

# Arsenic used to treat leukemia

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Massive native arsenic with quartz and calcite. Marie-aux-mines, Alsace, France. Photo taken at the Natural History Museum, London. (via Wikipedia)

(PhysOrg.com) -- Arsenic, known in the West mainly as a poison, has been used in traditional Chinese medicine for around two thousand years for the treatment of conditions such as syphilis and psoriasis. It has also been shown to have a substantial anti-cancer effect for a type of leukemia, but until now no one has known the mechanism for this effect. Now scientists in China have discovered arsenic targets proteins that contribute to the growth of cancer cells.

The researchers from China and France, led by Xiao-Wei Zhang of the State Key Laboratory of Medical Genomics, Shanghai Institute of Hematology, wanted to find out how [arsenic](#) works. The group, which

included the Chinese Health Minister Chen Zhu, found that arsenic trioxide ( $\text{As}_2\text{O}_3$ ) acts by promoting the degradation of a protein that encourages the growth of acute promyelocytic leukemia (APL) cells, although a detailed mechanism of how it works has yet to be established.

It was already known that a fusion protein called PML-RARalpha is produced as a result of a genetic mutation in APL, and this protein is essential to the growth and survival of the [cancer cells](#). When arsenic trioxide is present, a [cellular protein](#) known as SUMO tags the fusion protein, which is then destroyed. When the protein is destroyed, the cancer cell can no longer survive. What the new research demonstrated was that  $\text{As}_2\text{O}_3$  binds to a part of the protein called a zinc finger, which is rich in cysteine residues. As a result several protein molecules join together to form an insoluble protein, and the aggregate is then bound by SUMO, which destroys it.

APL affects the blood and bone marrow, and causes a drop in production of normal [red blood cells](#) and platelets. Until the 1970s there was no effective treatment for the disease and the death rate was virtually 100%, but in 1992 a group of Chinese doctors demonstrated the effectiveness of arsenic in treating the disease. Now, as a result of treating APL with arsenic in China, over 90 per cent of patients survive at least five years with no signs of the disease.

Arsenic treatment has an advantage over chemotherapy because there is a lower incidence of side effects such as hair loss and suppression of the immune system. Many other countries now use arsenic in the treatment of APL, but some doctors refuse to recommend it, and some patients refuse to accept it because of its reputation as a poison.

The paper was published on 9 April, in the journal *Science*.

**More information:** Arsenic Trioxide Controls the Fate of the PML-

RAR-[alpha] Oncoprotein by Directly Binding PML, Science 9 April 2010: Vol. 328. no. 5975, pp. 240 - 243, [DOI:10.1126/science.1183424](https://doi.org/10.1126/science.1183424)

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