Image credit: flickr.com/photos/8989278@N03/

DNA Barcoding Poisonous Plants

Written by: Massimo Labra (University of Milano-Bicocca)
Photos by: Andrea Moro

Exposures to toxic plants are the most frequent cause of poisonings that are reported to poison control centers. Although most of the cases of plant exposures occur in children, due to the accidental ingestion of showy fruits, the new trend of nutritional therapies and phytotherapy increases the poisoning cases in adults too.

Most people believe that plants are naturally safe and can be used as healing remedies for human health. This belief often leads to the spontaneous use of plants for medicinal and aesthetic purposes without evaluating the effects of their secondary metabolites on humans.

Moreover, confusion of an edible plant with a toxic one is another source of poisoning as suggested by the medical staff of "Ca' Granda" Hospital of Milan (Italy). Among the most relevant cases is the exchange of Alpine Sow-thistle (*Lactuca alpine* (L.) Wallr.) with the toxic *Aconitum* spp..

A correct plant identification is of essential importance for clinical diagnosis. Currently, toxic plants are identified on the basis of a patient's symptoms and morphological analysis of the ingested fragments. However, in most cases the plant samples are partially digested and therefore morphologically unrecognizable.

"A correct plant identification is of essential importance for clinical diagnosis."

In 2010, ZooPlantLab® at the University of Milano-Bicocca (www.zooplantlab.btbs.unimib.it) proposed the use of DNA barcoding techniques to identify poisonous plants. Results suggested that core barcode markers (*rbcL* and *matK*) combined with an additional spacer region *trnH-psbA* were able to distinguish poisonous plants from edible ones.

A dedicated BOLD project (ZPLPP) was created by the research group of ZooPlantLab®. The team developed a dedicated reference database including morphological and molecular data of poisonous species.

To support the diagnostic analysis at the poison centers, FEM2-Ambiente S.r.l. (www.fem2ambiente.com), a start-up born from the ZooPlantLab®, developed a molecular protocol for fast analysis of small plant fragments based on DNA barcoding.

Sequence Characterized Amplified Regions (SCARs) were identified starting from the DNA barcode sequences of poisonous plants. These markers were used to identify poisonous species by Real Time Polymerase Chain Reaction (rt-PCR). The tests were set up on the two most dangerous and frequently reported species: *Atropa belladonna* L. and *Colchicum autumnale* L.

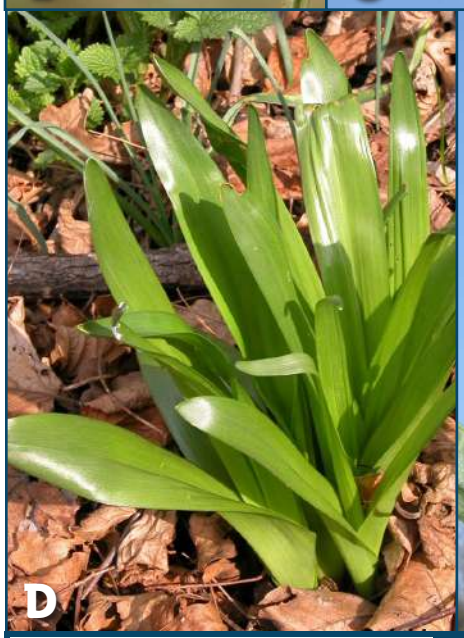
A. belladonna L. (Fig. A) produces tropane alkaloids (atropine, hyoscyamine and hyoscine) with anticholinergic properties. Unfortunately, the fruits of this species are often misidentified as blueberries (Fig. B. - *Vaccinium myrtillus* L.) and other poisonous plants such as *Solanum nigrum* L. (Fig. C)

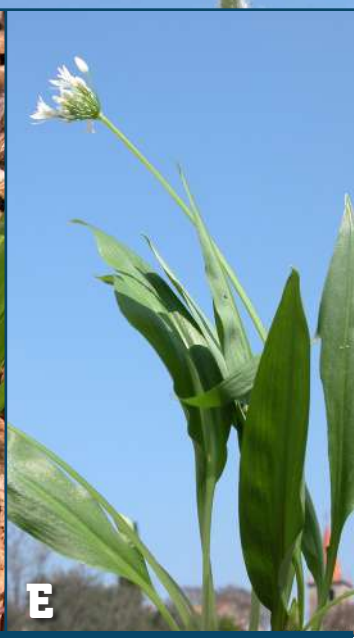
"...developed diagnostic kits for hospitals and poison centers..."

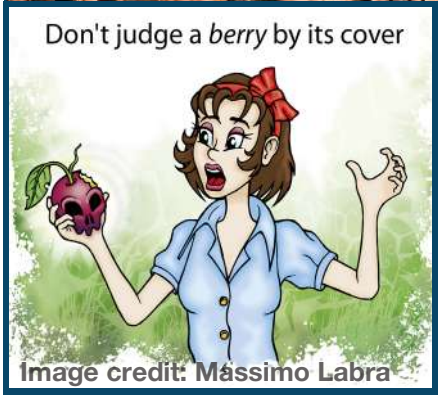
C. autumnale L. (Fig. D) contains an alkaloid called colchicine, which blocks cell division by inhibiting mitosis. This species is accidentally ingested as bear's garlic (Fig. E). Several species of the genera *Allium* and *Colchicum* have similar leaves and for this reason they could be mistakenly identified.

Results demonstrated that the use of specific SCARs combined with the analysis of PCR melting curves, enable the clear detection of poisonous plants. Thanks to this research, the team of FEM2-Ambiente S.r.l. have developed diagnostic kits for hospitals and poison centers to obtain a rapid response in cases of poisoning.

For more information about the results discussed in this article, see DOI: 10.1080/11263504.2014.941031







***Atropa belladonna* L., also known as deadly nightshade, is an extremely toxic plant bearing a fruit that is easily mistaken for a blueberry. Eating as few as two to five berries can be fatal to a human adult.**