Advanced Underwater Sciences

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The New Venomous Fish in The Mediterranean: the Lionfish

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Keywords
Pterois sp.,
Lionfish,
Venom,
Marine toxins.

ABSTRACT

In recent years, more alien fish species have been encountered in the Mediterranean. One of the alien species that have entered the Mediterranean in recent years is the lionfish. Lionfish attract attention with their appearance but should be carefully monitored due to their rapid and successful invasions on the West Atlantic coasts, and they are venomous. They contain a neurotoxin in protein structure. The lionfish, which spread rapidly in the Mediterranean in a short time, also cause poisoning due to the venom they include in their spines. For this reason, it has become even more important to have information about the properties and possible effects of the venom they contain, as well as the rapid invasion skills of lionfish. This study compiled some information on venom content, poisoning mechanism, and poisoning cases of lionfish (*Pterois sp*.).

1. INTRODUCTION

An intense migration of non-native marine species enters through the Suez Canal in the Mediterranean Sea. Toxic fish are among many non-native species that came and settled in the Mediterranean through this migration, called the Lessepsian migration due to its proximity to the Suez Canal and intensive maritime traffic. After the poisonous pufferfish, which is very popular throughout the Mediterranean, a new toxic fish species, the lionfish, started to appear and spread rapidly (Bariche et al., 2013; Aktaş and Mirasoglu, 2017; Ulman et al., 2020). The effective invasion success of the lionfish previously observed in the Caribbean is a frightening warning to the Mediterranean. Because lionfish pose a risk to natural resources, fisheries, and public health due to them contain venom and physical tolerance abilities such as high fecundity rates, low parasite load, being ability to starve for a long time, being successful hunters at the top of the food chain (Albins and Hixon, 2015; Cote and Smith 2018).

The lionfish, which spread rapidly in the seas of our country and in the Mediterranean, is a fish in the Scorpaenidae family, native to the Indo-Pacific regions. The Scorpaenidae family is divided into three major subfamilies, the lionfish, the scorpionfish, and the stonefish subclass, by the morphology of the fish's venomous spines (Elston, 2006). These fish have spines on their dorsal, pelvic, and anal fins. These spines are encapsulated by integumentary sheaths that produce glandular venom. When integumentary sheaths are mechanically disrupted by contact with a victim, it releases venom (Rensch and Murphy-Lavoie, 2021). Although the venom contains, lionfish are popular species that have been preferred in aquariums for many years due to their attractive appearance (Aldred et al., 1996; Elston et al., 2006; Morris et al., 2008; Haddad et al., 2009; Badillo et al., 2012). In addition to these features, successful invasion skills have recently attracted more attention to lionfish. (Albins and Hixon, 2015; Galanidi et al., 2018; Galloway and Porter, 2019). Lionfish have been able to settle on the eastern coast of the United States, the western Atlantic, the Gulf of

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Cite this article;

Koşker, A. R. & Ayas, D. (2022). The new venomous fish in the Mediterranean: the lionfish. *Advanced Underwater Sciences*, 2(2), 40-43

Reiview Article

Received: 03/10/2021; Accepted: 30/09/2022

Mexico, and the Caribbean within twenty years and are considered one of the most dangerous invasive fish due to these characteristics (Morris et al., 2008; Badillo et al., 2012; Albins and Hixon, 2015; Rensch and Murphy-Lavoie, 2021). In the first instance imported to the US as a popular fish, the lionfish is now one of the most abundant top predators in much of this region's marine ecosystem (Galloway and Porter, 2019).

The lionfish invasion in the northwest Atlantic and Caribbean represents one of the fastest marine fish invasions in history (Morris et al., 2008). The early period of the lionfish invasion on the coasts of the West Atlantic is similar to the invasion that is taking place in the Mediterranean today. Similar invasion potential of lionfish exists for the Mediterranean and Turkish coasts. The first record of the lionfish in the Mediterranean was given in Israel in 1992 (Golani and Sonin, 1992). However, lionfish, which were not reported in any region throughout the Mediterranean in the following years, was reported again about twenty years later with two specimens caught in Lebanese waters (Bariche et al., 2013). After this process, the lionfish that spread quite rapidly were reported in the Gulf of Iskenderun, on the coasts of Turkey (Turan et al., 2014), in Cyprus (Oray et al., 2015; Iglésias and Frotté, 2015; Jimenez et al., 2016) in Rhodes Island (Crocetta et al. 2015). Also, the first record for the Central Mediterranean in Tunisian waters was reported by Amor and Ghanem (2016). Subsequently, lionfish records were reported from Sicily in southern Italy (Azzurro et al., 2017) and the Libyan coast (Mabruk and Rizgalla, 2019). The first record of lionfish found in the southern coasts of Turkey was reported by Turan et al. (2014), and then they spread rapidly westwards to Fethiye Bay and Dalyan (Ozbek et al., 2017).

Awareness of the venom content of lionfish, which attracts attention with its rapid invasion ability, its ability to find a place in the market, and its visuality, is important for public health. This paper compiled venom content, poisoning cases, and poisoning symptoms of lionfish.

2. Toxicity of Lionfish

The lionfish are venomous, with its spines containing apocrine-type venom glands. Each spine of the lionfish (except tail spines) is venomous (Fig 1), including 13 dorsal spines, three anal spines, and two pelvic spines (Galloway and Porter, 2019).

The venomous spines of lionfish contain acetylcholine as well as venom. Similar to the species of Soldierfish (*Gymnapistes marmoratus*) and stonefish (*Synanceia trachynis*), lionfish venom induces marked neuromuscular activity. The venom of the toxic Scorpaenidae species usually provides a 2-3-fold increase in intracellular calcium. (Elston, 2006).

The spines are covered with an integumentary sheath or skin and contain two glandular epithelial grooves containing venom-producing tissue. Spinal glandular tissue extends for approximately three-quarters of the distance from the base of the spine to the tip (Halstead et al. 1955). Lionfish venom is a proteinaceous neurotoxin, and heat quickly denatures the venom.

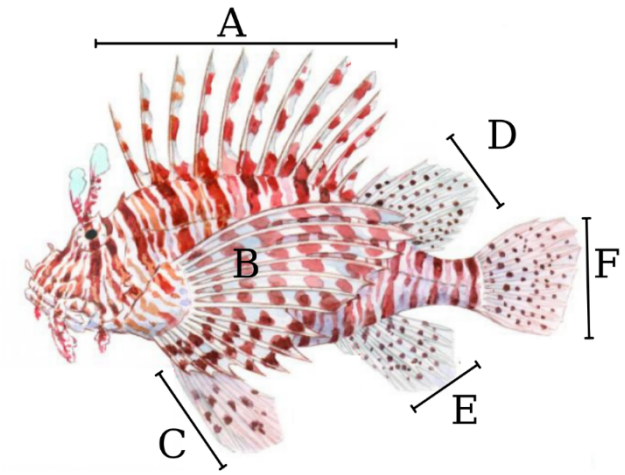

Figure 1. External anatomy of lionfish (A: Dorsal spines, 13 spines are venomous; B: Pectoral fin, non-venomous; C: Pelvic fin, the first spine of each pelvic fin is venomous; D: Secondary dorsal fin, non-venomous; E: Anal fin, the first three spines are venomous; F: Caudal fin, non-venomous)

Priyadharsini et al. (2015) reported that lionfish venom could be a neuroprotective agent. On the other hand, Sommeng et al. (2019) investigated the use of antioxidant compounds isolated from *P. volitans* venom as a drug or food component.

3. Lionfish's envenomation

Envenomations of lionfish native to Indo-Pacific coastal waters have been seen in these regions for many years. However, over the last few decades, there have also been records of envenomation on the West Atlantic coast, mostly for divers, tourists, and aquarists. Particularly in the United States, it is more common for aquatic workers to attempt to hand-feed, transfer, or catch these fish without containment equipment (Aldred et al., 1996; Haddad et al., 2009; Schaper et al., 2009; Rensch and Murphy-Lavoie, 2021). In the USA, poisoning cases can occur in interior areas due to aquariums. Lionfish pose an additional epidemiological threat as valuable aquarium fish. Of the 45 cases of lionfish (*P. volitans*) reported to the San Francisco Bay Area Regional Poison Control Center from 1979 to 1983, 82% occurred in homes with saltwater aquariums and 18% in tropical fish stores. Injuries occurred while transferring, catching, or hand-feeding fish (Rensch and Murphy-Lavoie, 2021). Similarly, 188 cases of lionfish envenomation were reported to the Texas poison control center between 1998 and 2006, some of whom were employees of commercial aquatic aquariums, while others that were poisoned were also patients who had a hobby aquarium at home (Forrester, 2008). In patients, mostly adult males, 94% of poisonings occurred by contact with lionfish from the hands and fingers (Forrester, 2008). In addition, divers are exposed to poisoning by lionfish in their natural habitats. Many divers hunt lionfish to serve the health of the reef, but this must be done very carefully, wearing gloves and other protective gear to avoid being pierced by the spines. (Rensch and Murphy-Lavoie,2021).

The fact that lionfish are attractive aquarium fish causes poisoning from lionfish fed in aquariums in Europe and the USA. Between 1996 and 2006, many poisonings from exotic domestic animals were observed in Europe, mainly from lionfish (*Pterois sp*.) (Schaper et al., 2009). Although there is news of poisoning in the media or social media in Turkey, there is one case report (Ayaz et al., 2020).

Lionfish envenomation occurs when the integumentary sheath of the spine is compressed as it burrows into the victim. This process ruptures the glandular tissue, allowing the venom to diffuse into the puncture wound (Saunders and Taylor, 1959). The lionfish venom contains acetylcholine and a neurotoxin that affects neuromuscular transmission (Cohen and Olek, 1989). Lionfish venom has been found to cause cardiovascular, neuromuscular, and cytolytic effects, from mild reactions such as swelling, extreme pain, and paralysis in the upper and lower extremities (Kizer et al., 1985). The antidote of related stonefish (Synanceia spp.) is highly effective in neutralizing lionfish venom activity (Shiomi et al., 1989, Aldred et al., 1996; Church and Hodgson, 2002).

Immediately after envenomation, local symptoms such as extreme pain, redness, and swelling are triggered in victims; In severe cases, deaths may occur (Kiriake et al., 2013). The severity of sting reactions in humans depends on factors such as the amount of venom administered, the victim's immune system, and the site of the sting. Records of home aquarists stung by lionfish provide a comprehensive assessment of how lionfish stings affect humans (Kizer et al., 1985, Vetrano et al., 2002; Morris et al., 2008). Because venomous glandular tissue is closer to the end of the spine, envenomation is more likely in contact with smaller-sized and short-spined lionfish (Halstead et al., 1955).

First aid for envenomation in the case of a lionfish sting involves immersing the affected area in hot water (45°C) until the pain subsides. The affected area should be immersed in hot water for at least 30 minutes, preferably 60-90 minutes, and repeated when pain persists (Aldred et al., 1996; Vetrano et al., 2002; Haddad et al., 2015). The primary clinical effect of lionfish envenomation is local pain, systemic symptoms include headache, malaise, nausea, hypotension, chest pain, hypertension, cardiac arrhythmias, and pulmonary edema (Aldred et al., 1996; Elston, 2006; Badillo et al. 2012; Wilcox and Hixon, 2015; Hornbeak and Auerbach, 2017). Secondary medical treatment is usually recommended, as symptoms and complications vary depending on the severity of the sting, whether part of the spine remains in the wound, and individual reactions to lionfish venom (Aldred et al., 1996; Galloway and Porter, 2019). Appropriate comprehensive wound care is the basis of treatment and is extremely important. Therefore, it is important to investigate foreign bodies through examination and possibly radiographs. Tetanus prophylaxis is important, and booster immunization may be required (Aldred et al., 1996). As most of these envenomations present as puncture wounds on the hands and feet, prophylactic antibiotics are often recommended (Aldred et al., 1996).

4. CONCLUSION

Lionfish are fish that should be monitored carefully and regularly, given their invasive abilities in the Western Atlantic and the potential public health risks of the venom they contain. There is no scientific research conducted in the Mediterranean regarding lionfish venoms yet. In order to take correct and timely measures by public health and public authorities, it is important to know the venom levels of lionfish in our coasts and whether these venom levels have regional differences. In addition to the scientific studies to be carried out, it will be beneficial to raise awareness of the community and health sector workers, especially those living in coastal areas, in order to prevent envenomation.

Author contributions

The authors contributed equally to the article.

Conflicts of interest

The authors declare that they have no conflict of interest.

Statement of Research and Publication Ethics

For this type of study formal consent is not required.

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