THE INFLUENCE OF ARSENIC ON SELENIUM POISONING IN HOGS[1]

Alvin L. Moxon
South Dakota State College

Farmers in seleniferous areas are of the opinion that, among farm animals, hogs are the most susceptible to selenium poisoning. Many farmers have moved onto seleniferous ranches with herds of purebred hogs and lost most of them within a year, as a result of selenium poisoning. These farmers soon learned to buy feed of a lower selenium content, if they remained in the hog business. Any simple treatment that will prevent these losses of hogs or make it unnecessary to buy feed from non-toxic areas, should be desirable.

Soon after it was found that arsenic would prevent the toxic action of selenium in rats,[2 3 4] and in dogs,[5] preliminary experiments were started with hogs. Although the results reported herein are based on only 3 hogs, they follow so closely the results which have been obtained on a large number of dogs that we do not hesitate to draw some conclusions.

Experimental. Three spring pigs, litter mates, females, were put on experiment on May 24, 1939, as indicated in Table I. The ration was the same as used in the dog work and consisted of the following ingredients:

Corn (yellow)	72%
Casein	18
Lard	5
Salt	1

[1] South Dakota Agricultural Experiment Station, Journal Series No. 151.

[2] Moxon, A. L., The Effect of Arsenic on the Toxicity of Seleniferous Grains. Science, Vol. 88, p. 81, 1938.

[3] Moxon, A. L., and K. P. Dubois, The Influence of Arsenic and Certain Other Elements on the Toxicity of Seleniferous Grains. J. Nutrition, Vol. 18, pp. 447-457, 1939.

[4] Dubois, K. P., A. L. Moxon, and O. E. Olson, Further Studies on the Effectiveness of Arsenic in Preventing Selenium Poisoning. J. Nutrition, Vol. 19, pp. 477-482, 1940.

[5] Moxon, A. L., H. D. Anderson and Morris Rhian, The Effect of Arsenic, Proteins and Thiamin on the Toxicity of Selenium to Dogs. Paper presented at the 101st meeting of the American Chemical Society, St. Louis, Mo., April, 1941.

$CaCO_3$	1
$Ca_3(PO_4)_2$	1
Cod Liver Oil	1
Yeast (Northwestern)	1

TABLE I.

Pig	Sex	Selenium Content of Ration	Arsenic Content of Drinking Water	Weight at Start	Weight at End 20 wks.
A	female	none	none	20 lbs.	79 lbs.
B	female	9.0 p. p. m. (corn)	none	28 lbs.	63 lbs.
C	female	9.0 p. p. m. (corn)	5 p. p. m. (Na_2HAsO_3)	27 lbs.	80 lbs.

Feeds containing 9 p. p. m. of selenium are encountered on many farms in seleniferous areas. On August 2, 1939, the hogs were slaughtered and tissues and organs from B and C were sampled for analysis. (Table II).

Results and Discussion. The results indicate that arsenic as Na_2HAsO_3 when fed at the rate of 5 p. p. m. in the drinking water for pigs will counteract the toxicity of selenium when fed at the rate of 9 p. p. m. in the ration. This rate of arsenic administration is only slightly higher than the rate of arsenic administration which results when a certain "highly advertised" liquid hog tonic is fed according to directions. Undoubtedly this hog tonic would give some protection against selenium poisoning, but why should the hog raisers pay such high prices for a few cents worth of arsenic?

McCullough, St. John, and Groves[6] of the Washington Experiment Station fed a pig a total of 13.4 grams of arsenic in the form of lead arsenate spray residue on apples without any apparent injury to the pig. We have fed dogs 5 p. p. m. of arsenic in their drinking water for several months with no apparent injury.

The selenium pig after being on the seleniferous ration for 20 weeks was in poor condition. Its feet were so sore, as a result of the cracked hoofs, that it had great difficulty in moving about. There was considerable loss of hair, and a roughening of the skin.

[6] McCulloch, E. C., St. John, J. S., and Groves, Kermit, Moderate Amounts of Lead-arsenate-sprayed Apples Non-injurious to Swine. J. Am. Vet. Med. Association, Vol. 97, pp. 51-52, 1940.

In recent work with dogs we have found that by substituting tankage for the casein in the ration the symptoms of selenium poisoning appear earlier and are more severe. Since tankage is the common protein supplement for hogs, it is probable that they would appear earlier in most cases where hogs are fed seleniferous grains supplemented with tankage under farm conditions.

TABLE II. SELENIUM AND ARSENIC CONTENT OF TISSUES

(Moisture-Free Basis)

Tissue	Pig B (Se-As)		Pig C (Se)
	Arsenic Content	Selenium Content	Selenium Content
Liver	5.01	9.5	6.4
Kidney	2.29	6.4	9.6
Heart	1.42	7.8	6.4
Lungs	2.59	1.2	9.2
Spleen	3.19	5.4	6.6
Pancreas	.42	5.0	6.0
Stomach	.85	1.6	1.0
Hair	5.30	9.8	35.2
Muscle	3.79	8.0	16.0

The results shown in Table II indicate that the arsenic prevents at least a part of the selenium from entering the muscle tissues of the hog. The liver of the pig fed both selenium and arsenic contained more selenium than the liver of the pig fed selenium without the arsenic. This observation is in line with the results obtained by feeding dogs selenium with and without arsenic. We have advanced the theory that some of the selenium in the liver is bound there by the arsenic in a non-toxic form when selenium and arsenic are fed together.