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Review

Alocasia odora poisoning due to calcium oxalate needle crystals in Japan

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Abstract

Objective: To elucidate the actual circumstances of damage caused by Japanese *Alocasia* (*A*) *odora*.
Materials and Methods: We investigated cases in Japan from our own hospital in the eastern part of Shizuoka Prefecture as well as published reports.
Results: *A. dora*is found in western Japan, and plants of the *Alocasia* genus are cultivated often. *A. odora* is frequently associated with food poisoning because its aboveground parts resemble those of Satoimo (*Colocasia esculenta*). Moreover, *A. odora* contains insoluble calcium oxalate crystals, which cause poisoning symptoms, such as oral pain, nausea, vomiting, and laryngeal edema, resulting in near asphyxia, diarrhea following shock, and skin dermatitis. Calcium oxalate crystals are abundant in *Araceae* family plants, and cases of health damage owing to the accidental ingestion of *Araceae* plants have been reported worldwide.
Conclusion: Due to the strong irritation felt in the mouth upon contact with the plant, it is advisable to immediately spit out the plant and rinse the mouth. In addition to drug administration, ensuring a secure airway may be necessary if there is a risk of asphyxiation.

Key words: *Alocasia odora*, poisoning, clinical course

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Introduction

Alocasia (*A*) *odora*, (Japanese name: Kuwazuimo), is commonly known as Chinese Taro in English. This plant belongs to the order Alismatales, family Araceae, and genus *Alocasia* according to the Angiosperm Phylogeny Group classification system. The native habitats of this plant include the southern regions of Shikoku and Kyushu in Japan, the Ryukyu Islands, southern parts of China, Taiwan, the Indo Chinese Peninsula, and tropical to subtropical regions of India[1]. The plant typically grows in lowland evergreen forests, and plants of the *Alocasia* genus are often cultivated as ornamental plants. *A. odora* is frequently associated with food poisoning because its aboveground parts (leaves and petioles) resemble those of *Colocasia esculenta*[1]. There has only been one clinical case report of *A. odora* poisoning in South Korea[2]. To elucidate the actual circumstances of damage caused by Japanese *A. odora*, we investigated cases in Japan from our own hospital in the eastern part of Shizuoka Prefecture as well as published reports. Moreover, we documented the results for future studies.

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Summary of Previous Literature and Our Cases

To identify reports of *A. odora*-related human poisoning, we initially conducted a search of the Ichushi database (Japana Centra Revuo Medicine), which is a collection of Japanese medical articles, using the keyword "*A. odora*" on October 20, 2023. We also searched the PubMed database using the same keywords to identify related articles. The study included the following parameters that were investigated using medical records or registration data: sex, age, month of presentation, symptoms of poisoning, cause of poisoning, and clinical course.

Subsequently, we conducted a retrospective study using registered data from our department to extract and analyze cases of suspected *A. odora* poisoning among all poisoning cases treated in our emergency department between October 2012 and September 2023. We used the keyword "*A. odora*" to select patients from the registered data.

A search in the Ichushi database revealed 13 relevant reports[3–15]. Our search of the PubMed database yielded six articles. Of these, only two described intoxication induced by *A. odora*. The first was a report written in Japanese that had already been found in a previous search (only the abstract was in English)[10]. In addition, there were five cases suspected of *A. odora* poisoning, including one patient's spouse who completed a questionnaire and did not seek medical treatment in our department. We summarized the Japanese and English reports, along with our cases, in Table 1. Toda's report compiled cases from 1961 to 2010[10], and Yanagawa's report compiled cases from 2015 to 2023. Yanagawa's report indicates the occurrence of the year in parentheses in Table 2.

Epidemiology

Based on Table 1, the age distribution ranges from middle-aged to senior, and there appears to be no significant difference between the sexes.

A. odora poisoning in Japan has mainly been reported in its place of origin Kyushu[1]; however, cases have also occurred in major metropolitan areas, such as Tokyo, Kanagawa, and Osaka. Given that there were no previous reports of *A. odora* poisoning cases in Shizuoka Prefecture in our available data, this is the first report of its kind in this region.

Excluding *A. odora*, needle-like calcium oxalate crystals are abundant in plants of the *Araceae* family, and cases of health damage due to accidental ingestion of *Araceae* plants have been reported not only in Japan but also other countries[16–20].

Mechanism of Action

A. odora contains insoluble calcium oxalate crystals, which affect poisoning symptoms when the needle-shaped crystals cause irritation (Figure 1). Recently, toxicity in the *Araceae* family has been attributed to several proteolytic enzymes that trigger the release of potent kinins and histamines by the body[21]. These kinins, subsequently cause several local reactions that may be aggravated by the sharp calcium oxalate crystals contained in plant tissues[21].

Toxin Biosynthesis

Several pathways for oxalate production in plants have been hypothesized, including cleavage of isocitrate, hydrolysis of oxaloacetate, glycolate/glyoxylate oxidation, and oxidative cleavage of l-ascorbic acid[22, 23]. Plants absorb calcium ions and water from the soil through their roots. These ions then move within the plant body, where calcium ions combine with oxalate ions within the plant cells, leading to crystallization. Identification of the structural characteristics of calcium oxalate crystals contributes to understanding their protective and/or defensive functions against abiotic stress factors[23].

Calcium oxalate crystals are present in various forms in plants, including needle-shaped raphides, pencil-shaped styloids, block-shaped crystal sand, rosette-shaped druses, and prism[24, 25]. Among them, needle-shaped raphide shave garnered the most attention. Calcium oxalate crystals in wild taro were needle-shaped, in contrast to the block-shaped crystals found in spinach[24].

Clinical Manifestations

Calcium oxalate causes immediate symptoms, such as oral pain, nausea, vomiting, diarrhea, and skin dermatitis upon contact[26, 27]. Secondary dehydration, electrolyte imbalance, and shock are also possible[21]. Oral manifestations may resemble angioedema or anaphylaxis[19]. All patients in Table 1 complained of oral numbness and pain immediately after ingesting the suspected food. Moon *et al.* reported that two patients experienced oral numbness and intractable tongue pain, and one patient required endotracheal intubation because of upper respiratory tract obstruction[2]. Moreover, a dog died from asphyxia due to laryngeal edema after ingesting *Dieffenbachia picta*, which contains calcium oxalate, but not *A. odora*[17]. In addition, two patients in Table 1 required hospitalization, and one was discharged the following day. The remaining patient (a 37-year-old female) had the longest hospitalization period (four days); she had consumed a stew containing taro collected from her mother's garden. After taking a bite of taro, the patient experienced discomfort in her mouth and developed the aforementioned symptoms. Upon arrival, she was in a semi-sitting position and unable to swallow saliva, resulting in drooling. Throat and laryngoscopies revealed pharyngeal ulcerations (Figure 2). Supportive treatment was administered, and the patient was admitted for observation. The patient's condition improved, and she was able to resume eating on the third day of hospitalization, after which she was discharged.

Diagnosis

Diagnosis involves the observation of insoluble calcium oxalate using an optical microscope and/or analysis of oxalate using high-performance liquid chromatography[1]. Previous Japanese reports have mainly focused on the identification of calcium oxalate (a toxic component of *A. odora*) through analysis of reports from health authorities. However, our cases primarily emphasized the clinical course, and we did not specifically detect calcium oxalate. In one case, the local health department was requested to analyze the remaining food, but this was deemed impossible. Therefore, the diagnosis is purely clinical.

Table 1 Cases in our hospital

Year of visit	Age (years)	Sex	Symptoms	Cause of misrecognition	Treatment	Outcome
2023	87	Male	Burning sensation in the oral cavity	Tried eating Kyoto-imo	Oral mouthwash	Admission for 2 days
2019	34	Female	Numbness in the oral cavity, difficulty breathing, and excessive salivation	Ate a simmered dish of taro harvested from the garden	Oral mouthwash	Admission for 4 days
2017	43	Female	Numbness in the oral cavity, shortness of breath	Ate the Zuiqui received from an acquaintance	Oral mouthwash	Return home
2017	NR	Male	Numbness in the oral cavity	Same as above	Oral mouthwash	Without seeking medical attention, untreated
2015	67	Female	Numbness in the oral cavity, shortness of breath	Ate decorative taro	Oral mouthwash, adrenaline, hydroxyzine	Return home

NR: data not reported.

Table 2 Previous reported cases

Author	Year	Place	Number	Age (years)	Sex	Symptoms	Cause of misrecognition	Treatment	Duration of treatment
Ikeda[3]	2022	Oita	1	NR	NR	Severe pain in the oral cavity	Hasuimo	Oral mouthwash	Over 2 days
Miyazaki[4]	2020	Fukuoka	1	NR	NR	Pain in the oral cavity	Hasuimo	NR	NR
Takayama[5]	2020	Miyazaki	1	NR	NR	NR	NR	NR	NR
Murakami[6]	2018	Osaka	2	NR	1 male, 1 female	Pain and numbness in the oral cavity, short of breath	Roots of homegrown plants	NR	NR
Kimura[7]	2016	Tokyo	1	NR	NR	Sharp pain and numbness in the oral cavity	Satoimo	NR	NR
Shimoi[8]	2015	Tokyo	1	NR	NR	Burning pain and numbness in the oral cavity	Rhizomes of houseplants	NR	NR
Sakamoto[9]	2015	Saga	1	NR	NR	Severe pain in the oral cavity	Mizuimo	NR	NR
Toda[10]	2014	All Japan	64 (14 accidents)	NR	NR	NR	NR	NR	NR
Ikeno[11]	2012	Kanagawa	1	NR	NR	Pain and numbness in the oral cavity, tongue swelling	Satoimo	NR	NR
Morioka[12]	2009	Miyazaki	1	NR	NR	Numbness in the oral cavity	Hasugara	NR	NR
Ushiyama[13]	2004	Tokyo	2	NR	1 male, 1 female	Pain and numbness in the oral cavity	Wild yam	NR	NR
Kumano[14]	2001	Nagasaki	4	NR	NR	Pain in the oral cavity	Hasuimo	NR	over 2 days
Kosaka[1]	2000	Miyazaki	1	NR	NR	Swelling in the oral cavity	Satoimo	NR	NR

NR: data not reported.

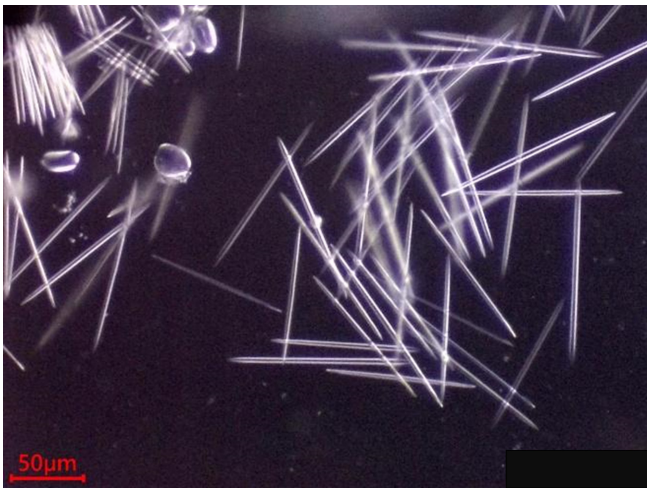

Figure 1 Calcium oxalate crystals. https://bestidea4u.com/japanese-yam/.

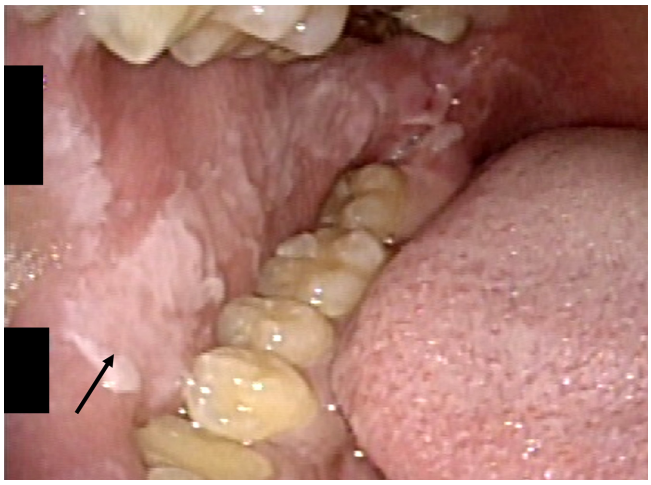

Figure 2 Oral cavity in Yanagawa's first case (37-year-old female) in Table 1.

Symptoms of *A. odora* Poisoning

Consider the possibility of *A. odora* poisoning when individuals display symptoms such as oral and upper airway irritation, instantaneous pain, swelling of the mouth, nausea, vomiting, abdominal pain, or skin irritation after exposure to the plant[18].

Treatment

Due to the strong irritation felt upon contact with the mouth, it is advisable to immediately spit out the plant and rinse the mouth. The oral administration of activated charcoal may prevent the absorption of calcium oxalate[21]. Calcium from sources, such as milk, may also help precipitate soluble calcium oxalate[21]. Administering antihistamines may help alleviate symptoms[21]. If vomiting and diarrhea persist, leading to dehydration and shock, intravenous fluid therapy may be necessary. When there is a risk of asphyxiation due to laryngeal edema, intravenous administration of steroids, inhalation of drugs containing catecholamines or steroids, or oxygen therapy may be performed[28]. If there is no improvement, or if there is a high likelihood of progression to asphyxiation, immediate airway management with endotracheal intubation, cricothyroidotomy, or tracheostomy may be necessary to secure the airways. Additionally, because contact with plant sap can lead to dermatitis, the use of rubber gloves or similar protective measures is recommended when handling it to prevent direct skin contact.

Outcome

A. odora may cause poisoning symptoms, such as oral pain, nausea, vomiting, laryngeal edema resulting in near asphyxia, diarrhea following shock, and skin dermatitis, when the needle-shaped crystals cause irritation. To the best of our knowledge, there have been no reports of fatal cases of *A. odora* poisoning in humans.

Prevention

Considering that *A. odora* can be purchased nationwide as an ornamental plant through online shopping, it is expected that cases of *A. odora* poisoning may occur in areas outside its place of origin[10]. Therefore, preventing *A. odora* poisoning requires raising awareness among the general public about its dangers and educating them about proper handling and cooking methods. Providing information and raising awareness among healthcare professionals regarding the symptoms and diagnoses of *A. odora* poisoning is essential. These efforts could reduce the incidence of *A. odora* poisoning and enable prompt intervention if cases arise.

Conclusion

A. odora contains insoluble calcium oxalate crystals, which affect poisoning symptoms, such as oral pain, nausea, vomiting, and laryngeal edema, resulting in near asphyxia, diarrhea following shock, and skin dermatitis when needle-shaped crystals cause irritation. Calcium oxalate crystals are abundant in plants of the *Araceae* family, and cases of health damage owing to the accidental ingestion of *Araceae* plants have been reported worldwide. Due to the strong irritation felt upon contact with the mouth, it is advisable to immediately spit out the plant and rinse the mouth. In addition to drug administration, ensuring a secure airway may be necessary if there is a risk of asphyxiation.

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