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NITRATES IN DRINKING WATER

R. W. Seerley, O. E. Olson and R. F. Fritschen

Nitrate poisoning in livestock is a recurring problem. In ruminants the bacteria are able to convert nitrates ( $\text{NO}_3$ ) to nitrites ( $\text{NO}_2$ ) in the gastrointestinal tract. If nitrite is present in large amounts it converts hemoglobin to methemoglobin, which has little or no oxygen-carrying capacity. The result in severe cases is asphyxiation. It is not known what effects nitrates may have on swine.

Nitrate levels as high as 700 parts per million (ppm) have been found in water samples from South Dakota. The probable ways nitrates get into drinking water are by natural means and pollution. The purpose of this experiment was to determine the effects these nitrates in the drinking water have on the performance of growing-finishing pigs.

Experimental Procedure

Two trials were conducted, the first began June 28 ending August 28. The second began July 18 ending October 23 for 3 lots and October 29 for the remaining lot. Composition of the ration fed is found in table 1 and was the same for both trials. All pigs were self-fed and watered ad libitum. Feeders and waterers were located in the same area in each pen. Animals were confined 6 to a pen with 4 lots for each trial. All animals were allotted on the basis of litter, weight, sex and general appearance. The sodium nitrate was kept in powder form until needed when it was dissolved in a weighed volume of water. Water was provided in an 80 gallon Pax waterer which had two drinking cups. Water samples were taken from the cups and tanks at 2 or 3 day intervals and analyzed for nitrites. Treatment levels were 0, 50, 125 and 300 ppm of nitrates.

Table 1. Composition of Rations

	Under 110 lbs.	Over 110 lbs.
Shelled corn	1626	1760
Soybean meal	250	136
Tankage	80	50
Dicalcium phosphate	20	20
Limestone	10	10
T. M. salt (Hi zinc)	10	10
B vitamin (Merck 92)	1.0	1.0
Vitamin B <sub>12</sub> (Merck 20)	.5	.5
Vitamin A and D (Dawes, Fixtay-Dee)	2.5	2.5
Aurofac 10	2.0	1.0
Hygromix 8	1.5	--

Results and Discussion

Tables 2 and 3 summarize the results of the two trials. In trial 1 pigs fed water with the two higher levels of nitrate gained slightly slower than control pigs, but in trial 2 they gained slightly faster than the control pigs. Pigs given 50 ppm in trial 1 gained rather slowly, but it is doubtful that nitrate was the major factor involved. At least no pattern was set as the level of nitrates were increased and pigs fed 125 or 300 ppm were not adversely affected. These pigs (50 ppm, trial 1 lot) developed a skin condition shortly after the start of the trial. The dermatosis was characterized by small gray irregular shaped areas on the ears and body. Approximately a week later the condition cleared up without treatment. During this period the pigs had slow daily gains and they appeared to be under a physiological stress. It remains to be shown if this was in any way related to the presence of nitrates or nitrites.

The average water consumption among the treatments did not agree between the two trials. In trial 1, pigs given the higher levels of nitrates drank more water than the control pigs, but they drank less than the control pigs in trial 2. Again, no pattern was established due to nitrates.

Nitrate treatment may have affected feed conversion. In both trials the control pigs required slightly less feed per pound of gain than nitrate-watered pigs.

Water in tanks (reservoir of the pig waterer) and water in the drinking cups were checked periodically for nitrites. The purpose for this analysis was to check if the nitrates were being converted to nitrites. In general there was little or conversion of nitrates to nitrites in the tanks, but more of the nitrates in the cups were reduced to nitrites. The highest average was nearly 13 ppm of nitrites in lot 3 during the second trial. The low content of nitrates did not have a serious adverse effect on the pigs. In summary, there were no serious effects due to the levels of nitrates studied.

Table 2. Trial 1

Nitrate level, ppm	0	50	125	300
Lot no.	1	2	3	4
Number of pigs	6	6	6	6
Av. initial wt., lb.	35.33	35.33	35.33	35.50
Av. final wt., lb.	125.0	113.2	122.5	121.3
Days on experiment	61	61	61	61
Av. daily gain, lb.	1.47	1.28	1.43	1.41
Av. daily feed, lb.	4.17	3.67	4.24	4.10
Feed/lb. gain, lb.	2.84	2.87	2.97	2.89
Av. daily water consumption, lb.	51.15	44.92	55.57	52.13
Av. nitrites, ppm				
Cups	.05	.78	2.43	4.83
Tanks	.01	.08	.44	1.16

Table 3. Trial 2

Nitrate level, ppm	0	50	125	300
Lot number	1	2	3	4
Number of pigs	6	6	6	6
Av. initial wt., lb.	46.5	46.2	46.8	46.2
Av. final wt., lb.	196.2	202.3	201.5	200.7
Days on experiment	97	103	97	97
Av. daily gain, lb.	1.54	1.52	1.59	1.59
Av. daily feed, lb.	5.11	5.06	5.50	5.36
Feed/lb. gain, lb.	3.31	3.34	3.45	3.37
Av. daily water consumption, lb.	77.62	69.15	72.27	67.47
Av. nitrites, ppm				
Cups	.12	5.26	12.92	10.95
Tanks	.33	.44	.49	.27