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“Research on arsenic-free water supply sources in the URUS community"

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INTRODUCTION

Arsenic is a public health problem because it is a toxic heavy metal that damages health and can be found freely in the environment as well as in groundwater (wells, streams, etc.) particularly in developing countries such as Bolivia, Peru, Ecuador, India and other countries. Based on different studies that were conducted in our environment, it was determined that in Oruro, exactly in Lake Poopó there is a high concentration of inorganic arsenic in the water.[1]
According to WHO, it is necessary to have access to water free of contaminants because it is a main source of hydration. For this reason is necessary to monitor the communities that suffer from natural arsenic contamination, since these places do not have access to drinking water.

The project seeks to determine the access that the Urus-Muratos community has to water sources free of arsenic. For this, a survey will be conducted to find more information about the sources of water supply in the community.

PROBLEM STATEMENT

The arsenic found in water is used for the supply of populations, therefore it is used for human consumption; proven high concentration could generate a series of adverse effects on health, mainly associated with prolonged contact, causing a progressive poisoning that gives way to different health problems such as chronic hydro arsenicism.

The presence of arsenic (As) in water for human consumption represents a public health problem of worldwide importance because its permanent and prolonged ingestion has the potential to generate several types of diseases, such as: hyperkeratosis, skin and lung cancers, cardiovascular diseases, being these the most common.[2]

Given that arsenic can be found in the atmosphere as well as in the water, it is important to determine which are the means of water supply for the daily use and consumption of the URUS-MURATA indigenous community.

1. OBJECTIVES

1.1 GENERAL

- Identify arsenic-free water supply sources in the URUS community.

1.2 SPECIFIC OBJECTIVES

- Collect data (age and sex) of the URUS community members.
- Apply a survey to the community members to determine if they depend or not on the consumption of rivers or wells contaminated with arsenic.
- Observe if they present any type of manifestation or symptomatology in case they drink water with arsenic.
- Identify the sources of water supply for the URUS community members.

2. JUSTIFICATION

The present investigation will focus on studying the sources of water supply for the consumption and daily use of the community members in the Urus-Murata since, according to the information reviewed, their water contains high amounts of arsenic. Arsenic is considered a chemical element harmful to human health, if consumed in high quantities and for a prolonged period of time, it could cause cardiovascular disease, hyperkeratosis, skin and lung cancer, among others. That is why it is considered a public health problem.

In this way, it will be possible to identify the exact sources (rivers, wells, streams) that are contaminated with arsenic to avoid its use and thus benefit the communities living around Lake Poopó. This will prevent the health damage that was mentioned above by the prolonged consumption of arsenic-contaminated water. For this reason, it is of great interest to analyze the exact sources of water supply for the villagers.[1]

3. THEORETICAL FRAMEWORK

Arsenic occurs naturally in high concentrations in groundwater in several countries and is highly toxic in its inorganic form. Its greatest threat to public health is related to the use of contaminated water for drinking, food preparation and irrigation of food crops. Prolonged exposure to arsenic through consumption of contaminated water and food, can cause cancer and skin damage. It has also been associated with developmental problems, cardiovascular diseases, among other pathologies.
In Bolivia, Brazil, Chile and other Latin American countries, high levels of arsenic have been detected in fish, cow's milk, grains and vegetables, including potatoes, onions, beets, squash, radishes, cabbage and beans.

3.1 Epidemiology

Worldwide, arsenic affects approximately 140 million people. In rural areas of Bolivia it represents a great threat, because exposure can cause chronic diseases. Therefore, it is important to detect arsenic in order to propose solutions and disseminate reliable information on scientific issues to the population.
Data was collected about the environmental effects and health damages caused by arsenic in highlands and valleys of the country. Highlighting physiological problems and some genetic disorders that affect people constantly exposed to arsenic.

The altiplano communities around Lake Poopó in the department of Oruro in Bolivia, live in one of the regions that receives the highest solar radiation in the world and scarce rainfall annually. Therefore, local residents often consume well water contaminated with high concentrations of inorganic arsenic.[3]

Many of the rural and indigenous communities settled around Lake Poopó and Uru Uru have frequently found themselves lacking access to potable water sources, and for this reason the use of groundwater collection wells and Wijiñas (earthen wells for rainwater collection) is very common. These types of collection practices are generally problematic and can result in water with inadequate characteristics for consumption.[4] To mitigate this problem, committees and organizations have initiated the installation of rainwater collectors on roofs of each home This strategy is considered adequate to meet the demand without the risks of more rudimentary practices, but at the same time there is a history of work reporting contamination with heavy metals in these devices due to corrosion of the roofing material. Studies have shown that arsenic concentrations inside the collection tanks were up to 5 times higher than the recommended limit (0.01 mg/L) and in the search for the source they determined that neither the roofing material nor the rain were responsible, but rather the wind and the dust particles it dragged, which ended up settling on the roofs, dragged by the rain and ended up contaminating the water inside the tanks.[5]

3.2 Biopathology

The toxic compounds of arsenic are in inorganic and gaseous forms (producing acute hemolysis). Its inorganic form tends to bind to hemoglobin and distribute itself through the various organs of the human body such as liver, kidneys, etc. It tends to contain a higher concentration of arsenic than the inorganic form. It tends to contain a higher concentration in tissues that have a large amount of keratin (hair, skin, nails).
This metal tends to affect various biological mechanisms in humans such as the Krebs cycle, by altering gluconeogenesis. It can also affect cardiac conduction by blocking potassium channels. It can alter gene expression, transmission of electrical signals, among others.

The first clinical manifestations after ingestion of inorganic arsenic are: nausea, vomiting, bloody diarrhea and abdominal pain. After a few days hematological signs such as pancytopenia may be observed.
After the digestive symptoms improve, a distal symmetric peripheral neuropathy occurs, which may be accompanied by weakness or encephalopathy. Chronic exposures may affect the bone marrow, skin and peripheral nervous system. Cutaneous effects are patchy or diffuse alopecia, hyperpigmentation and melanosis, as well as hyperkeratosis on the palms and soles. The pigmentation of chronic intoxication usually appears in a freckled "raindrop" pattern of symmetrical pigmentation or depigmentation, which is particularly pronounced on the trunk and extremities. The nails may show transverse white bands, which are called "Mees' lines" and reflect growth interruptions during intoxication.
Anemia, pancytopenia, neutropenia, thrombocytopenia and eosinophilia may be observed.

Neuropathy, which is a feature of arsenic poisoning, is described as a diffuse, symmetrical, ascending, painful sensory motor neuropathy, most prominent in a sock and glove distribution. In severe poisoning, ascending weakness and paralysis may result in respiratory failure simulating a "Guillain-Barre syndrome". Arsenic exposure also causes a dose-dependent decline in lung function. Peripheral vascular disease, including peripheral vascular gangrene (black foot disease), may occur in chronically exposed patients. Even low to moderate chronic exposure to arsenic increases the long-term risk of cardiovascular disease by about 30%. Arsenic is a human carcinogen, and exposed populations have an increased risk of malignant neoplasms in the lung, skin and bladder.[6]

3.3 Ethnography

The Uru Muratos communities live in harsh conditions due to the water ups and downs of Lake Poopó, which now has little fish, mainly because of contamination from mining activity. The current lowering of water gives them some possibility of planting quinoa, which they can sell and probably get to export it. But some Aymara neighbors prevent them from doing so with barbed wire.
It is a small and long-suffering nation, today dispersed in four discontinuous pockets, even between two states, which are testing strategies to combine their roots and the new challenges of globalization.[7]

4. METHODOLOGICAL DESIGN

The research will be of a descriptive-quali quantitative nature, which will allow us to identify and obtain information about the water sources that the Urus-Murata community members have, through the use of surveys that will be carried out to the families of this community.
The method for the present investigation will be exploratory and documentalist, because it includes strategies and procedures used for the search of relevant information for our topic (sources of water consumption in Urus-Murata community members).

5. RESULTS

In the community of the Urus-Murata (Llapallapani) with a population of approximately 250 people. A sampling was carried out by means of surveys of 75 inhabitants where it was found that 42.9% of the inhabitants obtained water from their own wells; 35.7% from a common well and the remaining 21.4% obtained water from other sources (springs, private wells).

The villagers indicated that the water is usually in a normal state, but sometimes there are some alterations (cloudy, dirty, unpleasant smell).From the information gathered, it was observed that the community members did not receive any type of education about arsenic and other metals, so they do not know the damage that this element could cause to their health; however, the community members are willing to receive a type of education and implement a system for arsenic detection and timely water treatment.

The following data was obtained at the clinic:

TABLE I

OBSERVABLE DERMAL MANIFESTATIONS

Signs	Number of persons	Statistical significance
Hyperpigmentation-hypopigmentation	37	50%
Hyperkeratosis in the plantar and palmar región	6	8.3%
Eczematous lesions (inflammatory lesions)	6	8.3%
Maculopapular eruptions (warts)	31	41.7%
No signs	19	25%

TABLE II

NEUROLOGICAL MANIFESTATIONS

Signs	Number of persons	Statistical significance
Numbness and tingling in soles and palms of feet	35	46.2%
Burning sensation in the soles of the feet	29	38.5%

Cramping in the calves	52	69.2%
Decreased temperature perception	29	38.5%
No signs	10	14.14%

6. DISCUSSION

In the field work carried out, it was evident that most of the villagers have access to water through their own wells or directly from the common well that is connected to each other (it is the same water for consumption), the extraction of water is done by pumps that drive the water that is found subway and thus is distributed in various parts of the community (APPENDIX 1,2); However, since the residences farther away from the community are not supplied, they depend on other sources of access to water, whether it is the spring they have or their own wells (currently there is not the same amount of water to subsist) (Annex 3). It was also seen how there was a change in the lifestyle of the villagers because their main economic source was fishing, but due to the contamination of the water with arsenic and other metals, the fish population in the lake was reduced until its total disappearance.

In the interaction that existed with the settlers, they mentioned that they raised fish in springs. However, after one season the fish began to die again (probably due to the presence of arsenic in the water used for fish breeding). Because of the lack of economic resources, the inhabitants began to migrate to other communities or to other departments; those who still live in the community work in agriculture and handicrafts, among other things.

Most of the inhabitants who live in the area and have lived there for more than 40 years have been consuming these contaminated waters for a long time, mainly generating the following clinical manifestations in the community members: cramps in the calves, hyperpigmentation or hypopigmentation (table 1,2). (Table 1,2).

Education in the community about arsenic is almost null. In this way, we can see that there is not a correct water treatment for the community of llapallapani in the same way the water that comes from the common well does not have the control measures that it should have since the water that is pumped goes outside and is immediately contaminated with external agents (bacteria, virus, parasites) that is why it frequently causes continuous diarrhea in the community (especially in children). ANNEX 4,5

7. CONCLUSION

The investigation was able to show that most of the population's water supply is from common wells, as well as natural lakes or springs, which due to the situation, are usually dry. It is worth mentioning that these water sources do not receive any treatment or sanitation, which is necessary due to the natural arsenic contamination in the Llapallapani region. The

community does not receive water from outside sources. Access to water is restricted to **only one source**, even though since 2000 there have been programs in place that allow access to the essential liquid with considerable quality, however, the requirement of full and safe access to water bodies is not met, and access is limited to wells and pumps that come into contact with natural arsenic, the latter affecting the health of the population considerably.

8. RECOMMENDATIONS

It is necessary to implement an adequate education to the community members about the treatment and care that the water should have because it is contaminated, causing problems in community members' health, so this problem is relevant for public health.

9. ANNEXES

ANNEXES 1

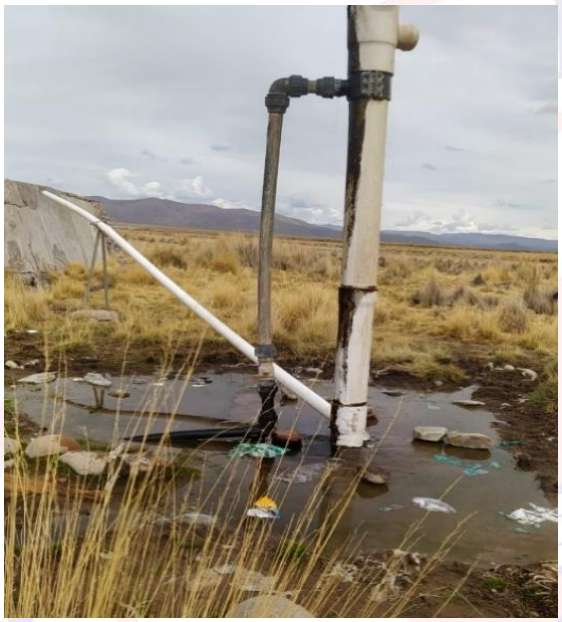

Photo 1. Water pump, presence of arsenic in contact with soil.

ANNEXES 2

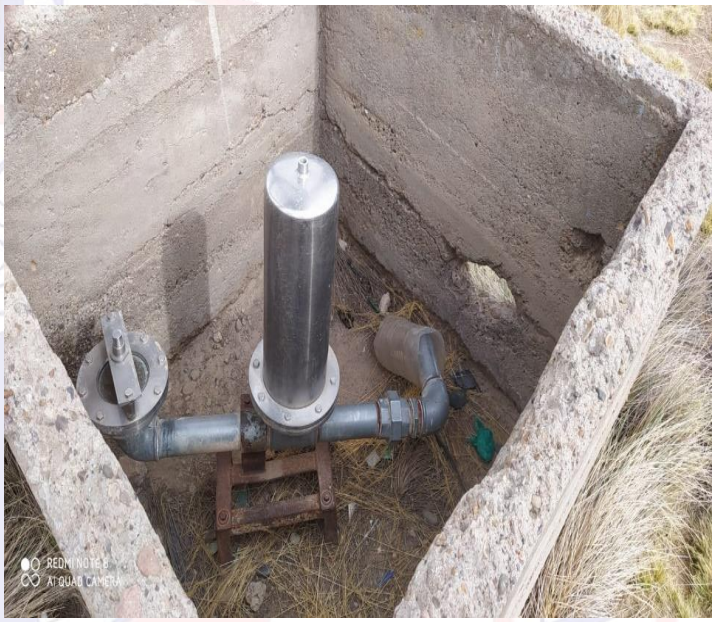

Photo 2. Water pump motor construction

ANNEXES 3

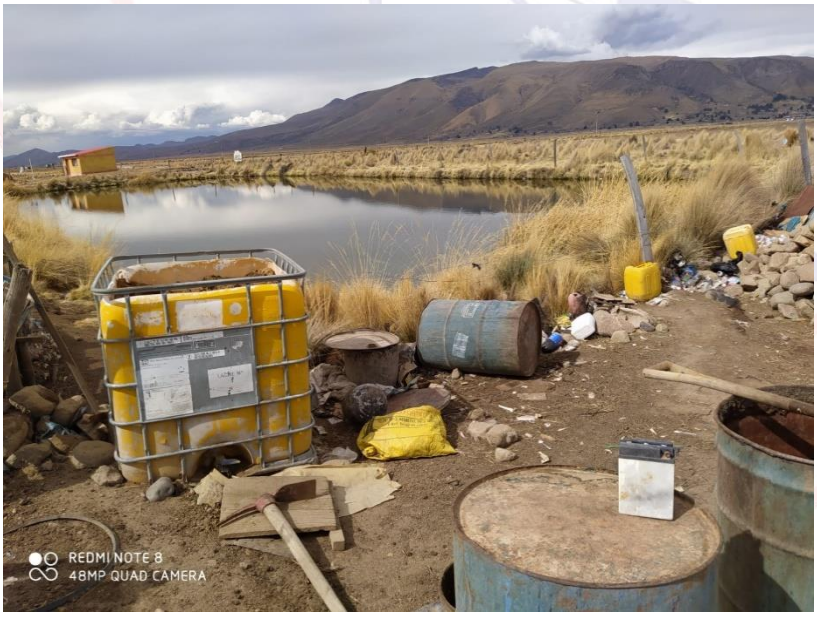

Photo 3. Fish farming lake, very precarious and unsustainable according to community members' testimonies

ANNEXES 4

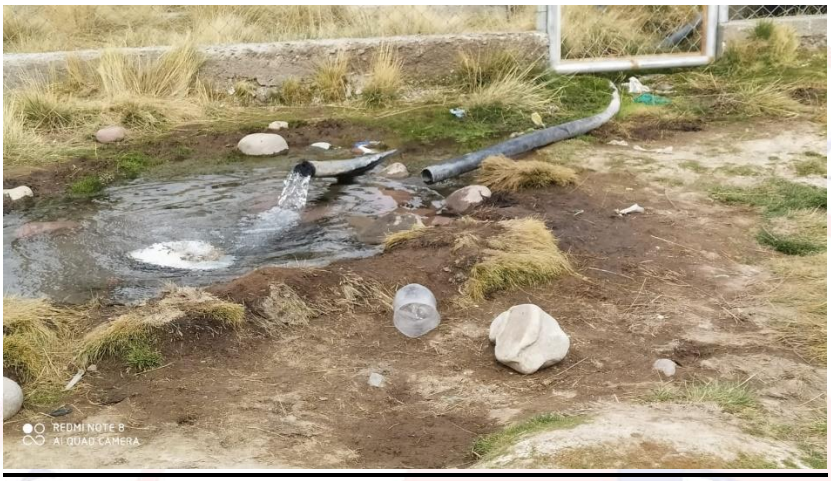

Photo 4. Water in contact with soil, possible parasitemies or bacteremies.

ANNEXES 5

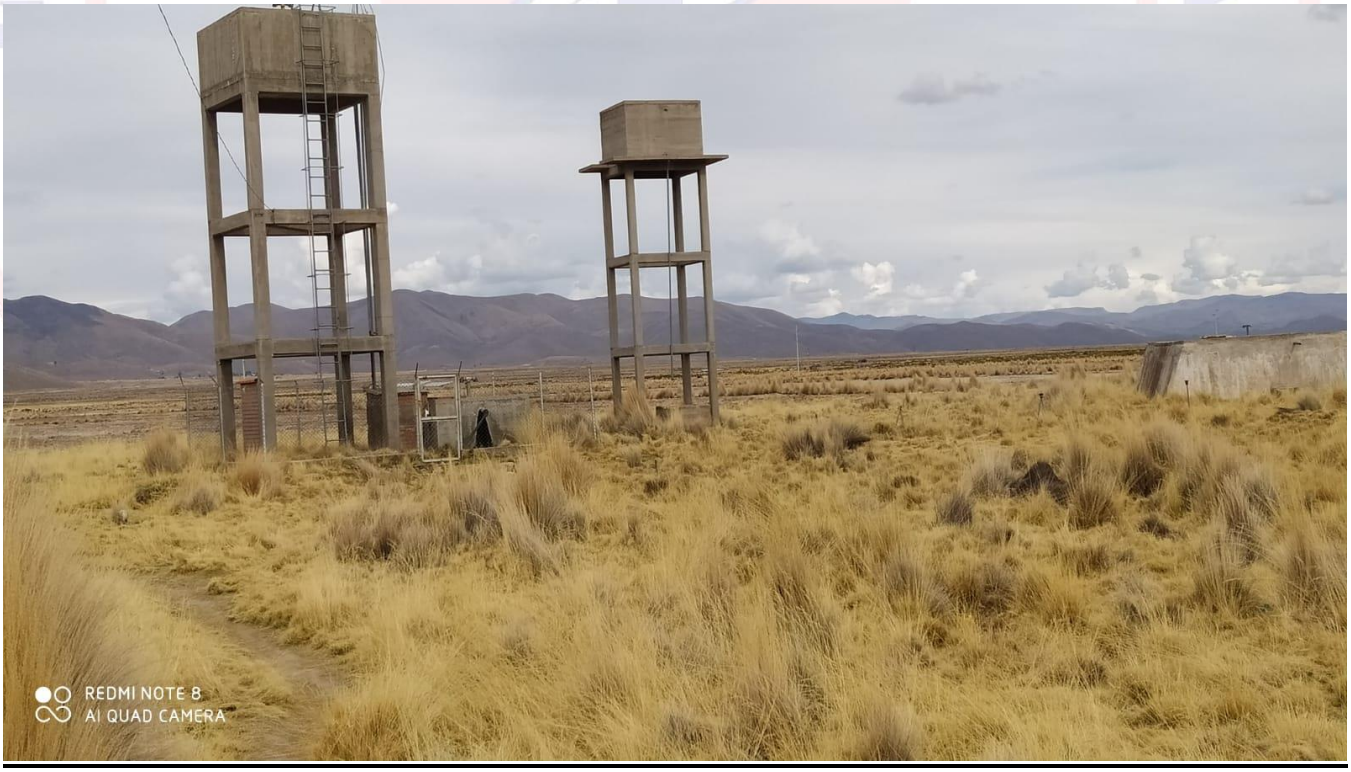

Photo 5. Water purification towers, which leaks into the ground with the presence of arsenic.

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