

Ciguatera: cases of poisoning from ciguatoxins (algal toxins) in marine fish and shellfish

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Ciguatoxin poisoning, or 'ciguatera' when referring to outbreak cases, can occur after consuming a meal prepared from certain marine fish or shellfish and is recognized as one of the most common non-bacterial seafood poisonings worldwide. While rare in Germany, ciguatera cases could increase in the future as the global trade of marine products continues to expand. Because repeated ciguatera outbreaks have occurred in Germany, the German Federal Institute for Risk Assessment (BfR) has collected this Q&A on poisoning caused by ciguatoxins in seafood.

What are ciguatoxins?

Ciguatoxins are classified as marine biotoxins (algal toxins). These toxins are formed by dinoflagellates (single-celled algae) of the genus *Gambierdiscus* and *Fukuyoa*. Both genera of dinoflagellates are commonly found in warm marine environments in the tropics and subtropics, but ciguatoxin-forming algae species are also increasingly found in the Mediterranean region. Because they are marine phytoplankton, these algae are a food source for various marine animals that feed on algae for nutrition. It is sometimes the case that younger (i.e., smaller) herbivorous fish tend to exhibit lower concentrations of ciguatoxins than older (i.e., larger) carnivorous fish.

What is ciguatera?

Ciguatera (also: ciguatoxin poisoning) is the term used to describe the wide variety of clinical symptoms caused by ciguatoxins. Symptoms specific to ciguatera can include a sensation of temperature reversal (i.e., hot/cold sensitivity) and sometimes pain resulting from contact with cold tap water.

What happens to ciguatoxins in the body after being ingested?

The level of toxicity experienced after ingesting ciguatoxins is the result of the toxins' ability to bind to the sodium ion channels (or just 'sodium channels') in the cells of your body. Sodium channels ensure the controlled inflow of sodium ions into the cell, which plays an important role in the transmission of stimuli to nerve cells. These channels normally open for just a few milliseconds. Substances such as ciguatoxins can cause sodium channels to be activated (opened) for a longer period of time. This leads to the uncontrolled inflow of sodium ions into the cell, resulting in disruptions to the transmission of stimuli to nerve cells, this can lead to the often described temperature reversal sensation.

What symptoms occur in a case of ciguatoxin poisoning (ciguatera)?

Ciguatera is associated with a wide variety of clinical symptoms, which appear during a period of a few minutes to 48 hours after the fish or shellfish have been consumed (individually or as part of a meal). Symptoms may be gastrointestinal (e.g. nausea, vomiting, diarrhoea and painful stomach cramps) or neurological (e.g. muscle/joint pain and pruritus) as well as cardiovascular (e.g. hypotonia or - very rarely - cardiac arrhythmias). Typical symptoms for ciguatera poisoning also include a reversal of normal hot/cold sensitivity as well as pain resulting from contact with cold objects. Some symptoms may last for several months. Even after symptoms have subsided, the intake of certain kinds of foods and stimulants (e.g. alcohol, coffee) or other environmental factors (e.g. hot weather, physical activity) can cause the symptoms to reoccur. There is no immunity, If ciguatoxins are ingested on multiple occasions, symptoms may be worse when they appear again.

I have symptoms of ciguatoxin poisoning after consuming marine fish/shellfish. What action should I take?

Seek medical attention as soon as possible and mention your suspicion of ciguatoxin poisoning (ciguatera). If possible, keep any remnants of the meal you ate for analysis. This analysis can confirm the presence of ciguatoxins in the food. You can also get expert medical advice any time of the day or night by calling one of the Poison Information Centres run by the German states ('Laender').

As a consumer, is it possible for me to tell whether marine fish or shellfish contain ciguatoxins?

No. Ciguatoxins do not cause any changes to the sensory experience (appearance, odour, flavour, consistency) of the fish or shellfish, so you cannot tell whether these contain ciguatoxins. Ciguatoxins can only be detected in the laboratory.

Can ciguatoxins be broken down by storage or food preparation?

No. Ciguatoxins are very stable: ciguatoxin concentrations in marine fish or shellfish are not affected by heating (e.g., boiling, frying) or by deep-freezing. Ciguatoxin levels are also unaffected by other types of storage, treatment or food preparation (e.g., pickling).

Are all marine fish and fish products affected in the same way?

Ciguatoxins tend to occur in certain fish species caught in tropical and subtropical fishing grounds, especially in regions that feature coral reefs. It may even be the case that fish living on the reef have high levels of ciguatoxins while fish from nearby areas exhibit no levels of toxins at all. Large predator fish species such as barracudas, mackerel, snappers and groupers are especially suspect if they were caught in warm shallow coastal areas. Within a fish, the liver, roe (eggs), or head can have higher concentrations of ciguatoxins than the flesh. Fish living in colder waters such as the North Atlantic or the North Pacific are less likely to be contaminated with ciguatoxins.

Are some groups of consumers more at risk from ciguatoxin poisoning?

As a general rule of thumb, anyone consuming marine fish, products made from these fish or shellfish can be exposed to ciguatoxins. Ciguatoxins tend to occur in certain species of fish caught in tropical and subtropical fishing grounds. People who consume products from these regions may therefore have a higher risk of suffering a case of ciguatoxin poisoning than consumers who never eat such products.

Fish species such as barracudas, mackerel, snappers and groupers are especially affected if they live in coastal areas. Compared with fish liver, fish roe or fish heads, fillets of fish tend to exhibit lower concentrations of ciguatoxins, due to their lower fat content.

Is there a safe level of ciguatoxins that would not lead to any symptoms if ingested?

Undetermined. In 2010, the European Food Safety Authority (EFSA) published a scientific opinion that assessed the potential health risks posed by toxins of the ciguatoxin group after the consumption of fish or shellfish. Due to a lack of available data, the responsible working group was unable to determine any health-based reference values for ciguatoxins, such as the acute reference dose (ARfD). The ARfD specifies the estimated maximum quantity of a substance that can be taken up with food in the course of one day - either during one meal or during several meals - without a detectable risk to health. This value is applied for assessing the health risk that is associated with the acute exposure to such substances (i.e. intake). Generally, even very low levels of toxins in fish or shellfish have the ability to trigger ciguatoxin poisoning symptoms in humans. If ciguatoxins are ingested on multiple occasions, then symptoms may be stronger when they reappear.

How can I avoid becoming exposed to ciguatoxins if I am on holiday in affected regions, for example?

The safest strategy here is simply to avoid eating any marine fish or shellfish - and especially if you have caught these fish or shellfish yourself. Chefs and restaurant owners in regions where ciguatoxins occur more frequently can provide you with more information about the products that are safe to eat in any particular season. In general, fish caught in open (deeper) water farther from coral reefs are safer than fish caught near the coast. Younger herbivorous fish tend to exhibit lower concentrations of ciguatoxins than older carnivorous fish.

Marine fish from regions affected by ciguatera should generally be avoided, particularly by anyone who has previously suffered from ciguatera, as symptoms can be more severe in cases of repeated exposure.

How does the law act to protect consumers from exposure to ciguatoxins that occur in fish, fish products, and shellfish?

Within the European Union, ciguatoxins in fishery products are regulated by Commission Implementing Regulation (EU) 2019/627 (Annex VI, Chapter 1 G 3.) and Regulation (EC) 853/2004 (Section VIII, Chapter V E 2.). These regulations prohibit the placing of any products on the market that contain ciguatoxins. Food business operators, importers and exporters must ensure that their products are fully compliant with the requirements of EU law.

About the BfR

The German Federal Institute for Risk Assessment (BfR) is a scientifically independent institution within the portfolio of the Federal Ministry of Food and Agriculture (BMEL) in Germany. The BfR advises the Federal Government and the States ('Laender') on questions of food, chemicals and product safety. The BfR conducts its own research on topics that are closely linked to its assessment tasks.