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EFFECT OF SODIUM SELENITE LEVELS ON TISSUE AND BLOOD COMPOSITION AND PERFORMANCE OF GROWING-FINISHING SWINE

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A second trial was conducted to further study the problem of selenium toxicity. In this experiment, sodium selenite was utilized as the selenium source. The FDA has approved sodium selenite and sodium selenate supplementation of pig starter diets up to a level of .3 parts per million (ppm) of selenium. The study reported herein was conducted to determine the effect of sodium selenite levels on tissue and blood composition and performance of growing-finishing swine.

Experimental Procedure

This study was designed in a manner similar to that of the preceding experiment. In addition, the same blood, enzyme and performance parameters were measured in this study as in the preceding experiment reported in SWINE 82-2. Twenty-four weaned crossbred pigs initially averaging 18.4 lb were individually fed in a 17-week growing-finishing trial. Six barrows were allotted to each of four dietary selenium levels. The 21% protein diets were composed of corn, wheat, oats and soybean meal. Sodium selenite was added at levels to obtain the desired dietary selenium levels of 0, 3, 6 and 9 ppm in diets I, II, III and IV, respectively. Dietary composition is shown in table 1.

Table 1. Percent Composition of Diets

Diet	I	II	III	IV
Selenium level				
Calculated (ppm)	0	3	6	9
Actual analysis (ppm)	.47	2.71	5.55	9.00
Wheat	35	35	35	35
Oats	20	20	20	20
Corn	17	17	17	17
Soybean meal	25	24.95	24.89	24.83
Dicalcium phosphate	1.6	1.6	1.6	1.6
Limestone	.9	.9	.9	.9
Trace mineralized salt	.3	.3	.3	.3
Vitamin-antibiotic premix[a]	.2	.2	.2	.2
Sodium selenite premix[b]	0.0	.055	.11	.17

[a] Supplied per lb of diet: vitamin A, 1818 IU; vitamin D, 182 IU; vitamin E, 4 IU; vitamin K, 1.6 mg; riboflavin, 2 mg; pantothenic acid, 8 mg; niacin, 12.8 mg; choline, 80 mg; vitamin B_{12}, 8 mcg; selenium, 72 mcg; aureomycin, 120 mg; and Banminth (pyrantel tartrate), 47.7 milligrams.

[b] 2.27 g selenium as sodium selenite per lb premix.

Results

The effect of sodium selenite level on pig performance is shown in table 2. The level of sodium selenite had no effect on pig performance as measured by average daily gain, average daily feed intake or feed conversion.

Table 2. Effect of Selenium Level on Pig Performance[a,b]

	Selenium level (ppm)			
	0	3	6	9
Avg daily gain	1.63	1.72	1.63	1.70
Avg daily feed	4.59	5.09	4.74	5.00
Feed/gain	2.81	2.97	2.90	2.95

[a] All weights in pounds.
[b] Six individually-fed pigs per treatment, initial weight 18.5 lb.

Selenium concentrations in the liver, kidney, heart, spleen, diaphragm muscle and hair were significantly affected by dietary treatment (table 3). In general, the selenium concentration was linearly increased in these organs and tissues as selenium in the diet increased. Levels of selenium in the organs and tissues of pigs fed the control diet for 17 weeks were similar to the levels found in pigs in the previous experiment, although those pigs received the diet for only 6 weeks. However, the content of selenium found in pigs fed diets supplemented with sodium selenite in this experiment were considerably less than that found in pigs fed similar levels of selenium but derived from seleniferous grains in the previous experiment. Although we had previously found that the selenium level of the hair was related to hair color, the pigs utilized in this study were essentially all white, making it impossible to evaluate the influence of hair color. The liver/body weight ratio was significantly affected by dietary treatment, increasing at the higher selenium concentrations.

The effect of sodium selenite level on blood composition is shown in table 4. The selenium levels of the blood increased linearly with increasing sodium selenite level. As in the preceding experiment, high levels of sodium selenite did not produce an anemic condition as indicated by the Packed Cell Volume (PCV) and hemoglobin level, which did not differ among treatments. In this experiment, the serum bilirubin levels were too low to accurately measure, again suggesting no liver damage in these animals.

The effect of selenium level on blood enzyme activity is shown in table 5. Certain enzymes are indicative of either the selenium status of the body or of tissue damage. Because selenium is an essential component of the enzyme glutathione peroxidase, the level of this enzyme might be expected to increase with increasing sodium selenite level. In this study, the lowest level of sodium selenite supplementation produced the maximum increase in cellular glutathione peroxidase and serum glutathione peroxidase. The highest level of sodium selenite tended to decrease this maximum value slightly. An increase in serum glutamic oxalacetic transaminase (SGOT) and serum glutamic

Table 3. Effect of Selenium Level on Selenium Content of Organs and Tissue[a]

	Selenium level (ppm)			
	0	3	6	9
Liver[bc]	.64	2.56	3.23	3.63
Kidney[b]	1.65	2.15	2.43	2.98
Heart[b]	.42	.49	.62	.69
Spleen[bd]	.38	.61	.55	.94
Muscle[b]	.31	.37	.40	.47
Hair[e]	.98	2.81	4.26	4.24
Liver (% body wt)[f]	1.60	1.54	1.85	1.71

[a] Parts per million selenium, wet basis.
[b] Linear effect (P<.01).
[c] Quadratic effect (P<.01).
[d] Cubic effect (P<.01).
[e] Linear effect (P<.05).
[f] Cubic effect (P<.05).

Table 4. Effect of Selenium Level on Blood Composition

	Selenium level (ppm)			
	0	3	6	9
Blood selenium, ppm[a]	.31	.94	2.13	3.84
Packed Cell Volume, %	42.0	42.0	41.0	39.0
Hemoglobin, g/100 ml	12.7	12.6	12.6	12.6

[a] Linear effect (P<.01).

Table 5. Effect of Selenium Level on Blood Enzyme Activity[a]

	Selenium level (ppm)			
	0	3	6	9
GSH-Px cells				
EU/mg protein[b]	25.4	35.8	37.4	31.0
EU/mg hemoglobin[c]	37.8	53.6	57.6	45.7
GSH-Px serum,				
EU/mg protein[bd]	6.3	7.9	7.9	7.5
SGOT, S-F units/ml	42.0	45.0	49.0	40.0
SGPT, S-F units/ml	30.0	34.0	38.0	37.0

[a] Glutathione peroxidase (GSH-Px), serum glutamic oxalacetic transaminase (SGOT) and serum glutamic pyruvic transaminase (SGPT).
[b] Quadratic effect ($P<.05$).
[c] Quadratic effect ($P<.01$).
[d] Linear effect ($P<.05$).

pyruvic transaminase (SGPT) is used as an indication of liver damage. However, the SGOT and SGPT levels were not different, indicating no liver damage at any of the sodium selenite levels fed in this experiment.

Summary

A 17-week growing-finishing trial was conducted to determine the effect of sodium selenite levels on tissue and blood composition and performance of growing-finishing swine. Selenium levels of approximately 0, 3, 6 and 9 ppm had no effect on pig performance as measured by average daily gain, average daily feed or feed/gain. The selenium concentrations of the blood, hair, liver, kidney, heart, spleen and muscle were significantly increased by dietary treatment. Blood glutathione peroxidase activity was significantly increased by dietary treatment. Other blood parameters were not affected by dietary treatment. No signs of selenium toxicity were produced.