

Name	Origin	Food Product	Lethal Dose (µg/kg)	Illness	Regulation	Preventive Measures	Comments
Phycotoxins							
Amnesic Shellfish Poisoning (ASP)	Diatoms: <i>Pseudo-nitzschia spp.</i>	Shellfish (mussels, scallops, clams, crabs).	Humans: 1-4 mg domoic acid/kg bw. LOAEL (memory loss): 0.9 mg/kg bw (EFSA 2009;7(12):1382)	GI symptoms (vomiting, diarrhoea, pain) within 24h; neurological (confusion, memory loss, seizures) within 48h.	• Reg. (EC) No 853/2004: Max limit 20 mg domoic acid/kg shellfish flesh. • Reg. (EU) 2019/627: Official controls.	Monitoring of <i>Pseudo-nitzschia</i> & domoic acid in shellfish. Harvest area closures.	Water-soluble, heat-stable. Concern in Europe and globally; increasing incidence.
Paralytic Shellfish Poisoning (PSP; Saxitoxins)	Dinoflagellates: <i>Alexandrium</i> , <i>Gymnodinium</i> , <i>Pyrodinium spp.</i>	Shellfish (mussels, scallops, clams, crabs).	Humans: Lethal oral dose: 1-4 mg total toxin (EFSA 2009;7(12):1306).	Muscle paralysis, respiratory failure, death. Onset: 30 min - 2h. Mortality: 1-20% without support.	• Reg. (EC) No 853/2004: Max limit 800 µg STX eq./kg shellfish flesh. • Reg. (EU) 2019/627: Official controls.	Monitoring of toxic algae & PSP toxins. Harvest area closures.	Water-soluble, heat-stable. Global issue, recurrent in Europe. Many analogues.
Diarrhetic Shellfish Poisoning (DSP; Okadaic Acid - OA & Dinophysistoxins - DTXs)	Dinoflagellates: <i>Dinophysis</i> , <i>Prorocentrum spp.</i>	Shellfish (mussels, scallops, clams, crabs).	Humans: (LOAEL for OA): ~0.3 µg/kg bw (total dose ~20-50 µg) (EFSA 2008;6(1):589).	Severe diarrhoea, nausea, vomiting, abdominal pain. Onset: 30 min - several hours. Not usually lethal.	• Reg. (EC) No 853/2004: Max limit for OA, DTXs & Pectenotoxins combined: 160 µg OA eq./kg shellfish flesh. • Reg. (EU) 2019/627: Official controls.	Monitoring of toxic algae & DSP toxins. Harvest area closures.	Lipophilic, heat-stable. Common in European shellfish farming.
Pectenotoxins (PTXs)	Dinoflagellates: <i>Dinophysis spp.</i>	Shellfish (mussels, scallops, clams, crabs).	Humans: Oral toxicity data limited. Primarily hepatotoxic in animal studies. Mice (i.p. LD50 PTX2): 250 µg/kg bw (EFSA 2009;7(7):1209)	Liver damage in animals. Human GI effects from PTXs alone not clearly established.	• Reg. (EC) No 853/2004: Included in the 160 µg OA eq./kg limit with OA & DTXs. • Reg. (EU) 2019/627: Official controls.	Monitoring as part of DSP complex. Harvest area closures.	Lipophilic. Concern in Europe. Contribution to human diarrhetic illness less than OA/DTXs, but regulated due to other potential toxicities.
Yessotoxins (YTXs)	Dinoflagellates: <i>Protoceratium</i> , <i>Lingulodinium</i> , <i>Gonyaulax spp.</i>	Shellfish (mussels, scallops, clams).	Humans: Acute oral toxicity low. Mice (i.p. LD50 YTX): 100-500 µg/kg bw; (oral LD50 YTX): >5000 µg/kg bw (EFSA Journal 2009;7(3):1029)	Cardiotoxic in animals. No confirmed human illness from YTXs via shellfish at typical levels.	853/2004: Max limit 3.75 mg YTX eq./kg shellfish flesh (3750 µg/kg). • Reg. (EU) 2019/627: Official controls.	Monitoring of YTXs. Harvest area closures.	Lipophilic. Found in European waters. Regulated due to potential cardiotoxicity seen in animals.
Azaspiracid Shellfish Poisoning (AZP; Azaspiracids)	Dinoflagellates: <i>Azadinium</i> , <i>Amphidoma spp</i>	Shellfish (mussels, oysters, scallops, clams, crabs).	Humans (Estimated toxic dose AZA1): ~2.3 µg/kg bw (EFSA Journal 2008;6(9):771)	Severe GI symptoms (nausea, vomiting, diarrhoea, cramps). Prolonged illness possible. Potential tumor promoter.	• Reg. (EC) No 853/2004: Max limit 160 µg AZA eq./kg shellfish flesh. • Reg. (EU) 2019/627: Official controls.	Monitoring of toxic algae & AZAs. Harvest area closures	Lipophilic. Significant concern in Europe. Many analogues known.
Neurotoxic Shellfish Poisoning (NSP;Brevetoxins)	Dinoflagellates: <i>Karenia spp.</i> (mainly <i>K. brevis</i>).	Shellfish (oysters, clams, mussels)	Humans: Intoxication reported at 2.8-4.8 µg BTX-2 eq./kg bw. (Search result 7.2). Mice (oral LD50 BTX-3): 520 µg/kg bw (EFSA CONTAM Panel, 2009)	GI & neurological symptoms (tingling, dizziness, temperature reversal). Respiratory irritation from aerosols. Rarely fatal. Onset: minutes to hours.	No specific EU-wide limits. National measures may exist. General Food Law applies. Monitoring in some areas.	Monitoring of <i>Karenia</i> blooms & toxins. Harvest area closures. Avoid recreational harvest during blooms.	Lipophilic, heat-stable. Primarily Gulf of Mexico, NZ. Potential emerging concern in Europe due to <i>Karenia</i> presence.
Palytoxin (PITX ; Group Toxins)	Dinoflagellates: <i>Ostreopsis spp.</i> ; Soft corals: <i>Palythoa spp.</i>	Shellfish (mussels, clams, sea urchins), crabs, fish exposed to blooms.	Humans (Oral ARfD by EFSA): 0.2 µg/kg bw for PITX + ostreocin-D. Guidance: 30 µg/kg shellfish.	Shellfish (mussels, clams, sea urchins), crabs, fish exposed to blooms.	No specific EU-wide limits. National measures may exist. General Food Law applies.	Avoid seafood from areas with <i>Ostreopsis</i> blooms/ <i>Palythoa</i> . Harvest area closures. Avoid aerosol contact during blooms.	Heat-stable. <i>Ostreopsis</i> blooms an emerging issue in some European areas (e.g., Mediterranean).
Cyclic Imines (CIs; Spirolides - SPXs) Gymnodimines (GYMs, Pinnatoxins - PnTXs, etc.)	Dinoflagellates: <i>Alexandrium</i> , <i>Karenia</i> , <i>Vulcanodinium spp.</i>	Shellfish (bivalve molluscs).	Humans: No confirmed poisoning cases. Data limited. Mice (SPXs oral LD50: 50µg/kg bw. (PnTXs oral LD50 mix E/F): 23 µg/kg bw.	Neurotoxic in mice (fast-acting: paralysis, respiratory distress). Human symptoms unknown.	No specific EU-wide limits/ National measures may exist. General Food Law applies.	General shellfish monitoring principles. Research ongoing.	Lipophilic. Emerging toxins. Detected at low levels in European shellfish. Risk assessment ongoing.
Other Marine Biotoxins							
Ciguatera Fish Poisoning (CFP - Ciguatoxins - CTXs, Maitotoxins - MTXs)	Dinoflagellates: <i>Gambierdiscus</i> , <i>Fukuyoa spp.</i>	Large predatory reef fish (barracuda, grouper, snapper, etc.) accumulating toxins via food chain.	CTXs (Humans): LOAEL ~0.001-0.0025 µg P-CTX-1/kg bw (EFSA 2010;8(6):1627). MTXs: Extremely potent by injection in mice (LD50 ~0.05 µg/kg bw).	GI, neurological (paresthesia, itching, cold allodynia), and cardiovascular symptoms. Rarely fatal. Onset: 1-24h.	No specific EU-wide limits for CTXs in fish. General Food Law applies. Some regional monitoring (e.g., Canaries, Madeira). Reg. (EC) No 853/2004:	Avoid large predatory reef fish from endemic areas, especially viscera. Monitoring in affected areas.	Lipophilic, heat-stable. Primarily tropical/subtropical; emerging in Europe (Macaronesia). Imported fish also a risk.
Tetrodotoxin (TTX)	Marine bacteria (e.g., <i>Vibrio</i> , <i>Pseudoalteromonas spp.</i>).	Pufferfish (Tetraodontidae). Also some gastropods, bivalves, other marine animals.	Humans (MLD): 1-2 mg total dose. Serious effects at 0.2 mg (~4 µg/kg bw).	Potent neurotoxin: tingling (lips, tongue), paralysis, respiratory distress, cardiac arrhythmia. Can be fatal. Onset: minutes to hours.	Fish: Marketing of Tetraodontidae prohibited. Shellfish: No specific EU limit EFSA (2017) proposed guidance: <44 µg TTX eq./kg.	Prohibition of pufferfish marketing. Monitoring of TTX in shellfish in at-risk areas.	Water-soluble, heat-stable. Concern in Asia; emerging in Europe in shellfish and via invasive fish (e.g., <i>Lagocephalus sceleratus</i> in Mediterranean).