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Acute Borehole Poisoning in Livestock in Kargi, Marsabit, Kenya: A Case Report

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Abstract
In January in the year 2000, sudden deaths of an estimated 7,000 heads of livestock occurred following drinking of water from a Government managed borehole in Kargi settlement, Marsabit District. The incidence was investigated by, amongst others, a veterinary toxicologist. Informal interviews from a cross-section of community leaders and affected pastoralists were conducted, samples of water from the borehole was collected for toxicological analyses, clinical examinations of surviving animals and autopsies of dead ones were carried out. Key clinical observations included acute muscular weakness, ataxia, brown mucous membranes and abortions. Major autopsy observations were methamoglobinaemia, gastrointestinal corrosion, cooked appearance of internal organ, swelling, and rapid decomposition of carcasses. Chemical analyses showed that both nitrates were five to ten times higher than WHO recommended levels in drinking water, while the levels of other normally toxic chemicals like arsenic, selenium, lead and fluoride were within acceptable ranges. The clinical picture, autopsy and chemical analyses led to a high probability of nitrate poisoning.
Keywords: Borehole, water poisoning, livestock, Kargi, Marsabit, Nitrite, Nitrate.

Introduction

Kargi is a small settlement of formally nomadic Rendille tribesmen of estimated population of 6,000 (CBS, 2000), situated about 89 kilometers South West of Marsabit town. Kargi was previously a water point with a single well that was constructed in 1920's by the British army. Amongst the problems faced by this community are harsh climate, with a mean annual rainfall of 600mm, insecurity, high rates of illiteracy and lack of livestock markets. Water security is, however, the leading problem (GL-CRSP, 2001).

Shallow wells have been the most reliable source of water. Since 1970's a total of 20 wells have been dug, but only seven remain in use due to drying up or the water becoming unfit for human and livestock use. The wells are located at the lowest point of the settlement within a few hundreds meters along a drainage canal, making them vulnerable to contamination from human and livestock wastes, especially during the occasional rainstorms (Shivoga, 2002).

In the year 1975 a borehole was sunk and commissioned for use by the government. The government took charge of Operation and Maintenance of the borehole till the 1980's. The withdrawal of Operation and Management lead to serious management problem such as the frequent breakdown of the pump and subsequently the borehole falling into prolonged periods of disuse. According to the Pastoralist Integrated Support Programme report of 2001 (PISP, 2001) the borehole was out of use from 1998, post El nino period.

In January 2000, the borehole was rehabilitated by a Non-governmental Organization for use. When in the same month animals first drink the water, it was reported that sheep, goats, cattle, camels and dogs, totaling about 7,000 died with acute symptoms, some dying within one hour of drinking the water. Some households reported an overall mortality rate of 90%. No deaths were however, reported amongst humans and donkeys, although they reportedly showed milk, clinical signs. The borehole was abandoned immediately.

Materials and Methods

Following suspected poisoning incident a team of investigators consisting of a veterinary toxicologist from the University of Nairobi, officials of the Community Education Concern (CEC), local leaders, community elders and affected pastoralists visited the borehole and the community for investigation.

A questionnaire was used to obtain a complete case history and relevant information from a cross-section of the community leaders and pastoralists. Samples of the water from the borehole and neighbouring wells were collected for toxicological analyses. The main objective of the investigation was to diagnose the cause of the deaths, especially its association with the borehole water, determine the levels of various toxicants in the water and offer recommendation regarding the future use of the borehole.

Clinical examination and autopsies conducted by veterinarians indicated that death in some cases occurred within one hour of drinking the water.

Using procedures described by the American Public Health Association (APHA), chemical analysis of the borehole water was carried out and results shown in the Table 1 were obtained.

About a month after the deaths the Ministry of Water Laboratory carried out chemical analysis of water from borehole and five wells used by the Kargi Community in general.

Results

Muscular weakness, ataxia, brown mucous membranes, abortions within 24 hours were some of the key clinical observations. Methemaoglobinaemia (chocolate brown blood), gastrointestinal corrosion, cooked appearance of internal organs, swelling, rapid decomposition of the carcasses and aborted fetuses covered with a fibrinous membrane, were key autopsy observations.

The levels of the toxicants varied at different sampling times in the course of the day as seen in the table. The results showed that Nitrates were five to ten times above the World Health Organization (WHO) recommended levels in drinking water (Table 1). The levels of arsenic, selenium, lead and fluoride were within the acceptable ranges.

The results showed that the levels of the various chemicals in all the samples from the wells and the borehole were higher than the WHO recommended levels, but with nitrites and nitrates appearing between five and ten times higher than the other chemicals. Well waters containing 200-500ppm of potassium nitrate equivalent may cause poisoning, especially in ruminants (Blood and Redostits, 2000). These levels were exceeded as shown in Table 2.

Conclusion

Based on the chemical analyses, clinical signs and the autopsies carried out, nitrite and nitrate poisoning were the most probable causes of the mortalities (Bjornson, 1961). There is a probability that an underground source of contamination exists. There was a consensus of feeling that a regular and rapid screening test needed to be done, especially following the rainstorms, which are believed to be partly responsible for contamination of the wells.

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Table 1: Chemical analysis of the borehole water soon after the mass livestock deaths

Toxicant	Concentration	Maximum WHO allowed limit in drinking water
Sodium ions	193.7ppm	200
Potassium	14.6ppm	
Nitrate	450 & 950 mg/1	45
Arsenic	66.8 & 0.0 mg/1	0.05
Selenium	4.4 & 2.8 mg/1	0.011
Lead	0.01 ppm	0.05
Fluoride	0.020.71 ppm	1.5

Table 2: Analysis of water from sample of wells and the borehole done at a later date

Chemical	Maximum WHO allowed	Wells					Kargi Borehole
		1	2	3	4	5	
Potassium		18	24	5.1	4.5	35	35
Sodium	200	240	460	93	80	1350	1350
Nitrite	10	30	30	20	0.4	50	50
Nitrate	45	460	460	218	260	420	450
Calcium	100	324	324	342	308	38.4	38.4
Magnesium	30	43.5	3.9	3.9	38.9	25.8	25.8
Sulphate	400	217	150	150	50	717	217

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