Atacama Desert people found to have evolved greater tolerance of arsenic

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A large sample of native arsenic. Credit: Aram Dulyan/Public Domain

(Phys.org)—A team of researchers affiliated with several institutions in

Chile has found that some people living in a part of the Atacama Desert have evolved over time for survival despite drinking water that contains 100 times the suggested maximum safe limit of arsenic as set by the World Health Organization. In their paper published in the *American Journal of Physical Anthropology,* the team describes a genetic study they conducted of the people in the area and what they found.

Native people living in a part of the Atacama Desert in Chile (in a place known as the Quebrada Camarones, where it is drier than any other non-polar spot on the planet) are descended from settlers that moved into the area approximately 7,000 years ago. Those early settlers faced serious health problems due to very high concentrations of arsenic in the only water available. The researchers with this new effort suggest that many such settlers likely perished before they could produce offspring, leaving those that were more physically suited to dealing with the toxic metalloid to keep the population going.

To find out how the modern people there are able to drink water that would seriously harm other people, the researchers collected blood from 150 of the local residents and subjected the samples to genetic testing. In particular, the researchers looked for variants of an enzyme called AS3MT—prior research has shown that people with such variants are better able to tolerate arsenic. The team reports that approximately 68 percent of the people they tested had such a variant. AS3MT breaks arsenic down into two compounds: monomethylarsonic acid and dimethylarsinic acid. Those with the stronger gene variant produce more of the latter.

The researchers note that their results show that AS3MT variants are only part of the answer; 32 percent of those tested did not have the variant, which suggests there is some other factor at play. The next step, they suggest will be to sequence the whole chromosomal region around the variant that has been found to see if there are others that might be

providing some sort of unknown resistance.

More information: Mario Apata et al. Human adaptation to arsenic in Andean populations of the Atacama Desert, *American Journal of Physical Anthropology* (2017). DOI: 10.1002/ajpa.23193

Abstract

Objectives
Quebrada Camarones, in the Atacama Desert, has the highest arsenic levels in the Americas (>1,000 μg/L). However, the Camarones people have subsisted in this adverse environment during the last 7,000 years and have not presented any epidemiological emergencies. Therefore, to solve this conundrum we compared the frequencies of four protective genetic variants of the AS3MT gene associated with efficient arsenic metabolization, between the living populations of Camarones and two other populations historically exposed to lower levels of arsenic.

Materials and Methods
The Chilean selected population samples come from Quebrada Camarones (n = 50) and the Azapa Valley (n = 47) in the north and San Juan de la Costa (n = 45) in southern Chile. The genotyping was conducted using PCR-RFLP. We compared the genotypic and allelic frequencies, and estimated the haplotype frequencies in the AS3MT gene.

Results
We found higher frequencies of the protective variants in those people from Camarones than in the other two populations. The haplotype estimation showed that the combination of protective variants of CTTA is very frequent in Camarones (68%) and Azapa (48%), but extremely low in San Juan de la Costa (8%). Also, the C variant associated with toxicity risks in the SNP Met287Thr had a lower frequency in

Camarones (1%) and is higher in the other populations.

Discussion

The higher frequency of protective variants in both northern Chilean populations indicates a long exposure to naturally arsenic-contaminated water sources. Our data suggest that a high arsenic metabolization capacity has been selected as an adaptive mechanism in these populations in order to survive in an arsenic-laden environment.