Ciguatera

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Ciguatera is a foodborne illness caused by eating certain reef fish whose flesh is contaminated with a toxin made by dinoflagellates such as *Gambierdiscus toxicus* which live in tropical and subtropical waters. These dinoflagellates adhere to coral, algae and seaweed, where they are eaten by herbivorous fish which in turn are eaten by larger carnivorous fish. This is called biomagnification.

Gambierdiscus toxicus is the primary dinoflagellate responsible for the production of a number of similar polyether toxins, including ciguatoxin, maitotoxin, gambieric acid and scaritoxin, as well as the long-chain alcohol palytoxin.[1][2] Other dinoflagellates that may cause ciguatera include *Prorocentrum* spp., *Ostreopsis* spp., *Coolia monotis*, *Thecadinium* spp. and *Amphidinium carterae*.[3] Predator species near the top of the food chain in tropical and subtropical waters are most likely to cause ciguatera poisoning, although many other species cause occasional outbreaks of toxicity.[4]

Ciguatoxin is odourless, tasteless and cannot be removed by conventional cooking.[5][6]

Researchers suggest that ciguatera outbreaks caused by warm climatic conditions propelled the migratory voyages of Polynesians between 1000 and 1400.[7][8]

Contents [hide]

Signs and symptoms [edit]

Hallmark symptoms of ciguatera in humans include gastrointestinal and neurological effects.[9][10] Gastrointestinal symptoms include nausea, vomiting, and diarrhea, usually followed by neurological symptoms such as headaches, muscle aches, paresthesia, numbness, ataxia, vertigo, and hallucinations.[5][10] Severe cases of ciguatera can also result in cold allodynia,

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which is a burning sensation on contact with cold.[9] Neurological symptoms can persist and ciguatera poisoning is occasionally misdiagnosed as multiple sclerosis.[11]

Dyspareunia and other ciguatera symptoms have developed in otherwise healthy males and females following sexual intercourse with partners suffering ciguatera poisoning, signifying that the toxin may be sexually transmitted.[12] Diarrhea and facial rashes have been reported in breastfed infants of poisoned mothers, suggesting that ciguatera toxins migrate into breast milk.[13]

The symptoms can last from weeks to years, and in extreme cases as long as 20 years, often leading to long-term disability.[14] Most people do recover slowly over time.[15] Often patients recover, but symptoms then reappear. Such relapses can be triggered by consumption of nuts, seeds, alcoholic beverages, fish or fish-containing products, chicken or eggs, or by exposure to fumes such as those of bleach and other chemicals[*citation needed*]. Exercise is also a possible trigger.[5]

Detection methods [edit]

Scientific methods [edit]

Currently, multiple laboratory methods are available to detect ciguatoxins, including liquid chromatography-mass spectrometry (LCMS), receptor binding assays, and neuroblastoma assays. Although testing is possible, in most cases, LCMS is insufficient to detect clinically relevant concentrations of ciguatoxin in crude extracts of fish.

Folk methods [edit]

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In Northern Australia, where ciguatera is a common problem, two different folk science methods are widely believed to detect whether fish harbor significant ciguatoxin. The first method is that flies are supposed not to land on contaminated fish. The second is that cats will display symptoms after eating contaminated fish. A third, less common testing method involves putting a silver coin under the scales of the suspect fish. If the coin turns black, according to the theory, it is contaminated.

On Grand Cayman island the locals will test barracuda by placing a piece of the fish on the ground and allowing ants to crawl on it. If the ants continue to move then the fish is deemed safe to eat.[*citation needed*]

The validity of many of these tests has been scientifically rejected.[16] While animals such as cats do react to eating infected fish, such tests are difficult to execute properly and are sensitive to complications.

Treatment [edit]

There is no effective treatment or antidote for ciguatera poisoning. The mainstay of treatment is supportive care. There is some evidence that calcium channel blockers like nifedipine and verapamil are effective in treating some of the symptoms that remain after the initial sickness passes, such as poor circulation and shooting pains through the chest. These symptoms are due to the cramping of arterial walls caused by maitotoxin[10][17][18][19] Ciguatoxin lowers the threshold for opening voltage-gated sodium channels in synapses of the nervous system. Opening a sodium channel causes depolarization, which could sequentially cause paralysis, heart contraction, and changing the senses of hearing and cold. Some medications such as amitriptyline may reduce some symptoms, such as fatigue and paresthesia,[20] although benefit does not occur in every case.[21] Steroids and vitamin supplements support the body's recovery rather than directly reducing toxin effects.

Mannitol was once used for poisoning after one study reported symptom reversal.[10][22] Follow-up studies in animals[23] and case reports in humans[24] also found benefit from mannitol. However, a randomized, double-blind clinical trial found no difference between mannitol and normal saline,[25] and based on this result, mannitol is no longer recommended.[9]

Folk remedies [edit]

Various Caribbean folk and ritualistic treatments originated in Cuba and nearby islands. The most common old-time remedy involves bed rest subsequent to a guanabana juice enema.[*citation needed*] Other folk treatments range from directly porting and bleeding the gastrointestinal tract to "cleansing" the diseased with a dove during a Santería ritual.[*citation needed*] In Puerto Rico, natives drink a tea made from mangrove buttons, purportedly high in B vitamins, to flush the toxic symptoms from the system.[*citation needed*] There has never been a funded study of these treatments.

An account of ciguatera poisoning from a linguistics researcher living on Malakula island, Vanuatu, indicates the local treatment: "We had to go with what local people told us: avoid salt and any seafood. Eat sugary foods. And they gave us a tea made from the roots of ferns growing on tree trunks. I don't know if any of that helped, but after a few weeks, the symptoms faded away."[26]

Senescent leaves of *Heliotropium foertherianum* (Boraginaceae), also known as octopus bush, a plant used in many Pacific islands as a traditional medicine to treat ciguatera fish poisoning, contain rosmarinic acid and derivatives, which are known for their antiviral, antibacterial, antioxidant and anti-inflammatory properties.[27] Rosmarinic acid may remove the ciguatoxins from their sites of action, as well as being an anti-inflammatory.

Epidemiology [edit]

The current estimated global incidence annually is 20,000 to 50,000 people, though a large number of cases are believed to go unreported.[28]

Due to the limited habitats of ciguatoxin-producing microorganisms, ciguatera is common only in subtropical and tropical waters, particularly the Pacific and Caribbean, and usually is associated with fish caught in tropical reef waters.[9] Exportation of reef fish, as well as tourism, often account for cases that develop in other regions.[28] Ciguatoxin is found in over 400 species of

reef fish. Avoiding consumption of all reef fish is the only sure way to avoid exposure.[6] Imported fish served in restaurants may contain the toxin and produce illness which often goes unexplained by physicians unfamiliar with the symptoms of a tropical toxin.[6][29] Ciguatoxin can also occur in farm-raised salmon.[30] Furthermore, species substitution, labeling a reef fish as a non-reef fish at restaurants and retail, can complicate efforts by consumers to avoid ciguatera.

In 2007, ten people in St. Louis, Missouri developed the disease after eating imported fish.[31]

In February 2008, the U.S. Food and Drug Administration (FDA) traced several outbreaks to the Flower Garden Banks National Marine Sanctuary in the northern Gulf of Mexico, near the Texas–Louisiana shoreline. The FDA advised seafood processors that ciguatera poisoning was "reasonably likely" to occur from eating several species of fish caught as far as 50 miles (80 km) from the sanctuary.[32]

From August 2010 to July 2011, there were six outbreaks of Ciguatera Fish Poisoning in New York City. Outbreaks were linked to barracuda and grouper purchased at a fish market in Queens, New York.[33]

In Q1 2012, two restaurants in Lanzarote, Canary Islands are thought to have been the source of ciguatera poisoning, leading to new fishing regulations issued 18 April 2012. The first outbreak was reported in February 2012. Diners suffered with vomiting, diarrhoea and abdominal pain several hours after eating amberjack. The second case was in early April affecting six people who live in Lanzarote and had all eaten amberjack at a local restaurant.[34]

In April 2015, fourteen crew members of a potash ship were hospitalized in Saint John, New Brunswick, Canada after consuming tropical fish obtained from international waters.[35] After the incident, Marine Catering Services issued a reminder to seafarers that the UK Food Act makes it illegal for crews to fish for food from their vessels.[36]

History [edit]

Ciguatera was first described by one of the surgeon's mates, William Anderson, on the crew of HMS Resolution in 1774.[37]

See also [edit]

- Algal bloom
- Dinoflagellate (see "neurotoxins" and "red tide" under Ecology and fossils and see "phosphate" under Life Cycle)
- Red tide
- Yessotoxin

Footnotes [edit]

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