

Outbreak Reports

A Poisoning Outbreak Caused by *Anisodus tanguticus* — Maqin County, Qinghai Province, China, July 2021

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Summary

What is already known about this topic?

Anisodus tanguticus belongs to the Solanaceae family. The plant is toxic due to the tropane alkaloids it contains and can cause poisoning when it is ingested or used inappropriately.

What is added by this report?

A poisoning outbreak involved 10 patients, and one death was caused by *Anisodus tanguticus*. The etiological association of plant exposure and poisoning was confirmed with evidence from an epidemiological investigation, clinical manifestations, plant identification and a toxin analysis.

What are the implications for public health practice?

The risk of poisoning caused by mistakenly collecting and ingesting tropane alkaloid-containing plants should be highlighted, and public health practitioners should be on alert.

At 4:40 am on July 17, 2021, the Qinghai CDC received a telephone report from Guoluo Prefecture CDC of 10 patients with similar complaints and spatiotemporal aggregation who were admitted to Guoluo Prefecture People's Hospital in 2 sessions from 23:00 on July 16 to 1:00 on July 17. They assumed this outbreak was due to food poisoning and initiated an investigation. The Qinghai CDC evaluated and verified the outbreak promptly and sent a team with 2 epidemiologists and 1 laboratory expert to the incident site to cooperate with the local government and the CDC to respond to the incident. According to the clinical syndrome and the information provided by the local CDC, this outbreak was probably caused by tropane alkaloid-containing plants, and the researchers contacted the China CDC for further confirmation. Then, field epidemiological and hygiene investigations were conducted, and plant samples were collected in collaboration with provincial, prefecture, and county CDC staff. The plant samples were identified as

Anisodus tanguticus by morphological identification and molecular analysis.

INVESTIGATION AND RESULTS

The outbreak occurred in a remote village located on the Tibetan Plateau at an average altitude of 3,500 m. It is approximately 60 km away from the Maqin county seat, and travel was inconvenient. A total of 69 households with more than 300 people are in the village. All the patients (9 males, 1 female, ages: 27–57 years old) were migrant workers from a construction company in Henan Province who engaged in road maintenance in the second bid and lived in 3 tents around the construction site on a temporary base.

On July 16, approximately 30 min after dinner at 20:00, the first case appeared and was characterized by stagger, fatigue, dizziness, and nausea; subsequently, another 9 workers exhibited similar symptoms and signs, and only 1 worker had no symptoms. Then, all the patients were sent to Guoluo People's Hospital from 23:00 on July 16 to approximately 1:00 on July 17. Four patients had severe neurotoxic symptoms with unconsciousness and dilated pupils, and the other 6 patients had dizziness, fatigue, nausea, blurred vision, irritability, and tachycardia. The clinical presentation resembled atropine poisoning, which probably indicated that the poisoning outbreak was caused by atropine-containing plants. The first patient vomited twice by stimulating his pharynx with his fingers when feeling discomfort. All patients in Guoluo People's Hospital underwent gastric lavage, monitoring with electrocardiography, and fluid infusion therapy. A 49-year-old male patient suddenly developed dysphoria and choking cough and then suffered cardiac arrest with loss of consciousness and facial cyanosis when pumping his stomach. Endotracheal intubation and mechanical ventilation were performed, while external cardiac compression and intravenous administration of adrenaline were performed to restore the beating of the heart. Unfortunately, the patient died after 45 minutes

of rescue. During intubation, a large quantity of gastric contents filled his mouth, which might have resulted in suffocation and further aggravated the condition. Because 1 patient died, the other 9 patients were transferred to Qinghai People's Hospital and Qinghai Red Cross Hospital in Xining City for further treatment. A patient treated at Qinghai Red Cross Hospital underwent hemoperfusion. When arriving at Xining, the vital signs of the patients were stable; after symptomatic and supportive treatment, the patients were discharged from the hospital from July 22 to 25.

The latency period of the first case was 30 min, and the longest latency period was approximately 40 min. The average latency was 35 min. The temporal, spatial, and population distributions and correlations of the patients revealed that this outbreak may have been a food-borne outbreak. The field and food hygiene investigation showed that 10 male migrant workers lived in 2 tents, while another tent was the kitchen and the living room of the female migrant worker as chef; their living and sanitary conditions were poor. Their drinking water was obtained from the river beside their residence, and all vegetables and ingredients were purchased in Maqin County every 2 days. Their living conditions and food supply had not changed compared to previous ones, and their residence was isolated from outsiders. The only difference in the dinner was excess consumption of cold wild vegetables; all the patients had ingested the cold dish, while the worker who did not develop the disease did not eat the cold dish. This outbreak was a single exposure, and no new cases occurred after the consumption of wild vegetables was stopped. The result of the field epidemiological investigation indicated that the cold wild vegetables may be the cause of this outbreak.

The wild vegetables were picked by 3 migrant workers belonging to the Sichuan Province, from neighboring areas to the construction site. Approximately 1 kg was blanched by the chef, and then a cold dish was prepared. Guoluo CDC took pictures and videos of the wild vegetables immediately to allow the plant to be recognized and identified. Then, the pictures and videos were sent to the China National Center for Food Safety Risk Assessment, Institute of Occupational Health and Poisoning Control (National Poison Control Center), and the College of Pharmacy at Qinghai Nationalities University for further expert support. All the experts had a preliminary consensus opinion that the plant belongs to the *Anisodus* genus. The plant specimens were collected in the field and then identified as

Anisodus tanguticus (Figure 1) by morphological and molecular identification. A voucher specimen was deposited in the Poisonous Plants Herbarium affiliated with the National Poison Control Center (No: 2021071701).

The remainder of the dinner, plants, and vomitus were collected to screen and confirm the toxicants. The results of the tests for organophosphorus pesticides, carbamate pesticides, tetramine, fluoroacetamide, and nitrite were negative. According to the epidemiological investigation result, the distinct toxins of the wild plants were analyzed using high-performance liquid chromatography coupled to tandem mass spectrometry. The main tropane alkaloids, atropine, anisodamine, scopolamine, and anisodine, in the cold dish were present at concentrations of 107.4, 0.58, 12.6, and 39.8 mg/kg, respectively, and at 107.0, 1.498, 15.4, and 95.8 mg/kg, respectively, in the wild vegetable plant. The contents of atropine, anisodamine, and anisodine in a vomitus sample were 0.492, 0.07, and 0.802 µg/kg, respectively, and scopolamine was undetected (Table 1). Cardiac blood and stomach content samples of the death patient were collected and tested by the police agency, and atropine, anisodamine, scopolamine and anisodine were detected in the biological samples. All four toxins were positive in all the aforementioned samples.

DISCUSSION

This poisoning outbreak was responded to and investigated by the national, provincial and local CDCs with multidisciplinary experts in clinical



FIGURE 1. The *Anisodus tanguticus* plant that caused a poisoning outbreak in Maqin County, Qinghai Province. (A) Collection of the plant sample; (B) The *Anisodus tanguticus* plant; (C) The *Anisodus tanguticus* flower; (D) The *Anisodus tanguticus* seeds.

TABLE 1. The contents of tropane alkaloids in the remainder of the cold dish, plants and vomitus sample from one patient in the poisoning outbreak caused by *Anisodus tanguticus*.

Sample	Atropine	Anisodamine	Scopolamine	Anisodine
Remainder of the cold dish (mg/kg)	107.4	0.580	12.6	39.8
Wild vegetable plant(mg/kg)	107.0	1.498	15.4	95.8
Vomitus* (µg/kg)	0.492	0.070	Undetected	0.802

* Only vomitus sample from one patient was obtained and analyzed.

toxicology, analytical toxicology, epidemiology and plant taxonomy. Clearly, the incident was a food-borne poisoning outbreak caused by eating the wild plant *Anisodus tanguticus* as a vegetable. According to the solid results from the epidemiological investigation, hygienic investigation, clinical diagnosis and treatment, laboratory tests, and wild plant morphological identification analysis, tropane alkaloids in the plant were confirmed as the etiological toxins. This outbreak indicated that eating *Anisodus tanguticus* by mistake as a wild vegetable might cause severe public health problems, and the public should be alerted and educated to avoid poisoning incidents.

The clinical manifestations of patients with poisoning were explained by the anticholinergic activity of tropane alkaloids. Unlike one etiological chemical associated with anticholinergic drug overdose or poisoning, more tropane alkaloids are usually present in plants, and differences exist in the effects exerted by the different toxins, all of which should be included in the poisoning hypothesis formation and validation. In this outbreak, 4 tropane alkaloids were tested to explain the poisoning. *Anisodus tanguticus* belongs to the *Anisodus* genus of the Solanaceae family and is mainly distributed in Qinghai, Gansu, Sichuan (northwest and southwest), Tibet (east), Yunnan (northwest) of China and Nepal (1). *Anisodus tanguticus* is the most important species used in Tibetan medicine (2), and the whole plant, especially the roots, contains a variety of tropane alkaloids, such as hyoscyamine, scopolamine, cuscohygrine, anisodamine and anisodine. These alkaloids allow the plants to be used as medicinal plants and important sources of anticholinergic drugs, and these alkaloids are also the main cause of their toxicity.

In China, tropane alkaloid-containing plant poisoning is due to people mistakenly picking plants as vegetables and using them as drugs for therapy. Poisoning caused by another tropane-containing plant, *Datura stramonium*, is more common. Tropane alkaloid-containing plant poisoning has been reported in other countries and regions. In Germany (3), the United Kingdom (4), and Morocco (5), poisoning

caused by berries of *Atropa belladonna* has been reported. In Uganda in 2009, a batch of super cereals was contaminated with *Datura* seeds, resulting in a series of food poisoning outbreaks; 278 cases and 5 deaths occurred, and atropine and scopolamine were detected as the main toxins (6). In Turkey (7), Iran (8), and Israel (9), tropane alkaloid poisoning was caused by *Datura stramonium*.

As we noted, this report is the first to document tropane alkaloid poisoning caused by eating the stems and leaves of *Anisodus tanguticus*, and the poisoned population was migrant workers. With the rapid development in China, many people working in different locations may be exposed to a different environment; thus, the possibility of harvesting and ingesting wild poisonous plants has significantly increased. The public should be alerted and educated to increase their awareness of self-protection and avoid eating unfamiliar or unknown wild plants to cope with this challenge.

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REFERENCES

- Ma LJ, Gu RH, Tang L, Chen ZE, Di R, Long CL. Important poisonous plants in Tibetan ethnomedicine. *Toxins* 2015;7(1):138 – 55. <http://dx.doi.org/10.3390/toxins7010138>.
- Zheng W, Wang LY, Meng LH, Liu JQ. Genetic variation in the endangered *Anisodus tanguticus* (Solanaceae), an alpine perennial endemic to the Qinghai-Tibetan Plateau. *Genetica* 2008;132(2):123 – 9. <http://dx.doi.org/10.1007/s10709-007-9154-5>.
- Bogan R, Zimmermann T, Zilker T, Eyer F, Thiermann H. Plasma level of atropine after accidental ingestion of *Atropa belladonna*. *Clin Toxicol* 2009;47(6):602 – 4. <http://dx.doi.org/10.1080/15563650903058906>.
- Southgate HJ, Egerton M, Dauncey EA. Lessons to be learned: a case study approach: Unseasonal severe poisoning of two adults by deadly

- nightshade (*Atropa belladonna*). *J R Soc Promot Health* 2000;120(2):127 – 30. <http://dx.doi.org/10.1177/146642400012000212..>
5. Berdai MA, Labib S, Chetouani K, Harandou M. *Atropa belladonna* intoxication: a case report. *Pan Afr Med J* 2012;11:72. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3361210/>.
6. Haughey SA, Chevallier OP, McVey C, Elliott CT. Laboratory investigations into the cause of multiple serious and fatal food poisoning incidents in Uganda during 2019. *Food Control* 2021;121:107648. <http://dx.doi.org/10.1016/j.foodcont.2020.107648>.
7. Disel NR, Yilmaz M, Kecec Z, Karanlik M. Poisoned after dinner: dolma with datura stramonium. *Turk J Emerg Med* 2015;15(1):51 – 5. <http://dx.doi.org/10.5505/1304.7361.2015.70894>.
8. Mirakbari SM, Shirazi MH. *Datura stramonium* poisoning: misunderstanding and misidentification in toxic plant exposures. *Wild Environ Med* 2020;31(3):378 – 80. <http://dx.doi.org/10.1016/j.wem.2020.04.001>.
9. Diker D, Markovitz D, Rothman M, Sendovski U. Coma as a presenting sign of *Datura stramonium* seed tea poisoning. *Eur J Intern Med* 2007;18(4):336 – 8. <http://dx.doi.org/10.1016/j.ejim.2006.09.035>.