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Short communication

Ciguatera fish poisoning on the West Africa Coast: An emerging risk in the Canary Islands (Spain)

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ABSTRACT

Ciguatera fish poisoning (CFP) is endemic in certain tropical and subtropical regions of the world. CFP had not been described on the West Africa Coast until a 2004 outbreak in the Canary Islands. In 2008–2009, two additional outbreaks of ciguatera occurred. Individuals afflicted had consumed lesser amberjack (*Seriola rivoliana*) captured from nearby waters. Caribbean ciguatoxin-1 (C-CTX-1) was confirmed in fish samples by LC-MS/MS. Ciguatoxic fish in this region may pose a new health risk for the seafood consumer.

Ciguatera fish poisoning (CFP) is a seafood-borne illness endemic to tropical and subtropical coral reef regions of the world (Stewart et al., 2010). CFP is characterized by a range of gastrointestinal and neurological signs and symptoms, and in severe cases cardiovascular disturbances (Wong et al., 2005). CFP is caused by consumption of fishes that have accumulated lipid-soluble, polyether toxins known as ciguatoxins (CTXs). CTXs have their origin in benthic microalgae of the genus *Gambierdiscus*, and are assimilated and metabolized through multiple trophic levels of the food web. CTXs are accumulated at levels acutely toxic to the consumer in many valued food fishes (Wang, 2008).

Numerous fishes have been linked to CFP, in particular certain species of barracuda, snapper, grouper, and jack (Caplan, 1998; Pearn, 2001). Worldwide, more than 25,000 persons are affected annually, with the highest rates occurring in endemic tropical and subtropical areas. The collection of CFP epidemiological data is inefficient, and the public health impact of this disease is likely significantly underestimated. This is attributable in part to reticence of the public to report the illness in endemic areas, and the lack of diagnostic recognition in non-endemic areas (Dickey and Plakas, 2010).

Distribution of ciguatoxic fish, and occurrence of CFP, is endemic in discrete regions of the Pacific and West Indian Oceans, and the Caribbean Sea (Caplan, 1998; Pearn, 2001; Ting and Brown, 2001). Occasionally, CFP outbreaks occur outside of endemic areas, and often linked to consumption of imported toxic fish (Farstad and Chow, 2001). Recent observations also suggest expansion of the biogeographical range of *Gamberdiscus* spp. and ciguatoxic fish (Villareal et al., 2007; Bienfang et al., 2008; Dickey and Plakas, 2010).

The Canary Islands Archipelago was considered a non-endemic region for CFP (Perez-Arellano et al., 2005).

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Located approximately 100 km from the West Africa Coast, southwest of Morocco, the Archipelago consists of seven major islands, with approximately two million inhabitants. The economy of the Canary Islands is based fundamentally on tourism. Typical of island communities, fish and shellfish are vital components of the diet. In 2004, the first documented outbreak of CFP in the Canary Islands occurred (Perez-Arellano et al., 2005). In the same year, *Gambierdiscus* spp. was found in the waters of the Canary Islands Archipelago, adjacent to the islands of Tenerife and La Gomera (Aligizaki et al., 2008). In 2008 and 2009, two additional outbreaks occurred. Implicated fish were captured regionally, and were tested and confirmed positive for ciguatoxins. These findings reinforce data suggesting geographical expansion of CFP endemicity worldwide, and are the focus of the present report.

In the first outbreak of CFP, in 2004, illnesses were linked to a single fish, a lesser amberjack (*Seriola rivoliana*), captured along the eastern coast of the Islands (Perez-Arellano et al., 2005). Individuals who consumed portions of the fish presented gastrointestinal (nausea, vomiting, and diarrhea) and neurological symptoms (metallic taste, myalgia, paresthesia and reversal of hot and cold sensations) consistent with CFP. Patients received supportive care, with none requiring hospitalization. Gastrointestinal symptoms resolved in 24–48 h, while neurological symptoms were slowly resolved over a period of months. A portion of the original fish tested positive for CTXs using a commercially-available immunoassay test (Cigua-Check®), as described by Hokama and Nishimura (1998). A sample was sent to the FDA Gulf Coast Seafood Laboratory (USA) for toxicity assessment by sodium channel-specific cytotoxicity (N2a) assay, and structural confirmation by liquid chromatography–mass spectrometry (LC–MS/MS). The sample tested positive by cytotoxicity assay, with composite toxin levels estimated at 1 ng equiv./g, measured against Caribbean ciguatoxin-1 (C-CTX-1, Fig. 1) standard. C-CTX-1 was confirmed in sample extracts by LC–MS/MS.

In 2008, public health authorities of the Canary Islands investigated a second outbreak of CFP involving 20–30 individuals. Symptoms reported were mainly gastrointestinal (nausea, vomiting, and diarrhea) occurring within a few hours after consumption of fish identified as lesser amberjack, as in the 2004 outbreak. The fish were purchased at a supermarket in the Islands. At least three individuals developed fatigue and neurologic manifestations (myalgia). Victims did not require hospitalization or further medical treatment. Amberjack involved in this event were captured off the northern coast of the Canary Islands, near the Salvagem Islands (Portugal). Fish samples, collected at the supermarket by public health authorities, tested positive for ciguatoxins by immunoassay (Cigua-Check®). Fish samples were extracted and analyzed for CTXs at the Gulf Coast Seafood Laboratory by using sodium channel-specific N2a cell assay (cytotoxicity) and LC–MS/MS according to the protocols described by Dickey (2008). N2a assay measures the composite toxin levels in the samples, with results expressed in equivalents of C-CTX-1. Two samples were tested, one contained trace levels, and the other 0.17 ng C-CTX-1 equiv./g. These samples were further analyzed by using LC–MS/MS for structural confirmation of the toxin. Confirmation of Caribbean CTX in the fish is based on the detection of C-CTX-1, one of the CTX analogues found in Caribbean ciguatoxic fish. LC–MS/MS analysis with selected reaction monitoring of three transitions (m/z 1123 → 1105, 1123 → 1087 and 1123 → 1069) specific for C-CTX-1 confirmed the presence of C-CTX-1 in both samples (Fig. 2).

In 2009, public health authorities of the Canary Islands investigated a third putative outbreak of CFP. An estimated 10–40 individuals developed gastrointestinal symptoms (nausea, vomiting, and diarrhea) after consumption of filets of the lesser amberjack from a supermarket. Symptomatic individuals did not require hospitalization or medical treatment, and a physician did not diagnose most. As in the previous outbreaks, amberjack were captured in an area north of the Canary Islands, near the Salvagem Islands. In a single sample obtained for analysis, toxin activity was

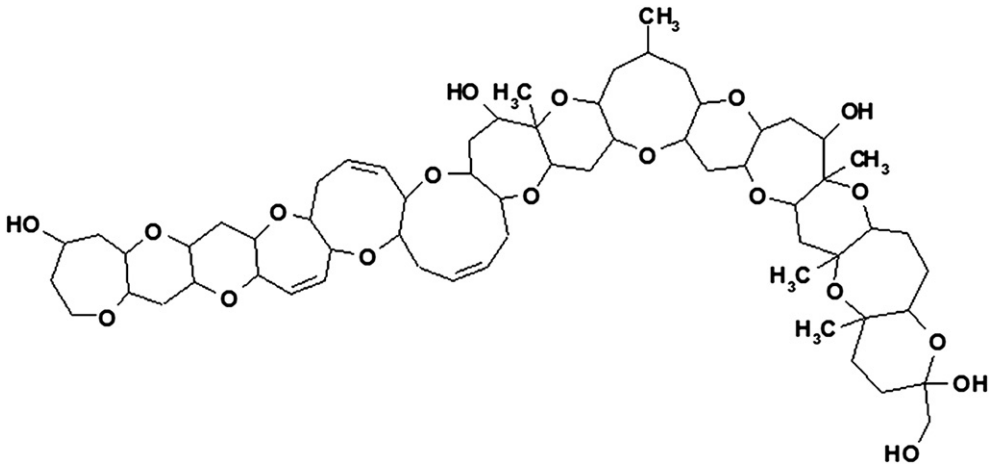

Fig. 1. C-CTX-1 structure.