Faecal	289	286	310	328	10	0.02
Urinary	2839	2492	3417	2608	256	0.07
Growth[2]	266	290	278	278	12	0.57
Total output	3394	3069	4005	3213	252	0.06
Water:feed	2.50	2.46	3.14	2.66	0.15	0.01
Performance, kg						
ADG	0.98	0.89	1.02	1.03	0.04	0.04
ADFI	2.21	2.02	1.99	2.07	0.05	0.01
G:F	0.45	0.44	0.51	0.50	0.02	<0.01

[1] Water produced by metabolism of feed ingredients.

[2] Based on N retention data, calculated as (PDR*2.25)*70/100 (NRC 1998).