An Investigation of an Arsenic Poisoning Case*

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After lead, arsenic constitutes one of the most important toxicological hazards to farm animals. Arsenic is rather ubiquitous in nature, and trace or background levels can be found normally in nearly all animal and plant tissues. Arsenical compounds have been used for a variety of purposes, including for treatment of disease, as feed additives to promote weight gains, and as herbicides, cotton defoliants and appetite stimulants.

Toxicity varies with the species of animal exposed, the formulation of the arsenical, the route of exposure, and factors affecting rate of metabolism and excretion. It has long been known that most animals except the rat and man rapidly excrete arsenic.[1]

Arsenic poisoning in cattle is manifested by acute or subacute syndrome, and chronic poisoning has not been clearly documented. Veterinary diagnostic laboratories have found that if an animal survives the acute crisis and lives for several days after consuming a toxic dose of arsenic, then the liver and kidney levels of arsenic may be below levels ordinarily considered diagnostic.[2,3]

The following case emphasizes the need for documenting normal background levels of arsenic and other toxicants in animal tissues.

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Case History

In mid-June, 1975, the Diagnostic Service, Department of Pathology, was presented with 4 cattle for necropsy that had orginated from 2 premises where an electric power line right-of-way had been recently sprayed with a herbicide assumed to be a mixture of propylene glycol butyl ether esters of 2, 4, 5-T (Esteron 24505, Dow Chemical Co.) In addition, the base of wood utility poles was painted with a mixture of sodium fluoride, dinitrophenol, potassium dichromate, pentachlorphenol, creosote and tar filler 15 in (37 cm) below ground level and 4-6 (10-15 cm) above ground level. The painted area was then covered with creosote impregnated Kraft paper. The 2 premises were located 1 mile (1.5 km) apart.

Spraying of vegetation was accomplished on Thursday afternoon. Cattle on each ranch were observed and considered to be normal on Friday. Cattle were not observed on Saturday, but on Sunday, dead and ill animals were present in each pasture. Illness was characterized by diarrhea which became flecked with blood, a marked depression, an ataxic gait, tremors, terminal salivation and death. It was noted that brush and grass in the sprayed area was already "dead".

Necropsy of 4 affected mature cattle revealed diffusely reddened, edematous abomasal and small and large intestinal mucosa, excessively mucoid content of the small intestine, and edema and hemorrhage of the wall of the gall bladder. Because of the prevalence of illness and death, and because of postmortem lesions present and the rapid kill of sprayed vegetation, it was suspected that the herbicide

applied was an arsenical. Selected specimens of rumen content, liver and residual spray mixture from one of the containers allegedly used were subjected to the Reinsch test. Strongly positive reactions for arsenic occurred in rumen and liver specimens. The spray mixture was weakly positive for arsenic.

Subsequently quantitative assay for arsenic in various specimens was performed by the modified Gutzeit method.[4] The results are tabulated in Table 1. Tissue for assay on cattle no 1, 2 and 3 were collected 5 days after spraying and 3 days after the cattle were removed from sprayed pasture. Specimens from no 4 were obtained 7 days after spraying and 4 days after cattle were removed from sprayed pasture. The transformer oil tested 6.0 mg arsenic/l.

Table 1. Arsenic Levels (ppm) in Tissues of Poisoned Cattle

Animal No.	Kidney	Rumen Contents	Liver
1	4.96	10.88	--
2	4.83	10.88	--
3	4.25	15.90	--
4	3.50	24.00	2.00

The final morbidity and mortality on farm A on Monday was 4 dead and 4 sick out of 24 cattle. By Wednesday farm B had 11 dead and 3 ill out of 33 cattle.

The Electric Cooperative thought they were using a 2, 4, 5-T herbicide concentrate. They were mixing the herbicide in used transformer oil for spraying. Examination of four barrels that were used in the spraying operation showed barrels 3 and 4 contained 54 ppm and 66 ppm arsenic. Barrels 1 and 2 had only a trace (<1 ppm) of arsenic. Another container thought to contain the 2, 4, 5-T herbicide was found to have 5500 ppm arsenic. Grass samples from the affected areas had 3800 ppm and 6840 ppm arsenic. The contaminated area was fenced and the vegetation was later removed. The topsoil was plowed under and new topsoil was graded over the area. Neither farm A or B experienced further losses and Farm A was paid for damaged incurred.

The owner of farm B was concerned about possible long-term effects in his registered herd of limosine cows, as he assumed arsenic accumulated in the tissues and could cause permanent damage to their reproductive performance. One year after the episode had occured, the owner of Farm B assumed that his cattle still had significant levels of arsenic in their tissues and prepared for litigation against the Electric Cooperative. It became apparent that for comparison normal background levels of arsenic would have to be determined for cattle under similar conditions and management. It was decided that blood and hair levels could be used to compare the cattle from farm B to a control herd of Limosine cattle from farm C, where there had been no known exposure to any arsenicals. As is often the situation in toxicology cases where litigation is pending, normal background levels are not always available in the literature. Without normal background levels for comparison it is difficult to evaluate the status of a herd where there has been possible exposure to a toxicant.

In late August, 1976, over 1 year from the initial exposure, hair and blood samples were collected from 20 Limosine cows on farm B for arsenic determination. Hair and blood samples were also collected from 10 Limosine cows on farm C for comparison of arsenic levels. All blood samples were collected from the jugular vein in heparinized blood tubes. Hair samples were clipped from the polls and ears. Samples were analyzed by the modified Gutzeit method.[4] The results are summarized in Table 2.

Table 2. Arsenic Content (ppm±SE) of Cattle Samples from Suspect Arsenic Exposed and Non-exposed Control Cattle

Sample	Farm B (N=**20**) Suspect Cows	**Farm C (n=10)** Control Cows
Hair	Mean 0.125±0.025	0.357±0.041
	Range 0.06-0.53	0.11-0.55
Blood	Mean 0.051±.006	0.034±.004
	Range 0.03-0.12	0.03-0.07

Efforts to litigate the case against the Electric Cooperative were eventually dropped since the plaintiffs could not demonstrate significant levels of arsenic in the tissues of the cattle. It is interesting to note that mean levels of arsenic in the hair of both the suspect group (farm B) and the control group (farm C) were less than that reported for human hair, 0.650 ppm.[5]

References

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