

THE CHEMISTRY OF POISONOUS FROGS

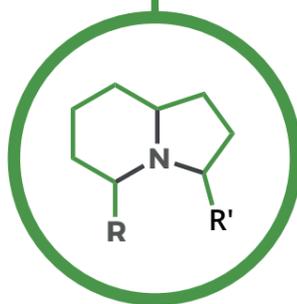
There are many different species of poisonous frogs. Where does their poison come from, and how do they avoid poisoning themselves?

POISONOUS FROGS



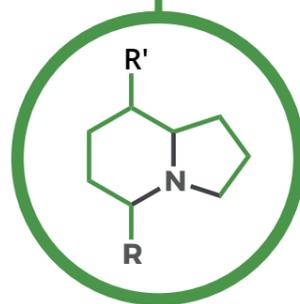
There are several families of poisonous frogs. The most well known are poison dart frogs, which are native to Central and South America. There are over 170 species of poison frogs, which vary in their toxicity.

UNBRANCHED ALKALOIDS



LIKELY SOURCE: ANTS

BRANCHED ALKALOIDS

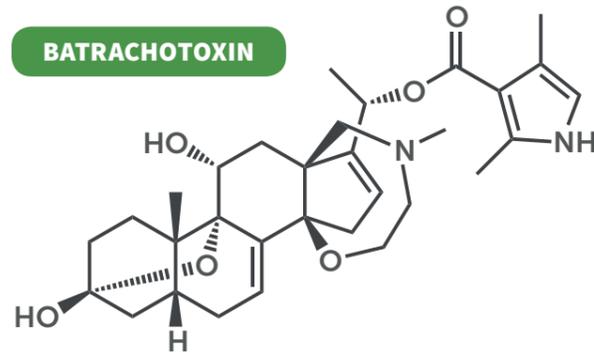


LIKELY SOURCE: MITES

For many years it was thought that poison frogs synthesised poisonous alkaloid compounds themselves. It was later discovered that they derive their poisons from their diet of ants, mites, and termites.

DIFFERENT FROGS, DIFFERENT POISONS

BATRACHOTOXIN



GOLDEN POISON FROG



KOKOE POISON FROG



BLACK-LEGGED POISON FROG

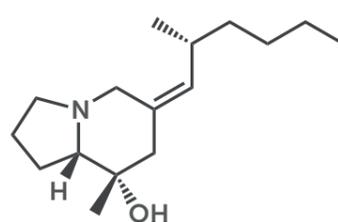
Batrachotoxin is one of the most potent alkaloid poisons known, found at high levels in the three frog species above. The highest levels are found in the golden poison frog; it's estimated that the average frog of this species contains enough batrachotoxin to kill 20,000 mice.



ONE GOLDEN POISON FROG HAS ENOUGH POISON TO KILL AT LEAST TEN ADULT HUMANS

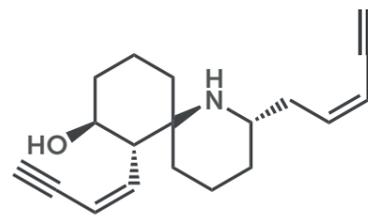


Over 800 alkaloids have been identified in various species of poison frogs. Any one species commonly contains a mixture of many of these compounds. More examples are shown below.



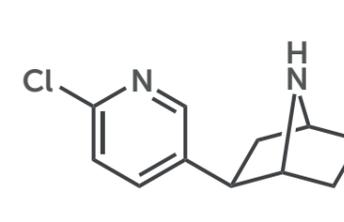
PUMILIOTOXIN 251D

Pumiliotoxins are much less toxic than batrachotoxins.



HISTRIONICOTOXIN 283A

Less toxic than other poison frog alkaloids.

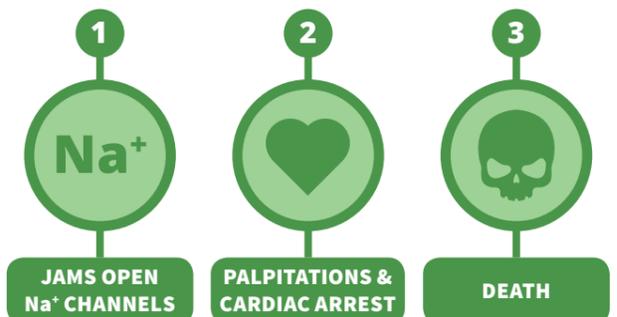


EPIBATIDINE

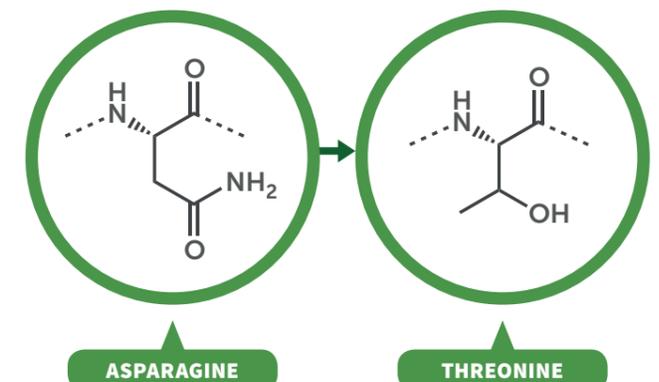
Toxic, but also has painkilling effects at low doses.

AVOIDING SELF-POISONING

Frog poisons can work in a number of ways. Batrachotoxin is a neurotoxin which works by binding irreversibly to sodium ion channels in nerve and muscle cells. This interferes with nerve signals to the muscles, resulting in paralysis and death.



How do poisonous frogs that have batrachotoxin in their skin avoid poisoning themselves? Recent research has found that they are protected from the toxin by a single amino acid mutation in their version of the sodium ion channel protein.



Dashed lines = continuing protein structure.

