Impact of Drinking Water Sulphate Levels on Gas Emissions and Manure Nutrients

B.Z. Predicala and J.F. Patience

SUMMARY

The impact of varying sulphate levels in drinking water on odour and gaseous emissions and on swine manure properties was evaluated. Results showed that drinking water with up to 1,800 ppm sulphate had no adverse effect on pig performance, gas and odour emissions, and manure nutrient levels. This can allow the pork industry to expand into areas previously considered as having unacceptable or undesirable sulphate levels in drinking water sources.

INTRODUCTION

Odour and gaseous emissions from swine operations is a major environmental concern for the pork industry. Out of the 10 most odourous components of swine odour identified, six are sulphur-containing compounds. No studies have been undertaken to fully assess the extent of the impact of the pig's sulphur intake levels on air quality and on manure characteristics, especially under actual production conditions. The overall goal of this study was to assess the impact of animal drinking water quality on swine manure nutrients and on air emissions.

"Water with up to 1,800 ppm sulphate had no adverse effect on pig performance, gas and odour emissions, and nutrient levels."

RESULTS AND DISCUSSION

The concentrations and emissions of NH_3 and CO_2 were not significantly ($p>0.05$) affected by the increasing levels of water sulphate (Table 1). No measurable impact on levels of H_2S gas was observed when manure was undisturbed. However, the average peak H_2S values obtained during plug-pulling from each treatment room was significantly ($p<0.01$) affected by the treatment. During individual replicates, the maximum peak H_2S values measured during pit-plug pulling in the treatment rooms provided with drinking water with 1,200 and 1800 ppm sulphate were 288 and 134 ppm H_2S, respectively; these spikes occurred for only a short period of time and the high levels dissipated to less than 10 ppm in less than 10 min. These observations would appear to indicate that high-sulphate levels in drinking water could contribute to the generation of high H_2S levels during manure clearing operations.

Table 1. Average weekly gas (NH_3 and CO_2) concentration and emission levels from the treatment rooms during the replicates.

	Ammonia Concentration (ppm)			Ammonia Emission Rate (g/hr)			CO_2 Concentration (ppm)			CO_2 Emission Rate (g/hr)		
Treatment	Mean[a]	n	SE	Mean[a]	n	SE	Mean[a]	n	SE	Mean[a]	n	SE
Control	9.9	40	0.5	12.1	38	2.0	728.6	40	36.4	1,880.1	39	154.4
600 ppm	10.7	40	0.6	13.4	40	1.5	769.6	40	44.9	2,052.3	40	69.4
1,200 ppm	10.0	40	0.4	12.5	38	1.6	740.8	40	38.0	2,077.7	38	93.3
1,800 ppm	9.7	40	0.4	9.8	37	1.4	735.0	40	36.1	1,896.5	37	108.9

a – Treatment mean values not significantly different ($p>0.05$)

Table 2. Average H_2S concentrations measured in each room throughout the study

	Peak H_2S Concentration (ppm)			Day-long H_2S Monitoring (ppm)	
Treatment	Mean*	n	SE	Mean**	n
Control	22.5a	17	8.4	0.0	11
600 ppm	21.0a	17	7.6	0.0	2
1,200 ppm	54.2b	17	22.4	0.0	2
1,800 ppm	27.9a	17	8.4	0.0	6

* Treatment mean values followed by the same letter are not significantly different
** Below detection limit

ACKNOWLEDGEMENTS

Strategic funding provided by Sask Pork, Alberta Pork, Manitoba Pork Council and Saskatchewan Agriculture and Food. Project funding provided by U.S. National Pork Board. Technical assistance provided by Scott Cortus, Robert Fengler, and Erin Cortus is acknowledged.

Odour concentration and emissions from the rooms were not significantly ($p>0.05$) affected by the treatment applied. Wide variability in the measured odour values contributed to the difference being not statistically significant.

In general, the measured manure nutrient levels were consistent with typical reported levels for swine manure. Except for the levels of sulphur, the nutrient properties of fresh manure from the treatment rooms were generally not affected by the amount of sulphate in the drinking water. Fresh manure generally had higher nutrient levels compared to stored manure (Figure 1). Stored manure from pigs given high-sulphate water tended to retain nutrients better compared to stored manure from pigs with low-sulphate water (Figure 2).

Pig performance was not adversely affected by high levels of sulphate in the pig's drinking water. For all replicates, the average daily gain ranged between 0.86 to 1.12 kg/day. During the study, no notable incidence of scouring or diarrhea was observed.

CONCLUSION

Elevated levels of sulphur intake from water had no adverse impact on manure nutrient composition, odour and gas (NH_3 and CO_2) emissions or on the performance of grower-finisher pigs. Thus, for water sources with up to about 1600 to 1800 ppm sulphate content, water treatment is not necessary. However, when using high-sulphate drinking water, proper measures should be in place to consider the increased potential for generating high spikes in H_2S levels during manure handling operations. These results support the possibility of constructing pig barns in locations where the available ground water is high in sulphate (up to 1600 ppm), without concern for adverse impact on growing-finishing pig performance, odour emissions, and manure nutrient value.

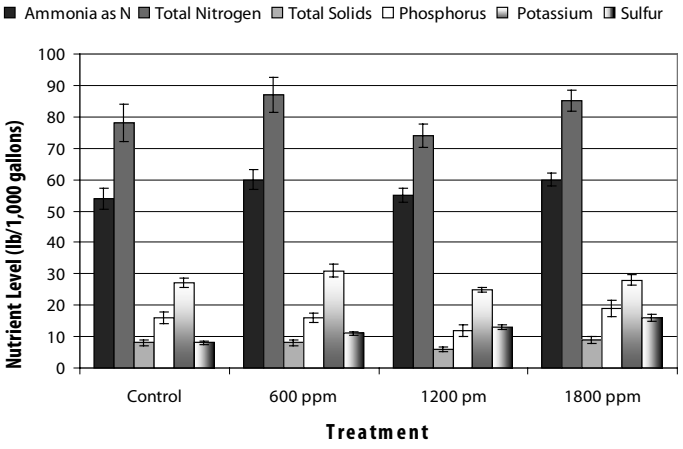

Figure 1. Nutrient properties of manure in the pits of the treatment rooms (each bar, n=15).

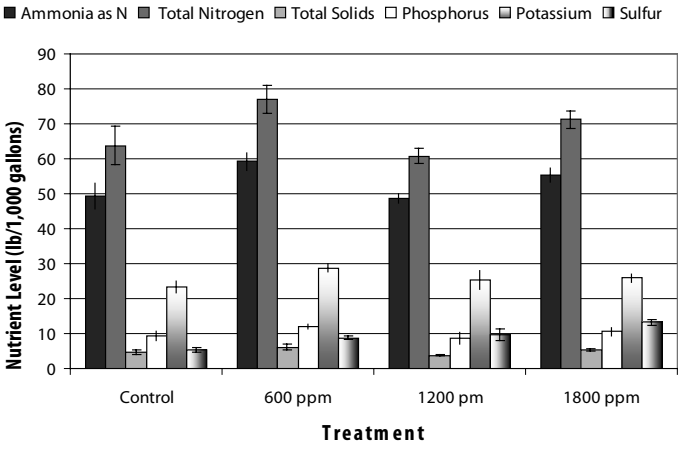

Figure 2. Nutrient properties of manure from the barrels used to simulate long-term storage (n=12).