

Innovative Processing Approaches for Heavy Metal Detoxification in Seafood

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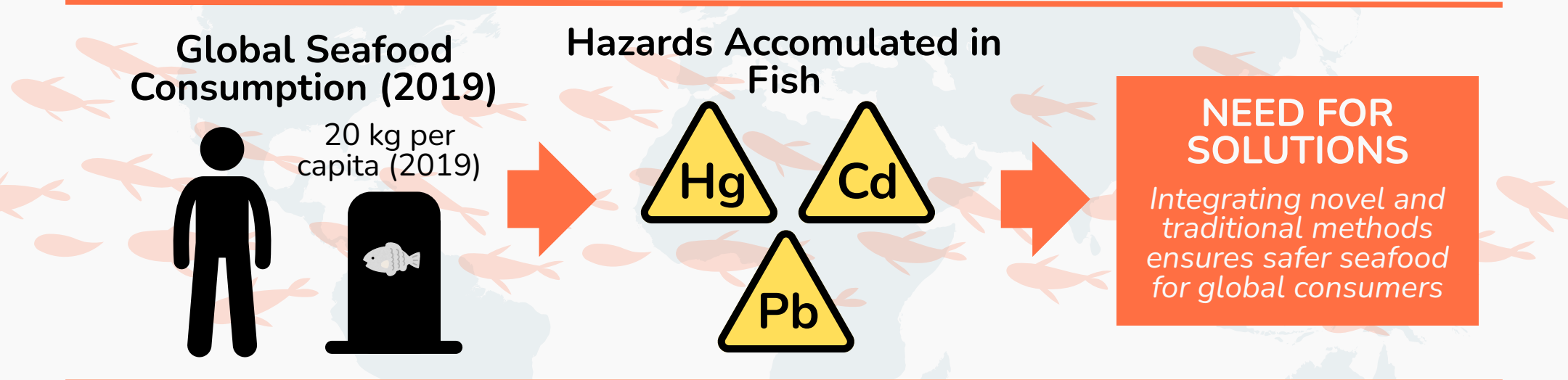


Table 1: Summary of the Efficacy of Traditional Methods

Method (Treatment)	Species / Product	Heavy Metal(s)	Reduction Achieved	Ref.
Acidic marination (vinegar)	Rainbow trout fillets (pickled)	Arsenic (As)	~90% reduction	(Cieřlik et al., 1970)
Salt-water soaking (10% NaCl, 75 °C (348.15°K))	Tilapia fillets (pre-drying)	Nickel (Ni), Copper (Cu)	Significant reduction (>30% lower levels)	(Basak et al., 2023)
Boiling (5 min)	Common carp fillets	Copper (Cu)	54.1% reduction	(Neidoni et al., 2024)
Frying (pan-fry)	Common carp fillets	Copper (Cu)	80.3% reduction	(Neidoni et al., 2024)
Microwaving	European sea bass fillets	Lead (Pb)	44% reduction	(Ersoy et al., 2006)

Table 2: Summary on modern removal of heavy metals from seafood

Seafood Species	Technique	Optimum Treatment Conditions	Removal percentage	Ref.
Clarius batrachus (Catfish)	Eggshell-based catalyst with trisodium citrate dihydrate (TCD)	0.400 kg/m ³ 3 hours 32.50 ± 0.50°C (305.65 ± 0.5°K)	90% of Cu 84% of Cd 72% of Pb 100% of Ni	(Wan Abdullah, Naushad Ali, et al., 2020b)
Perna viridis (Green mussel)	Trisodium citrate, disodium oxalate, and sodium acetate	<u>Sodium Acetate:</u> 0.500 kg/m ³ 32.5 ± 0.5°C (305.65 ± 0.5°K) 5 hours pH 6–7	59.90% of As 88.57% of Pb 68.01% of Cd 79.67% of Ni	(Wan Azelee et al., 2014)
Fish oil	Supercritical CO ₂ extraction (SFE)	61 MPa, 40 C (313.15 K), 4 h (with CO ₂ flow ~3.7 mL/min)	98.3% of Pb 96.1% of Cu 94.9% of As 93.7% of Hg	(Hajeb et al., 2014)
Tilapia fish (Oreochromis niloticus)	Electrocoagulation + water immersion	~6 V DC, 35–40 min in distilled water bath	~90% reduction of total heavy metals	(Sandra et al., 2020)

