

# Inhalation poisoning with palytoxin from aquarium coral: case description and safety advice

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*Palythoa* spp. corals and some other marine organisms contain one of the most poisonous substances ever known – palytoxin (PTX). Due to their modest life requirements and ease of breeding, these corals are popular in home aquariums. Here we refer to a case of PTX poisoning of a middle-aged woman who inhaled poisonous vapours while brushing the corals from live rock and compare it with the available literature. As the case revealed that the symptoms of PTX poisoning are not specific and neither is treatment, our aim was to give a brief tabulated review of the symptoms that may indicate such poisoning. Cases of palytoxin poisoning have been reported worldwide, and severe ones (mostly due to ingestion of contaminated sea food) can end in death. As it appears, most (if not all) poisonings result from unawareness of the risk and reckless handling by aquarists. This is one of the first articles which provides some practical advice about the use of personal protection equipment, including gloves, masks, eyewear, and other clothing during any coral manipulation to minimise the risk. We also draw attention to the lack of marketing/trading regulations for dangerous coral species and/or regulations or instructions dealing with their removal and health protection.

KEY WORDS: aquarists; *Palythoa* spp.; PTX; protection equipment

Palytoxin (PTX) is a complex marine cnidarian toxin and one of the most poisonous, non-protein substances for humans. It is also one of the largest naturally occurring compounds with a molecular mass of around 2680 u that has at least ten congeners. It occurs in various marine organisms, such as corals, crustaceans, fish, molluscs, and dinoflagellates of the genus *Ostreopsis*. PTX was first isolated in the 1970s from the marine cnidarian *Palythoa toxica*, from which its name is derived (1, 2). *Palythoa* spp. corals (Figure 1) are common among marine aquarists, because they are easy to maintain and breed, but this also makes them a serious threat.

The threat of PTX poisoning is evident from numerous cases reported around the world (3–14). Its toxicity depends on the route of entry into the body. Research on mammals has shown that intravenous injection is the most toxic, whereas oral administration is less toxic. There are reports about human food poisoning after consuming sea food contaminated with palytoxins (15). However, there are no reports of inhalation poisoning in animal studies. Poisoning at home usually happens through inhalation of the toxin from broken coral tissue or direct contact with eyes or skin (8, 16–18). Regardless of the route, palytoxin acts by converting Na,K-ATPase into an ion channel that pumps

out K<sup>+</sup>, and pumps in Na<sup>+</sup>, depolarises the membrane, and causes a number of secondary pharmacological consequences (19). In this report, we describe a case of poisoning through inhalation of PTX vapours. We believe that the inhalation route of poisoning should be urgently investigated and results should serve as a preventive knowledge database to be disseminated among aquarists.

## BRIEF CASE DESCRIPTION

On 28 December 2017, a 38-year-old woman cleaned her marine home aquarium to remove overgrown *Palythoa*



Figure 1 Presumably palytoxin-containing zoanthid coral in a home aquarium (photo taken by one of the authors)

spp. corals from live rocks. She took out a live rock with the corals and moved it to the bathtub. According to her statement, as she brushed the rock and poured hot tap water over the cleaned rock, an unpleasant smell spread around the room. In an instant, she could not breathe and weakness overcame her. An ambulance was called in and the woman was immediately taken to an emergency department. There she was diagnosed hypoxia, tachypnoea, metabolic acidosis, and raised lactate. Her blood pressure was as low as 50/60 mm Hg. After treatment with levofloxacin, oral steroids, and salbutamol inhaler, intoxication symptoms partly subsided. The patient fully recovered about a month after the incident.

## DISCUSSION AND SAFETY ADVICE

One of the most important issues with PTX poisoning is public and professional unawareness of the risks associated with this coral (20), especially in non-tropical countries. The patient described above is an aquarium hobbyist from the UK with lifetime experience, yet she did not expect to be at risk. The medical staff who treated her could not identify the cause of her symptoms until she suggested PTX poisoning herself. Patients poisoned with PTX are often discharged from the hospital after symptoms have subsided without ever having been identified the cause (5). In the case of patient described above, not even laboratory tests did confirm PTX, and she was treated for symptoms, and symptoms of PTX poisoning are very diverse. Tubaro et al. (21) referred once to a fatal case where the symptom was indigestion. A basic data sheet with guidelines for identification of PTX poisoning would therefore be very helpful for diagnosis (21). Tests such as advanced enzyme-linked immunosorbent assay (ELISA), cytotoxicity assays, haemolysis assays, receptor binding assays, or immunoassays could be of some use in identifying PTX poisoning (22). Table 1 gives a brief overview of the symptoms described in literature. However, there is no specific treatment for PTX poisoning other than supportive (7).

### *Better safe than sorry*

We would like to dedicate this part to some practical advice about how to minimise the risk of PTX poisoning. Before buying a coral or live rock (or any other organism) for the aquarium, one should read information about the species and avoid any that may contain palytoxins. Some organisms, including corals, are extremely valuable and even endangered, like the ones listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), whose trade has also been regulated by the EU by Council Regulation (EC) No. 338/97 (24). However, we could not find any specific regulations dealing with the trade of corals containing PTX or even official warnings of the health risks, yet we believe that without

such marketing regulations or specific trade bans for dangerous species, the problem will not be solved in the long run.

In the meanwhile, if a PTX-containing coral has been purchased within return period, it should be locked in a safe container and returned to the store as soon as possible to ensure its safe disposal. Those who already have a PTX-containing organism in their aquariums should be very cautious during all operations. Wear protective gloves, masks, and eyewear to avoid contact of PTX with skin and mucosa. The best way to proceed with zoanthids growing in the aquarium is to commission their safe removal by a specialist as soon as possible, following the regulations of your country if there are any. Until the coral is safely removed, do not buy reef-unsafe fish or invertebrate species, as they can damage the coral and cause the toxins to spread all over the tank. If there is a risk that PTX has already leaked into the tank, it would be reasonable to turn off the aquarium skimmer, as it can easily release the toxins into the indoor air (not only in the room where the tank is located but other rooms as well and even to other floors in the building) (5). Turning off the skimmer pump is also advisable when manipulating a *Palythoa*-inhabited tank (25). Contact an aquarium specialist and/or special services dealing with the removal of hazardous substances in your area for further instructions. Some sources claim that one of the most effective ways to remove almost all PTX from water is to use activated carbon (14). If you are working with an aquarium or its equipment you should always stay in a well-ventilated area and, if possible, open the windows to cause a draught.

The issue of palytoxin poisoning from corals has several important ramifications. For one, because of non-specific symptoms, we do not know what the actual scale is among the general population or in occupational settings (large aquariums). Only more thorough background surveys of patients with nonspecific symptoms and identification tests would help in that respect. The second very important issue is – to the best of our knowledge – unregulated trade of dangerous/poisonous corals in the EU and perhaps in other countries as well. This issue should be addressed immediately, as marketing limitations or bans could minimise the risk of exposure. The third and related issue is the lack of awareness among the general public of how dangerous certain reef corals can be.

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### *Conflicts of interest*

We declare no conflict of interests.

**Table 1** Selected PTX poisoning cases with indicated route of exposure to the toxin, cause of poisoning and identifiable symptoms

Cause of poisoning	Symptoms	Sex	Age	Ref.
Coral transfer without personal protective equipment, pouring boiling water over the coral	Shortness of breath and chest tightness, heart rate of 120 BPM, blood pressure of 140/80 mmHg, respiratory rate of 24 breaths per minute with an oxygen saturation of 100% on room air, white blood cell count of 21000/ $\mu$ L	M	32	
	Shortness of breath, body temperature of 39.4 °C, leukocytosis of 16000/ $\mu$ L	M	42	
	Dry cough, chills, myalgia and fatigue, leukocytosis of 27600/ $\mu$ L, LDH – 292 U/L	M	51	
Pouring boiling hot water over a coral	Dry cough, chills, myalgia, fatigue, paraesthesia in both upper extremities, nausea and had one episode of non-bilious, non-bloody emesis, mild wheezing	F	35	6
	Non-bilious and non-bloody emesis, became extremely fatigued, temperature of 39.4 °C, heart rate of 154 BPM, leukocytosis of 34100/ $\mu$ L, LDH – 331 U/L	M	3	
	Leukocytosis of 34400/ $\mu$ L, LDH – 507 U/L, venous lactate measured 5 mmol/L, elevated initial creatine kinase MB isoenzyme (CKMB) of 7.82 ng/mL (normal <4.8 ng/mL) and an elevated CKMB relative index of 4.6 (normal range is 0–2.5)	F	2 months	
Attempt to remove a colony of zooanthids from the aquarium by pouring boiling water over them	Fever, hypotension and symptoms of a metallic taste in the mouth, nausea, headache, shivering and severe muscle cramps, low blood pressure and fever >38.5 °C. Blood analysis showed leukocytosis and an elevated CRP	M	37	
		F	35	7
		NDA	10	
Cleaning the home aquarium	Dyspnoea, fever, chills and malaise, myalgia, tachycardia at a rate of 112 BPM, a blood pressure of 155/83 mmHg, and a temperature of 38.9 °C	M	53	5
Drilling a zooanthid coral from a live rock	Ocular irritation, redness and a bitter, metallic taste in the mouth, eye pain, eyelid swelling, photophobia, and purulent discharge from both eyes, conjunctival hyperaemia without purulent discharge	M	31	
	Eye pain, redness, and blurry vision, papillary reaction of the upper and lower palpebral conjunctiva, bulbar conjunctival injection, a few scattered punctate epithelial erosions of the cornea	M	49	23
	Handling the coral without protection	F	39	3
Bursting zooanthid corals	Left eye corneal oedema			
	Bilateral corneal melts, corneal oedema with descemet folds on both eyes and peripheral thinning to 85% normal stromal thickness	M	45	3
Handling an aquarium zooanthid coral without protection in order to cut the coral in half to replicate it	Metallic taste in mouth, perioral paraesthesia, dysgeusia, local dermatological issues, hives on torso and extremities, oedema and erythema with pruritus of both hands, an urticarial rash on bilateral upper arms, thighs, abdomen, upper chest, and back	F	25	9
	Injury of three fingers while cleaning the aquarium	M	32	4

Ref. – reference no., M – male, F – female, BPM – beats per minute, LDH – lactate dehydrogenase, CRP – C reactive protein, NDA – No data available

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## Inhalacijsko trovanje palitoksinom iz akvarijskoga koralja – kratki pregled slučajja i sigurnosni savjeti

Koralji roda *Palythoa* spp. i neki drugi morski organizmi mogu sadržavati i jedan od najjačih otrova u prirodi – palitoksin (PTX). Budući da ti koralji nisu zahtjevni u pogledu održavanja i lako se razmnožavaju, postali su veoma popularni među vlasnicima kućnih akvarija. Ovdje kratko opisujemo jedan slučaj trovanja palitoksinom u sredovječne žene koja je udahnula otrovne pare četkajući koralj s kamena te ga uspoređujemo sa slučajevima iz literature. Ustanovili smo da trovanje palitoksinom nema specifične simptome, a ni liječenje nije specifično. Stoga donosimo tablični pregled simptoma koji mogu upozoravati na takvo trovanje. Slučajevi trovanja zabilježeni su diljem svijeta, a oni teški (uglavnom zbog konzumacije otrovane morske hrane) mogu biti smrtonosni. Većina (ako ne i svi) slučajeva trovanja posljedica je nepoznavanja rizika i nepažljiva rukovanja akvarijem. Ovo je jedan od prvih članaka u kojemu su dani i neki praktični savjeti za smanjenje rizika: od uporabe zaštitne opreme (rukavica, maski i naočala) do drugih zaštitnih mjera tijekom rukovanja koraljima. Njime također želimo upozoriti na nedostatak zakonske regulative kojom bi se definirala ili zabranila trgovina opasnim vrstama koralja odnosno njihovo uklanjanje i zaštita zdravlja.

KLJUČNE RIJEČI: akvarist; *Palythoa* spp.; PTX; zaštitna oprema